Appendix C

Supplementary Existing Environment Information

C1 Acoustic Assessment Report

Acoustic Assessment Report
Swift River Energy Limited – North Bala Small Hydro Project

Table of Contents

1. Introduction

1.1 Project Background

Swift River Energy Limited Partnership (SREL) is proposing to construct a 4.3 MW run-of-river hydroelectric power facility at the south end of the existing North Bala dam on the Moon River in Bala, Ontario (Figure 1). The dam is owned by the Ontario Ministry of Natural Resources (MNR). The site was offered for competitive release under the MNR Waterpower Site Release Policy. The MNR had originally offered a Request for Qualifications for Waterpower Generation Development Opportunities at MNR Dam Structures. Swift River Energy met the requisite criteria and submitted a Plan of Development (POD) in July 2005. SREL was named as the Applicant of Record (AR) following assessment of their Plan of Development (POD).

The facility will be located adjacent to North Bala dam in the village of Bala, in the Township of Muskoka Lakes. The development will consist of the excavation of an approach channel, the installation of an intake leading to a powerhouse and a tailrace returning water to the Moon River immediately downstream of dam. The facilities will utilize the hydraulic head provided by the existing dam. There will be no structural changes made to the dam as part of the project.

A 44-kV line will convey power from the transformer station to an interconnection point. It is anticipated that the interconnection would consist of an underground cable running approximately 40 m from the proposed powerhouse to an existing hydro pole just south of the intersection of Highway 169 and the original route of Highway 69 (Figure 2). It is intended that power produced by the project will be sold under the terms of a Standard Offer Contract (SOC) with the Ontario Power Authority.

It should be noted that the detailed design of the proposed facilities has not yet commenced, so detailed quantitative information regarding noise sources (e.g., tonal characteristics, directivity pattern, and octave sound power levels), potential noise impacts and required mitigation measures can not yet be provided. It is intended that this preliminary Acoustic Assessment Report will provide preliminary information to the MOE regarding the general noise impacts and commitments made by Swift to ensure that all noise mitigation requirements are met. Detailed noise impact assessment would then occur during the detailed design stage, as a precursor to the eventual application for a Certificate of Approval(s) (Noise) for the facilities under Section 9 of the Environmental Protection Act. Accordingly, this preliminary Acoustic Assessment Report has been prepared having regard to MOE's document entitled "Information to be submitted for Approval of Stationary Sources of Sound" (NPC 233), although it is acknowledged that additional information will be required in subsequent approval stages.

1.2 Proposed Project Overview

1.2.1 Project Components and Structure

The arrangement of the proposed development is based on a gross head of 5.86 m which is provided by the existing dam at the site location. The preliminary concept for the development is described as follows.

1. There will be no dam erection involved in the project since there is an existing MNR-owned dam at the site. This dam is presently operated as a control structure, assisting in the regulation of water levels on Lake Muskoka and the control of flows downstream along Moon River. The

dam is presently operated by the removal and insertion of timber stop logs. The proposed facility will utilize the head created by the existing dam.

2. An approach channel will be created by modifying sections of the bedrock upstream of the existing dam by excavation. This approach channel will lead to the intake of the powerhouse. The intake will be located beside (south of) the dam and will allow water to flow into the powerhouse to enable generation. The intake will be fitted with trashracks.

3. The powerhouse will contain one turbine and its associated generator. The powerhouse will also employ a draft tube for flows exiting the turbine and a room above which will contain electrical components such as switchgear and a power transformer. The switchgear and a transformer will convert the generated power to a voltage desired for distribution. The placement of the transformer in this room will eliminate the visual impact of a typical external transformer and switchyard. The reinforced concrete powerhouse structure will be founded on bedrock to the southwest of the dam. A short tailrace channel will be excavated to convey the powerhouse flows back into the river.

4. The power generated will be conveyed from the "transformer room" of the powerhouse via an underground cable to an interconnection point on the local distribution line. The final distribution line voltage will be at 44 kV. During construction it is anticipated that the main infrastructure components that will be required are a works yard and a site office.

1.2.2 Construction

Construction of the proposed facilities is scheduled to commence in early 2009 and last for between 12 and 18 months. Construction will involve the erection of a downstream cofferdam with diversion of flows being primarily through the South Bala Dam.

Construction will require some blasting activities, e.g., for the powerhouse foundation, intake and tailrace, and possibly other components. More precise details on blasting requirements will not be available until the detailed engineering phase.

1.2.3 Operation

The proposed hydroelectric plant will be operating 24 hours, 7 days a week. In addition, hydroelectric projects are typically designed for a 50 to 100-year lifespan.

1.2.4 Sound Characteristics of the Sites and Applicable Sound Level Limits

A noise survey was undertaken to characterize the baseline sound environment in the proximity of the development site. Using the MOE acoustical environment classification system as defined in publication LU-131 (MOE, 1997), the closest receptors locations could be classified as a Class 2 area, described as "an area with an acoustical environment that has qualities representative of both Class 1 (urban) and Class 3 (rural) areas, and in which a low ambient sound level, normally occurring only between 23:00 and 07:00 hours in Class 1 Areas, will typically be realized as early as 19:00 hours."

Other characteristics which 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;
- No clearly audible sound from stationary sources other than from those under impact assessment.

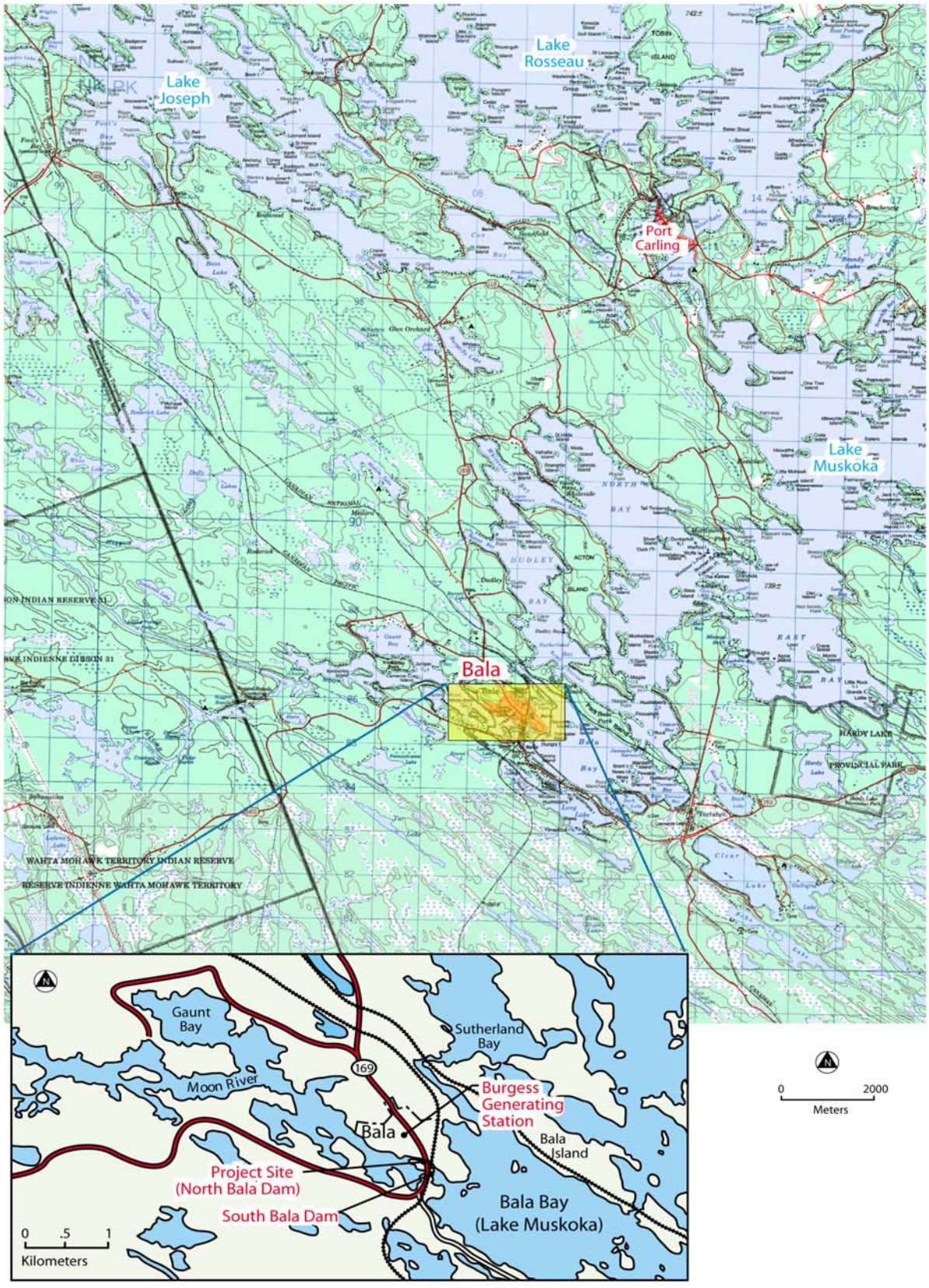

Figure 1
Swift River Energy Limited
North Bala Hydroelectric Project
Project Area

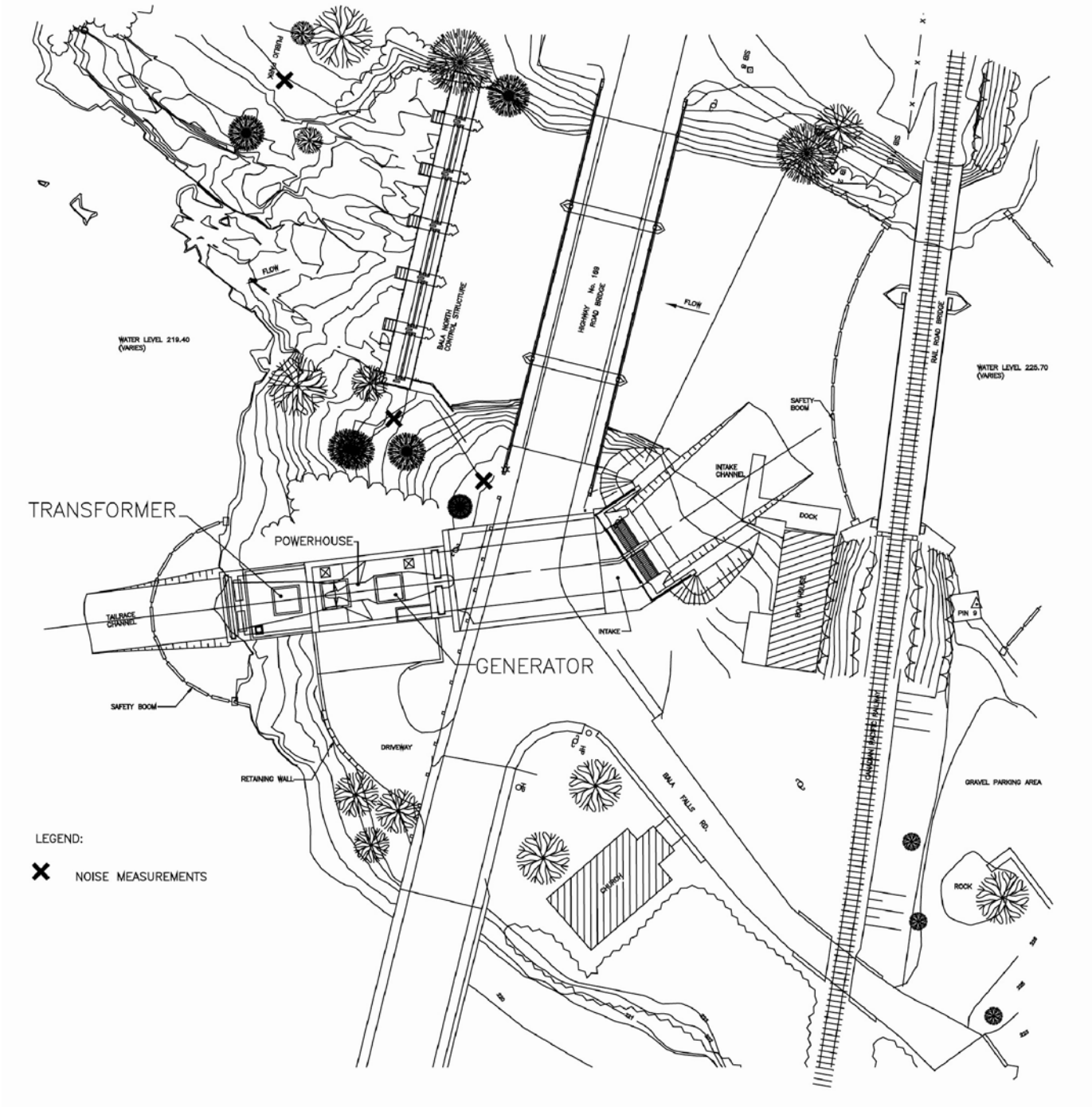

Figure 2
Swift River Energy Ltd.
North Bala Small Hydro Project
General Arrangement/Location of the Noise Sources and Noise Measurement Sites

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The cottages located along the shoreline of the lake, more than 200 m from the railway and roads, should be categorized as Class 3 areas. The closest buildings to the proposed facility are Burgess Memorial Church (previously a Church, now a commercial building) and Purk's Place Boat House and Marina (commercial building). These will be considered as Class 1 areas due to their location (at the intersection of Highway 169 and Bala Falls Road). These particular PORs are subjected to both noise from the road and nearby railway, as well as the background noise from the falls. MOE Publication NPC-205 indicates that for stationary noise sources located in Class 1, 2 or 3 Areas, the minimum one hour L_{eq}[1] at the closest Points of Reception (POR)[2] should be the least restrictive of either the background sound levels or the values listed in Table 1.1.

Table 1.1
Minimum Values of One Hour L_{eq} by Time of Day

Time of Day	One Hour L_{eq} (dBA)		
	Class 1 Area	Class 2 Area	Class 3 Area
07:00-19:00	50	50	45
19:00-23:00	47	45	40

[1]The guidelines use hourly equivalent sound levels $L_{eq,1h}$ measured in A-weighted decibels, dBA. This is an average sound level over a 1 hour period, A-weighted to give the sound level meter a frequency response analogous to the human ear. L_{eq} is widely used around the world for measuring and assessing community noise.

[2] POR defined as "any point on the premises of a person where sound or vibration originating from other than those premises is received. The POR may be located on any of the following existing or zoned for future use premises: permanent or seasonal residences, hotels/motels, nursing/retirement homes, rental residences, hospitals, campgrounds and noise sensitive buildings such as schools and places of worship (MOE, 2005)

2. Noise Characteristics of the Facility

2.1 Operating Hours

When sufficient water is available, the proposed facility will be operating 24-hours a day, with the exception of necessary maintenance shutdowns. However, depending on flow availability, the potential exists to operate the facility primarily during the peak energy demand periods during the daytime, in which case it may shut down at night if sufficient water is not available for generation. For the purposes of this Acoustic Assessment Report, as a "predictable worst-case" scenario, it has been assumed that the facilities will operate 24 hours per day. Assuming equal power generation levels, no difference would occur in the noise levels generated from the facility during the day or the night.

2.2 Noise Sources

The generating plant will be enclosed within the powerhouse so that noise from the equipment will be substantially reduced by the walls and roof of the enclosure. The only path for the sound to propagate outside of the powerhouse is through the ventilation fan louvers. In addition, noise may be audible outside of the powerhouse when the access doors are open. Protocols will be put in place by Swift to ensure that the powerhouse doors closed at all times, except during maintenance or inspection which, when necessary, will normally be scheduled between 09:00 and 17:00 hours. The ventilation system will have adequate capacity to keep the powerhouse at an acceptable working temperature.

2.2.1 Generator

The generator will use forced air cooling, in which outside air is drawn into the powerhouse enclosure through a ventilation grille, cycled through the generator, and discharged from the powerhouse enclosure back outside. This forced air system is a noise source that has the potential to create a noise nuisance at nearby receptors. At this stage in the facility design, it is assumed that the location of the air inlet grilles and the air discharge is as indicated in Drawing 327078-SK-401.

2.2.2 Transformer

It is currently anticipated that the transformer will be located inside the powerhouse. At this stage in the facility design, there is no engineering data available to specify the transformer that will be required, so no specifications regarding source noise levels from the transformers are available.

2.2.3 Noise Data from Manufacturer

The definitive sound power levels of the generator cooling equipment and the transformer will be obtained from the suppliers, once the supplier and generator/air cooling systems and transformer have been selected during the detailed design process. This source sound power level will then be used to predict the sound pressure level at nearby sensitive receptors to ensure compliance with the sound level limits identified in this report. For the purpose of a preliminary assessment, general noise data will be used to characterize the sound emissions from the generator and transformer (Section 3.2).

2.3 Site Plan identifying All Significant Noise Sources

A drawing detailing the preliminary layout for the proposed hydroelectric facility and other significant noise sources associated with it are provided in Figure 2.

3. Noise Source Summary

3.1 Noise Source Summary Table

Table 3.1 identifies the noise sources within the proposed hydroelectric facility, characterizes the noise emissions from each of the sources and identifies the noise equipment controls that may be required.

Table 3.1
Noise Source Summary Table for Proposed Hydroelectric Power Generation Development

Noise Source	Noise Emissions	Required Noise Control Equipment
Power Generation Facilities		
4.3-MW Axial Flow Bulb-type turbine unit with a rated hydraulic capacity of 96 m^3/s under a rated gross head of 5.86 m	Air intake and exhaust noise	Silencer specified to reduce noise levels below MOE sound level limits.
Station Step-up Transformer (inside the powerhouse)	Magnetostrictive noise	No noise barrier required.

3.2 Source Noise Emission Specifications

The source noise emission specifications will be developed during the detailed design process. However, some estimates are required to evaluate the sound pressure levels at the locations of interest. Table 3.2 shows the estimated noise data for the generator cooling fans, based on general data for Propeller type fans (from the Handbook of Noise Control by C. Harris). The noise data shown in Table 3.2 has not been corrected based on the fan operating conditions (air flow rate, pressure difference), hence representing the worst case scenario.

Table 3.2
Estimated Octave Band Data for Noise Sources

Source	Frequency (Hz)							
	64	**128**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
Generator Fan	96	93	94	92	90	90	88	86

The sound pressure level for an air-cooled dry type transformer is assumed to be 74 dBA, based on the recommendations of the NEMA TR1-1993: Transformers, Regulators and Reactors, for forced air-cooled transformers from 5,001 to 6,667 kVA.

3.3 Source Power/Capacity Ratings

The source power and capacity ratings will be determined during the detailed design process.

3.4 Noise Control Equipment Description and Acoustical Specification

Noise barriers will be used if needed to keep sound at sensitive points of reception within the identified MOE sound level limits, as per Publication NPC-205 (MOE, 1995).

4. Point of Reception Noise Impact Calculations

4.1 Point of Reception (POR) Noise Impact Table

Two potential receptors were located at less than 100 metres from the proposed site (see Figure 3, Table 4.1). Since the exact location of each POR is not know yet, the distance at which the sound emission from the powerhouse will be reduced to 45 and 40 dBA will be calculated in addition to the sound pressure levels based on the estimated distances. When more specific source noise data and the receptor locations become available, the noise impact table will be finalised to show the predicted noise levels at the receptors. If the predicted noise levels are greater than MOE sound level limits, then a noise barrier or silencer will be used to decrease sound levels below the MOE-specified limit. The sound attenuation used in the calculations does not include the contributions of ground absorption, height differences, atmospheric or meteorological factors and attenuation during propagation through foliage. Only the attenuation due to distance from the noise source is considered. The factors mentioned above will contribute to further decrease our estimate of sound pressure levels at the POR.

Some of the potential receptors that have been identified are shown in Table 4.1. The distance from the powerhouse to the receptors has been estimated using aerial pictures and other diagrams.

4.2 Points of Reception (POR) List and Description

Each POR should be characterized as belonging to a specific acoustical environment (i.e. Class 1, 2 or 3) based on the results of the baseline noise survey (Table 4.1). These classifications are then used to set the allowable sound level limits at the nearest POR. For this particular case, the POR may have a maximum measured noise level of 50 dBA from 07:00 to 19:00 hours and 45 dBA between 23:00 and 07:00 hours (Class 2). NPC-205 indicates that higher sound levels are permissible if the background sound levels in the area are higher than the allowable limits. In most cases, background sound levels at the nearest POR, as determined by the noise survey and traffic noise estimates, were found to be in excess of the MOE sound level limits. However, in order to be conservative, the MOE sound level limits, and not the higher background sound levels, have been selected as the target sound levels.

4.3 Acoustic Survey

4.3.1 Procedure Used to Assess Noise Impacts at each POR

In September and November of 2007 and April of 2008, sound level measurements were taken at POR in the vicinity of the proposed power generation facility. The measurement locations are shown in Figure 2. The sound meter, a Larson Davis Model 700, was programmed to run during time intervals from 11 to 20 hours, with a 1 hour interval period.

4.3.2 List of Parameters/Assumptions Used in Calculations

Parameters analyzed in this study included Leq and LMAX, measured during the noise surveys. For the prediction of the noise levels inside the Powerhouse, it was assumed that the generator cooling fans and the transformer were each located in different rooms with no physical communication. This assumption produces a conservative estimate of both the noise levels inside each room and the combined effect of those to determine the noise generated inside the powerhouse.

4.3.3 Results of Acoustic Survey

The results of this study are presented in Appendix B. The noise levels measured were very similar when comparing the three locations. The average Leq observed was relatively steady throughout the observation period, averaging 62.2 dBA for the three locations. The primary sources of this noise are the falls located north of the project area, although some traffic noise coming from Highway 169 also contributes to the measured sound levels, especially at the proposed location for the powerhouse. It is important to note that the background levels observed are well above the sound pressure levels of the typical classes used by the MoE.

Table 4.1 Point of Reception Noise Impact Table

Receptor Number*	Point of Reception	Coordinates	Distance and Direction from Project Site	Existing Sound Environment	MOE Acoustic Class	Predicted Noise Impacts
R-1	Non-Residential (former Church)	E 609200 N 4985291	57 m South-East	Dominated by traffic noise and water flow through the south control structure	Class 1 Area	Noise from powerhouse would be masked by existing sound environment
R-2	Non-residential (Commercial) [Purk's Place (retail)]	E 609226 N 4985333	64 m East	Dominated by traffic and train noise.	Class 2 Area	Noise from powerhouse will be masked by existing sound environment
R-3	House	E 609129 N 4985435	107 m North-West	Houses located on the shore of the lake, occasional traffic noise and train noise.	Class 2 Area	Noise from powerhouse will be masked by existing sound environment
R-4	House	E 609113 N 4985442	120 m North-West	Houses located on the shore of the lake, occasional traffic noise and train noise.	Class 2 Area	Noise from powerhouse will be attenuated by distance from the powerhouse.
R-5	House	E 609077 N 4985452	146 m North-West	Residential area dominated by water noise from the falls and Traffic noise.	Class 2 Area	Noise from powerhouse will be attenuated by distance from the powerhouse.

Receptor locations are shown on Figure 3.

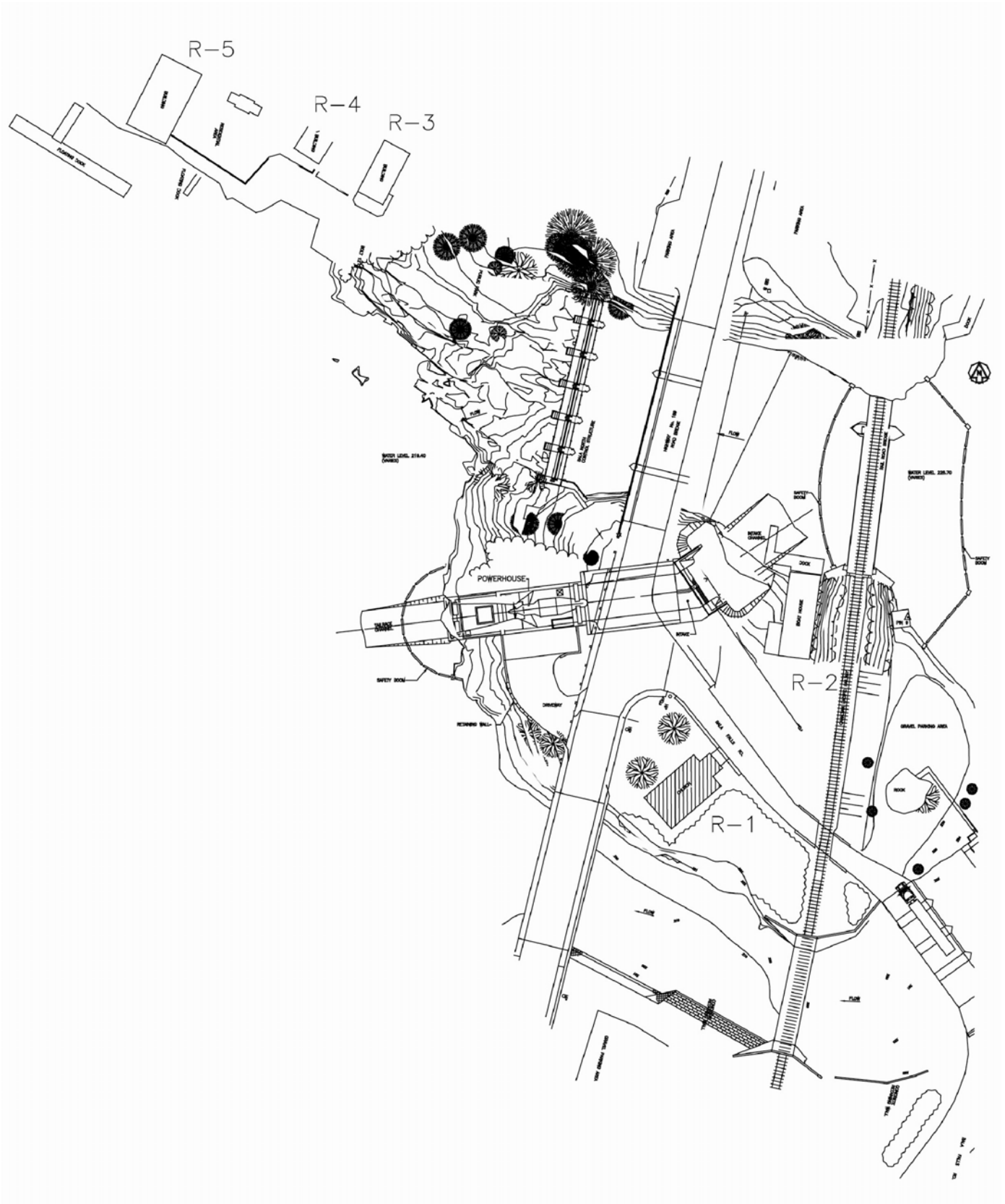

Figure 3
Swift River Energy Ltd.
North Bala Small Hydro Project
Location of the Points of Reception (POR)

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5. Acoustic Assessment Summary

5.1 Acoustic Assessment Summary Table

Table 5.1
Acoustic Assessment Summary Table

Point of Reception	Sound Level at POR	Verified by Acoustic Audit	Performance Limit	Compliance with Performance Limit
R-1	48.6	No	To be determined once engineering data is available	**Yes**
R-2	47.5	No	To be determined once engineering data is available	**Yes**
R-3	43.1	No	To be determined once engineering data is available	**Yes**
R-4	42.1	No	To be determined once engineering data is available	**Yes**
R-5	40.4	No	To be determined once engineering data is available	**Yes**

It is important to note that receptors R-1 and R-2 present sound pressure levels above 45 dBA, which corresponds to the minimum acceptable for Class 2 areas. However, these buildings are not residential, and hence the applicable minimum sound pressure level is 50 dBA (7:00 to 19:00 hours).

5.2 Predictable Worst Case Impacts Operating Scenario

The combined sound pressure level produced by the noise sources inside the powerhouse has been estimated to be 83.7 dBA. For propagation outdoors, the powerhouse was considered an omni-directional source, meaning that the noise is irradiating equally in all directions. In reality, the exhaust fans are oriented in certain directions to mask the powerhouse noise under the background noise produced by the traffic and railway. The fan may be located to minimize the impact on the houses that are along the lakeshore on the west side of the project. On the east side, the houses are located at a greater distance (more than 200 m) from the powerhouse, which will attenuate the sound below the MoE levels.

The predictable worst case impacts operating scenario occurs when the hydroelectric facility is operating at full capacity, 24-hours per day. This represents a worst-case scenario since the night time period is when the background sound levels are at their lowest. The project will be designed so that sound levels at POR meet the MOE sound level limit requirements at this predictable worst case impact operating scenario.

6. Conclusions

Given the existing sound environment, the proposed project should have no discernible impact on the sound environment at all identified points of reception. If required following completion of detailed facility design and acoustic impact assessment, mitigation measures like exterior covers for the louvers can be successfully put in place.

SREL is committed to ensuring that sound levels at the nearest POR of the facility is in accordance with MOE sound level limits, through the implementation and appropriate mitigation, as required.

References

MOE. 1997. Noise Assessment Criteria in Land Use Planning. Publication LU-131. Ontario Ministry of the Environment. 12 pp + Annex.

MOE. 1995. Sound Level Limits for Stationary Sources in Class 1 & 2 Areas (Urban). Publication NPC-205. Ontario Ministry of the Environment. 6 pp. + Annex.

MOE. 1995. Sound Level Limits for Stationary Sources in Class 3 Areas (Rural). Publication NPC-232. Ontario Ministry of the Environment. 8 pp. + Annex.

NEMA. 2000. Standards Publication No. TR 1-1993 (R2000): Transformers, Regulators and Reactors. National Electrical Manufacturers Association. 31 pp.

IEEE. 2006. C57.12.90-2006: Standard Test Code for Liquid-Immersed, Power and Regulating Transformers. pp. 64 to 76.

Harris C. M. 1979. Handbook of Noise Control, Second Edition. McGraw-Hill.

Appendix A
Noise Calculations

ESTIMATION OF NOISE LEVELS – GENERATOR FANS

NORTH BALA PROJECT - GENERATOR COOLING FANS

FAN NOISE DATA

Full Octave

Freq (Hz)	Lw (dB)
63	96.0
125	93.0
250	94.0
500	92.0
1000	90.0
2000	90.0
4000	88.0
8000	86.0
Total Lw (dB)	101.2

Energy Absorption Coefficient

2m - Air at 10 C , RH=50%

Freq (Hz)	(10^{3} Np/m)
63	0.0
125	0.1
250	0.2
500	0.5
1000	1.0
2000	2.8
4000	9.8
8000	33.6

Internal Wall Sound Absorption Coefficient (α_d)

Gypsum Board, 1/2" thick

Freq (Hz)	α_d
63	0.29
125	0.29
250	0.10
500	0.05
1000	0.04
2000	0.07
4000	0.09
8000	0.09

Total Room Absorption (A)

Full Octave

Freq (Hz)	A (m^2)
63	328.6
125	329.1
250	114.3
500	59.1
1000	50.2
2000	93.0
4000	149.9
8000	266.1

Room Constant (R)

Full Octave

Freq (Hz)	A (m^2)
63	462.9
125	463.6
250	127.0
500	62.2
1000	52.3
2000	100.0
4000	164.7
8000	292.4

The Fan Noise data was taken from Table 27.1; Specific SPLs produced by Propeller-type fans, Handbook of Noise Control (Harris). The data was not adjusted for operating conditions.

Generating Room Volume

Service Area + Generator Room

17.40	m	Length
15.37	m	Height
9.13	m	Width

2441.7 m^3 = 86228.1 ft^3

Generating Room Surface Area

1133.3 m^2 = 12198.3 ft^2

Speed of Sound

344 m/s Air at STP

Source Sound Power Level Demand (Lw)

85 dB @ 1m

Diffuse-Field Sound Pressure Level (Lp)

Lp = Lw +10*log(4/R) Applicable when using the SI system

DIFFUSE FIELD SOUND PRESSURE

Full Octave

Freq (Hz)	Lp (dB)
63	75.4
125	72.4
250	79.0
500	80.1
1000	78.8
2000	76.0
4000	71.9
8000	67.4
Total SPL (dB)	85.7

A-Weighted DIFFUSE FIELD SPL

Full Octave

Freq (Hz)	Lp (dBA)
63	49.2
125	56.3
250	70.4
500	76.9
1000	78.8
2000	77.2
4000	72.9
8000	66.3
Total SPL(dBA)	83.3

ESTIMATED INTERIOR NOISE 83.3 dBA

ESTIMATION OF NOISE LEVELS – TRANSFORMER

NORTH BALA PROJECT - TRANSFORMER

NEMA Audible Sound Level
Dry-Type, Forced Air Cooled

kVA	SPL (dBA)
5,001-6,667	74.0

Based on NEMA TR1-1993 (R2000) Table 0-4

Based on IEEE C57.12.90 (2006), the correspondent Sound Power Level is

88.8 dBA

Energy Absorption Coefficient

2m - Air at 10 C , RH=50%

(10^{3} Np/m)

at 125 Hz: 0.1

Internal Wall Sound Absorption Coefficient (α_d)

Gypsum Board, 1/2" thick

α_d

at 125 Hz: 0.29

Total Room Absorption (A)

A (m^2): 111.6

Room Constant (R)

A (m^2): 157.1

Surface Area of Transformer Tank 30 m^2

2	m	Depth
3	m	Length
3	m	Height

Generating Room Volume

Equipment Room

10.5	m	Length
4.57	m	Height
9.57	m	Width

459.2 m^3 = 16217.1 ft^3

Generating Room Surface Area

384.4 m^2 = 4137.8 ft^2

Speed of Sound

344 m/s Air at STP

Source Sound Power Level Demand (Lw)

85 dB @ 1m

Diffuse-Field Sound Pressure Level (Lp)

Lp = Lw +10*log(4/R) Applicable when using the SI system

DIFFUSE FIELD SOUND PRESSURE

Lp (dBA)

72.8

SPL (dBA) 72.8

ESTIMATED INTERIOR NOISE 72.8 dBA

SOUND PRESSURE LEVELS AT RECEPTORS – DISTANCES REQUIRED FOR ATTENUATION TO 45 AND 40 dBA.

ESTIMATED TOTAL NOISE LEVELS - POWERHOUSE AND RECEPTORS

Source	Diffuse Field Sound Pressure Level (dBA)
Cooling Fans	**83.3**
Transformer	**72.8**
TOTAL	**83.7**

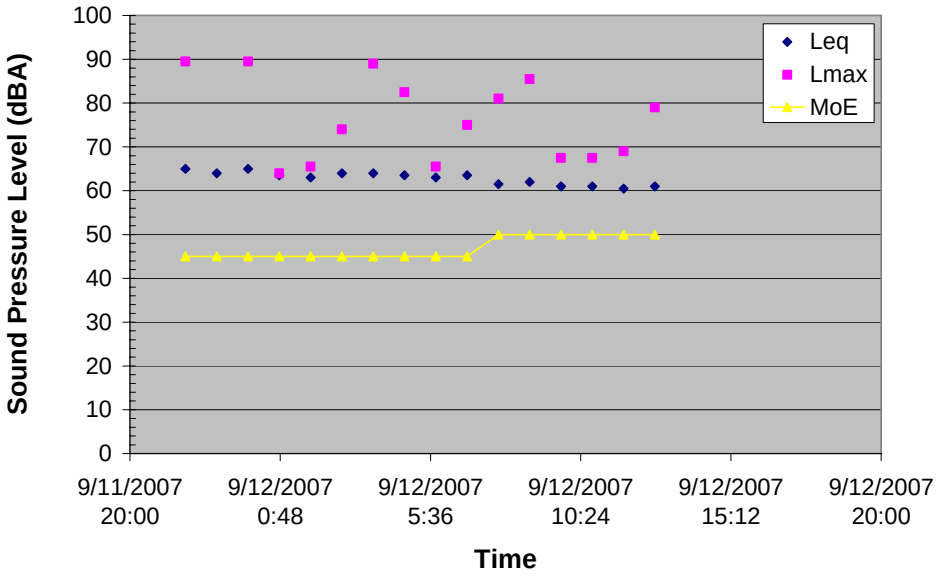
Receptor ID	Distance Powerhouse-Receptors, m (estimated)	Description	Distance Attenuation to Receptor (dB)	SPL at Receptor (dBA)
R-1	57	Church	35.1	48.6
R-2	64	Bait Store	36.1	47 5
R-3	107	House	40.6	43.1
R-4	120	House	41 5	42.1
R-5	146	House	43 3	40.4

Distance Required for reducing SPL to 45dBA
86 m

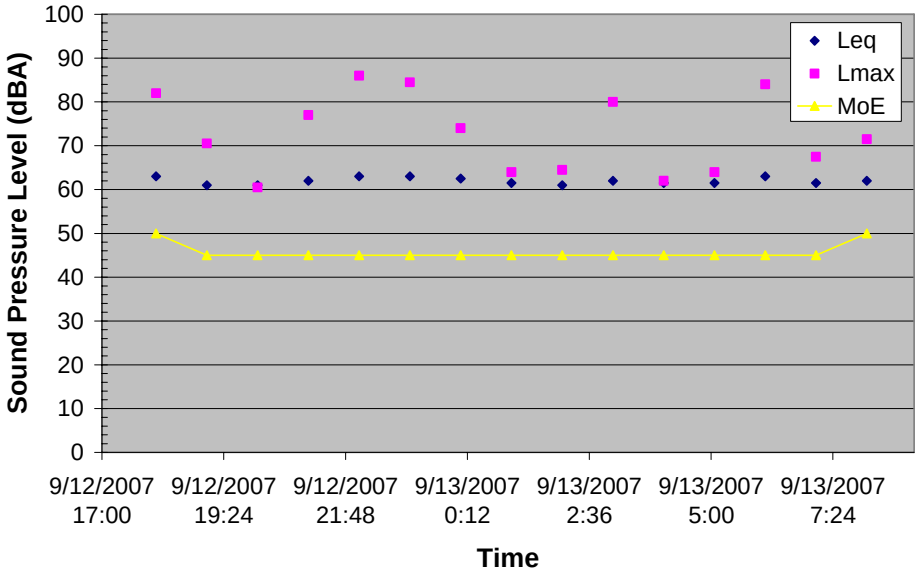
Distance Required for reducing SPL to 40dBA
152 m

Appendix B
Results of Acoustic Survey

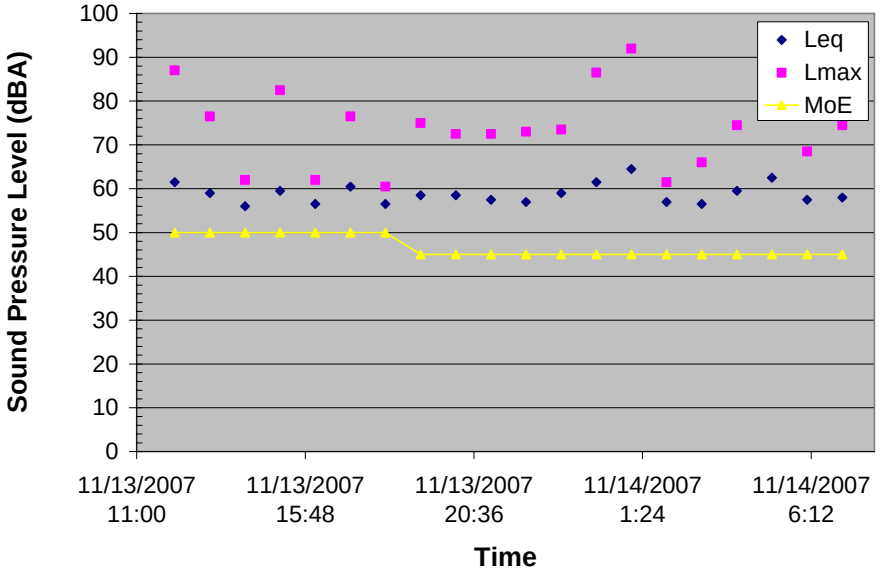
Results of Acoustic Survey - September 11,12/2007 North Side Ahead of Falls



Results of Acoustic Survey - September 12,13/2007 Future Powerhouse Site



Results of Acoustic Survey - November 13,14/2007
North of falls at edge of park



Results of Acoustic Survey - April 22,23/2008
North of falls at edge of park