EXECUTIVE SUMMARY

Greater Wellington Regional Council is interested in establishing the wind resource in the Wellington region, particularly on Mt Clime, to the west of Upper Hutt in Wellington, New Zealand. Wind monitoring equipment was installed at the top of the BCL (Broadcast Communications Limited) communications tower on Mt Climie via a mounting boom. Two anemometers and two wind vanes were installed - one set facing east and the other facing west.
The net energy production of a generic wind turbine model based on Vestas-V47 47m-rotor 0.66 MW wind turbines, was established at the monitoring location. This report outlines the findings of PB Power's investigation regarding site wind data analysis from 25 August 2003 to 29 February 2004.

For this study, PB Power used six months of 10 minute averaged wind data from the 28 m communications tower installed at Mt Climie, on the proposed wind farm land and 29 years of 60 minute averaged wind data from an anemometer installed at 117 m meteorological site at Mt Kaukau. The monitoring locations are within 30 km of each other. The 28 m communications tower measures wind data and wind direction information at one height. The wind data recorded at Mt Kaukau at 117 m is termed the reference long-term wind data, and the 28 m Mt Kaukau monitoring tower wind data is the short-term site wind data.
The 28 m Mt Climie monitoring location, with its six months of data, takes into account only half a year of seasonal effect, but the cross-correlation analysis between the wind speed measured at 28 m AGL for the Mt Climie monitoring site and the 117m reference data site, takes into account the long-term seasonal patterns.

The cross correlated data gave a predicted average long-term wind speed at 28m of 13.3 m/s and a cross correlation coefficient of 77 %. The wind data was subsequently adjusted to the long-term average wind speed and extrapolated to a hub height of 50m, using a wind shear of 0.06. The main uncertainty in the long-term hub height wind speed is in the wind shear profile.

The following wind speeds were established at the monitoring tower locations:

- Average wind speed at the Mt Kaukau reference location ('75-'04) 12.45 m/s @ 117 mAGL
- Average 6-month wind 'speed at Mt Climie 28m unsheltered 13.89 mls @ 28 mAGL
- Average 6-month wind speed at Mt Climie 28m sheltered 12.04 m/s @ 28 mAGL
- Predicted average long-term wind speed at Mt Climie 13.27 m/s @ 28 mAGL

The predicted average long-term wind speed at a hub height of 50m for the Mt Climie monitoring location:

- Predicted site average long-term wind speed (wind shear=0.06) 13.74 m/s @ 50 mAGL

The IEC (15m/s) turbulence intensity at the unsheltered 28 m anemometer is 8.8% and the sheltered anemometer IEC (15m/s) turbulence intensity is 11.3%. Both are well within Category B for lower turbulence characteristics. Category A (IEC 61400-1:1999 Wind Turbine Generator Systems - Part 1: Safety Requirements) states that turbulence at 15 m/s is to be 18% or less and Category B 16% or less.

The Mt Kaukau reference site shows some seasonal effects with higher wind speeds recorded during the spring and summer months (September to January). There is a diurnal pattern to the wind speeds, with higher wind speeds during the day and early afternoon from 13:00 to 22:00.

The energy production of a single wind turbine at the Mt Climie monitoring location is calculated as:

Wind turbine at 50m hub height	Net GWh per year	Average losses	Capacity Factor
Vestas V47-66OkW	3.74	7%	64.6%

The loss factor accounts for electrical, blade contamination, other (icing etc), and non-availability losses – all estimated. The wind turbine capacity factor is based on the net production. Hysteresis losses have not been taken into account in the power curves.

The main areas of uncertainty for the resulting average annual energy predictions are: extrapolation to hub height and prediction of a long-term average wind speed for the site. The uncertainties in availability and anemometer calibration are relatively small.

Due to the very high average wind speed, the main issue for the viability of the site are the cost and availability of the few turbines models that would be suitable for the site.