

Dundonnell Wind Farm

Noise Compliance Test Plan

In response to Condition 14 of Planning Permit 2015/23858

March 2018

PLANNING AND ENVIRONMENT ACT 1987
PLANNING SCHEME MOYNE
PERMIT NO. 2015/23858
ENDORSED PLAN
SIGNED S. Mearns FOR
MINISTER FOR PLANNING
DATE: 16/10/18

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ENDORSED TO COMPLY
WITH CONDITION
14
OF PLANNING PERMIT
2015/23858

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GLOSSARY

A weighting	Frequency adjustment representing the response of the human ear.
Background Noise Assessment	<p>Contained in Marshall Day Report: DUNDONNELL WIND FARM EES Noise Impact Assessment Rp001 R03 2012480ML 2 September 2014</p> <p>and Sonus Report: Dundonnell Wind Farm Background Noise Monitoring S5345C6 November 2017</p>
dB(A)	A weighted noise level measured in decibels.
Intermediate Position	A sound level meter location between the wind farm and a receptor location. The Intermediate position will be selected to minimise noise from sources other than the wind farm (such as wind in trees and road traffic). The Intermediate position will be located within 15° of the line between the receptor and the closest wind turbine.
ISO1996.2	International Standards Organisation ISO1996.2 (2007) Acoustics — Description, measurement and assessment of environmental noise — Part 2: Determination of environmental noise levels
L _{A90}	The A weighted sound pressure level that is exceeded for 90 per cent of the time over which a given sound is measured. The L _{A90} measured over a 10 minute time period is commonly termed “background sound level” and “post-installation sound level” with respect to wind farms.
L _{Aeq}	The A weighted equivalent continuous noise level – the energy-average of noise levels occurring over a measurement period.
The Permit	Permit Number: 2015/23858
NZS6808:2010	New Zealand Standard NZS 6808:2010 Acoustics – The assessment and measurement of sound from wind turbine generators
Residential Logging Locations	Locations where noise loggers are placed at residences

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1 INTRODUCTION

This noise compliance test plan provides the proposed procedure for determination of compliance with the noise related Permit Conditions.

2 PLANNING PERMIT CONDITIONS

The Permit provides conditions for the operation of the Dundonnell Wind Farm. The noise related conditions include:

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NOISE

Performance requirement

11. Subject to condition 12, the operation of the wind energy facility must not result in wind farm sound levels that exceed the relevant base noise limit described below when measured in accordance with New Zealand Standard 6808:2010, Acoustics – Wind Farm Noise (**the Standard**):
 - a. 40dB LA90(10 min) at ‘noise sensitive locations’ (as defined in the Standard); or
 - b. Any higher base noise limit that the wind farm operator and dwelling owner agree applies to a particular dwelling. This agreement must be in a form that runs with the land for the life of the wind energy facility.

Where the background sound level plus 5dB is greater than the relevant base noise limit, the noise limit will be the background sound level LA90 (10 min) plus 5dB.

12. Where special audible characteristics, including tonality, impulsive sound or enhanced amplitude modulation occur, as assessed in accordance with Appendix B of the Standard, the noise limit will be modified by applying a penalty of up to + 6 dB LA90 in accordance with Section 5.4 of the Standard.

Post-construction assessment

14. Before the wind energy facility starts operating, a noise compliance testing plan shall be prepared by a suitably qualified and experienced independent acoustic engineer which sets out the methodology used to demonstrate compliance with the relevant noise limit specified in condition 11. The noise compliance testing plan must be submitted to and be to the satisfaction of the responsible authority and must also:
 - a. demonstrate that noise assessment positions have been located according to the Standard, and show the location of the noise assessment positions on a map. Alternative noise assessment positions should also be included in case a noise assessment position on private land become inaccessible.
 - b. require noise monitoring in accordance with the Standard for the purpose of preparing the compliance reports required by this condition.
 - c. if the wind energy facility is developed in stages, require a noise compliance investigation to be carried out and reported to the responsible authority by no later than six months after completion of each stage of the wind energy facility.
 - d. require a post-construction noise compliance investigation to be carried out and reported to the responsible authority within 6 months from the commissioning of the wind energy facility, and then repeated 12 months later.
 - e. in the event of non-compliance with the Standard include a noise non-compliance action plan which shall be prepared and implemented to the satisfaction of the responsible authority including actions to make the wind energy facility compliant.
 - f. include a report from an environmental auditor accredited under the Environment Protection Act 1970 with their opinion on the methodology and results contained in the noise compliance testing plan.
15. The noise compliance testing plan must be carried out to the satisfaction of the responsible authority and the plan and all results made publicly available on the project website.

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3 NEAR FIELD AND INTERMEDIATE TESTING

Near field and intermediate testing is proposed for the purpose of determining the character of the noise from the turbines and enabling noise from other sources to be excluded from the noise at Residential Logging Locations.

The near field measurements at two representative turbines will be in general accordance with IEC61400-11 Edition 3.0 (2012) including measurement locations and calculation of sound power level.

Samples of the data collected during the sound power testing will also be used for a tonality calculation. The tonality calculation will be conducted in accordance with Annex C of ISO1996.2 (2007). The average level of tonality for each integer wind speed is determined, based on the average of tonality for every 2 minute period at each integer wind speed.

An objective test for modulation has not been established by NZS6808:2010 or in any Australian jurisdiction. An “interim test method” was provided in NZS6808:2010 in the absence of a more robust method. The modulation testing procedure will be based on the interim method in NZS6808:2010 and will be conducted for representative time periods at each integer wind speed.

The outcome of the measurements and analysis for each integer wind speed from cut-in to the wind speed at rated power will be:

- The apparent sound power level (IEC61400-11);
- The tonal adjustment K_t (ISO1996.2) and tonal frequency for any tones present;
- An assessment of amplitude modulation (NZS6808 Interim Test Method)

The apparent sound power levels will be used to determine the wind speed at which the highest sound power level is emitted from the turbines. If the noise at Residential Logging Locations continues to increase at wind speeds above the wind speed of highest noise emission, this will indicate that the noise is from sources other than the turbines (most commonly wind in trees) for high wind speed conditions.

The tonal adjustment is used to assist in determining the wind speeds and frequencies of potential tones at Residential Logging Locations.

Where the data indicate a measurable modulation trace at the blade pass frequency that exceeds the objective criteria in Section B3.2 of the NZS6808:2010 for the overall A-weighted noise level, longer term testing at the Residential Logging Locations will be conducted.

Loggers may be placed at Intermediate Positions between the turbines and receptors. These loggers would operate at the same time as the residential loggers and would assist in determining the contribution of noise from the wind farm as well as providing a calibration point for any required noise modelling.

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4 NOISE COMPLIANCE TESTING

The near field and intermediate test data will be used to support the following noise compliance testing regime, to satisfy the operational noise related Permit Conditions.

4.1 Residential logging locations

Compliance testing will be conducted at the locations listed in Table 1 subject to permission for access being granted. The locations have been selected to demonstrate compliance at noise sensitive locations where the landowner does not have an agreement with the developer. The locations include the closest residences where the landowner has no agreement as well as residences owned by participating neighbours which are representative of other non-participating neighbours. Alternate house locations are also provided in the event that access to the proposed property is not available. If permission is not granted for access to the alternate house locations, no further alternatives will be considered. These locations have also been overlaid on an aerial photograph in Figure 1.

Table 1 Proposed locations for noise logging and alternate locations

House	Easting (m)	Northing (m)	Alternate House
18**	680221	5807762	17
46 (PN)**	673610	5803201	47 (PN)
52 (PN) *	671547	5811153	51 (PL)
62**	675853	5812054	21

(PL) Participating Landholder

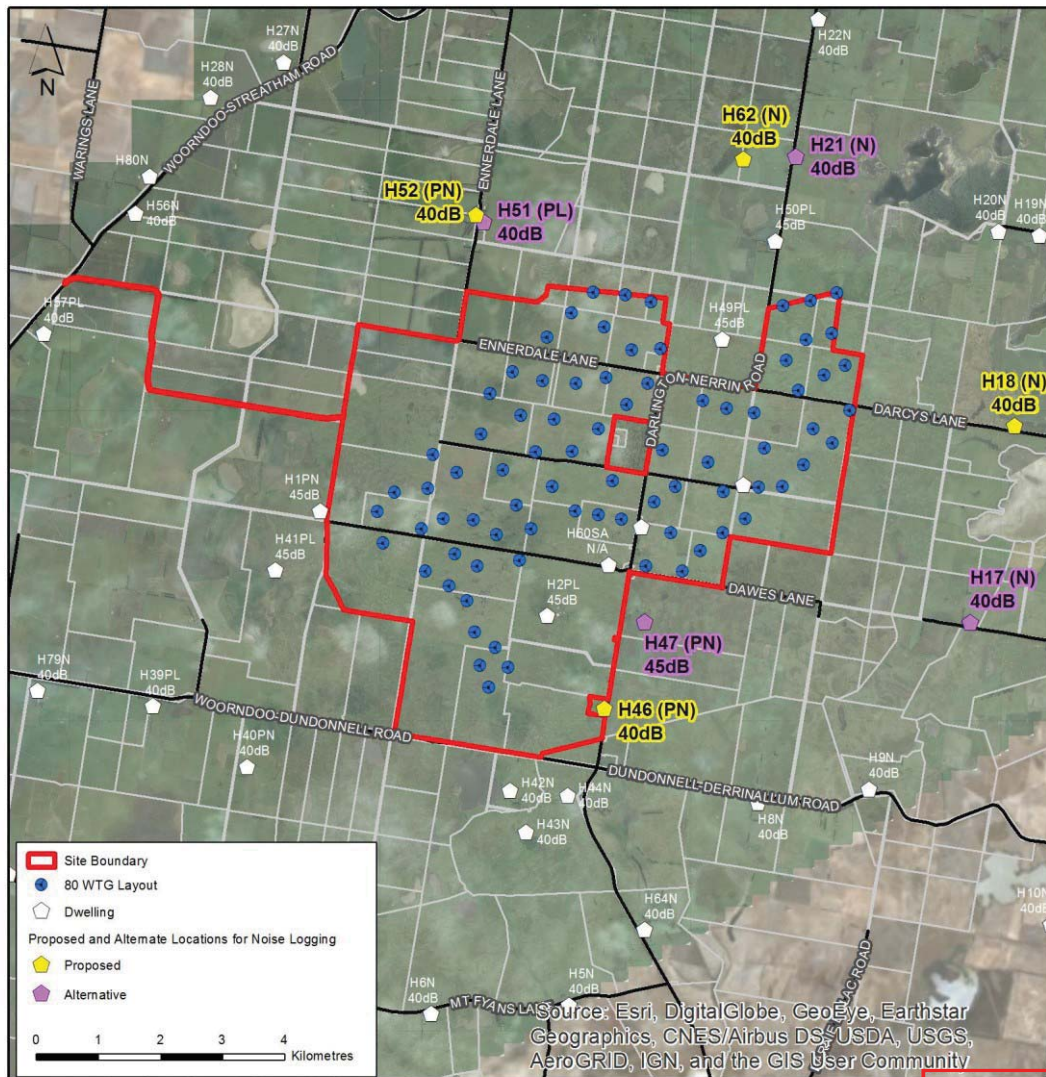
(PN) Participating Neighbour

* Background noise measurements previously conducted at this location by Marshall Day

** Background noise measurements previously conducted at this location by Sonus

All coordinates in WGS84 Zone 54

The location of the equipment will be consistent with the positions documented for the Background Noise Assessment, subject to any changes to the local conditions that might result in modified results such as the construction of structures, change in vegetation or the installation of pumps or air conditioning units. The changes will be documented and the rationale provided for any alternative location.



Document Path: C:\GIS\Development_Sites\VIC\Dundonnell\Mapworking\DDWF_027_NoiseMonitoringLocations_Aerial_A5.mxd

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Figure 1 Proposed and alternate locations for noise logging

4.2 Equipment

Sound level meters with a noise floor no greater than 20 dB(A) will be used. The equipment will be either Class 1 or Class 2 sound level meters in accordance with the Australian Standard AS 1259-1990 *Acoustics – Sound Level Meters* and IEC 61672.1-2004 *Electroacoustics – Sound Level Meters* as relevant.

A wind shield with a diameter of at least 100mm will be used to minimise noise on the microphone.

A calibrated reference sound source will be used before and after the compliance testing regime.

4.3 Data

The compliance testing will collect L_{90} data made continuously over 10 minute intervals.

Data filtering must remove time periods:

- (i) affected by rain, hail or wind based on a weather logger placed at an equivalent location to one of the noise loggers. Data is adversely affected where precipitation occurs in a 10 minute period or where a wind speed greater than 5 m/s is exceeded for 90% of a 10 minute period;
- (ii) when sufficient WTGs have not been connected to the grid to influence the measured level during the current 10 minute period; and
- (iii) considered abnormal, such as during local construction or maintenance activities.

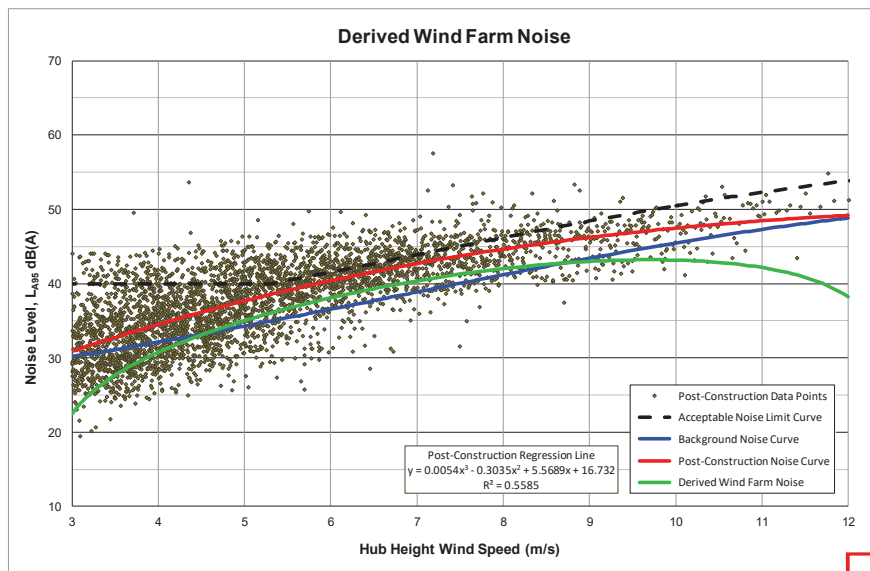
Further data filtering may remove time periods or frequency content where noise data collected at an Intermediate Position confirms that the source of the noise at a receptor is not the wind turbines. For example, noise data collected in a particular 10 minute interval at a receptor may be removed:

- if the noise measured in the same period at the Intermediate Position (closer to the turbines) is a lower level; or
- if the frequency content of the noise at the receptor is not consistent with the frequency content at the Intermediate Position.

Following removal of the data defined above and application of applicable penalties for special audible characteristics (refer below), all of the remaining noise data for the full monitoring period will be correlated with the corresponding hub height wind speed data for each monitored receptor.

If the Intermediate position has not been used to remove data points, the wind farm noise contribution at the dwelling will be derived by logarithmically subtracting the background noise curve from the curve generated by the compliance testing data correlation.

An example of a wind farm noise contribution line derived from the post-construction measured noise regression line and background noise curve is shown in the figure below.



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4.4 Supplementary Testing

The residential logging method of NZS6808:2010 cannot be used in all circumstances to demonstrate compliance. This is primarily related to changes in local conditions or extraneous noise sources when compared to the conditions and noise sources that existed at the time of the original testing regime.

Where the residential logging method of NZS6808:2010 cannot be used to demonstrate compliance, then the alternate “on/off” compliance testing will be conducted as follows:

- Only at Residential Logging Locations where the primary test method cannot be used to demonstrate compliance;
- Only at integer wind speeds where the primary test method cannot be used to demonstrate compliance
- With the noise monitoring equipment at the same position where the primary test had been conducted, or if that position is considered to be a factor in the inability of the primary test to demonstrate compliance, at an equivalent position with respect to turbine noise at the Residential Logging Location, but which has a higher turbine to background noise level ratio;
- Conducted under a downwind condition. A downwind condition is defined as the wind direction at the relevant wind mast being within 45 degrees of the direct line from the closest turbine to the dwelling;
- Over a minimum interval of 2-minutes with the wind farm operational, then a measurement over the same interval with the wind farm shut off to obtain the background noise level;
- Monitoring the wind speed and direction over the measurement intervals to identify the comparable “on” and “off” measurements.
- Repeating the above “on” and “off” process to collect at least 3 intervals with comparable wind speed and direction conditions at each integer wind speed of interest.

4.5 Special Audible Characteristics – Tonality

As the noise from wind farms reduces with distance, so too does the audibility of tones. Therefore tonality testing will be conducted if the tonal adjustment K_t at either near field test was greater than 0dB at any wind speed. The testing will be conducted;

- in accordance with Annex D of ISO1996.2;
- for the specific tonal frequencies identified in the near field tests as having a tonal adjustment K_t greater than 0 dB;
- for each 10 minute period at the wind speeds where the tonal adjustment K_t was greater than 0 dB in the near field tests.
- at the closest non-associated residence where the landowner has granted permission to place the equipment.

For each 10 minute period where tonality is identified (and there is no evidence that the tone is from a source other than the wind farm), the relevant adjustment K_t from the near field tests will be added to the measured noise level, prior to correlation with wind speed. Where the addition of the tonal adjustment increases the overall noise at any wind speed by 1 dB(A) or more, this increase will be applied to other non-associated residences (at the same wind speeds), unless there is evidence that the tone(s) are not audible at the other residences.

4.6 Special Audible Characteristics - Modulation

In a similar way as the tonality testing, amplitude modulation testing will be conducted at the Residential Logging Location with the highest predicted noise level if the objective criteria for the overall A-weighted noise level in Section B3.2 of the NZS6808:2010 are exceeded in the near field test.

The testing at a Residential Logging Location will be conducted:

- At the dwelling with the highest predicted noise levels;
- At the integer wind speed where the difference between the predicted noise level and the project criteria is the least;
- Conducted under a downwind condition;
- Over a minimum interval of 2-minutes with the wind farm operational;
- Collecting at least 5 measurement intervals where the modulation of the wind farm is audible;
- Reviewing the noise level time trace for modulation at the blade pass frequency;
- Comparing the results against the objective criteria for the overall A-weighted noise level in Section B3.2 of the NZS6808:2010.

Where the comparison indicates a measurable modulation trace at the blade pass frequency that exceeds the objective criteria in Section B3.2 of the NZS6808:2010 for the overall A-weighted noise level, longer term testing at the nearest dwelling will be conducted over the same period as the compliance testing.

For each 10 minute period where excessive amplitude modulation is identified (and there is no evidence that the amplitude modulation is from a source other than the wind farm), an adjustment of 5 dB(A) will be added to the measured noise level, prior to correlation with wind speed.

Where the addition of the modulation adjustment increases the overall noise at any wind speed by 1 dB(A) or more, this increase will be applied to other non-associated residences (at the same wind speeds), unless there is evidence that the modulation is not present at the other residences.

It is recognised that the methodology outlined in NZS6808:2010 is an “interim test method”. Should a more widely accepted methodology (such as the Institute of Acoustics UK (IOA) method as specified in “IOA noise working group (Wind turbine noise), Amplitude Modulation Working Group, Final report, A method for Rating Amplitude Modulation in Wind Turbine Noise” dated 9 August 2016 version 1”) become available prior to the above testing period, then subject to approval by the responsible authority, the framework outlined above might be superseded.

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4.7 Testing Schedule

Testing will commence within 2 months of the commissioning of the final turbine and will collect data for at least 6 weeks at each location. A report will be prepared within 6 months following commissioning.

The testing will be repeated 12 months after the testing described above (within 14 months of commissioning the final turbine) and will collect data for a further 6 weeks at each location.

A final noise compliance report will be provided within 3 months of the completion of the testing.

5 NON-COMPLIANCE ACTION PLAN

Where the results of the testing indicate that the noise limits during operation are exceeded by the operation of the wind farm, the following Noise Compliance Action Plan will be implemented:

1. Modifications, improvements, adjustments, replacement of parts or repairs to the turbines may be undertaken to reduce noise levels. Repeat noise compliance testing as per Section 4 above;
2. If the results from the repeat noise compliance test show that noise limits during operation are still exceeded, implement Step 3;
3. Design a Noise Management System (NMS) to ensure that the project criteria are achieved. The NMS will consider the following options as necessary:
 - the operation of turbines under reduced noise level modes for particular conditions (such as certain wind speed and direction);
 - the parking of turbines for particular conditions.
4. Conduct noise modelling with the above options implemented to ensure that compliance can be achieved. The noise modelling is to include any differences in the installed turbine sound power

levels and the turbine manufacturer's near field¹ sound power level test results and the effect of any penalties and;

5. If the modelled noise levels exceed the project criteria, then repeat steps 3 and 4;
6. Confirm noise compliance of the wind farm through noise compliance testing at the relevant dwellings and document the noise management system determined in Step 3 (if relevant);
7. Prepare a NMS document which includes the following information:
 - Results for the primary testing for each dwelling;
 - Results for any required supplementary testing for each dwelling;
 - The make, model and sound power levels of turbines;
 - The turbines which are to operate under reduced noise level modes;
 - The modes that each turbine must operate under and the wind speeds and directions that initiate that mode;
 - The turbines required to be parked and the wind speeds and directions that initiate that parking;
 - Photographs of the noise logging location and a general description of the local conditions in the vicinity of the location including structures, vegetation, and any noise generating plant and equipment;

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The wind farm will operate in accordance with the NMS document.

¹ The turbine manufacturer will confirm the sound power level through measurements of the installed wind farm.