

**PRELIMINARY WIND RESOURCE ASSESSMENT OF
WINDYGATES FIRST NATIONS PROJECT**

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1 INTRODUCTION

The Department of Innovation, Energy and Mines of Manitoba (hereafter “**IEM**” or “**Client**”) has requested that GL Garrad Hassan Canada, Inc. (“**GL GH**”), formerly Helimax Energy, Inc., conduct an independent preliminary assessment of the wind speed at the Windygates site. The results of this work are reported here.

The Windygates project is located in southern Manitoba, approximately 125 km south of Manitoba Lake and 27 km southeast of the town of Manitou. The current Windygates project measurement campaign consists of one 60 m NRG XHD meteorological mast.

The site terrain is simple and mostly flat with only minor variation in elevation across the site. Elevations range between 380 m and 480 m. Based on satellite imagery (Google Earth), the ground cover on the site is a mix of deciduous trees creating windbreaks between open fields containing agricultural crops.

The table below indicates the location of the monitoring met tower.

Site	Latitude [°]	Longitude [°]
Windygates	49.0139 N	98.3780 W

This document provides a summary of the analysis of the wind regime for the meteorological mast. IEM has provided GL GH approximately 1.2 years of data recorded at the Windygates site from one meteorological mast, Mast 9030. Information concerning the configuration, instrument mounting arrangements, and sensor calibrations of the site mast have been assumed from the documentation and the information provided by the Client. Furthermore, it has not been possible for GL GH to independently verify this information, as it was not in the scope of the present mandate to visit the proposed site. GL GH strongly recommends that an inspection of the site and installed mast be completed in order to verify the mast configuration and site land cover assumptions when a comprehensive independent assessment of the wind regime of the Project is performed.

2 MONITORING TOWER INSTRUMENTATION AND WIND DATA ANALYSIS

2.1 Windygates

The measurement campaign consists of one tubular-type meteorological mast, 60 m in height. The Mast 9030 was installed in October 2009 and the data have been provided for the period from October 2009 to January 2011.

Information about the meteorological mast and data has been provided by IEM. Mast 9030 has been reportedly equipped with NRG Systems sensors: #40C anemometers, 200P wind vanes, 110S thermometer and LI-COR pyranometer. A NRG Symphonie data logger has been programmed to record 10-minute mean, standard deviation, maximum and minimum of wind speed, direction, temperature and solar radiation flux.

Mast 9030 is reportedly equipped with the following instrumentation:

Instrument	Serial Number	Height [m]	Boom Orientation (true North)
NRG #40C anemometer	121344	60.0	225
NRG #40C anemometer	121341	60.0	45
NRG #40C anemometer	121329	50.0	225
NRG #40C anemometer	121327	50.0	45
NRG #40C anemometer	121345	40.0	225
NRG #40C anemometer	121337	40.0	45
NRG #40C anemometer	121342	10.0	225
NRG #40C anemometer	121330	10.0	45
NRG 200P wind vane	-	60.0	135
NRG 200P wind vane	-	10.0	135
NRG 110S Thermometer	-	2.0	-
LI-COR pyranometer	PY64555	2.0	-

The wind data have been subject to a quality checking procedure by GL GH to identify records which were affected by equipment malfunction and other anomalies. Characteristic of this region, the instruments on the mast experienced some periods of icing, resulting in erroneous or inconsistent data during the winter months.

The following table summarizes the data recovery at the Mast 9030 at 60 m measurement height.

Mast	Measurement Height [m]	Available Data [years]	Data Recovery Rate [%]
9030	60.0	1.2	88

2.2 Long-term Mean Wind Speeds

Data have been recorded on the Windygates site at one met mast with sensor heights up to 60.0 m. Data are available at the mast for the period from October 2009 to January 2011. The calculation of the long-term wind regime at the site was performed as described below:

- The annual wind speed at the Carman, Deerwood, Gretna, Morden, and Pilot Mound EC stations and MERRA points was established from the measured data for the period from January 1995 to March 2012.
- Data recorded at the EC stations, as well as the MERRA point data, were correlated to the measured data recorded at Mast 9030. The results of these correlations were observed to have coefficients of determination (R^2) values between 0.65 and 0.86.
- In order to extend the period of measurement at the Windygates site, daily correlations were conducted from the meteorological reference station Carman and Pilot Mound, which are operated by Environment Canada, as well as from two MERRA points. The correlations (R^2) between these reference stations and the meteorological mast of Windygates range from 0.75 to 0.86, and are judged to be good. Consequently, GL GH considered an upward adjustment of 2.9% to the site data appropriate to extend the period of data measured on site to the longer period measured at the reference stations. This adjustment resulted in long-term mean wind speed at the Windygates mast of 7.6 m/s at 60 m. It is noted that uncertainty is present in these predictions due to the amount of data available to correlate between the reference station and the site.
- The annual wind speed and direction frequency distribution at Mast 9030 were established from the measured data for the period from October 2009 to January 2011, and subsequently adjusted to reflect the predicted long-term mean wind speed.
- The boundary-layer power law shear exponents were derived at Mast 9030. The concurrent wind speed data recorded at the measurement heights were used to derive the expected long-term mean power law shear exponent at the mast locations. The results were used to extrapolate the long-term wind regimes to the proposed hub height of 80 m. The following table presents the predicted long-term mean wind speed at Mast 9030. No displacement height was used for the site considering the fact that the mast is mostly surrounded by agricultural crops.

Mast	Measurement Height [m]	Long-term Wind Speed at Measurement Height [m/s]	Power-law Shear Exponent [α]	Long-term Wind Speed at 80 m [m/s]
9030	60.0	7.6	0.24	8.2

It is noted the measurement heights on Mast 9030 have not been verified by GL GH staff and as such there is additional uncertainty associated with the shear analysis.

The hub height wind speed frequency distribution at Mast 9030 has been derived by extrapolating the measured wind speed data on a time series basis. The extrapolated wind speed data were combined with directional data recorded at the highest measurement level available to create 80 m wind speed and direction frequency distributions. The calculated 80 m frequency distribution was scaled to reflect the long-term hub height mean wind speed prediction at the same height and is shown in the form of a wind rose in Figure 1.

3 CONCLUSIONS AND RECOMMENDATIONS

Recorded wind data have been analyzed at the Windyates site. Based on the results from the analysis of this data, the following conclusions have been made concerning the site wind regime:

- The following table presents the long-term mean wind speed at mast location at the highest anemometer measurement height and at a proposed typical hub height of 80 m.

Mast	Measurement Height [m]	Mean Wind Speed at Highest Measurement Height [m/s]	Power-law Shear Exponent [alpha]	Mean Wind Speed at 80 m Hub Height [m/s]
9030	60.0	7.6	0.24	8.2

- Considering that data for only a short period were available at the met mast, additional data would provide a better understanding of the site wind regime. It is recommended that a more detailed assessment be completed once additional data become available.
- All information concerning the configuration, instrument mounting arrangements, and sensor calibrations of the mast site has been taken from the documentation provided by IEM. It has not been possible for GL GH to independently verify this information. GL GH strongly recommends that an inspection of the site and installed mast be completed in order to verify the mast configuration and site land cover assumptions when a comprehensive independent assessment of the wind regime of the proposed wind farm is performed.

4 WIND ROSE

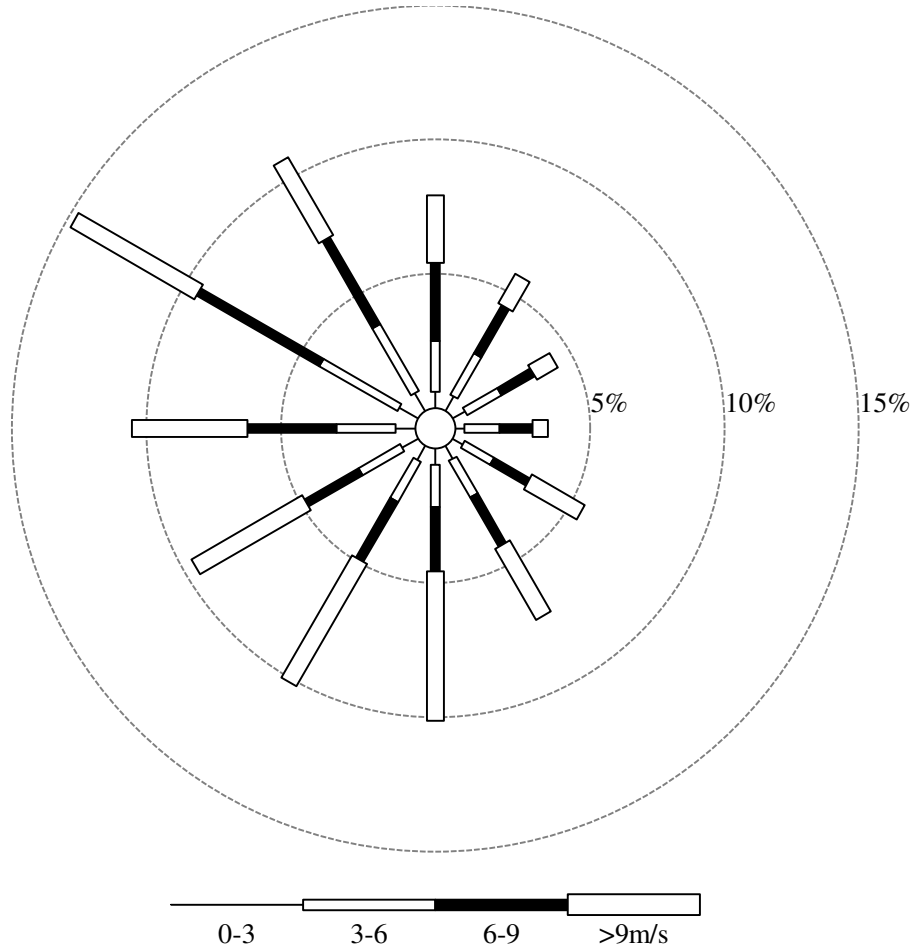


Figure 1 Predicted long-term annual wind rose at Mast 9030 at 80 m