

**BEFORE THE HEARING COMMISSIONERS
AT PALMERSTON NORTH**

IN THE MATTER of the Resource Management Act 1991
(the Act)

AND

IN THE MATTER of a review by **PALMERSTON NORTH CITY
COUNCIL** of the conditions of consent for
Te Rere Hau Windfarm under section 128
of the Act

**STATEMENT OF EVIDENCE OF STEPHEN GORDON CHILES ON BEHALF OF
NZ WINDFARMS LIMITED**

DATED 25 AUGUST 2017



ATKINS | HOLM | MAJUREY

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SUMMARY

1. I have experience in assessing sound from numerous wind farms of various sizes and I served as chair of the 2010 revision of the wind farm noise standard NZS 6808. I have been engaged to give evidence around the rationale of certain provisions in NZS 6808, where Mr Evans has recommended deviations from the standard.
2. Mr Evans has proposed a method for assessing special audible characteristics which is inconsistent with NZS 6808. Under NZS 6808 adjustments are only made to sound level samples which meet thresholds for special audible characteristics. Mr Evans proposes that adjustments should also be made to samples which do not meet those thresholds. I disagree with Mr Evans and consider his approach to be inappropriate.
3. Mr Evans considers the Te Rere Hau wind farm should be assessed to determine whether a high amenity noise limit should apply at all wind speeds below 8 m/s. Mr Evans appears to have misinterpreted the guideline screening criteria in NZS 6808, and has unjustifiably proposed an increased wind speed threshold of 8 m/s rather than the standard value of 6 m/s recommended in NZS 6808.
4. I discuss the operational state of wind turbines during sound level measurements. However, while I have a different opinion to Mr Evans as to required constraints, NZ Windfarms has accepted the condition put forward by Mr Evans in this respect.
5. I have set out a clarification that I consider is required to allow for background sound level measurements without other wind farms being shut-down. I have also detailed a clarification needed that assessment positions should be within notional boundaries of dwellings.

INTRODUCTION

Qualifications and experience

1. My full name is Dr Stephen Gordon Chiles.
2. I am self-employed as an acoustician by my company Chiles Ltd.
3. I have the following qualifications and experience relevant to the evidence I will give:
 - (a) Doctor of Philosophy in Acoustics from the University of Bath, and Bachelor of Engineering in Electroacoustics from the University of Salford;
 - (b) I have been employed in acoustics since 1996, and I have previously held positions as a research officer at the University of Bath, a principal environmental specialist for the New Zealand Transport Agency, and as a consultant for the international firms Arup, WSP, and URS, and for the specialist firms Marshall Day Acoustics and Fleming & Barron;
 - (c) I have made assessments and measurements of sound from many wind farms, including Meridian Energy's Hurunui and Mill Creek wind farms, Kaimai wind farm, Blueskin wind turbine, four distributed generation wind farms for Energy3 in Marlborough, Pioneer Generation's Mt Stuart and Flat Hill wind farms, and Fiji Electricity Authority's Butoni wind farm; I conducted reviews for Trustpower's Mahinerangi and Kaiwera Downs wind farms;
 - (d) I was chair for the 2010 revision of the New Zealand wind farm noise standard (NZS 6808¹) and I co-authored draft guidelines based on NZS 6808 for the Environment Protection Authority in Victoria;
 - (e) I am Convener of the New Zealand Industry Reference Group for the committee responsible for approximately 200 published 'ISO' standards relating to acoustics;
 - (f) I was chair of the 2012 Standards New Zealand acoustics standards review group and on the

¹ NZS 6808:2010 Acoustics – Wind farm noise

committee for the 2008 general environmental noise standards (NZS 6801² and NZS 6802³); and

- (g) I am a member of relevant associations and hold registrations, including Chartered Professional Engineer and Fellow of the UK Institute of Acoustics.

Expert Witness Code of Conduct

4. Although this is a Council hearing I confirm I have read and agree to comply with the Code of Conduct for Expert Witnesses set out in the Environment Court's Practice Note. This evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from my expressed opinions.

Involvement in project

5. I am familiar with the Te Rere Hau wind farm and the Windflow 500 wind turbine in a general manner as I reviewed Te Rere Hau compliance measurements for New Zealand Windfarms Limited (NZ Windfarms) and gave evidence to the Environment Court in 2014; conducted a site visit to the Te Rere Hau wind farm in 2008; made a peer review of the original noise assessment for the Te Rere Hau wind farm for NZ Windfarms in 2004; advised a nearby resident about noise effects from the Te Rere Hau Extension in 2010; assisted in sound level monitoring of the Gebbies Pass Windflow 500 prototype wind turbine in 2004 and 2005; and was engaged by the Christchurch City Council to review monitoring and to give evidence to the Environment Court for the consenting of the Gebbies Pass wind turbine in 2015 and 2016.

Purpose and scope of evidence

6. Tom Evans has reviewed the existing consent conditions for noise from the Te Rere Hau wind farm, and recommended alternative controls in his report dated 27 October 2016 and letter dated 15 March 2017. He has recommended use of the current, 2010, version of NZS 6808. However, Mr Evans has also recommended deviations from NZS 6808. I have been engaged by NZ Windfarms to provide evidence on the rationale for the relevant provisions in NZS 6808 and whether deviations are appropriate in this case. Miklin Halstead

² NZS 6801:2008 Acoustics – Measurement of environmental sound

³ NZS 6802:2008 Acoustics – Environmental noise

addresses the wider context of noise effects and practicality of the proposed conditions in his evidence.

7. In my evidence I will address specific issues relating to:
 - (a) Special audible characteristics;
 - (b) High amenity noise limits;
 - (c) Compliance assessment;
 - (d) Background sound level monitoring;
 - (e) Notional boundaries; and
 - (f) Basis for noise controls.
8. My evidence is based on my experience assessing and monitoring sound from numerous wind farms around New Zealand, and on my experience in the development and application of acoustics standards; in particular NZS 6808.
9. In paragraphs 81 and 82 of John Maassen's statement of evidence dated 17 August 2017 he pre-empts my evidence asserting that I do not have expertise in the intention of NZS 6808. I confirm that in my opinion NZS 6808 should be interpreted as it is written. However, as stated in paragraphs 80, 82 and 83 of Mr Maassen's evidence, I agree the context of NZS 6808 is relevant. In my evidence, I will address the rationale for some aspects of NZS 6808 to provide such context. I also note that rather than being somehow improper, an explicit part of my terms of reference from Standards New Zealand as chair of NZS 6808:2010 is resolution of general enquiries received after publication, including matters of technical interpretation.

SPECIAL AUDIBLE CHARACTERISTICS

10. Mr Evans recommends a method for addressing special audible characteristics (SACs) that is contrary to NZS 6808. I will set out the NZS 6808 method and Mr Evans' method, and I will explain why I consider Mr Evans' method to be inappropriate.
11. NZS 6808 requires sound levels to be measured in 10-minute sample periods. In most cases hundreds of samples are then analysed to determine background or wind farm sound

levels. This is necessary to account for constantly changing background and wind farm sound levels.

12. NZS 6808 defines SACs that may cause adverse subjective reactions to wind farm sound, and specifies sound level adjustments to account for those effects. Clause B4 of NZS 6808 states that adjustments “...shall only be applied to samples in which special audible characteristics are present.” In the same way that wind farm sound levels vary between samples, the extent of any characteristics also varies. Therefore, if a SAC is found to occur during a 10-minute sample then an adjustment is made to that 10-minute sample, and not to any other 10-minute samples or overall results determined from analysis. This requirement is clear and unambiguous in NZS 6808.
13. Under NZS 6808, if a SAC occurs regularly under certain wind conditions then the majority of corresponding sound level samples will be adjusted and the overall results determined from analysis will reflect those adjustments to individual samples. However, if for particular wind conditions a SAC only occurs intermittently and/or for short durations then only a small number of samples might be adjusted, which may only have a slight effect on the overall results. In my opinion, this is an appropriate method as it provides a sliding scale whereby the outcome of SAC adjustments is directly related to the occurrence of the adverse effect.
14. The requirement for SAC adjustments described above is specified in clause B4 of NZS 6808. Clause B4 is contained within a ‘normative’ appendix to NZS 6808, which is defined in clause 2.1 as being an integral part of NZS 6808, and the clause uses the word ‘shall’, which is defined in clause 2.1 as meaning the provision is mandatory. The requirement in clause B4 is consistent with Section 5.4 of NZS 6808, where SACs are introduced.
15. Clause 7.6.2 of NZS 6808 includes guidance with respect to SACs that could appear to contradict clause B4 and Section 5.4, as it refers to adjustments made to ‘wind farm sound levels’ rather than ‘samples’. In my opinion, the wording in clause 7.6.2 is a mistake. This matter has not been widely discussed within the acoustics profession, and to my knowledge it has not been raised with Standards New Zealand; primarily as wind farms in New Zealand generally do not have SACs regardless of how adjustments are made.

16. Regardless of whether the terminology in clause 7.6.2 is a mistake, making a literal interpretation of NZS 6808 as written, clause 7.6.2 uses the word 'should', which is defined in clause 2.1 as being advisory rather than mandatory, and therefore the mandatory ('shall') requirement of clause B4 prevails. However, in practical terms, the key guidance in clause 7.6.2 can still be implemented when applying SAC adjustments to individual sound level samples.
17. Mr Evans has recommended an alternative approach that is contrary to NZS 6808, by effectively requiring adjustments to some samples that do not contain SACs.
18. Instead of a sliding scale, Mr Evans proposes the full SAC adjustment be applied to the overall results whenever at least 10% of individual samples have SACs. Thus, under the regime proposed by Mr Evans a wind turbine that exhibited SACs all of the time would be assessed as having the same noise effects as one that only exhibited SACs for 10% of the time. I am not aware of any evidence of subjective responses to SACs that support this 10% threshold, which appears to be an arbitrary value. I consider this threshold to be inappropriate, inconsistent with NZS 6808, and unnecessary to manage noise effects.
19. Mr Evans explains the reasons for his approach in paragraphs 21 to 31 of his statement of evidence. Specifically, in paragraph 25 he states that "*...NZS 6808:2010 does not adequately consider the situation where a wind turbine is known to produce a tonal SAC in the near field but where this characteristic may only be detected at residences under certain conditions.*" I disagree with Mr Evans, and in this specific context I consider sound near the wind turbines to be irrelevant.
20. NZS 6808 is clearly and explicitly focussed on effects experienced by people at noise sensitive locations. All noise limits and adjustments specified in Section 5 of NZS 6808 only apply at noise sensitive locations such as houses. If a SAC only occurs at a noise sensitive location under certain conditions then that is what will be experienced by people, regardless of whether anything else happens more frequently closer to a wind turbine where nobody is present.
21. The tests specified in NZS 6808 to detect SACs are based on how sound is perceived by people. If these tests only detect infrequent SACs at noise sensitive locations I consider it is

appropriate that adjustments should only have a slight influence on an assessment.

22. In paragraph 26 of his evidence Mr Evans gives another reason for his approach to SAC adjustments as being that the method for wind farms in NZS 6808 is not consistent with methods for general industrial noise. In his letter he states that he considers a penalty would normally be applied for an industrial source if a tone (SAC) existed for at least 20% of the time. Mr Evans does not quote a reference for that approach, but I assume it is related to practice in Australia as I am not aware of such an approach being applied in New Zealand.
23. In New Zealand, general industrial noise is normally assessed in accordance with NZS 6802. Clause B4.5 of NZS 6802 states that adjustments for SACs "*...shall only be applied to the measurement time intervals in which special audible characteristics are present.*" This is the same requirement that applies to wind farms in NZS 6808. From my involvement in the committees for both NZS 6802 and NZS 6808 I am aware that the SAC provisions in NZS 6808 were deliberately copied from NZS 6802, ensuring consistency in the way different sound sources are treated with respect to SACs.
24. In his letter and paragraph 26 of his evidence Mr Evans discusses a further reason for his recommendations, that if adjustments did not significantly alter the overall results they would be unlikely to change a compliance outcome. In my opinion, if compliance is maintained, following SAC adjustments in accordance with NZS 6808 that is a good indication that the noise effects should still be reasonable. Mr Evans appears to be recommending a method to deliver a predetermined outcome that SACs should result in non-compliance, regardless of the nature and extent of effects.
25. In relation to SACs, in paragraph 92 of his evidence Mr Maassen states the Te Rere Hau wind turbines "*do not meet international recognised standards for noise emissions*". I am not aware of any international recognised performance standards for wind turbine sound power and tonal audibility. IEC 61400-11 provides measurement methods and reporting requirements but does not set performance standards.
26. Seemingly on the basis of reportable tonal audibility under IEC 61400-11 Mr Maassen describes the Te Rere Hau wind turbines as an "outlier class" in paragraph 92 of his evidence,

and he asserts this does not meet a core assumption of NZS 6808. He makes a similar assertion at paragraph 112 of this evidence. Craig Auckram in paragraph 81 of his statement of evidence dated 17 August 2017 also makes similar comments that *“there are elements of TRH that do not fit easily with some base assumptions that NZS 6808:2010 makes”*. I disagree as NZS 6808 does not exclude assessment of wind turbines that have reportable tonal audibility under IEC 61400-11. Conversely, NZS 6808 does explicitly acknowledge that installed wind turbines may have SACs and provides an adjustment mechanism. In my opinion the current situation at the Te Rere Hau wind farm is clearly within the scope of NZS 6808.

HIGH AMENITY NOISE LIMITS

27. Mr Evans considers that a high amenity noise limit might be justified for the Te Rere Hau wind farm at times during the evening and night when the wind speed is below 8 m/s.
28. I disagree with Mr Evans that a high amenity noise limit could be justified for the Te Rere Hau wind farm at all, but that question is outside the scope of my evidence. In this section of my evidence I will set out why I consider the standard 6m/s wind speed cap recommended by NZS 6808 would be appropriate if a high amenity noise limit were applied.
29. Prior to the current version of NZS 6808 there was no standard procedure for applying more stringent noise limits to wind farms where justified by local circumstances. In my opinion the lack of a standardised approach resulted in poor technical outcomes that could be complex and costly to implement, and did not always benefit affected residents.
30. The current version of NZS 6808 sought to address this issue through the introduction of a standardised high amenity noise limit to be applied where justified. NZS 6808 includes an efficient control mechanism for this limit based on the wind farm wind speed. This mechanism works as lower background sound levels at noise sensitive locations occur most frequently at lower wind farm wind speeds.
31. In locations where a high amenity noise limit applies it is triggered by default when the wind farm wind speed falls below 6 m/s. If necessary, the wind farm operation is then modified to reduce sound levels at noise sensitive locations.

The control is designed to limit the frequency of occurrence of wind farm sound intruding on lower background sound environments.

32. Even with a high amenity noise limit there can still be some meteorological conditions when wind farm sound will intrude on lower background sound environments. To trigger the control for all such sensitive times would have the side effect of also applying the control unnecessarily for substantial periods of non-sensitive times. This is because at progressively higher wind speeds there will only be lower background sound levels for a smaller proportion of the time. A balance has been proposed in NZS 6808. At all times, wind farm sound levels are restricted by normal limits recommended for the protection of sleep. During the majority of, but not necessarily all, sensitive periods, the high amenity limit will additionally provide a greater degree of protection of amenity.
33. The details of the high amenity noise limit caused significant debate amongst the NZS 6808 technical committee during drafting of the current version. One of the resulting compromises is the text from clause 5.3.2 of NZS 6808 quoted by Mr Evans in his letter, which allows for a wind speed criterion other than 6 m/s. While I support NZS 6808 as written, I consider that a value other than 6 m/s would only be justified in exceptional circumstances.
34. Mr Evans justifies consideration of a high amenity noise limit up to 8 m/s primarily on the basis that background sound levels at two locations are below 30 dB under certain wind directions at wind speeds of 7 and 8 m/s. I disagree with this reasoning as the measured background sound levels between 24 dB and 34 dB are typical of many rural areas and as such are not cause for an alternative wind speed criterion. I consider there is no basis for applying 30 dB as a criterion to determine a wind speed for a high amenity noise limit. If that were intended, NZS 6808 would have directly specified a 30dB criterion rather than a 6 m/s criterion.
35. Mr Evans' reasoning for an alternative wind speed criterion in paragraph 18 of his evidence also makes reference to the wind turbines only operating at wind speeds above 5.5 m/s, so a criterion of 6 m/s does not result in significant constraints on the wind farm. Clause 5.3.1 of NZS 6808 states that a high amenity noise limit is to protect amenity for residents under certain conditions. If that protection is largely provided

regardless, due to the particular operating wind speed range of the specific wind turbine, then in my opinion it is the correct outcome that the high amenity noise limit should be required to a lesser extent.

36. A further reason for an 8 m/s threshold given by Mr Evans in paragraph 18 of his evidence is that the wind turbines have reportable tonal audibility in accordance with IEC 61400-11, and might therefore attract adjustments for SACs at noise sensitive locations. With this reasoning Mr Evans is essentially double-counting the effect of SACs and penalising them twice. The effect should be correctly addressed with explicit SAC adjustments as I have discussed above. In my opinion there is no justification for an additional covert adjustment by using SACs as a basis for determining the wind speed criterion for high amenity noise limits.
37. I consider that based on measured background sound levels set out in the 2014 Marshall Day Acoustics compliance report for the Te Rere Hau wind farm that there is no justification for an alternative wind speed threshold to the 6 m/s value recommended by NZS 6808.
38. I agree with Mr Evans that high amenity noise limits should only apply in evening and night periods, in accordance with clause 5.3.3 of NZS 6808. For general sound sources, NZS 6802 and every district plan that I am aware of sets higher noise limits during the daytime than at night, other than in commercial and urban areas. Most district plans do not set separate noise limits during the evening period, but where they do exist they are also lower than daytime limits. In this context of higher sound levels from other sources being permitted during the daytime, I do not consider a stringent high amenity noise limit for a wind farm would be appropriate other than in evening and night periods.
39. In paragraph 43 of his statement of evidence Mr Evans appears to have misinterpreted commentary clause C5.3.1 of NZS 6808. Mr Evans appears to suggest that an 8 dB threshold test applies between the background sound and wind turbine sound at discrete wind speeds, or potentially only to low wind speeds. The test in clause C5.3.1 explicitly applies to the average of a range of wind conditions and not discrete wind speeds. Mr Evans' apparent approach of specifying wind speeds would make the test significantly more stringent, which I consider inappropriate.

40. Another aspect related to high amenity limits is that in paragraph 96 of his evidence Mr Maassen makes reference to findings of the Environment Court with respect to the Gebbies Pass wind turbine in Christchurch. I was engaged by the Christchurch City Council in that matter and am familiar with that area. The discussions in that instance were primarily related to residents living at the end of the base of a valley below the wind turbine. In terms of topography and related acoustical effects, that location is substantially different to the location of most receivers around the Te Rere Hau wind farm. A high amenity noise limit was not applied at Gebbies Pass for the nearest house that was located on a ridge rather than at the base of a valley.

COMPLIANCE ASSESSMENT

41. Mr Evans proposes exclusion of some measurement data from compliance assessment, depending on the status of wind turbines.
42. I agree with Mr Evans that any consideration of wind turbine status should be based on whether each wind turbine is operational and available to generate power, regardless of whether it is generating power. This results in assessment of the wind farm as it actually operates and the corresponding noise effects experienced by neighbours.
43. I agree with Mr Evans' apparent intent in specifying minimum percentages of turbines operating. However, in my opinion it is not appropriate to specify this in conditions as it might unnecessarily exclude valid data points. Regardless of my reservations I understand that NZ Windfarms accepts this aspect of the conditions put forward by Mr Evans, so I will not discuss this matter further.

BACKGROUND SOUND LEVEL MONITORING

44. Mr Evans recommends that background sound levels should not be influenced by other wind farms. I agree with Mr Evans, and this approach is required in Section 5.6 of NZS 6808. However, paragraph 4.8 of his report and his proposed changes to the consent conditions could be interpreted as requiring all other wind farms to be shut-down for background sound level measurements. I do not consider it

necessary to shut-down other wind farms and in my experience it is unlikely to be practical.

45. In paragraph 5.9 of his report Mr Evans acknowledges clause C5.6.3 of NZS 6808, which discusses methods that can be used to account for sound from other wind farms without shutting them down, including use of predicted levels. In my opinion those methods should be explicitly allowed for in the consent conditions to make clear that other wind farms are not required to be shut-down.

NOTIONAL BOUNDARY

46. In paragraphs 5.6 and 5.7 of his report Mr Evans discusses the assessment position for noise limits. He appears to accept the requirements of NZS 6808 that noise limits apply at noise sensitive locations, including points within the notional boundary extending 20 metres from dwellings, but not within the wider rural area. I agree that noise limits should only apply at noise sensitive locations, as defined in NZS 6808.
47. In the conditions proposed by Mr Evans the assessment points are specified as "*residences*". It is implicit from a subsequent requirement for assessment in accordance with NZS 6808 that this refers to the notional boundary of these residences, but there could be uncertainty or debate around the assessment point. I recommend that if the term residences is maintained the noise limits should explicitly apply "*at any point within the notional boundary of residences*".
48. In my opinion, good practice is to explicitly list residences where the noise limits apply as it provides greater certainty and removes future ambiguity. Alternatively, it should be specified that noise limits only apply at residences existing at a certain date; typically the date the consent was first notified or granted, or as suggested by NZ Windfarms the date of completion of the review.

BASIS FOR NOISE CONTROLS

49. In paragraph 70 of Mr Maassen's evidence and paragraphs 117 and 118 of Mr Auckram's evidence they make statements about noise outcomes in terms of annoyance. While I agree with the general sentiments they express, I do

not consider it appropriate to set noise controls to cater for individuals' annoyance. For example, I am aware of a resident by a wind farm who reported the sound to be extremely annoying. However, a subsequent owner of the same house did not. In my opinion, it would not be appropriate to set a noise control that differentiates between two such people. As such, in accordance with NZS 6808 I consider the basis for noise controls in this respect should be to maintain reasonable residential amenity.

50. Mr Maassen also references "*thresholds of inappropriateness*" in paragraphs 71 and 72 of his evidence. I do not consider the apparent criteria Mr Maassen sets out in these paragraphs to be appropriate. NZS 6808 sets out noise controls to provide protection against sleep disturbance and maintain reasonable amenity, which I consider are appropriate for wind farm sound.

CONCLUSIONS

51. NZS 6808 requires SAC adjustments to only be made to individual sound level samples that are found to have SACs. I consider this to be an appropriate method that results in a sliding scale of outcomes depending on the extent of SACs. I consider that Mr Evans' alternative method of effectively applying SAC adjustments to some samples that do not exhibit SACs to be inappropriate.
52. NZS 6808 seeks to achieve a balanced outcome by applying high amenity noise limits, where justified, at wind farm wind speeds below 6 m/s. In my opinion, this should only be varied in exceptional circumstances. Based on the measured background sound levels I do not consider such circumstances exist around the Te Rere Hau wind farm. I disagree with Mr Evans that a high amenity noise limit should be investigated for wind speeds up to 8 m/s. Furthermore, if the screening test from NZS 6808 is used then in my opinion the 8 dB threshold should apply to average results across all wind speeds and not discrete wind speeds as implied by Mr Evans.
53. Under standard analysis in accordance with NZS 6808, the operational state of wind turbines during compliance measurements is one of a multitude of factors that is considered. I agree with Mr Evans that consideration of a turbine operational status should not be dependent on

whether it is generating power. I disagree with Mr Evans that minimum percentages of operational turbines should be specified in conditions, but regardless, NZ Windfarms accept that condition.

54. NZS 6808 requires that background sound levels exclude other wind farms. NZS 6808 provides guidance on mechanisms to give effect to this requirement without requiring other wind farms to be shut-down during sound level measurements. I consider that consent conditions should allow for these processes from NZS 6808 to be applied, as it is unnecessary for other wind farms to be shut-down.
55. Mr Evans accepts the assessment positions for noise limits specified in NZS 6808, but these are not clearly specified in the notified review conditions. To avoid ambiguity I recommend conditions specify that noise limits apply at any point within the notional boundary of a list of dwellings that existed at the time of the completion of this review.
56. I consider that NZS 6808 sets appropriate criteria for wind farm sound to provide protection against sleep disturbance and maintain reasonable amenity. Mr Maassen and Mr Auckram reference annoyance, which is relevant but in my opinion, is not the appropriate basis for setting criteria.



Stephen Gordon Chiles

25 August 2017