



# REPORT COVER NOTES

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**To:** Readers of Northwest Hydraulic Consultants Ltd. January 2014 Report Entitled:

***Southern Lakes Enhanced Storage Concept Wind Data Analysis***

**From:** Yukon Energy Corporation

**Date:** March 19, 2015

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## **Background**

During the Southern Lakes Enhanced Storage Concept planning studies some stakeholders commented that Yukon Energy's use of Whitehorse wind data for the purposes of its wave run-up and shoreline erosion study might not be representative of the local wind regime in the Southern Lakes. There was some speculation that this might lead to erroneous study conclusions and otherwise underestimate the magnitude of the erosion potential of the Concept. In order to examine this question Yukon Energy engaged Northwest Hydraulic Consultants Ltd. (NHC) to conduct a comparative analysis of Whitehorse wind data (used in the original wave run-up and shoreline erosion modelling) and locally available wind data. NHC was specifically requested to assess the suitability of using Whitehorse wind data as a proxy in the earlier shoreline erosion studies, and to review the Whitehorse wind climate data in the context of local wind data. Locally available wind data collected from Army Beach and California Beach were compared to the Whitehorse wind data for the same periods.

## **Study Outcomes**

The report reader will note two key conclusions from this independent analysis:

1. The results show that the wind data recorded in the Southern Lakes are, in general, weaker than those at Whitehorse. Over the period of potential effects (October and November), the average hourly wind speed at the Whitehorse station is more than 2 times greater than that measured at Army Beach and California Beach.

and,

2. Using the Whitehorse wind data for the Concept shoreline erosion potential assessment will likely produce a conservative design benchmark.



Project No. 300271

January 31, 2014

**Hemmera**

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Whitehorse, Yukon Y1A 0K7

**Attention:      Natasha Sandys, EP**  
**Environmental Scientist**

Dear Ms. Sandys:

**Subject:          Southern Lakes Enhanced Storage Concept**  
**Wind Data Analysis**

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## 1 Introduction

Previous studies<sup>1</sup> used Environment Canada (EC) Whitehorse Airport 2101300 climate station (EC Whitehorse) wind data to evaluate the wave run-up and shoreline erosion on Marsh Lake related to the assessment of potential effects of Yukon Energy Corporation (YEC) Southern Lakes Enhanced Storage Concept. These studies indicated that the greatest direct risk of shoreline erosion to private property exists at the North M'Clintock and Army Beach properties on Marsh Lake ([Figure 1](#)).

YEC has recently indicated that local wind data is available from weather stations at Army Beach and California Beach. EC Whitehorse station is situated approximately 38 km northwest of the Marsh Lake and was used in the earlier AECOM studies.

Northwest Hydraulic Consultants Ltd. (NHC) was requested to assess the suitability of using EC Whitehorse wind data as a proxy in the earlier shoreline erosion studies, and to review the EC Whitehorse wind climate data in the context of local wind data. This report describes the comparative analysis of wind data at Army Beach and California Beach to EC Whitehorse.

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<sup>1</sup> AECOM. 2012. Marsh lake Run-up Analysis. Prepared for Yukon Energy Corporation. November 27, 2012;  
AECOM. 2012. Preliminary Shoreline Design Concepts for March and Tagish Lake Shorelines. Prepared for Yukon Energy Corporation. December 31, 2012.

## 2 Wind Stations and Data

The location and length of record for each of these stations are shown in the table below and these exists a concurrent period of overlap between the gauges.

**Table 1. Wind station information**

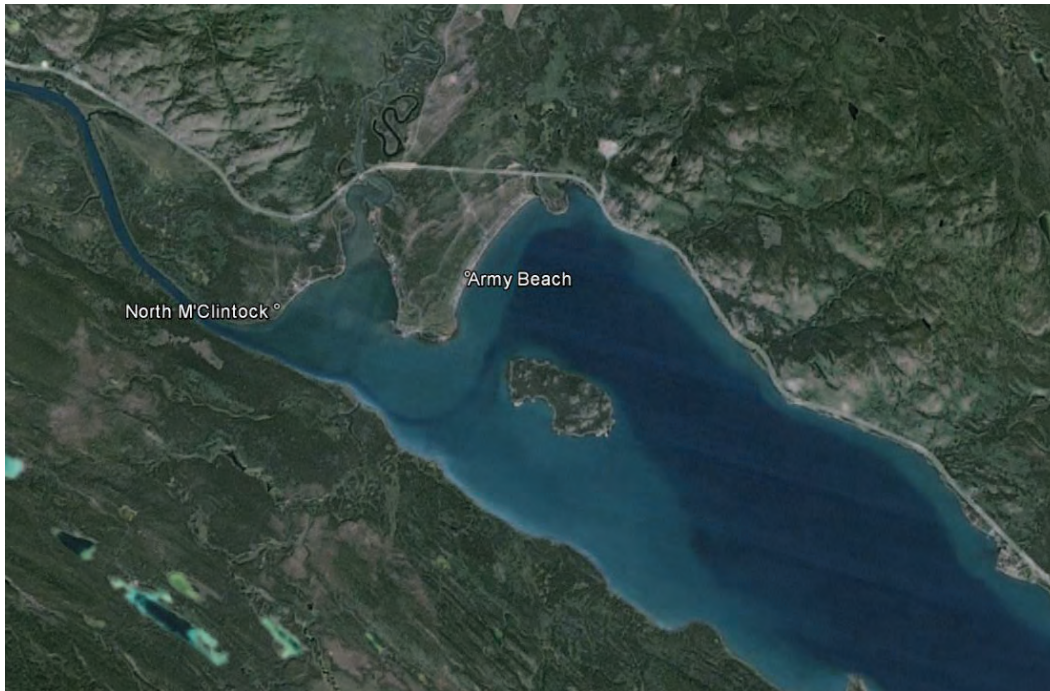
Station	Latitude	Longitude	Elevation (m above sea level)	Duration
EC Whitehorse A	60 °42'34"	135°04'08"	706.2 m	1953 to December 2012
EC Whitehorse A	60 °42'34"	135°04'02"	706.2 m	December 2012 to current
Army Beach	60 °32'32"	134 °28'38"	656 m	August 2000 to July 2001
California Beach	Not available	Not available	Not available	July 2012 to November 2013



**Figure 1. Wind station locations**

## 2.1 Army Beach Wind Station

The Army Beach wind station (**Figure 2**) was situated at the Phillips residence ( $60^{\circ}32'32''$   $134^{\circ}28'38''$ ). According to Cottrell-Tribes (2001), the Army Beach wind station recorded hourly wind data from August 2000 to July 2001 at 10 m above the ground and the site was well exposed to the lake and its prevailing winds.

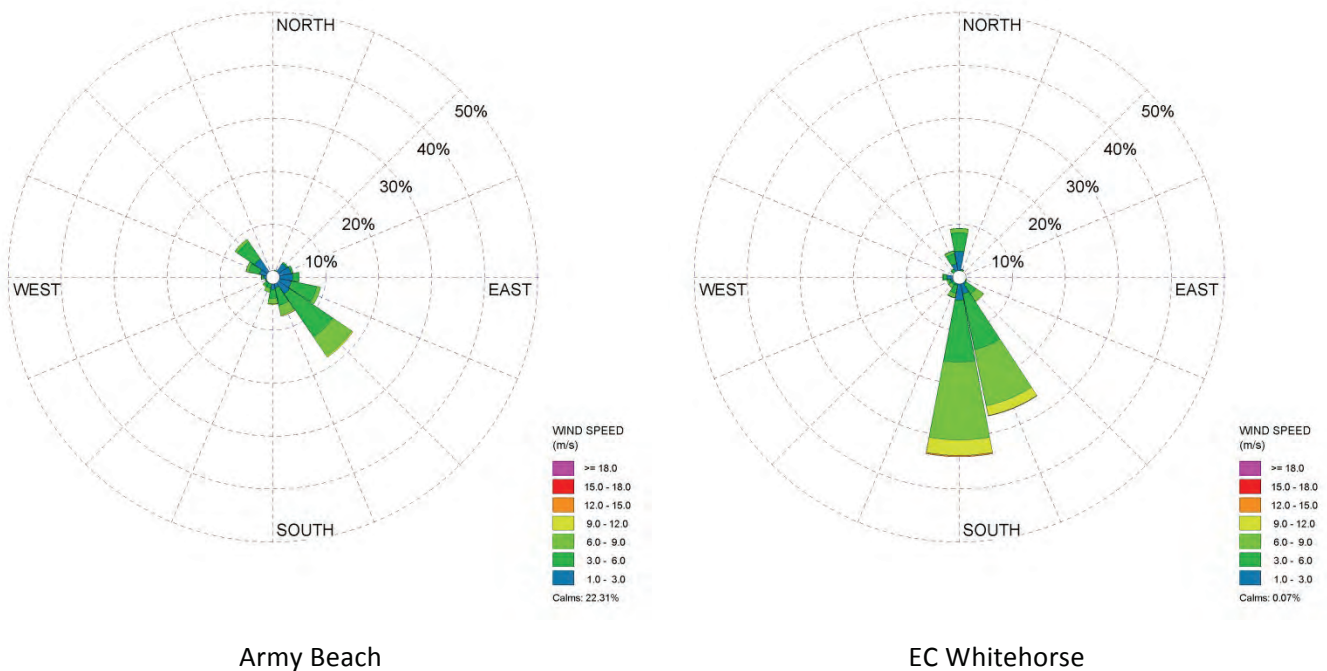


**Figure 2. Army Beach station**

A review of the hourly wind data from Army Beach and EC Whitehorse data over the period from August 2000 to July 2001 shows that 9% of Army Beach data and 17% of EC Whitehorse data consist of incomplete/missing record.

Wind rose diagrams, which show the distribution of speed and direction, for Army Beach and EC Whitehorse over the period from August 2000 to July 2001 are shown in **Figure 3**.



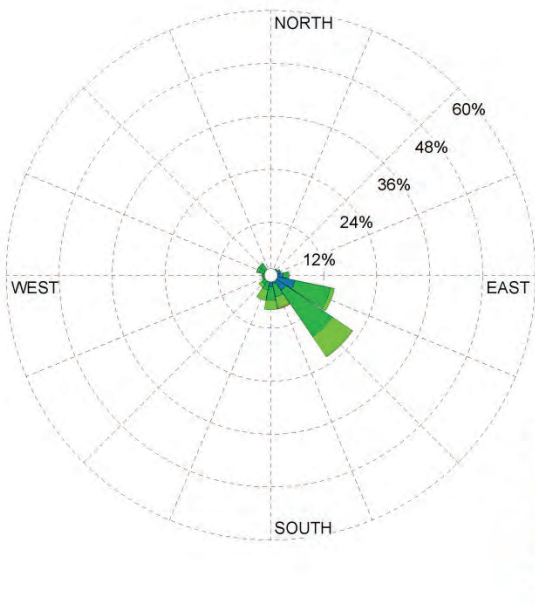


**Figure 3. Army Beach and EC Whitehorse wind roses (August 2000 to July 2001)**

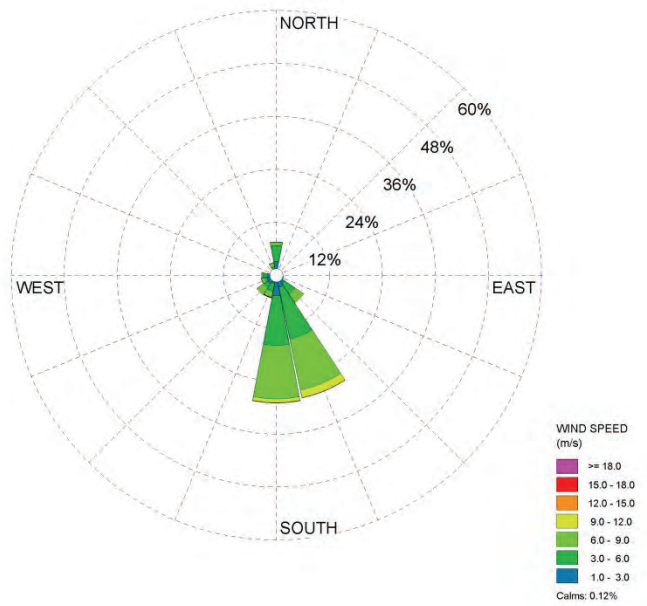
The figure shows that the prevailing winds recorded at Army Beach are primarily in the southeast-northwest direction corresponding to the orientation of the local lake valley. Prevailing winds recorded at EC Whitehorse on the other hand are from south and south-southeast direction. In general the winds at Army Beach are weaker than those at EC Whitehorse and are calm (less than 1 m/s) during a greater percentage of the time.

The winds at Army Beach exceeded 9 m/s less than 1% of the time whereas the winds at EC Whitehorse exceeded 9 m/s approximately 4% of the time. The average wind speed at Army Beach and EC Whitehorse over the period between August 2000 and July 2001 are 2.7 m/s and 4.6 m/s respectively.

Wind roses illustrating the prevailing wind direction and magnitude, by season, are presented in [Figure 4](#), [Figure 5](#), [Figure 6](#) and [Figure 7](#).

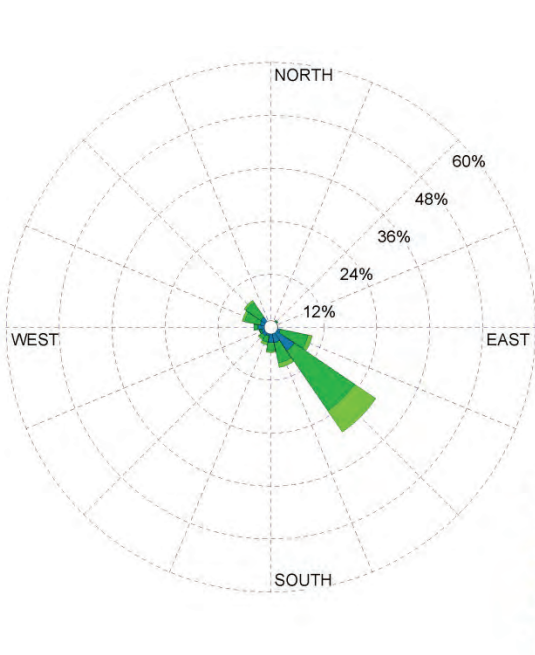


Army Beach

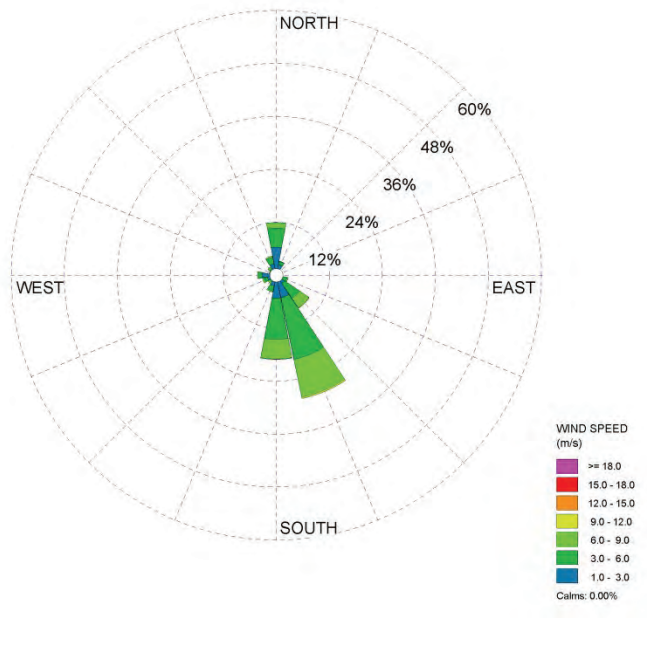


EC Whitehorse

Figure 4. Army Beach and EC Whitehorse wind rose (Spring – Mar, Apr, May 2001)

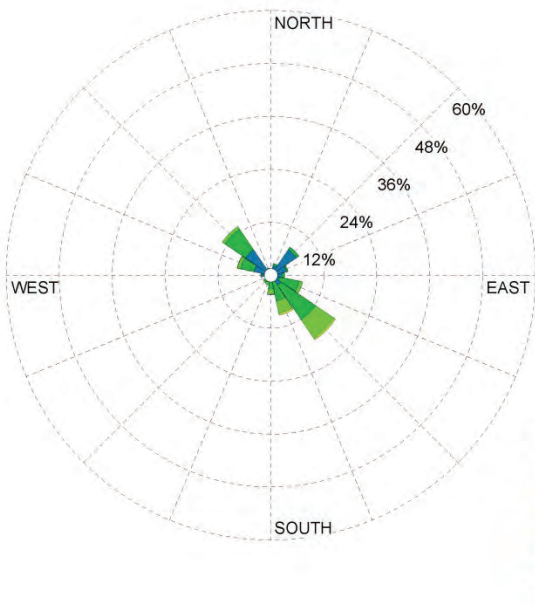


Army Beach

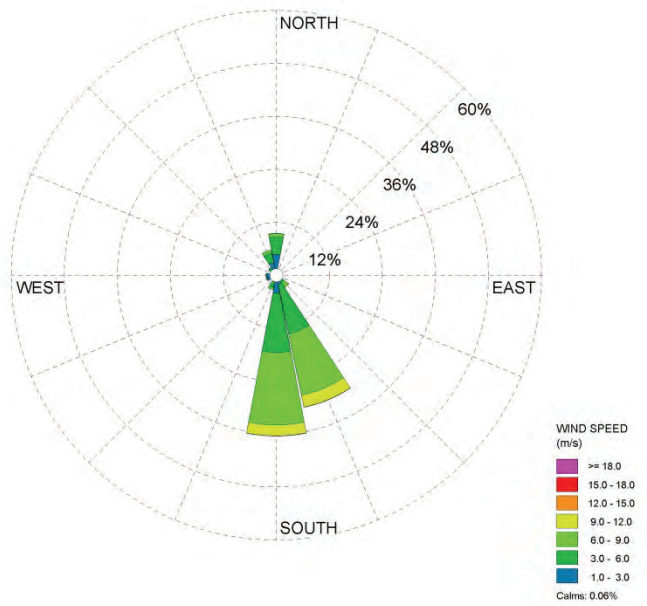


EC Whitehorse

Figure 5. Army Beach and EC Whitehorse wind rose (Summer – Jun, Jul 2001, Aug 2000)

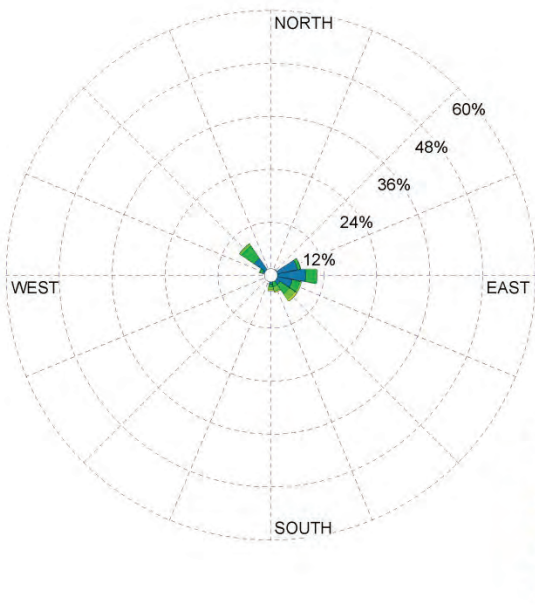


Army Beach

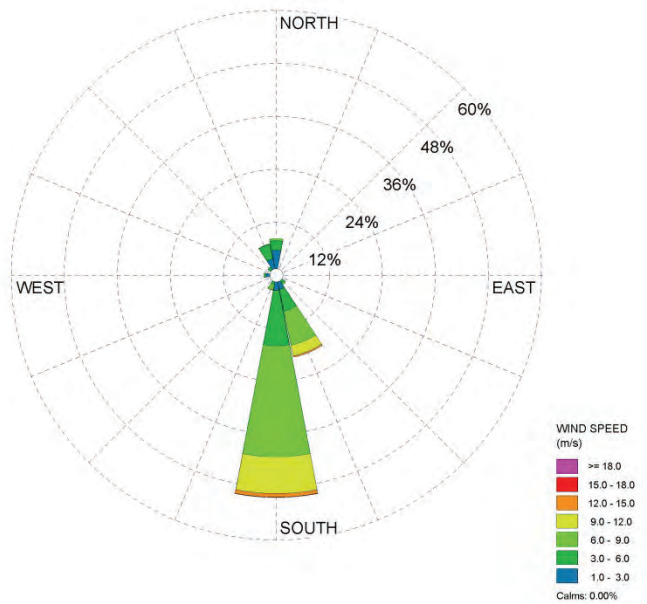


EC Whitehorse

Figure 6. Army Beach and EC Whitehorse wind rose (Fall – Sep, Oct, Nov 2000)



Army Beach



EC Whitehorse

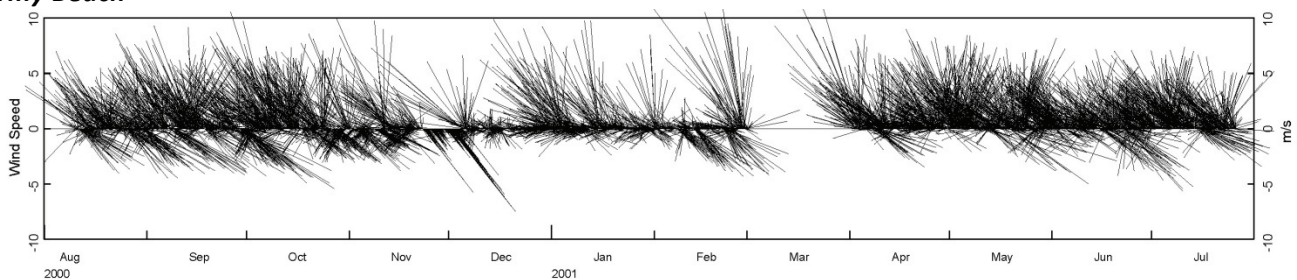
Figure 7. Army Beach and EC Whitehorse wind rose (Winter – Dec 2000, Jan, Feb 2001)

Seasonal wind roses show that at Army Beach the prevailing wind direction during the spring and summer months is from the southeast. In the fall, the prevailing wind directions are from northwest and southeast. In winter, the wind climate at Army Beach is relatively calm with 43% of the winds measured less than 1 m/s.

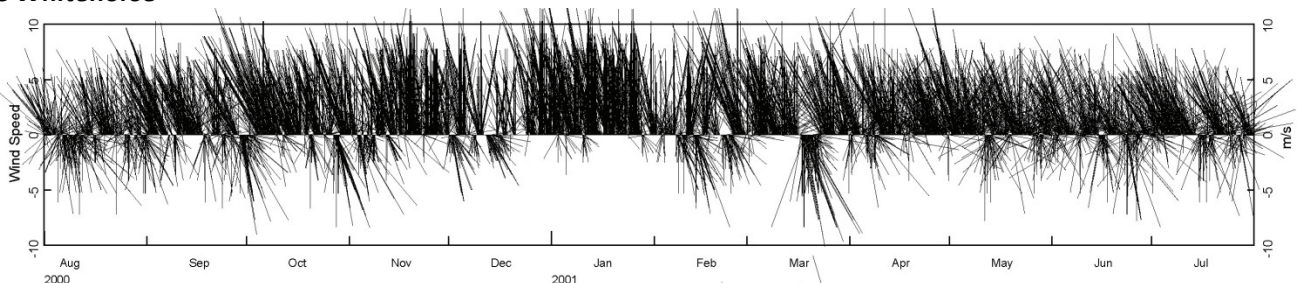
Seasonal wind roses show that at EC Whitehorse the measured wind directions do not vary significantly between seasons. Unlike the wind climate at Army Beach, the largest winds measured at EC Whitehorse occur in the winter months.

The seasonal wind roses show significant differences between measured wind speed and directions at Army Beach and EC Whitehorse during the winter months. This can also be visualized by examining the wind stick plot as shown in [Figure 8](#).

### ***Army Beach***



### ***EC Whitehorse***



**Figure 8. Army Beach and EC Whitehorse stick plots**



The average and peak hourly wind speeds at Army Beach over the period of concern (October and November) are 2.9 m/s and 11.1 m/s respectively. The average and peak hourly wind speeds at EC Whitehorse, on the other hand, are 5.1 m/s and 13.9 m/s respectively.

## 2.2 California Beach Wind Station

The California Beach station is located in Tagish Lake and has been in operation since July 2012. No information is available on the exact location and the elevation of the station as well as the height of the anemometer. The approximate location of the station provided by YEC is shown in [Figure 9](#).



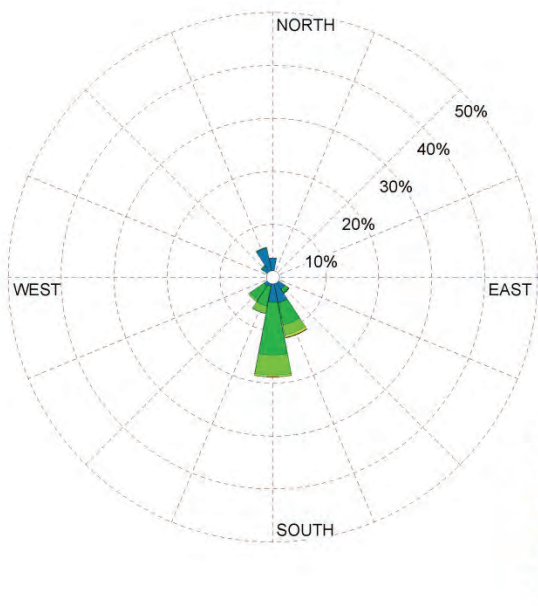
**Figure 9. California Beach station**

Through personal communication, it is known that the station is situated approximately 100 m south of the forest. The geographic location of the station can have impact on the recorded wind data depending on the height of the trees and the height of the anemometer. For this analysis, it is assumed that the anemometer is installed 10 metre from the ground. No information on the tree height is available.

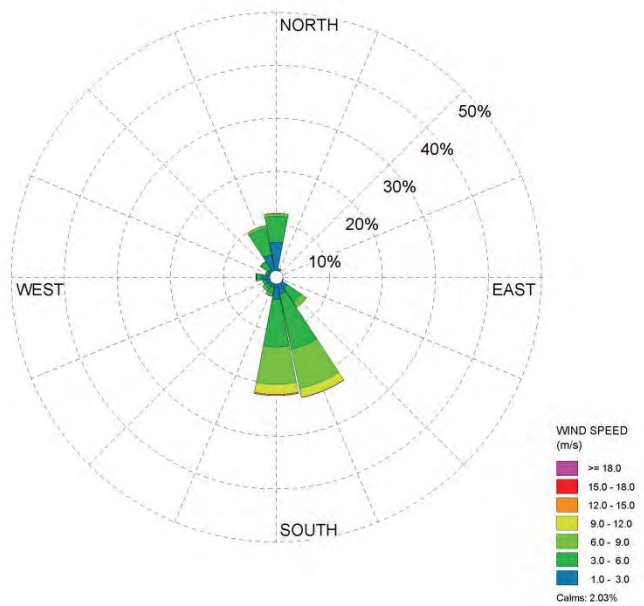
It should also be noted that the California Beach data provided has not gone through any quality assurance or quality control process. The data provided show 30 minute interval measurements over the period between July 13 13:28 2012 and November 11 18:00, 2012 and 2 hour interval measurements over the period between November 11 18:00, 2012 to December 2 10:00, 2013.

A review of the hourly wind data from California Beach and EC Whitehorse data over the period from July 2012 to November 2013 shows that 22% of California Beach data and 6% of EC Whitehorse data consist of incomplete/missing record.

Wind rose diagrams, which show the distribution of speed and direction, for California Beach and EC Whitehorse over the period from July 2012 to November 2013 are shown in [Figure 10](#).



California Beach

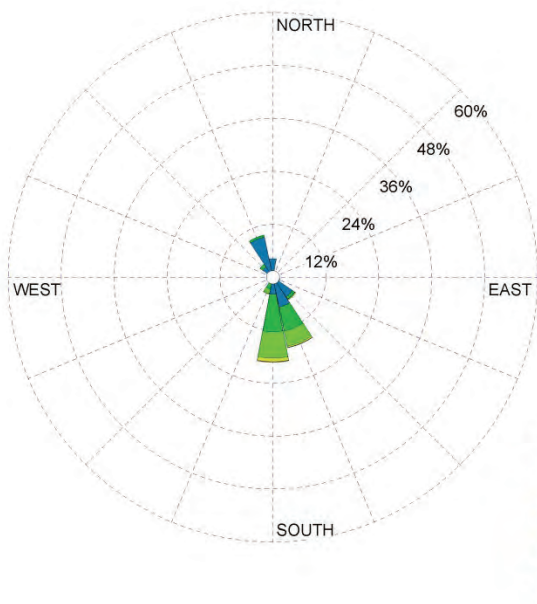


EC Whitehorse

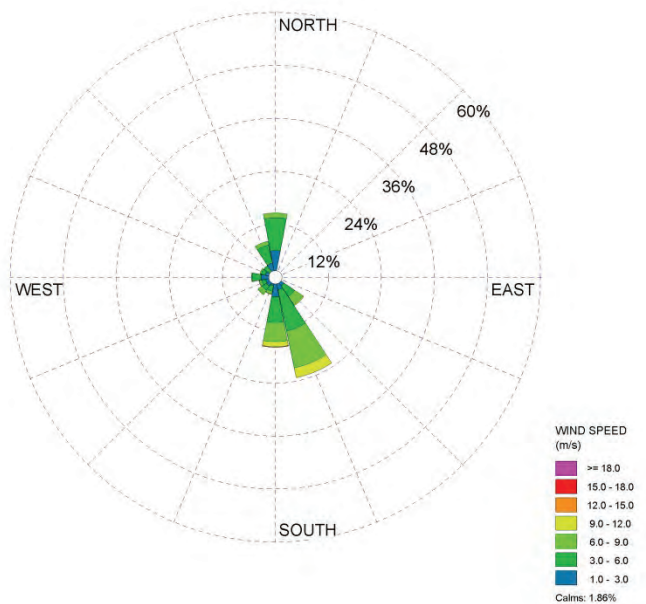
**Figure 10. California Beach and EC Whitehorse wind roses (July 2012 to November 2013)**

The figure show that the prevailing winds recorded at California Beach and at EC Whitehorse are from south and south-southeast direction. In general the winds at California Beach are weaker than those at EC Whitehorse and are calm (less than 1 m/s) during a greater percentage of the time. The winds at California Beach exceeded 9 m/s approximately 1% of the time whereas the winds at EC Whitehorse exceeded 9 m/s approximately 4% of the time. The average wind speed at California Beach and EC Whitehorse over the period between July 2012 and November 2013 are 2.1 m/s and 4.1 m/s respectively.

Wind roses illustrating the prevailing wind direction and magnitude, by season, are presented in [Figure 11](#), [Figure 12](#), [Figure 13](#) and [Figure 14](#).

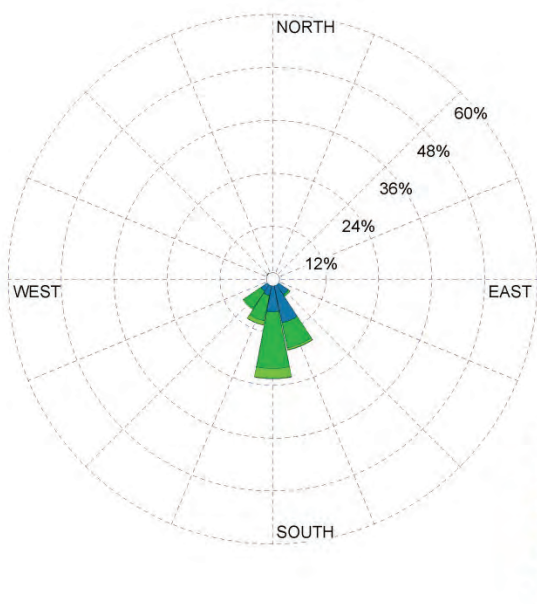


California Beach

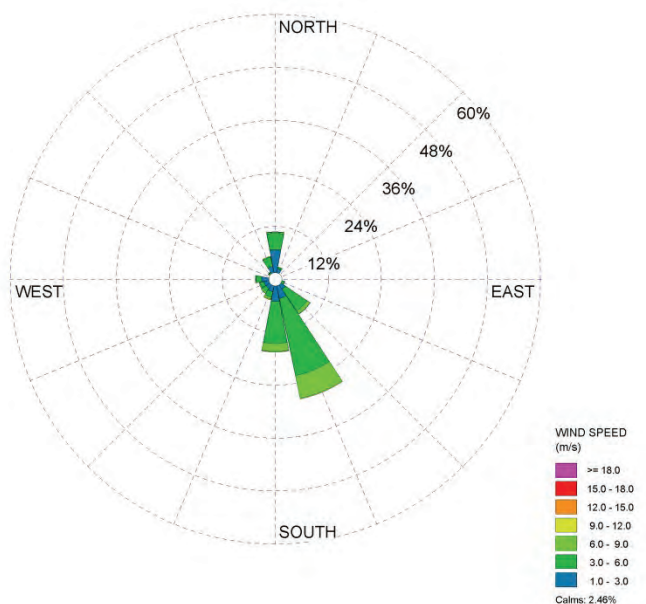


EC Whitehorse

Figure 11. California Beach and EC Whitehorse wind rose (Spring – Mar, Apr, May 2013)

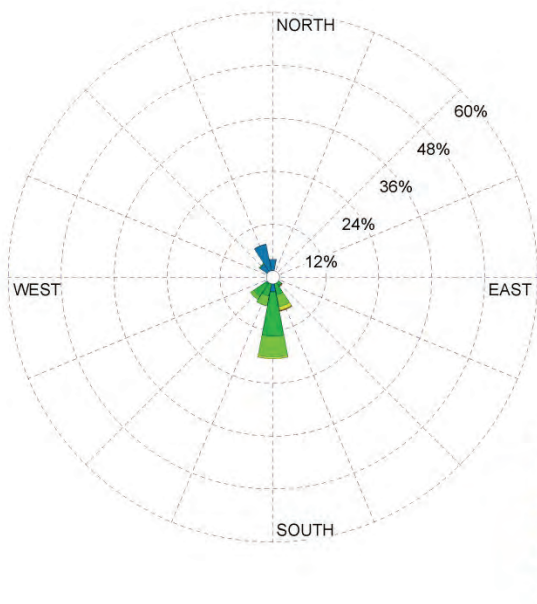


California Beach

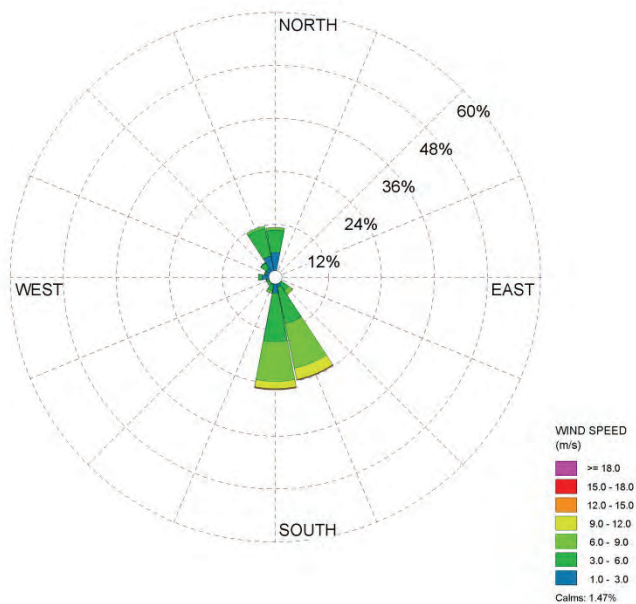


EC Whitehorse

Figure 12. California Beach and EC Whitehorse wind rose (Summer –Jul, Aug 2012, Jun, Jul, Aug 2013)

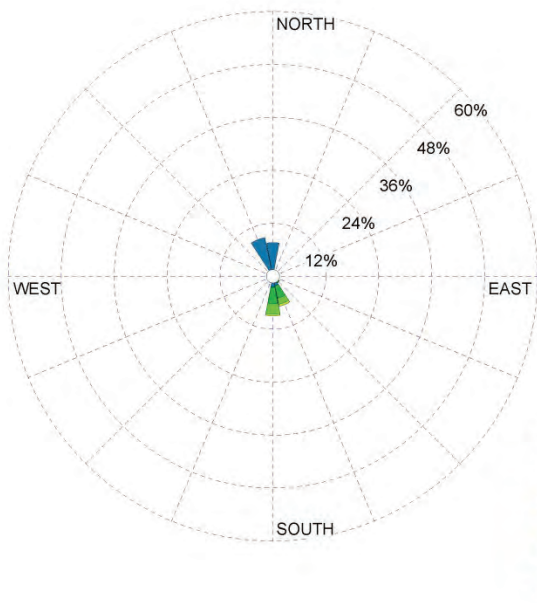


California Beach

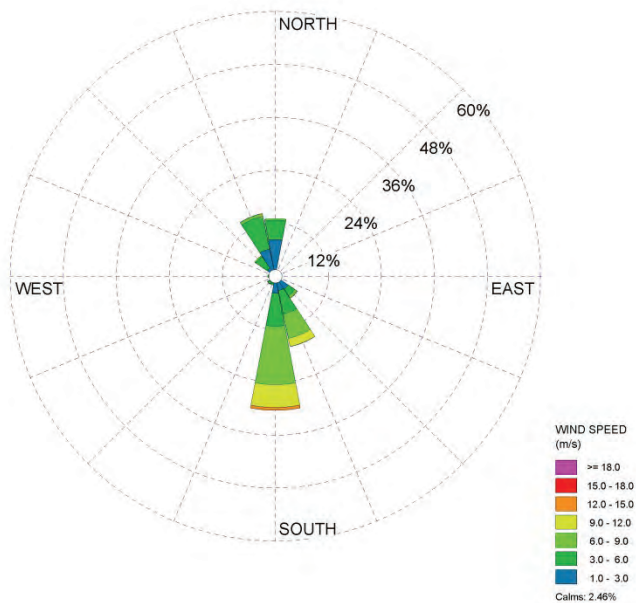


EC Whitehorse

Figure 13. California Beach and EC Whitehorse wind rose (Fall – Sep, Oct, Nov 2012, Sep, Oct, Nov 2013)



California Beach



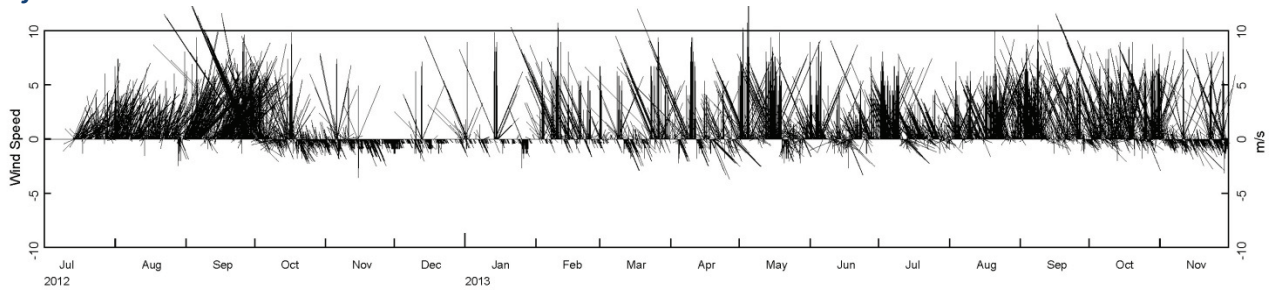
EC Whitehorse

Figure 14. California Beach and EC Whitehorse wind rose (Winter – Dec 2012, Jan, Feb 2013)

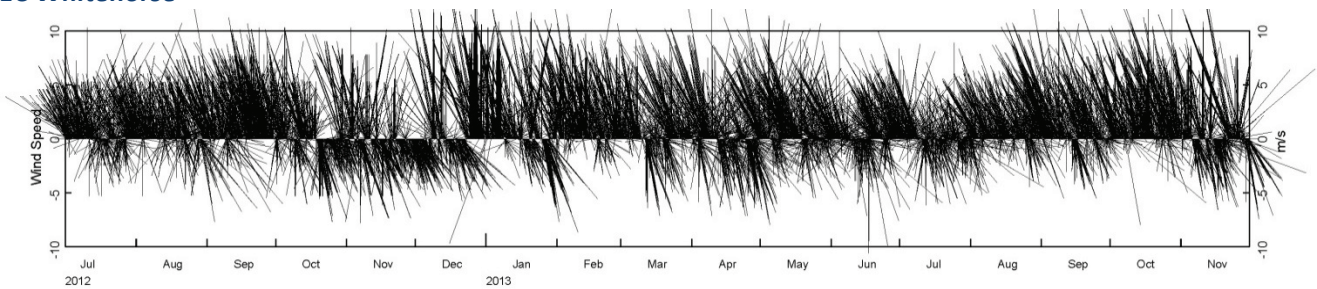


Seasonal wind roses show that the prevailing wind directions measured at California Beach are similar to that measured at EC Whitehorse. However, the magnitude of the winds measured at California Beach is much less especially in the winter. This can also be visualized by examining the wind stick plot as shown in [Figure 15](#).

#### California Beach



#### EC Whitehorse



**Figure 15. California Beach and EC Whitehorse stick plots**

The average and peak hourly wind speeds at California Beach over the period of concern (October and November) are 1.6 m/s and 12.5 m/s respectively. The average and peak hourly wind speeds at EC Whitehorse, on the other hand, are 4.2 m/s and 17.8 m/s respectively.

### 3 Summary

A comparative analysis of wind data at Army Beach and California Beach to EC Whitehorse was conducted. The results show that the wind data recorded at Army Beach and California Beach are in general weaker than those at EC Whitehorse in particular during the winter months. Over the period of potential effects (October and November), the average hourly wind speed at EC Whitehorse station is about 2.2 and 2.6 times greater than that at Army Beach and California Beach respectively. The prevailing wind directions are different between Army Beach and EC Whitehorse but are similar between California Beach and EC Whitehorse. The differences between nearby stations are due to changes in local topography that modify the wind direction.

Using the EC Whitehorse wind data for Marsh Lake shoreline erosion potential assessment will likely produce a conservative design criterion.



## 4 Closure

If you have any questions, please do not hesitate to contact Edwin via email ([ewang@nhcweb.com](mailto:ewang@nhcweb.com)) or telephone (604.980.6011).

Sincerely,

**northwest hydraulic consultants ltd.**

Report Prepared by:

*Original signed by*

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Edwin Wang P.Eng., Coastal Engineer

Report Reviewed by:

*Original signed by*

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Barry Chilibeck, P.Eng., Principal

## References

Cottrell-Tribes (2001). Phillips Wind Analysis August 2000 – July 2001 Customer Report. Report prepared for Yukon Energy Corporation. October 2001.

## Notification

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