BEFORE AN INDEPENDENT HEARINGS COMMISSIONER FOR WAITOMO DISTRICT COUNCIL

IN THE MATTER	of the Resource Management Act 1991 ("Act")
AND	
IN THE MATTER	of an application to vary resource consent RM050019 by Taumatatotara Wind Farm Limited under s127 of the Act

EVIDENCE OF MICHAEL SMITH
ON BEHALF OF TAUMATATOTARA WIND FARM LIMITED
ACOUSTICS
20 OCTOBER 2023

Counsel: G K Chappell

FOUNDRY CHAMBERS | M 0273034757
| Level 4, Vulcan Buildings, Vulcan Lane,
| A P O Box 1502 | DX CP 19020 | Auckland 1140
E gillian@chappell.nz | W www.chappell.nz

Table of contents

1. INTRODUCTION

1.1 My full name is Michael James Smith.

1.2 I am a Principal Acoustics Engineer and a director of Altissimo Consulting Ltd, based in Christchurch. I have previously been employed by multi-disciplinary firms AECOM and URS, and specialist acoustics firm Marshall Day Acoustics.

1.3 I have the following qualifications and experience relevant to this assessment:

(a) I hold the degrees of Bachelor of Engineering (Mechanical) and Bachelor of Mathematical and Computer Sciences from the University of Adelaide.

(b) I have practised in the field of acoustics since 2006. I am a full member of Engineering New Zealand (MEngNZ), the Acoustical Society of New Zealand (MASNZ) and the Australian Acoustical Society (MAAS).

1.4 In relation to wind farm noise assessments, I have been involved with:

(a) Background sound level measurements for numerous wind farms in New Zealand and Australia.

(b) Computer noise modelling and/or assessment of effects for Jericho, Flat Hill, Mill Creek, Pouto, and Dominion Salt wind farms.

(c) Compliance monitoring for Mt Stuart and Mill Creek wind farms (traditional) and on-off testing for Flat Hill wind farm

(d) Sound power level (IEC61400-11) measurements of Snowtown wind farm (Australia)

(e) Near-field / tonality measurements for Mill Creek wind farm[1].

[1] John Bull et al., 'Determining Tonal Audibility in Large Data Sets', in *Proceedings of the 22nd Biennial Conference of the Acoustical Society of New Zealand*, 2014.

1.5 I authored an article for 2012 Wind Farm Special Edition of the *Acoustics Australia* journal[2].

1.6 I have been retained by Taumatatotara Wind Farm Ltd ("T4") to provide acoustics evidence in respect of the proposed alteration to the consented wind farm to authorise a reduced number of taller turbines.

1.7 In preparing my evidence I have relied on and reviewed the following:

(a) The application documents;

(b) Section 92 Requests and responses;

(c) Exchanges with Siiri Wilkening of Marshall Day Acoustics;

(d) The Section 42A Report.

Code of conduct

1.8 I confirm that I have read the Expert Witness Code of Conduct set out in the Environment Court's Practice Note 2023. I have complied with the Code of Conduct in preparing this evidence and will continue to comply with it while giving oral evidence. Except where I state that I am relying on the evidence of another person, this written evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed in this evidence.

Scope of evidence

1.9 In my evidence, I

(a) Provide an executive summary of my key conclusions;

(b) Provide a summary of the assessments prepared for the application for variation;

(c) Summarise further issues arising from the s92 requests;

(d) Address relevant submissions;

[2] Michael Smith and Stephen Chiles, 'Analysis Techniques for Wind Farm Sound Level Measurements', *Acoustics Australia / Australian Acoustical Society* 40 (1 April 2012): 51–56.

(e) Address the Section 42A Report;

(f) Assess the potential acoustic effects of the proposed minor changes to the hub / tip height as part of the updated proposal to reduce the number of turbines and increase height; and

(g) Set out what I consider to be appropriate amendments to the proposed consent conditions.

2. EXECUTIVE SUMMARY

2.1 The proposed variation to the consent to allow a smaller number of physically larger turbines (11 turbines instead of 22) will result in a net decrease in wind farm noise at all nearby dwellings.

2.2 Similarly, construction traffic noise effects will reduce, as a smaller number of turbines will result in fewer heavy vehicle movements.

2.3 Noise from construction activities within the wind farm site will be well below the noise limits set out in Condition 12, due to the large separation distances and permissive noise limits.

2.4 I consider the scale of effects of an 8-turbine layout with larger turbines to be the same as the 11-turbine layout that was publicly notified.

2.5 In terms of conditions, aligning the revised conditions with the current (2010) version of NZS 6808 will result in increased certainty for all parties. However, I consider that it is appropriate that condition 9 which requires background sound level measurements refers to this occurring prior to installation of the turbines, rather than prior to commencing development. Otherwise, I agree with the amendments as proposed by Ms Wilkening in the Section 42A Report.

3. PROJECT BACKGROUND

3.1 T4 holds a resource consent to construct and operate a wind farm at Taumatatotara, in the Waitomo District. This consent was granted in 2008 and amended in 2011 (Existing Consent).

3.2 The consented wind farm authorises a maximum of 22 turbines with a tip height of 121.5m for the northern 11 turbines and 110m for the balance.

These turbines nominally had a hub height 60 m. Noise from turbines is modelled based on hub heights.

3.3 The conditions of the Existing Consent include the following noise controls:

(a) The consent is subject to meeting the noise limits prescribed in NZS 6808:1998, which are 40 dB L_{A95}, plus an allowance for increased generation where background sound is already higher (condition 8).

(b) The wind turbines shall not exceed a rotor tip height of 110 m above ground level and a sound power level of 107.2 dB L_{WA} unless it can be demonstrated that higher turbine heights or sound power will still comply with noise limits at receivers (condition 11).

3.4 The inclusion of a height restriction in an acoustics condition is unusual, and I am not aware of an effects-based reason for this.

3.5 The original assessment was undertaken in accordance with NZS 6808:1998, which has since been superseded by NZS 6808:2010.

3.6 The original modelling was completed using a 2-dimensional approach and did not include a reduction in the predicted noise level due to topography or obstructions. In that context, the predicted sound levels are insensitive to the wind turbine height. The predictions for the original consent (granted in 2008) were undertaken using the *WindFarm* software package. This was commonly used by wind farm developers either for a preliminary assessment or for low-risk projects. Since the adoption of NZS 6808:2010, wind farm noise levels are generally predicted using specialised acoustics software[3], by appropriately experienced engineers.

3.7 The original modelling predicted that the highest noise level at a third-party dwelling was 24 dB L_{A90}. Noise contours from the concept layout are provided in Appendix A.

[3] Such as SoundPLAN. Cadna/A, and Predictor

4. PROPOSED VARIATION TO EXISTING CONSENT

4.1 I was engaged by Taumatatotara Wind Farm Limited in 2021 to review the proposal to revise the wind farm scheme to use fewer turbines (11 turbines) with increased power output. While these turbines are physically bigger (up to 172.5m), they do not produce more noise.

4.2 Initially, I prepared a high-level review[4] of the changes and reported that from a purely geometric perspective[5], the increase in height would not result in increased noise levels. I considered that was reasonable, as effects were directly managed by the conditions I have identified in paragraph 3.3.

4.3 During the processing of the consent variation, I understand that Waitomo District Council had reservations about whether the application could be accepted as a variation or whether a new resource consent was required. A series of requests for information from WDC ensued, which in my view, were focussed on determining the effects of the wind farm as if it were a new activity, rather than considering what the change in effects would be.

4.4 In response, I modelled noise from both the original 22 x 60m (hub height) turbine layout and the revised 11 x 95m (hub height) turbine layout using current best practices[6]. This showed a reduction in sound level at all dwellings, particularly in the southern group, where the string of turbines 12 -22 has been removed. The results of the predictions are shown in Table 1 below.

4.5 Except for the Martin dwelling (which had been constructed post-consent), all predicted sound levels are below 30 dB – that is, more than 10 dB below the consented noise limit. While I have not undertaken noise monitoring in the project area, I expect that wind farm noise is likely to be at a similar level to the natural environment.

---

[4] Altissimo Consulting, 'Taumatatotara Wind Farm – Noise Effects of Change in Turbine', 25 June 2020.

[5] Predictions under the former NZS 6808:1998 used a 2D model

[6] This included both NZS 6808:2010 and the UK Institute of Acoustics Good Practice Guide

Table 1 Predicted sound levels (Table 7 from Letter 04_D dated 7 April 2021)

House ID	Owner	11x 95m turbines	22x 60m turbines	Difference
		NZS 6808:2010	NZS 6808:2010	
Northern dwellings				
22	Martin*	32.4 dB	32.5 dB	-0.1 dB
23	Froggat / Walsh	27.7 dB	29.4 dB	-1.6 dB
24	Stokes & Co	26.6 dB	29.3 dB	-2.7 dB
25	Stokes & Co	26.6 dB	29.4 dB	-2.8 dB
Southern dwellings				
13	Galbraith and Panapa	20.9 dB	29.6 dB	-8.8 dB
14	Knight	23.6 dB	30.8 dB	-7.2 dB
15	Mitchell	21.9 dB	29.4 dB	-7.5 dB
16	Mitchell, McMahon, Williams	21.1 dB	28.5 dB	-7.4 dB
17	Mitchell, McMahon, Williams	20.5 dB	27.9 dB	-7.5 dB
18	Gilbert S	18.4 dB	30.7 dB	-12.3 dB
19	Gilbert C&D	16.7 dB	30.9 dB	-14.2 dB
20	Gilbert C&D	16.9 dB	31.7 dB	-14.8 dB
21	Awamarino	18.1 dB	36.6 dB	-18.5 dB

* Dwelling was not built when consent was granted.

4.6 On this basis, I do not consider that the revised scheme with larger turbines has a greater degree of noise effects than the original layout but, as shown in the above table, the effect of the 11 turbine option shows a reduction in noise effects.

4.7 I have proposed an updated suite of conditions to use the more ‘modern’ framework of NZS 6808:2010. I consider these conditions to provide more certainty than the original conditions.

5. RESPONSE TO RELEVANT SUBMISSIONS

5.1 I have reviewed the submissions relevant to this project. I note that issues raised in the submissions are largely in relation to wind farm noise in general, rather than the proposal alteration scheme. While there may be some scope issues, I have covered these for completion.

5.2 The location of the submitters’ dwellings and property boundaries are shown in Figure 1, along with the proposed turbine layout and indicated sound levels.

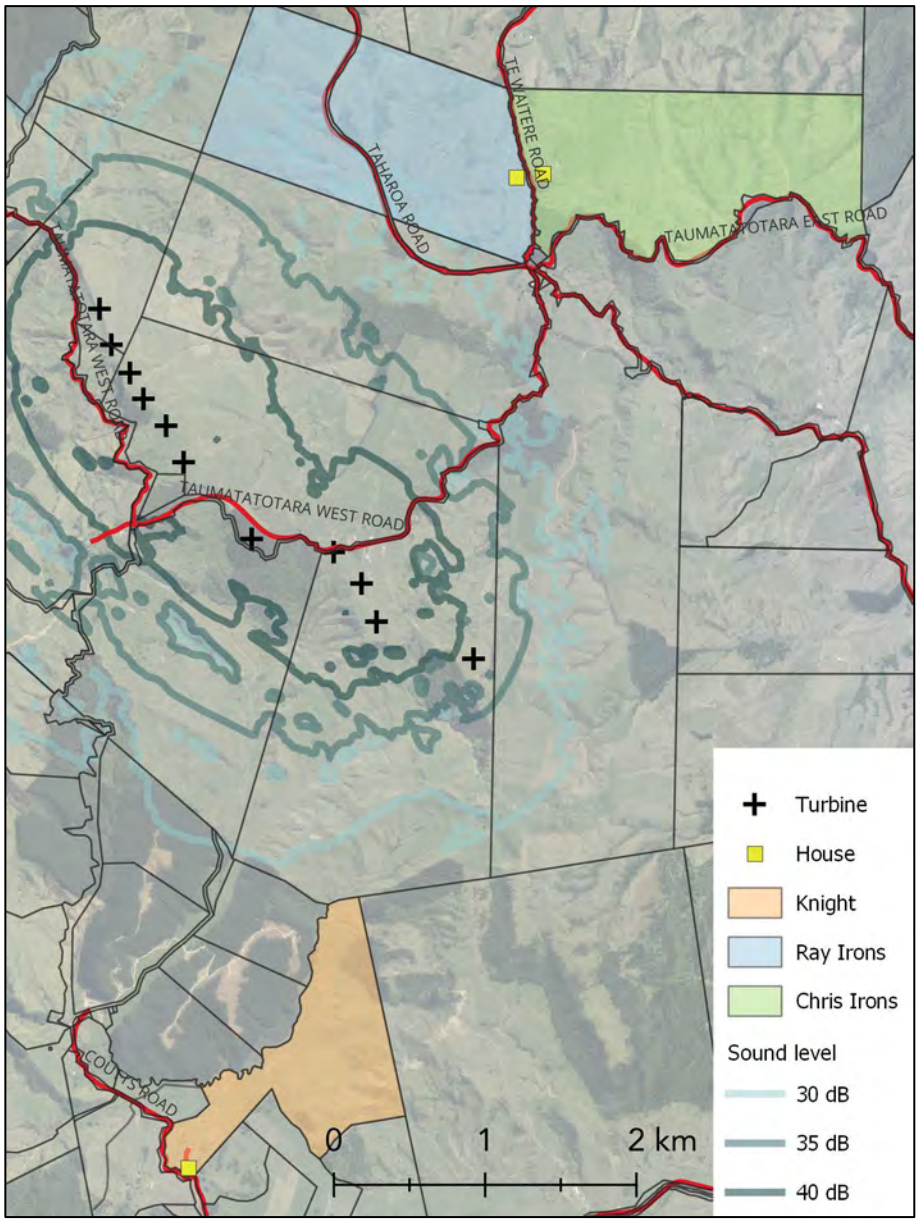


Figure 1 Submitter locations and predicted wind farm sound levels

5.3 The key topics raised in submissions relevant to acoustic issues are:

(a) Health effects from wind farm sound, including “wind turbine syndrome”;

(b) Amenity effects on residents;

(c) Noise effects on wildlife;

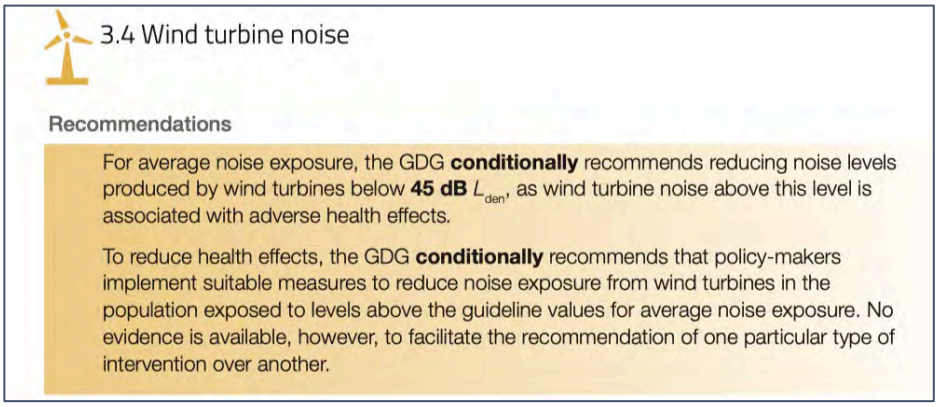
(d) Vibration effects on soil stability; and

(e) Noise from construction traffic.

Health effects

5.4 While the NZS 6808:2010 does not have an explicit method for assessing effects, in terms of health effects the noise limits in the standard have been designed to provide protection from sleep disturbance. The Environment Court has accepted this point on several wind farms, for example, Meridian's *Hurunui Wind Farm*.[7]

5.5 In their 2018 guidance[8], the World Health Organisation introduced a recommendation that wind turbine noise should not exceed 45 dB L_{den}.



3.4 Wind turbine noise

Recommendations

For average noise exposure, the GDG **conditionally** recommends reducing noise levels produced by wind turbines below **45 dB** L_{den}, as wind turbine noise above this level is associated with adverse health effects.

To reduce health effects, the GDG **conditionally** recommends that policy-makers implement suitable measures to reduce noise exposure from wind turbines in the population exposed to levels above the guideline values for average noise exposure. No evidence is available, however, to facilitate the recommendation of one particular type of intervention over another.

5.6 The conditional recommendation was made for annoyance-related health considerations. The recommendation is conditional on the basis that "the evidence of the adverse effects of wind turbine noise was rated low quality". No suitable studies were available concerning cardiovascular disease or learning impairment.

5.7 The recommended L_{den} metric is the day-evening-night level defined in NZS 6801:2008 and referenced in the European Noise Directive. It is the annual average of all 24-hour periods, after the addition of 10 dB to sound levels at night, and the addition of 5 dB to sound levels in the evening. The potential benefit of this type of metric for wind farms is that it may also differentiate between locations where the highest wind farm noise levels are similar, but where the amount of time that these levels are experienced differs significantly (i.e. due to receivers being in or out of the prevailing wind direction)[9]. It is problematic in that it cannot be readily measured.

---

[7] Re Meridian Energy Limited [2013] NZEnvC 59 at [273]

[8] World Health Organisation (2018) *Environmental Noise Guidelines for the European Region*

[9] Adcock and Delaire (2019), *WHO Environmental Noise Guidelines for the European Region: conditional recommendation for wind turbine noise in the context of Australian regulations*. Proceedings of Wind Turbine Noise.

5.8 Wind farm noise that achieves 40 dB $L_{A90(10min)}$ for all periods, will result in a long-term exposure of less than 45 dB L_{den}, and therefore meet the WHO recommendation.

5.9 "Wind Turbine Syndrome" is a term established by Nina Pierpont in her self-published book of the same name[10]. While this book has been criticised for lack of scientific rigour and bias[11], others have sought to identify potential mechanisms for reported effects[12]. I am not aware of any projects in New Zealand where the Environment Court or a Board of Inquiry has accepted "Wind Turbine Syndrome" as a valid concern.

Vibration

5.10 A study at a New Zealand turbine has measured vibration levels and concluded that these are well-below values that are known to cause land damage.[13]

Noise effects on wildlife

5.11 Effects of noise on animals are not within my area of expertise. However, I am not aware of any unique setting to this wind farm.

Construction traffic

5.12 The existing consent allows for the transportation of these turbines by the public road network. As identified by Traffic Engineering Solutions Ltd, the proposed scheme with fewer turbines is likely to result in a reduction in the number of trips per day and the duration and period of transportation. A reduction in the number of trips will reduce overall transport noise.

5.13 While construction traffic may be audible and cause disturbance, I am satisfied that these effects can be managed through the Construction

---

[10] Nina Pierpont, 'Wind Turbine Syndrome: A Report on a Natural Experiment', 1 January 2009.
[11] Simon Chapman, and Fiona Crichton. *Wind Turbine Syndrome: A Communicated Disease*. Sydney University Press, 2020. https://ses.library.usyd.edu.au/handle/2123/17600.
[12] G. James Rubin, Miriam Burns, and Simon Wessely, 'Possible Psychological Mechanisms for "Wind Turbine Syndrome". On the Windmills of Your Mind', *Noise and Health* 16, no. 69 (1 March 2014): 116, https://doi.org/10.4103/1463-1741.132099.
[13] Paul Botha, 'Ground Vibration, Infrasound and Low Frequency Noise Measurements from a Modern Wind Turbine', *Acta Acustica United with Acustica* 99, no. 4 (1 July 2013): 537–44, https://doi.org/10.3813/AAA.918633.

Traffic Management Plan, and will be at a similar level to the consented wind farm.

6. HOUSE 28 - CHRIS IRONS

6.1 The submitter's dwelling is located at 84 Te Waitere Road and the predicted wind farm sound levels are below 30 dB L_{A90} (i.e, more than 10 dB below the consented noise limit). There is no material difference in the predicted sound levels between the two schemes.

7. HOUSE 29 - RAY IRONS

7.1 The submitter's dwelling is located at 83 Te Waitere Road and the predicted wind farm sound levels are below 30 dB L_{A90} (i.e, more than 10 dB below the consented noise limit). The submitter's land to the west and south of the dwelling may experience wind farm sound levels up to 32 dB L_{A90}. However, NZS 6808 does not require protection on land other than around dwellings.

7.2 There is no material difference in the predicted sound levels between the two schemes at both the dwelling and surrounding land.

8. HOUSE 14 - KNIGHT

8.1 The submitter's dwelling is located at 158 Coutts Road, which is over 3km from the nearest turbine in the revised scheme. The dwelling is well outside the 30 dB L_{A90} noise contour (i.e, more than 10 dB below the consented noise limit) and will experience a lower noise level compared to the consented scheme, due to the removal of the southern string of turbines.

8.2 Noise monitoring is often used for forming an appreciation of the existing environment when consenting a new project, or for setting a baseline for compliance measurement. Given that there already is a consented wind and the proposed variation results in a reduced level of effect, I do not consider noise monitoring required at this dwelling.

Construction noise

8.3 It is standard practice to manage construction noise effects by preparing and implementing a Construction Noise Management Plan (**CNMP**), as required by Condition 14.

8.4 As the key construction noise effect will be related to the upgrade of public roads and heavy vehicle traffic on these roads, the CNMP will be tightly integrated with other design and management plans.

8.5 Noise from construction activities within the wind farm site will be well below the noise limits set out in Condition 12, due to the large separation distances and permissive noise limits.

9. RESPONSE TO SECTION 42A REPORT

9.1 The s42A report references consultant advice from Ms Siiri Wilkening of Marshall Day Acoustics.

9.2 Ms Wilkening observes that based on the noise levels that I have predicted:

> *the wind farm will likely be largely inaudible, and only intermittently audible when there are still conditions at the dwelling location and windy conditions at the wind farm site.*

9.3 I agree with the amendments proposed in the Section 42A report by Ms Wilkening. The only item of contention is whether the background sound levels required by Condition 9 need to be established prior to commencing any development of the site.

9.4 I agree with Ms Wilkening that it would be inappropriate for background noise levels to be contaminated by construction activity. However, I disagree that it is necessary to conduct this survey prior to the "development" of the wind farm.

9.5 Given the geographic extent of the wind farm and road upgrades required, I consider that it would be practical to conduct this survey at a future date where there is no undue influence from construction noise.

9.6 Background noise surveys are typically undertaken for 3 weeks, and report the results of consecutive 10-minute measurements. The

statistical approach of analysing a large dataset will result in the overall method being robust to intermittent external noise sources. Seasonal variations, including insect noise, are likely to affect noise level measurements more significantly.

9.7 In my experience, it is typical for the acoustics specialist conducting background and compliance measurements to split the dataset by time of day, as the nighttime period is generally quieter due to reduced noise from birds, insects, and anthropogenic noise sources (eg. traffic). Construction activities will not be undertaken at night, so the background sound levels in these periods will remain 'clean'.

9.8 I have personally undertaken background noise surveys for the Mill Creek and Mt Stuart wind farms in the months prior to commissioning/opening. While in these projects, background noise surveys had been undertaken in the consenting phase, the consent holder sought to obtain up-to-date results in case the environment had changed.

9.9 For the above reasons, I do not consider that it is necessary to undertake the background noise surveys prior to the development of the wind farm. However, to recognise the issue raised by Ms Wilkening I have proposed amendments to condition 9. These are set out in the evidence of Mr Shearer and are a pragmatic response to the issues raised.

10. AMENDMENTS PROPOSED TO NUMBER OF TURBINES AND HUB / TIP HEIGHT

10.1 The Applicant has refined its application for variation to propose an 8-turbine scheme, with slightly larger turbines. These turbines would have a maximum diameter of 163m and a maximum tip height of 180.5m.

10.2 As the layout of the turbines is the same as the previously assessed wind farm (minus 3 turbines), and the sound power levels of the larger turbines will be similar to previously proposed candidate turbines, noise levels at nearby dwellings will not be materially changed, and are likely to be slightly reduced.

10.3 The dwelling noise limits in Condition 8 provide an absolute limit on noise effects, and the prediction report required by Condition 10 will confirm noise levels for the specific turbine make/model, hub height and sound

power level when these are selected. I consider this to be an effective control, and consistent with NZS 6808:2010[14] and best practices.

10.4 In summary, I consider the scale of effects of an 8-turbine layout with larger turbines to be the same as the 11-turbine layout that was publicly notified. I note that neither layout is tied to a specific turbine type.

11. CONDITIONS

11.1 The conditions included in the evidence of Mr Shearer are based on my letter L03_B with an update to condition 16 based on feedback from Ms Wilkening at the time (June 2021).

11.2 I note that these conditions have been proposed for the purpose of updating the existing conditions to take account of changes to the NZS since the original consent. I continue to support these conditions on this basis. Subject to the amendment to condition 9, I also support the drafting suggestions in the Section 42A Report which improve the readability.

Michael Smith

[14] NZS 6808:2010 explicitly allows for a ‘consenting envelope’ where specific turbine types have not been selected.

Appendix One: Predicted noise levels for previous layout (2D model)

Appendix Two: Predicted noise levels for both turbine layouts (3D model)