AURORA RESEARCH INSTITUTE
AURORA COLLEGE

Paulatuk Wind Energy Study

Overview of Wind Study

- In 2005 the Aurora Research Institute established a wind monitoring station in a field east of the water reservoir near Paulatuk (Figure 1).
- This station measured winds from 10 to 30 metres above the ground using wind speed measuring instruments called anemometers (see Figure 2 and Figure 3).

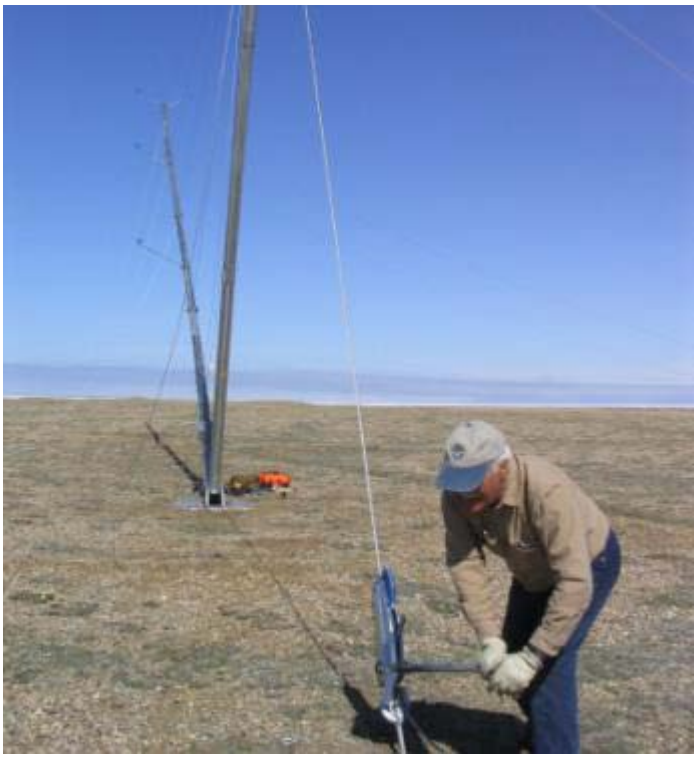

Figure 1: Lifting up the wind monitoring station near Paulatuk.

- This site was monitored with the help of Keith Dodge who collected wind speed data every month during the study.
- After several years of measurements the wind data collected at the site was analysed with a computer wind model to estimate the long term wind speed for several sites in the area around Paulatuk.
- An economic analysis was also made to determine the cost of developing a wind project for two sites in the area of Paulatuk.

Figure 2: An anemometer is a piece of scientific equipment that measures wind speed. These are placed on the wind monitoring tower shown in Figure 3.

Wind Monitoring Results

- The wind data analysis estimates that the site of the wind monitoring station has a long-term annual average wind speed of 5.8 meters per second (m/s; or 21 km/h) at a height of 37-metres above ground level (AGL).
- The dominant wind direction in the area is from the south-southwest.
- Seasonally, the wind speeds are highest in October and lowest during the spring and summer.
- The measurements reveal that there is a good wind resource in the area. The winds may be strong enough year-round to consider a wind development as a source of energy for the community.
- The site of the wind monitoring station is too far from the existing powerline, so other sites closer to the grid are being considered.

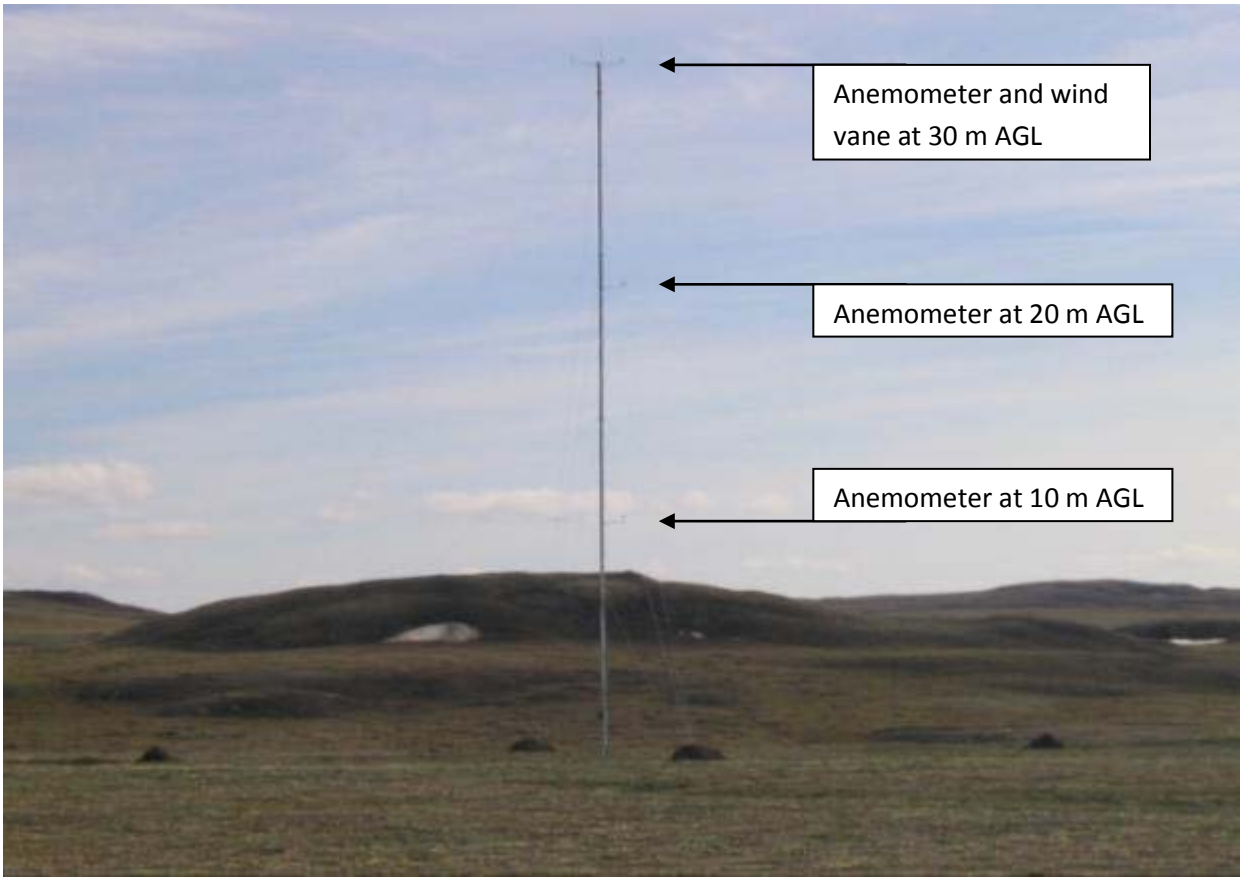

Figure 3: The wind monitoring tower is east of Paulatuk and east of the water reservoir. It has three anemometers at 10, 20, and 30 m above the ground level (marked as AGL on image) to measure wind speeds.

Sites that could be Considered for a Wind Development

- To determine the wind speeds at several other locations in the area a computer wind flow model was used.
- The images below (Figure 4 and Figure 5) show two sites that could be considered for a wind development.
    - The Quarry site is located near a gravel quarry by the coast. Its long-term average wind speed is estimated to be 5.6 m/s at 37 m AGL.
    - The Reservoir Ridge site is located on a ridge next to the water reservoir. The average wind speed here is 5.9 m/s (37 metres AGL).

Figure 4: Paulatuk area showing the location of the wind measurements and the possible wind developments (Quarry and Reservoir Ridge). Images are from MACA and Google Earth.

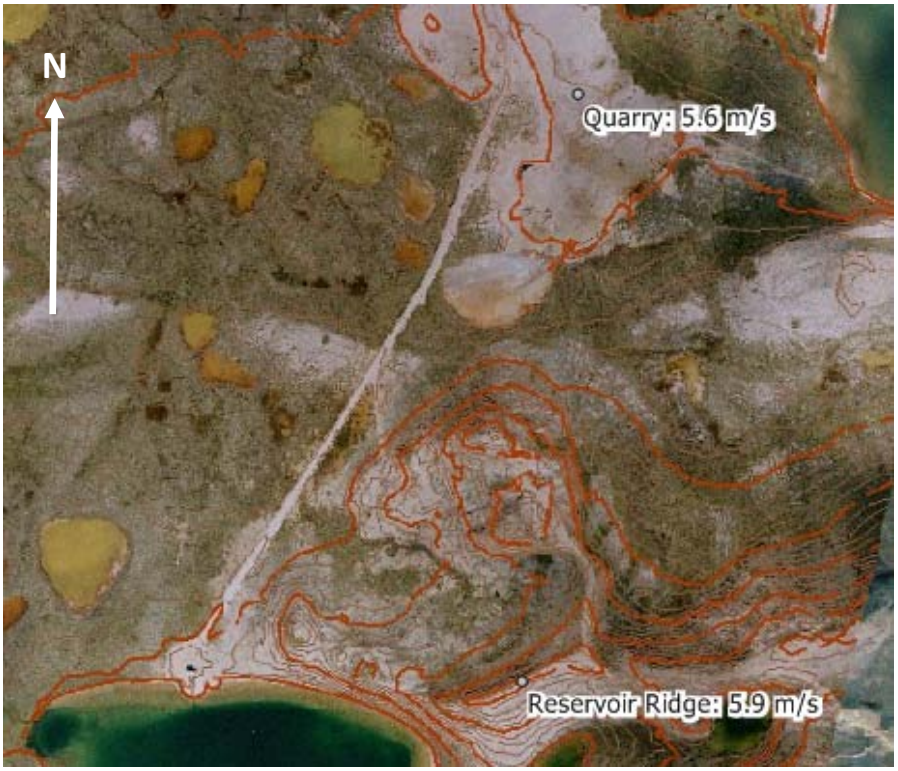

Figure 5: Area southeast of Paulatuk showing the locations of the possible wind developments. The thick orange lines are 5-metre elevation contours: the Quarry site is just below 5 metres above sea level (ASL) and the Reservoir Ridge is at 30 metres ASL. Image is from MACA.

How the Costs of Wind Power are Calculated

- The tallest tower available for a small scale wind development suitable for this community is 37 meters tall designed for the EW50 wind turbine made by Entegrity (see Figure 6).
- When calculating the cost of installing a wind turbine you need to consider the following costs:
    - Costs to upgrade the road to the site,
    - Costs to build a new powerline to the site,
    - Costs to construct tower foundation,
    - Shipping costs for the equipment and many other costs.

Figure 6: A EW50 wind turbine installed at Nome Alaska. This model is recommended for Paulatuk.

- We estimate that the cost to borrow money is at 8% interest rate (repaid over 20 years) and the annual operating cost is $15,000 per turbine.

What the Utility will Pay for the Wind Power

- A utility company will purchase wind energy at the cost of displaced diesel. The current cost of displaced diesel in Paulatuk is $0.43/KWh when diesel is purchased at $1.50 per litre.
- A wind farm must then be able to produce power at a cost that is lower than the avoided cost of diesel to make a profit.
- A wind development in Paulatuk will require subsidies to compensate for the extra costs.

How much each Proposed Location will Cost

The table below shows all of the costs and subsidies that will be required to build a wind farm at each site.

Site	Wind Speed (m/s)	Total Project Cost	Per kWh Energy Cost	Subsidy Required	Subsidy if Paid per kWh
Quarry	5.6	$534,000	$0.77	$304,000	$0.34
Reservoir Ridge	5.9	$617,000	$0.75	$330,000	$0.32

- The Quarry site is less expensive to build because it is closer to the power line.
- The Quarry site costs more per kWh of energy it produces because its wind resource is less than at Reservoir Ridge site.
- At the Quarry site a wind project will produce 88,000 kWh of electricity and displace 25,000 litres of diesel per year.

Conclusions

- Of the locations studied the Quarry site has the best economy with its moderate winds, close proximity to the power line, and easy access.
- A wind project at this site will cost $534,000 and require $304,000 in capital subsidies in order for it to happen.
- Costs will be reduced if this project is carried out simultaneously with other wind projects in the Beaufort region, such as those being proposed in Ulukhaktok, Tuktoyaktuk, and Sachs Harbour.
- Results of a wind monitoring program reveals that Paulatuk will save 25,000 litres of fuel annually from installing a wind turbine near the hamlet, making Paulatuk one of the few Arctic communities to use sustainable energy.

The full report is at:

http://www.nwtresearch.com/resources/publications/wind.aspx

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