

IN THE MATTER of the Resource Management Act
1991

AND

IN THE MATTER of applications to the **WAIKATO
DISTRICT COUNCIL** and
WAIKATO REGIONAL COUNCIL
by **WEL NETWORKS LTD** for
resource consents to authorise the
establishment, operation and
maintenance of 28 wind turbines
for the generation of electricity and
associated activities on the
Wharaurua Plateau near Te Uku.

STATEMENT OF EVIDENCE OF DAVID RUSSELL BLACK

1. INTRODUCTION

Qualifications and experience

- 1.1 My name is David Russell Black. I am currently Senior Lecturer in the Department of Medicine of the Faculty of Medical and Health Sciences at the University of Auckland. I am also a founding director and currently the Principal Consultant of Enviromedix, an academically based New Zealand Institute of Occupational and Environmental Medicine.
- 1.2 My qualifications are BHB and MBChB from the University of Auckland, which qualifies me as a medical practitioner. I am a Fellow of the Australasian Faculty of Occupational and Environmental Medicine of the Royal Australasian College of Physicians which qualifies me as a Specialist Physician, currently vocationally registered in Occupational Medicine in New Zealand (FAFOEM). I am also a Member of the Australasian Radiation Protection Society (MARPS) and am a Member of the Royal Society of New Zealand (MRSNZ).
- 1.3 I have been working as an academic at the University of Auckland since 1990. Prior to this I was at the University of Otago from 1986. Between 1989 and 1997 I was employed by Air New Zealand Ltd, firstly as their Regional Medical Officer (Northern) and finally as Chief Medical Officer. I remain an active, fully registered specialist medical practitioner in good standing with the New Zealand Medical Council and am recognised by both my

colleagues and the Environment Courts of New Zealand and Australia as an expert in Occupational and Environmental Medicine.

Involvement in project

- 1.4 I have considerable experience in the electricity generation, distribution and supply industry but have not previously worked on a wind generation project. I have two decades of experience in applying the evidence based principles of public health protection to the interface between health and technology, including work in standards setting in New Zealand, Australia and the USA. My work has always specialised in clinical medicine and the physical environment. in which I have extensive practice and teaching experience.
- 1.5 At the initial phase of design of the WEL Wind Park, *Te Hauhiko O Wharauoa*, I was consulted by WEL and asked to provide an assessment of potential health effects which could arise from this proposal. I was given a wide brief and provided with detailed information about the proposal.
- 1.6 I made several visits to the area in August, September and October 2005. During those visits, I inspected the specific site proposed for the turbines and associated transmission lines and familiarised myself with the physical characteristics of the environment and the nature of the surrounding communities and sites. I also considered any conceivable, even theoretical influence of the proposed wind park on the surrounding area, which might result in any issues affecting the health and wellbeing of people living or working in the area.
- 1.7 Following my assessment, I provided a report to WEL which outlined the matters I had observed and my conclusions.
- 1.8 I subsequently attended a public open day at Te Uku on 27 November 2006. At that meeting, I provided a brief fact sheet which addressed electrical effects, noise effects and shadow flicker. I also had a number of constructive conversations with local residents about their interests and concerns about the proposal.
- 1.9 In addition, I have reviewed the applications to Waikato District Council and Environment Waikato, the assessment of environmental effects and relevant submissions.

Purpose and scope of evidence

- 1.10 The purpose of my evidence is to summarise my conclusions from the perspective of a medical officer with public health responsibility for the community. I will also address some important issues relating to Occupational Health and Safety which will need to be

considered in the construction phase although they may be outside of the scope of resource consent.

1.11 In that regard, this evidence will address the following:

- (a) Provide an overview of health related concerns commonly raised in relation to wind farms (Section 3);
- (b) Put my evidence into context by providing and describing the geographical environment and providing some background to the operation of wind turbines (Section 4);
- (c) Outline the key issues relevant to the consideration of public health effects (Section 5);
- (d) Address occupational health issues (Section 6).
- (e) Address the issues raised in specific submissions (Section 7);
- (f) Comment on the proposed conditions (Section 8).
- (g) Conclusions and recommendations (Section 9)

1.12 Section 2 contains an overview summary of my evidence.

Expert Witness Code of Conduct

1.13 I have been provided with a copy of the Code of Conduct for Expert Witnesses contained in the Environment Court's Consolidated Practice Note 2006 [2006] NZRMA 357. I have read and agree to comply with that Code. This evidence is within my area of expertise, except where I state that I am relying upon the specified evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

2. SUMMARY OF EVIDENCE

2.1 My evidence addresses the possible health and safety concerns surrounding the construction and operation of wind driven turbines at a site near Te Uku.

2.2 I will discuss issues surrounding both visual effects (such as flicker, glare and blade glint) and auditory effects (such as noise disturbance and subsonic noise). I will then provide evidence that these effects will have no impact on public health and are well within safe and acceptable levels.

- 2.3 The issue of air quality will also be discussed, and I will show that the quality of air will be unaffected by the presence of wind turbines.
- 2.4 I will also address concerns about electromagnetic and electrical safety, and show that there will be no undue danger to the public from the proposed wind park.
- 2.5 Finally, I will describe and answer areas of concern raised by the public such as vibro-acoustic disease, subsonic noise and “Wind Turbine Syndrome”. I will also discuss how fear generated through misunderstanding and misinterpretation by the public can lead to anxiety and distress, affecting public health and wellbeing.
- 2.6 Aside from this potential issue, the conclusion of my evidence is that the proposed wind park will have no identifiable adverse effects on public health or wellbeing.

3. HEALTH RELATED CONCERNS COMMONLY RAISED IN RELATION TO WIND FARMS

- 3.1 Health related concerns commonly raised in relation to wind farms often relate to visual impacts, noise and vibration, electromagnetic fields as well as the potential for disruption to the natural environment during construction and operation. The submissions that raised these issues in relation to this proposal will be addressed presently.
- 3.2 Visual concerns relating to the impact on the landscape are outside my expertise and will be dealt with by others. However other visual-related concerns include flicker, glare and blade glint. I have researched these matters in some detail and address them below.
- 3.3 The other main area of general concern related to my evidence is that related to noise and vibration, including subsonic energy (sound waves below the frequency of audible sound). With regard to low frequency noise and vibration, I rely on the evidence of Mr Hegley in quantifying the magnitude of this energy and offer the results of my own research on these issues.
- 3.4 At the outset, it is my conclusion that, although all of these are reasonable issues to raise, none of them have characteristics or are of a magnitude which will have any significant impact on the local community. My rationales for these conclusions are detailed below.

4. CONTEXT

- 4.1 In this section, I will address key elements of the proposal, and aspects of the local environment and the technology to be used which are relevant to my later analysis in relation to health and safety issues.

Key elements of the proposal

- 4.2 The proposal is to construct 28 wind driven electricity generating turbines mounted on supporting columns on a naturally elevated ridge south of Te Uku. The location provides relative isolation from any densely populated area and an open aspect to the prevailing winds from the west and south west. Electricity generated from this facility will be carried away to the north by overhead transmission lines for which separate resource consent will be sought. The details of the proposal have been covered by Mr Burchett.

Geographical environment

- 4.3 Te Uku is situated in a relatively sparsely populated area due south of the eastern reaches of the Raglan Harbour. The site has been selected for its exposure to the prevailing winds, which are generally from the west. The wind park will be positioned on a ridge running off to a north-western catchment to the Raglan Harbour and to the northeast of the Waipa River.
- 4.4 The nearest settlement to the proposed wind park is that of Te Uku, which is located 3.5 kilometres to the north of the wind park site. The nearest town to the wind park is Raglan, which is 12 kilometres to the northwest of the site. The nearest city is Hamilton, which is 30 kilometres to the east of the site.

Wind generation technology

- 4.5 The principle of wind generation is to convert the kinetic energy caused by atmospheric gases moving to equalise pressure as well as the earth's rotation against the inertia of the atmosphere to electrical energy. This is done by the use of a "turbine" which consists of an alternator driven by three blades. The turbine units use computer controlled orientation to face into the wind and for pitch setting of the blades. The turbines are run synchronously with each other at the frequency of the national grid (50 Hz).
- 4.6 The turbine heads are mounted atop robust columns equipped with internal access and are connected to each other in parallel chains providing the energy to a substation. The turbines generate at a voltage of 660V which is stepped up for efficient despatch to users by conventional transmission lines.
- 4.7 When turbines are withdrawn from use, for maintenance or other reasons, they are generally turned parallel to the wind. When they are started, they are run up to speed before connection to ensure synchronisation with minimum effect on the quality of generated electricity.

Interaction and effects of wind turbines on the immediate environment

- 4.8 When a turbine is operating, the moving air of wind is intercepted by the turbine blades. As the air approaches, it is generally flowing in a relatively laminar (smooth layered) fashion and the flow is split around the blade. The setting of the pitch of the blade varies the angle of attack.
- 4.9 The difference in airflow paths causes differential pressures on either side which imparts a force on the blade normal to the direction of air flow thus rotating the turbine. Past the blade, the flow of air becomes laminar again, although there will inevitably be some turbulence around the trailing, and to a lesser extent the leading edges of the blade. This turbulence creates some friction which vibrates the air across a broad spectrum of low frequencies and may be audible as noise carried downstream from the turbine. As each blade passes the supporting tower, the turbulent airflow will encounter the structure which will also result in scattered turbulent flow which will generate noise to some degree. (Bowman 2000).
- 4.10 Thus there are two wind related sounds from a wind turbine. Firstly, the continuous sound of turbulent air and, secondly, the sound of distorted air passing the column.
- 4.11 The whole turbine is a rotating machine, running on bearings. In general, such machines have the potential to generate noise from the bearings as well as noise of electrical origin from the windings and magnetic material used in the armature and stators. However, such noise is practically eliminated in later models.
- 4.12 Thus, there are a number of potential sources of noise in a wind driven generator. All of these can be mitigated to a greater or lesser extent and considerable research and development has been undertaken in minimising unwanted effects in wind generator turbines.
- 4.13 There is nothing added to or taken from the air passing over a turbine generator. The electrical elements are totally enclosed, there is no opportunity for ionisation of air or electrical discharge such as corona. The mass of air approaching the turbine is identical to the mass leaving it, however, the pressure immediately downstream of the turbine must be reduced compared with the surrounding air since the energy which maintains the force of travel of the moving mass of air has been reduced.
- 4.14 From first principles, it would be expected that this effect will be greatest immediately behind the turbine and that the surrounding air will move to equalise the pressure and density of the moving mass. This effect can be accurately mathematically modelled for various wind speeds and atmospheric pressures. Any residually detectable effects exist

under conditions of wind from the south westerly aspect (prevailing) for a maximum distance of several kilometres.

- 4.15 The air quality behind the turbines is identical to that approaching them, the only changes being pressure and turbulence. At distances greater than hundreds of metres away, the only detectable effect might be some degree of perceptible sound as outlined by Mr Hegley.
- 4.16 The turbine output is locked to the frequency of the national grid and thus is constant and synchronous between all generators in a wind park. Although the speed of the generator and thus the hub of the blades is relatively slow (9-20 rpm) the length of the blades is 45 metres and thus the angle of velocity of the tips is relatively fast, generally of the order of 30 metres per second. However, from any viewing distance, including immediately adjacent to the structure, all parts of the turbine are seen by the naked eye as a resolvable moving object, they are not perceived as a blur or flicker.
- 4.17 Electrical energy generated by a turbine is transmitted down conductors inside the tower and underground by buried cables. All time varying electric currents are surrounded by associated electric and magnetic fields. The steel structure of the tower is electrically conductive as is the ground. Together, these would be expected to form an effective shield for electric fields. Consequentially, electric fields are unlikely to be encountered in the space around wind generators or their associated underground cables. Magnetic fields, however, are not screened by conductors and therefore will be detectable adjacent to both the generating towers and above the conductors.
- 4.18 Human exposure to magnetic fields is a topic which has been extensively researched and is covered by up-to-date scientific evidence based standards such as the guideline of the International Commission On Non Ionising Radiation Protection (ICNIRP) (ICNIRP 1998) and the International Committee on Electro Magnetic Safety (ICES) (IEEE 2005). The approach in both of these documents is similar. New Zealand, on the advice of the Ministry of Health, adopts the ICNIRP Guideline, which provides a threshold for general public exposure of 100 microtesla (μT) magnetic flux density. This level should not be exceeded in any area to which the public has reasonable access.

5. ISSUES RELEVANT TO PUBLIC HEALTH CONSIDERATIONS

- 5.1 This section of my evidence addresses issues relevant to public health considerations, namely:
- (a) Air quality;
 - (b) Water quality;

- (c) Visual effects
- (d) Auditory effects;
- (e) Electromagnetic effects; and
- (f) Electrical safety.

Air quality

5.2 As described, the laminar flow of wind is interrupted and disturbed by the presence and operation of the turbines, however, the flow reassembles downstream and within a relatively short distance (less than a kilometre) from the turbine any change in air pressure or flow is insignificant. There is no change in the gaseous mixtures of air and no added contaminants to air from the turbines or other aspects of the WEL Wind Park. All electrical equipment is enclosed, so there is no ionisation of air anywhere in the generation facility.

Water quality

5.3 During the construction phase, there will be human activity and earthmoving in areas previously undisturbed apart from farming activity. This does have the potential to cause transient changes in water quality, which need to be controlled. The relevant waterways have been identified by reference to maps and aerial photographs (provided by Mr Mansergh) and site inspection from the roads around the downstream aspects of the site. The waterways I have identified are as follows:

- (a) The Pakihi Stream
- (b) The Pakoka River.
- (c) The Mangakino Stream

5.4 I have conducted a search of the Ministry of Health's Drinking Water Quality Database, which shows that no public supply is dependent on these watercourses. Nevertheless, although none have been specifically identified, there may be farms relying on water from these waterways, downstream from the project and so existing water quality needs to be protected particularly during the construction phase. It is understood that measures to ensure water quality are proposed and that these are required by the recommended resource consent conditions which WEL accepts.

Visual effects

- 5.5 The turbines will become a noticeable aspect of the landscape on the skyline from some viewpoints. Matters related to visual effects, etc. are covered by Mr Mansergh and Mr Evans.
- 5.6 However, there is some concern amongst submitters that the rotating blades may cause “flicker” and that there is a known causal relationship between flicker and epilepsy.
- 5.7 Flicker shadows have been observed close to wind turbines and the potential for these is discussed in a specially commissioned study for this project (Hydro Tasmania Consulting, “Te Uku Wind Farm – Shadow Flicker Assessment” (September 2006).
- 5.8 Visual flicker is an accepted cause of epilepsy, particularly in children and there have been some well documented cases of this occurring, for example, as a result of particular characteristics of electronic games and television programmes (Fylan, Harding et al. 1999). The characteristics of this effect are well described in the scientific literature with regard to the area of visual field which must be affected and in turn the neurophysical amplitude of the flicker signal as well as frequency and colour characteristics of the flicker (Wilkins, Emmett et al. 2005).
- 5.9 In essence, epilepsy can be precipitated in a few susceptible individuals when the light falling on a substantial part of their vision, at least a quarter of the visual field, is interrupted in a regular pulsating fashion at a particular rate. The effect is also greater at certain colours, generally red.
- 5.10 None of these characteristics are present in viewing the WEL Wind Park from any angle and the possibility of epileptogenic flicker effect can be confidently excluded. There is the potential for a flickering effect if the light is behind the turbines (unlikely at Te Uku since the Wind Park is invariably viewed from the north) but the since the velocity of the blades varies along the length there is never a clear pulse effect. Furthermore, the contrast of the flicker image is low and diffuse as the turbine blades are illuminated by skylight. There is no source of intense red light energy analogous to that associated with epilepsy. Finally, and most importantly at the viewing distances from the community the turbine blades occupy only a small part of the viewers visual field.

Auditory effects

- 5.11 Any noise from the WEL Wind Park would result largely from air movement over the turbine blades. There is generally insignificant noise from the modern turbines and generators which will be used (Pedersen and Waye 2004).

- 5.12 Noise from the airflow effects have been calculated by Mr Hegley and are of a magnitude which are insignificant from a public health point of view in all places other than the immediate property on which the turbines are located. Mr Hegley's calculations show that noise levels at residential properties will not be more than 35 dB, which is below the background noise generally encountered in a rural living environment. In my view, those noise levels are entirely acceptable for a residential area. For example, these levels are much less than the sound of the wind in the trees and would not be noticed by most people.
- 5.13 Mr Hegley has calculated that the only noticeable sound of a wind generator, which is the swishing as the air passes over the blades will hardly be noticed beyond 400 metres downwind of the turbines and there will be no audible machine noise. Thus, the auditory effects of this proposed WEL Wind Park will be negligible and imperceptible. Mr Hegley's report provides more details.

Vibro-acoustic disease

- 5.14 Vibro-acoustic disease (VAD) has been raised as a concern. VAD is a multi-systemic entity caused by occupational or chronic exposure to large pressure amplitude low frequency (LPALF) noise (greater than 90 dB SPL at frequencies under 500 Hz). The clinical picture described for this controversial disorder involves extra-auditory pathology, such as neurological disturbances, respiratory disorders and cardiovascular problems.
- 5.15 VAD has also been observed in some workers in industrial settings at levels of pressure literally millions of times higher than those predicted by Mr Hegley and expected at Te Uku. I am aware that VAD has been raised in the context of wind turbines but only in the immediate proximity of the machines and even then a cause and effect relationship has never been established. At the separation distances applying at Te Uku, VAD is not an issue which should cause any concern (Branco and Alves-Pereira 2004).
- 5.16 Vibration through the ground requires a source of high energy pulses which do not and could not arise from wind turbines under any conditions other than a fault which would require immediate shut down and rectification. The extent to which vibration in air could be generated is very minor and of no consequence.

Electromagnetic effects

- 5.17 Conductors between the turbines and from the WEL Wind Park substation to Te Uku (WEL substation) and Te Kowhai (WEL/Transpower substation) will have associated electric and magnetic fields. These will be of a magnitude typically found around 110 kV power distribution lines and will be maintained to generally comply with the public exposure reference levels in the ICNIRP guideline (ICNIRP 1998). Compliance with

these guidelines is designed to eliminate any adverse biological or health effect. Specifically, around the area of the wind park, which has controlled access levels, electromagnetic field strength levels should not exceed the ICNIRP occupational reference levels. The table below gives ICNIRP limiting values for electric (*E*) and magnetic (*B*) fields for exposure to workers with appropriate skills and training.

Occupational Levels at 50 Hz (ICNIRP)		
<i>E</i> -field strength (V m ⁻¹)	<i>H</i> -field strength (A m ⁻¹)	<i>B</i> -field (μT)
500/0.05 = 10,000 Vm ⁻¹	20/0.05 = 400 Am ⁻¹	25/0.05 = 1000 μT

- 5.18 Outside of this area, in locations that the public may reasonably access, levels should comply with the general public levels in the ICNIRP guideline.

Public Levels at 50 Hz (ICNIRP)		
<i>E</i> -field strength (V m ⁻¹)	<i>H</i> -field strength (A m ⁻¹)	<i>B</i> -field (μT)
250/0.05 = 5000 V m ⁻¹	4/0.05 = 80 A m ⁻¹	5/0.05 = 100 μT

Electrical safety

- 5.19 Electrical conductors around the WEL Wind Park are all insulated and buried. The substation is totally enclosed and security restricted. There is therefore no risk to lawful public activity from any conductor. Past the substation, un-insulated (bare conductor) overhead lines may be used. These will comply with the New Zealand Electrical Code of Practice for Electrical Safe Distances which provides a high level of safety equivalent to that found in other electrical facilities in New Zealand.

6. OCCUPATIONAL HEALTH ISSUES

6.1 In this section, I will address specific issues which, in the course of investigating this matter, have become apparent as matters requiring attention during the building and operation of the project.

Construction phase

6.2 In the construction phase many of the required activities will be technically challenging and require highly specialised techniques with associated safety procedures which are outside the scope of this report.

6.3 Construction will be undertaken in an area immediately adjacent to the large microwave relay station which is co-located on the site. The continued operation of this requires attention to radiofrequency safety and in this regard for both construction and ongoing operation and maintenance minimum safe distances from each radiating antenna, particularly parabolic dish antennas must be established and documented. All such operations and estimates should comply with the approach recommended in the New Zealand Standard for Radiofrequency Safety NZS 2772.1 (Standards New Zealand 1999). The maximum permissible exposure levels of microwave radiofrequency energy RF to which workers on this site should ever be exposed must be limited to;

Occupational Levels from NZS 2772.1: 1999	
Frequency (GHz)	Max level (W/m²)
400 MHz – 2 GHz	$f/40$ *
> 2 GHz	50

(Extract from Table 6 in NZS 2772)

* f = frequency in MHz

6.4 I note the condition recommended with respect to radiofrequency hazards and consider that this is adequate to ensure that any hazard is adequately dealt with. Ultimately none of the turbines are planned to be located in the microwave paths from the telecommunications tower so the presence of the turbines should not degrade the performance of the existing facility.

6.5 Public exposure levels to RF is not a matter for WEL at this stage and in the future will remain the responsibility of the transmission station operator(s) and the land owner.

Operational Phase

6.6 In the operational phase, continued care needs to be taken about RF safety. The origin of this RF energy is solely from the existing microwave facilities, as discussed above.

7. ISSUES RAISED BY SUBMISSIONS

7.1 I have reviewed all of the submissions from the public made with regard to this project, taking particular notice of concerns about health effects including concerns people have about their wellbeing in the presence of sensory signals or reminders of the presence of the wind park arriving as noise, visual images or perceived changes in air.

Noise

7.2 By far the most common concerns are about noise. Mr Hegley has dealt with the absolute magnitude of noise to be expected from the turbines in operation and I have previously described in my evidence the origins of these sounds. Many people have also mentioned concerns about subsonic or infrasonic vibration which, in this context, could only be very low frequency sound conveyed as vibration in air on the basis that it is not plausible that vibration through the ground, even if there was any, could reach populated area from the remote and elevated position proposed for the Te Uku Wind park. Any significant vibration requires a source of high energy pulses which do not and could not arise from wind turbines under any conditions other than a fault which would require immediate shut down and rectification. It is intrinsic to the design and operation of the machines that they run smoothly against the continuous and even or gently varying load presented by the generating equipment.

Vibro-acoustic disease

7.3 A number of submitters have referred to vibro-acoustic disease (VAD) which I have described in my evidence at 5.14-5.16 above.

7.4 It is certain that the levels of noise energy which could reach any living or working area from the turbines would be many orders of magnitude (that is to say tens to thousands of times) lower than levels which have been speculated as potentially causing this distress. True vibro-acoustic disease requires enormous levels of energy, more than would ever be experienced from a wind turbine.

7.5 However, the concerns which I have seen in the literature are of people who become distressed at noise or sensation which triggers their awareness of the presence of the facility and escalating concern about harm. That can arise where there are misconceptions about effects in the first place, anxiety builds and a cue to the presence of a facility becomes sufficient to trigger anxiety and distress. Such a condition can verge on

a diagnosable phobia in psychiatric terms. Such conditions are much better to avoid than end up having to treat. It is, therefore, important for the community at large to recognise that the sound levels from the Te Uku wind park will be detectable but in the context of other sources of noise in the rural environment will be a much less than minor contributor which are readily accommodated by most people.

Visual issues

- 7.6 Similarly, any untoward visual intrusion from the turbines should also be minimised as far as practicable by avoiding the production of visual stimuli such as pulsed glare which might arise from a rotating reflective surface. Phenomena such as “blade glint” come into this category and although not in themselves in any way harmful or intrusive may become an irritation which might hinder the otherwise inevitable process of the wind park becoming a non- intrusive and accepted feature of the landscape. This is also assisted by avoiding undue disturbance to residents in the first place and then minimising the impact of the park when it is operational. These are matters of landscape design and communication both of which have been given adequate attention in planning.

Cox submission

- 7.7 Section 8 of the submission by Mr Sean Barrington Cox entitled “Subsonic noise and dishonesty”, seeks an assurance that the turbines will be stopped should air pressure levels drop below 15Hz. Mr Cox says “*subsonic sound pollution is the most recently discovered and possibly the worst of all the bad environmental effects of giant wind turbines*”. However, my literature review has found no significant health effects due to subsonic noise from wind turbines documented in the medical literature.
- 7.8 Mr Cox discusses the well recognised and justified feelings of “*unease and fear*” experienced by people in Europe during World War II when they could detect the subsonic beat frequencies of approaching aircraft. The anxiety experienced by these communities is understandable in anticipation of inevitable bombings causing injury, death and destruction. The subsonic noise itself was only a signal of what was to come.
- 7.9 In section 9 entitled “Health”, Mr Cox describes “*significant rises in health problems in the areas around large wind turbine arrays*.” More specifically, Mr Cox describes depression and asthma but does not reference these statements with any scientific literature. He suggests that these health problems may be the result of “*subsonic pollution*.”
- 7.10 I conducted a thorough review of the medical literature using the “Medline” database for low frequency sound and mental disorders. No relevant articles were identified. Similarly, a Medline search of low frequency sound and asthma was undertaken and again no relevant articles were found.

Van der Voorden submission

- 7.11 Ms Nora Van der Voorden's submission discusses health effects on page 11. In the section entitled "Health Effects", Ms Van der Voorden implies that the World Health Organisation supports the hypothesis that wind parks may cause adverse health effects. This misunderstands the WHO's position. The WHO simply recommends a level of community noise (as discussed in Dr Pierpont's article). I agree that compliance with these WHO guidelines for community noise should be achieved and Mr Hegley's research suggests that these levels will not be exceeded.
- 7.12 Ms Van de Voorden's submission also contains the testimony before the New York State Legislature Energy Committee of Dr Nina Pierpont, a specialist paediatrician. In this Dr Pierpont puts forward the hypothesis of Wind Turbine Syndrome (WTS) Dr Pierpont refers to several doctors studying this area but does not provide any names or references. I cannot confirm the existence or even tentative acceptance of such a syndrome in the medical literature.
- 7.13 Having read all of the submissions about carefully, it is my opinion that there are no issues raised which are not adequately dealt with by optimisation of design and implementation to current best practice. I respect the specific concerns which have been raised but have explained that none of them can be sustained as real potential effects. In particular, vibration through the ground will not occur because the energy for it is not generated at the source, vibration through the air or subsonic noise will be miniscule and probably undetectable in communities. Flicker is very unlikely to be observable from the realistic distances of view, particularly having regard to the geometry of the position of the light path from the sun to the inhabited areas around Te Uku.

8. PROPOSED CONDITIONS

- 8.1 In my opinion the proposed conditions as amended by the applicant cover all of the issues I have identified. There is a requirement for a detailed environmental management plan at section 3.0 which covers groundwater (3.2e), the Pakoka River (3.2h) (6e) and worker safety at (3.2k.iii) and 9.2 with respect to the existing microwave radio transmitters near the site. Noise during both construction and operation is covered in Section 5. There are prescribed mechanisms for notification of residual concerns at 11.1 and 11.2.

9. **CONCLUSIONS AND RECOMENDATIONS**

9.1 In my opinion this proposal to build a Wind Park near Te Uku will not have more than minor effects on the living environment around it. Once construction is finished and the wind park is operating I cannot identify any actual or potential adverse effect on public health or wellbeing unless misunderstanding or misinformation caused unjustified fear or concern and sensitises individuals to the ongoing presence of the wind park.

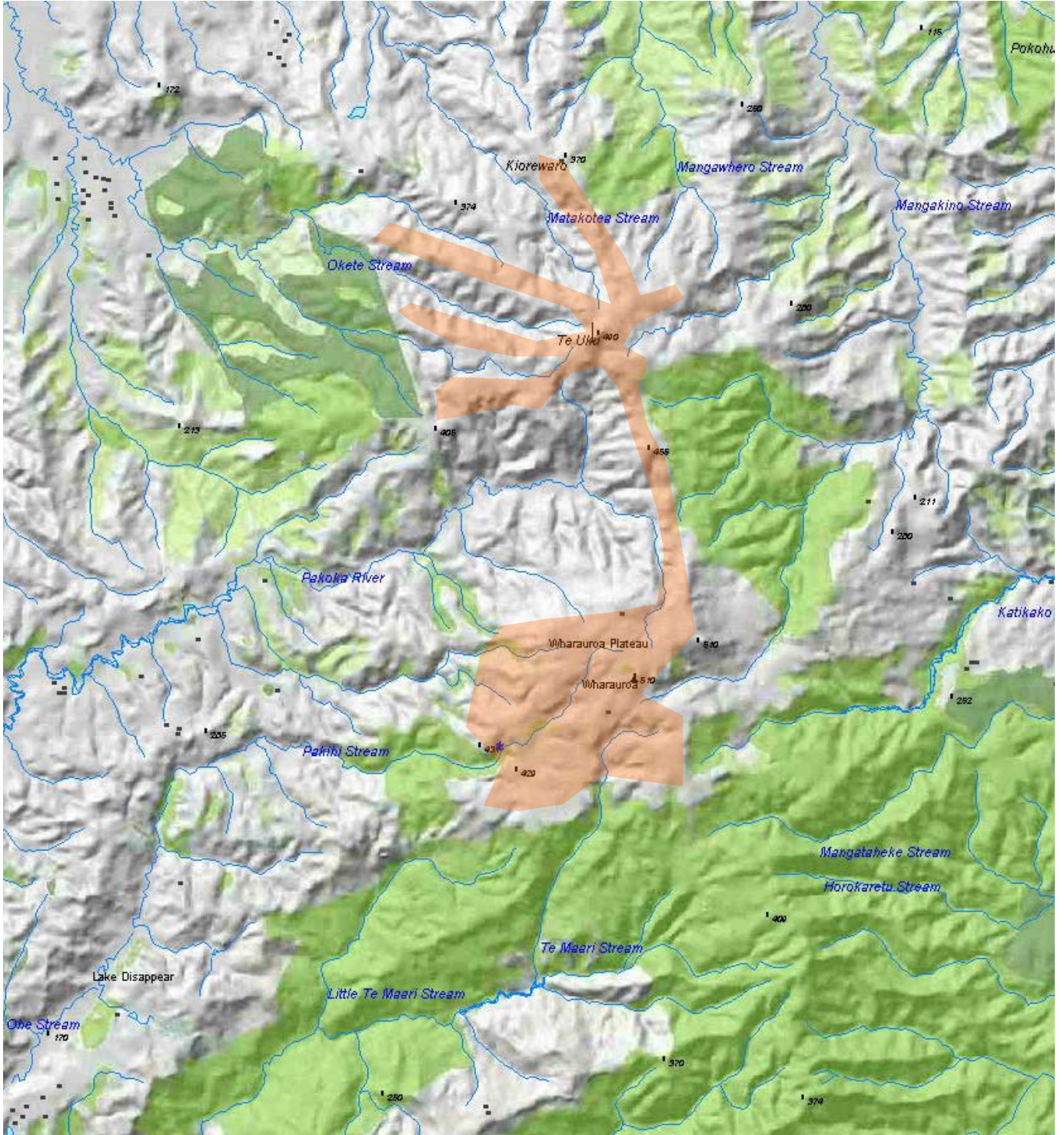
9.2 I therefore support this proposal for wind generation at Te Uku. However, as these and similar new technologies are implemented provision of full and accurate information to communities is very important and I recommend that the priority given to communications by WEL so far is continued.

David Russell Black

November 2007

Appendix A

Map Showing Waterways



Appendix B

References

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