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# Progress Report for Thor Lake Wind Monitoring 2009-2010

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## Summary

The meteorological tower was installed on a ridge overlooking the Hearne Channel on September 17th, 2009, and will likely continue to monitor the wind climate until September, 2011. The average wind speed from the existing data reveals winds of 5.57 m/s at 48 m above the ground. There was evidence of icing, and additional warm weather measurements will provide more uncontaminated data to correlate with Lutselk'e and Inner Whalebacks stations. Once there is at least a full year of wind data it will be possible to determine the long term wind speed with greater confidence.

## Introduction

Following the initial request from Avalon and a desktop study that suggested that the wind potential in the Thor Lake was very good, a wind monitoring program was initiated for this mine site.

The Thor Lake wind monitoring station was erected on September 17th, 2009 (Figure 1). The installation crew included David Burke and Mark Plotner from Deton Cho, William Hurst from ARI, Wade Carpenter of ENR and the primary author. The tower visits have been made by Chris Pedersen who collected the data cards and observed and reported the conditions of the station on a monthly basis.

The tower is located on high ground next to the Hearne Channel. Its elevation is about 250 m ASL and it is 90 m above the channel and about 500 m north of the shoreline. The tower is 50 m tall and is equipped with wind sensors at 20 (speed and direction), 30 (speed), 40 (two speed sensors), and 48 m above the ground (two speed and one direction). The station also has a temperature sensor at 2 m above the ground.

Figure 1: Installation of the wind monitoring tower near Hearne Channel, NWT.

## Challenges with the data logging

There is a period with no data from December 8th, 2009 to January 19th, 2010. The data was collected on December 9th and the batteries (two alkaline industrial D-cell batteries) were reported to be in good condition. After this visit the temperatures dropped below -30°C and the data logger stopped operating until the return visit on January 19th when the batteries were replaced and the logging resumed. The industrial grade batteries, which should have lasted one year, died prematurely after three months in service.

Icing was observed on the sensors on January 18th (see Figure 2). On a return visit on January 20th there was still ice on the instruments and Chris Pedersen's observation was that the speed sensors seemed to be spinning more slowly than the winds appeared to be. On January 29th more frost was observed on the sensors, again the sensor seemed to be spinning less than the wind's apparent speed. Further evidence of icing is apparent from the data for other months. In the final analysis the data will be filtered to eliminate the ice-corrupted data.

Figure 2: Photo of wind monitoring station taken on January 18th, 2010.

To illustrate the effects of icing, the top graph in Figure 3 shows the air temperature and wind direction at the Thor Lake site for the month November 2009. The lower graph shows the wind speeds for Inner Whalebacks (red), Lutselk'e (pink), and at Thor Lake (light to dark blue). In the upper graph, there is a period from November 6th to 14th when the direction vane was stuck in one position. During this period the temperature was below 0°C. Also during this the wind speeds of the wind speeds at Thor Lake are noticeably lower than those of Inner Whaleback. This is an indication that there was icing on the anemometers.

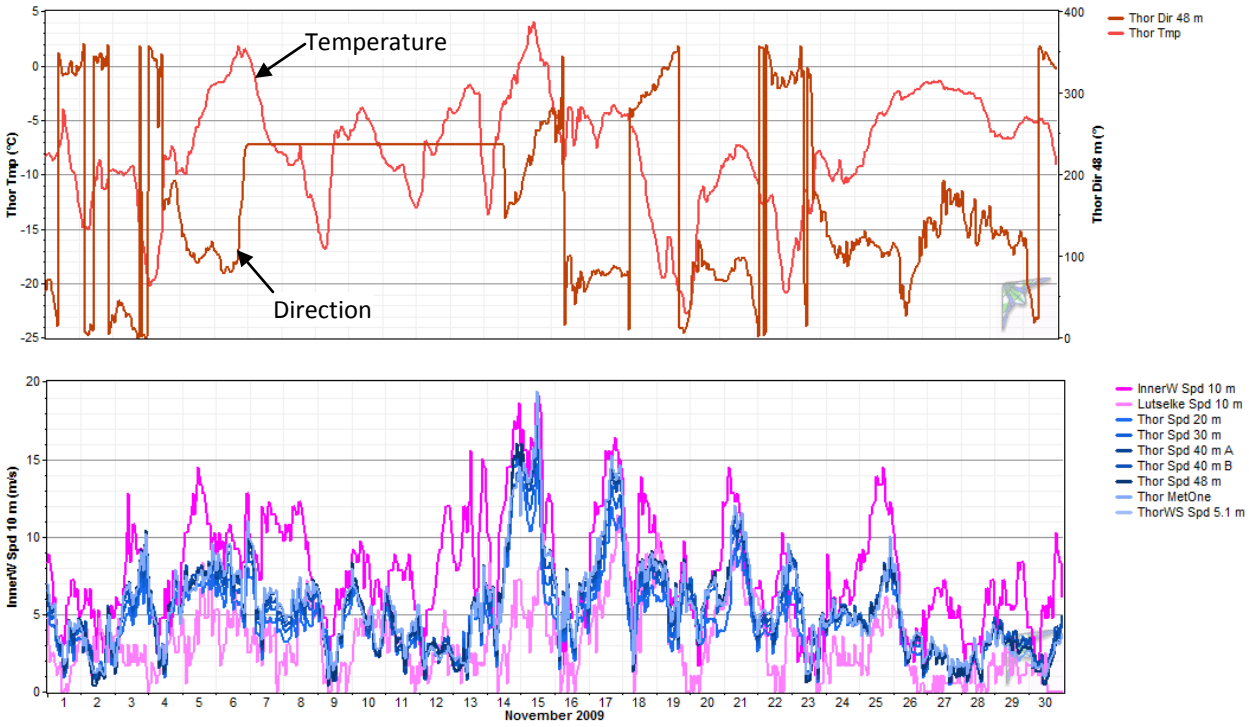


**Figure 3: Time series showing the wind measurements for the period of November, 2009. The top graph shows the air temperature (red) and the direction (brown). The lower graph shows the wind speed at Inner Whalebacks (magenta), Lutselk'e (pink), and Thor Lake (shades of blue).**

With the above in mind it is not possible at this stage in the monitoring program to make an appropriate assessment of long term wind speed until a full year of data has been collected.

In the final analysis, with more summer data, it will be easier to perform a confident correlation between the Thor Lake station and the two Environment Canada weather stations.

## Initial Results

The mean wind speed for the period September 17th to December 9th, 2009 at 48 m above the ground was 5.74 m/s. This is compared to 7.57 and 3.24 m/s at Inner Whalebacks and Lutselk'e, respectively.

Figure 4 shows the daily mean wind speed for the fall measurement period September 17th to December 9th, 2009. It can be seen here that the wind speed at Thor Lake follows those of Inner Whalebacks and Lutselk'e but the ratio of wind speed between Thor Lake and the other stations does not appear

consistent. This is partly caused by the complex terrain, the probability of icing on the sensors, and also the size of weather systems affecting each station in a given time frame.

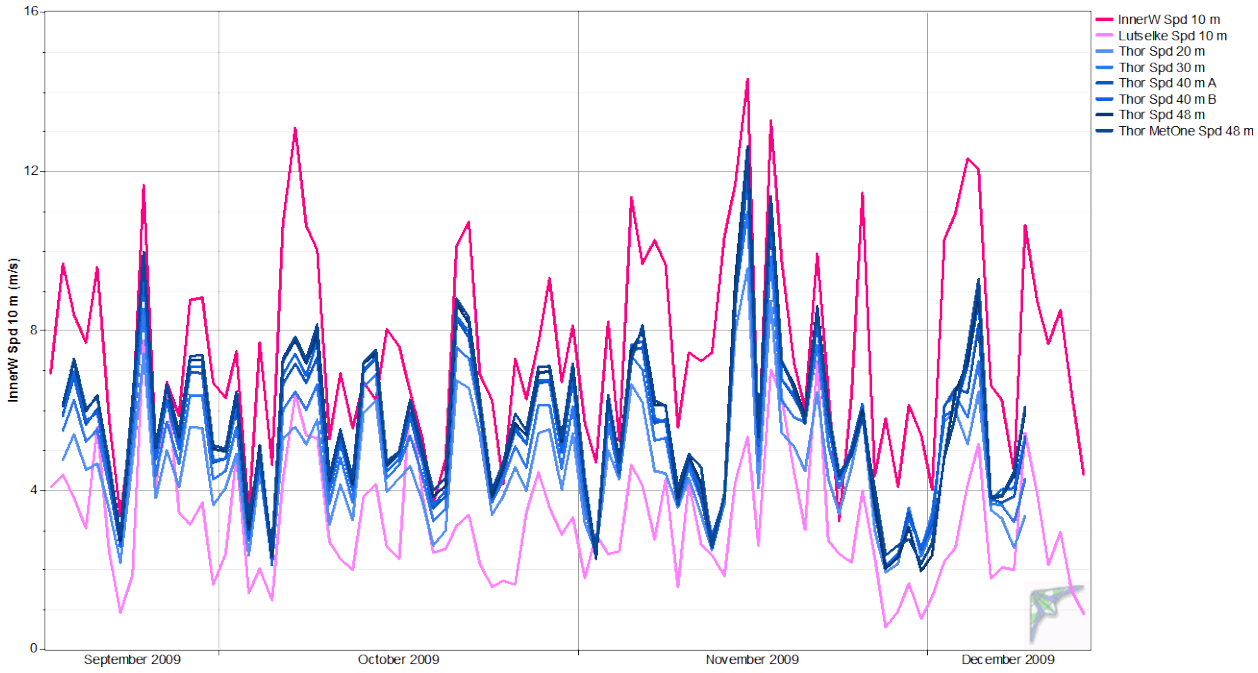


**Figure 4: This graph shows the daily mean wind speed at Inner Whalebacks (magenta), Lutselk'E (pink), and Thor Lake (shades of blue) for the period September 17th to December 9th 2009.**

As noted above the wind speed difference between Inner Whalebacks and Thor Lake appears to change according to direction, when say, the winds are from the north, in which case it would be expected that the winds are stronger at Inner Whalebacks than at Thor Lake. At Inner Whalebacks (an island on Great Slave Lake) there is open water in all directions, whereas, at Thor Lake there is bush and undulating terrain to the north, and to the south the terrain drops onto open water (Hearne Channel). Because of this variation of terrain in each direction the correlation between the two station will likely be better if they are categorized by direction. This will be possible to do when we have more summer data which is not contaminated by sensor icing.

Figure 5 illustrates the effect that topography and wind direction has on wind speeds at each site. For example, when the winds are from the east as shown for the period September 26th to 29th, the wind speeds at Thor Lake are only slightly less than at Inner Whalebacks. When the winds are from the north as shown in the period of October 6th to 9th the wind speeds at Thor Lake are about 60% of those of Inner Whalebacks.

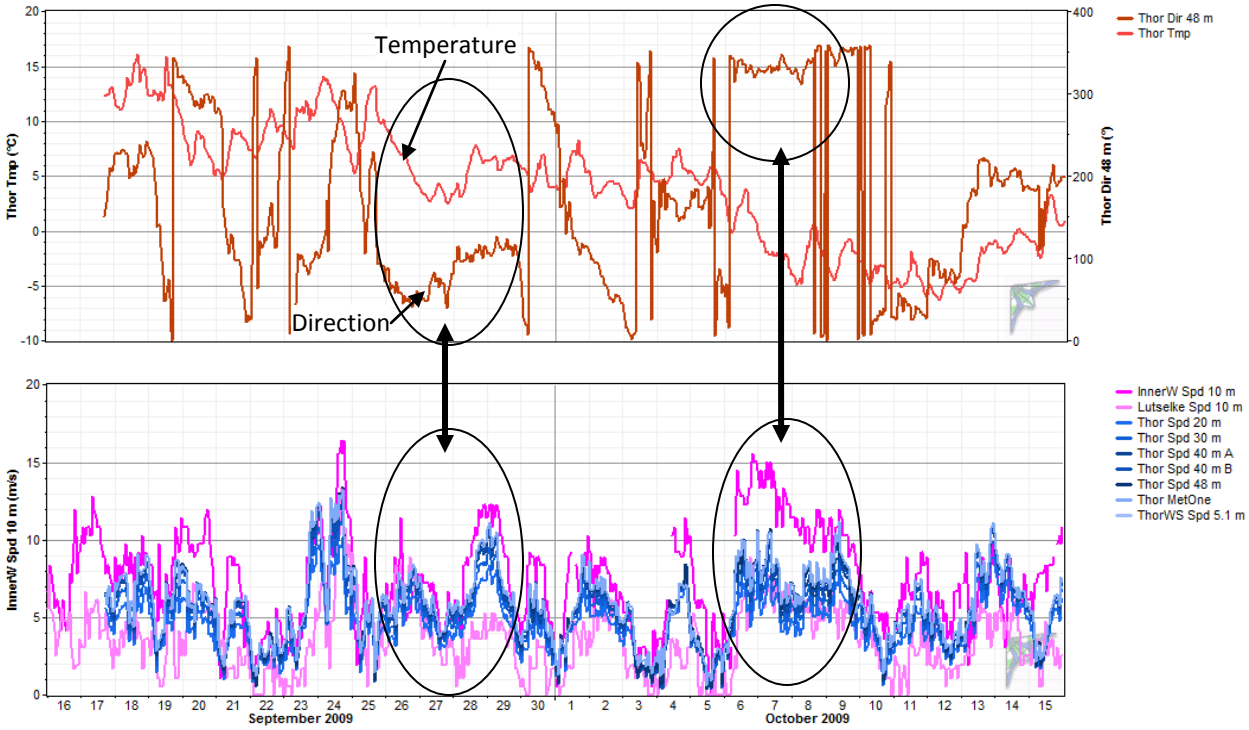


**Figure 5: Time series showing the wind measurements for the period of September and October, 2009. The top graph shows the air temperature (red) and wind direction (brown) for the region. The lower graph shows the wind speed at Inner Whalebacks (magenta), Lutselk'e (pink), and Thor Lake (shades of blue).**

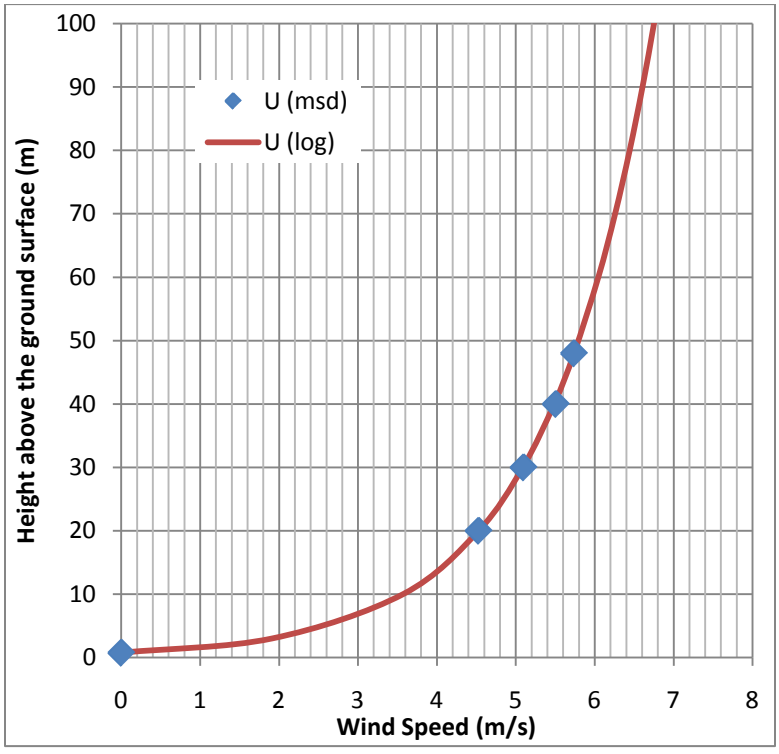


**Figure 6: A logarithmic profile (red line) fitted to the wind speeds measured on the tower (blue diamonds) at the Thor Lake wind monitoring station.**

The vertical profile of the wind speeds from September 17th to December 9th, 2009 at the Thor Lake station is plotted in the graph of Figure 6 above. From this graph the wind speeds, as measured in this period, are about 6 and 6.4 m/s at 60 and 80 m AGL, respectively. These numbers are for a short period of time and will change as more measurements are analysed.

As shown in Figure 7 below, the dominant wind energy direction for the fall 2009 measurement period was from the east, accounting for about 40% of the total wind energy. Other less dominant direction were from the north-northwest and the west-southwest. The Inner Whalebacks and Lutselk'e stations both report wind that almost exclusively from the easterly directions.

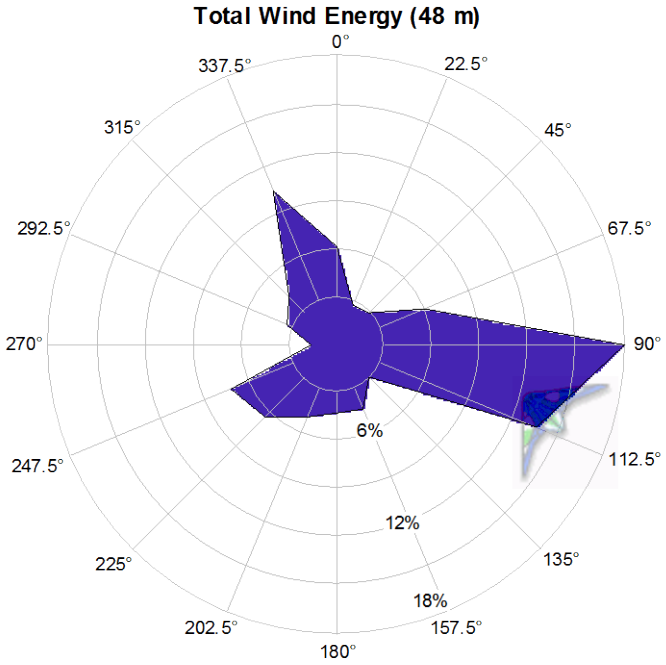


**Figure 7: Wind rose of the Thor Lake wind station. The rose shows the relative wind energy by direction. North (0°) is towards the top.**

## Conclusions

The wind measurements from the fall period of analysis show evidence of a moderate wind climate for wind energy production. There is evidence of a modest amount of icing on the anemometers that is causing reduced apparent wind speeds. This is shown by the wind direction sensors being still for periods of time at temperatures below freezing point. As more data becomes available, further analyses will be conducted.

## Reference

Pinard, J.P., 2009, **Wind Study for Thor Lake Area.** Prepared for Aurora Research Institute, Inuvik, NT.