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FINAL REPORT

Sound Impact Assessment
Amherst Wind Power Project

ACCIONA WIND ENERGY CANADA INC.

PROJECT NO. 1005774

REPORT NO. 1005774

REPORT TO **Acciona Wind Energy Canada Inc.**
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ON **Amherst Wind Power Project**

Sound Impact Assessment

April 17, 2007

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EXECUTIVE SUMMARY

Acciona Wind Energy Canada Inc. is proposing to construct a wind energy project consisting of 20 wind turbine generators in the vicinity of Amherst Nova Scotia. To quantify the potential sound impacts resulting from this Project, Jacques Whitford was asked to conduct a sound impact assessment.

The key issues dealt with in the sound impact assessment were sound produced by Project construction and Project operations. A set of receptors were selected (receptors 1-17), which were considered potentially sensitive to Project-related sound, and underwent sound surveys performed by Wind Dynamics Inc. and Jacques Whitford. Jacques Whitford recorded background sound measurements for receptors 14-17.

The Ontario Ministry of Environment (MOE) guideline NPC-205 *Sound Level Limits for Stationary Sources in Class 1&2 Areas (Urban)* was consulted in terms of general assessment guidelines for industrial sound impacting land use that has qualities of both urban and rural areas (Class 2), such as the area considered in the current study. In addition, the MOE's guidance document *Interpretation for Applying MOE NPC Technical Publications to Wind Turbine Generators* was used to determine wind turbine sound criteria according to wind speed.

Sound modelling was conducted using CadnaA version 3.6, which includes the calculation methodology of the International Organization for Standardization (ISO) *Standard 9613 – Attenuation of Sound during Propagation Outdoors* (ISO 9613). Local meteorology and terrain was considered in modelling. Sound resulting from construction activities was modelled. Sound power level data provided by the manufacturer were used to model operational sound at the selected receptors. Predicted sound levels at receptors increased with increasing wind speed due the fact that the sound power level of the wind turbine generators also increased wind increasing wind speed, with the exception of results at a wind speed of 10 m/s. At 10 m/s the wind turbine sound power level decreases slightly, which could be a result of a reduction in inflow turbulence sound and/or separation sound, which both relate to the interaction of the blade and blade surface with atmospheric turbulence.

In general, the sound levels at the receptor locations are mostly dominated by existing background sound levels and not by the sound produced from operations of the Amherst Wind Power Project. Therefore, it was concluded that that the Project is not expected to have a significant sound impact on nearby receptors.

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SOUND IMPACT ASSESSMENT

1.0 INTRODUCTION

Acciona Energy Canada Inc. (Acciona) is proposing to construct and operate a 30 MW wind energy facility consisting of 20 wind turbine generators with a 12 kV sub-surface collection system connected to a new substation. This facility is proposed to be located on in Cumberland County, near the town of West Amherst, Nova Scotia (the Project).

The proposed project site location is a rural area, and taking this into consideration, the project layout is such that the setback distance between the nearest residence and the facility will exceed what is required according to local sound by-laws. This Project will use a setback of approximately 500 m from the nearest residence. Regardless of taking this precaution, as well as turbine design features, to minimize sound impacts on potentially sensitive receptors, sound resulting from the construction and operation of the Project should be assessed to verify the actual sound impacts, if any, on nearby residences.

The sound impact assessment will include sound level data representative of the existing ambient sound environment in the study area and modeling results, showing the predicted sound levels at receptors resulting from Project construction and operation.

2.0 ASSESSMENT FOCUS

Sound modelling was undertaken to predict the impact of the Project on the sound environment in the study area to support the preparation of the Sound Impact Assessment (SIA) for the Project. Table 2.1 lists the key issues taken into consideration during the modelling exercise.

TABLE 2.1 Summary of Sound Issues Associated with Construction and Operation of the Amherst Wind Power Project

Project Phase	Key Issue	Relevance to Project
Construction	Effects of construction sound on local residents	Construction sound will include site leveling, grading, pile driving, excavation, concrete pouring and steel erection. The level of sound will vary depending on the types of construction activities occurring at any given time. Because materials will have to be transported to the site during construction and operations, there may be an increase in trucks and/or traffic overall in the area. The level of sound will vary depending on the speed and type of vehicle.
Operations	Effects of operations sound on local residents	Operations sound will include sound emitted by equipment associated with the wind turbine, which can vary according to wind speed. Other sound sources related to Project operations could include increased road traffic during maintenance periods.

2.1 Project Study Area

The proposed Project is to be located in Cumberland County, near the town of West Amherst, Nova Scotia. The wind energy facility will be constructed on agricultural lands generally bounded to the east by Highway 104, west by marshlands and north and south by sparsely populated residential areas. The Primary Study Area identified for the Project for the sound assessment includes the Project development Area (PDA) and the vicinity of Amherst. Within this area, there are a number of potentially sensitive receptors, which were considered in this sound impact assessment. Both Jacques Whitford and Wind Dynamics Inc. conducted sound surveys for Acciona Wind Energy Canada Inc.; therefore both sets of receptors were included in the sound modelling analysis. For details on the locations of the sites, see Table 2.2.

TABLE 2.2 Residential Receptor Locations

Receptor No.	Receptor Name	Latitude (N)	Longitude (W)	UTM Easting (m)	UTM Northing (m)	Orientation from PDA	Distance from Centre of PDA (m)
Receptors Selected by Wind Dynamics Inc.							
1	Portable Welding (Rock Gould)	45 50 29	62 14 29	403602.3	5077174.2	Northeast	1,110
2	Hawkes Blueberries	45 50 30	64 14 31	403559.6	5077205.7	Northeast	1,130
3	McCarron's Vacuum Shop	45 50 30	64 14 31	403559.6	5077205.7	Northeast	1,130
4	McCarron Residence	45 50 32	64 14 32	403539.0	5077267.8	Northeast	1,180
5	McCarron's Cleaning	45 50 32	64 14 32	403539.0	5077267.8	Northeast	1,180
6	Drifter's Restaurant	45 50 36	64 14 37	403433.1	5077392.9	Northeast	1,250
7	Between the Hearts Renewal Centre	45 50 38	64 14 37	403434.1	4077454.6	Northeast	1,310
8	Demolition Resources Inc.	45 50 38	64 14 42	403326.2	5077456.3	East	1,270
9	Riverbend Golf Centre	45 50 39	64 14 42	403326.7	5077487.2	East	1,310
10	Residence 21364	45 50 42	64 14 46	403241.9	5077581.1	East	1,375
11	Commercial Building	45 50 43	64 14 49	403177.6	5077613.0	East	1,375
12	Hampton Diner	45 50 43	64 14 49	403177.6	5077613.0	East	1,375
13	Athol Forestry Co-op	45 50 44	64 14 52	403113.4	5077644.9	East	1,410
Receptors Selected by Jacques Whitford							
14	Lennox Avenue	45 49 38	64 13 14	405191.5	5075589.6	East	2,160
15	LaPlanche Street	45 50 20	64 14 2	404171.8	5076890.6	Northeast	1,415
16	Wind Turbine/RCMP Location	45 49 10	64 14 4	404097.4	5074727.8	Southeast	1,830
17	Wandlyn Inn Amherst	45 49 9	64 14 24	403662.8	5074706.8	Southeast	1,715

Background sound measurements were collected for receptors 14-17, which were used to assess the existing sound levels in the PDA.

3.0 SOUND DESIGN AND MITIGATION

The Amherst Wind Power Project will be designed to reduce sound from the installed turbines and the transmission of sound to potentially sensitive receptors.

Best practices will be followed at all times, including low sound equipment where applicable and local sound control. Specific mitigation that will be applied at the site during the construction and operations phases is described in the following sections.

3.1 Construction

Construction sound will occur during site leveling and grading, pile driving, excavation, concrete pouring and steel and component erection. Nova Scotia does not have any provincial regulations or guidelines to regulate sound emitted during construction, which is consistent among other provinces. Alberta's Energy Utilities Board (EUB) *Directive 038: Noise Control Directive* states that reasonable measures must be undertaken to reduce the effect of construction sound from new facilities (or modifications to new facilities) on nearby residences (EUB,1999). Based on this, the following mitigation measures will be applied:

- Nearby residents will be advised of significant sound generating activities and these will be scheduled to create the least disruption to receptors.
- All internal combustion engines will be fitted with appropriate muffler systems.

The EUB allows for construction to occur 24 hours/day; however it recommends attempting to limit construction activities to the hours of 07:00 and 22:00 to reduce the potential impacts of construction sound on receptors. While an attempt should be made to adhere to this recommendation, construction activities may occur outside of this period, as required by the Project schedule. Environment Canada provides guidelines for acceptable construction-related sound levels at residences resulting from on-site construction activities, which should be taken into consideration. In particular, efforts should be made to limit the operation of noisier activities associated with construction (*i.e.*, impact pile driving) to daytime hours.

3.2 Operations

Wind turbine generators produce sound through a number of different mechanisms which can be categorized into mechanical and aerodynamic sound sources. The major mechanical components including the gearbox, generator and yaw motors each produce their own characteristic sounds, including sound with tonal components. Other mechanical systems such as fans and hydraulic motors can also contribute to the overall sound emissions. Mechanical sound is radiated at the surfaces of the turbine, and by openings in the nacelle casing. Mechanical issues involving yaw motor supports or power train design can result in anomalous sounds such as periodic booming or tonal sounds.

The interaction of air and the turbine blades produces aerodynamic sound through a variety of processes as air passes over and past the blades. The sound produced by air interacting with the turbine blades tends to be broadband sound, but is amplitude modulated as the blades pass the tower, resulting in a characteristic 'swoosh'. Generally, wind turbines radiate more sound as the wind speed increases.

To reduce sound impacts resulting from Project operations the following mitigative measures are recommended:

- Adhering to the recommended setback between the Project site and receptors to maximum separation distance; and
- Attending to routine maintenance of the wind turbines and associated equipment, as recommended by the manufacturer.

4.0 PROJECT RESIDUAL EFFECTS

4.1 Analyses

4.1.1 Determining Environmental Sound Criteria

Nova Scotia does not have specific sound guidelines for assessing the acoustic impact of wind turbines on residential properties. Consequently, the sound guidelines of the Ontario Ministry of Environment (MOE) have been used for the basis of this assessment.

Specifically, MOE guideline NPC-205 *Sound Level Limits for Stationary Sources in Class 1&2 Areas (Urban)* provides general assessment guidelines for industrial sound impacting urban land use (Class 1) and land use that has qualities of both urban and rural areas (Class 2), such as the area considered in the current study. For instance, a Class 2 area would have a low ambient sound level between the hours of 19:00 and 07:00, as opposed to a Class 1 area where lower levels are not observed until between 23:00 and 07:00. In addition, other characteristics that may indicate the presence of a Class 2 area include:

- Absence of urban hum between 19:00 and 23:00 hours;
- Evening background sound level defined by natural environment and infrequent human activity; and
- No clearly audible sound from stationary sources other than from those under impact assessment.

The MOE refers to one-hour energy equivalent average sound levels (Leq), in units of A-weighted decibels (dBA). NPC-205 indicates that the applicable sound level limit for a stationary sound source is the existing background sound level. The sound level limit must be representative of the minimum background sound level that occurs or is likely to occur during the operation of a stationary source. Data from background sound monitoring conducted during times when the background sound level is at its lowest can be used to determine the lowest one hour Leq, which will represent the background sound level. However, where background sound levels are low, exclusionary minimum criteria apply, with an exclusionary limit of 45 dBA specified for quiet nighttime periods, and 50 dBA specified for quiet daytime periods.

Wind turbines are unique in that they generate more sound as wind speeds increase, and because increasing wind speeds cause elevated background sound levels, MOE have set out supplementary guidance for the assessment of wind turbine generator sound in the *Interpretation for Applying MOE NPC Technical Publications to Wind Turbine Generators.* The guidance document gives criteria for the combined impacts of all wind turbine generators in an area as a function of wind speed (Table 4.1).

TABLE 4.1 MOE Criteria for Wind Turbines

Wind Speed (m/s)	4	5	6	7	8	9	10	11
Wind Turbine Sound Criteria, NPC-205 (dBA)	45	45	45	45	45	49	51	53

The lowest sound level limit at a point of reception in a Class 2 area, under conditions of average wind speed up to 8 m/s, expressed in terms of the hourly Leq is 45 dBA or the minimum hourly background sound level established in accordance with requirements in Publications NPC-205, whichever is higher.

The sound level limit at a point of reception in a Class Areas 2 area, under conditions of average wind speed above 8 m/s and 6 m/s respectively, expressed in terms of the hourly Leq, is determined by the wind turbine sound criteria (Table 4.1) or the minimum hourly background sound level established in accordance with requirements in Publications NPC-205, whichever is higher.

Sound monitoring was conducted for receptors 14-17 by Jacques Whitford and the minimum hourly background Leq values were determined for these four receptors (Table 4.2).

TABLE 4.2 Background Sound Levels for Selected Receptors

Receptor No.	Receptor Name	Lowest One Hour Leq (dBA)
14	Lennox Avenue	41.6
15	LaPlanche Street	59.6
16	Wind Turbine/RCMP Location	52.5
17	Wandlyn Inn Amherst	47.6

No background measurements were taken for receptors 1-13; however receptor 15 is located closest to receptors 1-13, therefore the minimum hourly background Leq at receptor 15 was used for receptors 1-13. With the exception of receptor 14, the lowest one hour Leq values replace the wind turbine sound criteria given in Table 4.1, since they indicate higher sound levels.

Interpretation for Applying MOE NPC Technical Publications to Wind Turbine Generators details the method of sound impact assessment to undertake whereby the manufacturers sound power level data is entered into the sound model, which predicts sound at a receptor over a full range of wind speeds. It also specifies using the calculation methodology of the International Organization for Standardization (ISO) *Standard 9613 – Attenuation of Sound during Propagation Outdoors* (ISO 9613). ISO 9613 yields a receptor sound level under a downwind propagation situation, which is favourable to the propagation of sound from a source to a receptor. ISO 9613 does not describe a method for predicting sound levels under a specific meteorological condition, nor does it claim to predict a sound level impact under a worst-case atmospheric condition.

Environment Canada provides guidelines on acceptable on-site construction sound levels (Environment Canada 1989). The maximum construction-related sound levels recommended for residential areas near construction sites are as follows:

- day (07:00 – 19:00) – 65 dBA L_{eq};
- evening (19:00 – 23:00) – 60 dBA L_{eq}; and
- night (23:00 – 07:00) – 55 dBA L_{eq}.

There is not a specific noise bylaw in place for Cumberland County. Colchester County, which is immediately adjacent to Cumberland County, has a noise bylaw that states that no person shall generate a sound that is measureable at a point of reception in excess of 70 dBA between the hours of 22:00 – 07:00 and in excess of 90 dBA at other times.

4.1.2 Modelling Methods

4.1.2.1 General Overview

Sound modeling was completed to predict the effects of the Project on the sound environment in the local study area. The sound modelling was undertaken in accordance with the requirements of *Interpretation for Applying MOE NPC Technical Publications to Wind Turbine Generators* and ISO 9613.

4.1.2.2 Model Description

Sound modelling was conducted using CadnaA (Computer Aided Noise Abatement) version 3.6, a computer program capable of predicting sound levels at specified receiver positions originating from a variety of sound sources. Applicable national or international standards can also be included in its analysis, such as those prescribed by ISO 9613.

CadnaA can also account for such factors as:

- distance attenuation (*i.e.,* geometrical dispersion of sound with distance);
- atmospheric attenuation (*i.e.,* the rate of sound absorption by atmospheric gases in the air between sound sources and receptors);
- ground attenuation (*i.e.,* effect of sound absorption by the ground as sound passes over various terrain and vegetation types between source and receptor);
- screening effects of surrounding terrain; and
- meteorological conditions and effects.

The influences of meteorology and terrain and vegetation on sound attenuation in the local study area were considered to be of particular importance and are described in the following topics.

4.1.2.3 Meteorology

Meteorological factors, such as temperature, humidity, wind speed and direction influence sound propagation. The effects of wind on outdoor sound propagation during different weather conditions could cause large variations in project-related sound levels measured at a receptor. If the receptor is upwind of the facility, the wind could cause greater than normal outdoor sound attenuation and lower sound levels at the residence than would occur with no wind. However, if the residence is downwind of the facility, the opposite effect could occur, resulting in higher sound levels than normal at the residence. Crosswinds have little effect on outdoor sound propagation and would render sound levels that are similar to those in calm conditions. The ISO 9613 sound model simulates downwind propagation under a mildly developed temperature inversion (both of which enhance sound propagation) and provide a worst case representation of potential effects.

The following meteorological parameters were assumed for the sound assessment:

- temperature = 10°C;
- relative humidity = 70 percent; and
- wind conditions = variable.

The relative humidity was assumed to be 70 percent because this condition enhances sound propagation. Based on the likelihood of receiving complaints in the summer, an average temperature value typical of summer conditions in the area was used in the sound model. These meteorological parameters can be considered typical of night-time conditions in the spring and summer (when outdoor activities are more likely) and representative of the sound effects during these seasons. Wind conditions, including wind direction and speed, were accounted for in the model. This is of particular importance in the current application since wind speed not only affects background sound levels but also affects the amount of sound generated from the wind turbine (as provided in manufacturer sound power level data).

4.1.2.4 Terrain and Vegetation

Factors such as terrain conditions, types of vegetation and ground cover can all affect the absorption that takes place when sound waves travel over land. For example, if the ground is moist or covered in fresh snow or vegetation, it will be absorptive and aid in sound attenuation. In contrast, if the ground is hard-packed or frozen, it will be reflective and will not aid in sound attenuation.

With the exception of the town of Amherst and the presence of Highway 104, the vicinity of the proposed Project site is primarily agricultural and is relatively flat in nature, mostly consisting of low-lying vegetated ground with some intermittent treed areas and roadways. The facility will be in operation throughout the year; therefore, a variety of ground conditions will occur that affect sound attenuation potential. Typically, ground conditions in summer promote sound attenuation, whereas winter ground conditions often do not. At the same time, residents are more likely to be outdoors or have their house windows open, which can make them more sensitive to potential sound effects. The topography of the area was included during modelling; therefore any terrain shielding effects that may attenuate sound were taken into account.

4.1.2.5 Model Prediction Confidence

The sound propagation algorithm used in the sound model is from ISO 9613 standard. The published accuracy for ISO 9613 is $\pm$ 3 dBA over source-receiver distances between 100 m and 1000 m. A similar degree of accuracy would be expected over the distances considered in this assessment, which is an exceptional level of accuracy for a sound model over such a large distance.

In terms of meteorological conditions, ISO 9613 produces results that are representative of meteorological conditions favouring sound propagation (*i.e.,* downwind and inversion conditions). Because these conditions do not occur everyday, model predictions are conservative and actual sound levels at the receptors might be less than predicted the majority of the time.

In general, the predictive capacity of the model is considered to be high, leading to a high level of confidence in the results of the model.

4.2 Construction Sound

The construction activities that would create sound and the typical levels of sound produced were identified and their combined effect on receptors was modelled. For a list of the typical construction equipment and associated sound levels, see Table 4.3. Actual equipment used on site might differ from those modelled.

TABLE 4.3 Typical Sound Emission Levels of Construction Equipment

Construction Equipment	Typical Sound Level at 15 m (dBA)
Earth Moving	
Loader	**85**
Bulldozer	**85**
Backhoe	**80**
Scraper	**89**
Grader	**85**
Materials Handling	
Crane (mobile)	**83**
Concrete mixer	**85**
Concrete pump	**82**
Concrete vibrator	**76**
Stationary Equipment	
Air compressor	**81**
Generator	**81**
Impact Equipment	
Jack hammer	**88**
Pile driver (impact)	**101**
SOURCE: US Department of Transportation (2006)	

Construction sound levels were calculated for each residential receptor location. It was assumed for the purposes of modelling that 12 major items of construction equipment were operating at any given time in the PDA. When conducting sound modelling, the construction equipment was positioned at the centre of the proposed Project site. Under actual conditions, construction activity will vary in duration, sound level and location.

Since noisier construction activities will likely occur between daytime hours of 07:00 and 22:00, construction activity is expected to have little to no effect on night-time sound levels. For the predicted construction sound levels at each residential receptor location, see Table 4.4. The level of sound will vary according to the type of construction activity and the number of pieces of equipment in operation at any given time; however, the predicted values offer an indication of effects on nearby residential receptors.

TABLE 4.4 Modelled Construction Sound Levels

Receptor No.	Receptor Name	Predicted Construction Sound Level (dBA)
Receptors Selected by Wind Dynamics Inc.		
1	Portable Welding (Rock Gould)	56.4
2	Hawkes Blueberries	56.3
3	McCarron's Vacuum Shop	56.3
4	McCarron Residence	55.7
5	McCarron's Cleaning	55.7
6	Drifter's Restaurant	54.8
7	Between the Hearts Renewal Centre	54.2
8	Demolition Resources Inc.	54.3
9	Riverbend Golf Centre	54.0
10	Residence 21364	53.2
11	Commercial Building	52.9
12	Hampton Diner	52.9
13	Athol Forestry Co-op	53.6
Receptors Selected by Jacques Whitford		
14	Lennox Avenue	48.7
15	LaPlanche Street	55.4
16	Wind Turbine/RCMP Location	50.6
17	Wandlyn Inn Amherst	51.6

4.3 Operations Sound

Operational sound associated with the Project was modelled, excluding other existing sound sources. Modelling the sound generated from operations of the 20 wind turbine generators was conducted by first obtaining the manufacturer sound power level data as a function of wind speed (Table 4.5).

TABLE 4.5 Manufacturer Sound Power Level Data

Reference Point		Sound Emission Parameter
Normalized Wind Speed at 10 m (m/s)	Electrical Power	Sound Power Level (dBA)
6	775	102.6
7	1155	103.7
8	1414	104.3
9	>95% of Rated Power	104.3
10	>95% of Rated Power	103.8

The information provided in Table 4.5 was included in sound modelling. In addition, the coordinates and tower height of the wind turbine generators were also incorporated. These details are given in Table 4.6.

TABLE 4.6 Wind Turbine Generator Locations

Wind Turbine No.	UTM Northing (m)	UTM Easting (m)	Tower Height (m)
1	402916	5075278	78.8
2	402796	5075496	78.8
3	402677	5075714	78.8
4	403327	5075273	78.8
5	403242	5075483	78.8
6	403157	5075693	78.8
7	403071	5075904	78.8

TABLE 4.6 Wind Turbine Generator Locations

Wind Turbine No.	UTM Northing (m)	UTM Easting (m)	Tower Height (m)
8	403019	5076158	78.8
9	402888	5076348	78.8
10	402810	5076551	78.8
11	402699	5076753	78.8
12	402596	5076942	78.8
13	403567	5075774	78.8
14	403474	5075986	78.8
15	403448	5076215	78.8
16	403288	5076386	78.8
17	403145	5076572	78.8
18	403021	5076827	78.8
19	402460	5077192	78.8
20	402086	5077047	78.8

Sound modelling was conducted for five different scenarios, which varied according to the wind speeds presented in Table 4.5. Wind direction frequency data was entered into the model to represent meteorology specific to the region. The predicted sound levels at receptors resulting from these scenarios are shown in Tables 4.7-4.11. Other sound sources contributing to baseline sound levels were not included when predicting sound levels.

TABLE 4.7 Modelled Project Operational Sound Levels at a Wind Speed of 6 m/s

Receptor No.	Receptor Name	Wind Speed (m/s)	Predicted Operational Sound Level (dBA)	Wind Turbine Sound Criterion NP-205 (dBA)
Receptors Selected by Wind Dynamics Inc.				
1	Portable Welding (Rock Gould)	6	36.3	59.6
2	Hawkes Blueberries	6	36.3	59.6
3	McCarron's Vacuum Shop	6	36.3	59.6
4	McCarron Residence	6	35.9	59.6
5	McCarron's Cleaning	6	35.9	59.6
6	Drifter's Restaurant	6	35.5	59.6
7	Between the Hearts Renewal Centre	6	35.0	59.6
8	Demolition Resources Inc.	6	35.6	59.6
9	Riverbend Golf Centre	6	35.3	59.6
10	Residence 21364	6	34.9	59.6
11	Commercial Building	6	34.9	59.6
12	Hampton Diner	6	34.9	59.6
13	Athol Forestry Co-op	6	34.8	59.6
Receptors Selected by Jacques Whitford				
14	Lennox Avenue	6	27.7	45.0
15	LaPlanche Street	6	33.7	59.6
16	Wind Turbine/RCMP Location	6	32.0	52.5
17	Wandlyn Inn Amherst	6	34.5	47.6

TABLE 4.8 Project Operational Sound Levels at a Wind Speed of 7 m/s

Receptor No.	Receptor Name	Wind Speed (m/s)	Predicted Operational Sound Level (dBA)	Wind Turbine Sound Criterion NP-205 (dBA)
Receptors Selected by Wind Dynamics Inc.				
1	Portable Welding (Rock Gould)	7	37.4	59.6
2	Hawkes Blueberries	7	37.4	59.6
3	McCarron's Vacuum Shop	7	37.4	59.6
4	McCarron Residence	7	37.0	59.6
5	McCarron's Cleaning	7	37.0	59.6
6	Drifter's Restaurant	7	36.6	59.6
7	Between the Hearts Renewal Centre	7	36.1	59.6
8	Demolition Resources Inc.	7	36.7	59.6
9	Riverbend Golf Centre	7	36.4	59.6
10	Residence 21364	7	36.0	59.6
11	Commercial Building	7	36.0	59.6
12	Hampton Diner	7	36.0	59.6
13	Athol Forestry Co-op	7	35.9	59.6
Receptors Selected by Jacques Whitford				
14	Lennox Avenue	7	28.8	45.0
15	LaPlanche Street	7	34.8	59.6
16	Wind Turbine/RCMP Location	7	33.1	52.5
17	Wandlyn Inn Amherst	7	35.6	47.6

TABLE 4.9 Modelled Project Operational Sound Levels at a Wind Speed of 8 m/s

Receptor No.	Receptor Name	Wind Speed (m/s)	Predicted Operational Sound Level (dBA)	Wind Turbine Sound Criterion NP-205 (dBA)
Receptors Selected by Wind Dynamics Inc.				
1	Portable Welding (Rock Gould)	8	38.0	59.6
2	Hawkes Blueberries	8	38.0	59.6
3	McCarron's Vacuum Shop	8	38.0	59.6
4	McCarron Residence	8	37.6	59.6
5	McCarron's Cleaning	8	37.6	59.6
6	Drifter's Restaurant	8	37.2	59.6
7	Between the Hearts Renewal Centre	8	36.7	59.6
8	Demolition Resources Inc.	8	37.3	59.6
9	Riverbend Golf Centre	8	37.0	59.6
10	Residence 21364	8	36.6	59.6
11	Commercial Building	8	36.6	59.6
12	Hampton Diner	8	36.6	59.6
13	Athol Forestry Co-op	8	36.5	59.6
Receptors Selected by Jacques Whitford				
14	Lennox Avenue	8	29.4	45.0
15	LaPlanche Street	8	35.4	59.6
16	Wind Turbine/RCMP Location	8	33.7	52.5
17	Wandlyn Inn Amherst	8	36.2	47.6

TABLE 4.10 Modelled Project Operational Sound Levels at a Wind Speed of 9 m/s

Receptor No.	Receptor Name	Wind Speed (m/s)	Predicted Operational Sound Level (dBA)	Wind Turbine Sound Criterion NP-205 (dBA)
Receptors Selected by Wind Dynamics Inc.				
1	Portable Welding (Rock Gould)	9	38.0	59.6
2	Hawkes Blueberries	9	38.0	59.6
3	McCarron's Vacuum Shop	9	38.0	59.6
4	McCarron Residence	9	37.6	59.6
5	McCarron's Cleaning	9	37.6	59.6
6	Drifter's Restaurant	9	37.2	59.6
7	Between the Hearts Renewal Centre	9	36.7	59.6
8	Demolition Resources Inc.	9	37.3	59.6
9	Riverbend Golf Centre	9	37.0	59.6
10	Residence 21364	9	36.6	59.6
11	Commercial Building	9	36.6	59.6
12	Hampton Diner	9	36.6	59.6
13	Athol Forestry Co-op	9	36.5	59.6
Receptors Selected by Jacques Whitford				
14	Lennox Avenue	9	29.4	49.0
15	LaPlanche Street	9	35.4	59.6
16	Wind Turbine/RCMP Location	9	33.7	52.5
17	Wandlyn Inn Amherst	9	36.2	49.0

TABLE 4.11 Modelled Project Operational Sound Levels at a Wind Speed of 10 m/s

Receptor No.	Receptor Name	Wind Speed (m/s)	Predicted Operational Sound Level (dBA)	Wind Turbine Sound Criterion NP-205 (dBA)
Receptors Selected by Wind Dynamics Inc.				
1	Portable Welding (Rock Gould)	10	37.5	59.6
2	Hawkes Blueberries	10	37.5	59.6
3	McCarron's Vacuum Shop	10	37.5	59.6
4	McCarron Residence	10	37.1	59.6
5	McCarron's Cleaning	10	37.1	59.6
6	Drifter's Restaurant	10	36.7	59.6
7	Between the Hearts Renewal Centre	10	36.2	59.6
8	Demolition Resources Inc.	10	36.8	59.6
9	Riverbend Golf Centre	10	36.5	59.6
10	Residence 21364	10	36.1	59.6
11	Commercial Building	10	36.1	59.6
12	Hampton Diner	10	36.1	59.6
13	Athol Forestry Co-op	10	36.0	59.6
Receptors Selected by Jacques Whitford				
14	Lennox Avenue	10	28.9	51.0
15	LaPlanche Street	10	34.9	59.6
16	Wind Turbine/RCMP Location	10	33.2	52.5
17	Wandlyn Inn Amherst	10	35.7	51.0

All predicted sound levels, for each wind speed scenario, are in compliance with the corresponding Wind Turbine Sound Criterion, NP-205. As the predicted operational sound levels indicate, the sound levels at receptors increased with increasing wind speed. This increase in predicted sound level resulted from a rise in the wind turbine sound power level, which is directly related to wind speed, as provided by the manufacturer (please refer to Table 4.4). As Table 4.4 shows, wind turbine sound power level decreases slightly at a wind speed of 10 m/s, which could be a result of a reduction in inflow turbulence sound and/or separation sound, which both relate to the interaction of the blade and blade surface with atmospheric turbulence.

Some jurisdictions outside of North America are adopting more stringent guidelines such as “Wind Farms: Environmental Noise Guidelines” from the state of South Australia. These guidelines stipulate a maximum of 35 dBA or 5 dBA above background. This project meets the second criterion, and this provides further support for the conclusions that sound should be of concern. It does not preclude the possibility that sound be alleged to be a problem when other factors, such as aesthetics, are not accepted by local residents.

5.0 SUMMARY AND CONCLUSIONS

In summary, it is useful to combine the predicted operational sound levels with background sound data to obtain a more accurate representation of the potential sound levels at the selected receptor locations (Table 5.1).

TABLE 5.1 Combined Predicted Operational and Background Sound Levels at Receptors

		Predicted Operational and Background Sound Level (dBA)				
	Wind Speed	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s
Receptors Selected by Wind Dynamics Inc.						
1	Portable Welding (Rock Gould)	59.6	59.6	59.6	59.6	59.6
2	Hawkes Blueberries	59.6	59.6	59.6	59.6	59.6
3	McCarron's Vacuum Shop	59.6	59.6	59.6	59.6	59.6
4	McCarron Residence	59.6	59.6	59.6	59.6	59.6
5	McCarron's Cleaning	59.6	59.6	59.6	59.6	59.6
6	Drifter's Restaurant	59.6	59.6	59.6	59.6	59.6
7	Between the Hearts Renewal Centre	59.6	59.6	59.6	59.6	59.6
8	Demolition Resources Inc.	59.6	59.6	59.6	59.6	59.6
9	Riverbend Golf Centre	59.6	59.6	59.6	59.6	59.6
10	Residence 21364	59.6	59.6	59.6	59.6	59.6
11	Commercial Building	59.6	59.6	59.6	59.6	59.6
12	Hampton Diner	59.6	59.6	59.6	59.6	59.6
13	Athol Forestry Co-op	59.6	59.6	59.6	59.6	59.6
Receptors Selected by Jacques Whitford						
14	Lennox Avenue	45.1	45.1	45.1	49.0	51.0
15	LaPlanche Street	59.6	59.6	59.6	59.6	59.6
16	Wind Turbine/RCMP Location	52.5	52.5	52.6	52.6	52.6
17	Wandlyn Inn Amherst	47.8	47.8	47.9	49.2	51.1

The results presented in Table 5.1 show that sound levels at the receptor locations are primarily dominated by existing background sound levels and not by the sound produced from operations of the Amherst Wind Power Project. Therefore, it is not expected that the Project will have a significant impact, with respect to sound, on nearby receptors.

6.0 REFERENCES

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