Report No. 70802-2

ORTECH

Report:

Summary of Engineering and Environmental Studies in Support of the Wolfe Island Shoals Offshore Wind Farm

Date: February 15, 2017



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Report No.: 70802-2
55 pages including 1 Appendix

Revision History

Version	Date	Summary Changes/Purpose of Revision
1	February 15, 2017	Original

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EXECUTIVE SUMMARY

ORTECH Consulting Inc. ("ORTECH") was contracted by Windstream Wolfe Island Shoals Inc. ("Windstream") to prepare a summary of engineering, environmental and technical studies and other analysis completed to-date in support of the development of the 300 MW Wolfe Island Shoals off-shore wind farm ("WIS Project"). The objective of this summary is to:

- consolidate the large amount of existing work completed during the past six and a half years;
- reference the original source and;
- summarize the key findings as they apply to the upcoming Renewable Energy Approval ("REA") process for the WIS Project.

This report summarizes the key studies and other analysis works commissioned by Windstream and do not include any related studies that have been conducted by or on behalf of agencies of the Ontario government.

The various studies and other analysis works were started after Windstream was awarded a FIT contract and include work done both before and after the Ontario Ministry of Environment and Climate Change ("MOECC") moratorium on off-shore wind development announced in February 2011 ("Moratorium"). The studies were necessary to maintain the project schedule and maintain momentum for the REA consultation process.

As a result of the imposition of a Moratorium in February 2011, some uncertainty was created by the regulators which required that Windstream do a number of "work-arounds" in order to maintain the project momentum. Uncertainties associated with the timing of site release, the proposed (but never ratified) 5 km setback, the proposed removal of additional areas for off-shore development have been addressed and Windstream has continued to advance the WIS Project in an ongoing effort to meet timelines and to address technical issues raised. By definition, a moratorium has a finite period and Windstream has had to deal with the reality that, at some point, it will be removed and the project team must be ready to "hit the ground running."

A secondary benefit of some of the delays imposed by the moratorium is that Windstream has been able to extensively study the issues originally raised by Ontario as the basis for a moratorium. These issues have been addressed and shown to be of insignificant concern.

Studies done to date have significantly advanced Windstream's understanding of relevant technical issues, have addressed concerns raised by the government as a justification for the Moratorium and, most importantly, have not identified any material impediments or potentially significant environmental impacts that would prevent the WIS Project from being built.

In summary:

- Windstream has completed sufficient studies that address the concerns raised by regulators in the announcement of the Moratorium,
- these studies have not identified any potentially significant environmental impacts,
- these studies have shown that the WIS Project is technically feasible and can be commissioned within timelines that are consistent with the Feed-in Tariff ("FIT") Contract, and
- the work completed has significantly advanced our knowledge of the project, the design, and the environmental details. In short, the work completed to date have put the project at a much more advanced technical stage

In September 2016 a NAFTA Arbitration Panel confirmed that the FIT Contract for the WIS Project remains valid, and that the actions of Ontario that led to the moratorium was neither fair nor equitable. With this conclusion in hand, Windstream intends to advance with the necessary next project development activities including initiation of the REA process. This is a normal requirement for all renewable energy projects with a FIT Contract, and has been shown to be allowed under current regulations. There is no reason for Windstream to further delay the REA process.

1. BACKGROUND

The FIT Contract for the Wolfe Island Shoals off-shore wind farm ("WIS Project") project was announced in April 2010, awarded in May 2010 and executed in August 2010.

In June 2010, MOECC posted a notice on its Environmental Bill of Rights website that it was conducting a public consultation on a possible 5 km set back from shore for off-shore wind projects. The consultation appeared to be related to concerns by the public over the absence of a shoreline set back requirement and technical concerns about noise impacts on receptors. On shore projects have a minimum set back of 550 meters from noise receptors and must not exceed a de-minimus 40dB noise threshold at receptor locations. Some of the studies summarized herein address specific questions related to meeting the de-minimus noise thresholds using setbacks.

In addition to noise and shoreline setbacks, the 2010 consultation initiated by the government identified several other potential technical issues related to coastal and other environmental impacts. Some of the studies summarized herein address specific questions related to coastal effects and the off-shore setting.

The 2010 consultation initiated by the government was never formally concluded and no findings were published. Specifically, no new regulatory requirement for the setback of off-shore wind projects was implemented. Prior to the 2010 consultation and in the absence of specific guidelines, the WIS Project was proposed with a minimum set back of 2 km from shoreline noise receptors. The WIS Project layout was subsequently revised to achieve a minimum setback of 5 km from shoreline noise receptors in response to the setback proposed by the government. Some of the studies summarized herein relate to the reconfiguration of the WIS Project layout, as well as, studies that demonstrate that the noise impacts can be mitigated with 2 km to 5 km setbacks.

In February 2011, the MOECC (formerly the MOE) posted a policy decision notice which placed a moratorium on off-shore wind development (the "Moratorium") stating:

"In light of the comments received in response to MOE and MNR's postings and in particular the identified need for further study, Ontario is not proceeding with any development of offshore wind projects until the necessary scientific research is completed and an adequately informed policy framework can be developed".

The Moratorium cited the need for further study and the lack of necessary scientific research as rationale for not proceeding with off-shore wind development at that time. Many of the studies summarized herein address items specifically raised as part of the Moratorium and were commissioned to answer these concerns. The studies and other analysis works commissioned by Windstream shows that considerable information related to the science of off-shore wind project

development is readily available. This science is available from dozens of actual off-shore wind farm projects completed globally in the past 20 years, including in fresh water as well as near-fresh water environments. It also builds on the experience of almost two hundred on-shore wind projects in the province plus numerous infrastructure projects built in Ontario's lakes. Many on-shore wind projects have shared similar technical challenges to off-shore wind projects and some are located in close proximity to the WIS Project. The Windstream studies have identified no environmental or technical issues that cannot be addressed in the normal course of the project planning.

Prior to 2016, the WIS Project was the subject of an arbitration conducted under the North American Free Trade Agreement (NAFTA). Various technical and environmental questions were raised as part of the proceedings. Some of the studies summarized herein address items specifically raised by the Government of Canada during the proceedings. While done to answer questions raised by Canada about various technical and environmental issues, these studies also advanced our knowledge of the project and provided the basis for the next steps in the environmental assessment (REA) process. As the Tribunal noted, they were a necessary part of keeping the project on track. The studies did not identify any technical obstacle or significant environmental impact that would prevent the WIS Project from being successfully commissioned.

The main studies and analysis commissioned by Windstream are referenced in Table 1 with an electronic copy provided on a DVD attached in Appendix 1. The studies and other analysis works summarized in this report are categorized into the following general topics:

- Technical Feasibility:
  - Wind Resource
  - Grid Connection
  - Geotechnical / Geophysical
  - Coastal Processes and Wind, Wave and Ice
  - Shipping and Navigation
  - Domestic Content
  - Overall Project Feasibility
- Environmental:
  - Noise
  - Sediments and Drinking Water
  - Underwater Cables
  - Birds / Bats
  - Fisheries Permitting

- Cultural Heritage
- Visual Impacts
- Overall Environmental Process and Permitting

A summary of the key findings is provided in Section 2.

Table 1: List of Main Studies and Other Analysis

Study Topic	Study Title	Study Author (Date)	Report Section Reference
Technical Feasibility:			
Wind Resource	Meteorological and Energy Yield Report	Helimax Energy Inc. (October 2009)	Section 2.1.1
	Offshore Wind Speeds from Boundary Layer Modelling	Zephyr North Limited (May 2010)	Section 2.1.1
	Wolfe Island Shoals Offshore Wind Report	ORTECH (July 2010)	Section 2.1.1
	Updated Wolfe Island Shoals Offshore Wind Report	ORTECH (March 2011)	Section 2.1.1
	Updated Wolfe Island Shoals Offshore Wind Report - 2012	ORTECH (October 2012)	Section 2.1.1
	Wolfe Island Shoals Wind Project – Wind Resource and Energy Production Summary	AWS TrueWind (July 2013)	Section 2.1.1
	Wolfe Island Shoals Wind Farm – Preliminary Energy Assessment	GL Garrad Hassan (September 2013)	Section 2.1.1
	WRA for Wolfe Island Shoals Offshore Wind Project Using SWT2.3MW-113 Turbine - 2014	ORTECH (August 2014)	Section 2.1.1
	WRA for Wolfe Island Shoals Offshore Wind Project - 2015	ORTECH (May 2015)	Section 2.1.1
Grid Connection	Wolfe Island Shoals GS 300 MW Wind Turbine Generator – Generation Connection: Customer Impact Assessment	Hydro One Networks Inc (November 2010)	Section 2.1.2
	Wolfe Island Shoals Wind Generation Station: System Impact Assessment Report	Independent Electrical System Operator (November 2010)	Section 2.1.2
	Update Regarding Grid Connection (Notes of Meeting with IESO)	WSP (formerly Genivar) (November 2012)	Section 2.1.2

Table 1: List of Main Studies And Other Analysis - Continued

Study Topic	Study Title	Study Author (Date)	Report Section Reference
Technical Feasibility: Continued			
Geophysical / Geotechnical Investigations	Charity Shoal and Upper Gap of Adolphus Reach Survey (Fall 2010): Final Field Report	Canadian Hydrographic Services (January 2011)	Section 2.1.3
	2010 Preliminary Site Investigation: Lake Ontario Wind Farm and Cable Route Survey	Canadian Seabed Research (March 2011)	Section 2.1.3
	Offshore Wind Farm – Wolfe Island: Geotechnical Desktop Study	Inspecsol Engineering Solutions (February 2013)	Section 2.1.3
Coastal Processes and Wind, Wave and Ice Study	Wolfe Island Shoals Offshore Wind Farm: Ice Study	W.F. Baird & Associates Coastal Engineers Limited (December 2012)	Section 2.1.4
	Preliminary Wave Analysis	ORTECH (April 2013)	Section 2.1.4
	Comparison of Metocean and Marine Specific Conditions: Baltic Sea versus Lake Ontario	W.F. Baird & Associates Coastal Engineers Limited (October 2013)	Section 2.1.4
	Wolfe Island Shoals Offshore Wind Energy Project (Response to URS Technical Report January 20, 2015)	W.F. Baird & Associates Coastal Engineers Limited (June 2015)	Section 2.1.4
Shipping and Navigation	Wolfe Island Shoals Offshore Wind Energy Project (Response to URS Technical Report January 20, 2015)	W.F. Baird & Associates Coastal Engineers Limited (June 2015)	Section 2.1.5
Domestic Content	Wolfe Island Shoals: Domestic Content Plan	ORTECH (November 2011)	Section 2.1.6

Table 1: List of Main Studies And Other Analysis - Continued

Study Topic	Study Title	Study Author (Date)	Report Section Reference
Technical Feasibility: Continued			
Overall Technical Feasibility	Wolfe Island Shoals Foundation Parametric Study Report	Sgurr Energy (October 2013)	Section 2.1.7
	Wolfe Island Shoals Offshore Works Construction Plan: Foundation Conceptual Design and Installation Strategy	Ocean and Coastal Consultants Inc. (COWI) (March 2014)	Section 2.1.7
	Wolfe Island Shoals Gravity Based Foundation and Wind Turbine Generator Installation: Offshore Installation Means and Methods	Weeks Marine Inc. (May 2014)	Section 2.1.7
	Wolfe Island Offshore Wind Farm: Engineers Report	Sgurr Energy (August 2014)	Section 2.1.7
	Wolfe Island Shoals: Technical Memorandum for Foundation Construction	Ocean and Coastal Consultants Inc. (COWI) (June 2015)	Section 2.1.
	Responses to URS Windstream Arbitration Technical Report / Windstream Energy – Wolfe Island Shoals Wind farm in Lake Ontario	Weeks Marine Inc. / McNally Construction (June/May 2015)	Section 2.1.7
	Wolfe Island Shoals Offshore Wind Project – Project Design and Construction	Sgurr Energy (June 2015)	Section 2.1.7
	Wolfe Island Shoals Offshore Wind Energy Project (Response to URS Technical Report January 20, 2015)	W.F. Baird & Associates Coastal Engineers Limited (June 2015)	Section 2.1.7
Environmental:			
Noise	Wolfe Island Shoals Wind Energy Project, Lake Ontario: Acoustic Predictions	HGC Engineering (August 2014)	Section 2.2.1
	Frequency Analysis of Atmospheric Jets Regarding Wolfe Island Shoals Offshore Wind Energy	ORTECH (May 2015)	Section 2.2.1
	Wolfe Island Shoals Sound Study	Aercoustics Engineering Limited (June 2015)	Section 2.2.1

Table 1: List of Main Studies And Other Analysis - Continued

Study Topic	Study Title	Study Author (Date)	Report Section Reference
Environmental: Continued			
Sediments and Drinking Water	Wolfe Island Shoals Offshore Wind Farm: Clean Water Act	W.F. Baird & Associates Coastal Engineers Limited (January 2013)	Section 2.2.2
	Wolfe Island Shoals Offshore Wind Energy Project (Response to URS Technical Report January 20, 2015)	W.F. Baird & Associates Coastal Engineers Limited (June 2015)	Section 2.2.2
Underwater Cables	Submarine Cables in Ontario	Genivar (December 2012)	Section 2.2.3
	Electro-magnetic fields and Underwater Cables: Overhead and Underground EMF Analysis	Power Engineers Inc. (April 2014)	Section 2.2.3
Birds / Bats	Potential Impact of the Wolfe Island Shoals Offshore Wind Energy Power Project on Birds	Curry & Kerlinger LLC (August 2014)	Section 2.2.4
	Potential Impact of the Wolfe Island Shoals Offshore Wind Energy Power (WIS) Project on Bats	North East Ecological Services (August 2014)	Section 2.2.4
Fisheries Permitting	Wolfe Island Shoals Offshore Wind Energy Project (Response to URS Technical Report January 20, 2015)	W.F. Baird & Associates Coastal Engineers Limited / Beacon Environmental (June 2015)	Section 2.2.5
Cultural Heritage	Review of Cultural Heritage in the WIS Project Area – Lighthouses & Landscapes	ORTECH (July 2014)	Section 2.2.6
	Wolfe Island Shoals Offshore Wind Energy Project (Response to URS Technical Report January 20, 2015)	W.F. Baird & Associates Coastal Engineers Limited / Scarlett Janusas Archeology (June 2015)	Section 2.2.6

Table 1: List of Main Studies And Other Analysis - Continued

Study Topic	Study Title	Study Author (Date)	Report Section Reference
Environmental: Continued			
Overall Environmental Process and Permitting	Draft Project Description Wolfe Island Shoals Offshore Wind Farm	ORTECH (October 2010)	Section 2.2.7
	Draft Project Description Wolfe Island Shoals Offshore Wind Farm	ORTECH (January 2012)	Section 2.2.7
	Review of Draft Complete Submission Requirements Checklist for Offshore Wind Projects under O.Reg. 359/09	ORTECH (May 2014)	Section 2.2.7
	Wolfe Island Shoals Offshore Wind Energy Project – Environmental Effects / Natural Heritage Analysis	ORTECH (August 2014)	Section 2.2.7
	Overall Summary of the REA Process as it Pertains to the WIS Project	ORTECH (August 2014)	Section 2.2.7
	Renewable Energy Approval and Permitting	WSP (June 2015)	Section 2.2.7

2. MAIN STUDIES AND OTHER ANALYSIS

A summary of the main studies and other analysis works conducted for the WIS Project including a description of the purpose and the main conclusions drawn from each are provided below.

2.1 Technical Feasibility

2.1.1 Wind Resource

2.1.1.1 Initial (Helimax, Zephyr North and ORTECH) Wind Resource Assessments (Reports: October 2009, May 2010 and July 2010)

The initial wind resource studies demonstrated that an excellent wind resource exists in the WIS Project area.

One of the key factors identified for the WIS Project is the understanding of the wind regime and thus the energy and revenue generating potential of the off-shore wind farm. It is clearly understood that capital and operating costs of off-shore wind farms are higher than conventional on-shore projects. However, the wind speeds and associated energy potential are also generally higher off-shore as these regions are less affected by surface friction associated with land topography, trees, buildings, etc.

Windstream commissioned several initial wind resource assessments over the course of several years to improve the understanding and increase confidence in the energy potential of the WIS Project. Each built upon the increasing volume of information available from ono-site wind measurement. The earliest wind resource assessments are listed below:

- Helimax Energy Inc. (Meteorological and Energy Yield Report: October 2009)
- Zephyr North Limited (Offshore Wind Speeds from Boundary Layer Modelling: May 2010)
- ORTECH Power (Wolfe Island Shoals Offshore Wind Report: July 2010)

Ideally, wind resource assessments would be based on meteorological data collected off-shore in the very near vicinity of the WIS Project or such data is used to verify other calculations methods. Windstream submitted a request to the MNR in October 2010 and again in January 2012 for Applicant of Record for the WIS Project location as well as permitting for an off-shore testing facility (meteorological tower) to be located in the vicinity of the WIS Project at Charity Shoals. A project description was provided in support of the submission. However, Windstream requests related to off-shore testing facilities have remained unanswered.

A number of internationally renowned meteorological consultants were consulted and Windstream was advised that accurate wind speed and power production prediction was possible if a number of

correlating on-shore sources could be used. As a result, Windstream erected an 80 m anemometer tower on a spit of land that projected 2 km from mean shore line, in the direction of the project. This site is surrounded by water on three sides and is, to all intents and purposes, within the wind stream of Lake Ontario. A sodar unit that was capable of measuring up to 200 m vertically was also deployed at this site. Windstream was aware that a number of German offshore wind projects deploy a similar system whereby a single wind measurement can be extrapolated to other projects within the same wind field (i.e. The FINO towers in the Baltic). Many commercially proven offshore projects also utilize Lidar for remote wind sensing from the adjacent shore. Finally, Windstream has access to more than nine years of wind data from multiple wind measuring masts at the adjacent Wolfe Island wind project, as well as data from in-water buoys and a series of wind measuring stations that surround Lake Ontario. The on-shore wind speeds were projected off-shore using recognized meteorological techniques.

2.1.1.2 ORTECH Wind Resource Assessment (Report: March 2011)

The additional wind resource study confirmed that an excellent wind resource exists in the WIS Project area. Speeds are comparable to offshore to those seen only in European offshore wind projects and are considerably higher than onshore speeds measured in Ontario.

One of the ongoing factors identified for the WIS Project was the need to continue to improve the understanding of the wind regime and thus the energy and revenue generating potential of the off-shore wind farm. To further reduce uncertainty, additional wind resource assessments were initiated between execution of the FIT Contract and the moratorium.

Windstream commissioned another wind resource assessment to improve the understanding and increase confidence in the energy potential of the WIS Project identified below:

- ORTECH Power (Updated Wolfe Island Shoals Offshore Wind Report: March 2011)

In the absence of the require regulatory permissions to install a suitable off-shore towers, the wind resource study relied on data collected from on-shore meteorological towers located near the WIS Project area. The on-shore wind speeds were projected off-shore using recognized meteorological techniques.

To further reduce uncertainty, a meteorological tower was installed on Wolfe Island at Long Point (December 2011) and additional wind resource assessments were initiated as described in sections to follow.

2.1.1.3 ORTECH Wind Resource Assessment (Report: October 2012)

The additional wind resource study confirmed that an excellent wind resource exists in the WIS Project area.

One of the ongoing factors identified for the WIS Project was the need to continue to improve the understanding of the wind regime and thus the energy and revenue generating potential of the off-shore wind farm. To further reduce uncertainty, additional wind resource assessments were initiated after the moratorium.

Windstream commissioned another wind resource assessment to improve the understanding and increase confidence in the energy potential of the WIS Project identified below:

- ORTECH Power (Updated Wolfe Island Shoals Offshore Wind Report - 2012: October 2012)

In the absence of the require regulatory permissions to install a suitable off-shore towers, the wind resource study relied on data collected from on-shore meteorological towers located near the WIS Project area. The on-shore wind speeds were projected off-shore using recognized meteorological techniques.

2.1.1.4 AWS TrueWind and GLGH Wind Resource Assessments (Reports: July and September 2013)

The updated wind resource studies once again confirmed the existence of an excellent wind resource in the WIS Project area with slightly higher revenue potential than earlier studies.

One of the factors identified for the WIS Project is continuing to improve the understanding of the wind regime and thus the energy and revenue generating potential of the off-shore wind farm. Windstream commissioned wind resource assessments to improve the understanding and increase confidence in the energy potential of the WIS Project. The studies commissioned by Windstream during this period are listed below. These studies are based on the same turbine layout (beyond 5 km), make and model (130 Siemens 2.3 MW – 113) and using the most current wind measurement data, including data collected from the meteorological tower installed nearby at Long Point.

- AWS TrueWind (Wolfe Island Shoals Wind Project Wind Resource and Energy Production Summary: July 2013)
- GL Garrad Hassan (Wolfe Island Shoals Wind Farm Preliminary Energy Assessment: September 2013)

In the absence of the required regulatory permissions to install a suitable off-shore towers, the wind resource study relied on data collected from on-shore meteorological towers located near the WIS

Project area. The on-shore wind speeds were projected off-shore using recognized meteorological techniques.

To further reduce the uncertainty associated with the data from existing meteorological towers located on Wolfe Island, Windstream installed an 80 m meteorological tower at Long Point on Wolfe Island. Long Point was selected as it represents a spit of land that projects out into the WIS Project area and thus expected to be more representative than the towers located farther inland. The Long Point tower started collecting valid meteorological data in December 2011.

The testing facilities and further wind resource assessments were updated to ensure that the WIS Project was significantly advanced in testing and development when issues related to the site release process for offshore wind projects are resolved. The primary objective of these most recent studies were to provide more than one independent assessment using the same layout and turbine make and model using a range of modeling methods and the most recent meteorological data including data collected at Long Point in order to further reduce uncertainty in the predicted wind resource.

The key conclusions of this study are summarized below (paraphrased from report identified above).

The range in results from these most recent wind resource studies conducted with comparable turbine layout and meteorological data is complementary. These wind resource assessments carried out using multiple industry standard methods indicate that the expected range of wind speeds and energy potential are sufficient to support the development of the WIS Project with capacity factors ranging from approximately 43% to 45%. These values are slightly improved over earlier studies and have greater certainty due to the additional data available for the analysis. A higher capacity factor is directly related to higher revenue generation potential. Ultimately, when allowed by government agencies, off-shore testing may be conducted to confirm these results.

2.1.1.5 ORTECH Wind Resource Assessment (Report: August 2014)

The updated wind resource study once again confirmed the existence of an excellent wind resource in the WIS Project area with comparable revenue potential relative to the previous two most recent studies.

One of the factors identified for the WIS Project is continuing to improve the understanding of the wind regime and thus the energy and revenue generating potential of the off-shore wind farm. Windstream commissioned another wind resource assessment to improve the understanding and increase confidence in the energy potential of the WIS Project. The study commissioned by Windstream during this period is listed below. The study was based on the same turbine layout (beyond 5 km), make and model (130 Siemens 2.3 MW – 113) using the most current wind measurement data, including data collected from the meteorological tower installed at Long Point.

- ORTECH (Wind Resource Assessment for Wolfe Island Shoals Offshore Wind Project Using SWT2.3-113: August 2014)

The key conclusions of this study are summarized below (paraphrased from report identified above).

The results from this most recent wind resource study are consistent with the previous two most recent studies conducted with comparable turbine layout and meteorological data. The wind resource assessment indicate that the expected range of wind speeds and energy potential are sufficient to support the development of the WIS Project with a capacity factor of approximately 44%. Ultimately, when allowed by government agencies, off-shore testing may be conducted to confirm these results and further reduce uncertainty associated with projecting the long term revenue of the WIS Project.

2.1.1.6 ORTECH Wind Resource Assessment (Report: May 2015)

The updated wind resource study once again confirmed the existence of an excellent, highly certain and bankable wind resource in the WIS Project area with comparable revenue potential relative to the previous most recent studies.

Windstream commissioned a follow-up study conducted by ORTECH Consulting Inc. ("ORTECH") with the primary objective to update the wind resource assessment using the latest meteorological data collected near the WIS Project site.

This updated detailed wind resource assessment ("WRA") utilized the most recent measurement data (December 2011 to March 2015) from SODAR equipment, the Long Point meteorological tower ("met mast") located on the south west apex of Wolfe Island and corresponding third party wind reference data. The previous ORTECH WRA, dated August 7, 2014, utilized Siemens SWT2.3MW-113 turbines with two layouts for the WIS Project. The two (2) layouts considered in this updated analysis are:

1. The Original 2014 Layout: including a minimum 5 km setback, consistent in layout with the previous ORTECH WRA dated August 7, 2014, the AWS TrueWind WRA, dated 2013, and the GL Garrad Hassan WRA, also dated 2013;

2. A revised 2015 Layout: including a minimum 5 km setback and incorporating a 1.5 km wide shipping lane buffer as reflected in a coastal constraint study by Baird, dated 2015 (see Section 2.1.5).

This updated WRA incorporates an extensive amount of wind resource data, including roughly 3.5 years of project specific met mast data, complementary SODAR data, and multiple long-term reference data sources corresponding to the same time period. This updated WRA estimates long-term average wind speed and net energy output at the same 90 meter hub height as the previous ORTECH WRA, dated 2014.

The key conclusions of this study are summarized below (paraphrased from report identified above).

Nearly identical net energy production of 1157 GWh/year and 1159 GWh/year was calculated for the Original 2014 Layout and the revised 2015 Layout respectively. Similarly, a capacity factor of 44.2% was calculated for both layouts. The results indicate that the layout revision possibly required to accommodate a shipping lane buffer has minimal impact on the overall energy output for the WIS Project.

The updated net energy output projections, incorporating significantly more wind resource data, are nearly the same as previous WRAs. The consistency in the energy output projections of the various WRAs, despite differences in layout and available wind data, provide a high degree of confidence in the overall results.

Certainty in Wind Resource Data and Analysis

The wind resource data and assessment for the WIS Project is considered to have a high degree of certainty and is suitable in support of financing for a multitude of reasons including:

1. ORTECH alone has completed four (4) previous WRAs (July 2010, March 2011, October 2012, and August 2014) plus this updated WRA. In addition to ORTECH, two other independent and reputable service providers conducted independent WRAs (AWS-2013, GLGH-2013). All service providers using different but industry recognized methods and different reference stations predicted similar energy output results. Each WRA carried out has been consistent with previous analyses. It is not uncommon for financing entities to require two (2) independent WRAs. The fact that Windstream has multiple analyses further increases the confidence in the predicted results.
2. The 80m tall met mast and Sonic Detection And Ranging (SODAR) installed by Windstream are ideally located on Long Point, a point of land that projects out into the WIS Project area. At the time of this updated WRA, Windstream had collected high quality data at Long Point for roughly 3.5 years, much longer than one (1) year of site specific data typically required for financing.
3. The data collected at the Long Point met mast is considered to be high quality since overall the various instruments have been collecting valid data for approximately 95% of the time, much higher than the 90% overall recovery rate normally considered by industry to be the minimum to ensure the data are representative.
4. The comparative analysis between the Long Point met mast and SODAR shows very good correlation coefficient ("R^2") for both wind speed and wind direction ($R^2 > 0.95$) measurements at the same height. This strong correlation between two independent measurement methods greatly improves certainty.

5. Wind shear is a measure of the change in wind speed with elevation and the calculated wind shear exponent is used to project the wind speed from the top of the met mast (80m) to the turbine hub height (90m). The SODAR also provides wind speed data up to a height of 200m. The wind shear exponent calculated using the SODAR and met mast were very similar and this strong correlation between two independent measurement methods greatly improves certainty.

6. Multiple additional short-term meteorological stations (Merry Farm, Hulton, Pikes, 50m Tower Buoy Stations) in the vicinity of the WIS Project were available and used to compare with Long Point data thus improving confidence in the modeling result.

7. The Long Point met mast data has good correlation with more than 30 years of wind speed measurements at various nearby reference stations (Point Petre, MERRA and NARR grid points). This improves the certainty in the analysis process of converting the relatively short-term Long Point met mast data (3.5 years) to predict the long-term wind regime.

The proximity of the WIS Project to the existing onshore Wolfe Island (TransAlta) project provides a significant amount of wind resource data that is often not available for new projects. This data, combined with extensive regional reference data, project specific SODAR data and a project specific meteorological tower on Long Point provided a large amount of available wind resource data for the WIS Project. The volume of data and the good correlation of the various wind data sources to one another provide a high degree of certainty in the WRA results.

Bankability

Based on a literature review of criteria used by debt rating agencies, the available wind resource data for the WIS Project is extensive and of high quality. Although lending decisions are made by the lender and at the lender's sole discretion, a comparison of published credit rating criteria would suggest that the available wind resource data or adequacy thereof would not be a limiting factor to the bankability of the WIS Project.

A quantitative analysis shows that the P90 probability rated energy output test used by debt rating agencies is not a limiting factor in debt sizing for the WIS Project. The results of the debt rating test results are a direct reflection of the quantity and quality of the wind resource data available for the WIS Project.

2.1.2 Grid Connection

2.1.2.1 HONI and IESO Grid Connection Assessment (Reports: November 2010)

The electrical impact assessment studies have not identified any material impediments that would prevent the WIS Project from successfully connecting to the Ontario electricity grid system. Windstream's priority access to the Ontario grid remains intact.

One of the key factors for any generation project is a secure electrical grid connection with sufficient capacity. Windstream commissioned WSP (formerly Genivar) to gather the required electrical specifications from possible wind turbine generator (WTG) suppliers and prepare various documents including but not limited to a single line drawing, protection and operating philosophy and collector feeder in support of the applications for impact assessments. Windstream also contracted MKE Engineering to project manage the impact assessment application process.

The application documentation was submitted to Hydro One Networks Inc. ("HONI") and the Independent Electricity System Operator ("IESO") requesting impact assessments for the WIS Project from both entities related to connecting the project to the Ontario transmission grid system at the existing Lennox Transformer Station (TS).

The Customer Impact Assessment (CIA) completed by HONI evaluates the impact of the WIS Project on existing customers connected to the transmission system while the System Impact Assessment (SIA) issued by the IESO evaluates the overall impact of injecting 300MW of wind power generation from the WIS Project on the reliability of the IESO controlled grid.

The CIA concludes that the proposed WIS Project will increase the supply available to the Lennox area and will provide generation in the area when Lennox GS is operating at a lower capacity as well as the possibility of voltage support in the Lennox region. HONI states that the WIS Project is not expected to adversely impact the transmission customers in the area.

The SIA concludes that based on the information provided, the proposed connection of the WIS Project, subject to the requirements specified, will not result in a material adverse effect on the reliability of the IESO-controlled grid. The SIA recommends that a Notification of Conditional Approval for Connection be issued for the WIS Project.

2.1.2.2 WSP (formerly Genivar) Grid Connection Confirmation Study (Report: November 2012)

It has been confirmed that the previously issued grid connection studies (described above) remain valid and that grid capacity continues to be available for the WIS Project.

One of the key concerns after the moratorium in February 2011 was whether the electrical grid connection previously approved by HONI / IESO as described above would remain secured for the WIS

Project. A grid connection confirmation study was conducted by WSP (formerly Genivar). The objective of the study was to meet with the IESO to obtain clarity on the status of the previously approved grid connection.

The key conclusions of this study are summarized below (paraphrased from report identified above).

WSP and ORTECH met with IESO in November 2012 during which the IESO confirmed that the System Impact Assessment for the WIS Project remains valid with no expiry date. As long as the WIS Project has a valid FIT Contract, the IESO considers the project as committed and that an SIA for any new generating projects proposing to connect at the Lennox TS will include the WIS Project as part of their study. Therefore, the SIA for other new projects will not change the connection requirements for the WIS Project. Barring any material changes that justify renewing the SIA, as far as the IESO is concerned, the next steps for the WIS Project is to initiate the Market Entry Process, typically about 9 months before commercial operations.

2.1.3 Geophysical / Geotechnical

2.1.3.1 Canadian Hydrographic Services and Canadian Seabed Research Lake Bottom Investigation Studies (Reports: January and March 2011)

The lakebed investigation studies have not identified any material impediments that would prevent the WIS Project from being built.

Windstream collected background data on the conditions of the lake bottom from publically available and other sources. However, one of the factors identified is the potential lack of information related to the geophysical conditions of the lake bottom specific to the WIS Project area. To improve this understanding, Windstream conducted lake bottom investigation studies that did not require land tenure or Ministry of Natural Resources (MNR) approval such as a regional bathymetry and geotechnical survey.

A preliminary site investigation was conducted by Canadian Seabed Research ("CSR") in 2010 which included a regional bathymetry and geophysical survey of the turbine area (5 km setback layout) as well as the export cable route of the WIS Project. CSR used state of science bathymetry, high resolution seismic and side scan sonar techniques including identification of artifacts such as shipwrecks in the WIS Project area. In addition, Windstream participated as a co-sponsor of a detailed bathymetry study conducted by Environment Canada: Canadian Hydrographic Services ("CHS"). CHS was conducting the survey to improve their understanding of the area of Charity Shoal and the Upper Gap of Adolphus Reach the latter of which overlaps with parts of the WIS Project proposed export cable route and thus the interest in co-sponsoring the survey.

The key conclusions of this study are summarized below (paraphrased from report identified above).

The water depth in the turbine area (5 km layout) and cable route range from approximately 6m to 41m and 6m to 60m, respectively. The sediments within the survey areas ranged from soft and fine sediments with varying amounts of shell fragments to coarse materials to bedrock that is exposed on the lake floor. Unconsolidated sediment depths vary up to 2m thick with some pockets of shallow gas.

The lake bottom investigations confirm that there is a significant understanding of the water depth and geophysical conditions with sufficient information available to engineers for the purpose of conceptual design of the WIS Project foundations and cable route. Based on these studies, Windstream developed a general turbine layout (5km setback layout) choosing water depths ranging from > 5m but < 30 m based on environmental and engineering design considerations. When allowed by government agencies, additional study such as turbine location specific bathymetry and geophysical testing will be required to better understand the sedimentary layers and further advance engineering design of the foundations. Also, although relatively few issues are expected in routing the export cable from Pigeon Island to the mainland (near Lennox TS), additional ground truth testing such as grain size and composition of the surficial geological units will also be conducted when allowed by government agencies.

2.1.3.2 Inspecsol Geotechnical Study (Report: February 2013)

The geotechnical study has not identified any material impediments that would prevent the WIS Project from being built.

In January 2012, Windstream submitted an application to the MNR (Petroleum Operations Section) for a geotechnical test drilling program to improve the understanding of the conditions of the lake bottom in the WIS Project area. The application was rejected by the MNR on the basis that the WIS Project does not have the required land tenure that would permit access to these Crown Lands for the purpose of test drilling. On this basis, despite the fact that the fact of land tenure was a result of the actions of the government including but not limited to the proposed 5 km set back, the MNR decided not to process the permit application for geotechnical test drilling.

However, improving the understanding of the geotechnical conditions remained a factor and as a result Windstream commissioned a desktop geotechnical study with the primary objective to improve the understanding of the conditions in the WIS Project area.

The preliminary geotechnical review was conducted by Inspecsol Engineering Solutions (“Inspecsol”). Inspecsol was provided with geotechnical data collected to date by Windstream. Inspecsol conducted additional research of publically available bathymetry and geotechnical data and evaluated internal data sources based on their considerable experience having been involved in the geotechnical assessment for several renewable energy and construction projects in the area.

The key conclusions of this study are summarized below (paraphrased from report identified above).

The geotechnical study confirms that there is a level of understanding of the prevailing geotechnical conditions and sufficient information is available to engineers for the purpose of conceptual design of the WIS Project foundations. Additional study, including geotechnical drilling, will be conducted to further advance engineering design when allowed by government agencies.

2.1.4 Coastal Processes and Wind, Wave and Ice

2.1.4.1 Baird Ice Study (Report: December 2012)

The ice study has not identified any material impediments that would prevent the WIS Project from being built.

The off-shore wind farms currently in operation are built in salt water (North Sea), brackish water (western Baltic) or close to fresh water (north-eastern Baltic) environments. One of the factors identified by government as the basis for a moratorium is the alleged lack of understanding of the cold weather environment and in particular information related to ice impacts on a wind farm built in fresh water such as Lake Ontario. However, the Baltic Sea does have ice conditions that are similar to, or exceed those of eastern Lake Ontario.

In addition, the MOECC moratorium stated (bolding added):

"Offshore wind power development in ocean environments is relatively well understood technology and has been successfully deployed in several locations in Europe. By contrast, offshore wind power development in freshwater lakes is relatively new and presents technical challenges that do not exist in a saltwater environment, such as the need to manage potential impacts to drinking water **and the effects of ice build-up on support structures**. A recently constructed offshore wind pilot project is currently operating in Lake Vänern, a freshwater lake in Sweden. A second pilot project has been proposed in the State of Ohio in Lake Erie near Cleveland. Ontario will monitor these projects and the resulting knowledge gained from their construction and operation. Ontario will work with our US neighbours to undertake collaborative research and study that will ensure that any future projects are designed and implemented in a manner that is protective of human health, cultural heritage and the environment."

Windstream commissioned an ice study with the primary objective to improve the understanding of the current extent of information available to evaluate ice impacts and whether a lack of information posed a technical risk to the WIS Project. The ice study was necessary to evaluate whether there were any material impediments associated with ice-related issues that could not be mitigated through good engineering practices.

An ice study was conducted by W.F Baird & Associates Coastal Engineers Limited ("Baird"). Baird was provided with wind turbine generator layouts based on the WIS Project reconfigured beyond the proposed 5 km shoreline exclusion zone. The ice study included a review of literature and a preliminary ice assessment specific to the WIS Project area including a summary of historical ice conditions, development of ice loads on foundations suitable for preliminary design purposes, an evaluation of the potential impact of the WIS Project on the ice environment as well as summary of site access considerations.

The key conclusions of this study are summarized below (paraphrased from report identified above).

The ice study confirms that there is a level of understanding and sufficient information available to engineers to assess ice impacts for the purpose of design. The potential impact on the shoreline due to changes in the ice conditions as a result of the WIS Project is expected to be minor and in the case of lee shoreline owners, may actually reduce erosion. Also, reasonable provisions are available to mitigate risk associated with access to the wind turbines for maintenance purposes during periods of ice. The ice study addresses the concern raised in the moratorium related to "technical challenges….such as the need to manage potential impacts to drinking water and **the effects of ice build-up on support structures**".

2.1.4.2 ORTECH Preliminary Wave Analysis Study (Report: April 2013)

The wave study has not identified any material impediments that would prevent the WIS Project from being built.

It is expected that wave heights in the WIS Project area are on average significantly less than those associated with most other off-shore projects.

Windstream commissioned a preliminary wave study with the primary objective to improve the understanding of the current extent of information available to evaluate wave impacts and whether a lack of information posed a technical risk to the WIS Project. A preliminary wave study was conducted by ORTECH Consulting Inc. ("ORTECH"). The screening level study included the review and statistical analysis of select publically available wave data.

The key conclusions of this study are summarized below (paraphrased from report identified above).

Although further wave data sources are available, the preliminary wave study confirms that there is a level of understanding and sufficient information available to engineers to assess impacts for the purpose of design. Additional study, which may include wave and current field monitoring, will be conducted to further advance engineering design when allowed by government agencies.

2.1.4.3 Baird Baltic Sea versus Lake Ontario Study (Report: October 2013)

The Baltic Sea versus Lake Ontario study has not identified any material impediments that would prevent the WIS Project from being built.

Windstream commissioned a study with the primary objective to improve the understanding of the current extent of information available on metocean conditions and whether a lack of information posed a technical risk to the WIS Project. The study compared the metocean conditions of the Baltic Sea, which includes several offshore wind farms, versus Lake Ontario with respect to the ability to design, build, operate, and maintain an offshore wind farm in these environments.

The Baltic Sea versus Lake Ontario study was conducted by W.F Baird & Associates Coastal Engineers Limited ("Baird"). The study included a review of literature and a preliminary assessment and comparison of Baltic Sea and Lake Ontario metocean conditions including winds, waves, water levels, currents, salinity, water level and ice conditions.

The key conclusions of this study are summarized below (paraphrased from report identified above).

The study confirms that there is a level of understanding and sufficient information available to engineers regarding metocean conditions for the purpose of design. The differences between the metocean conditions at existing Baltic Sea sites and those on Lake Ontario do not undermine the ability to use the existing operating wind farms in the Baltic Sea to better understand the potential effects of a Lake Ontario wind farm.

The two regions share a similar climate, and a similar geological history. The Baltic Sea is larger, deeper, and contains more water than Lake Ontario; however the two water bodies show many similarities under typical daily conditions (wind, waves, water levels, currents, and water temperature). During storms the Baltic Sea generally has more severe conditions (wind, waves, and water levels) than Lake Ontario.

Other parameters such as salinity and winter ice cover have significant spatial variations in the Baltic Sea. The salinity is relevantly different in the southern Baltic Sea compared to Lake Ontario, but the northern Baltic Sea demonstrates salinity conditions that are very close to the freshwater conditions present in Lake Ontario. Winter ice cover in the northern Baltic Sea is more severe than is experienced on Lake Ontario, with the southern Baltic Sea less severe than Lake Ontario.

The meteorological and oceanographic conditions in the Baltic Sea and Lake Ontario are sufficiently similar to support direct comparisons of likely impacts from an offshore wind farm. There is no evidence to suggest that impact assessment methods or tools developed for use on offshore wind farms in the Baltic Sea cannot be reasonably used for Lake Ontario.

2.1.4.4 Baird Coastal Processes and Wind, Wave and Ice Study (Report: June 2015)

The coastal processes and wind, wave and ice study has not identified any material impediments that would prevent the WIS Project from being built.

Windstream commissioned a study conducted by W.F Baird & Associates Coastal Engineers Limited ("Baird") with the primary objective to improve the understanding of coastal processes and wind, wave and ice conditions and whether this posed a technical risk to the WIS Project.

The key conclusions of this study are summarized below (paraphrased from report identified above).

Baird demonstrated that there will be no impact. The predominant waves are not directed to the U.S. shore, and in any event, the WIS Project will have negligible effect on waves in the far-field. The U.S. shore is 8 to 10 km away and predominantly bedrock. It is not sensitive to changes in wave climate. A further detailed assessment of the effects of the WIS Project on shoreline processes would have been undertaken as a routine part of the project assessment, and the WIS Project schedule allows for this be completed.

Based on the available evidence of the site conditions, Baird's extensive experience with Lake Ontario coastal conditions, as well as analysis completed by others for similar conditions in peer-reviewed literature, Baird had "*not identified any material impacts or impediments with respect to the physical coastal processes."* Certainly, but for the Moratorium, additional, more detailed coastal studies would have been completed by Windstream as part of the standard, routine design development to confirm the preliminary analysis by Baird. Nevertheless, Baird's expert understanding of the fundamentals of coastal processes, experience with actual Lake Ontario conditions and analysis of similar projects supports the position that material impacts or impediments with respect to the physical coastal processes related to the WIS Project were not identified and are not expected.

Knowledge of the wave conditions is sufficient for the safe design of the WIS Project in-water Structures and additional field measurements are not required. Weather windows (wind and waves) for construction have been appropriately considered in the WIS Project schedule. Baird completed a statistical analysis using 40 years of wind and wave data. This information was combined with actual operating limits for off-shore construction activities provided by Sgurr and their construction subcontractor Weeks/McNally Marine to confirm that weather related delays were adequately characterized in the WIS Project schedule.

Ice conditions were studied in the early design phase of the WIS Project and were incorporated into the preliminary design of the turbine foundations. Sensitivity analysis would have been included in the standard, routine design development phase of the WIS Project and is allowed for in the WIS Project schedule. There is sufficient information and experience with ice to show that the WIS Project is feasible.

2.1.5 Shipping and Navigation

2.1.5.1 Baird Shipping and Navigation Study (Report: June 2015)

The shipping and navigation study has not identified any material impediments that would prevent the WIS Project from being built.

Windstream commissioned a study conducted by W.F Baird & Associates Coastal Engineers Limited ("Baird") with the primary objective to improve the understanding of shipping and navigation activity in the area and the current practice on the St. Lawrence Seaway and whether this posed a technical risk to the WIS Project.

The key conclusions of this study are summarized below (paraphrased from report identified above).

The existing channel configuration and width of the designated Lake Ontario up bound navigation route for Great Lakes - St. Lawrence Seaway shipping, adjacent to the WIS Project turbine array (refined 2015 layout), is safe.

The existing navigated channel is 1200 to 1500 m wide and is limited to one-way traffic only. At minimum, the existing channel for one-way traffic is more than two times wider than most of the other established navigation channels on the Great Lakes – St. Lawrence Seaway system that carry two-way traffic. The Seaway has been safely operating in this manner for over 50 years. Pilotage is mandatory on the Seaway, thus minimizing risk of collisions. Further, the existing 1200 – 1500 m wide up bound channel is physically limited to its present width and location by the presence of natural shoals and islands.

2.1.6 Domestic Content

2.1.6.1 ORTECH Domestic Content Plan (Report: November 2011)

The domestic content study has not identified any material impediments that would prevent the WIS Project from being built.

The FIT Contract awarded for the WIS Project in May 2010 specified a minimum required domestic content level (MRDCL) of 50%. One of the factors identified for the WIS Project is the ability to meet this contractual requirement.

Windstream received a Waiver Agreement Re: Pre-NTP Termination Right from the Ontario Power Authority ("OPA") in August 2011 (the "waiver"). In support of the waiver, Windstream submitted a Domestic Content Plan for the WIS Project in the form prescribed by the IESO (formerly the Ontario Power Authority). While not a mandatory requirement, to assist in the assessment of the Domestic Content Plan, Windstream also submitted a report prepared by ORTECH titled "Wolfe Island Shoals

Domestic Content Plan (Waiver)" which provides additional detail on how the WIS Project will be delivered to meet the contractual domestic content requirements.

The key conclusions of this study are summarized below (paraphrased from report identified above).

While not necessarily a current requirement, due to a World Trade Organization decision, based on the contemplated project supply arrangements and evidence provided by suppliers, the domestic content analysis carried out indicates there is no reason to believe that the WIS Project cannot meet or exceed the MRDCL of 50% as defined in the FIT Contract.

2.1.7 Overall Project Feasibility

Several studies were completed to improve the understanding of foundation design options, foundation and turbine installation strategies and the overall technical feasibility of the WIS Project as described in the following sections.

2.1.7.1 Sgurr Initial Installation Vessels Study (Report: November 2013)

The installation vessel study has not identified any material impediments that would prevent the WIS Project from being built.

One of the key factors identified is the level of understanding of installation vessel options relevant to the WIS Project. This is particularly relevant to the WIS Project which must consider the limitations presented by the St Lawrence Seaway lock system.

An installation vessel study was conducted by Sgurr Energy ("Sgurr"). The objective of the study was to improve the level of understanding and general specifications of vessels needed in support of the offshore construction activities of the WIS Project. The study outlined general specifications including but not limited to codes and standards, environmental/health/safety, turbine supplier requirements, transportation protection, adverse weather considerations, inspection and testing and documentation requirements.

The WIS Project has considered vessel specifications required to support the offshore construction activities including vessels required in support of the foundation and WTG installation as described above.

2.1.7.2 COWI Initial Foundation Design Study (Report: March 2014)

The foundation design study has not identified any material impediments that would prevent the WIS Project from being built.

One of the factors identified is the level of understanding of foundation design options relevant to the WIS Project. The lake bottom investigation, geotechnical, ice and other studies discussed previously confirm that there is a level of understanding and sufficient information available to engineers to assess impacts for the purpose of conceptual foundation design. It is understood that additional study, which may include field monitoring, will be required to further advance engineering design when allowed by government agencies. Sgurr Energy conducted an overall technical feasibility study (discussed below) and identified that a gravity based foundation design had a strong potential for the WIS Project.

A more detailed foundation design study was conducted by Ocean and Coastal Consultants Inc. ("COWI"). The objective of the study was to develop a conceptual design of a semi-floating concrete gravity based foundation ("GBF") including determination of overall dimensions and weights to understand the viability of such a design for the WIS Project. The parameters considered in the design included site specific conditions such as water depth, design wave height, design current, ice (sheet and ridge) parameters, geotechnical conditions and turbine characteristics or loads. The design considered methods for staging, fabrication, site preparation and installation relevant to Lake Ontario.

Gravity based foundations have been selected as the most likely foundation type for the majority of the WIS Project due to a number of site specific conditions including the proximity of bedrock and lack of overburden suitable for monopole type foundations common in ocean environments. Additionally, the ready availability of aggregate and cement products in the immediate area as well as seasonal icing also influenced this selection. The final foundation design would include an ice cone. It is expected that the GBFs will be fabricated at a Lake Ontario facility.

A semi-floating GBF concept for the WIS Project was designed for transportation and installation without heavy lift construction vessels.

The study provides construction and load out/launching facility recommendations including upland area, wharf capacity, water depth and air draft based on the proposed installation methodology. The GBFs will be fabricated on land and skidded on concrete rails using large hydraulic jacks. The foundations will be skidded until over water and loaded on to an elevator platform. The elevator system will then lower the GBF into the water where the transportation process will begin. Transportation of the GBF will rely on integrated buoyancy tanks with supplemental flotation provided by detachable, reusable steel pontoons or barges. The supplemental flotation units also serve to lower the GBF into final position during the installation phase. Further details related to foundation

installation and installation vessels are described in the following sections ("Foundation and WTG Installation Study" and "Installation Vessels Study").

The study presents a viable foundation design that considers the unique challenges associated with building the WIS Project in Lake Ontario within the confines of the St Lawrence Seaway. From a foundation design perspective, no material impediments were identified that would suggest the WIS Project could not have been built.

2.1.7.3 Weeks Marine Initial Foundation and WTG Installation Study (Report: March 2014)

The foundation and wind turbine generator installation study has not identified any material impediments that would prevent the WIS Project from being built.

One of the key factors identified is the level of understanding of foundation and wind turbine generator (WTG) installation options relevant to the WIS Project. This is particularly relevant to the WIS Project which must consider the limitations presented by the St Lawrence Seaway lock system.

A foundation and WTG installation study was conducted by Weeks Marine Inc. ("Weeks"). The objective of the study was to provide a summary of the means and methods available for the installation of the semi-floating gravity based foundations described above as well as the wind turbine generators themselves.

The study describes the roles of the Offshore Installation Contractor ("OIC") including providing supplemental flotation, towing to the site, site preparation (dredging and stone bedding) and lowering the GBF on to the stone bedding. The OIC is also responsible for providing the equipment and the support crews for the installation of the Wind Turbine Generator (WTG) components including the towers, nacelles and blades.

Plans for the required specialized barges and heavy lift devices are provided including supplemental floatation barges and jacking devices. Methods for preparation of the gravity bed foundation locations such as dredging to remove overburden, if necessary, and placement of a gravel bed are described. The procedures involved in securing the semi-floating GBF at the fabrication yard, transportation to the site and placement by removal of supplemental floatation are described including the estimated cycle time. Once in place, the sand ballast tanks of the GBF will be filled and scour protection will be installed to prevent erosion during severe weather conditions.

Barges, including a jack up barge capable of installing the wind turbine generators, are accessible to Lake Ontario. A jack up barge was selected for the WTG installation due to the generally hard (limestone) lake bottom making traditional anchoring challenging.

Considering known geotechnical, bathymetric and weather data, the study describes means and methods considered to be a viable and a comprehensive solution for the installation of foundations and wind turbine generators for the WIS Project. As the final design progresses, these means and methods may be adjusted accordingly.

2.1.7.4 Sgurr Initial Overall Technical Feasibility Study (Report: July 2014)

The overall technical feasibility study has not identified any material impediments that would prevent the WIS Project from being built.

Dozens of offshore wind projects have been constructed or are under development around the world. Although there are examples of offshore wind projects built in fresh water (Lake Vanern, Sweden) or low salinity environments, most are built in salt water ocean environments such as the North Sea. Windstream understood that building an off-shore wind farm in Lake Ontario has several advantages but also some unique challenges relative to traditional ocean environments.

An overall technical feasibility study was conducted by Sgurr Energy ("Sgurr"). At the time of writing the study, Sgurr had been lead engineer, financier's engineer or project manager on 39 offshore wind projects. They are considered one of the world's foremost engineering authorities on offshore wind. The objective of the study was to review available documentation and comment on the feasibility of constructing and viability of operating the WIS Project. The study primarily focused on an evaluation of the technical aspects of the WIS Project including review of studies prepared by others (many of which are also discussed independently in this summary report) but also considered other aspects of the development of infrastructure projects such as the capabilities of the project team. The study evaluated the known attributes of the site, including transmission system, foundation and installation aspects considering general industry practices.

The key conclusions of this study are summarized below (paraphrased from report identified above).

Although the moratorium has created delays which have limited the WIS Project from completing all the necessary studies, considerable progress has been made to advance a study of the overall feasibility of the WIS Project. Several key attributes were identified that contribute to the overall technical viability of the WIS Project such as:

- a Feed-in Tariff (FIT) contract for a fixed duration and rate
- a robust and dedicated grid interconnection point with significant existing transmission capacity
- a realistic foundation fabrication and installation strategy
- a fresh water location which limits corrosion and provides favorable metocean conditions relative to tradition ocean environments (i.e. lower current/waves and weather risk)

- close proximity to construction raw materials and industrial manufacturing capacity
- a well experienced and financially sound turbine supplier (Siemens)
- a robust wind energy source that will lead to comparatively high energy production

The implementation of the WIS Project as proposed is technically feasible and in several areas considered less technically challenging than existing offshore wind projects of similar size in Europe.

2.1.7.5 COWI Follow-up Foundation Design Study (Report: June 2015)

The foundation design study has not identified any material impediments that would prevent the WIS Project from being built.

Windstream commissioned a follow-up study conducted by Sgurr Energy ("Sgurr") in association with Energy Ocean and Coastal Consultants Inc. ("COWI") further assess the proposed foundation design and manufacturing process and the associated schedule and whether this posed a technical risk to the WIS Project.

The key conclusions of this study are summarized below (paraphrased from report identified above).

Based on COWI experience and the information provided by Windstream and Sgurr Energy, it is COWI's opinion that the GBF is the most suitable foundation for the WIS Project. GBF's are a proven technology that has been installed in multiple European offshore wind farms.

GBF have been successfully installed at over 13 operating offshore wind farms. As future projects are becoming larger, and the number of installed turbines increases, GBF are becoming increasingly favorable; GBF are envisioned as a viable and efficient foundation for many UK Round III projects in up to 55m of water.

The semi floating GBF provides significant advantages to the WIS Project by capitalizing on the local supply chain, eliminating the need for specialized heavy lift installation vessels and supporting a higher rate of foundation installation. This foundation design was chosen for the WIS Project based on site conditions, ready supply of raw materials and an experienced supply chain.

GBF are particularly well suited for installation at the WIS Project. The materials and technology required to fabricate GBF are readily available, the foundation design is particularly well suited for the water depth, geotechnical conditions and ice found on Lake Ontario and similar designs are being studied or are in process of being developed at other locations in the Great Lakes.

The foundation fabrication facility design selected Bowmanville, Ontario as a representative site at which to demonstrate the potential of establishing such a fabrication facility on the Ontario side of Lake Ontario. In addition, SgurrEnergy and COWI were able to identify a number of other potential

sites on Lake Ontario, including Oakville, Toronto, Pickering Oshawa, Port Hope Harbor, Cobourg, Victoria Beach, Picton and Kingston that are likely also capable of serving as a foundation fabrication facility.

2.1.7.6 Weeks/McNally Marine Follow-up Foundation and WTG Installation Study (Report: June 2015)

The foundation and wind turbine generator installation study has not identified any material impediments that would prevent the WIS Project from being built.

Windstream commissioned a follow-up study conducted by Sgurr Energy ("Sgurr") in association with Weeks Marine/McNally Construction ("Weeks/McNally") further assess the proposed foundation and turbine installation process and the associated schedule and whether this posed a technical risk to the WIS Project.

The key conclusions of this study are summarized below (paraphrased from report identified above). The foundation installation plan assumes the use of multiple, low-cost, supplemental floatation barges, which are small vessels that can be built in any small to medium size shipyard or steel fabrication facility with water access. This is a significant cost and schedule advantage for the WIS Project as multiple sets of supplemental floatation barges support a much faster foundation installation rate than that achievable with a heavy lift vessel. Another distinct advantage is that multiple sets of supplemental floatation barges provide redundancy and schedule certainty, something not available to a project reliant on a single heavy lift vessel.

The on-water construction work can be accomplished in two seasons, with fabrication of the precast foundation units beginning the year ahead of the start of on-water work. This includes weather and mechanical downtime.

Weeks Marine estimates that 4 separate foundation installation barges transporting and setting the units will be used. This will require less than 12 months setting the foundations, including the winter shutdown. With four installation barges in rotation and a 35% weather and mechanical contingency, one foundation would be installed approximately every 2.5 days. The transport of the semi-buoyant foundations while attached to installation pontoons will only be minimally affected by the wave and wind conditions expected on Lake Ontario during the construction season, and the 35% downtime incorporated into the WIS Project schedule covers those delays.

Weeks/McNally has a marine operations yard less than 50 nautical miles from the WIS Project site and their significant experience working on the lake raises no concern that lake conditions will significantly impact operations. The foundation design and installation methodology is specifically tailored to use

the types of vessels readily available in Canadian waters. At least 6 existing jack-up or pin-up vessels, not counting the R.D. MacDonald have been identified that could be utilized for turbine installation.

2.1.7.7 Sgurr Follow-up Overall Technical Feasibility Study (Report: June 2015)

The overall technical feasibility study has not identified any material impediments that would prevent the WIS Project from being built.

Windstream commissioned a follow-up study conducted by Sgurr Energy ("Sgurr") in association with several other technical experts identified and discussed throughout this report to further assess the overall technical feasibility including the main design and construction aspects and the associated schedule and whether this posed a technical risk to the WIS Project.

The key conclusions of this study are summarized below (paraphrased from report identified above).

The responses and inputs from industry experts, combined with Sgurr Energy's experience on offshore wind projects, provide clear evidence that the WIS Project is viable and could be constructed within the Feed-in-Tariff ("FIT") program's timelines.

The WIS Project should not be considered "first of a kind" when viewed through the wider lens of the 8,759 MW of offshore wind capacity installed globally, or the 9,700 MW of onshore Canadian wind projects. Much of the technology proposed to be used for the WIS Project (wind turbine generators, gravity based foundation, undersea power cable) is widely proven and extensively used both throughout North America and the world.

2.1.7.8 Baird "First of Kind" Analysis (Report: June 2015)

The study has identified numerous infrastructure and construction projects which confirm that the WIS Project is not "first of kind".

Windstream commissioned a study conducted by W.F Baird & Associates Coastal Engineers Limited ("Baird") with the primary objective to improve the understanding of large fresh water construction projects and whether this posed a technical risk to the WIS Project.

The key conclusions of this study are summarized below (paraphrased from report identified above).

The WIS Project should not be considered "*first of kind*" on the Great Lakes because the design, impact assessment, permitting, scheduling and construction of the various components of the WIS Project have been undertaken before on the Great Lakes.

Above the turbine foundation ice cone and above water, the offshore wind turbines are substantially the same as onshore turbines that have been designed and permitted in Ontario. Below water, the marine components of the WIS Project, such as dredging, stone bedding, concrete pier foundations

and electrical cables, are similar to other marine projects that have been safely permitted and constructed in freshwater Lake Ontario and other Great Lakes for over a century. One example is the Yamachiche Light Pier on the freshwater, ice-covered St. Lawrence Seaway. Another example, with multiple concrete piers, is the Confederation Bridge between New Brunswick and Prince Edward Island, Canada. Many more examples are provided in the Baird report. Wind turbines have also been successfully constructed in freshwater in Europe (e.g., a 30 MW wind energy project in operation on Sweden's Lake Vänern since late 2009) and many more in low salinity environments. In fact, in many ways freshwater conditions pose fewer challenges than saltwater (e.g., less corrosion).

2.2 Environmental

2.2.1 Noise

2.2.1.1 HGC Noise Study (Report: July 2014)

The noise study has not identified any material impediments that would prevent the WIS Project from being built.

Windstream commissioned a preliminary noise study to evaluate the potential impact of the WIS Project based on the current MOECC noise criteria and technical publications. The primary objective of the preliminary noise study was to better understand whether the WIS Project could meet the current noise criteria.

A preliminary noise study was conducted by HGC Engineering ("HGC"). HGC was provided wind turbine generator layouts based on the WIS Project reconfigured beyond the proposed 5 km shoreline exclusion zone. The noise propagation over water was estimated using various models (uncorrected and corrected ISO model, Swedish model) to evaluate the impact at the nearest point of reception (dwelling) to a wind turbine generator. These models were selected as they were being considered by the MOECC for evaluating noise from off shore wind projects at the time of the preliminary noise study. The preliminary noise study also considered the cumulative impact of the WIS Project in addition to other nearby wind projects, specifically the existing operating wind farm on Wolfe Island.

The key conclusions of this study are summarized below (paraphrased from report identified above).

Calculations made using the various models predict a value of less than 40 dBA at the closest existing residential receptor. Although there is a significant variation in the results predicted by the various models, considering the setback distance currently proposed for the WIS Project, all models indicate compliance with the MOECC sound level limits at the closest existing receptor location. The noise study indicates that the WIS Project developed beyond the proposed 5 km setback could meet current noise criteria.

2.2.1.2 ORTECH Atmospheric Jet Study (Report: May 2015)

The study of atmospheric jets has not identified any material impediments that would prevent the WIS Project from being built.

Windstream commissioned a study conducted by ORTECH Consulting Inc. ("ORTECH") to analyze meteorological data and investigate the potential for atmospheric jets (low level jest and boundary layer jets) specific to the area of the WIS Project.

The analysis use synthesized wind speed data from the Sonic Detection And Ranging ("SODAR") unit as well as data from the 80m meteorological tower both installed at Long Point on Wolfe Island, a spit of land that extends out in to the turbine area.

The key conclusions of this study are summarized below (paraphrased from report identified above).

This analysis indicates that jets of 2 hours or more in duration are **not common** with evidence of only sixteen (16) occasions over the 39 month data period (December 2011 to March 2015). When evaluating the potential impact of industrial facilities, the MOECC allows for the removal of up to eight (8) one (1) hour predictions for each year of analysis (i.e. ≈0.1% = 8 x 1 hour / 24 hr x 365 days/yr x 100) which are deemed as meteorological outliers. Based on the available data, the frequency of jets in the area of the WIS Project are in the range of the frequency of meteorological outliers the MOECC allow to be omitted when evaluating industrial facilities.

2.2.1.3 Aercoustics Noise Study (Report: June 2015)

The noise study has not identified any material impediments that would prevent the WIS Project from being built.

Windstream commissioned a study conducted by Aercoustics Engineering Limited ("Aercoustics") to investigate noise propagation characteristics over water and ice specific to the area of the WIS Project in order to improve the overall understanding of the topic and whether this posed an environmental risk to the WIS Project. The findings of the noise propagation measurement work were used to inform noise modelling of the WIS Project.

The noise study involved two phases:

1. Conducting noise propagation measurements in the actual WIS Project area to determine an appropriate noise propagation model for offshore wind projects, specifically whether the existing approved MOECC noise model for over-land wind projects would be applicable for an over-water wind project; and
2. Noise modelling for the WIS Project for two (2) proposed 130 turbine layouts:

- The original (2014) Layout: including a minimum 5 km shoreline setback (Note: the same layout was evaluated in a previous noise analysis (HGC Noise Study discussed above)
- A slightly revised (2015) Layout: also including a minimum 5 km mean setback (excluding uninhabited or uninhabitable points) with a 1.5 km wide shipping lane buffer included (Note: the shipping lane buffer is discussed in detailed in Section 2.1.5).

The key conclusions of this study are summarized below (paraphrased from report identified above).

Based on this study, Aercoustics is of the opinion that it is appropriate to conduct noise modelling of the WIS Project using the existing standard modelling practices required in Ontario for evaluating outdoor noise impact from onshore wind energy projects (ISO 91613-2).

The results show that the proposed WIS Project (both 2014 and 2015 layouts) is expected to have a very small noise impact at any of the land based noise receptors near the project area. The analysis also shows that the WIS Project (both 2014 and 2015 layouts) would meet the 40 dBA sound level limit requirements specified by the MOECC.

If receptors are within 1.5km of a turbine, the existing noise modelling guideline would trigger the need to also assess cumulative impacts at those receptors. There would not be any receptors within 1.5km of the WIS Project. However, at the request of Windstream, the noise impact analysis considered the cumulative impact at all the receptors up to at least 10km from the closest wind turbine, as well as the existing onshore Wolfe Island wind energy project (TransAlta). The analysis has shown that for all the receptors within 1.5km from an existing TransAlta wind turbine, the contribution from the WIS Project would be at 25dBA or less. This corresponds to a noise level comparable to a very still night in a rural environment. This noise level is 15 dBA below the 40 dBA MOECC noise limit, and therefore the WIS Project is not expected to have any cumulative effect beyond the existing wind energy Project (TransAlta).

Based on the work conducted so far and considering the existing 550m setback for land based turbines, the equivalent noise setback from water based turbines would be approximately 750m from sensitive noise receptors. Thus, the originally proposed 5 km setback (MOECC proposed limit in 2010) is more than five times farther than would likely be required from a noise perspective.

2.2.2 Sediments and Drinking Water

2.2.2.1 Baird Initial Sediments and Drinking Water Study (Report: January 2013)

The drinking water study has not identified any material impediments that would prevent the WIS Project from being built.

The moratorium on off-shore wind development identified the need for "further study" and "scientific research" and that off-shore wind development "presents technical challenges that do not exist in a saltwater environment, such as the need to manage **potential impacts to drinking water**…"

As a result, one of the factors identified for the WIS Project is the level of understanding of the potential impact, if any, on drinking water. The objective of the drinking water study was to review the Clean Water Act to provide Windstream with a better understanding of the current Ontario Clean Water Act and the potential implications to the WIS Project.

A drinking water study was conducted by W.F Baird & Associates Coastal Engineers Limited ("Baird"). Baird was provided wind turbine generator layouts based on the WIS Project reconfigured beyond the proposed 5 km shoreline exclusion zone. The drinking water study provided an overall summary of the Ontario Clean Water Act and a preliminary assessment of how the Act applies to the WIS Project. This included a review of the Assessment Reports for local drinking water intakes and the associated protection zones relative to the WIS Protect area, a preliminary assessment of drinking water threats and preliminary mitigation recommendations for compliance with the Clean Water Act.

The key conclusions of this study are summarized below (paraphrased from report identified above).

The drinking water study concludes that the Source Water Protection program and existing policies and science based procedures are in place and are sufficient to identify and review the potential impact of threats to drinking water. Although further study will be needed when allowed by government agencies for the WIS Project to meet the requirements of the Clean Water Act, the current Clean Water Act Review addresses the concern raised in the moratorium related to "technical challenges….such as the **need to manage potential impacts to drinking water…**".

The potential impacts of the WIS Project on drinking water are considered comparable to the type of impacts that might be expected from other in-water construction projects that exist in Lake Ontario already, such as pipelines, marinas, industrial cooling systems, underwater transmission lines, port facilities or effluent discharge structures. As the WIS Project is located off-shore over 10 km from the nearest water intake and at least 5km from other shoreline receptors, and given the proposed conceptual design, the potential environmental risks related to an off-shore wind project are no greater, and likely less, than other permitted in-water construction projects.

2.2.2.2 Baird Follow-up Sediments and Drinking Water Study (Report: June 2015)

The drinking water study has not identified any material impediments that would prevent the WIS Project from being built.

Windstream commissioned a follow-up study conducted by W.F Baird & Associates Coastal Engineers Limited ("Baird") with the primary objective to improve the understanding of sediment transport and potential for impact on drinking water and whether this posed an environmental risk to the WIS Project.

The key conclusions of this study are summarized below (paraphrased from report identified above).

Based on the available evidence, the lakebed sediments are safe and the WIS Project would not pose a threat to drinking water. The report demonstrates that the levels of contaminants in the existing lakebed sediments in the area of the WIS Project are relatively low and could be readily and safely managed within established Ontario Ministry of the Environment and Climate Change (MOECC) criteria and guidelines, and that the shifting of those sediments during installation of the turbine foundations would pose no threat to drinking water.

Analysis indicates that the concentration of contaminants in the sediment disturbed during the installation of each turbine would be readily diluted to MOECC drinking water quality standards within a radius of 60 m of each turbine. The nearest drinking water intake is 12,000 m away. Additionally, initial particle tracking numerical modelling indicates that the sediments disturbed during dredging from the turbine closest to shore would be approximately 5 km away from the designated intake protection zone (IPZ) around the nearest intake, and therefore would not threaten drinking water.

The most informative manner to further confirm that shifting of the lakebed sediments during the installation of the turbine foundations for the WIS Project would not pose a threat to drinking water would be to undertake a detailed, site specific study of the WIS Project site, using accepted scientific and engineering principles, as part of the design development process. The WIS Project schedule considers these site- specific studies to be undertaken, as would have been the normal procedure for any major infrastructure project. But for the Moratorium, WIS would have completed the studies.

The MOECC has well-established guidelines and procedures to review the WIS Project for the protection of drinking water. The WIS Project schedule allows for these studies to be completed and for the review by MOECC. It would also appear that an internal MOECC email was consistent with the Baird opinion that the WIS Project would not likely pose a risk to drinking water. The email noted:

"…point a consultant at some Environment Canada sediment data…suggesting reviewing the Source Water Protection Modelling might be a fast way to demonstrate why re-suspended sediments from

>5km offshore in depths of >100m cannot pose a significant threat to drinking water intakes located only ~0.5km to 2km offshore in depths of <20m".

Therefore, in Baird's opinion, the presence of low levels of contaminants in the lakebed sediments does not have the potential to contaminate drinking water and the WIS Project would meet MOECC criteria for the protection of drinking water.

2.2.3 Underwater Cable

2.2.3.1 WSP (formerly Genivar) Submarine Cable Study (Report: December 2012)

The submarine cable study has not identified any material impediments that would prevent the WIS Project from being built.

One of the factors identified in the moratorium was a perceived lack of understanding of the possible impact of underwater cables. An underwater cable study was conducted by WSP (formerly Genivar). The objective of the study was to understand how common underwater cables are in Ontario including the eastern end of Lake Ontario in the area of the WIS Project.

The key conclusions of this study are summarized below (paraphrased from report identified above).

The study highlights that Ontario has a long history of underwater cables to feed islands and other offshore installations including a high voltage cable in the North Channel/Georgian Bay (McLean Mountain Wind Farm on Manatoulin Island) which has been approved under the MOECC Renewable Energy Approval (REA) process. There are four (4) existing and one (1) proposed high voltage underwater cables in the area of the WIS Project including a high voltage cable connecting the operating Trans Alta Wind Farm on Wolfe Island to the mainland. In addition, there are thousands of kilometers of low voltage cables laid on lake beds throughout Ontario. The study concludes that underwater cables, including high voltage cables, are very common in Ontario and on this basis the moratorium claim of a lack of understanding of the possible impacts of underwater cables does not appear justified.

2.2.3.2 Power Engineers Electro-Magnetic Field Study (Report: April 2014)

The electro-magnetic field study has not identified any material impediments that would prevent the WIS Project from being built.

One of the factors identified in the moratorium was a perceived lack of understanding of the possible impact of underwater cables. An electro-magnetic field ("EMF") study was commissioned by Windstream and conducted by Power Engineers. The objective of the study was to understand the

EMF associated with underwater and underground cables relative to traditional overhead transmission lines.

EMF calculations were conducted using Safe Engineering Services software for a typical 230 kV overhead line (16 m above ground), a cable buried underground (1.3 m deep) and a cable laid on the lake bed (20 m below the surface of the water).

The key conclusions of this study are summarized below (paraphrased from report identified above).

The study concludes that the electric field strengths from both the underground and underwater cables are negligible and that the magnetic field strengths from the underwater cable are orders of magnitude lower than that generated from the buried and overhead cables. In summary, the EMF from a high voltage underwater cable is predicted to be negligible relative to what the general public is routinely exposed to from traditional overhead cables and on this basis the moratorium claim of a lack of understanding of the possible impacts of underwater cables does not appear justified.

2.2.4 Birds / Bats

2.2.4.1 Curry & Kerlinger Birds Study (Report: August 2014)

The bird study has not identified any material impediments that would prevent the WIS Project from being built.

Windstream commissioned a study conducted by Curry & Kerlinger LLC with the primary objective to improve the understanding of the potential impacts on birds during construction, operation and decommissioning, what mitigation measures would be reasonably be expected and whether this posed an environmental risk to the WIS Project.

The key conclusions of this study are summarized below (paraphrased from report identified above).

No biologically significant impacts to any birds are expected to result from the installation and operation of the WIS Project. Biologically significant impacts mean an impact that result in a material decline, a material acceleration of an existing decline, or a fundamental destabilization of a given population of a particular species. Any impacts will not likely result in serious or irreversible harm to the populations of any bird species.

2.2.4.2 North East Ecological Bat Study (Report: August 2014)

The bat study has not identified any material impediments that would prevent the WIS Project from being built.

Windstream commissioned a study conducted by North East Ecological Services with the primary objective to improve the understanding of the potential impacts on bats during construction, operation and decommissioning and whether this posed an environmental risk to the WIS Project.

This report summarizes known bat species in Ontario, summarizes knowledge of existing near-shore and offshore data on bats, provides a summary of several operational wind facilities that may be relevant to the proposed project site, and makes predictions of the likely scope and scale of impact on bats of the Wolfe Island Shoals Offshore Wind Energy (WIS) Project.

The key conclusions of this study are summarized below (paraphrased from report identified above).

There are eight species of bats that have the potential to occur within the vicinity of the WIS Project site. Three species (the tricolored bat, the little brown myotis, and the northern myotis) are listed as Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Two of these species (the little brown myotis and the northern myotis) are also listed as Endangered by the Committee on the Status of Species at Risk in Ontario (COSSARO).

The current Bat and Bat Habitat Assessment Process (MNR, 2011) is currently inadequate to effectively evaluate the impact of off-shore wind development on bats in Ontario. However, it is likely that off-shore wind development will have very little indirect impact on bats due to the lack of alteration or loss of the terrestrial habitats that bats rely upon for roosting and foraging. It is likely that the only potential impact of off-shore wind development is the risk of turbine-related collision. Although there has been relatively little research on the behavior of bats along coastlines, existing data suggest that most bat activity will run parallel to the coastline and be concentrated during the fall migratory period. Existing data suggest that the level of bat activity off-shore will be lower than coastal or inland bat activity and that most of this activity will be from the migratory tree bats; none of which are listed by COSEWIC or COSSARO. Data from Europe suggests that off-shore bat migrations are highly sensitive to prevailing wind conditions and therefore current adaptive management techniques (such as increased turbine cut-in speed) are likely to be highly successful as a mitigation strategy.

2.2.5 Fisheries Permitting

2.2.5.1 Baird/Beacon Environmental Fisheries Permitting Study (Report: June 2015)

The fisheries permitting study has not identified any material impediments that would prevent the WIS Project from being built.

Windstream commissioned a study conducted by W.F Baird & Associates Coastal Engineers Limited ("Baird") in association with Beacon Environmental Ltd. (Beacon) with the primary objective to improve the understanding of fisheries permitting and potential for SAR and whether this posed an environmental risk to the WIS Project.

The key conclusions of this study are summarized below (paraphrased from report identified above).

Windstream is fully aware of the requirements of the *Renewable Energy Approval* (REA) process and the *Fisheries Act* and the WIS Project schedule allows the appropriate time for field work, analysis and consultation to assess potential impacts for fish, fish habitat (under the *Fisheries Act*) and SAR (under the provincial ESA, as well as the federal *Species at Risk Act*). In Baird's opinion, an authorization under the *Fisheries Act* should be obtainable for the WIS Project and is adequately considered in the WIS Project schedule.

2.2.6 Cultural Heritage

2.2.6.1 Cultural Heritage (Lighthouses and Landscapes) Review (Memo: July 2014)

The screening level cultural heritage (lighthouses and landscapes) review has not identified any material impediments that would prevent the WIS Project from being built.

Windstream commissioned a study conducted by ORTECH Consulting Inc. ("ORTECH") to review and comment on the significance of the built heritage in the area surrounding the WIS Project, specifically as it relates to lighthouses in the area in order to make an informed opinion on whether these features represent any known material impediment to achieving a Renewable Energy Approval (REA). In addition to this review, a short discussion on the REA process for cultural heritage assessment was included.

The key conclusions of this study are summarized below (paraphrased from report identified above).

Based on our screening level review of known cultural heritage features (built and landscapes), no material impediments to achieving REA were identified. It is expected that these cultural heritage aspects can be adequately addressed through the use of mitigation measures.

2.2.6.2 Baird/Scarlett Janusas Archeology Study (Report: June 2015)

The archeology study has not identified any material impediments that would prevent the WIS Project from being built.

Windstream commissioned a study conducted by W.F Baird & Associates Coastal Engineers Limited ("Baird") in association with Scarlett Janusas Archaeology Inc. (SJAI) with the primary objective to improve the understanding of archeology permitting and study aspects and whether this posed an environmental risk to the WIS Project.

The key conclusions of this study are summarized below (paraphrased from report identified above).

The preliminary geotechnical survey by Canadian Seabed Research (see Section 2.1.3) provided valuable information to inform the development of the WIS Project with respect to possible archaeological resources. The survey area covered approximately 50% of the turbine area and 100% of the cable route and identified seven (7) shipwrecks (five near the turbine array and two near the cable route). The five shipwrecks were detected near, but actually outside the turbine array and should not pose a problem for the turbine layout. The turbine foundations cover an extremely small fraction (about 0.1%) of the turbine area and the WIS Project design team is confident that if any additional shipwrecks are detected during subsequent archeology surveys in the remaining 50% of the area, they could be avoided through micro-siting of the turbines.

Based on the experience of SJAI, the existing surveys completed to date and the use of multiple archaeological teams to complete the work as required, the timeframe allocated in the WIS Project schedule is reasonable.

2.2.7 Overall Environmental Process and Permitting

2.2.7.1 Draft Project Description Reports

Windstream commissioned ORTECH Consulting Inc. (ORTECH) to create the Draft Project Description Reports(PDR) as required for all proposed renewable energy projects requiring an REA under O. Reg. 359/09 (Renewable Energy Approvals under Part V.0.1 of the Environmental Protection Act, R.S.O. 1990). The first Draft Project Description Report (ORTECH 2010) was completed in support of Geophysical Investigations and the second Draft Project Description Report (ORTECH 2012) was completed in support of the Applicant of Record process and an offshore testing facility.

2.2.7.2 ORTECH Review of Complete Submission Requirements for Offshore Wind (Memo: May 2014)

The environmental effects study has not identified any material impediments that would prevent the WIS Project from being built.

Windstream commissioned ORTECH Consulting Inc. (ORTECH) to review the document titled "DRAFT Complete Submission Requirements Checklist for Offshore Wind Projects under O.Reg. 359/09" (Draft Checklist) from the MOECC, dated January 11, 2011. Particularly, ORTECH has been asked to review the Draft Checklist with regards to progress on the WIS Project prior to the February 2011 moratorium on offshore wind, and in relation to work completed to date.

The key conclusions of this study are summarized below (paraphrased from report identified above).

- ORTECH was not aware that this document existed until it was provided by Windstream (in 2014) and to ORTECH's knowledge this document has not been released to the public,
- The document appears to be an unreleased draft of the offshore wind chapter of the Technical Guide to Renewable Energy Approvals released by agencies in June, 2011,
- The document provides specific guidance for proponents towards successfully completing the Renewable Energy Approvals process for offshore wind,
- The guidance includes technical requirements for noise mitigation, protection of drinking water intakes and completion of a Coastal Engineering Report that are not included in earlier guidance documentation for offshore wind,
- The guidance includes a process for obtaining an "MNR Clearance Letter" that is consistent with the regulatory process used for onshore wind,
- The document does not set out regulatory or technical requirements that could not have been successfully addressed in a professionally executed environmental assessment process, and
- Based on the study reports provided to ORTECH to-date and subject to further study, there is currently no information that would suggest that the WIS Project would not meet the requirements set out in the document.

2.2.7.3 ORTECH Environmental Effects / Natural Heritage Study (Report: August 2014)

The environmental effects study has not identified any material impediments that would prevent the WIS Project from being built.

Windstream commissioned a study initiated by MK Ince (2013) and completed by ORTECH Consulting Inc. ("ORTECH") with the primary objective was to assess the viability of successfully completing the Natural Heritage components of the Renewable Energy Approval (REA) process for the proposed WIS Project if the moratorium for offshore wind facilities were to be lifted.

The scope of the assessment consisted of reviewing the REA documentation for four (4) nearby large scale onshore wind projects that have advanced through the REA process as an indicator of environmental viability for the WIS project. Specifically, the scope consisted of:

- Review of the regulatory (REA) context
- Stage 1 Review:
  - » Review of the known natural heritage features for WIS
  - » Review of the natural heritage features of the four (4) nearby projects
- Stage 2 Analysis of the four (4) nearby projects as it relates to WIS:
  - » Analysis of specific natural heritage features and project impacts
  - » Analysis of mitigation strategies deployed
  - » Analysis of regulatory outcome

The key conclusions of this study are summarized below (paraphrased from report identified above).

The Stage 1 and Stage 2 review resulted in the following findings:

1. the REA process for Class 4 onshore wind projects also applies to Class 5 offshore wind projects, with the addition of an Offshore Wind Facility Report;
2. there is a reduced number of Natural Heritage features that appear to pertain to the offshore WIS project;
3. potential impacts related to the four (4) nearby projects have been successfully mitigated; and,
4. the REA process for the four (4) nearby projects has been successfully completed.

In light of these findings, there appears to be no known material impediment to successful completion of the Natural Heritage components of the REA process for the WIS Project. Indeed, fewer known Natural Heritage features exist for the WIS Project than the nearby onshore projects and the permitting outcome of nearby projects has been positive. The conclusion of this report is that it is reasonable to assume that the WIS Project could successfully complete the Natural Heritage reporting for the REA process if the moratorium on offshore wind projects were to be lifted.

2.2.7.4 ORTECH Renewable Energy Approval Process Study (Report: August 2014)

The renewable energy approval process review has not identified any material impediments that would prevent the WIS Project from being built.

Windstream commissioned a study conducted by ORTECH Consulting Inc. (“ORTECH”) to determine whether, on the basis of studies commissioned by Windstream for the WIS Project from its consultants, as well as other available information and ORTECH expertise, there are any material

impediments to the WIS Project having obtained a Renewable Energy Approval ("REA") or other permitting for the WIS Project proposed by Windstream.

The assessment was based on:

- The REA requirements that were in place at the time the Ontario Power Authority ("OPA") FIT Contract was executed (August 2010)
- the assumption that the moratorium on offshore wind development issued in February 2011, was not in place; and,
- the WIS Project would be developed to meet the 5 km shore exclusion zone proposed by the Ministry of Environment (MOE) in June 2010.

The following keys aspects of the REA process were considered in this study:

- Construction, Design and Operations, and Decommissioning Plan Reports
- Consultation Process: General, Aboriginal, Visual Impacts, Agencies
- Noise Impact Study
- Natural Heritage Assessment requirements: General, Birds, Bats, Fish
- Electromagnetic Fields (EMF)
- Offshore Wind Facility Report: Coastal Engineering, Drinking Water, Ice, General
- Cultural Heritage Report (lighthouses) and Archaeology Report: marine, on shore
- Wind Turbine Specifications Report
- Water Bodies Report and Water Bodies Assessment Report
- additional non-REA Requirements also considered:
    - Navigation & Permits
    - Fisheries Act
    - Radio communications
    - Species at Risk

In addition to the 2010 REA requirements, ORTECH also reviewed a document titled "DRAFT Complete Submission Requirements Checklist for Offshore Wind Projects under O.Reg. 359/09" ("Draft Checklist") from the Ministry of the Environment ("MOE"), dated January 11, 2011. To our knowledge, this document (which provides specific guidance to successfully completing the REA process for offshore wind) was not released to the public.

The key conclusions of this study are summarized below (paraphrased from report identified above).

On the basis of studies completed by Windstream for the WIS Project and its consultants, other available information, and ORTECH expertise, that there are no material impediments for the WIS Project to achieve a Renewable Energy Approval (REA) or other permitting. This analysis and associated opinion are based on:

- The requirements that were in place at the time the Ontario Power Authority (OPA) FIT Contract was executed (August 2010),
- The assumption that the moratorium on off-shore wind development, issued in February 2011, was not in place, and
- The WIS Project would be developed to meet the 5 km shore exclusion zone proposed by the MOECC in June 2010 although this proposal is yet to be promulgated.

ORTECH reviewed the key aspects of the REA process and concluded that there are no material impediments to completing each of these key aspects.

In addition to the 2010 REA requirements, ORTECH also reviewed the elements specified in the unpublished "DRAFT Complete Submission Requirements Checklist for Offshore Wind Projects under O.Reg 359/09" (Draft Checklist) from the Ministry of the Environment (MOE), dated January 11, 2011. ORTECH concluded that there are no known material impediments that would suggest the WIS Project could not have also met the requirements set out in this unreleased guidance document.

Based on the assessment carried out, ORTECH is of the opinion that there is no reason to believe the WIS Project would not have been able to successfully complete the REA process or other permitting.

2.2.7.5 WSP Renewable Energy Approval and Permitting Study (Report: June 2015)

The renewable energy approval and permitting study has not identified any material impediments that would prevent the WIS Project from being built.

Windstream commissioned a study conducted by WSP Canada Inc. ("WSP") in collaboration with other Windstream technical experts with the primary objective to improve the understanding of REA permitting and study aspects and whether this posed an environmental risk to the WIS Project.

The key conclusions of this study are summarized below (paraphrased from report identified above).

WSP has developed the permitting and approvals section of the overall WIS Project schedule. The agency review timelines provided in the WIS Project schedule are based on statutory, published service standards or common timelines. The scheduling confirms that more likely than not, the WIS Project

would have achieved the major permitting milestones within the contractual constraints of the FIT program.

In WSP's opinion, there are no material impediments to the WIS Project receiving a REA and other permits and authorizations. The WIS Project schedule is comprehensive and includes all mandatory consultation, studies, permits and authorizations that would be needed to construct the WIS Project at the federal, provincial, and local levels. The schedule timelines provided by WSP are based their experience planning and obtaining REAs for renewable energy projects, including onshore wind projects in Ontario.

3. CONCLUSION

The various studies commissioned by Windstream have not identified any material technical or environmental impediments that would prevent the WIS Project from being built.

Several studies have been carried out in support of the development of the WIS Project and independent of the Moratorium on off-shore wind projects. The scope of the studies was designed to address key factors identified at this stage of the development. These studies improve the understanding of topics including overall technical feasibility, civil, foundation and construction, electrical, wind resource and environmental aspects.

Due to the uncertainty associated with the timing of site release, the proposed 5 km setback, the proposed removal of additional areas for off-shore development and the Moratorium, the timing of completing the WIS Project remains uncertain. Much will depend on the date of removal of the moratorium and the resulting lifting of restrictions from Windstream. It is understood that further field testing and study will be required when allowed by government agencies to obtain the permits required and proceed with the Renewable Energy Approval (REA) process.

However, the studies conducted to date show that considerable information related to the science of off-shore wind project development is readily available and have advanced the understanding of **technical** aspects of the WIS Project including but not limited to:

- the existence of an excellent, highly certain and bankable wind resource in the WIS Project area,
- the electrical impact assessment studies confirm the WIS Project could successfully connect to the Ontario electricity grid system and that these assessment studies remain valid and that grid capacity continues to be available for the WIS Project,
- lakebed investigation and geotechnical studies have not identified any material impediments that would prevent the WIS Project from being built,
- ice studies confirms that there is a level of understanding and sufficient information available to engineers to assess ice impacts and that the potential impact on the shoreline due to changes in the ice conditions as a result of the WIS Project is expected to be minor,
- material impacts or impediments with respect to the physical coastal processes related to the WIS Project were not identified and are not expected,
- the existing main shipping channel will remain in place and does not need to be relocated,

- although not necessarily a current requirement, due to a World Trade Organization decision, based on the contemplated supply arrangements and evidence provided by suppliers, the domestic content analysis carried out indicates that the WIS Project can meet or exceed the MRDCL of 50% as defined in the FIT Contract, and
- considering inputs from industry experts combined with Sgurr Energy experience on offshore wind projects, provide clear evidence that the WIS Project is viable and could have been constructed within the Feed-in-Tariff ("FIT") program's timelines.

The studies conducted to date show that considerable information related to the potential impact of off-shore wind project development is readily available and have advanced the understanding of **environmental** aspects of the WIS Project including but not limited to:

- the noise studies indicate that the WIS Project developed beyond the proposed 5 km setback could meet current MOECC noise criteria,
- the Source Water Protection program and existing policies and science based procedures are in place and are sufficient to identify and review the potential impact of threats to drinking water,
- the levels of contaminants in the existing lakebed sediments in the area of the WIS Project are relatively low and could be readily and safely managed within established MOECC criteria and guidelines, and that the shifting of those sediments during installation of the turbine foundations would pose no threat to drinking water,
- underwater cables, including high voltage cables, are very common in Ontario,
- electric field strengths from underwater cables proposed for the WIS Project are negligible and that the magnetic field strengths from an underwater cable are orders of magnitude lower than that generated from buried and overhead cables,
- no biologically significant impacts to any birds are expected,
- it is likely that off-shore wind development will have very little indirect impact on bats due to the lack of alteration or loss of the terrestrial habitats that bats rely upon for roosting and foraging,
- the probability of aquatic Species at Risk (SAR) habitat at the WIS Project site is low and that the likelihood of requiring a SAR permit under s. 17(2)(c) of the provincial *Endangered Species Act* (ESA) is highly unlikely,
- a screening level review of known cultural heritage features (built and landscapes) did not identify any material impediments to achieving REA and it is expected that cultural heritage aspects can be adequately addressed through the use of mitigation measures,

- an initial geotechnical survey (covering 50% of the turbine area) provided valuable information to inform the development of the WIS Project with respect to possible archaeological resources and that the turbine foundations cover an extremely small fraction (about 0.1%) of the turbine area and if any additional shipwrecks are detected during subsequent archeology surveys, they could be avoided through micro-siting of the turbines, and
- no material impediments to the WIS Project receiving a REA and other permits and authorizations.

APPENDIX 1: DVD (ELECTRONIC COPY OF ALL STUDIES REFERENCED IN REPORT)