

Response to Draft Report and Decision for Turitea Wind Farm Huatau Marae (Submitter No. 9)

Huatau Marae wishes to thank the Board of Inquiry for this opportunity to comment on the draft decision, which falls short of the concerns Huatau Marae has about the proposed Turitea Wind Farm. The concerns remaining are:

1. The Board states that Huatau marae was established within the rohe of Rangitane with the sanction of some of their elders (Chapter 17 (3)). This statement is disrespectful to the mana of Joe (Tanenuiarangi) Te Awe Awe who was the last Paramount Chief of Rangitane and similarly disrespectful to Joe Tukapua, Tohunga. They were not merely elders of Rangitane.
2. Huatau marae has been established primarily by the Jones whanau and not the Adams family as stated by the Board.
3. Maori traditions rely on face to face to discuss issues. MOU's are a recent construct that bypass traditional ways and cannot be relied upon as having emerged from consultation, or as representing a mandate.
4. TMI's MOU without a mandate does not take precedence over Joe Te Awe Awe's determination, as Paramount Chief, of links through whakapapa that justified the blessing of Huatau as a return of ancestral lands that had previously been lost through sale.
5. There has been adequate time for the MOU's from TMI and ROTNAR to be in the public domain and to have provided evidence and opportunity for scrutiny/ rebuttal at the hearing.
6. ROTNAR's rohe traditionally ends at approximately the northern end of the wind farm on the Eastern side. ROTNAR's MOU is not relevant to the remaining turbines at the southern end of the wind farm.
7. Initially TMI was the tribal authority for the Treaty Settlement process but has been required by the OTS to encompass other Rangitane groups. It is no longer the sole one stop shop for Rangitane. Similarly TMI has no mandate to issue MOU's on behalf of Rangitane.
8. After the Turitea hearing ended the elders of Te Rangimarie met with us to reaffirm their support for Huatau when they heard their Chairman acted without mandate in negotiating with MRP without fully consulting other trustees and whanau.

9. The Board considers that MRP has followed good practice in their consultation with Huatau. This consultation was not good faith consultation and amounted to a ticking the box exercise where nothing was negotiable. The Board has a sense of MRP's approach to Huatau and residents when it states in Chapter 13 (74), *MRP did not appear to undertake extensive consultation with residents before the turbine layout was finalised*
10. In the consultation meeting held between Mighty River Power and Huatau the kaupapa and tikanga of Huatau marae was clearly outlined to MRP in Te Reo. This included the importance of quietness and peacefulness of the Marae site to the whanau of Huatau. It was only after a lengthy delivery, Huatau discovered MRP had no speaker of Maori.
11. The actions of noise monitoring and photomontages are common practice for all sites requesting them and not solely a favour granted to Huatau.
12. Before Joe Te Awe Awe, the Rangitira of Rangitane, and Joe Tukapua, Tohunga, gave their blessing to Huatau they deliberated for many months to consider whakapapa. They established links that satisfied them and justified their decision.
13. The Board concludes in Chapter 17 (20) that Huatau marae as being Ngati Apa and being closely related to Rangitane does not equate to the same level of rights as that of Rangitane. Joe Te Awe Awe, as the Paramount Chief of Rangitane, decided otherwise as a result of long deliberations. Ancestral land is not defined under the RMA and the linkage required under the RMA, was established to the satisfaction of the Paramount Chief and Tohunga at the time.
14. Section 8 of the RMA requires the decision maker to take into account the principles of the Treaty of Waitangi. The principles of partnership, protection and participation acting as a guide to interpreting the meaning of the treaty have not been met. These principles could have easily been honoured with good faith negotiation
15. The retention of turbines 54, 52, 48, 121, 111 & 120 has left Huatau feeling violated and trampled upon. In Chapter 17 (73) the Board states, *also as part of the redesign process several turbines have been removed and repositioned which have been beneficial to Huatau Marae.*
16. The turbines that were removed were beneficial to Huatau but unfortunately turbines still prominently intrude visually on and violate Huatau. Visitors on the marae atea face these turbines. The highly visible moving blades in an elevated position above Huatau marae, does not provide undisturbed possession. In Chapter 13 (98) Mr. Wyatt acknowledges that the turning rotor attracts the eye.

17. Ian Christensen acknowledges the plight faced by Huatau in Chapter 17 (36), i.e. *can you imagine welcoming manuhiri onto Huatau Marae, secluded and peaceful in the afternoon setting sun except for the swish of blades from the turbines dominating and towering above the hills just behind the marae.*
18. The noise of trucks on the road directly above Huatau and turbine noise will rob Huatau of its taonga, i.e. the peace, quietness and serenity that nurtures the wairua of the site.
19. Paragraph 17 in Schedule 3 of the conditions states that the lower construction noise limit for nighttime ends at 7.00am. The same restriction should apply to construction traffic on Kahuterawa and Greens Road, i.e. a 6.30am start is unacceptable. There is no scientific evidence to support the noise limits quoted in paragraph 17 as being adequate to prevent severe noise nuisance.
20. Traffic management plans are notoriously difficult to monitor and enforce. Wind farm traffic for construction as well as operational and maintenance traffic post construction will create noise nuisance and annoyance at Huatau for the life of the wind farm. Furthermore, safety on the road will be severely compromised. It is highly likely a fatality will result from wind farm traffic. For most sections of the road there is insufficient width for safe passing of cyclists, runners and walkers.
21. Allowing additional traffic to use Kahuterawa/ Greens Road when the other access is blocked will permit a situation that cannot be monitored or enforced. Other wind farms manage successfully with only one access. Road construction does not require access from both ends. The Kahuterawa-Greens Road access is for convenience only and the imposition of this on the safety of recreational users as well as the whanau of Huatau marae is significant compared to the savings achieved by Mighty River Power having a second access for the wind farm.
22. To heap insult upon insult, in paragraphs 14 & 15 in Schedule 1 of the conditions Huatau marae has been omitted as part of the Community Liaison Group (CLG).
23. The Community Liaison Group (CLG) should include Huatau marae plus two residents, who have not signed an agreement with Mighty River Power, from the southern end as well as two residents from the northern end. The Board in its duty of care role must ensure that the CLG is not merely a token gesture and will have a role that protects the affected residents.
24. Section 5 of the RMA, i.e. *which enables people and communities to provide for their social, economic, and cultural well-being* will not be met as a result of the severe impact on Huatau.

25. The laying of a special mauri and subsequent blessings as determining a wahi tapu site is the call of the Paramount Chief and Tohunga at the time and not the call of the Board or TMI. Section 6 (e) of the RMA requires decision makers to recognise and provide for wahi tapu.
26. Section 6 (e) of the RMA requires decision makers to recognise and provide for other taonga, which in the case of Huatau is the serenity and quietness of the site. The site was specially selected to provide a spiritual retreat under traditional ways and is a taonga to the whanau of Huatau. The courts recognise that taonga includes anything that is highly valued and prized by Maori (Waitangi Tribunal, Te Reo claim, Wai 11, 1986).
27. The Board states in the Introduction that *Huatau Marae Trustees opposed the application in its entirety*. This statement is incorrect. Huatau Marae identified the turbines it wished to be removed. Huatau Marae would appreciate the record being correct.
28. The whare at Huatau is there for shelter and the surrounds are part of the experience and connection as an outdoor people. Because of this the attenuation arguments discussed in Chapter 15, paragraph 69 do not apply to Huatau.
29. Huatau Marae believes there has been inadequate acoustical and human perception analysis of wind farm noise. Noise standards do not address the core issue of the effect of noise on people. Variation in character of the sound means that people do not become used to it.
30. Sound level predictions are not accurate. Predictions are made with assumptions and uncertainties. Sound levels vary significantly over very short periods of time. An assessment based on an overall sound level may not truly represent the effect of varying sound character.
31. Meteorological conditions, wake and turbulence effects, vortex effects, turbine synchronicity, tower height, blade length and power settings all contribute to sound levels. This is why predictions are simplistic and have a high degree of uncertainty.
32. In the opinion of Huatau marae, the claims made that there is no evidence of health effects are based on a very simplistic understanding of epidemiology and self-serving definitions of what does not count as evidence. These reports do not represent proper scientific reasoning. Dr. Thorne's noise assessment report in the submission of legal counsel for Huatau marae is relevant to these points.
33. There is growing evidence of noise perception as being a psychophysical response that is linked to health and well being. The Board has dismissed this possibility on the basis of dismissing

Pierpont's book as a result of not meeting the tests for conclusive science.

34. Huatau Marae respectfully requests that the Board applies its criteria for establishing conclusive science to all evidence and presumptions in the Turitea hearing. In terms of establishing transparent consistency and fairness it would be beneficial to all parties if the Board stated in the decision their criteria for establishing conclusive science. Huatau also requests clarification about the burden of proof, e.g. does it lie with proving something won't happen, or does it lie with proving something will happen?
35. The draft wind farm does not have regard to the maintenance and enhancement of amenity values, which includes recreational attributes. Objective 3 of the PNC District Plan to avoid, remedy or mitigate the effects of roads and vehicles on the amenity values of the city will not be met. Action 3.1.2.2 of the PNCC Outdoor Recreational Plan, i.e. provide increased opportunity for safe cycling of Greens Road Loop will not be met.
36. The extreme sacrifices demanded by the residents of Kahuterawa Road and Huatau Marae as well as recreational users of the Kahuterawa Recreational Hub are solely to meet the Board's economic argument for a 69 MW wind farm when even a 50MW wind farm is still a reasonable size in balancing the perceived benefits.
37. The justification for consenting a wind farm of 69 MW in this area needs to be more robust. The viability of a smaller wind farm is confirmed in Chapter 4, Paragraph 58 i.e. *Dr Layton agrees with Mrs Melhuish that smaller scale wind farms can be as economic as large farms.*
38. The level of sound required to provide Huatau with undisturbed possession of its whenua, and to preserve the taonga of quietness and serenity is a level that:
 - does not annoy any person inside the whare at Huatau
 - does not disturb the sleep or relaxation or wellbeing of any person while inside the whare at Huatau
 - is not intrusive outside the whare where people gather, or where any person is seeking spiritual nourishment and relaxation
 - does not cause annoyance, anxiety, stress, or a loss of personal wellbeing whether inside or outside at Huatau.
39. Undisturbed possession and the recognition and provision under Section 6 (e) concerning taonga, requires that no turbines are visible above Huatau, as well as protection from audible noise nuisance. Huatau requests that turbines 54, 48 52, 121, 111 and 120 are removed.

40. Huatau Marae requests that Dr Thorne's noise assessment report on the draft decision turbine layout is given appropriate consideration. The Board of Inquiry has an ethical and moral obligation to ensure that turbines will comply with consent conditions as well as providing sufficient protection against noise nuisance.
41. Undisturbed possession and the recognition and provision under Section 6 (e) of the RMA concerning the taonga highly valued by Huatau, i.e. quietness and serenity, requires that Kahuterawa-Greens Rd is not used as access for wind farm construction, operation and maintenance.

The Trustees of Huatau Marae

Dr Thorne's noise assessment report for Huatau is attached.



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6 May 2011

Mr J. & Mrs R. Adams
Greens Road
Palmerston North

Dear John and Rosemary

PROPOSED TURITEA WIND FARM – ADVISORY REPORT ON NOISE ISSUES

Thank-you for your verbal instructions to advise on noise issues as they relate to the proposed Turitea wind farm potentially affecting the Adam's property, residence and Huatau marae.

1. Instructions

1.1 You have instructed me to advise you concerning the proposed Turitea wind farm development application in relation to the following:

- a) update the noise reviews prepared by Noise Measurement Services Pty Ltd following the draft decision by the Board of Inquiry;
- b) advise you concerning the draft noise conditions prepared by Mighty River Power;
- c) recommendations about appropriate conditions of approval.

1.2 In the course of preparation of this advice the application of the following were reviewed:

- a) The draft decision as it affects you, your home and Huatau marae;

- b) The proposed noise management conditions as they relate to certainty of application; practicality and relevance; and effectiveness.
- c) The consideration of noise issues with respect to wind farms including sleep disturbance, annoyance and adverse health effects.
- d) To briefly consider relevant acoustical and other standards, guidelines and reports, identified Environment Court decisions and legal advices that may assist you in preparation of a response to the Board with respect to noise issues.
- e) To provide supplementary draft noise conditions for the Board's consideration.

1.3 In the course of preparation of this advice I became aware of a reference (reference 8, page 16-6) made in the draft Report that pertains to myself that is ambiguous and mischievous. It is my request that the matter be drawn to the Board's attention and that the offending reference be removed.

2. Summary of Advice

2.1 The Board has identified noise as being an issue, and this is clearly stated on page ES-9 of the draft. The removal of the turbines as presented by the Board is supported for the reasons given in this advice. In addition, it is recommended that turbines 48, 52, 54, 111, 121, and 120 be declined (removed).

2.2 The Board does not accept the propositions advanced by myself with respect to noise mitigation or setback distances, preferring the evidence of others (page ES-9 of the draft).

2.3 The evidence that the Board accepts applies noise management conditions of a type that have failed to determine noise levels affected by ambient sound and special audible characteristics and have failed to effectively mitigate complaints at Makara (Wellington) and at Te Rere Hau (Palmerston North).

2.4 The acoustical experts that the Board prefers have not yet been able to deliver workable noise management measures (PNCC v Te Rere Hau wind farm refers¹).

¹ PNCC v NZ Windfarms, NZ Environment Court, ENV-2010-WLG-000114, Application for Declaration 11 October 2010 and Memorandum dated 21 December 2010

2.5 The draft noise conditions submitted by Mighty River Power on 28 April 2011 (Annexure 1) fail to adopt critical noise conditions recommended by the Board at para 108 page 15-25 of the draft report and fail to provide objective measures to effectively identify, assess and manage wind turbine noise and noise complaints.

2.6 The Board and Mighty River Power have recommended noise criteria that have previously failed to prevent complaints of unreasonable noise and adverse health effects at Makara and Te Rere Hau. Conditions need to address known failures to prevent, remedy or mitigate unreasonable noise. This advice includes draft conditions and explanations to address some of the issues.

2.7 This advice does not repeat material previously forwarded to Board with respect to wind farm noise issues. Annexure 2 provides a summary of significant recent health – noise information and technical information required for the identification of wind turbine noise. The cited independent, peer-reviewed scientific WHO Report confirms the linkages between environmental noise, annoyance, sleep disturbance, adverse health effects and disease.

3. Noise Assessment with the Turbine Layout permitted by the Board

3.1 The Board, in its draft decision of February 2011, says:

Creating an environment where wind farm noise will be clearly noticeable at times of quiet background sound levels is not an option the Board condones, especially where large numbers of residents are affected. It is the Board's view that energy operations in New Zealand will have to learn not to place wind farms so close to residential communities if they are not prepared to accept constraints on noise limits under such conditions.

3.2 The Board has recommended draft conditions (page 15-25) and these are discussed later in this advice.

3.3 The proposed turbine locations proposed by the Board for the wind farm are shown on Plate 1. It is clear from the distribution of turbines that residences near Greens Road will be significantly affected due to south-east winds that occur for about 16% of the year. This effect is more than minor.

3.4 Residences already affected by Te Rere Hau will be additionally adversely affected by the northern turbines of Turitea.

3.5 Plate 1 following illustrates the sound levels from the wind farm. The broad red LAeq 35 dB contour is the marker for night-time levels. (Unfortunately, there is also a red line around the turbine clusters. This line is not the predicted LAeq contour). Broadly, the LAeq 35 dB contour is at 2000 metres from the nearest turbine. Representative receiver and residential locations are given in the blue boxes. The LA90 residential levels for the 61 turbines, adjusted by -2dB for the difference between LAeq and LA90, are given in Table 1.

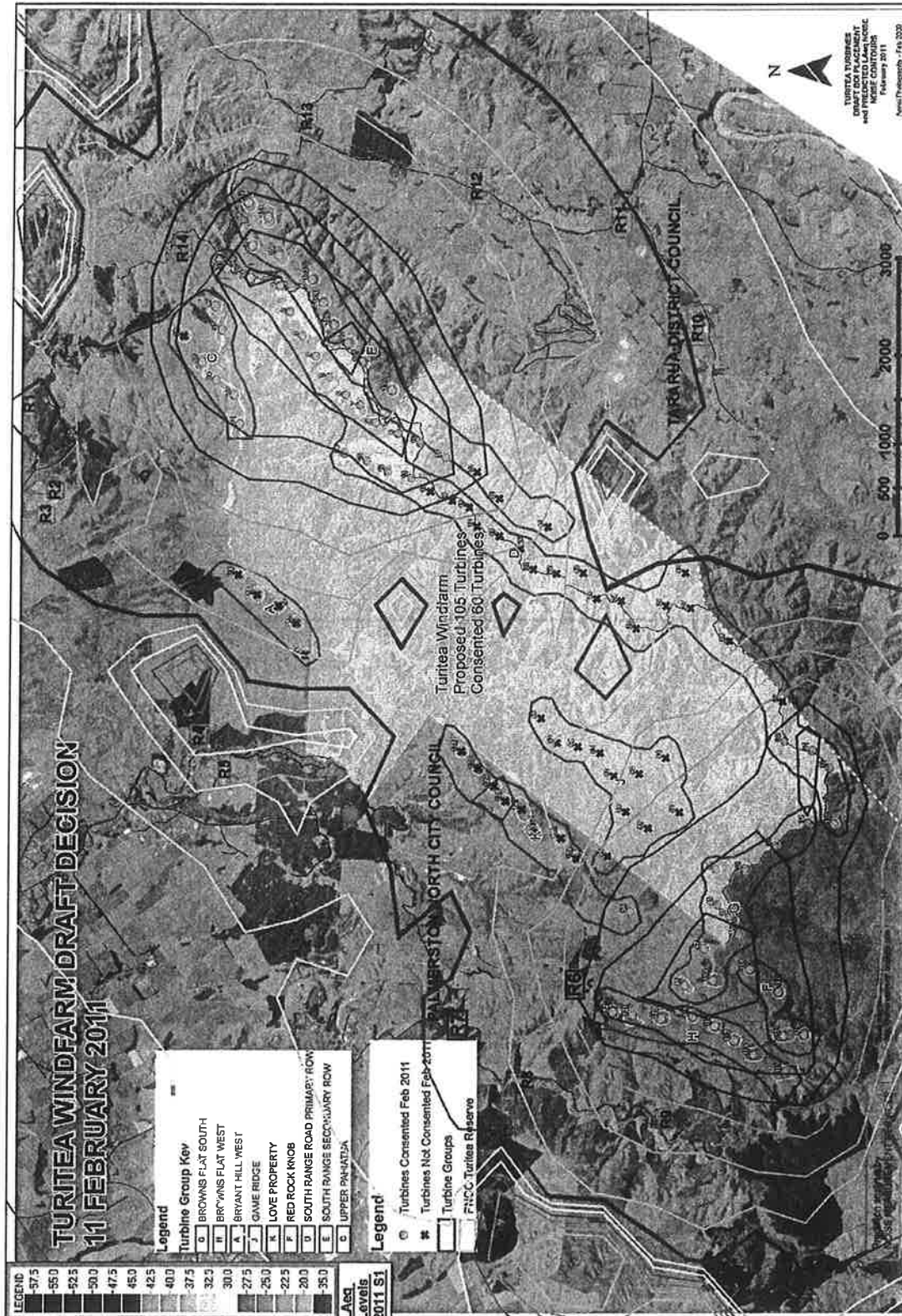
Table 1: Turitea predicted sound levels at receivers (residences, locales)

Receiver	LA90 dB	Turbine-Receiver Distance (metres)	Receiver	LA90 dB	Turbine-Receiver Distance (metres)
R1	33	1950	R8	36	1250
R2	35	2150	R9	40	1100
R3	34	2250	R10	33	3200
R4	29	3400	R11	34	3300
R5	30	3700	R12	38	2100
R6	44	450	R13	40	1150
R7	34	1750	R14	45	500

3.6 The predictions, made under ISO 9613-2 as required by NZS6808:2010. Some residences are significantly affected and will be above the criteria established by the Inquiry. There will be significant variation under south-east wind conditions. This is of particular importance for your home and Huatau marae (and residences to the north and north-west of the wind farm) as these are downwind of rows of turbines. Increases in sound level of 3dB to 6dB as well as significant amplitude modulated audible characteristics are anticipated. The penalty of 5dB for special audible characteristics must therefore be considered.

3.7 ISO 9613-2, as applied by the 2010 wind farm standard, states that the estimated accuracy for broadband noise under the meteorological conditions allowed for (a wind speed of between 1m/s and 5m/s at a measurement height of 3m to 11m above the ground) is an uncertainty of ± 3 dB. Thus it can be argued that by definition the standard does not apply to the high-wind conditions that are experienced at wind farms and the standard cannot be termed 'conservative'. That aside, in order to comply with the standard the range of predicted average levels must be considered, Table 2.

Plate T1: Proposed Turitea Wind Farm Noise Levels in Relation to residences and other receivers



Basemap sourced by J. Adams

Note 1 to Plate 1: the above contours are calculated in LAeq values and must be adjusted down by 2 dB to relate to LA90 values.

Note 2 to Plate 1: The Adams' residence and Huatau marae is R7, Hautika retreat is R6

3.8 The expected average range in background (LA90) sound levels, depending on wind speed and direction, are stated in Table 2. Higher wind speeds or turbines operating in a synchronous manner (turbines in a line ‘pointing’ towards a residence) will produce higher sound levels.

Table 2: Range of Turitea predicted sound levels at receivers (residences, locales)

Receiver	LA90 dB	Range of levels to ISO 9613-2	Receiver	LA90 dB	Range of levels to ISO 9613-2
R1	33	30 - 36	R8	36	33 - 39
R2	35	32 - 38	R9	40	37 - 43
R3	34	31 - 37	R10	33	30 - 36
R4	29	26 - 32	R11	34	31 - 37
R5	30	27 - 33	R12	38	35 - 41
R6	44	41 - 47	R13	40	37 - 43
R7	34	31 - 37	R14	45	42 - 48

3.9 To bring the upper range of predicted sound levels closer to the criteria established by the Board for your residence and Huatau marae (R7) requires the removal of turbines 48, 52, 54, 111, 120 and 121. (The levels are slightly above the 35 criterion at R7 even with these turbines removed).

3.10 NZS 2010 states explicitly (clause 5.4.2, Appendix B) that amplitude modulated sound is a ‘special audible characteristic’ and that amplitude modulated sound is characterised by the blades of the turbines passing the tower (clause CB3.1). Amplitude modulated noise, as acknowledged by NZS 6808-2010, requires specific mitigation or penalty when the sound becomes ‘significant’. Despite this – and the well known PNCC application before the Environment Court - the draft noise management conditions proposed by Mighty River Power (Annex 1) fail to propose an objective scientifically proven test for ‘significant’ amplitude modulation.

3.11 As stated previously the Te Rere Hau wind farm in New Zealand is presently the subject of an Application to the Environment Court² for a Declaration with respect to compliance issues and concerns with respect to the methodologies applied to measure

² PNCC v NZ Windfarms, NZ Environment Court, ENV-2010-WLG-000114, Application for Declaration 11 October 2010 and Memorandum dated 21 December 2010

background sound levels and compliance levels. In brief it is understood that the specific issues raised are:

- The acoustic information supplied in the AEE was inaccurate;
- The Te Rere Hau wind farm is being operated at levels higher than those predicted in the {wind farm} application;
- The respondent has substantially underestimated the effects of the wind farm noise on the amenity of the area;
- The AEE concluded noise from the wind farm would not exhibit special audible characteristics (i.e. clearly audible tones, impulses or modulation of sound levels). This conclusion is inaccurate {reasons given};
- The actual experience of residents (located up to 2.18 km from the nearest turbines) and the number of complaints made to the Council indicating there are noise effects (which also exhibit special audible characteristics) being experienced at a significant number of local properties;
- The actual results reported in the revised compliance report (April 2010) demonstrate the actual sound levels from the wind farm are significantly higher (up to 12.8 dBA higher) at the monitoring location under certain wind speeds and directions than predicted;
- The AEE noise report predicted the sound level from the wind farm to be 34.9 dBA to 40.8 dBA at the monitoring location in wind speeds of 8 m/s;
- While monitored noise included noise from all sounds in the area (not just wind farm noise), the uncertainty as to the actual wind farm noise levels warrants further investigation. A new noise testing specification is the subject of the memorandum of 21 December 2010.

3.12 The general issues of concern for Te Rere Hau (noise prediction, methods of measurement and assessment, special audible characteristics) have been raised in detail in my evidence with respect to Turitea prior to the Te Rere Hau application. The draft conditions proposed by Mighty River Power do not address any of these concerns and it is concluded that the conditions are uncertain in application and ineffective to address complaints.

4. Draft Proposed Noise Conditions

The following draft noise management conditions follow the argument and draft conditions proposed by the Board. The Board has not explicitly conditioned the type, specification, height or blade length of the turbines to be installed. At Makara the type of turbine (Vestas

V90) considered was replaced in practice by a Siemens 2.3 unit that was not reviewed by the community noise experts. The draft conditions of this section do not define objective measures for special audible characteristics, low frequency sound or infrasound. Such measures require continuous real-time sound monitoring, audio recording and analysis for effective management.

4.1 Except for times when the wind farm wind speed and background noise levels are such as to trigger a secondary noise limit, the turbines shall be designed, constructed, operated and maintained so that the wind farm sound levels ($L_{A90,10 \text{ min}}$) at any non-participant residence or noise-sensitive location shall not exceed the background sound level by more than 5dB, or a level of 40 dB(A) ($L_{A90,10 \text{ min}}$) whichever is the greater;

4.2 Where the wind farm wind speed is 6m/s or lower, a secondary noise limit shall apply under which the turbines shall be designed, constructed, operated and maintained so that the wind farm sound levels ($L_{A90,10 \text{ min}}$) at any non-participant residence or noise-sensitive location shall not exceed the background sound level by more than 5dB(A), or a level of 35 dB(A) ($L_{A90,10 \text{ min}}$) whichever is the greater.

4.3 This secondary noise limit shall apply only between the hours of 10:00pm to 7:00am the next day.

4.4 For sleep protection purposes, a breach of the condition set out in 4.3, for 10% of the night, amounts to a breach of the condition.

4.5 The noise from wind farm activity shall not exceed inside any habitable room of a dwelling with windows open

- a) during night-time a noise level of 30 dB $L_{Aeq,adj, 10 \text{ min}}$ and
- b) during daytime and evening a noise level of 35 dB $L_{Aeq,adj, 10 \text{ min}}$ and
- c) perceptible or audible noise from wind farm activity shall not affect human health or wellbeing including sleep or relaxation.

4.6 When noise from the wind farm has perceptible or audible characteristics giving rise to complaint, the measured sound level of the source shall have a 5 dB penalty added. Audible characteristics include tonal character measured as amplitude or frequency modulation, or both; impulsiveness and tonality.

4.7 Before the use commences, an effective noise monitoring, evaluation and response process must be submitted to and approved by the Palmerston North City Council to address the noise compliance conditions. Monitoring may be in accordance with New Zealand Standard NZS 6808-2010 *Acoustics-Wind farm noise*; International Standard ISO 1996-2:2007 *Acoustics-Description, measurement and assessment of environmental noise- Part 2: Determination of environmental noise levels* and such other standards or guidelines that may be relevant and appropriate. The monitoring process shall include all the sound levels as required by Conditions 4.1 to 4.6 and shall include monitoring for the characteristics described in Annex A of International Standard IEC 61400-11 *Wind turbine generator systems – Part 11: Acoustic noise measurement techniques*. Wind speed and wind direction shall be measured at the same location as the noise monitoring location.

4.8 A post-construction continuous noise monitoring program must be commissioned by the proponent within 2 months before the commissioning of the first turbine and continue for 12 months after the commissioning of the last turbine all to the satisfaction of the Palmerston North City Council. Noise monitoring stations shall be installed at not less than two residences subject to the approval of the Palmerston North City Council as to location. The consent holder must pay the reasonable costs of the monitoring program.

4.9 The data from each continuous monitoring station shall be available in real-time at the Council with real-time audio capability to allow a sound to be heard as it occurs and shall allow for the capture, recording and analysis of the sound levels necessary to identify special audible characteristics and prove compliance with the consent noise criteria.

4.10 An independent specialist noise consultant (other than the companies or persons who prepared the predictive acoustical reports) must be appointed by Palmerston North City Council to monitor and verify noise levels subject to complaint of either nuisance or harm due to noise. For the purposes of these conditions a specialist noise consultant is taken to be a person qualified in the science of acoustics. The consent holder must pay the reasonable costs of the monitoring and verification.

4.11 Before the use commences, an effective noise complaint, evaluation and response process must be submitted to and approved by the Palmerston North City Council to address any alleged breaches of the noise compliance conditions. The process must allow for an immediate 24-hour, 7-day response by the wind farm operator to a complaint, such response to include noise monitoring and noise mitigation as appropriate. Any complaint received must be notified within 24 hours of receipt to the Council and the wind farm operator must

state what action has been taken or is proposed to bring the wind farm into compliance. The consent holder must pay the reasonable costs of the complaint response process.

4.12 In the event that the post-construction noise monitoring at a residence reveals exceedance of the noise criteria specified in Conditions 4.1 to 4.6, or if a valid complaint lodged under the process established under Condition 4.10 is received by the Palmerston North City Council, the consent holder shall take immediate action to mitigate such noise.

a) Where reasonable and feasible, physical noise mitigation measures are to be provided by the consent holder for an existing dwelling or no more than one new dwelling built on any vacant parcel of land legally existing at the date of approval of the wind farm development application. The noise mitigation measures are to achieve a night-time noise level of 30 dB $L_{Aeq,adj, 10 \text{ min}}$ and daytime and evening noise level of 35 dB $L_{Aeq,adj, 10 \text{ min}}$ inside a habitable room of the dwelling with windows open. The sound inside the habitable room shall have no perceptible or audible noise from wind farm activity.

b) This condition applies only to a dwelling existing at the date of consent of the wind farm development application or to a new dwelling for which a development application is lodged with the Palmerston North City Council within five years of the date of commissioning of the final turbine.

5. Consideration of Noise Issues

5.1 Draft Condition 4.1 is as written in the Board's report page 15-25 with the following comments

- (a) the word 'operated' is emphasised as the condition should obviously apply when the turbines are operating;
- (b) the condition needs to apply to a specific place – the original condition does not say where the criteria will apply and therefore is uncertain in application and cannot be enforced

5.2 Draft Condition 4.2 is as written in the Board's report page 15-25 with the following comments

- (a) the word 'operated' is emphasised as the condition should obviously apply when the turbines are operating;

(b) the condition needs to apply to a specific place – the original condition does not say where the criteria will apply and therefore is uncertain in application and cannot be enforced

5.3 Draft Condition 4.3 is as written in the Board's report page 15-25.

The over-riding concern of the conditions proposed in this advice is to protect sleep at night. The conditions will not 'protect' persons who may be sensitive to noise and the turbines will be clearly audible outside most residences identified in Table 2 especially under low wind speeds at the residences.

5.4 Draft condition 4.4 is based on the application of NZS 6808-1998 / 2010 as applied to the night-time noise criterion for Victorian wind farms.

5.5 Draft Condition 4.5 addresses the requirements of protecting sleep and relaxation within the home without interference from noise.

5.6 Draft condition 4.6 acknowledges the unique character of wind farm noise with respect to special audible characteristics and, in association with the requirements of draft Condition 4.6, provides the adjustment ('adj') component of draft Conditions 4.5 and 4.12.

5.7 Draft Conditions 4.7 and 4.8 require a noise monitoring program to be established. The design of the program is a matter for the developer and Council to agree. The monitoring procedures are now reasonably well established and it is anticipated that the current Te Rere Hau Environment Court hearing will assist with the issues of measuring wind turbine sound mixed with ambient sound, and perceptible and audible characteristics. Notwithstanding this, there is sufficient information in the references provided in draft condition 4.7 to give certainty of application if sufficient thought is given.

5.8 Draft Condition 4.9 provides for monitoring locations and instrumentation.

5.9 Draft Condition 4.10 provides for independent monitoring and verification by a qualified person not in the employ (or previous employment) of the wind farm developer.

5.10 Draft Condition 4.11 establishes a noise complaint process. It is anticipated that the current Environment Court hearing dealing with Te Rere Hau compliance issues will assist

with the developing processes for complaint response, monitoring, assessment and compliance monitoring. The Court is due to report approximately mid-May.

5.11 Draft Condition 4.12 establishes a noise mitigation process for dwellings affected by wind farm noise. The process is refined from the condition established under para 341 of *Taralga Landscape Guardians v Minister of Planning and RES Southern Cross Pty Ltd*, Land and Environment Court of New South Wales, (2007) 161 LGERA 1.

6. Alternative Primary Noise Conditions

The following conditions are recommended in place of draft conditions 4.1 and 4.2 stated previously as they answer two important questions-

- (a) can a condition be written that has certainty of application; and
- (b) does the wording of that condition meet the intent of the Board to control noise under conditions of low wind

4.1 The wind farm and turbines shall be designed, constructed, operated and maintained so that the wind farm sound levels measured by ($L_{Aeq,adj,10 min}$) outdoor at a residence or noise sensitive place shall not exceed the background ($L_{A90,10 min}$) sound level of the existing acoustic environment at the residence or noise sensitive place by more than 5dB(A).

4.2 In the event that the measured background ($L_{A90,10 min}$) is less than 25 dB(A), then 25 dB(A) is to be substituted for the measured level.

The above conditions can be measured, have certainty of application, and do not rely on wind speeds from the wind farm. If the above are adopted, draft conditions 4.3 and 4.4 and explanatory notes 5.3 and 5.4 are redundant.

7. Matter Arising

In the course of preparation of this advice I became aware of a reference (reference 8, page 16-6) made in the draft Report that pertains to myself that is ambiguous and mischievous. It is my request that the matter be drawn to the Board's attention and that the offending reference be removed.

The relevant section deals with Dr Pierpont's book as in the 'Health and Safety' section. The quoted transcript attempts to link my evidence with that of Dr Black and Dr Dixon and then goes on to disparage the study by Dr Phipps. The plain meaning is that somehow my evidence re Pierpont disparages Dr Phipps. This is factually incorrect. I do not link the work of Dr Phipps with Dr Pierpont or vice versa. Secondly, the reference to Dr Phipps and stating that the study is discredited is not supported by the evidence laid before the Inquiry with respect to health and safety. A critique by McComish, commissioned by Mighty River Power and introduced into evidence by Mr Poff (para 75, page 13-21), is the only reference in the whole of the Inquiry and is introduced in the Landscape and Visual Effects section. The Board will be aware that I was involved in the social impact assessment expert's conclave and Dr Phipps' study falls into this area of research. Neither myself, nor the consultants for Council and Mighty River Power sought to introduce or debate the study. No research is perfect, and no critique is truly independent.

To disparage Dr Phipps (and the study) without benefit of being heard, and on the basis of a commissioned critique relating to an aspect of a significant independent study, is highly irregular, defies all principles of natural justice and shows unacceptable bias by the Board.

8. Discussion

a) It is concluded that draft noise Conditions presented by Mighty River Power are uncertain in application, ineffective and do not address noise complaint or immediate abatement. The conditions do not present a balance between the potential risk of adverse health effects due to sleep disturbance and the opportunity to establish the wind farm. It is recommended that the conditions be replaced by the draft conditions proposed in this advice.

b) The removal of a substantial number of turbines as presented in the draft report does reduce the noise levels at your home and Huatau marae but the noise levels will still exceed the criteria established by the Board. Consequently it is recommended that

- (i) turbines 48, 52, 54, 111, 120 and 121 be declined (removed); and
- (ii) the exact height, blade length, type and specification of the turbines be explicitly stated by the Board.

c) It is concluded that 'rumble-thump' amplitude modulated characteristics will be audible in your home and at Huatau marae, particularly under south-east wind conditions. These conditions exist for approximately 16% of the year and are more than minor in effect.

d) The risk of potential adverse health effects from environmental noise are explicitly identified by the World Health Organization. The actual effects of wind farm noise have been placed before the Board anecdotally and the Board has acknowledged the issue. The noise criteria derived from NZS 6808-2010 and relied on by Board in its draft conditions will result in significant consistent unreasonable noise that is more than minor at residences.

e) In my view there is a duty of care due owed to you by the Palmerston North City Council as the authority responsible for monitoring and applying the noise conditions, the wind farm developer Mighty River Power, the acoustic consultants responsible for the Mighty River Power draft conditions, and hosting land-owners inherent in the Mighty River Power conditions as drafted. Your legal advisor can assist you with matters of civil liability that may apply if you are adversely affected.

Thank-you for your instructions. Please do not hesitate to contact me if you have queries.

Yours truly,

A handwritten signature in black ink, appearing to read 'B Thorne', is positioned below the text 'Yours truly,'.

Bob Thorne PhD, M.Sc, FRSPH, MIOA, MAA

Annexure 1: Draft Noise Conditions Acceptable to Mighty River Power

The draft conditions that Mighty River Power submits as being acceptable to themselves are contained in the document circulated on 28 April 2011. The following are the draft noise conditions relating to turbine operation.

Operational Noise (Turbines)

18. The turbines shall be designed, constructed, operated and maintained so that wind farm sound levels shall comply with NZS6808 except where stated otherwise in the following conditions:

- 18.1 The wind farm sound levels ($L_{A90(10 \text{ min})}$) shall not exceed the background sound level (as described by the report discussed in condition **[21.1]** below) by more than 5dB, or a level of 40dB $L_{A90(10 \text{ min})}$, whichever is the greater except for times when the wind speed and background noise levels are such as to trigger a secondary noise limit, as set out in condition **[18.2]** below;
 - 18.2 When the wind farm speed is 6m/s or lower, a secondary noise limit shall apply under which the wind farm sound levels ($L_{A90(10 \text{ min})}$) shall not exceed the background sound level (as described by the NMP discussed in **[21.1]** below) by more than 5dB, or a level of 35dB $L_{A90(10 \text{ min})}$, whichever is the greater;
 - 18.3 This secondary noise limit shall apply only between the hours of 10pm to 7am.
- 19 Wind farm sound shall be measured and assessed in accordance with NZS 6808 and these conditions of consent within the:
- 19.1 notional boundary of any residential dwelling either existing or consented at the date of this consent (excluding residential dwellings on properties on which turbines are located or where the owner has provided written consent to the wind farm); or
 - 19.2 property boundary of any residentially zoned site on which a residential dwelling is able to be constructed as a permitted activity in accordance with the relevant plan rules, as at the date of this consent.
- 20 For the avoidance of doubt and for the purposes of compliance with condition [18], the "Reference Test method" shall be adopted for testing whether the wind farm has tonal special audible characteristics, in accordance with Appendix B of NZS 6808.

NMP

- 21 A Noise Management Plan (NMP) shall be submitted to the Palmerston North City Council and Tararua District Council Principal Planners for review, acting in a technical certification capacity, prior to commencement of operation of the wind farm. Should a response not be received within 30 working days of receipt, the Consent Holder shall be entitled to proceed in accordance with the conditions of consent.
- 22 The NMP shall be prepared by the Consent Holder in conjunction with an appropriately qualified and experienced acoustic consultant, and shall, as a minimum, include the following in general accordance with the "Draft Provisions for Noise Management Plan" attached to the Acoustic Consultants' Caucusing Agreement dated 23 March 2010:
 - 22.1 An assessment of background sound levels which shall form the basis of the noise limits described in condition [18];
 - 22.2 Wind turbine selection, having regard to the sound power level predictions obtained in accordance with section 6.2, and the special audible characteristics in clause 5.4.1 of NZS6808;
 - 22.3 Procedures for ensuring compliance with the noise conditions of these consents, including noise compliance testing, methods for addressing non-compliance, and contacts and complaints procedures;
 - 22.4 Procedures for addressing turbine malfunctions that cause material noise effects beyond typical operational noise;
 - 22.5 Requirements for post construction noise monitoring and assessment; and
 - 22.6 Provisions regarding review and updating of the NMP.
- 23 The Consent Holder shall operate the wind farm and act in compliance with the NMP at all times.

Noise Monitoring Costs

- 24 The Consent Holder shall pay all reasonable costs associated with the compliance testing or assessment undertaken in accordance with these conditions.

Pre-Instalment Assessment

Acoustic Emissions Report

- 25 The Consent Holder shall provide Palmerston North City Council's Environmental Services Group Manager with an Acoustic Emissions Report which details the sound power level of the selected turbines, and confirms the selected turbines are not expected to have special audible characteristics.

Noise Prediction Report

- 26 The Consent Holder shall provide Palmerston North City Council's Environmental Services Group Manager with a Noise Prediction Report in accordance with NZS6808 (and in particular sections 8.1 and 8.4.2). The Noise Prediction Report shall:
- 26.1 Be based on the sound power levels for the selected turbines, and demonstrate that the limits in condition **[18]** can be complied with; and
 - 26.2 include the finalised 35dBA contour for the project, pertaining to the wind speed at which the highest noise level is emitted from the selected turbines.

Background Noise Surveys

- 27 The Consent Holder shall engage an appropriately qualified and experienced acoustic consultant to undertake pre-installation background noise surveys at positions identified by the Consent Holder in consultation with the Palmerston North City and Tararua District Councils in addition to those undertaken for the Resource Consent application. The background noise surveys should include separately correlated background sound levels for the predominant north-westerly and south-easterly wind directions for both daytime and night-time periods (night-time as defined in condition **[18.3]**). The surveys shall be undertaken, and results assessed, in accordance with sections 7 and 8.2 of NZS6808.

Review of Noise Conditions

- 28 In accordance with section 128 of the Act, the Palmerston North City and Tararua District Councils may at one, three and five years after the completion of all construction works, or, if the wind turbine generators are installed in stages, then one year after completion of each stage and then three and five years after the final completion, serve notice on the Consent Holder of its intention to review any of the noise conditions of this consent.
- 29 Any reviews must be completed within six months of the notice being given in accordance with condition **[27]**.

Annexure 2: Wind farm Noise Guidelines

Documents that have been referenced in other jurisdictions but having relevance to this Inquiry and the application of noise management conditions are the National Health and Medical Research Council report 'Wind turbines and health – A rapid review of the evidence'; the Environment Protection and Heritage Council 'National wind farm development guidelines, draft, July 2010'; IEC wind turbine standards; and the World Health Organization Report 'Burden of disease from environmental noise – Quantification of healthy life years lost in Europe', 2011.

A2.1 National Health and Medical Research Council

The NHMRC report is quoted to 'prove' that there are no adverse health effects from wind farms. The review is essentially a literature review of a very small number of reports concerning wind farm noise and the effects on people. NHMRC have declined to provide the name and qualifications of the author(s) and have declined to confirm if the review was peer-reviewed prior to publication. In order to provide an understanding of the status of this document, and a less well publicised document 'Wind Turbines and Health Public Statement', comment was recently sought from the Assistant Director, Emerging Issues, NHMRC:

You have commented on an apparent contradiction between the two NHMRC publications in relation to wind turbines and adverse health outcomes.

As background it may be helpful to provide an explanation on how and why the two products were developed. Initially NHMRC Council wanted to determine whether there was any evidence to support the statement from Wind Turbines and Health - A Rapid Review of the Scientific Evidence, that indicated There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines.

To reach a determination, Council initiated a rapid review of current published scientific evidence on the potential health impacts of infrasound, noise, electromagnetic interference, shadow flicker and blade glint produced by wind turbines. The review concluded that the current available scientific evidence did support the statement that There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines. The findings generated the paper Wind Turbines and Health - A Rapid Review of the Scientific Evidence,

However, in acknowledgment of the small body of available evidence, NHMRC developed a Public Statement to provide balance to the initial rapid review outcome.

The NHMRC Public Statement clearly notes that because there is not enough robust scientific evidence available:

- 1. a precautionary approach should be taken*
- 2. research outcomes should continue to be monitored;*
- 3. wind turbine design standards should be complied with;*
- 4. site evaluation should occur to minimise potential impacts; and*
- 5. people who believe they are experiencing health problems should consult their Doctor promptly.*

NHMRC does not see the paragraph you have mentioned from Wind Turbines and Health - A Rapid Review of the Evidence as contradictory to the above public statement. (Comment: this query relates to the finding in the Review

This review of the available evidence, including journal articles, surveys, literature reviews and government reports, supports the statement that: There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines.

Wind energy is relatively new and therefore very little scientific evidence exists from which to draw a definite conclusion on potential health effects related to wind turbines. The evidence may change as time and experience contribute to the body of knowledge, but based on the literature available at the time NHMRC stands by the findings outlined in both documents.

With regard to your query about planning guidelines, you would need to contact the environmental sector for this material as it is outside the scope of NHMRC activities.

Following this reply independent medical advice was sought and this advice suggests that 'pathological' in the context of wind farm noise has the general meaning of 'indicative or in connection with a disease or disease process'. The NHMRC response assists consideration of the Turitea proposal by clearly stating that site evaluation should occur to minimise potential impacts.

A2.2 Environment Protection and Heritage Council

New Zealand is represented on the Australian Environment Protection and Heritage Council (EPHC). The EPHC 2010 draft report is an overview of wind farm environmental issues and protection of the environment. As far as can be ascertained the document has not been independently peer-reviewed. It is due for further review in June / July 2011. The report makes considerable reference to the Australian wind farm standard. The report is best read in association with the public consultation draft (October 2009) and the original *Report on Impediments to Environmentally and Socially Responsible Wind Farm Development*, November 2008. These two earlier documents are together more informative than the 2010 release.

A2.3 IEC wind turbine standards

Identification of special audible characteristics – and very low frequency noise – is addressed by the standard relating to the certification of wind turbines. Certification of wind turbine noise is undertaken in accordance with the International Standard *IEC 61400-11:2002 'Wind Turbine Generators Part 11, Acoustic noise measurement techniques'*, Wind turbine sound levels are presented in their test certificates as LAeq levels, not background (LA₉₀ or LA₉₅) levels. Emission levels are to be reported as A-weighted LAeq sound levels in one-third octave bands and audibility. Audibility under the wind turbine standard is given as a tone. Annex A, an informative annex to IEC 61400-11, states that:

In addition to those characteristics of wind turbine noise described in the main text of this standard, the noise emission may also possess some, or all, of the following:

- *Infrasound;*
- *Low frequency noise;*
- *Impulsivity;*
- *Low-frequency modulation of broad band or tonal noise;*
- *Other, such as a whine, hiss, screech, or hum, etc., distinct pulses in the noise, such as bangs, clatters, clicks or thumps, etc.*

A2.4 World Health Organization Report 2011

The WHO Report 'Burden of disease from environmental noise – Quantification of healthy life years lost in Europe', 2011, is a review of the scientific evidence supporting exposure-response relationships and case studies in calculating burden of disease. The Report has been peer reviewed. The report concludes that:

There is sufficient evidence from large scale epidemiological studies linking the population's exposure to environmental noise with adverse health effects. Therefore, environmental noise should be considered not only as a cause for nuisance but also a concern for public health and environmental health.

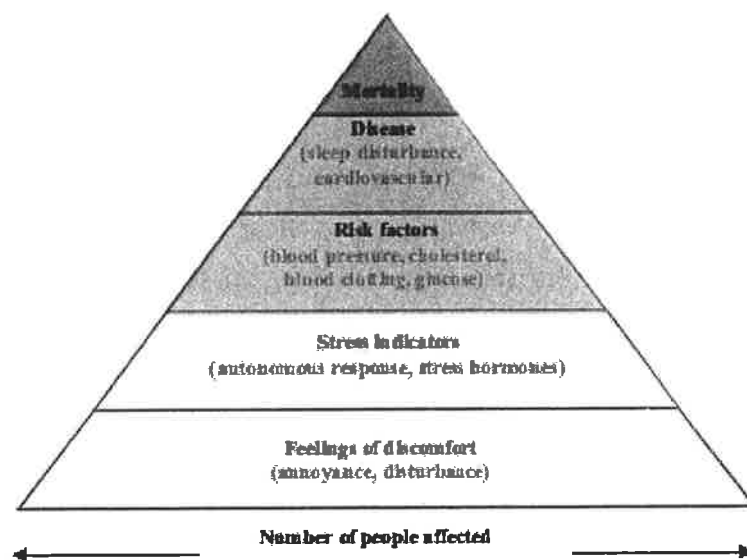
The Report is concerned with the effects of environmental noise in all its facets and does not specifically address potential for noise from wind turbines.

The Report presents the relationship between environmental noise, annoyance, sleep disturbance, adverse health effects and disease. The text relating to the effects of environmental noise are reproduced from page 100 of the Report:

Effects of environmental noise on selected health outcomes

The severity of health effects due to noise versus the number of people affected is schematically presented by Fig. 7.1. Annoyance, sleep disturbance, cardiovascular disease, cognitive impairment, hearing impairment and tinnitus were initially selected by the working group as health outcomes related to environmental noise.

Fig. 7.1. Severity of health effects of noise and number of people affected



Source: Babich (3).

Sufficient evidence was available to perform calculations of burdens of such outcomes as annoyance, sleep disturbance and cardiovascular disease. The epidemiological evidence was not as sufficient but was still enough for assuming the relationship of environmental noise to cognitive impairment and tinnitus. The epidemiological studies linking hearing impairment to environmental noise exposure are so sparse that any generalization can be considered exploratory and speculative. Therefore, following the recommendations of the peer-reviewers, the chapter on hearing impairment was not included in this publication.

The Report considers sleep disturbance and its potential for adverse health effects:

In 2009, WHO published the *Night noise guidelines for Europe*. This publication presented new evidence of the health damage of night-time noise exposure and recommended threshold values that, if breached at night, would threaten health. An annual average night exposure not exceeding 40 dB outdoors is recommended in the guidelines.

The WHO Europe (2009) 'Night Noise Guidelines for Europe' identifies (Table 1) the effects of outdoor noise on sleep.

- The WHO recognizes the existence of vulnerable groups and acknowledges the existence of individual differences in noise sensitivity.
- Health begins to be degraded between 30 and 40 dB.
- A $L_{\text{night,outside}}$ level of 30 dB is the level that can be considered "safe".

- A $L_{\text{night, outside}}$ level of 40 dB and above can be considered as the marker for “unsafe”.
- The Guideline is based on a 21 dB noise reduction from outside to inside the residence; a level of 40 dB outside is 19 dB inside
- Supplementary noise indicators (L_{Amax} , sound exposure, etc) may be needed to describe and assess noise for night period protection.

Table 1: WHO Europe (2009) ‘Night Noise Guidelines for Europe’.

Average night noise level over a year, $L_{\text{night, outside}}$

30 dB $L_{\text{night, outside}}$	Although individual sensitivities and circumstances may differ, it appears that up to this level no substantial biological effects are observed.
30–40 dB $L_{\text{night, outside}}$	A number of effects on sleep are observed from this range: body movements, awakening, self-reported sleep disturbance, arousals. The intensity of the effect depends on the nature of the source and the number of events. Vulnerable groups (for example children, the chronically ill and the elderly) are more susceptible. However, even in the worst cases the effects seem modest. $L_{\text{night, outside}}$ of 40 dB is equivalent to the lowest observed adverse effect level (LOAEL) for night noise.
40–55 dB $L_{\text{night, outside}}$	Adverse health effects are observed among the exposed population. Many people have to adapt their lives to cope with the noise at night. Vulnerable groups are more severely affected.
>55 dB $L_{\text{night, outside}}$	The situation is considered increasingly dangerous for public health. Adverse health effects occur frequently, a sizeable proportion of the population is highly annoyed and sleep-disturbed. There is evidence that the risk of cardiovascular disease increases.

The WHO’s Night Noise Guidelines for Europe’ description of the relationship between noise level ($L_{\text{night, outside}}$) and health are repeated in Table 1. The noise metric used, ($L_{\text{night, outside}}$), is referenced to the European Environmental Noise Directive (2002/49/EC) with a target of 40 dB ($L_{\text{night, outside}}$) to protect the public, including the most vulnerable groups such as children, the chronically ill and the elderly. ‘L_{night}’ is the A-weighted long-term average sound level determined over all nights of the year. Night is defined as 23.00 to 0700 hours. Annoyance criteria, as distinct from the ‘sleep’ criteria of Table 1, has a different night-time sound level derived from the measured L_{Aeq} sound level plus a penalty of 10 dB in the L_{den} equation:

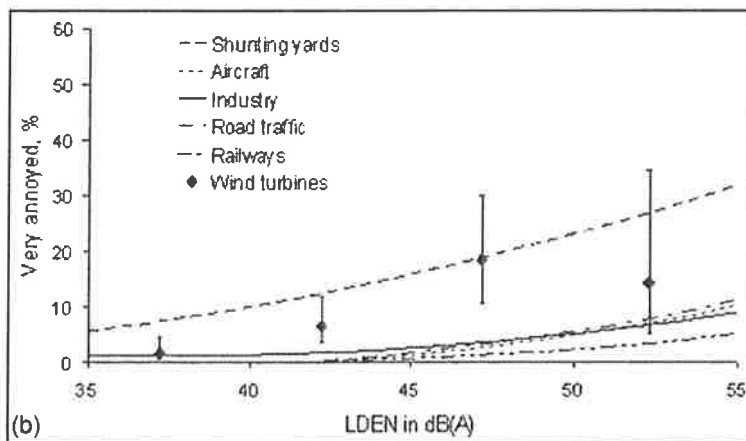
$$L_{den} = 10 \lg \frac{1}{24} \left(12 * 10^{\frac{L_{day}}{10}} + 4 * 10^{\frac{L_{evening} + 5}{10}} + 8 * 10^{\frac{L_{night} + 10}{10}} \right)$$

Calculating Lden values from LAeq (24hr)

A night-time level of 40 dB(A) is a measured level of 30 dB(A) plus a penalty of 10 dB.

- (a) a constant LAeq 'level' of 35 dB(A) over 24 hours is a Lden value of 41.4 dB(A).
- (b) a constant LAeq 'level' of 40 dB(A) over 24 hours is a Lden value of 46.4 dB(A).

The potential for annoyance is additional to the potential for sleep disturbance and is described in the paper 'Response to noise from modern wind farms in The Netherlands' by Pedersen et al.³ The levels of 41 and 46 Lden have an indicative 'very annoyed' rating of approximately 10-11% and 16-18% respectively, a significant effect that is more than minor.



Discussion

The noise criteria in the draft conditions proposed by Mighty River Power, the Board and NZS 6808-2010 are known anecdotally and by published research to cause noise annoyance, sleep disturbance and stress, as well as significant adverse health effects in susceptible individuals. The levels at your residence and Huatau marae will, hopefully, be less than this. The draft noise management conditions prepared by Mighty River Power and the acoustical consultants for Mighty River Power, Palmerston North City Council and the Board do not acknowledge the potential for unreasonable noise or adverse health effects and consequential mitigation of noise affecting sleep or health. The draft conditions of this advice do go some way to addressing these concerns.

³ Pedersen, E, van den Berg, F, Bakker, R, and Bouma J. 2009. Response to noise from modern wind farms in the Netherlands. J. Acoust. Soc. Am. 126 (2) August 2009. pp 634-643

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of a Board of Inquiry appointed under s146 of the Resource Management Act 1991 to consider an application by Mighty River Power Limited for resource consents to construct, operate, and maintain a wind farm at Turitea

**Huatau Marae Submission in Response to the Draft Report and
Decision of the Board of Inquiry into the Turitea Wind Farm
Proposal dated 11 February 2011**

12 May 2011

MAY IT PLEASE THE COURT

Introduction

[1] This submission is presented on behalf of Huatau Marae and a group of residents from Kahuterawa and Greens Roads in response to the Draft Report and Decision of the Board of Inquiry into the Turitea Wind Farm Proposal ("Draft Decision") dated 11 February 2011.

[2] The Draft Decision is supported in respect to the turbines that were declined in the MRP redesign resource consent application. The reasoning for those turbines being declined are also fully supported and appreciated and we accordingly oppose any submissions to the Draft Decision to have any of those declined turbines reconsidered for consent.

[3] This submission responds to the Draft Decision specifically on the following matters;

- (a) Traffic Issues and Revised Consent Conditions
- (b) Community Liaison Group
- (c) Cultural
- (d) Noise

Traffic Issues – Chapter 14

[4] In the early part of the hearing, prior to the redesign, traffic issues by and large went unnoticed. It should have followed that the redesign would have attracted less opposition and debate over traffic issues.

[5] During the redesign recess, the residents of Kahuterawa and Greens Road rallied together to challenge information, data and consent conditions for construction traffic presented by MRP and traffic experts.

[6] With the redesign reducing the number of turbines to be considered for consent it was expected that any adverse effects or impact from construction traffic should in theory and practical terms been reduced pro rata. This was not the case.

[7] On further analysis it became apparently clear that the traffic information and data that flowed from the redesign did not add up. To this extent the residents then started seriously questioning the validity and accuracy of the information presented by MRP. Thankfully the Board has also identified some of those issues to which this submission responds.

[8] This submission raises further issues of considerable concern that have not diminished and in some cases have increased since the Draft Decision was released and MRP (with the PNCC) given the opportunity to provide a revised schedule of restrictions that takes account of local residents concerns.

[9] The skewed use of information and data on construction traffic matters has cast further serious doubts over the accuracy and application of this information and data.

[10] For example, the use of *averages* for vehicle movements often distorts traffic use with the effect of adding minimal traffic increases on existing traffic use. The use of *averages over maximum* vehicle movements data is misleading and understates actual problems associated with maximum or peak loading. Peak traffic flows needed to be clearly indicated because of the higher likelihood and risk of vehicle related accidents.

[11] Using the 90-10% construction traffic movements split between the northern and southern access roads, the figure of 5,800 truck movements does not equate to the truck movements given in the revised consent conditions.

[12] In the Draft Decision at paragraph 14, it states "We acknowledge that these levels would be somewhat less under the redesign and less again for the number of turbines consented under our decision" I asked a question at the MRP and local residents meeting on 19 April whether vehicle numbers would be adjusted downwards due to the reduction in consented turbines. The answer given by MRP and their traffic expert was that the number of turbines consented have no bearing on the vehicle

movement numbers indicated in the revised consent conditions. No reason was given for this which only adds to doubts and confusion around stated vehicle numbers

[13] No explanation has been given as to why the total daily number of light vehicles will double at the end of the fourth month. The Draft Decision refers to this same issue on at least four occasions.

[14] At paragraph 49, according to Mr Galloway with regard to Kahuterawa Road, "...no road widening is required to accommodate the anticipated construction traffic apart from sealing parts of the road to noise and dust. It is also his view that this road is capable of carrying an additional 7 truck movements a day on average, subject to there being a proper construction traffic management plan to address peak days." The average truck movements per day are scheduled for 34 in the first 3-4 months notwithstanding peak loading periods. The existing road width is already a real concern for residents. Local residents are acutely aware of the traffic hazards on the existing road on an everyday basis and therefore this view by Mr Galloway is challenged by local residents. There is obvious unease in what may be proposed in a "proper traffic management plan" to address peak days.

[15] The same real concerns have been expressed by residents that live in Greens Road and further emphasized at paragraph 58, "...that there will be a major increase in the volume of traffic using Greens Road during the construction of the wind farm."

[16] "While Greens Road (and also Kahuterawa Road) does not comply with the 6 metres maximum width nor the 250 metres minimum sight distance required under the PNCC District Plan", (at paragraph 61), and "...with the road alignments severely limiting speeds, the expected low volumes of traffic and the proposed construction traffic management plan, this southern access should function well within safe and appropriate standards", (at paragraph 62), these two statements offer little comfort to residents particularly when it has already been expressed in the Draft Decision and by residents that there will be a major increase in traffic volumes.

[17] The Board at paragraph 97, requested MRP to develop, "...in consultation with PNCC and the local residents, for our approval, a revised schedule of restrictions for the

use of Kahuterawa Road and Greens.” As already mentioned a meeting scheduled by MRP with local residents was held on 19 April. MRP had already met with the traffic engineer for PNCC. There was no representation from PNCC at the meeting.

[18] Unfortunately, the meeting only managed to discuss the revised condition 40. While the meeting voted for changes to condition 40 none were carried through to the revised conditions. MRP, having the experience of facilitating two previous residents meeting post redesign, ought to have allowed more scheduled meetings to take place and scheduled earlier once a time extension requested by MRP was granted by the Board.

[19] The residents are aggrieved that their full consultation and recommendations to revised conditions have not been included in the revised conditions submitted to the Board and circulated to all parties on 28 April.

[20] Turning to the revised conditions that were supposed to be discussed in consultation with PNCC and local residents as requested by the Board at paragraph 97;

- A 6.30am start time as supported by the Board is included in Consent 40, but this was not supported by the local residents. Also, in the revised condition there is no “offset by a limitation on the time period that construction traffic is allowed to use the two roads” (paragraph 94).
- The 6.30am start was supposed to provide a one hour window for construction traffic before the start of the school commuting restriction at 7.30am. There is no such restriction on weekends but the revised consent extends the same 6.30am start to weekends without consultation.
- The 3-4 month construction period has been extended to 5 months in Condition 42, the reduced number of turbines obviously having little or no offset effects to reduce traffic movement numbers or construction period restrictions.
- Light vehicle numbers have been increased to 60vpd over 50vpd in the Draft Decision and light vehicle numbers have increased to 120vpd for the remainder

of the construction period, again raising questions to why the light vehicle numbers are still to double now at the end of a 5 month construction period.

- The maximum number of truck movements is a major concern for residents in revised condition 42 and they also lack of confidence in “..if unforeseen circumstances closes the internal road...”.

[21] Additionally the Board requested revised conditions for the restriction of construction traffic on Saturdays to a set number of light vehicles for the transport of construction workers over two short defined periods in the morning and afternoon. The Board recognized the need for such a restriction because of the high number of recreational users on weekends. This was not discussed with the local residents for the reasons given earlier. However, in a paper dated 6 April 2011 to Mr M Henry and circulated to local residents, Mr Galloway suggests that the use of mini-vans was not necessary.

[22] The reasoning for this suggestion was based on Mill Creek comparisons. The key differences why the use of mini-vans were not necessary were that a route to Mill Creek features a length through a private forest at the end of which cars can be parked before staff transfer to mini-vans to complete the final 2kms to the site, and the Turitea site does not offer such a location for parking up to 60 light vehicles.

[23] Another reason given was that Greens Road is to be substantially upgraded and as Kahuterawa Road users are accustomed to traffic levels twice that of the Mill Creek route. Another difference is an allowance for up to ten light vehicles and six truck movements per day at any time on weekends and public holidays. This latter difference has been added to Condition 40 although the Draft Decision only referred to two short defined periods on Saturdays, in the morning and afternoon.

[24] Reference to traffic levels comparisons between Kahuterawa Road with that of Mill Creek was not qualified, access to the Mill Creek site from the private road is only 2kms which is a much shorter distance than the southern access via Kahuterawa and Greens Roads, and also Ohariu Valley and Boon Rock Roads are distinctly different in nature to Kahuterawa and Greens Roads.

[25] By not reducing the number of light vehicles on Saturdays, as suggested by the Board, highlights the problem of using averaging and maximum numbers. The revised condition without reduced light vehicle traffic numbers (mini-vans) means that it is possible that up to 60 light vehicles could be traveling up Kahuterawa and Greens Road not including local residents, visitors and recreational users, in the one hour traffic window in the morning and back down in the afternoon. This possibility presents yet another major safety concern for residents.

[26] The residents of Kahuterawa and Greens Roads are disappointed with and critical of the PNCC traffic expert's lack of consultation with them throughout the consent process and the Draft Decision response period. This lack of confidence was expressed at the 19 April meeting by a significant majority. What was more discerning was that consultation had taken place between the MRP traffic expert and the PNCC traffic expert only for the residents to discover and have confirmed at the 19 April meeting that the PNCC traffic expert was no longer in the employment of the PNCC.

[27] While this is not a criticism of MRP the residents feel compromised and vulnerable again that consultation and agreement has been reached under these circumstances with the PNCC traffic expert that has no ongoing responsibility or accountability for the revised conditions.

[28] Following the results of the residents meeting on 19 April and the lack of consultation with the PNCC traffic expert the residents also feel compromised and vulnerable whether they will have a meaningful and serious contribution to the CTMP as indicated in paragraph 99.

[29] The residents have real concerns about traffic issues that will impact on them and these concerns are separate from any determination on the consenting of turbines, transmission lines, and substations. The traffic issues raised by the residents of Kahuterawa and Greens Road are health and safety first and foremost and then the considerable loss of amenity to their roads, properties, and quiet peace and enjoyment.

[30] At paragraph 21 it is correctly stated that many residents expressed considerable concern over the effects of construction traffic using Kahuterawa and Greens Roads and after a lack of consultation and contribution to the revised conditions these concerns have only increased.

[31] At paragraph 85 it states that “..we [the Board] have been left with some considerable reservations about the suitability of these roads for the safe passage of construction traffic. Our final decision on this will depend on MRP agreeing to much tighter conditions of consent that are currently contained within the 28 March 2010 Resource Consent Conditions..”

[32] It is submitted that the revised consent conditions do not represent much tighter conditions and in fact light vehicle traffic numbers and the construction periods have been increased, without proper consultation with local residents.

[33] It is further submitted that given that the southern access only represents 10% of total construction traffic movements for the wind farm, and this should have diminished with the smaller number of turbines consented in the Draft Decision, the use of Kahuterawa and Greens Roads should not and need not be approved for construction traffic use.

Community Liaison Group Schedule 1: Condition 14 Updated 28 April 2011

[34] Leading on from the considerable concerns of the residents of Kahuterawa and Greens Roads on construction traffic issues the Community Liaison Group is now more relevant particularly around consultation processes and representation.

[35] There are two organizations on the list that did not make submissions or representations before the Board of Inquiry.

[36] TMI, Te Rangimarie Marae, and ROTNAR should not be effected by Condition 16.1 and do not have marae or land within 3.5km of the wind farm.

[37] TMI have a MOU and ROTNAR have an Agreement in Principle with MRP that should satisfy Condition 16.2

[38] PNCC have a dual role of representing ratepayers and are landowners where turbines will be located.

[39] Huatau Marae that owns land and a marae within 3.5 kms of the wind farm is not on the list and should be.

[40] Residents organizations of TAG and FOTR are not on the list and should be.

[41] Under Condition 15, each of the organizations and interested parties listed in the condition that wish to participate in the CLG shall be entitled to at least one representative on that Group

[42] Local residents living within 3.5km of the wind are numerous and only get, according to Condition 15, one representative.

[43] The Draft Decision at Chapter 19 [45], states that the retained turbines will separate the wind farm into two distinct groups and with this being the case traffic issues with the northern access and the southern access are distinctly different as well.

[44] It is very possible that either the northern access or the southern access residents may not be represented.

[45] There are over 300 residences that may well qualify as local residents living within 3.5km of the wind farm.

[46] It is submitted that one representative from the local residents living within 3.5km is manifestly unfair, unbalanced and under represented in the Group

[47] It is submitted that the Board make a determination on the membership and representation on the CLG according to the stated functions of the CLG and that this determination not be left to Condition 17.

Cultural: Chapter 17

[48] Almost all aspects of the Cultural chapter and legislative provisions have to the satisfaction of the Board been achieved and reported based principally on a MOU signed by TMI and MRP and an Agreement in Principle with ROTNAR. It is assumed that the Board had the benefit of seeing the MOU.

[49] Without having the benefit of seeing the MOU and a request for a copy was declined for confidential reasons then I am not in a position to comment on the MOU and most of this chapter.

[50] The disappointment is that the MOU was not available and therefore an opportunity for robust analysis or discussion of the MOU was missed. While it is understandable that certain documentation such as agreements with landowners are commercially sensitive and private to the parties the same should not be the case for a MOU representing an iwi organization. Any commercially or culturally sensitive information could have been deleted and the MOU made available to requesting parties as a matter of appropriate disclosure on what is an important part of the RMA.

[51] There may have been no issues raised at all but non disclosure seriously prevents or limits a considered response to the findings in the cultural chapter.

[52] In the Environment Court in the Motorimu case, the MOU between TMI and the developer was presented in evidence as a matter of public record. Examination of that MOU included similar matters raised in the Draft Decision; Pou whenua, karakia, taonga species and tikanga and kaitiakitanga protocols, and a scholarship. However, the validity of many of the customary rights did not exist at that time or were inactive as they had either been extinguished by lawful land purchases over 120 years previously or voluntarily relinquished by discontinued practice. This inaction has been proven to be the case since the surrender of that resource consent. More importantly, the Motorimu TMI MOU was not challenged on these aspects but at least the MOU was available, open and processes transparent.

Noise: Chapter 15

[53] Dr Robert Thorne was invited by Mr and Mrs Adams and Huatau Marae to provide a response to the Draft Decision. Dr Thorne's response was comprehensive covering noise and he made additional comments on other aspects of the Draft Decision that he strongly felt required a response.

[54] In view that Dr Thorne's evidence was largely not accepted by the Board, that Dr Thorne was not under any directions arising from the Draft Decision and to avoid unnecessary repetition, possible misinterpreting or misquoting him, or providing exhaustive references to an appendix, Dr Thorne's response has been reproduced in full to be read as part of this submission.

[55] I will to be guided by the Board should his action be inappropriate.

A handwritten signature in black ink, appearing to read 'W. Johnson', with a large, stylized flourish extending downwards from the end of the signature.

Wayne Johnson
Counsel for Huatau Marae

PROPOSED TURITEA WIND FARM – ADVISORY REPORT ON NOISE ISSUES

Thank-you for your verbal instructions to advise on noise issues as they relate to the proposed Turitea wind farm potentially affecting the Adam's property, residence and Huatau marae.

1. Instructions

1.1 You have instructed me to advise you concerning the proposed Turitea wind farm development application in relation to the following:

- a) update the noise reviews prepared by Noise Measurement Services Pty Ltd following the draft decision by the Board of Inquiry;
- b) advise you concerning the draft noise conditions prepared by Mighty River Power;
- c) recommendations about appropriate conditions of approval.

1.2 In the course of preparation of this advice the application of the following were reviewed:

- a) The draft decision as it affects you, your home and Huatau marae;
- b) The proposed noise management conditions as they relate to certainty of application; practicality and relevance; and effectiveness.
- c) The consideration of noise issues with respect to wind farms including sleep disturbance, annoyance and adverse health effects.
- d) To briefly consider relevant acoustical and other standards, guidelines and reports, identified Environment Court decisions and legal advices that may assist you in preparation of a response to the Board with respect to noise issues.
- e) To provide supplementary draft noise conditions for the Board's consideration.

1.3 In the course of preparation of this advice I became aware of a reference (reference 8, page 16-6) made in the draft Report that pertains to myself that is ambiguous and mischievous. It

is my request that the matter be drawn to the Board's attention and that the offending reference be removed.

2. Summary of Advice

2.1 The Board has identified noise as being an issue, and this is clearly stated on page ES-9 of the draft. The removal of the turbines as presented by the Board is supported for the reasons given in this advice. In addition, it is recommended that turbines 48, 52, 54, 111, 121, and 120 be declined (removed).

2.2 The Board does not accept the propositions advanced by myself with respect to noise mitigation or setback distances, preferring the evidence of others (page ES-9 of the draft).

2.3 The evidence that the Board accepts applies noise management conditions of a type that have failed to determine noise levels affected by ambient sound and special audible characteristics and have failed to effectively mitigate complaints at Makara (Wellington) and at Te Rere Hau (Palmerston North).

2.4 The acoustical experts that the Board prefers have not yet been able to deliver workable noise management measures (PNCC v Te Rere Hau wind farm refers¹).

2.5 The draft noise conditions submitted by Mighty River Power on 28 April 2011 (Annexure 1) fail to adopt critical noise conditions recommended by the Board at para 108 page 15-25 of the draft report and fail to provide objective measures to effectively identify, assess and manage wind turbine noise and noise complaints.

2.6 The Board and Mighty River Power have recommended noise criteria that have previously failed to prevent complaints of unreasonable noise and adverse health effects at Makara and Te Rere Hau. Conditions need to address known failures to prevent, remedy or mitigate unreasonable noise. This advice includes draft conditions and explanations to address some of the issues.

¹ PNCC v NZ Windfarms, NZ Environment Court, ENV-2010-WLG-000114, Application for Declaration 11 October 2010 and Memorandum dated 21 December 2010

2.7 This advice does not repeat material previously forwarded to Board with respect to wind farm noise issues. Annexure 2 provides a summary of significant recent health – noise information and technical information required for the identification of wind turbine noise. The cited independent, peer-reviewed scientific WHO Report confirms the linkages between environmental noise, annoyance, sleep disturbance, adverse health effects and disease.

3. Noise Assessment with the Turbine Layout permitted by the Board

3.1 The Board, in its draft decision of February 2011, says:

Creating an environment where wind farm noise will be clearly noticeable at times of quiet background sound levels is not an option the Board condones, especially where large numbers of residents are affected. It is the Board's view that energy operations in New Zealand will have to learn not to place wind farms so close to residential communities if they are not prepared to accept constraints on noise limits under such conditions.

3.2 The Board has recommended draft conditions (page 15-25) and these are discussed later in this advice.

3.3 The proposed turbine locations proposed by the Board for the wind farm are shown on Plate 1. It is clear from the distribution of turbines that residences near Greens Road will be significantly affected due to south-east winds that occur for about 16% of the year. This effect is more than minor.

3.4 Residences already affected by Te Rere Hau will be additionally adversely affected by the northern turbines of Turitea.

3.5 Plate 1 following illustrates the sound levels from the wind farm. The broad red LAeq 35 dB contour is the marker for night-time levels. (Unfortunately, there is also a red line around the turbine clusters. This line is not the predicted LAeq contour). Broadly, the LAeq 35 dB contour is at 2000 metres from the nearest turbine. Representative receiver and residential locations are given in the blue boxes. The LA90 residential levels for the 61 turbines, adjusted by -2dB for the difference between LAeq and LA90, are given in Table 1.

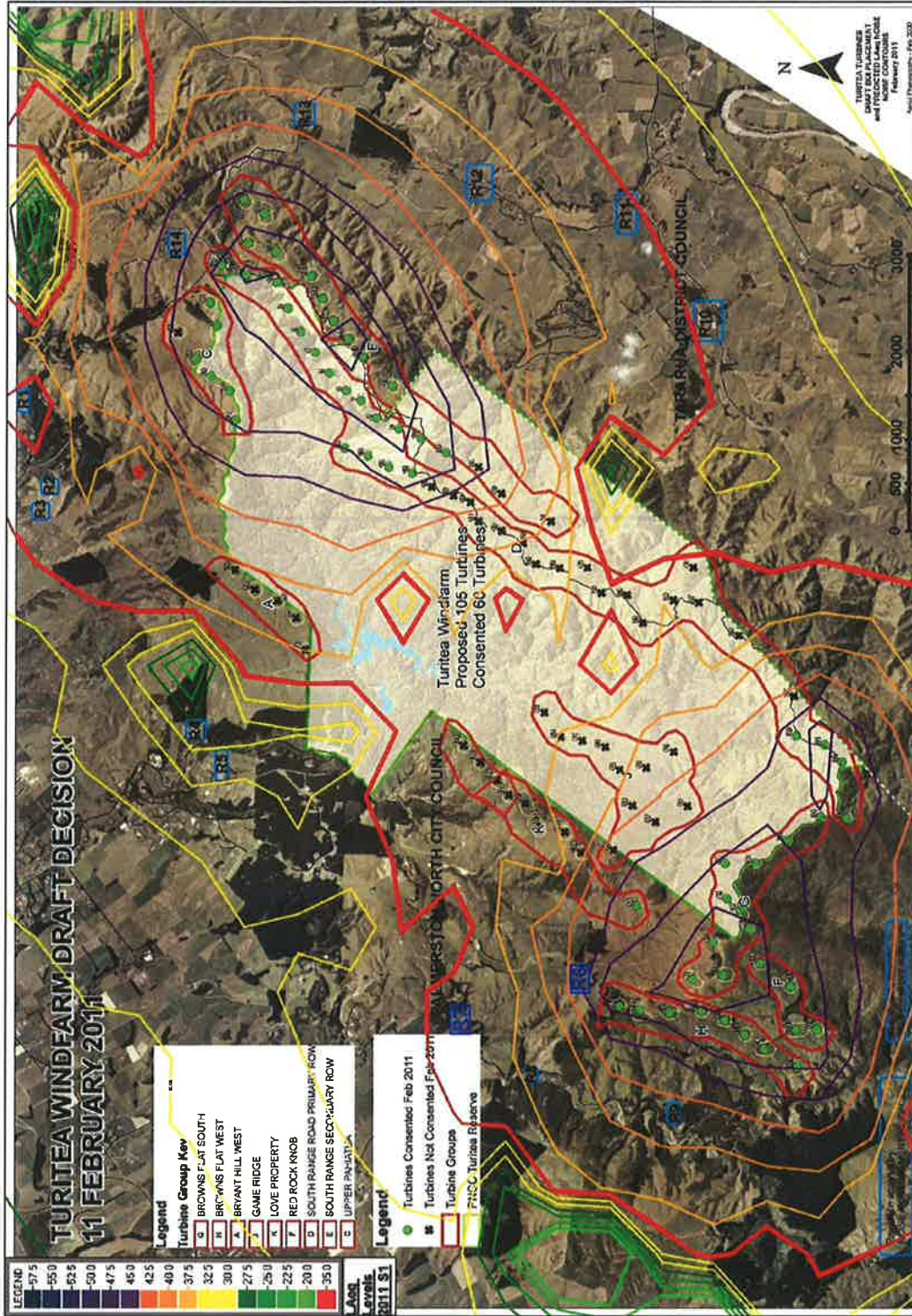
Table 1: Turitea predicted sound levels at receivers (residences, locales)

Receiver	LA90 dB	Turbine-Receiver Distance (metres)	Receiver	LA90 dB	Turbine-Receiver Distance (metres)
R1	33	1950	R8	36	1250
R2	35	2150	R9	40	1100
R3	34	2250	R10	33	3200
R4	29	3400	R11	34	3300
R5	30	3700	R12	38	2100
R6	44	450	R13	40	1150
R7	34	1750	R14	45	500

3.6 The predictions, made under ISO 9613-2 as required by NZS6808:2010. Some residences are significantly affected and will be above the criteria established by the Inquiry. There will be significant variation under south-east wind conditions. This is of particular importance for your home and Huatau marae (and residences to the north and north-west of the wind farm) as these are downwind of rows of turbines. Increases in sound level of 3dB to 6dB as well as significant amplitude modulated audible characteristics are anticipated. The penalty of 5dB for special audible characteristics must therefore be considered.

3.7 ISO 9613-2, as applied by the 2010 wind farm standard, states that the estimated accuracy for broadband noise under the meteorological conditions allowed for (a wind speed of between 1m/s and 5m/s at a measurement height of 3m to 11m above the ground) is an uncertainty of ± 3 dB. Thus it can be argued that by definition the standard does not apply to the high-wind conditions that are experienced at wind farms and the standard cannot be termed 'conservative'. That aside, in order to comply with the standard the range of predicted average levels must be considered, Table 2.

Plate T1: Proposed Turitea Wind Farm Noise Levels in Relation to residences and other receivers



Basemap sourced by J. Adams

Note 1 to Plate 1: the above contours are calculated in LAeq values and must be adjusted down by 2 dB to relate to LA90 values.

Note 2 to Plate 1: The Adams' residence and Huatau marae is R7, Hautika retreat is R6

3.8 The expected average range in background (LA90) sound levels, depending on wind speed and direction, are stated in Table 2. Higher wind speeds or turbines operating in a synchronous manner (turbines in a line 'pointing' towards a residence) will produce higher sound levels.

Table 2: Range of Turitea predicted sound levels at receivers (residences, locales)

Receiver	LA90 dB	Range of levels to ISO 9613-2	Receiver	LA90 dB	Range of levels to ISO 9613-2
R1	33	30 - 36	R8	36	33 - 39
R2	35	32 - 38	R9	40	37 - 43
R3	34	31 - 37	R10	33	30 - 36
R4	29	26 - 32	R11	34	31 - 37
R5	30	27 - 33	R12	38	35 - 41
R6	44	41 - 47	R13	40	37 - 43
R7	34	31 - 37	R14	45	42 - 48

3.9 To bring the upper range of predicted sound levels closer to the criteria established by the Board for your residence and Huatau marae (R7) requires the removal of turbines 48, 52, 54, 111, 120 and 121. (The levels are slightly above the 35 criterion at R7 even with these turbines removed).

3.10 NZS 2010 states explicitly (clause 5.4.2, Appendix B) that amplitude modulated sound is a 'special audible characteristic' and that amplitude modulated sound is characterised by the blades of the turbines passing the tower (clause CB3.1). Amplitude modulated noise, as acknowledged by NZS 6808-2010, requires specific mitigation or penalty when the sound becomes 'significant'. Despite this – and the well known PNCC application before the Environment Court - the draft noise management conditions proposed by Mighty River Power (Annex 1) fail to propose an objective scientifically proven test for 'significant' amplitude modulation.

3.11 As stated previously the Te Rere Hau wind farm in New Zealand is presently the subject of an Application to the Environment Court² for a Declaration with respect to compliance issues and concerns with respect to the methodologies applied to measure background sound levels and compliance levels. In brief it is understood that the specific issues raised are:

- The acoustic information supplied in the AEE was inaccurate;
- The Te Rere Hau wind farm is being operated at levels higher than those predicted in the {wind farm} application;
- The respondent has substantially underestimated the effects of the wind farm noise on the amenity of the area;
- The AEE concluded noise from the wind farm would not exhibit special audible characteristics (i.e. clearly audible tones, impulses or modulation of sound levels). This conclusion is inaccurate {reasons given};
- The actual experience of residents (located up to 2.18 km from the nearest turbines) and the number of complaints made to the Council indicating there are noise effects (which also exhibit special audible characteristics) being experienced at a significant number of local properties;
- The actual results reported in the revised compliance report (April 2010) demonstrate the actual sound levels from the wind farm are significantly higher (up to 12.8 dBA higher) at the monitoring location under certain wind speeds and directions than predicted;
- The AEE noise report predicted the sound level from the wind farm to be 34.9 dBA to 40.8 dBA at the monitoring location in wind speeds of 8 m/s;
- While monitored noise included noise from all sounds in the area (not just wind farm noise), the uncertainty as to the actual wind farm noise levels warrants further investigation. A new noise testing specification is the subject of the memorandum of 21 December 2010.

3.12 The general issues of concern for Te Rere Hau (noise prediction, methods of measurement and assessment, special audible characteristics) have been raised in detail in my evidence with respect to Turitea prior to the Te Rere Hau application. The draft conditions proposed by Mighty River Power do not address any of these concerns and it is concluded that the conditions are uncertain in application and ineffective to address complaints.

² PNCC v NZ Windfarms, NZ Environment Court, ENV-2010-WLG-000114, Application for Declaration 11 October 2010 and Memorandum dated 21 December 2010

4. Draft Proposed Noise Conditions

The following draft noise management conditions follow the argument and draft conditions proposed by the Board. The Board has not explicitly conditioned the type, specification, height or blade length of the turbines to be installed. At Makara the type of turbine (Vestas V90) considered was replaced in practice by a Siemens 2.3 unit that was not reviewed by the community noise experts. The draft conditions of this section do not define objective measures for special audible characteristics, low frequency sound or infrasound. Such measures require continuous real-time sound monitoring, audio recording and analysis for effective management.

4.1 Except for times when the wind farm wind speed and background noise levels are such as to trigger a secondary noise limit, the turbines shall be designed, constructed, operated and maintained so that the wind farm sound levels ($L_{A90,10 \text{ min}}$) at any non-participant residence or noise-sensitive location shall not exceed the background sound level by more than 5dB, or a level of 40 dB(A) ($L_{A90,10 \text{ min}}$) whichever is the greater;

4.2 Where the wind farm wind speed is 6m/s or lower, a secondary noise limit shall apply under which the turbines shall be designed, constructed, operated and maintained so that the wind farm sound levels ($L_{A90,10 \text{ min}}$) at any non-participant residence or noise-sensitive location shall not exceed the background sound level by more than 5dB(A), or a level of 35 dB(A) ($L_{A90,10 \text{ min}}$) whichever is the greater.

4.3 This secondary noise limit shall apply only between the hours of 10:00pm to 7:00am the next day.

4.4 For sleep protection purposes, a breach of the condition set out in 4.3, for 10% of the night, amounts to a breach of the condition.

4.5 The noise from wind farm activity shall not exceed inside any habitable room of a dwelling with windows open

- a) during night-time a noise level of 30 dB $L_{Aeq,adj, 10 \text{ min}}$ and
- b) during daytime and evening a noise level of 35 dB $L_{Aeq,adj, 10 \text{ min}}$ and

c) perceptible or audible noise from wind farm activity shall not affect human health or wellbeing including sleep or relaxation.

4.6 When noise from the wind farm has perceptible or audible characteristics giving rise to complaint, the measured sound level of the source shall have a 5 dB penalty added. Audible characteristics include tonal character measured as amplitude or frequency modulation, or both; impulsiveness and tonality.

4.7 Before the use commences, an effective noise monitoring, evaluation and response process must be submitted to and approved by the Palmerston North City Council to address the noise compliance conditions. Monitoring may be in accordance with New Zealand Standard NZS 6808-2010 *Acoustics-Wind farm noise*; International Standard ISO 1996-2:2007 *Acoustics-Description, measurement and assessment of environmental noise- Part 2: Determination of environmental noise levels* and such other standards or guidelines that may be relevant and appropriate. The monitoring process shall include all the sound levels as required by Conditions 4.1 to 4.6 and shall include monitoring for the characteristics described in Annex A of International Standard IEC 61400-11 *Wind turbine generator systems – Part 11: Acoustic noise measurement techniques*. Wind speed and wind direction shall be measured at the same location as the noise monitoring location.

4.8 A post-construction continuous noise monitoring program must be commissioned by the proponent within 2 months before the commissioning of the first turbine and continue for 12 months after the commissioning of the last turbine all to the satisfaction of the Palmerston North City Council. Noise monitoring stations shall be installed at not less than two residences subject to the approval of the Palmerston North City Council as to location. The consent holder must pay the reasonable costs of the monitoring program.

4.9 The data from each continuous monitoring station shall be available in real-time at the Council with real-time audio capability to allow a sound to be heard as it occurs and shall allow for the capture, recording and analysis of the sound levels necessary to identify special audible characteristics and prove compliance with the consent noise criteria.

4.10 An independent specialist noise consultant (other than the companies or persons who prepared the predictive acoustical reports) must be appointed by Palmerston North City Council

to monitor and verify noise levels subject to complaint of either nuisance or harm due to noise. For the purposes of these conditions a specialist noise consultant is taken to be a person qualified in the science of acoustics. The consent holder must pay the reasonable costs of the monitoring and verification.

4.11 Before the use commences, an effective noise complaint, evaluation and response process must be submitted to and approved by the Palmerston North City Council to address any alleged breaches of the noise compliance conditions. The process must allow for an immediate 24-hour, 7-day response by the wind farm operator to a complaint, such response to include noise monitoring and noise mitigation as appropriate. Any complaint received must be notified within 24 hours of receipt to the Council and the wind farm operator must state what action has been taken or is proposed to bring the wind farm into compliance. The consent holder must pay the reasonable costs of the complaint response process.

4.12 In the event that the post-construction noise monitoring at a residence reveals exceedance of the noise criteria specified in Conditions 4.1 to 4.6, or if a valid complaint lodged under the process established under Condition 4.10 is received by the Palmerston North City Council, the consent holder shall take immediate action to mitigate such noise.

a) Where reasonable and feasible, physical noise mitigation measures are to be provided by the consent holder for an existing dwelling or no more than one new dwelling built on any vacant parcel of land legally existing at the date of approval of the wind farm development application. The noise mitigation measures are to achieve a night-time noise level of 30 dB $L_{Aeq,adj, 10 \text{ min}}$ and daytime and evening noise level of 35 dB $L_{Aeq,adj, 10 \text{ min}}$ inside a habitable room of the dwelling with windows open. The sound inside the habitable room shall have no perceptible or audible noise from wind farm activity.

b) This condition applies only to a dwelling existing at the date of consent of the wind farm development application or to a new dwelling for which a development application is lodged with the Palmerston North City Council within five years of the date of commissioning of the final turbine.

5. Consideration of Noise Issues

5.1 Draft Condition 4.1 is as written in the Board's report page 15-25 with the following comments

- (a) the word 'operated' is emphasised as the condition should obviously apply when the turbines are operating;
- (b) the condition needs to apply to a specific place – the original condition does not say where the criteria will apply and therefore is uncertain in application and cannot be enforced

5.2 Draft Condition 4.2 is as written in the Board's report page 15-25 with the following comments

- (a) the word 'operated' is emphasised as the condition should obviously apply when the turbines are operating;
- (b) the condition needs to apply to a specific place – the original condition does not say where the criteria will apply and therefore is uncertain in application and cannot be enforced

5.3 Draft Condition 4.3 is as written in the Board's report page 15-25.

The over-riding concern of the conditions proposed in this advice is to protect sleep at night. The conditions will not 'protect' persons who may be sensitive to noise and the turbines will be clearly audible outside most residences identified in Table 2 especially under low wind speeds at the residences.

5.4 Draft condition 4.4 is based on the application of NZS 6808-1998 / 2010 as applied to the night-time noise criterion for Victorian wind farms.

5.5 Draft Condition 4.5 addresses the requirements of protecting sleep and relaxation within the home without interference from noise.

5.6 Draft condition 4.6 acknowledges the unique character of wind farm noise with respect to special audible characteristics and, in association with the requirements of draft Condition 4.6, provides the adjustment ('adj') component of draft Conditions 4.5 and 4.12.

5.7 Draft Conditions 4.7 and 4.8 require a noise monitoring program to be established. The design of the program is a matter for the developer and Council to agree. The monitoring procedures are now reasonably well established and it is anticipated that the current Te Rere Hau Environment Court hearing will assist with the issues of measuring wind turbine sound mixed with ambient sound, and perceptible and audible characteristics. Notwithstanding this, there is sufficient information in the references provided in draft condition 4.7 to give certainty of application if sufficient thought is given.

5.8 Draft Condition 4.9 provides for monitoring locations and instrumentation.

5.9 Draft Condition 4.10 provides for independent monitoring and verification by a qualified person not in the employ (or previous employment) of the wind farm developer.

5.10 Draft Condition 4.11 establishes a noise complaint process. It is anticipated that the current Environment Court hearing dealing with Te Rere Hau compliance issues will assist with the developing processes for complaint response, monitoring, assessment and compliance monitoring. The Court is due to report approximately mid-May.

5.11 Draft Condition 4.12 establishes a noise mitigation process for dwellings affected by wind farm noise. The process is refined from the condition established under para 341 of *Taralga Landscape Guardians v Minister of Planning and RES Southern Cross Pty Ltd*, Land and Environment Court of New South Wales, (2007) 161 LGERA 1.

6. Alternative Primary Noise Conditions

The following conditions are recommended in place of draft conditions 4.1 and 4.2 stated previously as they answer two important questions-

- (a) can a condition be written that has certainty of application; and
- (b) does the wording of that condition meet the intent of the Board to control noise under conditions of low wind

4.1 The wind farm and turbines shall be designed, constructed, operated and maintained so that the wind farm sound levels measured by ($L_{Aeq,adj,10 min}$) outdoor at a residence or noise

sensitive place shall not exceed the background ($L_{A90,10 \text{ min}}$) sound level of the existing acoustic environment at the residence or noise sensitive place by more than 5dB(A).

4.2 In the event that the measured background ($L_{A90,10 \text{ min}}$) is less than 25 dB(A), then 25 dB(A) is to be substituted for the measured level.

The above conditions can be measured, have certainty of application, and do not rely on wind speeds from the wind farm. If the above are adopted, draft conditions 4.3 and 4.4 and explanatory notes 5.3 and 5.4 are redundant.

7. Matter Arising

In the course of preparation of this advice I became aware of a reference (reference 8, page 16-6) made in the draft Report that pertains to myself that is ambiguous and mischievous. It is my request that the matter be drawn to the Board's attention and that the offending reference be removed.

The relevant section deals with Dr Pierpont's book as in the 'Health and Safety' section. The quoted transcript attempts to link my evidence with that of Dr Black and Dr Dixon and then goes on to disparage the study by Dr Phipps. The plain meaning is that somehow my evidence re Pierpont disparages Dr Phipps. This is factually incorrect. I do not link the work of Dr Phipps with Dr Pierpont or vice versa. Secondly, the reference to Dr Phipps and stating that the study is discredited is not supported by the evidence laid before the Inquiry with respect to health and safety. A critique by McComish, commissioned by Mighty River Power and introduced into evidence by Mr Poff (para 75, page 13-21), is the only reference in the whole of the Inquiry and is introduced in the Landscape and Visual Effects section. The Board will be aware that I was involved in the social impact assessment expert's conclave and Dr Phipps' study falls into this area of research. Neither myself, nor the consultants for Council and Mighty River Power sought to introduce or debate the study. No research is perfect, and no critique is truly independent.

To disparage Dr Phipps (and the study) without benefit of being heard, and on the basis of a commissioned critique relating to an aspect of a significant independent study, is highly irregular, defies all principles of natural justice and shows unacceptable bias by the Board.

8. Discussion

a) It is concluded that draft noise Conditions presented by Mighty River Power are uncertain in application, ineffective and do not address noise complaint or immediate abatement. The conditions do not present a balance between the potential risk of adverse health effects due to sleep disturbance and the opportunity to establish the wind farm. It is recommended that the conditions be replaced by the draft conditions proposed in this advice.

b) The removal of a substantial number of turbines as presented in the draft report does reduce the noise levels at your home and Huatau marae but the noise levels will still exceed the criteria established by the Board. Consequently it is recommended that

- (i) turbines 48, 52, 54, 111, 120 and 121 be declined (removed); and
- (ii) the exact height, blade length, type and specification of the turbines be explicitly stated by the Board.

c) It is concluded that 'rumble-thump' amplitude modulated characteristics will be audible in your home and at Huatau marae, particularly under south-east wind conditions. These conditions exist for approximately 16% of the year and are more than minor in effect.

d) The risk of potential adverse health effects from environmental noise are explicitly identified by the World Health Organization. The actual effects of wind farm noise have been placed before the Board anecdotally and the Board has acknowledged the issue. The noise criteria derived from NZS 6808-2010 and relied on by Board in its draft conditions will result in significant consistent unreasonable noise that is more than minor at residences.

e) In my view there is a duty of care due owed to you by the Palmerston North City Council as the authority responsible for monitoring and applying the noise conditions, the wind farm developer Mighty River Power, the acoustic consultants responsible for the Mighty River Power draft conditions, and hosting land-owners inherent in the Mighty River Power conditions as drafted. Your legal advisor can assist you with matters of civil liability that may apply if you are adversely affected.

Thank-you for your instructions. Please do not hesitate to contact me if you have queries.

Yours truly,

A handwritten signature in black ink, appearing to read 'B Thorne'. The signature is written in a cursive style with a large initial 'B' and a stylized 'Thorne'.

Bob Thorne PhD, M.Sc, FRSPH, MIOA, MAA

Annexure 1: Draft Noise Conditions Acceptable to Mighty River Power

The draft conditions that Mighty River Power submits as being acceptable to themselves are contained in the document circulated on 28 April 2011. The following are the draft noise conditions relating to turbine operation.

Operational Noise (Turbines)

18. The turbines shall be designed, constructed, operated and maintained so that wind farm sound levels shall comply with NZS6808 except where stated otherwise in the following conditions:.

18.1 The wind farm sound levels ($L_{A90(10 \text{ min})}$) shall not exceed the background sound level (as described by the report discussed in condition **[21.1]** below) by more than 5dB, or a level of 40dB $L_{A90(10 \text{ min})}$, whichever is the greater except for times when the wind speed and background noise levels are such as to trigger a secondary noise limit, as set out in condition **[18.2]** below;

18.2 When the wind farm speed is 6m/s or lower, a secondary noise limit shall apply under which the wind farm sound levels ($L_{A90(10 \text{ min})}$) shall not exceed the background sound level (as described by the NMP discussed in **[21.1]** below) by more than 5dB, or a level of 35dB $L_{A90(10 \text{ min})}$, whichever is the greater;

18.3 This secondary noise limit shall apply only between the hours of 10pm to 7am.

19 Wind farm sound shall be measured and assessed in accordance with NZS 6808 and these conditions of consent within the:

19.1 notional boundary of any residential dwelling either existing or consented at the date of this consent (excluding residential dwellings on properties on which turbines are located or where the owner has provided written consent to the wind farm); or

19.2 property boundary of any residentially zoned site on which a residential dwelling is able to be constructed as a permitted activity in accordance with the relevant plan rules, as at the date of this consent.

20 For the avoidance of doubt and for the purposes of compliance with condition [18], the "Reference Test method" shall be adopted for

testing whether the wind farm has tonal special audible characteristics, in accordance with Appendix B of NZS 6808.

NMP

- 21 A Noise Management Plan (NMP) shall be submitted to the Palmerston North City Council and Tararua District Council Principal Planners for review, acting in a technical certification capacity, prior to commencement of operation of the wind farm. Should a response not be received within 30 working days of receipt, the Consent Holder shall be entitled to proceed in accordance with the conditions of consent.
- 22 The NMP shall be prepared by the Consent Holder in conjunction with an appropriately qualified and experienced acoustic consultant, and shall, as a minimum, include the following in general accordance with the "Draft Provisions for Noise Management Plan" attached to the Acoustic Consultants' Caucusing Agreement dated 23 March 2010:
 - 22.1 An assessment of background sound levels which shall form the basis of the noise limits described in condition **[18]**;
 - 22.2 Wind turbine selection, having regard to the sound power level predictions obtained in accordance with section 6.2, and the special audible characteristics in clause 5.4.1 of NZS6808;
 - 22.3 Procedures for ensuring compliance with the noise conditions of these consents, including noise compliance testing, methods for addressing non-compliance, and contacts and complaints procedures;
 - 22.4 Procedures for addressing turbine malfunctions that cause material noise effects beyond typical operational noise;
 - 22.5 Requirements for post construction noise monitoring and assessment; and
 - 22.6 Provisions regarding review and updating of the NMP.
- 23 The Consent Holder shall operate the wind farm and act in compliance with the NMP at all times.

Noise Monitoring Costs

- 24 The Consent Holder shall pay all reasonable costs associated with the compliance testing or assessment undertaken in accordance with these conditions.

Pre-Instalment Assessment

Acoustic Emissions Report

- 25 The Consent Holder shall provide Palmerston North City Council's Environmental Services Group Manager with an Acoustic Emissions Report which details the sound power level of the selected turbines, and confirms the selected turbines are not expected to have special audible characteristics.

Noise Prediction Report

- 26 The Consent Holder shall provide Palmerston North City Council's Environmental Services Group Manager with a Noise Prediction Report in accordance with NZS6808 (and in particular sections 8.1 and 8.4.2). The Noise Prediction Report shall:

26.1 Be based on the sound power levels for the selected turbines, and demonstrate that the limits in condition **[18]** can be complied with; and

26.2 include the finalised 35dBA contour for the project, pertaining to the wind speed at which the highest noise level is emitted from the selected turbines.

Background Noise Surveys

- 27 The Consent Holder shall engage an appropriately qualified and experienced acoustic consultant to undertake pre-installation background noise surveys at positions identified by the Consent Holder in consultation with the Palmerston North City and Tararua District Councils in addition to those undertaken for the Resource Consent application. The background noise surveys should include separately correlated background sound levels for the predominant north-westerly and south-easterly wind directions for both daytime and night-time periods (night-time as defined in condition **[18.3]**). The surveys shall be undertaken, and results assessed, in accordance with sections 7 and 8.2 of NZS6808.

Review of Noise Conditions

- 28 In accordance with section 128 of the Act, the Palmerston North City and Tararua District Councils may at one, three and five years after the completion of all construction works, or, if the wind turbine generators are installed in stages, then one year after completion of each stage and then three and five years after the final completion, serve notice on the Consent Holder of its intention to review any of the noise conditions of this consent.
- 29 Any reviews must be completed within six months of the notice being given in accordance with condition **[27]**.

Annexure 2: Wind farm Noise Guidelines

Documents that have been referenced in other jurisdictions but having relevance to this Inquiry and the application of noise management conditions are the National Health and Medical Research Council report 'Wind turbines and health – A rapid review of the evidence'; the Environment Protection and Heritage Council 'National wind farm development guidelines, draft, July 2010'; IEC wind turbine standards; and the World Health Organization Report 'Burden of disease from environmental noise – Quantification of healthy life years lost in Europe', 2011.

A2.1 National Health and Medical Research Council

The NHMRC report is quoted to 'prove' that there are no adverse health effects from wind farms. The review is essentially a literature review of a very small number of reports concerning wind farm noise and the effects on people. NHMRC have declined to provide the name and qualifications of the author(s) and have declined to confirm if the review was peer-reviewed prior to publication. In order to provide an understanding of the status of this document, and a less well publicised document 'Wind Turbines and Health Public Statement', comment was recently sought from the Assistant Director, Emerging Issues, NHMRC:

You have commented on an apparent contradiction between the two NHMRC publications in relation to wind turbines and adverse health outcomes.

As background it may be helpful to provide an explanation on how and why the two products were developed. Initially NHMRC Council wanted to determine whether there was any evidence to support the statement from Wind Turbines and Health - A Rapid Review of the Scientific Evidence, that indicated There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines.

To reach a determination, Council initiated a rapid review of current published scientific evidence on the potential health impacts of infrasound, noise, electromagnetic interference, shadow flicker and blade glint produced by wind turbines. The review concluded that the current available scientific evidence did support the statement that There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines. The findings generated the paper Wind Turbines and Health - A Rapid Review of the Scientific Evidence,

However, in acknowledgment of the small body of available evidence, NHMRC developed a Public Statement to provide balance to the initial rapid review outcome. The NHMRC

Public Statement clearly notes that because there is not enough robust scientific evidence available:

- 1. a precautionary approach should be taken*
- 2. research outcomes should continue to be monitored;*
- 3. wind turbine design standards should be complied with;*
- 4. site evaluation should occur to minimise potential impacts; and*
- 5. people who believe they are experiencing health problems should consult their Doctor promptly.*

NHMRC does not see the paragraph you have mentioned from Wind Turbines and Health - A Rapid Review of the Evidence as contradictory to the above public statement. (Comment: this query relates to the finding in the Review

This review of the available evidence, including journal articles, surveys, literature reviews and government reports, supports the statement that: There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines.

Wind energy is relatively new and therefore very little scientific evidence exists from which to draw a definite conclusion on potential health effects related to wind turbines. The evidence may change as time and experience contribute to the body of knowledge, but based on the literature available at the time NHMRC stands by the findings outlined in both documents.

With regard to your query about planning guidelines, you would need to contact the environmental sector for this material as it is outside the scope of NHMRC activities.

Following this reply independent medical advice was sought and this advice suggests that 'pathological' in the context of wind farm noise has the general meaning of 'indicative or in connection with a disease or disease process'. The NHMRC response assists consideration of the Turitea proposal by clearly stating that site evaluation should occur to minimise potential impacts.

A2.2 Environment Protection and Heritage Council

New Zealand is represented on the Australian Environment Protection and Heritage Council (EPHC). The EPHC 2010 draft report is an overview of wind farm environmental issues and protection of the environment. As far as can be ascertained the document has not been independently peer-reviewed. It is due for further review in June / July 2011. The report makes considerable reference to the Australian wind farm standard. The report is best read in association with the public consultation draft (October 2009) and the original *Report on*

Impediments to Environmentally and Socially Responsible Wind Farm Development, November 2008. These two earlier documents are together more informative than the 2010 release.

A2.3 IEC wind turbine standards

Identification of special audible characteristics – and very low frequency noise – is addressed by the standard relating to the certification of wind turbines. Certification of wind turbine noise is undertaken in accordance with the International Standard *IEC 61400-11:2002 'Wind Turbine Generators Part 11, Acoustic noise measurement techniques'*, Wind turbine sound levels are presented in their test certificates as LAeq levels, not background (LA₉₀ or LA₉₅) levels. Emission levels are to be reported as A-weighted LAeq sound levels in one-third octave bands and audibility. Audibility under the wind turbine standard is given as a tone. Annex A, an informative annex to IEC 61400-11, states that:

In addition to those characteristics of wind turbine noise described in the main text of this standard, the noise emission may also possess some, or all, of the following:

- *Infrasound;*
- *Low frequency noise;*
- *Impulsivity;*
- *Low-frequency modulation of broad band or tonal noise;*
- *Other, such as a whine, hiss, screech, or hum, etc., distinct pulses in the noise, such as bangs, clatters, clicks or thumps, etc.*

A2.4 World Health Organization Report 2011

The WHO Report 'Burden of disease from environmental noise – Quantification of healthy life years lost in Europe', 2011, is a review of the scientific evidence supporting exposure-response relationships and case studies in calculating burden of disease. The Report has been peer reviewed. The report concludes that:

There is sufficient evidence from large scale epidemiological studies linking the population's exposure to environmental noise with adverse health effects. Therefore, environmental noise should be considered not only as a cause for nuisance but also a concern for public health and environmental health.

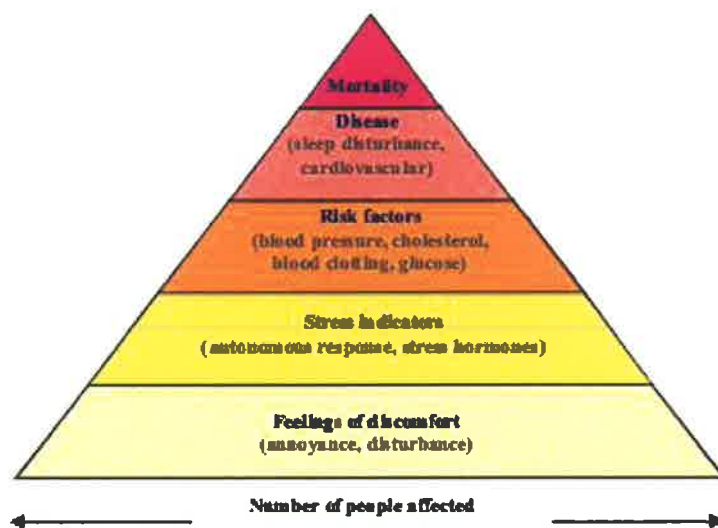
The Report is concerned with the effects of environmental noise in all its facets and does not specifically address potential for noise from wind turbines.

The Report presents the relationship between environmental noise, annoyance, sleep disturbance, adverse health effects and disease. The text relating to the effects of environmental noise are reproduced from page 100 of the Report:

Effects of environmental noise on selected health outcomes

The severity of health effects due to noise versus the number of people affected is schematically presented by Fig. 7.1. Annoyance, sleep disturbance, cardiovascular disease, cognitive impairment, hearing impairment and tinnitus were initially selected by the working group as health outcomes related to environmental noise.

Fig. 7.1. Severity of health effects of noise and number of people affected



Source: Babitsch (3).

Sufficient evidence was available to perform calculations of burdens of such outcomes as annoyance, sleep disturbance and cardiovascular disease. The epidemiological evidence was not as sufficient but was still enough for assuming the relationship of environmental noise to cognitive impairment and tinnitus. The epidemiological studies linking hearing impairment to environmental noise exposure are so sparse that any generalization can be considered exploratory and speculative. Therefore, following the recommendations of the peer-reviewers, the chapter on hearing impairment was not included in this publication.

The Report considers sleep disturbance and its potential for adverse health effects:

In 2009, WHO published the *Night noise guidelines for Europe*. This publication presented new evidence of the health damage of night-time noise exposure and recommended threshold values that, if breached at night, would threaten health. An annual average night exposure not exceeding 40 dB outdoors is recommended in the guidelines.

The WHO Europe (2009) ‘Night Noise Guidelines for Europe’ identifies (Table 1) the effects of outdoor noise on sleep.

- The WHO recognizes the existence of vulnerable groups and acknowledges the existence of individual differences in noise sensitivity.
- Health begins to be degraded between 30 and 40 dB.
- A $L_{\text{night, outside}}$ level of 30 dB is the level that can be considered “safe”.
- A $L_{\text{night, outside}}$ level of 40 dB and above can be considered as the marker for “unsafe”.
- The Guideline is based on a 21 dB noise reduction from outside to inside the residence; a level of 40 dB outside is 19 dB inside
- Supplementary noise indicators (L_{Amax} , sound exposure, etc) may be needed to describe and assess noise for night period protection.

Table 1: WHO Europe (2009) ‘Night Noise Guidelines for Europe’.

Average night noise level over a year, $L_{\text{night, outside}}$

30 dB $L_{\text{night, outside}}$	Although individual sensitivities and circumstances may differ, it appears that up to this level no substantial biological effects are observed.
30–40 dB $L_{\text{night, outside}}$	A number of effects on sleep are observed from this range: body movements, awakening, self-reported sleep disturbance, arousals. The intensity of the effect depends on the nature of the source and the number of events. Vulnerable groups (for example children, the chronically ill and the elderly) are more susceptible. However, even in the worst cases the effects seem modest. $L_{\text{night, outside}}$ of 40 dB is equivalent to the lowest observed adverse effect level (LOAEL) for night noise.
40–55 dB $L_{\text{night, outside}}$	Adverse health effects are observed among the exposed population. Many people have to adapt their lives to cope with the noise at night. Vulnerable groups are more severely affected.
>55 dB $L_{\text{night, outside}}$	The situation is considered increasingly dangerous for public health. Adverse health effects occur frequently, a sizeable proportion of the population is highly annoyed and sleep-disturbed. There is evidence that the risk of cardiovascular disease increases.

The WHO's Night Noise Guidelines for Europe' description of the relationship between noise level ($L_{\text{night, outside}}$) and health are repeated in Table 1. The noise metric used, ($L_{\text{night, outside}}$), is referenced to the European Environmental Noise Directive (2002/49/EC) with a target of 40 dB ($L_{\text{night, outside}}$) to protect the public, including the most vulnerable groups such as children, the chronically ill and the elderly. 'Lnight' is the A-weighted long-term average sound level determined over all nights of the year. Night is defined as 23.00 to 0700 hours.

Annoyance criteria, as distinct from the 'sleep' criteria of Table 1, has a different night-time sound level derived from the measured LAeq sound level plus a penalty of 10 dB in the Lden equation:

$$L_{\text{den}} = 10 \lg \frac{1}{24} \left(12 * 10^{\frac{L_{\text{day}}}{10}} + 4 * 10^{\frac{L_{\text{evening}} + 5}{10}} + 8 * 10^{\frac{L_{\text{night}} + 10}{10}} \right)$$

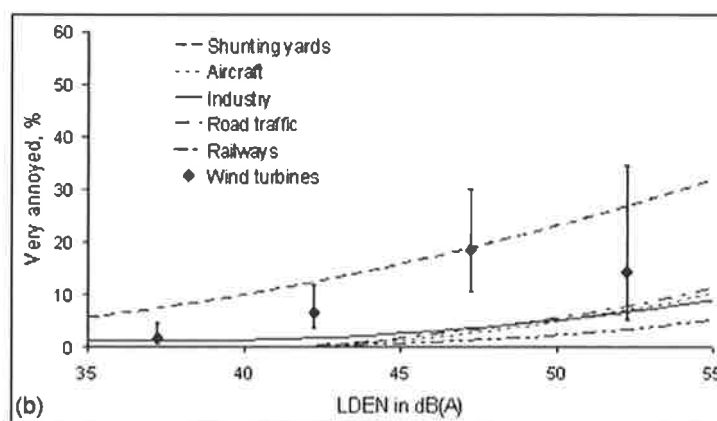
Calculating Lden values from LAeq (24hr)

A night-time level of 40 dB(A) is a measured level of 30 dB(A) plus a penalty of 10 dB.

- (a) a constant LAeq 'level' of 35 dB(A) over 24 hours is a Lden value of 41.4 dB(A).
- (b) a constant LAeq 'level' of 40 dB(A) over 24 hours is a Lden value of 46.4 dB(A).

The potential for annoyance is additional to the potential for sleep disturbance and is described in the paper 'Response to noise from modern wind farms in The Netherlands' by Pedersen et al.³

The levels of 41 and 46 Lden have an indicative 'very annoyed' rating of approximately 10-11% and 16-18% respectively, a significant effect that is more than minor.



³ Pedersen, E, van den Berg, F, Bakker, R, and Bouma J. 2009. Response to noise from modern wind farms in the Netherlands. J. Acoust. Soc. Am. 126 (2) August 2009. pp 634-643

Discussion

The noise criteria in the draft conditions proposed by Mighty River Power, the Board and NZS 6808-2010 are known anecdotally and by published research to cause noise annoyance, sleep disturbance and stress, as well as significant adverse health effects in susceptible individuals. The levels at your residence and Huatau marae will, hopefully, be less than this. The draft noise management conditions prepared by Mighty River Power and the acoustical consultants for Mighty River Power, Palmerston North City Council and the Board do not acknowledge the potential for unreasonable noise or adverse health effects and consequential mitigation of noise affecting sleep or health. The draft conditions of this advice do go some way to addressing