NOISE MEASUREMENT SERVICES

Chepstowe Wind Farm

Noise Assessment

REPORT CONTROL PAGE

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Introduction to this Report

The Pyrenees Shire is host to wind farms, proposed and operational, for the harnessing of wind power as a form of energy. The Shire has asked for an assessment of the potential effects of noise from wind farms and a critique of the Chepstowe Wind Farm proposal. This Report provides this assessment.

People who are not exposed to the sounds of a wind farm find it very difficult to understand the problems of people who do live near to wind farms. Some people who live near wind farms are disturbed by the sounds of the farms, others are not.

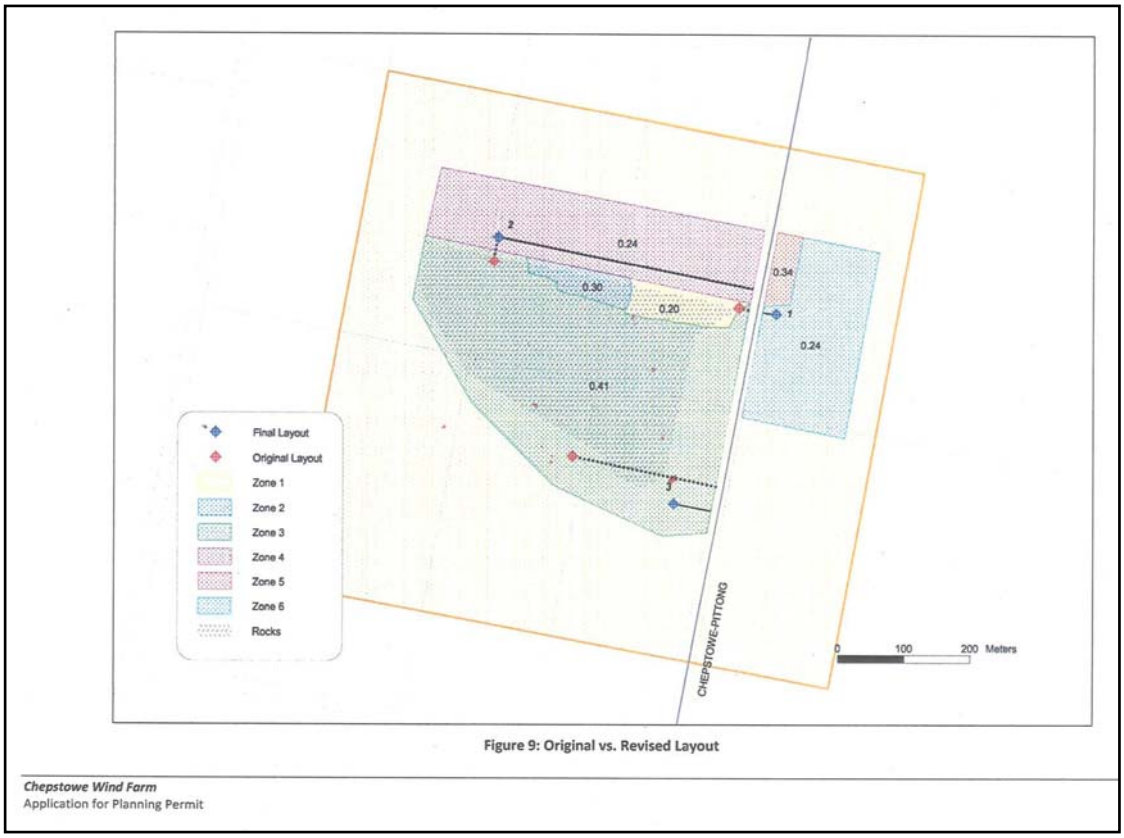
A companion document to this report is a Wind Farm Noise Assessment Technical Guide. The Guide has been prepared to assist people interested in or affected by wind farm noise. It discusses topics in the form of Annexes:

Annex 1 *"Audible Sound and Noise"*
Annex 2 *"Characteristics of Multiple and Single Wind Turbines"*
Annex 3 *"Predictions of Sound Levels – Approaches and Limitations*"
Annex 4 *"Responses of Residents near Wind Farms"*
Annex 5 *"Annoyance, Audibility, Low and Infrasound Perception"*
Annex 6 *"Flicker and the Human Perception of Wind Farm Activity"*
Annex 7 *"Sound, Noise, Flicker and the Human Perception of Wind Farm Activity"*

The Chepstowe Wind Farm Proposal

1. This Report considers the proposed Chepstowe wind farm proposal and the relevant standards applying to the proposal. The proposed development consists of three Repower MM92 2 MW turbines or similar. The original and revised locations of the turbines are shown in **Plan 1**, as provided in the planning permit application (page 17). The location of the proposed development is on Chepstowe – Pittong Road.

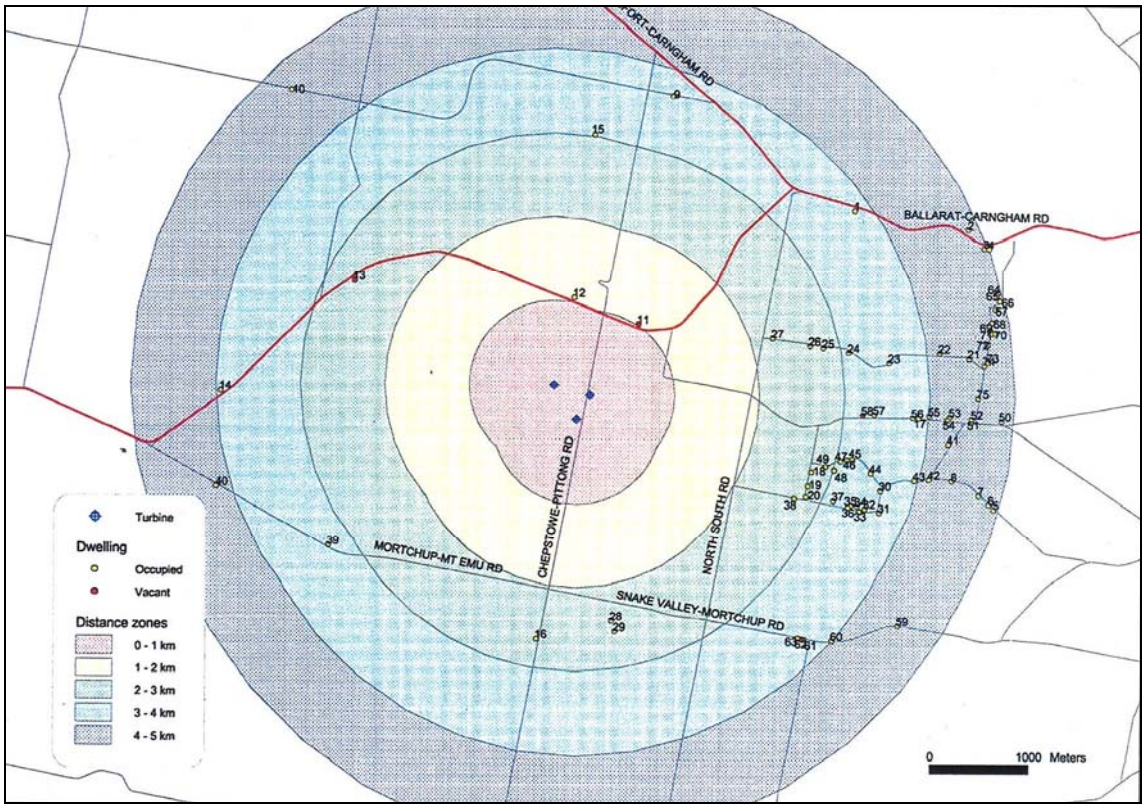
Plan 1: Location of turbines



2. The potentially affected residences as identified in the planning permit application (page 19) are shown in **Plan 2**, along with the setback distances.

3. From Plan 2 the most affected residences are numbers 11 and 12 as these are approximately 1000 to 1100 metres from the nearest turbine(s). There are no further residences until the 2000 to 3000 metre zone where there are 8 residences to the east of the wind farm, 3 residences to the south and 1 residence to the north-west. In the 3000 to 4000 metre zone there are 21 residences to the east of the wind farm, 4 residences to the south-east, 1 residence to the north-east, 2 residences to the north and 2 residences to the west, south-west.

Plan 2: Potentially Affected Residences



Noise predictions

5. The application documentation reviewed does not present much acoustic information but does provide a two page noise assessment prepared by Marshall Day Acoustics. This report is entitled "Chepstowe Wind Farm – Predicted noise levels" and is dated 21 July 2008. The Marshall Day Acoustics noise prediction assessment is presented in **Annex A.**

6. The application, at page 15 in Section 4.1 states:

> "However, the final selection of wind turbine will depend on intervening technological and economic developments, and as such may not be the Repower MM92. In the eventthat the final choice of turbine model differs from the Repower MM92, the overall height of the turbines will not exceed 130 m, and will comply with all conditions of the development approval."

7. The choice of turbine make, model and blade length has a significant effect on the potential for noise generation. In addition, the layout design of the turbines in relation to each other and the prevailing wind conditions will have a significant effect on potential noise generation. These matters are not considered in the Marshall Day Acoustics Report.

8. New Zealand Standard, *NZS 6808:1998 Acoustics-The assessment and measurement of sound from wind turbine generators* is referenced as being the basis for assessment of effect of a wind farm in Victoria. The standard is referenced in the *'Policy and planning guidelines for development of wind energy facilities in Victoria 2009'* and model permit conditions. In March 2010 a revision of the 1998 standard was issued, entitled NZS 6808:2010 *Acoustics – Wind farm noise* The revised 2010 standard has, I understand, been 'adopted' by VCAT[1].

9. The decision by VCAT requires the proposed development to be assessed under the new standard, rather than under the 1998 standard available when the application was lodged. This Report considers both standards.

10. Accurate background sound level measurements are necessary under both standards because the compliance assessment methodology requires a comparison between background levels at residences and wind speeds at the wind farm.

11. The application and the Marshall Day Acoustics report that I have reviewed do not contain measured background levels in accordance with either standard. Accordingly it is not possible to determine compliance.

12. NZS 6808:1998 and its replacement NZS 6808:2010 *Acoustics – Wind farm noise* both lack a methodology to separate background sound levels created by the wind turbines (whether for compliance testing purposes or for complaint assessment) from background sound levels existing at a specific time and place due to wind movement, vegetation movements, bird song and so on. Accordingly it is not possible to determine compliance unless a methodology is explicitly stated in the conditions of approval.

13. The 1998 version of the New Zealand standard at clause 4.4.2 states that:

> "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 (L95) by more than 5 dBA, or a level of 40 dBA L95, whichever is the greater".

14. NZS 6808:2010 is different from the 1998 edition by recognising a 35 dB(A) background level for evening and night-time. The lower limit is introduced by way of recognising locales of 'high amenity', clause 5.3.1: *'…a more stringent noise limit may be justified to afford a greater degree of protection of amenity during evening and night-time'.* No definition of 'high amenity' is provided as each area is established according to the New Zealand District Plans and these do not apply in Victoria. A comprehensive submission on this matter was raised by Mr Andrew Cox, solicitor, at the Stockyard Hill Wind Farm hearing, Melbourne, May 2010.

[1] The Sister's Wind Farm Pty Ltd v Mayne Shire Council & Ors (No. P2107/2009) applying to wind farms under 30 MW.

15. The Victorian EPA Guidelines[2] provide that where rural background sound levels are very low (less than 25 dB(A) at night or 30 dB(A) during the day or evening) the minimum limits for noise from the industry should be: day (45dB(A)), evening (37 dB(A)) and night (32 dB(A)). As the wind farm is an industrial activity it is concluded that these guidelines can apply.

16. The Planning Permit model conditions[3] confirms the importance of night time levels and compliance must be separately assessed for all-time and night-time. Night is between 10:00pm and 7:00am. The variation is not included in the Marshall Day Report.

17. Ambient sound level surveys that I have undertaken within the Shire and nearby locales indicate background levels (measured as "L95" levels) are in the order of 18 dB(A) to 22 dB(A) at night, with higher levels during the day and evening. It is concluded that the residences in the vicinity of the wind farm will meet this guidance and can considered as a being a low-noise locale.

18. NZS 6808 does not state the type of sound level meter to be used. As rural environments are relatively quiet at night-time "low-noise floor instruments" are necessary for sound level surveys. These instruments are capable of measuring to below 18 dB(A). Other instruments may not be suitable as they can not measure real, low-level sounds common in rural environments and give inaccurate high background sound levels. This is often shown as a 'flat line' at 22 to 24 dB(A) and low wind speeds (that is, below 5 metres/sec).

19. My observations over an extended period of months at wind farms in New Zealand and Victoria has shown that the operation of the turbines may be clearly heard at the residences under a wide range of meteorological conditions.

20. From data recorded at Ballarat the expected prevailing winds are from the north swinging to the south-east. There is significant wind from the west and south-west that will affect residences to the north and east. **Figure 1** presents the mid-morning and mid-afternoon wind roses at Ballarat airport. For the purposes of discussion I am assuming a similar pattern for night-time. Some residences or noise sensitive places will be more subject to the prevailing breeze than others at different times. This is complex wind pattern and there are a relatively large number of potentially affected residences within 4000 metres of the proposed wind farm

21. Under a prevailing breeze or stable, cool night-time conditions sound travels very clearly. It is my standard practice in modeling a risk assessment of a wind farm or other industrial activity to make allowance for analysis uncertainty when undertaking predictions. The consideration of uncertainty is now formalized under NZS6808:2010. Uncertainty is not considered in the Marshall Day Acoustics assessment.

[2] Interim Guidelines for Control of Noise from Industry in Country Victoria (N3-89).
[3] Planning and Environment regulations 2005 Form 11 Planning Permit, Model Permit Conditions, Issue 12 February 2009

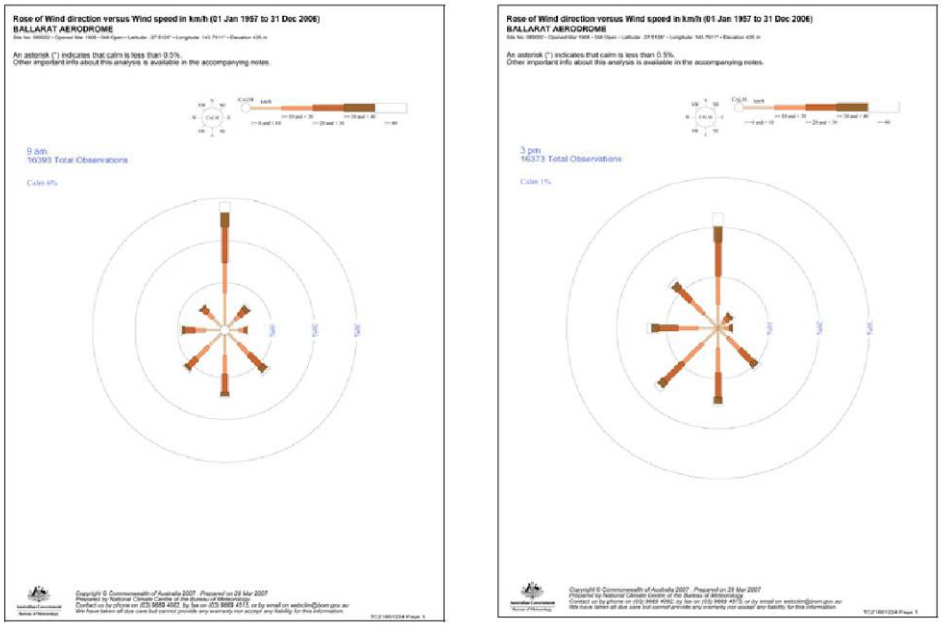


Figure 1: wind rose, Ballarat Aerodrome, mid-morning and mid-afternoon

22. The New Zealand wind farm standards NZS 6808:1998 and 2010 apply a penalty for wind farms that exhibit special audible characteristics. Modulation is an operational characteristic of wind turbines. Modulation is specifically defined as a special audible characteristic in both editions of the standard. Thus the nominal "limit" under NZS 6808:2010 is reduced from 35 dB(A) to **30 dB(A), L90, for evening and night-time.** The Marshall Day Acoustics report does not consider the effects of special audible characteristics.

23. Noise Measurement Services has recalculated the predicted sound levels from the three turbines using the prediction method *ISO 9613-2 (1996) Acoustics – Attenuation of sound propagation outdoors Part 2: General Method of Calculation*, as endorsed by NZS6808:2010. The predicted levels are provided in **Annex 2.** At residences 11 and 12 the predicted uncertainty is ±3 dB.

24. The assumptions for the predictions are limited under ISO9613-2:1996 and the model is not able to accommodate varying meteorological conditions. ISO9613 states that the average propagation equation of the standard holds under downwind conditions and well developed moderate ground based temperature inversion. This is not necessarily correct for wind turbine assessments, in my view. ISO 9613-2 states that prediction has an estimated accuracy (uncertainty) for broadband noise of ±3 dB at 1000 metres. The standard does not provide any guidance as to accuracy beyond 1000 metres. Sound level predictions and assumptions must, therefore, be treated with caution. The Marshall Reports do not address accuracy of prediction or advise that predictions must be treated with caution.

25. The Leq 30 dB(A) level is at the 2000 metre distance with residences 11 and 12 affected at approximately 37 dB(A) ±3 dB. The background level, in accordance with NZS6808, is approximately 2 dB(A) less than the Leq level. It is concluded that residences 11 and 12 are affected and the wind farm will, on occasion, be in non-compliance at these residences. If, however, the residences are owned by stakeholders then the model conditions allow exemption.

26. Wind farm activity, however, introduces changes to the wind patterns. In particular, as explained in the Wind Farm Noise Assessment Guidelines, there is good reason to consider the effects of low frequency sound and infrasound. The expression sub-audible character is given in this evidence to differentiate between low frequency sound (which has a solid foundation in hearing response) and infrasound, which has a less solid foundation in hearing response. Infrasound, however, has characteristics that may lead to adverse health effects. However, there is sufficient peer-reviewed research and solid acoustical foundation for analysis to be made. Of most importance, because of possible health effects, are the 5 Hz to 20 Hz bands, with 20 Hz band being a good indicator of effect. This is still the subject of debate, as outlined in the Guidelines.

Conclusions

1. It is concluded that New Zealand Standard NZS 6808:2010 *Acoustics – Wind farm noise* applies to this wind farm application.

2. It is concluded that the wind farm will, under southerly and westerly wind conditions, be in non-compliance with a background (L90) level of 35 dB(A) at residences 11 and 12.

3. It is concluded that the penalty for special audible characteristics is applicable to this wind farm. With the penalty applied the compliance level at residences 11 and 12 is a background (L90) level of 30 dB(A).

Signed

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ANNEX A:

PREDICTED SOUND LEVELS (MARSHALL DAY ACOUSTICS)

memo

MARSHALL DAY Acoustics

Noise emissions from the proposed wind farm were predicted at the neighbouring residential properties using the prediction method detailed in NZS6808:1998. Predicted noise levels together with the lowest possible NZS6808:1998 noise limit of 40dBA are presented in Figure 1.

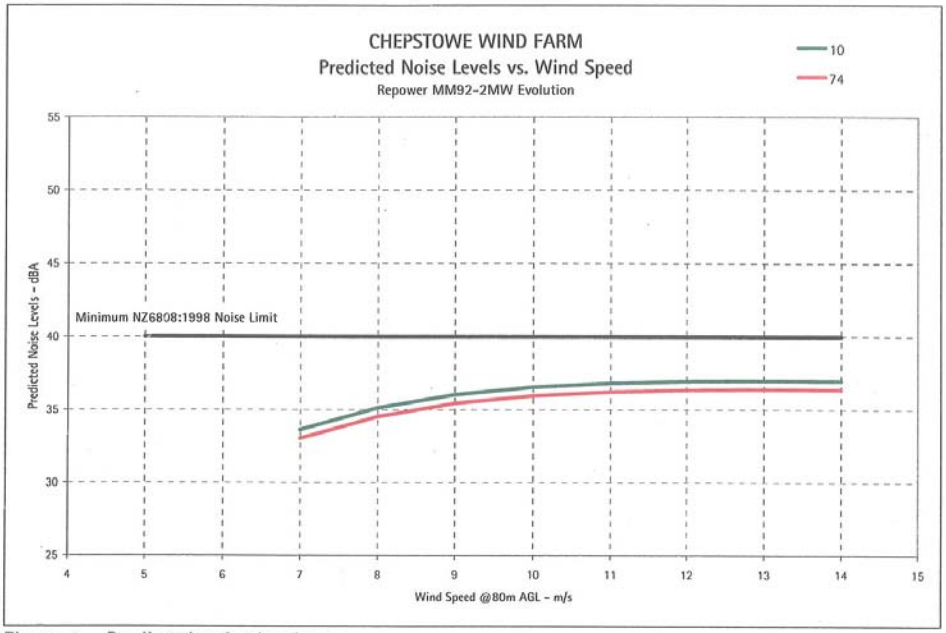

Figure 1 - Predicted noise levels

It can be seen from Figure 1 that noise emissions from the proposed Chepstowe Wind Farm at all two residential properties located within 2km of the nearest wind turbine will comply with the lowest possible NZS6808:1998 noise limits at all wind speeds.

Furthermore, noise emissions from the proposed Chepstowe Wind Farm at all residential properties located further than 2km of the nearest wind turbine will also comply with the lowest possible NZS6808:1998 noise limits at all wind speeds.

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ANNEX B:

PREDICTED SOUND LEVELS (THIS REPORT)