

**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 STEPHEN JOHN REID**

### **1. INTRODUCTION**

#### **Qualifications and experience**

- 1.1 My name is Dr. Stephen John Reid. I have recently retired from the National Institute of Water and Atmospheric Research (NIWA), where I held the position of research scientist for the past 16 years.
- 1.2 I obtained a BSc degree in physics from Victoria University, Wellington, New Zealand in 1964 and subsequently obtained a PhD degree in Meteorology at Imperial College in London (1970). I joined the New Zealand Meteorological Service in 1970 and represented them on the Wind Energy Task Force from the late 1970's until the Task Force was wound up in the mid 1980's. In the late 1980's I was selected by ECNZ as lead consultant on a project to survey New Zealand's wind resources. After joining NIWA in 1992, I led two Foundation for Research Science and Technology programs: Turbulence and Wind Energy (1994-1998) and a further wind energy program (Resource assessment for New Zealand wind farms, 1998-2002).

#### **Purpose and scope of evidence**

- 1.3 I have had no involvement in the Te Uku project but have been asked to address two specific questions related to general wind climate and meteorology raised by Mr Cox, which falls within my field of my expertise.

- 1.4 In that regard, Mr Cox referred to NIWA wind data in saying that there is nowhere in New Zealand where wind speeds of 9m/s would be found and that there is nowhere north of New Plymouth that would have wind speeds above 7 m/s. I disagree for reasons I will set out below.
- 1.5 Mr Cox also made comments about local weather effects which I do not agree with.
- 1.6 In that regard, my evidence will address the following:
- (a) Meteorological monitoring undertaken in the Waikato Region by NIWA (Section 3);
  - (b) Expectations relating to the wind resource at the Te Uku site based on our knowledge of the wind climate in the area (Section 4); and
  - (c) The likelihood of local weather effects caused by wind turbines (Section 5).
- 1.7 A summary of my evidence is contained at section 2.

#### **Expert Witness Code of Conduct**

- 1.8 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 MY EVIDENCE**

- 2.1 NIWA has prepared a wind map which shows mean wind speeds throughout New Zealand. The wind map has some limitations in that it is primarily based on a few hundred wind data points that are mainly near populated centres. It also represents wind speed relatively close to ground level (at 10 m) and it does not take into account speed up over hills and channelling in valleys. For these reasons, its use for determining wind resource for the purposes of a wind farm is indicative rather than definitive.
- 2.2 I have considered the likely wind resource at the Te Uku site and would not be surprised to see a mean speed between 8 and 9 m/s at 80 m above ground.
- 2.3 From my experience, I consider it unlikely that wind turbines could produce significant condensation in air passing through them and therefore result in any significant changes in local weather patterns.

### 3. **METEOROLOGICAL MONITORING UNDERTAKEN BY NIWA**

3.1 In this section of my evidence, I will summarise the availability of wind data in New Zealand and the basis for the wind resource map prepared from that data by NIWA.

3.2 NIWA hosts the national climate data base that contains public meteorological data acquired by the Meteorological Service of New Zealand, NIWA and other parties. It contains wind data for several hundred sites around New Zealand. Despite the large size of the data base, there is insufficient information to map the winds over the whole country because of the variability of wind caused by the complex terrain.

3.3 Because of the intense interest in wind resource over the whole of New Zealand, NIWA prepared a map of mean wind speed (see **Appendix A**). In the first stages of preparing the map, winds were generated on a 500 x 500 m grid by a spline interpolation (a continuous mathematical function) based on available mean wind speed data. To add further information, the spatial variation of mean daily temperature range (strongly related to mean speed) was combined with the pattern of mean speeds. This last map was based on elevation data as well as temperature data. Lastly, in some areas where the distribution of climate stations was insufficient to properly depict the local wind speed pattern, the data are adjusted towards the pattern present in nearby topologically-similar areas with better data density.

3.4 The map in Appendix A is limited to a fairly coarse resolution because there is no calculation of speed up effects over hills or channelling in valleys. There is a weighting procedure applied to the data that gives different stations areas of influence. Where stations are close together, the map shows quite a lot of detail, but where they are far apart, the detail is sparse. The wind stations near Te Uku are mostly located in the Waikato basin where wind speeds are low. However, speeds are shown to be higher nearer to the coast west of Hamilton and in the hill country where Te Uku lies.

3.5 For these reasons, the NIWA wind map might be a useful first step in identifying potential wind farm sites, but it cannot and should not be regarded as an accurate measurement of wind resource for that purpose.

### 4. **EXPECTATIONS OF WIND RESOURCE AT TE UKU SITE**

4.1 In this section of my evidence, I will summarise what the available wind data and the nature of the terrain indicates about wind resource at Te Uku.

4.2 The nearest wind station to Te Uku is about 20 km away at Hamilton Airport. The mean speed over a period of recent years is close to 3 m/s at 10 m above ground.

- 4.3 The hill country west of Hamilton is clearly windier and at Port Taharoa about 60 km southwest of Hamilton Airport the mean speed at 10 m above ground is about 4.5 m/s. Mean speeds over the open sea are around 8 m/s, however, these are modified near to the coast.
- 4.4 Te Uku lies on the northern flank of Mt Pirongia, and wind flows are almost certainly affected by the mountain and almost certainly increased above what they would be were the mountain not there. A height above ground of 80 m also increases wind speed above the speed at the 10 m level. Hence, I would not be surprised to see average wind speeds between 8 and 9 m/s at 80 m above ground at Te Uku.

## 5. LOCAL WEATHER EFFECTS

- 5.1 Mr Cox has raised the question of local effects on weather caused by turbines. In particular he has suggested that the turbulent wake behind wind turbines could produce condensation that could have a significant environmental effect, i.e. cause a significant change in local weather patterns.
- 5.2 It is true that wind turbines have turbulent rotating wakes, but I have never seen condensation occurring in them, nor am I aware of any other experience that such an effect occurs.
- 5.3 My only experience of condensation occurring in similar circumstances is seeing condensation sometimes instantaneously occurring over the above-wing area of a jet aircraft when near the ground in very humid conditions. The condensation does not persist, however, a narrow band coming off the outer end of the flaps sometimes lasts for a few hundred metres behind the aircraft.
- 5.4 The considerable weight of a jet aircraft and the high power driving it through the air means that it is not a good analogue for a wind turbine. However, despite large numbers of aircraft movements I would not consider that the condensation effects described in 5.4 were in any way significant for local climate.
- 5.5 From my knowledge and experience of the weather and with wind turbines. I doubt that wind turbines could have any significant effect in terms of condensation over the blades or in the wake and therefore do not consider that a wind farm could have a significant impact on local weather patterns.

## Appendix A – NIWA Wind Resource Map

