Site Information

From the list of locations provided, which includes crown-owned sites, parks and hospitals, Omeru reserve was picked as a possible location to host a 10m tall wind turbine. This was chosen due to the multiple geographical features present at this site. This scenic reserve is located on the east side of the Kaipara Coast Highway between Kaukapakapa and the Makarau River (Waterfalls NZ, n.d.). The reserve has a few culturally significant and natural elements within it. This includes a Maori Pa, two natural waterfalls, particularly the Waitangi and the Omeru falls, and native bushes (Venture NZ, n.d.). The reserve also contains multiple walkways for travellers to traverse through the reserve and take in its natural beauty.

Wind resource availability

Wind data was obtained from the national climate database's CLIFLO service and the Global Wind Atlas (GWA) to study wind resource availability at Omeru reserve. A marker was placed at the centre of the Omeru reserve to obtain the data from the Global Wind Atlas, and average wind speed data within a 9km^2 area was taken. A note of the area's average roughness, 0.03, was also considered. The surface wind was selected as the dataset type for the national climate database. The closest weather station to the reserve, Warkworth Ews, was 21.7 km away. Data between 2012 and 2015 was used for this analysis.

Weibull distributions were generated from the two datasets and displayed the distribution of wind speeds at different sector angles. The mean wind speed ranged from 4.01 m/s at 180 degrees to 6.25 m/s at 0 degrees. It shows there is some significant variability in the wind speeds available at the site. All the Weibull distributions presented at different sector angles are right-skewed. This means there is a higher probability of lower wind speeds than high ones at the Omeru reserve.

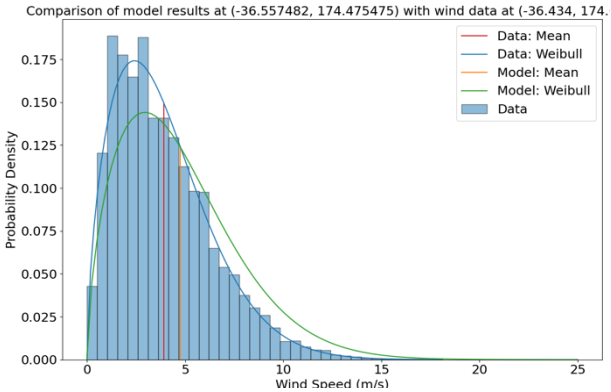

Figure 1 - comparing CLIFLO data with GWA results

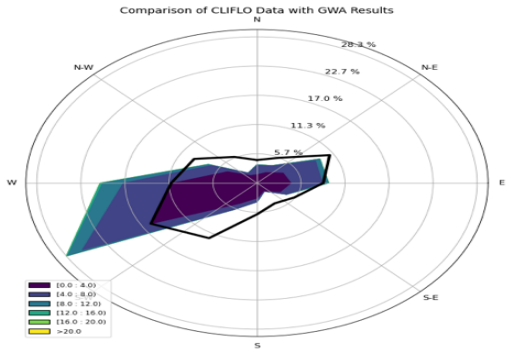

Figure 2 – comparing CLIFLO data with GWA results

A model was generated from the GWA climate data file and compared against the data from the weather station. From Figure 1, we can see that both the weather model and the data from the station follow a right-skewed Weibull distribution. It also seems that the model does a relatively good job of approximating the distribution of the data from the weather station. There are some discrepancies in the model, such as when it cannot match the data at higher probability densities and when the wind speeds are higher than 5 m/s. However, since the mean wind speed from the data, 4.4 m/s is relatively close to the mean speed depicted by the model, 4.8 m/s, the model provides a relatively good approximation of the data.

From Figure 2, we can determine that there is a higher probability of wind coming from the southwest direction. Approximately 16% of the wind with speeds between 0 m/s and 4 m/s arrive from the southwest direction, while about 4% come from the northeast. Similarly, approximately 7% of the wind, with average speeds between 4 m/s and 8 m/s arrives from the southwest, while 4% comes from the northeast. Approximately 2% of winds with average speeds between 8 m/s and 12 m/s come from the southwest, while 1% comes from the northeast.

Figure 2 also shows a clearer picture of the GWA model's approximation of the CLIFLO data. The model seems to approximate quite well for wind coming from the northeast direction and wind with speeds between 0 m/s and 4 m/s from the southwest direction. However, wind with speeds greater than 4m/s is not at all able to be predicted by the model.

One reason as to why this occurs could possibly have to do with the model overfitting to the CLIFLO wind data from the southwest region with speeds between 0 m/s and 4 m/s. The overfitting would have occurred due to a large proportion of the CLIFLO wind data having those specific speeds. To further improve the fitting of the model, we could manually remove some of the data or introduce methods to weigh and balance the speeds within the CLIFLO wind dataset.

Another reason the model may not be providing a perfect fit could be because the weather station is 21.7 km from Omeru reserve. Due to the large distance between the two sites, the wind at each location could have been slightly different, causing discrepancies between the output of the model and the distribution of the CLIFLO data.

It is also possible that the model may not have been able to estimate wind speeds greater than 4 m/s due to the wind data from CLIFLO being outdated. The wind data was collected between 2012 and 2015. It has highly possible that the wind at the Omeru reserve has changed quite a bit since 2015. Thus, the model, which is trained on 2023 GWA data, could not accurately represent the CLIFLO data.

Site Selection factors

Public Opinion and Kaitiakitanga

Having a Māori Pa, a place of significant historical and cultural significance, and two natural waterfalls located within the reserve means that careful steps must be taken before installing the turbine (Te Ara Encyclopedia, n.d.). Although renewable energies, such as wind power, fit in well with the concept of Kaitiakitanga, the presence of the Pa and the waterfalls is of historical significance. This means that prior permission would most likely be needed to be obtained by the nearby Iwi to start installing the wind turbine. The construction process, along with the natural operation of the turbine, has the potential to negatively affect the surrounding ecosystem, especially flora and fauna near the waterfalls. The noise or the visual impact of the turbines has the potential to scare or harm natural biodiversity in the vicinity, especially the indigenous Peripatoides species (NZ Organisms Register, n.d.). Thus, the wind turbine installation needs to be done that is disrespectful or damaging to the area.

Site Access and suitability of transmission lines

Being located on the east side of the Kaipara Coast Highway makes the Omeru reserve easy to access. Any trucks carrying wind turbine blades can access the site without much trouble. It's relatively close to Auckland city (an approximately 45-minute drive), and has one of Transpower’s transmission lines passing right over it. This makes it easy to transport goods to and from the reserve and also makes it easy to supply the national grid using this turbine.

Legal development constraints

Given that Omeru reserve is an NZ-protected area under the Reserves Act 1977 (Department of Conservation, n.d.), a resource consent application would need to be lodged to install the turbine. This is because the construction and the general operation of the turbine have the potential to adversely affect the environment within the reserve. There are also five houses located near the reserve. Noise pollution from the turbine operation can potentially negatively affect the owners of these houses. This means that permission from the owners of these houses would also need to be possibly obtained before installing the turbine. Due to the effects of NIMBY, it may be quite hard to obtain permission from the house owners.

Bibliography

Department of Conservation. (n.d.). *Categories of conservation land*. Retrieved from Department of Conservation: https://www.doc.govt.nz/about-us/our-role/managing-conservation/categories-of-conservation-land/

NZ Organisms Register. (n.d.). *Peripatoides species Omeru Scenic Reserve, Auckland* . Retrieved from NZ Organisms Register: https://www.nzor.org.nz/names/3f44167a-4e61-43ea-8a3f-801d8b11ff9f

Te Ara Encyclopedia. (n.d.). *Protected Areas*. Retrieved from Te Ara Encyclopedia: https://teara.govt.nz/en/protected-areas/page-1

Venture NZ. (n.d.). *Omeru Reserve*. Retrieved from Venture NZ: https://venturenewzealand.co.nz/place/omeru-reserve

Waterfalls NZ. (n.d.). *Omeru Falls*. Retrieved from WaterFalls NZ: https://waterfalls.co.nz/waterfalls-by-region/80-new-zealand-waterfalls/north-island/auckland/87-omeru-falls