RENEWABLE ENERGY APPROVAL APPLICATION
NOISE IMPACT ASSESSMENT

BORNISH WIND ENERGY CENTRE

April 2013

GL Garrad Hassan

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NOISE IMPACT ASSESSMENT
BORNISH WIND ENERGY CENTRE, ONTARIO

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REVISION HISTORY

Issue	Issue date	Summary
A	22 December 2011	Original Release (electronic version only)
B	13 January 2012	Update with new turbine specifications
C	30 April 2012	Update to Appendix D coordinates
D	28 June 2012	Updated receptor list and turbine noise specs
E	19 July 2012	Updated receptor list
F	20 September 2012	Responses to MOE comments
G	21 September 2012	Responses to MOE comments
H	20 March 2013	Updated substation location and sound level, new sound power level spectrum for GE turbine, and ground factor justification.
I	15 April 2013	Revised transformer height as per MOE request.

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1 INTRODUCTION

GL Garrad Hassan Canada Inc. ("GL GH") was retained by NextEra Energy Canada, ULC ("Client" or "NextEra") to prepare a Noise Impact Assessment ("NIA") of the Bornish Wind Energy Centre ("Project") in accordance with the Ontario Regulation 359/09 (Renewable Energy Approvals (REA) under Part V.0.1 of the Ontario Environmental Protection Act (EPA)) [1]. This NIA also follows the Ontario Ministry of the Environment (MOE) 2008 NPC Noise Interpretation Guidelines [2].

The proposed Bornish Wind Energy Centre is located in south-western Ontario, in the Municipality of North Middlesex, Middlesex County, Ontario.

The layout being evaluated is comprised of forty-eight (48) GE 1.6-100 (1.62 MW) turbines manufactured by General Electric (GE), though only 45 turbines will be constructed. The substation transformer location has been determined and it has been included in this assessment.

The objective of this assessment is twofold:

1. Confirm the sound level limit requirements for the Project by providing an assessment of the existing baseline environmental noise conditions in the vicinity of the wind farm; and

2. Predict the noise levels generated by the Project at all Points of Reception, Participants and Vacant Lot Receptors within 1,500 m of the turbines.

2 GENERAL DESCRIPTION OF PROJECT SITE

2.1 General Characteristics

The proposed Bornish Wind Energy Centre is located in south-western Ontario, in the Municipality of North Middlesex, Middlesex County, Ontario. More specifically, the Project is located south of Elginfield Road, east of Pete Sebe Road, north of Elmtree Drive and west of Fort Rose Road. It has a total project area of approximately 5,177 ha. Project components will be installed on privately-owned agricultural lots within this area.

The Project has been configured using forty-eight (48) GE 1.6-100 (1.62 MW), though only 45 turbines will be constructed. The wind turbines have been strategically sited on lands that the Client holds under lease options. It is anticipated that the Projects collection system may be partially located on public Right of Ways.

Energy generated by the Project will be collected via underground cabling and overhead lines and directed to a substation. A project-owned 115 kV transmission line will then travel north; approximately 11.4 km to a proponent owned switchyard and from there will connect to a Hydro One 500 kV transmission line located approximately 11 km east of the project switchyard.

The landscape in the study area is predominantly characterized by agricultural fields and associated farms punctuated with numerous hedgerows, isolated woodlands, and the occasional watercourse. Photographs included in Figure 2-1 show typical views of the land and features of the study area.

Figure 2-1: Land Features of the Bornish Wind Energy Centre

2.2 Land Use Description

The site is located within two two-tiered municipal systems. The County of Middlesex makes up the upper tier of the region, while Adelaide Metcalfe, North Middlesex and Strathroy-Caradoc, along with five additional townships and municipalities, have lower tier municipal status. Agriculture is the predominant economic activity and land use throughout the County of Middlesex; however, the municipalities that comprise the study area each have features creating distinct community character.

Surrounding properties and lands are characterized as low density residential while also including a number of agricultural buildings. Other land use within the study area includes rural and urban-rural, providing a foundation for manufacturing, business and tourism development. Access to the Bornish Project is provided by small paved and unpaved municipal roads that stem from larger municipal roads. The North Middlesex Zoning map can be found in Appendix A.

2.3 Points of Reception

Receptor locations (i.e. Points of Reception) for the Project were identified by GL GH using base data from recent aerial photos obtained from the Client, and field reconnaissance to verify locations and building types. The height of each Point of Reception - taken to be 1.5 m, 4.5 m and 7.5 m for one-storey, two-storey and three-storey houses respectively - was also noted. All Points of Reception, as per the definition of the MOE, were considered in this NIA.

The MOE Noise Guidelines [2] generally define a Point of Reception (POR) as a house, campground, church, school or other sensitive building that is not located on the same premises as the wind farm, including its turbines and ancillary structures. Points of Reception can also include locations on vacant lots that have residences as a permitted use; in this case GL GH, and a third-party consultant (IBI Group), identified Vacant Lot Receptors (VLR) on such lots in a location consistent with the building pattern in the area, as per the O. Reg. 359/09 and the Ontario MOE Noise Guidelines.

A residence located on the same premises as the wind turbine(s) or other Project infrastructure is not a Point of Reception as defined by the MOE noise guidelines, and considered a “Participating Receptor” and thus MOE noise limits do not apply.

The coordinates of each of the Points of Reception, Participants and Vacant Lot Receptors are listed in Appendix C and Appendix D, respectively.

3 DESCRIPTION OF POINTS OF RECEPTION

There is a total of 201 Points of Reception (PoR) located within a radius 1,500 m of a wind turbine or the substation, among which 97 are Vacant Lot Receptors (VLRs) and 104 are dwellings or other sensitive receptors such as churches and cemeteries. There are 25 dwellings and 43 Vacant Lot Receptors considered as Participants.

3.1 Receptor Classes

The MOE categorizes Points of Reception into three classes: 1, 2, and 3. Class 1 refers to an acoustic environment typical of a major population centre where the background noise is dominated by the urban hum. These areas are highly urbanized and have moderate to high noise levels throughout the day and night. Class 2 areas have an acoustic environment characterized by low ambient sound levels between 19:00 and 07:00, whereby the evening and night time levels are defined by natural sounds, infrequent human activity and no clearly audible sounds from stationary sources (e.g. industrial and commercial facilities). Class 3 areas are typical of rural and/or small communities (i.e. with populations of less than 1000) and an acoustic environment that is dominated by natural sounds with little or no road traffic.

Within the study area the main sources of ambient sound that currently exist include:

- Vehicular traffic on the local concession and side roads, some of which are gravel roads;
- Occasional sounds due to agricultural activities;
- Occasional sounds due to anthropogenic domestic activities; and
- Natural sounds.

Based on these conditions, **all Points of Reception are considered as having a Class 3 acoustic environment.**

3.2 Determination of Applicable Noise Limits

As stated in the MOE guidelines, the noise limits for a wind farm are set according to the existing MOE noise guidelines in NPC-205/NPC-232 while taking into account the wind-generated background noise.

For a Class 3 area, the sound level limits as defined by the MOE Interpretation are described in the sections below.

3.2.1 Wind Turbine Installations in Class 3 Areas (Rural), Wind Speeds Below 6 m/s

The lowest sound level limit expressed in terms of L_{eq} is: i) 40 dB(A); or ii) the minimum hourly background sound level established in accordance with Publications NPC-232/NPC-233, whichever is higher.

3.2.2 Class 3 Areas, Wind Speeds Above 6 m/s

The lowest sound level limit expressed in terms of L_{eq} is: i) the wind-induced background sound level, expressed in terms of ninetieth percentile sound level (L_{A90}) plus 7 dB; or ii) the minimum hourly background sound level established in accordance with Publications NPC-205/NPC-232/NPC-233, whichever is higher.

The applicable noise limits should be those defined by the MOE as summarized below in Table 3-1. A sample calculation of how noise modeling was determined for each Point of Reception appears in Appendix B where intermediate and cumulative A-weighted sound pressure levels from each turbine are provided.

Table 3-1: Summary of Noise Limits for Points of Reception (Class 3)

Wind Turbine Noise Criterion NPC-232 [dB(A)]	Wind Speed [m/s]				
	6	**7**	**8**	**9**	**10**
	40	43	45	49	51

4 DESCRIPTION OF SOURCES

4.1 Turbine Description

The proposed GE 1.6-100 turbine is a 3-bladed, upwind, horizontal-axis turbine. The total rotor diameter of the turbine is 100 m, resulting in a swept area of 7,854 m^2, and is designed to operate at between 9.75 and 16.18 revolutions per minute (rpm). The turbine rotor and nacelle are mounted on top of an 80 m tubular tower which is manufactured in sections from steel plate. Each turbine is mounted on a steel reinforced concrete foundation and equipped with a transformer, located outside the base of the tower.

Table 4-1 presents the general specifications of the wind turbine.

Table 4-1: Turbine Description – GE 1.6 - 100

Model	**GE 1.6 - 100**
Design	Steel, tubular, white; 3 sections
Rated power	1.62 MW
Hub height	80 m
Rotor diameter	100 m
Rotor swept area	7854 m^2
Operational interval	9.75 – 16.18 rpm
Number of blades	3
Cut-in wind speed	3 m/s
Cut-out wind speed	25 m/s
Nominal wind speed	12 m/s

Full noise specifications as provided by the manufacturer can be found in Appendix E. Coordinates of all turbines are listed in Appendix F.

The layout being evaluated consists of 48 GE1.6-100 turbines. The collector system will connect to the substation, where the voltage will be elevated to 115 kV. The main power transformer has been included in this NIA.

It should be noted that no adjacent wind farms in operation or under development within 5000m of the project are to be considered for this NIA.

5 NOISE EMISSION RATINGS

5.1 Noise Emission Rating of the Turbines

Broadband sound power levels and octave band sound power levels of the GE 1.6-100 wind turbine were provided by the manufacturer and are shown in Appendix E. Measurements were made in accordance with the IEC 61400 – 11 Ed. 2.1[3] method using standardized wind speeds at 10 m height. The worst case octave band and broadband sound power levels of the turbine were retained for the purpose of the noise impact assessment to account for summer night-time shear. These values correspond to a 10 m height wind speed of 10 m/s or more. The proposed version of the GE 1.6-100 wind turbine uses Low Noise Trailing Edge (LNTE) serrated blade technology, which results in a lower broadband sound level than the previous version.

The GE 1.6-100 wind turbine has an expected value for tonal audibility of $\Delta La,k < 2$ dB, irrespective of wind speed, hub height, and grid frequency based on the IEC 61400-11 standard. A letter confirming the current sound power levels and stating the tonality of the turbine is attached in Appendix E.

The octave band sound power levels used for the simulation in this NIA are those stated for each octave band centre frequency in Table 5-1.

Table 5-1: GE 1.6 100 Wind Turbine Acoustic Emission Summary

Make and Model : GE 1.6 100										
Electrical Rating : 1.6 MW										
Hub Height (m) : 80 m										
Wind Shear Coefficient : Typical summer night time shear of the region										
	Octave Band Sound Power Level [dB]									
	Manufacturer's Emission Levels					Adjusted Emission Levels				
Wind Speed [m/s]	6	7	8	9	10	6	7	8	9	10
Frequency [Hz]										
31.5	109.5	112.9	113.1	113	112.9	112.9	112.9	112.9	112.9	112.9
63	106.5	110.2	110.3	110.3	110.2	110.2	110.2	110.2	110.2	110.2
125	104.5	107.7	107.9	107.9	107.8	107.8	107.8	107.8	107.8	107.8
250	103.3	104	103.9	104	104.1	104.1	104.1	104.1	104.1	104.1
500	98.7	100.3	99.8	99.9	100.2	100.2	100.2	100.2	100.2	100.2
1000	91.8	97.1	97.5	97.6	97.8	97.8	97.8	97.8	97.8	97.8
2000	91.2	94.5	94.5	94.3	93.9	93.9	93.9	93.9	93.9	93.9
4000	87.9	88.7	88.1	87.4	86.9	86.9	86.9	86.9	86.9	86.9
8000	71.4	71.5	71.7	70.5	70.2	70.2	70.2	70.2	70.2	70.2
A-weighted	100.5	103	103	103	103	103	103	103	103	103

5.2 Noise Emission Rating of the Adjacent Wind Farm Turbines

There are no adjacent crystallized wind farms located less than 5 km from the Bornish wind farm. NextEra's Adelaide wind farm is located 6.9 km from the Bornish wind farm, and Suncor's Adelaide Project layout was not publicly available prior to the Site Plan Release of the Bornish Wind Energy Centre and was therefore not considered for cumulative effect in the Bornish NIA.

5.3 Noise Emission Rating of the Substation Transformer

The cumulative effect that the substation would have on nearby residents has been considered in this analysis.

Noise emission from the substation mainly originates from one (1) high-voltage 51/68/85 MVA, 121/34.5 kV, Wye/ Delta step-up transformer. The equipment proposed for the substation will be compliant with applicable standards (CAN/CSA-C88-M90, IEEE C57.12.90).

The Broadband Sound Power Level for the noise modelling calculations was calculated to be 102.8 dB(A), based on an audible noise level of 75 dBA guaranteed by the transformer manufacturer (shown in Appendix E), in accordance with the application of standard IEEE C57.12.90, for utility scale transformers. The 102.8 dB(A) includes a 5 dB(A) tonal penalty, as prescribed in Publication NPC-104.

The substation transformer drawings that were used to calculate the transformer's measurement surface area as defined in standard IEEE C57.12.90 are included in Appendix E. The calculated measurement surface area S was found to be 190.6 m². This calculation is based on an 8 sided polygon perimeter that includes a 2 m offset from both fan cooled surfaces and a 0.3 m offset from the other surfaces, as well as the top area of the transformer, in accordance with standard IEEE C57.12.90.

It excludes the reservoir above the main transformer tank since that height is not considered when determining the height of the IEEE C57.12.90 microphone placement, and therefore not part of the measurement surface area. The substation coordinates, as provided by the Client, are included in Appendix F.

Table 5-2 provides the octave band sound power levels of the substation transformer, using a typical transformer octave band sound distribution for a large transformer from the Handbook of Acoustics [4]. The point source representing the substation transformer was conservatively modelled at a height of 4.5 m agl at the request of the MOE. Table 5-3 details the octave band calculation.

Table 5-2: Bornish Project – Substation Transformer Sound Power Level

Transformer	Octave Band Sound Power Level* (dBA)									
Frequency (Hz)	31.5	63	125	250	500	1000	2000	4000	8000	Broadband
PWL (dBA)	60.0	79.2	91.3	93.8	99.2	96.4	92.6	87.4	78.3	102.8

*Includes 5 dBA penalty to account for tonality

Table 5-3: Transformer Octave Band Calculation Details

31.5	63	125	250	500	1000	2000	4000	8000	
-1	5	7	2	2	-4	-9	-14	-21	**Typical Outdoor Transformer Octave band relative distribution** [4] **[dB Lin]**
-39.4	-26.2	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.1	**dB Lin to dBA Conversion Scale**
-40.4	-21.2	-9.1	-6.6	-1.2	-4.0	-7.8	-13.0	-22.1	**Typical Outdoor Transformer Octave band relative distribution [dBA]**
60.0	79.2	91.3	93.8	99.2	96.4	92.6	87.4	78.3	**Scaled to 102.8 dBA Transformer**

6 NOISE IMPACT ASSESSMENT

The sound pressure levels at each Point of Reception, Participant and VLR for the aggregate of all wind turbines and substation associated with the Project were calculated based on the ISO 9613-2 method.

The ISO 9613 standard[5], [6] provides a prediction of the equivalent continuous A-weighted sound pressure level at a distance from one or more point sources under meteorological conditions favourable to propagation from sources of sound emission. These conditions are for downwind propagation or, equivalently, propagation under a well-developed moderate ground-based temperature inversion, commonly occurring at night.

The method consists of octave-band algorithms (i.e., with nominal mid-band frequencies from 63 Hz to 8 kHz) for calculating the attenuation of the emitted sound. The algorithm takes into account the following physical effects:

- Geometrical divergence – attenuation due to spherical spreading from the sound source;
- Atmospheric absorption – attenuation due to absorption by the atmosphere; and
- Ground effect – attenuation due to the acoustical properties of the ground.

ISO-9613-2 parameters were set as follows:

- Ambient air temperature: 10ºC;
- Ambient barometric pressure: 101.32 kPa;
- Humidity: 70%;
- Source ground factor: 0.7;
- Middle ground factor: 0.7;
- Receptor ground factor: 0.7;
- The effect of topography was considered

Justification for the use of a global ground factor of 0.7 is presented in Section 6.1.

Additional calculations concerning propagation through foliage were not performed in this NIA, implying that the values calculated for sound attenuation are likely to be conservative in areas where there is foliage present in the line of sight between any turbine and a Point of Reception. The estimated accuracy of the ISO 9613 method, as stated in ISO 9613-2, is ± 3 dB.

The noise emission ratings used for each octave band were those specified in Table 5-1and Table 5-2. The noise impact was calculated for each Point of Reception and Participant located within 1,500 m of one or more turbines or substation, and the calculated noise level was then compared with the applicable noise limit for each Point of Reception as stated in Table 3-1.

Noise levels were calculated at 4.5 m and 7.5 m a.g.l for 2-storey and 3-storey Points of Reception/Participants respectively, and at 1.5 m agl at 16 points along a 30-m radius circle for each 1-storey Point of Reception/Participant. For the latter, the highest of these 16 values was chosen and presented in the table of noise levels.

6.1 Justification of global ground factor G

GL GH has undertaken a refined estimate of the noise propagation around the project substation, based on recent comments from the MOE since this part of the site will have the largest area of hard ground, as well as the shortest source-receiver distance. This section presents a detailed ground factor calculation for the area expected to be most sensitive to ground factor assumptions. For the transformer-to-VLR210 case, ground factors for the source, middle, and receiver regions have been calculated based on ISO 9613-2. The distance from the transformer to VLR210 is 667 m. Figure 6-1 shows the regions and ground cover, including the gravel area around the substation.

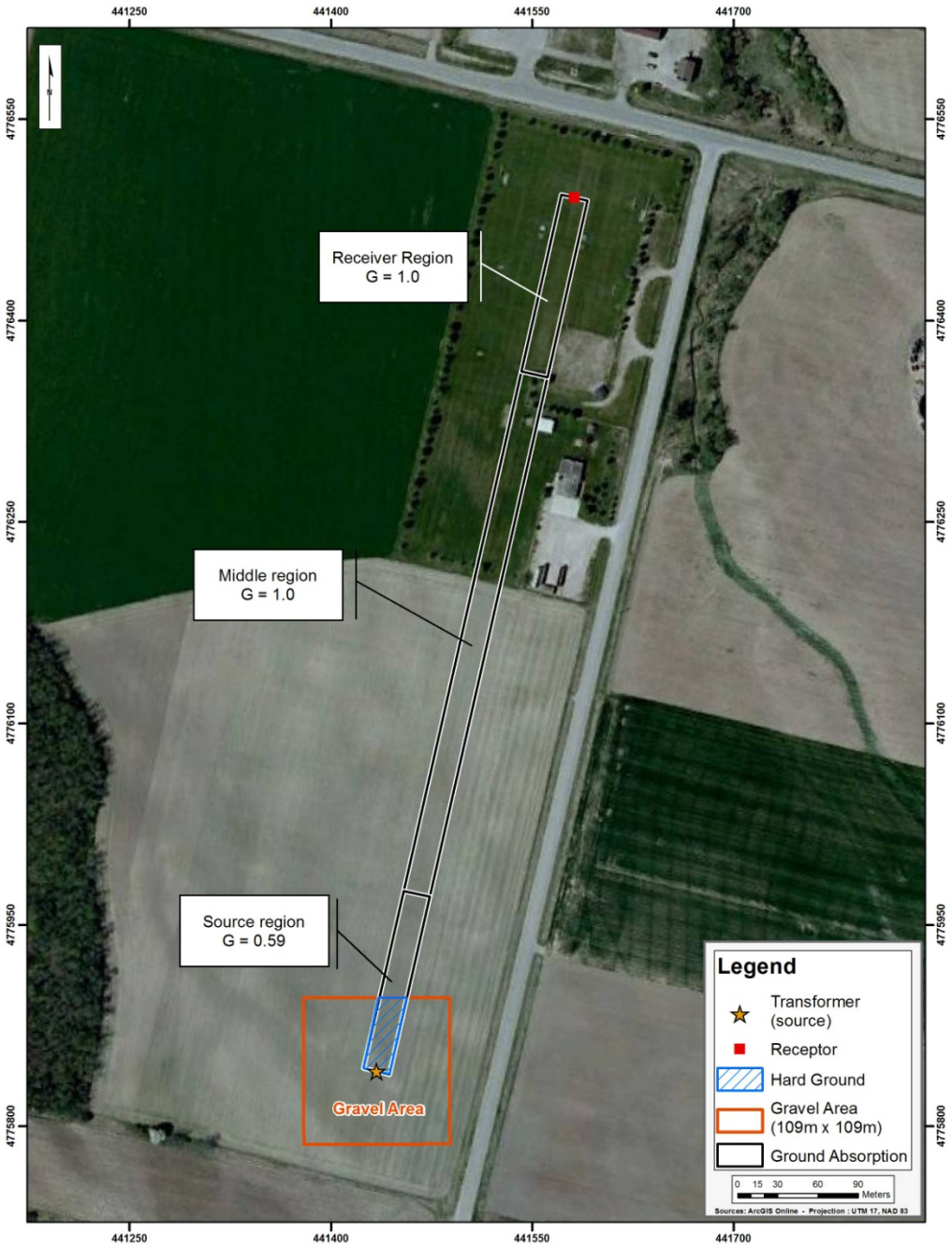

Figure 6-1: Ground factor coverage near Bornish substation

Source region ground factor G_S

As defined by ISO 9613-2, the source region extends over a distance of $30h_S$ from the source towards the receiver, where h_S is the source height of 4.5 m. The source region length is therefore 135 m. NextEra has supplied site plans indicating that an area of approximately 11,860 m^2 will be covered with gravel. A

geometric analysis has indicated that 56 m of the source region is covered with gravel. Based on aerial photography, the remaining 79 m is covered with grass. The source region ground factor G_S is then 0.59 (79 m / 135 m), as per ISO 9613-2.

Receiver region ground factor G_R
As defined by ISO 9613-2, the receiver region extends over a distance of $30h_R$ from the receiver towards the source, where h_R is the receiver height of 4.5 m. The receiver region length is 135 m. Based on aerial photography, 0% of the receiver region is covered by hard ground. The entire region that faces the transformer is covered by soft ground. The receiver region ground factor G_R is then 1.0, as per ISO 9613-2.

Middle region ground factor G_M
As defined by ISO 9613-2, the middle region stretches over the distance between the source and receiver regions. The middle region length is 397 m. Based on aerial photography, 0% of the receiver region is covered by roads or other hard ground. The entire region is covered by soft ground. The middle region ground factor G_M is then 1.0, as per ISO 9613-2.

CadnaA Calculations
Two sets of CadnaA calculations have been carried out. The first uses the three ground factors calculated as described above:

$G_S = 0.59$
$G_M = 1.00$
$G_R = 1.00$

The second CadnaA calculation uses a global ground factor of 0.7 for all three regions. The estimated sound pressure level at VLR210 is shown below for each case.

Case	Case 1, Global G = 0.7	Case 2, Specific G values for each region
Sound Pressure Level at VLR210 [dBA]	38.7	38.3

As seen in the table, Case 1 produces a sound pressure level of 38.7 dBA at VLR210, which is higher and therefore a more conservative assumption than Case 2. Because a global value of 0.7 has been shown to be more conservative for the most sensitive source-receiver case in the vicinity of the transformer, GL GH considers this to be further support that this value can be considered appropriate for use across the rest of the Bornish site, based on ISO 9613-2. Therefore the opinion of GL GH is that based on ISO 9613-2, a global ground factor of 0.7 is suitable for use when modeling noise propagation at the Bornish site.

7 NOISE IMPACT ASSESSMENT SUMMARY TABLE

7.1 Results

The noise level at each critical Point of Reception within 1,500 m of any turbine or substation of the Bornish Project, for wind speeds between 6 m/s and 10 m/s, is tabulated in Table 7-1. For each Point of Reception, the following information is provided:

- The distance to the closest wind turbine or substation;
- For Points of Reception at 1.5 m a.g.l., the sound pressure level presented for wind speeds from 6 m/s to 10 m/s is the maximum noise level on the circumference of a 30 m radius circle centered on the Point of Reception;
- For Points of Reception at 4.5 m or 7.5 m a.g.l., the sound pressure level presented for wind speeds from 6 m/s to 10 m/s is the noise level at the Point of Reception location at its respective height;
- The sound level limit for that Point of Reception according to the MOE noise guidelines at each wind speed from 6 m/s to 10 m/s;
- The applicable background sound level; and
- Whether or not the noise levels at the Point of Reception comply with the MOE guidelines (for continued reference, compliance is confirmed for all Points of Reception).

The closest distance between a wind turbine and a Point of Reception for this project is 574 m between Turbine 4 and Point of Reception 92, and 551 m between turbine 46 and VLR 254.

The highest calculated noise level was found at VLR255 at 39.2 dB(A) and at receptor PoR62 at 38.9 dB(A).

The results show that the Bornish Wind Energy Centre complies with the applicable MOE environmental noise guidelines at all wind speeds modelled (i.e., 6, 7, 8, 9 and 10 m/s). Noise iso-contour maps illustrating the maximum noise contribution of the Bornish Wind Project are shown in Appendix A.

Similarly, the maximum noise level at each Participant within 1,500 m of any turbine or substation is tabulated in Table 7-2.

Table 7-1: Noise Impact Assessment Summary

Point of Reception ID	Receptor height [m]	Distance to Nearest Turbine [m]	Nearest Turbine [ID]	Calculated Sound Pressure Level at Receptor [dB(A)] at selected Wind Speed in m/s					Sound Level Limit [dB(A)] at selected Wind Speed in m/s					Applicable Background Sound Level	Compliance With Limit (Yes/No)
				6 or <	7	8	9	10	6 or <	7	8	9	10	NPC 232 (C 3)	
PoR1	4.5	897	35	36.5	36.5	36.5	36.5	36.5	40	43	45	49	51	40	Yes
PoR3	4.5	905	34	37.1	37.1	37.1	37.1	37.1	40	43	45	49	51	40	Yes
PoR4	4.5	783	34	37.9	37.9	37.9	37.9	37.9	40	43	45	49	51	40	Yes
PoR5	4.5	825	34	37.2	37.2	37.2	37.2	37.2	40	43	45	49	51	40	Yes
PoR6	1.5	726	34	36.2	36.2	36.2	36.2	36.2	40	43	45	49	51	40	Yes
PoR7	4.5	818	34	37.2	37.2	37.2	37.2	37.2	40	43	45	49	51	40	Yes
PoR8	1.5	768	34	35.9	35.9	35.9	35.9	35.9	40	43	45	49	51	40	Yes
PoR9	1.5	838	34	35.4	35.4	35.4	35.4	35.4	40	43	45	49	51	40	Yes
PoR10	1.5	864	34	35.3	35.3	35.3	35.3	35.3	40	43	45	49	51	40	Yes
PoR11	4.5	904	34	37.6	37.6	37.6	37.6	37.6	40	43	45	49	51	40	Yes
PoR12	4.5	1175	34	36.5	36.5	36.5	36.5	36.5	40	43	45	49	51	40	Yes
PoR13	1.5	1486	46	30.7	30.7	30.7	30.7	30.7	40	43	45	49	51	40	Yes
PoR14	4.5	1043	46	33.0	33.0	33.0	33.0	33.0	40	43	45	49	51	40	Yes
PoR15	4.5	785	46	35.2	35.2	35.2	35.2	35.2	40	43	45	49	51	40	Yes
PoR16	7.5	653	46	37.0	37.0	37.0	37.0	37.0	40	43	45	49	51	40	Yes
PoR17	1.5	831	46	34.5	34.5	34.5	34.5	34.5	40	43	45	49	51	40	Yes
PoR19	4.5	796	35	37.3	37.3	37.3	37.3	37.3	40	43	45	49	51	40	Yes
PoR20	1.5	1092	35	33.5	33.5	33.5	33.5	33.5	40	43	45	49	51	40	Yes
PoR21	4.5	1094	39	36.5	36.5	36.5	36.5	36.5	40	43	45	49	51	40	Yes
PoR22	1.5	972	39	34.8	34.8	34.8	34.8	34.8	40	43	45	49	51	40	Yes
PoR23	1.5	891	39	34.9	34.9	34.9	34.9	34.9	40	43	45	49	51	40	Yes
PoR25	4.5	803	39	38.0	38.0	38.0	38.0	38.0	40	43	45	49	51	40	Yes
PoR26	1.5	905	39	35.8	35.8	35.8	35.8	35.8	40	43	45	49	51	40	Yes
PoR29	4.5	604	44	37.3	37.3	37.3	37.3	37.3	40	43	45	49	51	40	Yes
PoR30	4.5	1314	45	31.4	31.4	31.4	31.4	31.4	40	43	45	49	51	40	Yes
PoR31	4.5	1368	27	30.1	30.1	30.1	30.1	30.1	40	43	45	49	51	40	Yes
PoR32	1.5	1221	27	29.4	29.4	29.4	29.4	29.4	40	43	45	49	51	40	Yes
PoR33	4.5	956	27	33.8	33.8	33.8	33.8	33.8	40	43	45	49	51	40	Yes

Point of Reception ID	Receptor height [m]	Distance to Nearest Turbine [m]	Nearest Turbine [ID]	Calculated Sound Pressure Level at Receptor [dB(A)] at selected Wind Speed in m/s					Sound Level Limit [dB(A)] at selected Wind Speed in m/s					Applicable Background Sound Level	Compliance With Limit (Yes/No)
				6 or <	7	8	9	10	6 or <	7	8	9	10	NPC 232 (C 3)	
PoR34	4.5	964	27	34.3	34.3	34.3	34.3	34.3	40	43	45	49	51	40	Yes
PoR35	1.5	953	27	33.9	33.9	33.9	33.9	33.9	40	43	45	49	51	40	Yes
PoR36	4.5	810	26	37.1	37.1	37.1	37.1	37.1	40	43	45	49	51	40	Yes
PoR37	1.5	965	26	34.3	34.3	34.3	34.3	34.3	40	43	45	49	51	40	Yes
PoR38	1.5	900	26	35.2	35.2	35.2	35.2	35.2	40	43	45	49	51	40	Yes
PoR39	4.5	1081	26	36.1	36.1	36.1	36.1	36.1	40	43	45	49	51	40	Yes
PoR41	4.5	663	45	37.9	37.9	37.9	37.9	37.9	40	43	45	49	51	40	Yes
PoR42	4.5	1101	23	36.7	36.7	36.7	36.7	36.7	40	43	45	49	51	40	Yes
PoR43	1.5	1169	23	34.9	34.9	34.9	34.9	34.9	40	43	45	49	51	40	Yes
PoR44	1.5	1190	43	34.9	34.9	34.9	34.9	34.9	40	43	45	49	51	40	Yes
PoR45	1.5	1093	23	34.6	34.6	34.6	34.6	34.6	40	43	45	49	51	40	Yes
PoR46	1.5	1055	23	34.6	34.6	34.6	34.6	34.6	40	43	45	49	51	40	Yes
PoR47	4.5	1069	43	37.5	37.5	37.5	37.5	37.5	40	43	45	49	51	40	Yes
PoR51	4.5	1083	35	38.5	38.5	38.5	38.5	38.5	40	43	45	49	51	40	Yes
PoR54	1.5	1374	28	31.4	31.4	31.4	31.4	31.4	40	43	45	49	51	40	Yes
PoR55	4.5	1362	12	31.8	31.8	31.8	31.8	31.8	40	43	45	49	51	40	Yes
PoR56	4.5	1390	12	31.7	31.7	31.7	31.7	31.7	40	43	45	49	51	40	Yes
PoR57	4.5	967	12	34.8	34.8	34.8	34.8	34.8	40	43	45	49	51	40	Yes
PoR58	4.5	1026	12	34.6	34.6	34.6	34.6	34.6	40	43	45	49	51	40	Yes
PoR59	1.5	840	12	35.4	35.4	35.4	35.4	35.4	40	43	45	49	51	40	Yes
PoR62	4.5	872	17	38.9	38.9	38.9	38.9	38.9	40	43	45	49	51	40	Yes
PoR63	1.5	962	5	36.5	36.5	36.5	36.5	36.5	40	43	45	49	51	40	Yes
PoR65	1.5	869	8	36.6	36.6	36.6	36.6	36.6	40	43	45	49	51	40	Yes
PoR66	1.5	770	8	37.1	37.1	37.1	37.1	37.1	40	43	45	49	51	40	Yes
PoR67	4.5	871	21	38.7	38.7	38.7	38.7	38.7	40	43	45	49	51	40	Yes
PoR68	1.5	705	10	35.6	35.6	35.6	35.6	35.6	40	43	45	49	51	40	Yes
PoR69	4.5	850	11	37.8	37.8	37.8	37.8	37.8	40	43	45	49	51	40	Yes
PoR70	4.5	882	11	37.9	37.9	37.9	37.9	37.9	40	43	45	49	51	40	Yes
PoR73	1.5	791	26	36.3	36.3	36.3	36.3	36.3	40	43	45	49	51	40	Yes
PoR74	1.5	843	27	35.6	35.6	35.6	35.6	35.6	40	43	45	49	51	40	Yes

Point of Reception ID	Receptor height [m]	Distance to Nearest Turbine [m]	Nearest Turbine [ID]	Calculated Sound Pressure Level at Receptor [dB(A)] at selected Wind Speed in m/s					Sound Level Limit [dB(A)] at selected Wind Speed in m/s					Applicable Background Sound Level	Compliance With Limit (Yes/No)
				6 or <	7	8	9	10	6 or <	7	8	9	10	NPC 232 (C 3)	
PoR76	4.5	839	27	35.5	35.5	35.5	35.5	35.5	40	43	45	49	51	40	Yes
PoR77	1.5	845	27	33.1	33.1	33.1	33.1	33.1	40	43	45	49	51	40	Yes
PoR78	4.5	1408	27	29.7	29.7	29.7	29.7	29.7	40	43	45	49	51	40	Yes
PoR79	4.5	1456	11	29.7	29.7	29.7	29.7	29.7	40	43	45	49	51	40	Yes
PoR80	1.5	1076	11	29.9	29.9	29.9	29.9	29.9	40	43	45	49	51	40	Yes
PoR81	4.5	875	11	33.8	33.8	33.8	33.8	33.8	40	43	45	49	51	40	Yes
PoR82	1.5	1050	11	31.0	31.0	31.0	31.0	31.0	40	43	45	49	51	40	Yes
PoR83	4.5	997	11	34.3	34.3	34.3	34.3	34.3	40	43	45	49	51	40	Yes
PoR84	1.5	1059	10	31.4	31.4	31.4	31.4	31.4	40	43	45	49	51	40	Yes
PoR85	4.5	1138	8	36.3	36.3	36.3	36.3	36.3	40	43	45	49	51	40	Yes
PoR87	1.5	738	4	35.6	35.6	35.6	35.6	35.6	40	43	45	49	51	40	Yes
PoR88	4.5	1073	4	34.8	34.8	34.8	34.8	34.8	40	43	45	49	51	40	Yes
PoR89	4.5	1040	4	34.9	34.9	34.9	34.9	34.9	40	43	45	49	51	40	Yes
PoR90	1.5	1256	4	31.5	31.5	31.5	31.5	31.5	40	43	45	49	51	40	Yes
PoR91	7.5	1494	4	32.6	32.6	32.6	32.6	32.6	40	43	45	49	51	40	Yes
PoR92	1.5	574	4	37.1	37.1	37.1	37.1	37.1	40	43	45	49	51	40	Yes
PoR93	4.5	604	4	38.8	38.8	38.8	38.8	38.8	40	43	45	49	51	40	Yes
PoR94	4.5	869	4	37.0	37.0	37.0	37.0	37.0	40	43	45	49	51	40	Yes
PoR96	4.5	948	3	36.2	36.2	36.2	36.2	36.2	40	43	45	49	51	40	Yes
PoR97	4.5	950	Subs.	36.5	36.5	36.5	36.5	36.5	40	43	45	49	51	40	Yes
PoR98	4.5	828	1	37.1	37.1	37.1	37.1	37.1	40	43	45	49	51	40	Yes
PoR99	4.5	779	1	36.6	36.6	36.6	36.6	36.6	40	43	45	49	51	40	Yes
PoR100	4.5	621	1	38.0	38.0	38.0	38.0	38.0	40	43	45	49	51	40	Yes
PoR102	1.5	828	1	32.7	32.7	32.7	32.7	32.7	40	43	45	49	51	40	Yes
PoR103	4.5	886	1	34.0	34.0	34.0	34.0	34.0	40	43	45	49	51	40	Yes
PoR104	4.5	1131	1	32.2	32.2	32.2	32.2	32.2	40	43	45	49	51	40	Yes
PoR105	4.5	1281	9	32.4	32.4	32.4	32.4	32.4	40	43	45	49	51	40	Yes
PoR106	4.5	1238	9	33.0	33.0	33.0	33.0	33.0	40	43	45	49	51	40	Yes
PoR107	4.5	764	9	36.3	36.3	36.3	36.3	36.3	40	43	45	49	51	40	Yes
PoR109	4.5	872	23	36.8	36.8	36.8	36.8	36.8	40	43	45	49	51	40	Yes

Point of Reception ID	Receptor height [m]	Distance to Nearest Turbine [m]	Nearest Turbine [ID]	Calculated Sound Pressure Level at Receptor [dB(A)] at selected Wind Speed in m/s					Sound Level Limit [dB(A)] at selected Wind Speed in m/s					Applicable Background Sound Level	Compliance With Limit (Yes/No)
				6 or <	7	8	9	10	6 or <	7	8	9	10	NPC 232 (C 3)	
PoR110	1.5	921	23	34.8	34.8	34.8	34.8	34.8	40	43	45	49	51	40	Yes
PoR111	1.5	716	23	35.5	35.5	35.5	35.5	35.5	40	43	45	49	51	40	Yes
PoR112	4.5	904	23	37.1	37.1	37.1	37.1	37.1	40	43	45	49	51	40	Yes
PoR113	4.5	960	23	37.1	37.1	37.1	37.1	37.1	40	43	45	49	51	40	Yes
PoR116	1.5	823	47	35.5	35.5	35.5	35.5	35.5	40	43	45	49	51	40	Yes
PoR117	4.5	820	47	36.9	36.9	36.9	36.9	36.9	40	43	45	49	51	40	Yes
PoR118	4.5	1443	44	32.4	32.4	32.4	32.4	32.4	40	43	45	49	51	40	Yes
PoR119	4.5	1367	44	32.5	32.5	32.5	32.5	32.5	40	43	45	49	51	40	Yes
PoR120	4.5	1490	44	29.8	29.8	29.8	29.8	29.8	40	43	45	49	51	40	Yes
PoR121	4.5	630	45	36.6	36.6	36.6	36.6	36.6	40	43	45	49	51	40	Yes
PoR122	4.5	1410	46	31.0	31.0	31.0	31.0	31.0	40	43	45	49	51	40	Yes
PoR123	1.5	1266	11	28.5	28.5	28.5	28.5	28.5	40	43	45	49	51	40	Yes
PoR126	1.5	842	35	35.0	35.0	35.0	35.0	35.0	40	43	45	49	51	40	Yes
PoR127	4.5	1199	34	34.8	34.8	34.8	34.8	34.8	40	43	45	49	51	40	Yes
PoR128	4.5	801	6	38.6	38.6	38.6	38.6	38.6	40	43	45	49	51	40	Yes
VLR129	4.5	1186	9	33.0	33.0	33.0	33.0	33.0	40	43	45	49	51	40	Yes
VLR130	4.5	796	Subs.	37.5	37.5	37.5	37.5	37.5	40	43	45	49	51	40	Yes
VLR131	4.5	995	11	34.0	34.0	34.0	34.0	34.0	40	43	45	49	51	40	Yes
VLR132	4.5	1049	23	36.7	36.7	36.7	36.7	36.7	40	43	45	49	51	40	Yes
VLR133	4.5	946	47	35.7	35.7	35.7	35.7	35.7	40	43	45	49	51	40	Yes
VLR134	4.5	1097	6	36.4	36.4	36.4	36.4	36.4	40	43	45	49	51	40	Yes
VLR135	4.5	1067	11	33.1	33.1	33.1	33.1	33.1	40	43	45	49	51	40	Yes
VLR136	4.5	1223	27	31.1	31.1	31.1	31.1	31.1	40	43	45	49	51	40	Yes
VLR137	4.5	567	10	37.7	37.7	37.7	37.7	37.7	40	43	45	49	51	40	Yes
VLR138	4.5	873	45	37.0	37.0	37.0	37.0	37.0	40	43	45	49	51	40	Yes
VLR139	4.5	849	27	36.6	36.6	36.6	36.6	36.6	40	43	45	49	51	40	Yes
VLR140	4.5	1431	12	32.8	32.8	32.8	32.8	32.8	40	43	45	49	51	40	Yes
VLR141	4.5	1393	27	30.0	30.0	30.0	30.0	30.0	40	43	45	49	51	40	Yes
VLR142	4.5	1020	11	32.3	32.3	32.3	32.3	32.3	40	43	45	49	51	40	Yes
VLR143	4.5	804	44	34.7	34.7	34.7	34.7	34.7	40	43	45	49	51	40	Yes

Point of Reception ID	Receptor height [m]	Distance to Nearest Turbine [m]	Nearest Turbine [ID]	Calculated Sound Pressure Level at Receptor [dB(A)] at selected Wind Speed in m/s					Sound Level Limit [dB(A)] at selected Wind Speed in m/s					Applicable Background Sound Level	Compliance With Limit (Yes/No)
				6 or <	7	8	9	10	6 or <	7	8	9	10	NPC 232 (C 3)	
VLR144	4.5	1092	27	31.8	31.8	31.8	31.8	31.8	40	43	45	49	51	40	Yes
VLR145	4.5	744	4	37.6	37.6	37.6	37.6	37.6	40	43	45	49	51	40	Yes
VLR146	4.5	1257	1	31.7	31.7	31.7	31.7	31.7	40	43	45	49	51	40	Yes
VLR147	4.5	877	47	37.4	37.4	37.4	37.4	37.4	40	43	45	49	51	40	Yes
VLR148	4.5	811	9	36.1	36.1	36.1	36.1	36.1	40	43	45	49	51	40	Yes
VLR149	4.5	578	1	37.6	37.6	37.6	37.6	37.6	40	43	45	49	51	40	Yes
VLR150	4.5	831	Subs.	37.0	37.0	37.0	37.0	37.0	40	43	45	49	51	40	Yes
VLR151	4.5	979	9	34.4	34.4	34.4	34.4	34.4	40	43	45	49	51	40	Yes
VLR152	4.5	741	1	35.2	35.2	35.2	35.2	35.2	40	43	45	49	51	40	Yes
VLR153	4.5	1310	1	30.9	30.9	30.9	30.9	30.9	40	43	45	49	51	40	Yes
VLR155	4.5	1040	9	36.0	36.0	36.0	36.0	36.0	40	43	45	49	51	40	Yes
VLR156	4.5	1127	10	33.3	33.3	33.3	33.3	33.3	40	43	45	49	51	40	Yes
VLR157	4.5	1001	11	33.0	33.0	33.0	33.0	33.0	40	43	45	49	51	40	Yes
VLR158	4.5	603	10	38.4	38.4	38.4	38.4	38.4	40	43	45	49	51	40	Yes
VLR159	4.5	596	44	36.7	36.7	36.7	36.7	36.7	40	43	45	49	51	40	Yes
VLR160	4.5	600	4	38.4	38.4	38.4	38.4	38.4	40	43	45	49	51	40	Yes
VLR161	4.5	980	9	34.9	34.9	34.9	34.9	34.9	40	43	45	49	51	40	Yes
VLR162	4.5	800	Subs.	37.3	37.3	37.3	37.3	37.3	40	43	45	49	51	40	Yes
VLR163	4.5	1491	27	29.3	29.3	29.3	29.3	29.3	40	43	45	49	51	40	Yes
VLR165	4.5	640	44	36.2	36.2	36.2	36.2	36.2	40	43	45	49	51	40	Yes
VLR166	4.5	666	1	36.0	36.0	36.0	36.0	36.0	40	43	45	49	51	40	Yes
VLR167	4.5	756	11	38.7	38.7	38.7	38.7	38.7	40	43	45	49	51	40	Yes
VLR168	4.5	928	11	34.0	34.0	34.0	34.0	34.0	40	43	45	49	51	40	Yes
VLR169	4.5	722	25	38.3	38.3	38.3	38.3	38.3	40	43	45	49	51	40	Yes
VLR170	4.5	958	47	37.3	37.3	37.3	37.3	37.3	40	43	45	49	51	40	Yes
VLR171	4.5	1029	47	37.2	37.2	37.2	37.2	37.2	40	43	45	49	51	40	Yes
VLR172	4.5	1074	43	37.0	37.0	37.0	37.0	37.0	40	43	45	49	51	40	Yes
VLR173	4.5	1110	43	36.9	36.9	36.9	36.9	36.9	40	43	45	49	51	40	Yes
VLR174	4.5	1081	22	37.5	37.5	37.5	37.5	37.5	40	43	45	49	51	40	Yes
VLR175	4.5	1181	22	37.1	37.1	37.1	37.1	37.1	40	43	45	49	51	40	Yes

Point of Reception ID	Receptor height [m]	Distance to Nearest Turbine [m]	Nearest Turbine [ID]	Calculated Sound Pressure Level at Receptor [dB(A)] at selected Wind Speed in m/s					Sound Level Limit [dB(A)] at selected Wind Speed in m/s					Applicable Background Sound Level	Compliance With Limit (Yes/No)
				6 or <	7	8	9	10	6 or <	7	8	9	10	NPC 232 (C 3)	
VLR176	4.5	898	22	38.4	38.4	38.4	38.4	38.4	40	43	45	49	51	40	Yes
VLR177	4.5	969	23	36.9	36.9	36.9	36.9	36.9	40	43	45	49	51	40	Yes
VLR178	4.5	761	23	37.2	37.2	37.2	37.2	37.2	40	43	45	49	51	40	Yes
VLR179	4.5	1485	44	32.2	32.2	32.2	32.2	32.2	40	43	45	49	51	40	Yes
VLR180	4.5	912	35	36.5	36.5	36.5	36.5	36.5	40	43	45	49	51	40	Yes
VLR181	4.5	800	35	37.8	37.8	37.8	37.8	37.8	40	43	45	49	51	40	Yes
VLR182	4.5	839	34	37.2	37.2	37.2	37.2	37.2	40	43	45	49	51	40	Yes
VLR183	4.5	718	34	38.1	38.1	38.1	38.1	38.1	40	43	45	49	51	40	Yes
VLR184	4.5	683	46	37.7	37.7	37.7	37.7	37.7	40	43	45	49	51	40	Yes
VLR185	4.5	566	46	38.4	38.4	38.4	38.4	38.4	40	43	45	49	51	40	Yes
VLR186	4.5	651	46	37.1	37.1	37.1	37.1	37.1	40	43	45	49	51	40	Yes
VLR187	4.5	1159	46	32.3	32.3	32.3	32.3	32.3	40	43	45	49	51	40	Yes
VLR188	4.5	1173	35	35.9	35.9	35.9	35.9	35.9	40	43	45	49	51	40	Yes
VLR189	4.5	1089	39	36.1	36.1	36.1	36.1	36.1	40	43	45	49	51	40	Yes
VLR190	4.5	790	39	37.6	37.6	37.6	37.6	37.6	40	43	45	49	51	40	Yes
VLR191	4.5	716	39	38.0	38.0	38.0	38.0	38.0	40	43	45	49	51	40	Yes
VLR192	4.5	877	41	38.1	38.1	38.1	38.1	38.1	40	43	45	49	51	40	Yes
VLR193	4.5	849	41	37.9	37.9	37.9	37.9	37.9	40	43	45	49	51	40	Yes
VLR194	4.5	1138	47	34.8	34.8	34.8	34.8	34.8	40	43	45	49	51	40	Yes
VLR195	4.5	1018	44	34.7	34.7	34.7	34.7	34.7	40	43	45	49	51	40	Yes
VLR196	4.5	1337	44	33.3	33.3	33.3	33.3	33.3	40	43	45	49	51	40	Yes
VLR197	4.5	779	47	37.5	37.5	37.5	37.5	37.5	40	43	45	49	51	40	Yes
VLR198	4.5	1176	45	32.6	32.6	32.6	32.6	32.6	40	43	45	49	51	40	Yes
VLR199	4.5	890	24	37.3	37.3	37.3	37.3	37.3	40	43	45	49	51	40	Yes
VLR200	4.5	848	10	37.0	37.0	37.0	37.0	37.0	40	43	45	49	51	40	Yes
VLR201	4.5	946	6	37.5	37.5	37.5	37.5	37.5	40	43	45	49	51	40	Yes
VLR202	4.5	946	12	36.6	36.6	36.6	36.6	36.6	40	43	45	49	51	40	Yes
VLR203	4.5	1005	48	37.7	37.7	37.7	37.7	37.7	40	43	45	49	51	40	Yes
VLR204	4.5	1328	12	33.5	33.5	33.5	33.5	33.5	40	43	45	49	51	40	Yes
VLR205	4.5	1070	12	35.5	35.5	35.5	35.5	35.5	40	43	45	49	51	40	Yes

Point of Reception ID	Receptor height [m]	Distance to Nearest Turbine [m]	Nearest Turbine [ID]	Calculated Sound Pressure Level at Receptor [dB(A)] at selected Wind Speed in m/s					Sound Level Limit [dB(A)] at selected Wind Speed in m/s					Applicable Background Sound Level	Compliance With Limit (Yes/No)
				6 or <	7	8	9	10	6 or <	7	8	9	10	NPC 232 (C 3)	
VLR206	4.5	901	12	37.2	37.2	37.2	37.2	37.2	40	43	45	49	51	40	Yes
VLR207	4.5	801	28	37.9	37.9	37.9	37.9	37.9	40	43	45	49	51	40	Yes
VLR208	4.5	1077	28	35.5	35.5	35.5	35.5	35.5	40	43	45	49	51	40	Yes
VLR209	4.5	859	5	38.9	38.9	38.9	38.9	38.9	40	43	45	49	51	40	Yes
VLR210	4.5	667	Subs.	38.7	38.7	38.7	38.7	38.7	40	43	45	49	51	40	Yes
VLR211	4.5	986	35	38.4	38.4	38.4	38.4	38.4	40	43	45	49	51	40	Yes
VLR212	4.5	1386	46	30.8	30.8	30.8	30.8	30.8	40	43	45	49	51	40	Yes
VLR213	4.5	1417	4	33.5	33.5	33.5	33.5	33.5	40	43	45	49	51	40	Yes
VLR214	4.5	1255	11	30.6	30.6	30.6	30.6	30.6	40	43	45	49	51	40	Yes
VLR221	4.5	858	18	39.1	39.1	39.1	39.1	39.1	40	43	45	49	51	40	Yes
VLR223	4.5	1349	45	31.4	31.4	31.4	31.4	31.4	40	43	45	49	51	40	Yes
VLR226	4.5	863	33	39.1	39.1	39.1	39.1	39.1	40	43	45	49	51	40	Yes
VLR230	4.5	888	Subs.	37.1	37.1	37.1	37.1	37.1	40	43	45	49	51	40	Yes
VLR232	4.5	1008	18	38.6	38.6	38.6	38.6	38.6	40	43	45	49	51	40	Yes
VLR241	4.5	1032	33	38.6	38.6	38.6	38.6	38.6	40	43	45	49	51	40	Yes
VLR244	4.5	832	6	38.4	38.4	38.4	38.4	38.4	40	43	45	49	51	40	Yes
VLR248	4.5	808	23	37.4	37.4	37.4	37.4	37.4	40	43	45	49	51	40	Yes
VLR254	4.5	551	46	37.9	37.9	37.9	37.9	37.9	40	43	45	49	51	40	Yes
VLR255	4.5	685	39	39.2	39.2	39.2	39.2	39.2	40	43	45	49	51	40	Yes
VLR257	4.5	662	45	36.5	36.5	36.5	36.5	36.5	40	43	45	49	51	40	Yes
VLR258	4.5	1029	23	36.7	36.7	36.7	36.7	36.7	40	43	45	49	51	40	Yes
VLR268	4.5	955	10	36.9	36.9	36.9	36.9	36.9	40	43	45	49	51	40	Yes
PoR269	4.5	1422	27	31.6	31.6	31.6	31.6	31.6	40	43	45	49	51	40	Yes

Table 7-2: Noise Impact Assessment Summary – Participants

Participant ID	Height [m]	Distance to Nearest Turbine [m]	Nearest Turbine [ID]	Calculated Sound Pressure Level at Dwelling [dB(A)]
PR2	4.5	810	35	37.2
PR18	4.5	1020	30	37.5
PR24	4.5	554	39	39.6
PR27	1.5	685	41	38.2
PR28	1.5	516	44	36.6
PR40	4.5	853	45	37.5
PR48	4.5	494	42	42.9
PR49	4.5	530	20	42.8
PR50	1.5	484	18	40.1
PR52	1.5	691	33	39.4
PR53	1.5	741	16	39.8
PR60	4.5	686	2	39.8
PR61	4.5	700	17	39.9
PR64	4.5	580	8	40.8
PR71	4.5	679	24	39.1
PR72	7.5	580	25	40.0
PR75	7.5	698	27	38.2
PR86	1.5	569	4	37.6
PR95	1.5	664	3	36.9
PR101	1.5	474	1	37.5
PR108	4.5	581	10	38.6
PR114	1.5	1195	44	34.5
PR115	4.5	873	44	36.9
PR124	1.5	505	17	38.5
PR125	4.5	553	20	42.2
PV154	4.5	720	10	37.5
PV164	4.5	904	11	33.2
PV215	4.5	668	13	42.0
PV216	4.5	686	15	40.2
PV217	4.5	576	13	42.1
PV218	4.5	788	45	37.7

Participant ID	Height [m]	Distance to Nearest Turbine [m]	Nearest Turbine [ID]	Calculated Sound Pressure Level at Dwelling [dB(A)]
PV219	4.5	597	13	42.1
PV220	4.5	577	33	41.2
PV222	4.5	663	28	41.5
PV224	4.5	1139	47	36.8
PV225	4.5	656	31	41.9
PV227	4.5	922	14	38.7
PV228	4.5	597	19	42.7
PV229	4.5	636	9	38.2
PV231	4.5	680	45	37.8
PV233	4.5	705	17	39.1
PV234	4.5	761	12	39.2
PV235	4.5	688	30	41.9
PV236	4.5	715	41	39.1
PV237	4.5	542	42	42.6
PV238	4.5	625	37	42.5
PV239	4.5	892	14	39.0
PV240	4.5	720	11	38.8
PV242	4.5	661	38	42.7
PV243	4.5	615	18	41.9
PV245	4.5	701	10	38.3
PV246	4.5	646	47	38.8
PV247	4.5	998	23	36.7
PV249	4.5	1095	23	36.6
PV250	4.5	892	23	37.0
PV251	4.5	753	23	37.2
PV252	4.5	696	34	38.3
PV253	4.5	502	46	38.8
PV256	4.5	763	44	37.2
PV259	4.5	705	8	40.0
PV260	4.5	534	20	42.3
PV261	4.5	537	7	41.7
PV262	4.5	486	7	41.9
PV263	4.5	723	5	39.8

Participant ID	Height [m]	Distance to Nearest Turbine [m]	Nearest Turbine [ID]	Calculated Sound Pressure Level at Dwelling [dB(A)]
PV264	4.5	996	5	38.5
PV265	4.5	1073	3	38.3
PV266	4.5	665	17	40.2
PV267	4.5	695	Subs.	38.2

8 CONCLUSION

Based on the approach presented in this NIA, the Bornish Wind Energy Centre is compliant with the MOE noise limits at all Points of Reception and Vacant Lot Receptors within 1,500 m of the Project's noise sources, for wind speeds of 6, 7, 8, 9, and 10 m/s.

9 REFERENCES

[1] Ontario Regulation 359/09 (Renewable Energy Approvals (REA)

[2] MOE Noise Guidelines for Wind Farms, Interpretation for Applying NPC Publications, October 2008.

[3] International Electrotechnical Commission (IEC), 2006. IEC 61400 – 11 Ed. 2.1 Wind turbine generator systems – Part 11: Acoustic noise measurement techniques. 46 p.

[4] Handbook of Acoustics – Malcolm J. Crocker, 1998.

[5] International Organization for Standardization (ISO), 1993. Acoustics - Attenuation of Sound During Propagation Outdoors - Calculation of the Absorption of Sound by the Atmosphere. ISO 9613-1. 33 p.

[6] International Organization for Standardization (ISO), 1996. Acoustics - Attenuation of Sound During Propagation Outdoors - General Method of Calculation. ISO 9613-2. 25 p.

APPENDIX A ZONING AND NOISE ISO-CONTOUR MAPS

436000 438000 440000 442000 444000 446000 448000 450000

4778000 4776000 4774000 4772000 4770000 4768000

AUSABLE RIVER VALLEY LIFE ANSI

Sylvan

Parkhill

Big Swamp

ELLIOT DRIVE
MCINTYRE ROAD
QUEEN STREET
MCGUFFIN HILLS DRIVE
PETE SEBE ROAD
CENTRE ROAD
ELGINFIELD ROAD
NAIRN ROAD
SYLVAN ROAD
COLDSTREAM ROAD
FORT ROSE ROAD
BORNISH DRIVE
POPLAR HILL ROAD
RIVER DRIVE
RODDICK ROAD
HODGINS ROAD
HASKETT ROAD
ELM TREE DRIVE
KERWOOD ROAD
SPRINGBANK ROAD
CAMERON ROAD
AUSABLE ROAD
TOWNSEND LINE

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48

Legend

Project Components

- Wind Turbine (48)
- Substation
- Participating Receptor
- Project Area

Predicted Sound Level

- 40 dB(A) at 1.5 m agl*
- 40 dB(A) at 4.5 m agl*
- 40 dB(A) at 7.5 m agl*

*agl: Above Ground Level

Other Components

- 1-Storey Receptor
- 2-Storeys Receptor
- 3-Storeys Receptor
- Vacant Lot Receptor
- Other Building
- Railway
- Arterial / Collector
- Local Road / Street
- Permanent Watercourse
- Intermittent Watercourse
- Runway
- Residential Area
- Park / Sports Field
- Campground
- Cemetery
- ANSI - Life Science
- Pit or Quarry
- Waterbody
- Wetland
- Wooded Area
- Lot Line
- Municipal Boundary
- County Boundary

0 0.5 1 2 3 km

NEXTera ENERGY

Bornish Wind Energy Centre

48 TURBINE LAYOUT WITH SIMULATED SOUND ISOCONTOUR LEVELS (WIND SPEED OF 6 m/s)

GL Garrad Hassan

1008-001-130412-001-AB

April 12, 2013

Projection: UTM Zone 17, NAD83

Sources: Ontario Base Mapping, Ontario Road Network, Land Information Ontario, Geobase, CanVec, Industry Canada.

436000 438000 440000 442000 444000 446000 448000 450000

4778000 4776000 4774000 4772000 4770000 4768000

AUSABLE RIVER VALLEY LIFE ANSI

Sylvan

Parkhill

ELLIOT DRIVE

MCINTYRE ROAD

QUEEN STREET

CENTRE ROAD

MCGUFFIN HILLS DRIVE

PETE SEBE ROAD

ELGINFIELD ROAD

NAIRN ROAD

Big Swamp

SYLVAN ROAD

RODDICK ROAD

HODGINS ROAD

HASKETT ROAD

ELM TREE DRIVE

FORT ROSE ROAD

BORNISH DRIVE

POPLAR HILL ROAD

SPRINGBANK ROAD

CAMERON ROAD

RIVER DRIVE

AUSABLE RIVER VALLEY LIFE ANSI

KERWOOD ROAD

AUSABLE ROAD

TOWNSEND LINE

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48

Legend

Project Components

- Wind Turbine (48)
- Substation
- Participating Receptor
- Project Area

Predicted Sound Level

- 45 dB(A) at 1.5 m agl*
- 45 dB(A) at 4.5 m agl*
- 45 dB(A) at 7.5 m agl*

*agl: Above Ground Level

Other Components

- 1-Storey Receptor
- 2-Storeys Receptor
- 3-Storeys Receptor
- Vacant Lot Receptor
- Other Building
- Railway
- Arterial / Collector
- Local Road / Street
- Permanent Watercourse
- Intermittent Watercourse
- Runway
- Residential Area
- Park / Sports Field
- Campground
- Cemetery
- ANSI - Life Science
- Pit or Quarry
- Waterbody
- Wetland
- Wooded Area
- Lot Line
- Municipal Boundary
- County Boundary

0 0.5 1 2 3 km

NEXTera ENERGY

Bornish Wind Energy Centre

48 TURBINE LAYOUT WITH SIMULATED SOUND ISOCONTOUR LEVELS (WIND SPREED OF 8m/s)

GL Garrad Hassan

1008-001-130412-001-AB

April 12, 2013

Projection: UTM Zone 17, NAD83

Sources: Ontario Base Mapping, Ontario Road Network, Land Information Ontario, Geobase, CanVec, Industry Canada.

APPENDIX B SAMPLE CALCULATION FOR NOISE MODELING

Resulting A-weighted sound pressure level at Receptors PoR 62 and VLR 255

The calculation of cumulative receptor noise levels from wind turbines uses the methodology of ISO 9613-2, "*Acoustics — Attenuation of sound during propagation outdoors: Part 2: General method of calculation*". These calculations are conducted with CadnaA *(which is an implementation of ISO 9613-1 and ISO 9613-2)*.

As an example, in this appendix, the results are presented at PoR 62 and VLR 255. The following conditions were used:

- Turbine locations (Appendix F);
- Receptor locations (Appendix C).

Turbine characteristics and modelling parameters:

- Hub-heights: 80 m (GE 1.6 100);
- Ambient air temperature: 10ºC;
- Ambient barometric pressure: 101.32 kPa;
- Relative humidity: 70%;
- Wind speed (10 m agl): 6 m/s;
- Source ground factor: 0.7;
- Middle ground factor: 0.7; and
- Receptor ground factor: 0.7
- See Table 5-1 for broadband and octave band sound power level;

The following table presents an example result and intermediate values of the calculations as the A-weighted sound pressure levels at two chosen example receptors, due to each turbine or substation and each octave band. The net result, the A-weighted sound pressure level at the example receptors PoR 62 and VLR 255 for all bands and all noise sources within 5,000 m of the example receptor, is 38.9 and 39.2 dB(A) respectively.

Sample Calculations

Sound Pressure Levels at PoR 62

Turbine ID	Distance* [m]	Octave Band Sound Pressure Levels [dB(A)]									Total A-Weighted Sound Pressure Level by Turbine and for all Octave Bands [dB(A)]
		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	
17	876	6.6	17.0	19.8	24.7	26.4	25.7	17.7	-9.7	N/A	31.1
3	884	6.5	17.0	19.7	24.6	26.3	25.5	17.5	-10.1	N/A	31.0
Subs.	902	-5.0	14.1	17.1	22.3	28.9	24.5	15.3	-10.7	N/A	31.3
5	1426	2.4	12.7	15.3	19.9	21.1	19.4	8.1	-32.0	N/A	25.7
4	1459	2.2	12.5	15.0	19.6	20.8	19.1	7.6	-33.3	N/A	25.4
18	1532	1.7	12.1	14.6	19.1	20.2	18.4	6.5	-36.1	N/A	24.9
2	1561	1.6	11.9	14.4	18.9	20.0	18.1	6.1	-37.2	N/A	24.7
16	1598	1.4	11.7	14.2	18.7	19.7	17.8	5.5	-38.6	N/A	24.4
15	1758	0.5	10.9	13.3	17.7	18.6	16.4	3.1	-44.7	N/A	23.3
6	1789	0.4	10.7	13.1	17.5	18.4	16.1	2.7	-45.9	N/A	23.0
19	1933	-0.3	10.0	12.4	16.7	17.4	14.9	0.6	-51.3	N/A	22.1
1	2127	-1.1	9.2	11.5	15.6	16.2	13.3	-2.2	-58.6	N/A	20.9
7	2132	-1.1	9.2	11.5	15.7	16.2	13.4	-2.1	-58.4	N/A	20.9
14	2232	-1.5	8.8	11.0	15.1	15.6	12.6	-3.5	-62.3	N/A	20.3
20	2299	-1.8	8.5	10.7	14.8	15.2	12.1	-4.5	-64.8	N/A	20.0
33	2492	-2.5	7.8	10.0	13.9	14.2	10.7	-7.0	-71.8	N/A	19.0
21	2570	-2.7	7.5	9.7	13.6	13.8	10.1	-8.0	-74.6	N/A	18.6
8	2627	-2.9	7.4	9.5	13.3	13.5	9.7	-8.8	-76.7	N/A	18.3
13	2637	-2.9	7.4	9.4	13.3	13.4	9.7	-8.9	-77.0	N/A	18.3
36	2643	-2.9	7.4	9.4	13.3	13.4	9.6	-9.0	-77.2	N/A	18.3
32	2705	-3.0	7.2	9.2	13.0	13.1	9.2	-9.7	-79.4	N/A	18.0
35	2729	-3.1	7.2	9.1	12.9	13.0	9.1	-10.0	-80.3	N/A	17.9
37	2748	-3.1	7.1	9.1	12.8	12.9	8.9	-10.3	-81.0	N/A	17.8
31	2871	-3.4	6.8	8.7	12.4	12.3	8.1	-11.8	-85.3	N/A	17.3
22	2887	-3.4	6.8	8.6	12.3	12.2	8.0	-12.0	-85.9	N/A	17.2
48	2887	-3.4	6.8	8.6	12.3	12.2	8.0	-12.0	-85.9	N/A	17.2
38	2942	-3.6	6.7	8.5	12.1	12.0	7.7	-12.7	-87.9	N/A	17.0
34	3003	-3.7	6.5	8.3	11.9	11.7	7.3	-13.4	N/A	N/A	16.7
30	3171	-4.0	6.2	7.8	11.3	10.9	6.3	-15.5	N/A	N/A	16.1
39	3205	-4.1	6.1	7.7	11.2	10.8	6.0	-15.9	N/A	N/A	16.0
12	3231	-4.1	6.1	7.6	11.1	10.7	5.9	-16.2	N/A	N/A	15.9
42	3288	-4.3	5.9	7.4	10.9	10.4	5.5	-16.9	N/A	N/A	15.6
9	3331	-4.3	5.9	7.3	10.7	10.2	5.3	-17.4	N/A	N/A	15.5
40	3327	-4.3	5.9	7.3	10.7	10.3	5.3	-17.4	N/A	N/A	15.5
29	3558	-4.8	5.4	6.7	10.0	9.3	3.9	-20.1	N/A	N/A	14.7
41	3649	-4.9	5.2	6.4	9.6	8.9	3.4	-21.2	N/A	N/A	14.4
43	3718	-5.1	5.1	6.3	9.4	8.6	3.0	-22.0	N/A	N/A	14.1
28	3762	-5.2	5.0	6.2	9.3	8.4	2.7	-22.6	N/A	N/A	14.0
47	4138	-5.8	4.3	5.2	8.1	6.9	0.6	-27.0	N/A	N/A	12.8
46	4247	-6.0	4.1	5.0	7.8	6.5	0.0	-28.2	N/A	N/A	12.4
10	4582	-6.5	3.6	4.2	6.8	5.2	-1.9	-32.1	N/A	N/A	11.4
23	4793	-6.9	3.2	3.8	6.2	4.5	-3.0	-34.5	N/A	N/A	10.9
Total A-Weighted Sound Pressure Level											**38.9**

* Includes the heights of noise sources and receptors.
N/A indicates values below -88.0 dBA

Sound Pressure Levels at VLR 255

Turbine ID	Distance* [m]	Octave Band Sound Pressure Levels [dB(A)]									Total A-Weighted Sound Pressure Level by Turbine and for all Octave Bands [dB(A)]
		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	
39	690	8.7	19.1	22.0	26.9	28.8	28.4	21.6	-1.6	-78.4	33.7
40	926	6.1	16.6	19.3	24.1	25.8	25.0	16.7	-11.9	N/A	30.5
41	990	5.6	16.0	18.6	23.5	25.1	24.2	15.5	-14.6	N/A	29.8
38	1106	4.6	15.0	17.6	22.4	23.9	22.8	13.4	-19.3	N/A	28.6
37	1178	4.0	14.4	17.0	21.8	23.2	22.0	12.2	-22.2	N/A	27.9
36	1251	3.5	13.9	16.5	21.2	22.5	21.2	11.0	-25.2	N/A	27.2
47	1464	2.1	12.5	15.0	19.6	20.8	19.0	7.5	-33.5	N/A	25.4
42	1494	2.0	12.3	14.8	19.4	20.5	18.7	7.1	-34.7	N/A	25.2
43	1554	1.6	12.0	14.5	19.0	20.1	18.2	6.2	-36.9	N/A	24.7
35	2249	-1.6	8.7	11.0	15.0	15.5	12.4	-3.8	-62.9	N/A	20.3
19	2393	-2.2	8.1	10.4	14.3	14.7	11.4	-5.7	-68.2	N/A	19.5
20	2435	-2.3	8.0	10.2	14.2	14.5	11.1	-6.3	-69.7	N/A	19.3
18	2458	-2.4	7.9	10.1	14.0	14.3	10.9	-6.6	-70.6	N/A	19.1
22	2618	-2.8	7.4	9.5	13.4	13.5	9.8	-8.6	-76.3	N/A	18.4
21	2792	-3.2	7.0	8.9	12.7	12.7	8.7	-10.8	-82.5	N/A	17.6
33	2843	-3.3	6.9	8.8	12.5	12.4	8.3	-11.5	-84.3	N/A	17.4
34	2886	-3.4	6.8	8.6	12.3	12.2	8.0	-12.0	-85.9	N/A	17.2
32	3139	-4.0	6.3	7.9	11.4	11.1	6.5	-15.1	N/A	N/A	16.2
44	3148	-4.0	6.2	7.8	11.4	11.0	6.4	-15.2	N/A	N/A	16.2
31	3453	-4.6	5.6	7.0	10.3	9.7	4.5	-18.9	N/A	N/A	15.0
17	3710	-5.1	5.1	6.3	9.5	8.6	3.0	-22.0	N/A	N/A	14.1
45	3805	-5.2	4.9	6.0	9.1	8.3	2.5	-23.1	N/A	N/A	13.8
16	3913	-5.4	4.7	5.8	8.8	7.8	1.9	-24.4	N/A	N/A	13.5
30	3899	-5.4	4.8	5.8	8.9	7.9	1.9	-24.2	N/A	N/A	13.5
23	3943	-5.5	4.7	5.7	8.7	7.7	1.7	-24.7	N/A	N/A	13.4
7	3964	-5.5	4.6	5.7	8.7	7.6	1.6	-24.9	N/A	N/A	13.3
6	4093	-5.7	4.4	5.3	8.3	7.1	0.8	-26.5	N/A	N/A	12.9
8	4156	-5.8	4.3	5.2	8.1	6.9	0.5	-27.2	N/A	N/A	12.7
5	4224	-6.0	4.2	5.0	7.9	6.6	0.1	-28.0	N/A	N/A	12.5
15	4248	-6.0	4.1	5.0	7.8	6.5	0.0	-28.3	N/A	N/A	12.4
29	4474	-6.4	3.7	4.5	7.1	5.7	-1.3	-30.9	N/A	N/A	11.8
14	4486	-6.4	3.7	4.4	7.1	5.6	-1.4	-31.0	N/A	N/A	11.7
4	4627	-6.6	3.5	4.1	6.7	5.1	-2.1	-32.6	N/A	N/A	11.3
9	4656	-6.6	3.4	4.1	6.6	5.0	-2.3	-32.9	N/A	N/A	11.2
3	4711	-6.7	3.3	3.9	6.5	4.8	-2.6	-33.6	N/A	N/A	11.1
13	4752	-6.8	3.3	3.8	6.4	4.6	-2.8	-34.0	N/A	N/A	11.0
46	4742	-6.8	3.3	3.9	6.4	4.7	-2.7	-33.9	N/A	N/A	11.0
28	4820	-6.9	3.2	3.7	6.2	4.4	-3.2	-34.8	N/A	N/A	10.8
24	4895	-7.0	3.1	3.5	6.0	4.1	-3.6	-35.7	N/A	N/A	10.6
Subs.	4784	-23.7	-4.9	0	-0.6	2.4	-8.7	-41.2	N/A	N/A	6.1
Total A-Weighted Sound Pressure Level											**39.2**

* Includes the heights of noise sources and receptors.
N/A indicates values below -88.0 dBA

APPENDIX C COORDINATES OF POINTS OF RECEPTION

Coordinates of all modeled Points of Reception and Vacant Lot Receptors for the Bornish Wind Energy Centre (UTM17-NAD83 projection) are given in the tables below:

Point of Reception ID	Easting [m]	Northing [m]
PoR1	440492	4771514
PoR3	440033	4771602
PoR4	439966	4771712
PoR5	439532	4771702
PoR6	439562	4771796
PoR7	439422	4771758
PoR8	439363	4771853
PoR9	439361	4771770
PoR10	439307	4771775
PoR11	439071	4771955
PoR12	438788	4771895
PoR13	438402	4771331
PoR14	436943	4772310
PoR15	437210	4772352
PoR16	437540	4772183
PoR17	438244	4771973
PoR19	440754	4771654
PoR20	440685	4771333
PoR21	441164	4771421
PoR22	441310	4771389
PoR23	441490	4771253
PoR25	442335	4771021
PoR26	442469	4770950
PoR29	445950	4770504
PoR30	446671	4770136
PoR31	449038	4771469
PoR32	448751	4771458
PoR33	448414	4771614
PoR34	448177	4771580
PoR35	447805	4771673

Point of Reception ID	Easting [m]	Northing [m]
PoR36	447683	4771839
PoR37	447456	4771732
PoR38	447320	4771865
PoR39	447191	4771732
PoR41	446141	4772012
PoR42	444909	4772422
PoR43	444801	4772492
PoR44	444787	4772434
PoR45	444930	4772401
PoR46	444943	4772456
PoR47	444657	4772426
PoR51	441208	4773238
PoR54	436989	4774194
PoR55	437435	4775794
PoR56	437496	4775876
PoR57	437989	4775657
PoR58	438086	4775744
PoR59	438543	4775543
PoR62	441521	4774943
PoR63	442089	4774807
PoR65	444543	4774133
PoR66	444496	4774220
PoR67	444493	4773978
PoR68	445664	4773957
PoR69	446511	4773750
PoR70	446563	4773650
PoR73	448024	4773393
PoR74	448171	4773387
PoR76	448583	4773286
PoR77	448799	4773131

Point of Reception ID	Easting [m]	Northing [m]
PoR78	449553	4772906
PoR79	448486	4774894
PoR80	447960	4775018
PoR81	447316	4775164
PoR82	447105	4775353
PoR83	446795	4775234
PoR84	446545	4775477
PoR85	444009	4776036
PoR87	443235	4776297
PoR88	443429	4776574
PoR89	443349	4776596
PoR90	443471	4776774
PoR91	443526	4777025
PoR92	442955	4776289
PoR93	442456	4776303
PoR94	442311	4776526
PoR96	442012	4776698
PoR97	441091	4776727
PoR98	440782	4776706
PoR99	440666	4776840
PoR100	440538	4776746
PoR102	439421	4777027
PoR103	439351	4777038
PoR104	439165	4777198
PoR105	445721	4776028
PoR106	445829	4775845
PoR107	445553	4775384
PoR109	445333	4773628
PoR110	445068	4773388
PoR111	445193	4773159

Point of Reception ID	Easting [m]	Northing [m]
PoR112	444977	4773035
PoR113	444945	4773179
PoR116	444591	4771289
PoR117	444425	4770964
PoR118	444358	4770042
PoR119	444440	4770060
PoR120	446141	4769567
PoR121	446627	4770918
PoR122	436488	4772701
PoR123	447915	4775316
PoR126	440597	4771573
PoR127	439189	4771452
PoR128	443682	4775839
VLR129	445707	4775908
VLR130	441644	4776609
VLR131	446870	4775258
VLR132	444973	4772414
VLR133	444301	4770688
VLR134	443825	4776098
VLR135	446985	4775358
VLR136	448883	4771535
VLR137	446419	4774981
VLR138	446861	4771880
VLR139	447819	4771781
VLR140	436921	4774350
VLR141	448973	4771391
VLR142	447628	4775207
VLR143	445899	4770213
VLR144	449099	4771934
VLR145	442400	4776432

Point of Reception ID	Easting [m]	Northing [m]
VLR146	438947	4777122
VLR147	444669	4771475
VLR148	444713	4775890
VLR149	440306	4776925
VLR150	441388	4776671
VLR151	445634	4775674
VLR152	439639	4777082
VLR153	439918	4777743
VLR155	444315	4775983
VLR156	446787	4775404
VLR157	447218	4775303
VLR158	445481	4774483
VLR159	445406	4770328
VLR160	442694	4776362
VLR161	445724	4775530
VLR162	441551	4776633
VLR163	449588	4773068
VLR165	445603	4770282
VLR166	439756	4777055
VLR167	447378	4773582
VLR168	447032	4775224
VLR169	447693	4773507
VLR170	444715	4771743
VLR171	444748	4771867
VLR172	444779	4771980
VLR173	444804	4772098
VLR174	444656	4772531
VLR175	444768	4772504
VLR176	444442	4772583
VLR177	444939	4772702

Point of Reception ID	Easting [m]	Northing [m]
VLR178	445238	4773361
VLR179	444333	4770006
VLR180	440411	4771504
VLR181	440184	4771680
VLR182	439812	4771640
VLR183	439475	4771843
VLR184	438235	4772135
VLR185	438038	4772180
VLR186	437917	4772078
VLR187	436765	4772484
VLR188	441026	4771358
VLR189	441222	4771305
VLR190	441529	4771371
VLR191	441933	4771140
VLR192	442736	4770948
VLR193	443123	4770852
VLR194	444427	4770541
VLR195	444576	4770502
VLR196	444355	4770237
VLR197	443508	4770760
VLR198	446461	4770211
VLR199	447010	4771962
VLR200	445388	4774038
VLR201	443728	4775979
VLR202	438611	4775632
VLR203	439058	4775529
VLR204	437038	4774317
VLR205	437347	4774247
VLR206	437584	4774189
VLR207	437648	4774047

Point of Reception ID	Easting [m]	Northing [m]
VLR208	437312	4774120
VLR209	442232	4774787
VLR210	441581	4776492
VLR211	441048	4773237
VLR212	436544	4772431
VLR213	443867	4776602
VLR214	448138	4775084
VLR221	441536	4773146
VLR223	446561	4770059
VLR226	440877	4773298
VLR230	441039	4776637
VLR232	441336	4773207
VLR241	441021	4773387
VLR244	443596	4775913
VLR248	445827	4772140
VLR254	437557	4772297
VLR255	442369	4771150
VLR257	446826	4771275
VLR258	445323	4773814
VLR268	445236	4774083
PoR269	448795	4773832

APPENDIX D COORDINATES OF PARTICIPANTS

Coordinates of all modeled participants for the Bornish Wind Energy Centre (UTM17-NAD83 projection) are given in the table below:

Participant ID	Easting [m]	Northing [m]
PR2	440418	4771606
PR18	438688	4772081
PR24	441977	4771297
PR27	442804	4771133
PR28	445577	4770404
PR40	446689	4772025
PR48	443326	4772729
PR49	443253	4772892
PR50	442080	4773157
PR52	440110	4773577
PR53	439608	4773718
PR60	439974	4775313
PR61	440556	4775164
PR64	444080	4774330
PR71	447074	4773519
PR72	447611	4773383
PR75	448300	4773234
PR86	443148	4776144
PR95	441938	4776421
PR101	439911	4776901
PR108	445556	4774768
PR114	444972	4771983
PR115	444918	4771559
PR124	441090	4774106
PR125	443131	4773964
PV154	445618	4775074
PV164	447601	4775090
PV215	438901	4773767
PV216	440056	4775182
PV217	438919	4773859
PV218	446189	4772137
PV219	439002	4773842
PV220	440306	4773432
PV222	438344	4774001

Participant ID	Easting [m]	Northing [m]
PV224	444868	4771858
PV225	439692	4773576
PV227	439253	4775378
PV228	442894	4772911
PV229	445477	4774997
PV231	446325	4772012
PV233	441358	4774889
PV234	437868	4774111
PV235	438986	4773748
PV236	443143	4770986
PV237	443492	4772771
PV238	442457	4772940
PV239	439363	4775352
PV240	447264	4773592
PV242	442893	4772828
PV243	442173	4772996
PV245	445387	4774609
PV246	443538	4770892
PV247	445002	4772467
PV249	444968	4772337
PV250	444986	4772908
PV251	445127	4772880
PV252	439661	4771799
PV253	437841	4772230
PV256	444821	4771249
PV259	444209	4774204
PV260	443234	4773956
PV261	443260	4774529
PV262	443372	4774501
PV263	442565	4774695
PV264	442122	4774705
PV265	441884	4774756
PV266	440467	4775090
PV267	441471	4776535

APPENDIX E TURBINE AND TRANSFORMER TECHNICAL SPECIFICATIONS

GE Energy

Parker D. Powell
Technical Leader

March 19, 2013

Don Karwisch
NextEra Energy Resources
700 Universe Blvd
Juno Beach, FL 33408

RE: Tonality of 1.6-100 Wind Turbine Generator

Mr. Karwisch:

On September 20, 2012, I responded to your request to help respond to the Ministry of Environment's request to "Provide a letter and report from manufacturer indicating that GE1.6-100, 1.62 MW is not tonal based on IEC 61400-11-ed.2.1: 2006. State the tonality of the turbines in the report."

IEC 61400-11 only requires a report of any tonality that exceeds 3dB, but appears not to define the term "tonal".

The 1.6-100 turbine (with or without low-noise trailing edges) has an expected value for tonal audibility of $\Delta L_{a,k} < 2$ dB, irrespective of wind speed, hub height, and grid frequency based on the IEC 61400-11 standard and thuse does not require a report.

Nonetheless, please refer to the attached report on the 1.6-100 with LNTE's, the model NextEra plans to install, for more detailed acoustic information. This is an updated version of what was provided with my September 20, 2012 letter. The following changes were made:

- Tabel 1 was replaced to include lower wind speeds and to update the low frequencies based on measurement data.
- The description for Audible Tonality was updated to conform with IEC 61400-11 standard. It now says, "The tonal audibility ($\Delta L_{a,k}$), when measured in accordance with the IEC 61400-11 standard, for the GE's 1.6-100 with LNTE is less than or equal to 2 dB.".

Best regards,

Parker D. Powell

Attachment: Technical Description of the 1.6-100 Wind Turbine with Low-Noise Trailing Edges (LNTE's) and Major Components Rev 3

GE Energy
Bldg. 53-405B
1 River Road
Schenectady, NY 12345

1

Phone 518-385-5838
Cell 518-867-6298
email parker.powell@ge.com

2 Normal Operation Calculated Apparent Sound Power Level

The apparent sound power levels $L_{WA,k}$ are initially calculated as a function of the hub height wind speed v_{HH}. The corresponding wind speeds v_{10m} at 10 m height above ground level have been evaluated assuming a logarithmic wind profile. In this case a surface roughness of $z_{0ref} = 0.05$ m has been used, which is representative of average terrain conditions.

$$v_{10m} = v_{HH} \frac{\ln\left(10m / z_{0ref}\right)}{\ln\left(hub\ height / z_{0ref}\right)} \quad *$$

The calculated apparent sound power levels $L_{WA,k}$ and the associated octave-band spectra are given in Table 1 and Table 2 for two different hub heights. The values are provided as mean levels as a function of v_{10m} for Normal Operation (NO) over cut-in to cut-out wind speed range. The uncertainties for octave sound power levels are generally higher than for total sound power levels. Guidance is given in IEC 61400-11, Annex D.

1.6-100 with LNTE – Normal Operation Octave Spectra									
Standard wind speed at 10 m [m/s]		3	4	5	6	7	8	9	10-Cutout
Hub height wind speed at 80 m [m/s]		4.2	5.6	7.0	8.4	9.7	11.1	12.5	14-Cutout
Frequency (Hz)	31.5	62.5	62.2	66.1	70.1	73.5	73.7	73.6	73.5
	63	72.1	71.9	75.9	80.3	84.0	84.1	84.1	84.0
	125	79.0	79.2	83.8	88.4	91.6	91.8	91.8	91.7
	250	84.0	84.6	89.4	94.7	95.4	95.3	95.4	95.5
	500	85.5	84.9	89.7	95.5	97.1	96.6	96.7	97.0
	1000	83.4	83.0	86.9	91.8	97.1	97.5	97.6	97.8
	2000	81.7	83.4	87.9	92.4	95.7	95.7	95.5	95.1
	4000	74.9	77.7	83.5	88.9	89.7	89.1	88.4	87.9
	8000	55.5	57.6	63.5	70.3	70.4	70.6	69.4	69.1
	16000	7.9	13.2	18.9	24.7	27.2	26.6	27.5	29.0
Total apparent sound power level $L_{WA,k}$ [dB]		90.4	90.7	95.3	100.5	103.0	103.0	103.0	103.0

Table 1: Normal Operation Calculated Apparent Sound Power Level, 1.6-100 with LNTE with 80 m hub height as a function of 10 m wind speed ($z_{0ref} = 0.05$ m), the octave band spectra are for information only

* Simplified from IEC 61400-11, ed. 2.1: 2006 equation 7

NEXTera ENERGY	TRANSFORMER SPECIFICATION BORNISH COLLECTION STATION DETAIL REQUIREMENTS	Spec. No. Exhibit 1 Rev. No. 0 Date 7/24/12 Page 1 of 3

TRANSFORMER RATINGS

Application: (Wind Farm / Solar) Generator Step-Up (GSU)

Phase	3	Cooling	HV Volts (L-L)		XV Volts(L-L)		YV Volts		ZV(TV) Volts		Sound Level dBA
Frequency	60	Class	121 kV		34.5kV						
Cooling medium	Oil	Connection	Wye		Delta						
Phasor Diagram	YND1	ONAN	51	MVA	51	MVA		MVA		MVA	75@
Oil preservation	Conservator /diaphragm	ONAF	68	MVA	68	MVA		MVA		MVA	Top
		ONAF	85	MVA	85	MVA		MVA		MVA	ONAF

ADDITIONAL TAP VOLTAGES

Terminal	Style	Taps or kV	Capacity
HV	MR	± 10 % HV Line Voltage (33 Taps ULTC)	Full Capacity ULTC
XV	N/A	N/A	N/A

PERCENT IMPEDANCE VOLTS

%	Windings	At MVA
8.0	H - X	51 MVA
	H - Y	
	X - Y	

TEMPERATURE RISES	°C	MVA
Winding	≤65	Top ONAF
Metallic Part	≤100	Top ONAF
Metallic Part in contact with paper	≤80	Top ONAF
Top Oil	≤65	Top ONAF

PD = <300 pC
RIV = < 100 uV

Winding and Bushing Ratings

	Winding				Bushing					
Terminal	MVA	Voltage (kV)	BIL (kV)	Ampere (A)	Class (kV)	BIL (kV)	Ampere (A)	Min Strike Dist Ph to Ph	Min Strike Dist Ph to Gnd	Ext. Creep
HV Line	85	121	550		145	650				
HV Neutral			200		36	200				
XV Line	85	34.5	200		36	200				
XV Neutral										
YV Line										
YV Neutral										

UNUSUAL SERVICE CONDITIONS
Yes x No (Check one) – Conform to CSA-C88-M90

Ambient Temp. in °C (Max, Avg, Min)	38, 20, -30
Elevation/Wind Speed	See Exhibit 2
Seismic Zone Designation (see Appendix H)	See Exhibit 2
Snow/Ice Accumulation (under energized, but no load)	See Exhibit 2
Short-time emergency Overloading (except GSU)	See IEEE C57.91-1995 Table 8
Long-time emergency Overloading (except GSU)	
Abnormal harmonic currents solid-state short circuits	no
Geomagnetically Induced Current (GIC) location	yes
High-current isolated-phase bus duct connection	no
Parallel operation	yes
Neutral grounding resistor	no

FOUNDATION
Specific Details and Measurements

Foundation Type:	
Distance from Center of Foundation:	
To Segment 1	
To Segment 2	
To Segment 3	
To Segment 4	**LOSS EVALUATION**
No Load losses per kW will be evaluated at	See Appendix F
Load losses per kW will be evaluated at	See Appendix F
Auxiliary losses per kW will be evaluated at	See Appendix F

Exhibit 1 **NEXTERA ENERGY Transformer Detailed Requirements**

APPENDIX F COORDINATES OF TURBINES

Coordinates of turbines considered in the Bornish Wind Energy Centre are listed below in UTM17-NAD83 projection, though only 45 turbines will be constructed:

Turbine ID	Easting [m]	Northing [m]
1	440000	4776435
2	440302	4775915
3	441679	4775810
4	442726	4775763
5	442888	4775342
6	443298	4775136
7	443646	4774902
8	444147	4774906
9	444848	4775090
10	446083	4774524
11	447155	4774304
12	438297	4774740
13	438935	4774435
14	439343	4774461
15	439811	4774541
16	440057	4774307
17	440771	4774498
18	442262	4773605
19	442807	4773502
20	443243	4773422
21	443709	4773598
22	443882	4773285
23	445877	4772947
24	446958	4772850
25	447480	4772818
26	447771	4772644
27	448192	4772544
28	438099	4773385
29	438407	4773226
30	438971	4773061
31	439437	4772972
32	439760	4772893
33	440119	4772886
34	439808	4772479
35	440509	4772411
36	442023	4772350
37	442348	4772325
38	442633	4772221
39	442186	4771810
40	442888	4771912
41	443189	4771699
42	443389	4772239
43	443706	4771937
44	445507	4770915
45	446168	4771350
46	437898	4772729
47	443792	4771485
48	438655	4774608
Substation	441434	4775841