8.3 ACOUSTIC ENVIRONMENT

The Project may adversely affect the Acoustic Environment, including sound quality in the outdoor environment. The emission of sound waves from natural and manmade sources, their propagation through the atmosphere, and their detection through auditory or other means at a noise sensitive receptor in the ambient environment, characterize sound quality. The Project will affect sound quality near the Project, and therefore Acoustic Environment is a valued environmental component (VEC) for the environmental impact assessment (EIA). There is also potential for Project activities to generate vibration in the immediate vicinity of the Project that, if excessive, could be objectionable or cause property damage—thus for the purpose of this VEC, the Acoustic Environment also includes Project-related vibration that could affect nearby human receptors to the Project.

The equipment associated with earth moving, process equipment and building installation, quarrying, access road construction, and transportation of personnel and materials will emit sound and vibration. During Operation, sound and vibration emissions are generated from heavy equipment; drilling and blasting of ore and rock; transportation of personnel, materials, and products; crushing and conveying equipment; and processing equipment.

A group of recreational campsites in use near the Project are the nearest noise sensitive receptors (NSAs); the nearest campsite is approximately 1.5 km from the edge of the open pit, to the east of the Project. The nearest residential receptors (permanent residences) to the Project are located in Napadogan, approximately 10 km to the northeast of the Project site. Thus, the assessment of the Acoustic Environment centres on the Project Development Area (PDA) and extends out to 10 km in order to encompass the nearest permanent residential receptor in Napadogan.

Sound pressure level monitoring for a period of one week near the Project provides conservative existing baseline conditions for the environmental effects assessment. Sound pressure levels and vibration during Construction and Operation are likely to generate the highest sound and vibration levels during the Project life. Modelling of Project-related sound and vibration provides predicted sound pressure and vibration levels at both the nearest noise sensitive receptors (*i.e.*, recreational campsites) and nearest permanent residences, for comparison with objectives and standards.

The sound emissions estimates and sound pressure level monitoring show that, with the exception of sound emissions from blasting events, activities during Construction and Operation are not expected to be noticeable at the nearest residential receptor in Napadogan nor more proximally at the nearest recreational campsite. There was no predicted change in the measurable parameter of percent highly annoyed, an indicator of disturbance for people, for Construction or Operation at either location. Estimated vibration levels from heavy equipment movements and the process operation show that vibration will not be noticeable at the recreational campsites or at further distances, during either Construction or Operation. There is potential for occupants of the nearest recreational campsite to perceive vibration during a blasting event; however, the period is brief and the vibration amplitude is small (similar to the vibration caused by a large bulldozer operating 7.6 m away from a receptor).

Thus, as is demonstrated by the analyses that follow, with the proposed mitigation and environmental protection measures, the residual environmental effects of a Change in the Acoustic Environment during all phases of the Project will be not significant, no follow-up is proposed. Northcliff will monitor sound pressure levels and peak particle velocity during Construction or Operation in response to public concerns, or to demonstrate compliance with the anticipated conditions of the environmental permits issued for the Project.

8.3.1 Scope of Assessment

This section defines the scope of the environmental assessment of Acoustic Environment in consideration of the nature of the regulatory setting, issues identified during public and First Nations engagement activities, potential Project-VEC interactions, and existing knowledge.

8.3.1.1 Rationale for Selection of Valued Environmental Component, Regulatory Context, and Issues Raised During Engagement

The Acoustic Environment is a VEC because potential unwanted sound ("noise") or vibration emissions from the Project, if not properly managed, could cause adverse environmental effects to human receptors near the Project. The Acoustic Environment includes both sound quality in the outdoor environment and vibration (including ground vibration caused by shock waves moving through soil and concussion arising from sound waves moving through the air) in the immediate vicinity of the Project. If not properly managed, sound and vibration emissions from the Project could cause annoyance, loss of enjoyment of property, sleep disturbance of nearby residents, or property damage.

The Final Guidelines (NBENV 2009) and Terms of Reference (Stantec 2012a) require that potential impacts of noise on humans and wildlife be assessed. Additionally, the Terms of Reference require the Project-related vibration emissions be characterized and assessed.

There are no sound guideline levels, regulations, or standards currently established in the province of New Brunswick for limiting acceptable sound levels from industrial facilities. Certificates of Approval issued under the *Clean Air Act* or *Clean Environment Act* normally regulate noise. In such cases, the New Brunswick Department of Environment and Local Government (NBDELG) generally requires that sound emissions from any activity be controlled so as not to cause substantial loss of enjoyment of the normal use of any property, or substantial interference with the normal conduct of business. Vibration emissions are limited through the *Blasting Code Approval Regulation* under the *Municipalities Act*.

Health Canada has produced the document "Useful Information for Environmental Assessments" (Health Canada 2010), which provides guidance on sound levels at the most exposed façade of a noise sensitive receptor for both construction and operation of sound emission sources.

During engagement activities carried out for the Project, stakeholders raised the issue of how far from the Project site blasting would be heard, and whether Project related sound would be audible from recreational campsites located near the Project or from permanent residences located in nearby Napadogan. Consultation and engagement activities conducted did not identify any specific concerns in relation to vibration.

8.3.1.2 Selection of Environmental Effect and Measurable Parameters

The EIA of the Acoustic Environment focuses on the following environmental effect:

- Change in the Acoustic Environment.

Table 8.3.1 presents the measurable parameters used for the assessment of a Change in the Acoustic Environment and the rationale for their selection.

Table 8.3.1 Measurable Parameters for the Acoustic Environment

Environmental Effect	Measurable Parameter	Rationale for Selection of the Measurable Parameter
Change in the Acoustic Environment	Sound Pressure Levels, A-weighted scale (dB_A)	• Ambient sound pressure levels are characterized using a logarithmic decibel (dB) scale, with the A-weighted (dB_A) scale being the most commonly used for environmental sound assessments. Sound measurements are often expressed as an "equivalent sound level" (L_{eq}) which represents an equivalent energy level over a specified period of time (*e.g.*, 1-hour or 24-hours). Health Canada specifies an equivalent day-night (L_{DN}) sound level thresholds for projects undergoing an environmental assessment, and a corresponding percent highly annoyed.
	Peak particle velocity (PPV) (mm/s)	• Peak particle velocity is a measure of vibration through solid medium. Based on the California Department of Transportation's Guideline for Vibration (Jones & Stokes 2004), PPV is an appropriate descriptor with respect to building damage. Jones & Stokes (2004) indicate that a PPV of 6 mm/s in the vertical direction is the level where transient vibration is distinctly perceivable. For human reaction, the value applies at the point at which the person is situated. For buildings, the value refers to the ground motion (but without an allowance for the amplifying effect of structural components).

8.3.1.3 Temporal Boundaries

The temporal boundaries for the assessment of the potential environmental effects of the Project on the Acoustic Environment include the three phases of Construction, Operation, and Decommissioning, Reclamation and Closure of the Project, as defined in the Project Description (Chapter 3).

8.3.1.4 Spatial Boundaries

The definition of spatial boundaries for the environmental effects assessment of the Acoustic Environment is below.

Project Development Area (PDA): The PDA is the most basic and immediate area of the Project, and consists of the area of physical ground disturbance associated with the Project. Specifically, the PDA consists of an area of approximately 1,253 ha that includes : the open pit; ore processing plant; storage areas; tailings storage facility (TSF); quarry; the relocated Fire Road and new Project site access road, and new and relocated power transmission lines. The PDA is the area represented by the physical Project footprint as detailed in Chapter 3.

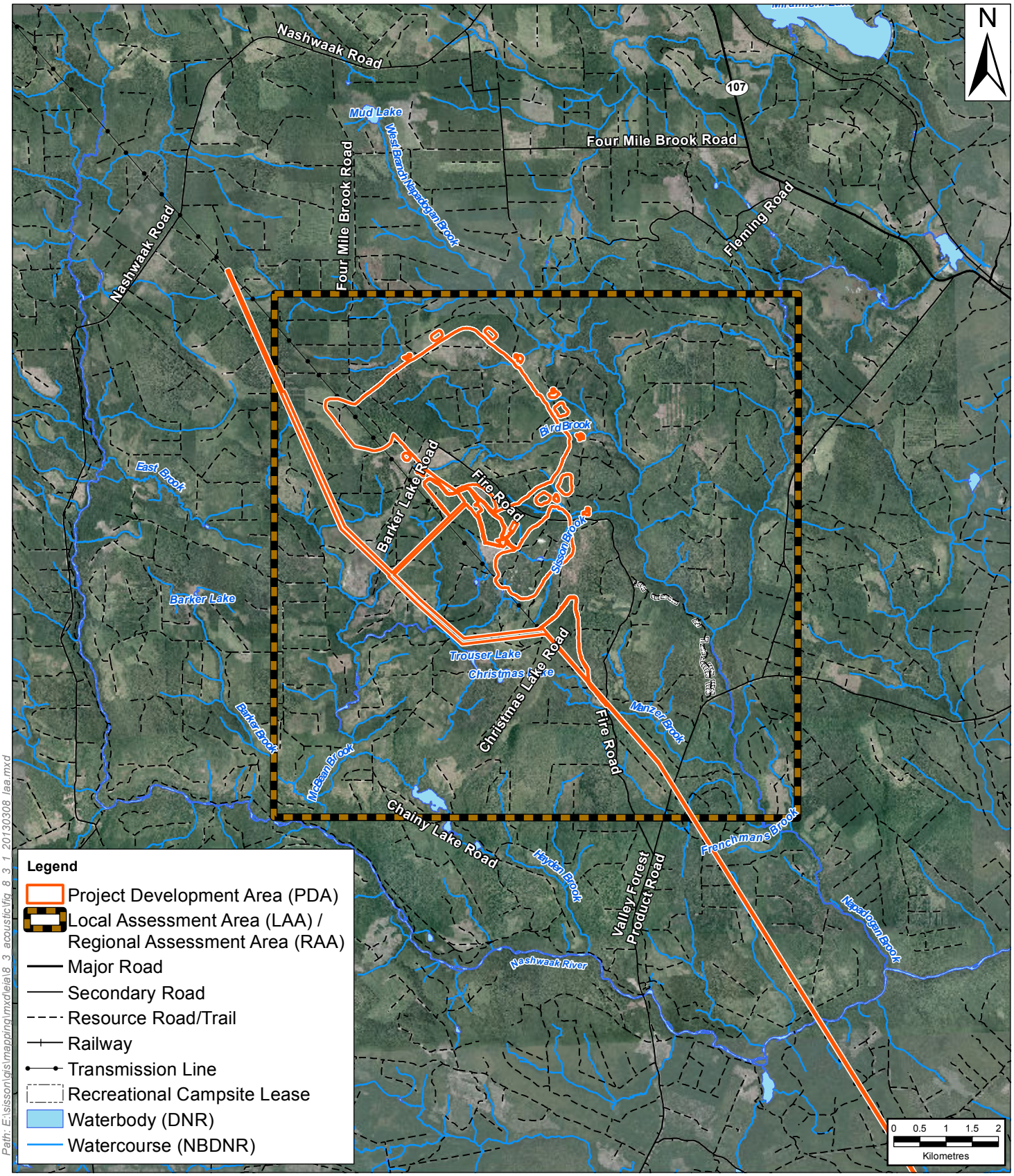
Local Assessment Area (LAA): The LAA (Figure 8.3.1) includes the PDA and forest roads and access routes out to a distance of 10 km from the processing facilities, and includes the nearest residential receptors to the Project (Napadogan) and the nearby recreational campsite leases (approximately 1.5 km from the edge of the open pit, to the east). The LAA is the maximum anticipated area within which Project-related environmental effects are expected. The LAA also includes a 1 km distance on either side of the transportation routes for the Project, to evaluate potential changes in sound pressure levels from Project-related traffic.

Regional Assessment Area (RAA): The RAA is the area within which the Project's environmental effects may overlap or accumulate with the environmental effects of other projects or activities that have been or will be, carried out. The RAA extends out to where modelling predicts a noticeable Change in the Acoustic Environment. With respect to blasting activities as well as transportation (traffic) associated with the Project, the RAA includes a 10 km radius from the Project's ore processing facilities. Beyond 10 km, any environmental effect from the Project would be less than that to be assessed within the RAA. The RAA also includes a 1 km distance from transportation routes for the Project, to evaluate potential changes in sound pressure levels from Project-related traffic.

8.3.1.5 Administrative and Technical Boundaries

The emission of sound waves from natural and manmade sources, their propagation through the atmosphere, and their detection through auditory or other means at a noise sensitive receptor in the ambient environment characterizes sound quality. Sound pressure level in units of A-weighted decibels (dB_A) is the typical measure of sound. The A-weighting scale is the most commonly used scale for expressing the perception of audible noise by humans. Peak particle velocity (PPV) in units of millimetres per second (mm/s) is the typical measure of ground vibration.

There are no overarching noise guideline levels, regulations, or standards currently established in the Province of New Brunswick for limiting acceptable noise levels from industrial facilities. Facility noise levels in New Brunswick are typically set in specific Approvals to Operate issued to individual facilities under the New Brunswick *Clean Air Act*. Generally, these Approvals require that proponents control sound emissions from any activity such that they do not cause substantial loss of enjoyment of the normal use of any property, or substantial interference with the normal conduct of business. In some approvals, a 1-hour L_{eq} sound guideline level of 65 dB_A has been set during the day (06:00-22:00) and 55 dB_A during the night (22:00-06:00). Other approvals specify that noise levels at the nearest sensitive receptor should not exceed 10 dB_A above background levels (Glynn, M. Personal communication, February 10, 2012).



Path: E:\sisson\gis\mapping\mxd\eia\8_3_acoustic\fig_8_3_1_20130308_laa.mxd

NOTE: THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC PROJECT AND SHOULD NOT BE USED FOR OTHER PURPOSES.

Local Assessment Area (LAA) and Regional Assessment Area (RAA) for Acoustic Environment Sisson Project: Environmental Impact Assessment (EIA) Report, Napadogan, N.B.	Scale: 1:100,000	Project No.: 121810356	Data Sources: NBDNR	Fig. No.: 8.3.1	Stantec
	Date: (dd/mm/yyyy) 08/03/2013	Dwn. By: JAB	Appd. By: DLM		
Client: Northcliff Resources Ltd.					

Map: NAD83 CSRS NB Double Stereographic

Day-night average sound levels (L_{DN}) and predicted percent highly annoyed are set for construction and operation of facilities under Health Canada's "Useful Information for Environmental Assessments" (Health Canada 2010). L_{DN} is an energy-weighted average, similar to the equivalent sound pressure level, L_{eq}, for a full day, except that the night time hour (22:00 to 07:00) levels are artificially weighted by an additional 10 dB_A to reflect increased sensitivity of the community to elevated sound levels during those hours. For construction phases less than one year in duration, Health Canada has set the guideline of an L_{DN} of 62 $dB_{A;}$ for construction phases greater than one year in duration—the guideline is based on the change in percentage of highly annoyed due to the construction activity. The guideline indicates that the increase from the estimated percent highly annoyed of the baseline condition to the construction of a project should not be greater than 6.5%. This is also the guideline suggested for operational phases. Health Canada guidance including the percent highly annoyed calculation relies on ISO 1996-1:2003 (Canadian Standards Association 2005).

New Brunswick regulates blasting through the *Blasting Code Approval Regulation* under the *Municipalities Act*, although some municipalities have additional provisions through municipal bylaws. The *Blasting Code Approval Regulation* limits peak overpressure (instantaneous blasting noise) to 128 dB (linear) and ground vibration to a peak particle velocity of 12.5 mm/s. These limits afford protection from damage to structures (such as cracking of drywall) with a reasonable margin of safety. The regulations are applicable at the nearest designated site, typically a residence or other building. Regulations stipulate that pre- and post-blast surveys may be required (as designated by an inspector) to assess whether damage has occurred. Whether required by an inspector or not, blasting contractors will generally conduct such surveys where warranted based on proximity to residents to avoid nuisance claims. In an urban setting, surveys within 400 m of the blasting source are typical (Dowding 2000).

Although there are no limits or guidelines for transient vibration from traffic or mobile equipment in New Brunswick, a general guideline that may be applied is the threshold where persons distinctly perceive vibration. Annoyance due to vibration will not occur unless the receptor perceives the vibration. Jones & Stokes (2004) identify a PPV level of approximately 6 mm/s as distinctly perceivable. Jones and Stokes (2004) have established 0.15 mm/s as a threshold of perceptibility for steady-state vibration. This guidance is part of Transportation- and Construction-Induced Vibration Guidance Manual, prepared by Jones & Stokes (2004) for the California Department of Transportation.

Technical boundaries for the Acoustic Environment include limitations with the use of the sound modelling software (CadnaA), estimates of existing conditions, and estimates of sound power levels associated with Construction and Operation activities. As with any model, there is some inherent uncertainty in the results as models are simplified representations that simulate what are complex physical phenomena. The CadnaA software estimated Project-related sound pressure levels at discrete receptors over a 10 km square grid (100 km^2, 50 m spacing) centred on the Project. A separate CadnaA modelling file was used to estimate Change in the Acoustic Environment (due to on road transportation sources) in Napadogan as it was beyond the extent of the 100 km^2, grid. This approach is acceptable as there is no contribution from Project site sources (mobile and non-mobile) at the edge of the 100 km^2 grid or further distances such as Napadogan. The ISO methodology provides a conservative (*i.e.,* high) estimate of the noise level at a receptor taking into account adverse wind and meteorological conditions which favour noise propagation towards the point of reception.

The existing sound pressure levels measured for a period of seven days at three locations characterize baseline conditions. Monitoring of sound pressure levels is a technical boundary given the spatial and temporal variation of sound level propagation from source to receptor, and influenced by weather conditions and other physical features (*e.g.*, sound reflection over flat surfaces). Background, sound pressure levels based on these data are representative of the conditions present during the monitoring. Based on professional judgment and experience, seven days is a suitable duration to characterize existing conditions for sound quality, as hourly and daily variations are included.

Estimating sound power levels from Project-related equipment is a technical boundary because those data are limited in the industry literature, and often do not exist for specific equipment. Professional judgment and experience with similar studies establish reasonable and conservative estimates of Project-related sound power levels for Project-related equipment.

8.3.1.6 Residual Environmental Effects Significance Criteria

For all aspects of a Change in the Acoustic Environment except those arising from blasting, a significant adverse residual environmental effect on the Acoustic Environment is one where:

- Project-related sound emissions (excluding blasting) cause the sound pressure levels at the nearest noise sensitive area or receptor (NSA) to frequently exceed a 1-hour L_{eq} of 65 dB_A during the day (06:00-22:00) and 55 dB_A during the night (22:00-06:00); or
- the peak particle velocity (PPV) resulting from transient ground vibration (such as from heavy equipment movements) exceeds 6 mm/s at the nearest residence.

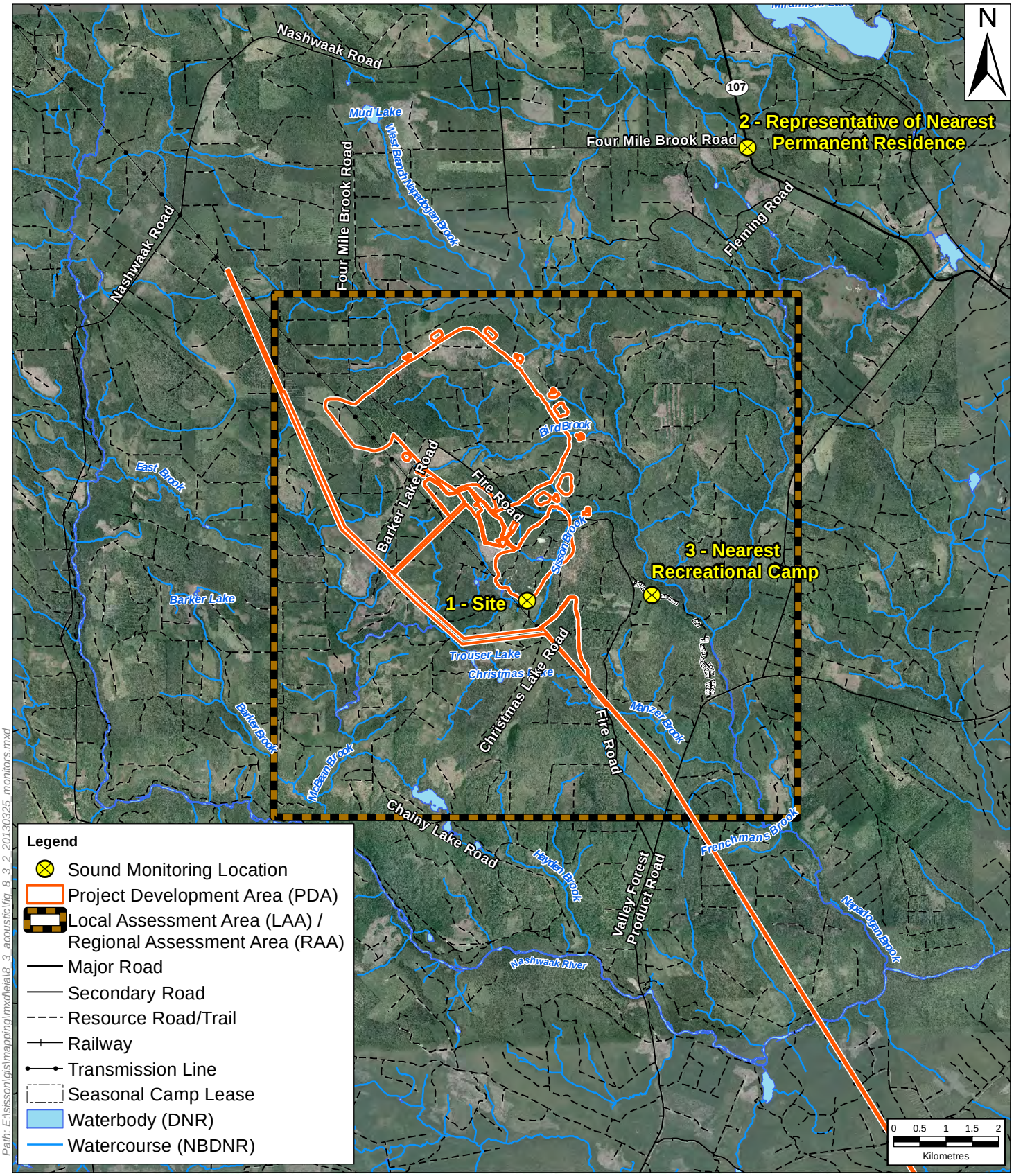
“Frequently” is defined as once (*i.e.*, one hour) per week.

For blasting, a significant adverse residual environmental effect on the Acoustic Environment is one where peak overpressure exceeds 128 dB (linear) at the nearest permanent residence, or where the peak particle velocity (PPV) exceeds 12.5 mm/s at the nearest permanent residence.

8.3.2 Existing Conditions

Stantec conducted baseline, sound pressure level monitoring at three locations near the Project (Figure 8.3.2) to characterize the existing sound quality. The sites selected for monitoring were:

- **Monitoring Site 1**, Sisson Mine meteorological station, located on the Christmas Lake Road (near the proposed open pit);
- **Monitoring Site 2**, site access road, intersection of Four Mile Brook Road and Route 107 (selected as representing the nearest permanent residence); and
- **Monitoring Site 3**, recreational campsite, located approximately 2 km from the edge of the proposed open pit.



Path: E:\sisson\gis\mapping\mxd\eia\8_3_acoustic\fig_8_3_2_20130325_monitors.mxd

NOTE: THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC PROJECT AND SHOULD NOT BE USED FOR OTHER PURPOSES.

Baseline Sound Pressure Level Monitoring Locations Sisson Project: Environmental Impact Assessment (EIA) Report, Napadogan, N.B. Client: Northcliff Resources Ltd.	Scale: 1:100,000	Project No.: 121810356	Data Sources: NBDNR	Fig. No.: 8.3.2	Stantec
	Date: (dd/mm/yyyy) 25/03/2013	Dwn. By: JAB	Appd. By: DLM		

Map: NAD83 CSRS NB Double Stereographic

The existing noise sources include natural sources (*e.g.*, wind through vegetation, bird songs), vehicle traffic on Route 107, and activities at the recreational campsite area.

The coordinates of the sound monitoring locations, and the corresponding dates of monitoring at each site, are provided in Table 8.3.2.

Table 8.3.2 Baseline Sound Monitoring Locations and Dates

Monitoring Site	UTM Coordinates		Monitoring Dates
	Easting (m)	Northing (m)	
1	2457664	7484492	October 20, 2011 to October 27, 2011
2	2462149	7493012	November 3, 2011 to November 10, 2011
3	2460046	7484530	October 6, 2011 to October 13, 2011

Wind speed and precipitation rates obtained from the meteorological tower during the monitoring periods indicate that wind speeds remained below 14 km/h and precipitation was less than 2 mm in any given hour.

The baseline sound pressure monitoring results are summarized in Tables 8.3.3 and 8.3.4 for 1-hour and 24-hour L_{eq}, respectively.

Table 8.3.3 Baseline Sound Pressure Level Monitoring Results – 1-h L_{eq}

Parameter	1-h L_{eq} (dB_A)			Guideline Value (1-h L_{eq}, dB_A)
	Meteorological Station (Monitoring Site 1)	Four Mile Brook Road (Monitoring Site 2)	Recreational Campsite (Monitoring Site 3)	
Maximum L_{eq}				
Day	59	59	62	65
Night	49	**59**	47	55
Minimum L_{eq}	26	26	26	--
Notes: Any values that appear in **bold** indicate a sound pressure level in excess of the significance criteria.				

Table 8.3.4 Baseline Sound Pressure Level Monitoring Results – 24-h L_{eq}

Parameter	24-h L_{eq} (dB_A)			Guideline Value (24-h L_{eq}, dB_A)
	Meteorological Station (Monitoring Site 1)	Four Mile Brook Road (Monitoring Site 2)	Recreational Campsite (Monitoring Site 3)	
Day 1	50	55	44	NA
Day 2	33	52	44	
Day 3	37	49	51	
Day 4	33	53	44	
Day 5	33	55	42	
Day 6	46	54	31	
Day 7	44	55	31	
Notes: Any values that appear in bold indicate a sound pressure level in excess of the significance criteria.				

The highest overall 1-h L_{eq} measured during the daytime was 62 dB_A, which occurred at Monitoring Site 3 (the Recreational Campsite). This L_{eq} is below the typical New Brunswick daytime noise guideline level of 65 dB_A. The lowest 1-h L_{eq} observed during both the daytime and nighttime periods at this location was 26 dB_A.

The highest overall 1-h L_{eq} measured during the nighttime was 59 dB_A, at Monitoring Site 2 (the Four Mile Brook Road site). This L_{eq} is above the typical New Brunswick nighttime noise guideline level of 55 dB_A. The lowest 1-h L_{eq} observed during the daytime and nighttime periods at this location was 41 dB_A and 26 dB_A, respectively.

The baseline sound pressure monitoring results of L_{DN} are in Table 8.3.5.

Table 8.3.5 Baseline Sound Pressure Level Monitoring Results - L_{DN}

Parameter	L_{DN} (24-hour periods)			Guideline Value (L_{DN}, dB_A)
	Meteorological Station (Monitoring Site 1)	Four Mile Brook Road (Monitoring Site 2)	Recreational Campsite (Monitoring Site 3)	
Day 1	51	60	44	62
Day 2	36	54	51	
Day 3	38	50	53	
Day 4	37	58	48	
Day 5	36	59	43	
Day 6	53	58	34	
Day 7	44	58	34	
Notes: Any values that appear in bold indicate a sound pressure level in excess of the significance criteria				

The highest overall L_{DN} measured was 60 dB_A, which occurred at Monitoring Site 2 (the Four Mile Brook Road site). The lowest overall L_{DN} measured over the 7-day period was 34 dB_A, which occurred at Monitoring Site 3 (the Recreational Campsite).

The measured sound pressure levels at the three monitoring sites (meteorological station, Four Mile Brook Road, and the Recreational Campsite) are in Figures 8.3.3, 8.3.4, and 8.3.5. These figures show the observed difference in monitored sound levels generally between day and night as well as the variation over the seven-day period. Four Mile Brook Road measurements included the highest sustained sound pressure levels, mainly due to Route 107 traffic while more variation was observed in the other two locations. Higher sound pressure levels were observed during the weekend period at the recreational campsite in comparison to weekdays which indicates less human activity during the week.

The estimated existing percent highly annoyed (% HA) of the Napadogan residents is approximately 5.8%, based on the average day-night equivalent measured at the Four Mile Brook Road site (50 dB_A). The estimated existing % HA of the recreational campsite users is approximately 1.7%.

Based on these results, the sound quality in the RAA varies depending on the proximity to the provincial road system. The sound quality at the recreational campsite is typical of a rural environment with infrequent influence from anthropogenic sources, more so on weekends.

As there are no substantive existing sources of vibration near the Project, the existing PPV in the PDA is assumed to be negligible.

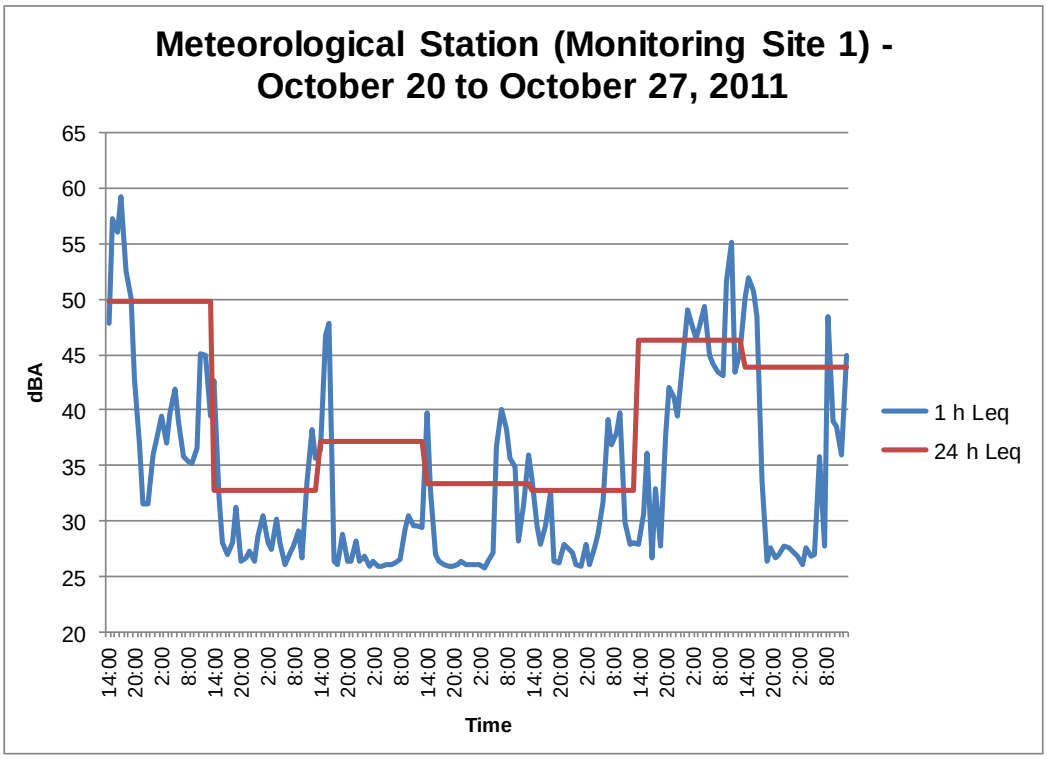


Figure 8.3.3 Baseline Sound Pressure Levels at Meteorological Station (Monitoring Site 1) – 1-h L_{eq} (October 20 to October 27, 2011)

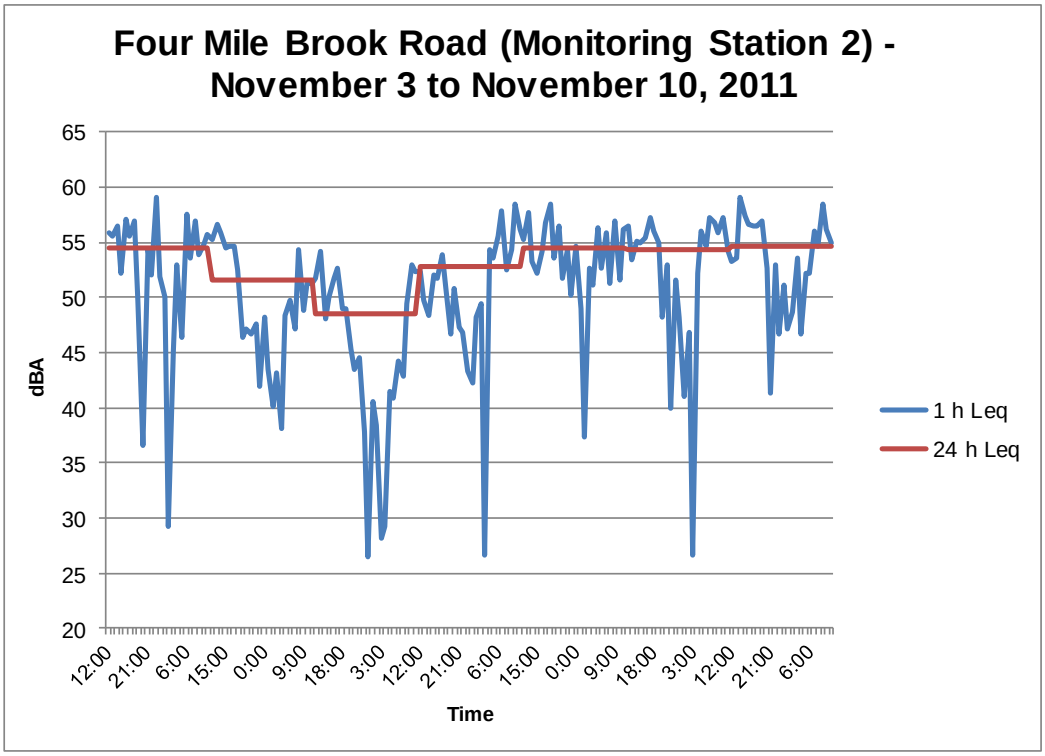


Figure 8.3.4 Baseline Sound Pressure Levels at Four Mile Brook Road (Monitoring Site 2) – 1-h L_{eq} (November 3 to November 10, 2011)

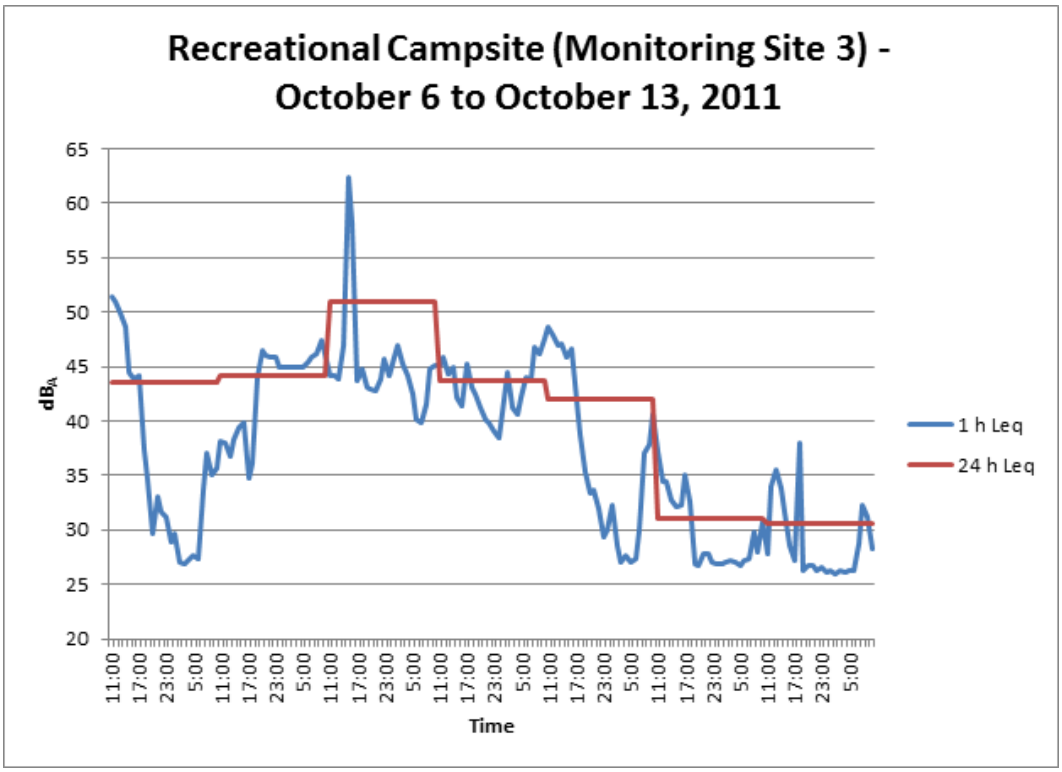


Figure 8.3.5 Baseline Sound Pressure Levels at Recreational Campsite (Monitoring Site 3) – 1-h L_{eq} (October 6 to October 13, 2011)

8.3.3 Potential Project-VEC Interactions

Table 8.3.6 below lists each Project activity and physical work for the Project, and ranks each interaction as 0, 1, or 2 based on the level of interaction each activity or physical work will have with the Acoustic Environment.

Table 8.3.6 Potential Project Environmental Effects to the Acoustic Environment

Project Activities and Physical Works	Potential Environmental Effects
	Change in the Acoustic Environment
Construction	
Site Preparation of Open Pit, TSF, and Buildings and Ancillary Facilities	0
Physical Construction and Installation of Project Facilities	0
Physical Construction of Transmission Lines and Associated Infrastructure	0
Physical Construction of Realigned Fire Road, New Site Access Road, and Internal Site Roads	0
Implementation of Fish Habitat Compensation Initiatives	0
Emissions and Wastes	2
Transportation	0
Employment and Expenditure	0

Table 8.3.6 Potential Project Environmental Effects to the Acoustic Environment

Project Activities and Physical Works	Potential Environmental Effects
	Change in the Acoustic Environment
Operation	
Mining	0
Ore Processing	0
Mine Waste and Water Management	0
Linear Facilities Presence, Operation, and Maintenance	0
Emissions and Wastes	2
Transportation	0
Employment and Expenditure	0
Decommissioning, Reclamation and Closure	
Decommissioning	0
Reclamation	0
Closure	0
Post-Closure	0
Emissions and Wastes	1
Transportation	0
Employment and Expenditure	0

Notes:
Project-Related Environmental Effects were ranked as follows:
0 No substantive interaction. The environmental effects are rated not significant and are not considered further in this report.
1 Interaction will occur. However, based on past experience and professional judgment, the interaction would not result in a significant environmental effect, even without mitigation, or the interaction would clearly not be significant due to application of codified practices and/or permit conditions. The environmental effects are rated not significant and are not considered further in this report.
2 Interaction may, even with codified mitigation and/or permit conditions, result in a potentially significant environmental effect and/or is important to regulatory and/or public interest. Potential environmental effects are considered further and in more detail in the EA.

Environmental effects assessment of the Project on the Acoustic Environment occurs under the activity identified as Emissions and Wastes, which encompasses all sound- and vibration-producing activities associated with the Project under a single activity during each Project phase. Sound and vibration producing activities associated with Transportation (vehicle travel on highways and access roads) are also considered under Emissions and Wastes. Thus, the interaction between Emissions and Wastes and a Change in the Acoustic Environment has been ranked as 2 during both the Construction and Operation phases, and ranked as 1 during Decommissioning, Reclamation and Closure.

Sound emissions and vibration associated with the Decommissioning, Reclamation and Closure activities of the Project are expected to generate emissions of sound and vibration levels that are similar to, or less than, those associated with Construction activities and have been ranked as 1. Decommissioning activities should require less use of heavy mobile equipment than Construction and there will be no emissions from blasting during this phase.

In consideration of the nature of the interactions and the planned use of proven mitigation, the potential environmental effects of all Project activities that were ranked as 0 or 1 in Table 8.3.6, including cumulative environmental effects, on the Acoustic Environment during any phase of the Project are rated not significant. The assessment does not consider these further.

Emissions and Wastes have been ranked as 2 as sound emissions from Project activities have the potential to cause significant environmental effects on Acoustic Environment. Emissions and Wastes during both Construction and Operation are further assessed in relation to the Acoustic Environment.

8.3.4 Assessment of Project-Related Environmental Effects

A summary of the environmental effects assessment and prediction of residual environmental effects resulting from interactions ranked as 2 on the Acoustic Environment is in Table 8.3.7.

Table 8.3.7 Summary of Residual Project-Related Environmental Effects on the Acoustic Environment

Potential Residual Project-Related Environmental Effects	Project Phases, Activities, and Physical Works	Mitigation / Compensation Measures	Residual Environmental Effects Characteristics						Significance	Prediction Confidence	Likelihood	Cumulative Environmental Effects	Recommended Follow-up or Monitoring
			Direction	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological/ Socioeconomic Context					
Change in the Acoustic Environment	Construction • Emissions and Wastes	• Implement an idling reduction policy • Limit construction activity to daytime hours where feasible • Limit blasting activity to daytime hours only, where feasible, and minimize the frequency of blasts • Complete drilling and blasting events during daytime hours only whenever feasible, and minimize the frequency of blasts • Use of mufflers • Ensure equipment is properly maintained	A	M	L	MT/ R	R	D	N	H	--	Y	If noise complaints are received, sound monitoring may be conducted and activities modified to reduce noise.
	Operation • Emissions and Wastes	• Complete drilling and blasting events during daytime hours only whenever feasible, and minimize the frequency of blasts • Notify nearby residents and camp owners of the blasting schedule • Implementation of an idling reduction policy • Routine trucking during daytime time hours only • Carry out preventative maintenance on equipment Processing equipment enclosed in buildings • Partially enclosed primary crusher and conveyors	A	M	L/ R	LT/ R	R	D	N	H	--	Y	Conduct sound and vibration monitoring at the nearest recreational campsite to confirm the estimated sound and vibration levels. If noise complaints are received, sound monitoring may be conducted and activities modified to reduce noise.

Table 8.3.7 Summary of Residual Project-Related Environmental Effects on the Acoustic Environment

Potential Residual Project-Related Environmental Effects	Project Phases, Activities, and Physical Works	Mitigation / Compensation Measures	Residual Environmental Effects Characteristics						Significance	Prediction Confidence	Likelihood	Cumulative Environmental Effects	Recommended Follow-up or Monitoring
			Direction	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological/ Socioeconomic Context					
	Decommissioning, Reclamation and Closure												
	Residual Environmental Effects for all Phases								N	H	--	Y	

KEY

Direction
- P Positive.
- A Adverse.

Magnitude
- L Low: Sound pressure levels at or below background, vibration below detection threshold.
- M Medium: Sound pressure levels above background but below limits, vibration noticeable but not causing annoyance or structural damage.
- H High: Sound pressure levels exceed limits, vibration is disturbing to nearest receptors or causes structural damage.

Geographic Extent
- S Site-specific: Within the PDA.
- L Local: Within the LAA.
- R Regional: Within the RAA.

Duration
- ST Short term: Occurs and lasts for short periods (*e.g.,* days/weeks).
- MT Medium term: Occurs and lasts for extended periods of time (*e.g.,* years).
- LT Long term: Occurs during Construction and/or Operation and lasts for the life of Project.
- P Permanent: Occurs during Construction and Operation and beyond.

Frequency
- O Occurs once.
- S Occurs sporadically at irregular intervals.
- R Occurs on a regular basis and at regular intervals.
- C Continuous.

Reversibility
- R Reversible.
- I Irreversible.

Ecological/Socioeconomic Context
- U Undisturbed: Area relatively or not adversely affected by human activity.
- D Developed: Area has been substantially previously disturbed by human development or human development is still present.
- N/A Not Applicable.

Significance
- S Significant.
- N Not Significant.

Prediction Confidence

Confidence in the significance prediction, based on scientific information and statistical analysis, professional judgment and known effectiveness of mitigation:
- L Low level of confidence.
- M Moderate level of confidence.
- H High level of confidence.

Likelihood

If a significant environmental effect is predicted, the likelihood of that significant environmental effect occurring, based on professional judgment:
- L Low probability of occurrence.
- M Medium probability of occurrence.
- H High probability of occurrence.

Cumulative Environmental Effects?
- Y Potential for environmental effect to interact with the environmental effects of other past, present, or foreseeable projects or activities in RAA.
- N Environmental effect will not or is not likely to interact with the environmental effects of other past, present or foreseeable projects or activities in RAA.

8.3.4.1 Potential Project Environmental Effects Mechanisms

During Construction, equipment use and activities will generate emissions of sound and ground vibration.

During Operation, ore mining includes blasting in the open pit will generate emissions of sound and vibration. Blasting generates a low frequency impulse sound as well as ground vibration that could be a concern for Project personnel, the public and wildlife near the Project. After blasting, excavation, loading and transport of ore will generate sound emissions and potentially noticeable vibration. Ore processing will generate sound during crushing, conveyance, and processing which includes the use of pumps, fans, grinders, ball mills, screens, packaging units, and other sound generating equipment inside a building.

Transportation during Construction and Operation includes the transport of materials, equipment, personnel (in cars and buses), and products to and from the Project site, and will generate emissions of sound and vibration. Off-site receptors may perceive sound and ground vibration from passing transport vehicles.

8.3.4.2 Mitigation of Project Environmental Effects

Based on the acoustic modelling, ongoing activities during Construction and Operation (activities other than blasting) are not expected to be noticeable at the nearest recreational campsite (1.5 km away from the edge of the open pit) or further away, thus no time of day restrictions on activities are required to meet the noise criteria for Project Construction or Operation.

The following mitigation measures, through careful design and planning, will reduce the environmental effects of the Project on the Acoustic Environment:

- construction activity during daytime hours where feasible;
- routine trucking during daytime hours only;
- complete drilling and blasting events during daytime hours whenever feasible, and minimize the frequency of blasts;
- notify nearby residents and camp owners of the blasting schedule;
- implementation of an idling reduction policy
- Processing equipment enclosed in buildings;
- Partially enclosed primary crusher and conveyors;
- use mufflers; and
- carry out preventative maintenance on equipment.

8.3.4.3 Characterization of Residual Project Environmental Effects

The results of sound and vibration modelling for the Construction and Operation phases of the Project are in Section 7.3.

Based on acoustic modelling, the Project contribution to ambient sound pressure levels at the nearest receptors from the operation of mobile equipment, heavy-duty vehicles, and processing equipment during Construction and Operation is small.

As was shown in Table 7.3.1, the predicted sound pressure levels during Construction of the Project during the daytime were 59 dB_A at the nearest residential receptor and 62 dB_A at the nearest recreational campsite (both expressed as a 1-h L_{eq}). These levels will not be noticeably different from the current background levels at both locations (Table 8.3.3), and are below the significance criterion of 65 dB_A as a 1-h L_{eq} during the daytime. The Project is thus not expected to contribute noticeably to background sound pressure levels at either receptor and is not expected to cause the 1-h criteria to be exceeded. Construction activity is restricted in the nighttime so modelling of nighttime noise levels was not required. Based on modelling of daytime activities for Construction, nighttime Construction would also not be noticeable at the nearest campsite. The predicted influence of Construction on sound pressure levels at the campsite is 29 dB_A and the nighttime background is more than 10 dB_A higher than this value. Thus, based on logarithmic summation of the sound pressure levels, no noticeable change will occur at the recreational campsite, even during night.

As was shown in Table 7.3.3, the predicted sound pressure levels during Operation of the Project during the daytime were 59 dB_A at the nearest residential receptor and 62 dB_A at the nearest recreational campsite (both expressed as a 1-h L_{eq}), representing essentially background levels. These levels are below the daytime significance criterion of 65 dB_A as a 1-h L_{eq}. The predicted sound pressure levels during Operation of the Project during nighttime were 59 dB_A at the nearest residential receptor and 47 dB_A at the nearest recreational campsite (both expressed as a 1-h L_{eq}), again unchanged from background. The nighttime predicted sound pressure level in excess of the nighttime significance criterion of 55 dB_A as a 1-h L_{eq} at the nearest residential receptor is solely the result of the elevated background level at this location, presumably due to traffic on Route 107.

There is no noticeable predicted change in sound pressure levels at the nearest recreational campsite or in Napadogan for Construction and Operation, with the exception of blasting (*i.e.,* only blasting will be audible at the recreational camps). Other Project-related noise will not be distinguishable from existing background sound levels at these locations. The predicted change in day-night equivalent sound pressure level (L_{DN}) from Project activities is also indistinguishable from background. The Health Canada advocated % highly annoyed evaluation is based on L_{DN} and therefore also does not change for the sensitive receptors during Construction or Operation.

During a blasting event, there is potential for sound pressure levels at the nearest recreational campsite to reach 125 dB (linear) or 80 dB_A. In comparison to common sounds, this sound pressure level is similar to that experienced at a busy traffic intersection (ERCB 2007a). Blasting noise is very brief (approximately 2 seconds at a time), and will occur approximately two to three times per week. Noise from blasting (air concussion) will be noticeable at the recreational campsites and at further distances. The sound pressure level at the nearest recreational campsite is predicted to be less than the *Blasting Code Approval Regulation* peak overpressure limit (instantaneous blasting noise) of 128 dB (linear). However, due to the infrequent and very short-term nature of blasting noise, annoyance will be low. Communication of blast times to camp owners to reduce the startle effect will minimize annoyance. Sound pressure levels at the nearest residential receptor in Napadogan may reach 101 dB (linear) or 56 dB_A during a blasting event, therefore will be difficult to notice over background sounds.

Ground vibration from heavy equipment movements and equipment operation during both Construction and Operation may be noticeable within 90 to 300 m of the activities. At further distances, these vibrations would not be perceptible, therefore no perceivable vibration will occur from heavy equipment operation at the nearest recreational campsite or at distances greater than 1,500 m. Ground vibration from blasting at the nearest recreational campsite may be noticeable by occupants; however the estimated PPV during an average blast is similar to the vibration caused by a large bulldozer operating 7.6 m away from a receptor. The estimated PPV from blasting will attenuate to the perception threshold within approximately 8.5 km from the blasting site, and hence will not be noticeable at Napadogan.

Vibration from blasting events will likely be noticeable at the nearest recreational campsite, but PPVs are not likely to exceed 3 mm/s. The estimated PPVs at the nearest campsite from blasting will be below the significance criteria of 6 mm/s (equipment) and 12.5 mm/s (blasting).

8.3.5 Assessment of Cumulative Environmental Effects

This section includes an assessment of the potential cumulative environmental effects of other past, present or foreseeable future projects or activities that have potential to cause environmental effects that overlap with those of the Project, as identified in Table 8.3.7. Table 8.3.8 below presents the potential cumulative environmental effects to the Acoustic Environment, and ranks each interaction with other projects or activities as 0, 1, or 2 with respect to the nature and degree to which important Project-related environmental effects overlap with those of other projects or activities.

Table 8.3.8 Potential Cumulative Environmental Effects to the Acoustic Environment

Other Projects or Activities With Potential for Cumulative Environmental Effects	Potential Cumulative Environmental Effects
	Change in the Acoustic Environment
Past or Present Projects or Activities That Have Been Carried Out	
Industrial Land Use (Past or Present)	0
Forestry and Agricultural Land Use (Past or Present)	1
Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons (Past or Present)	1
Recreational Land Use (Past or Present)	1
Residential Land Use (Past or Present)	1
Potential Future Projects or Activities That Will Be Carried Out	
Industrial Land Use (Future)	1
Forestry and Agricultural Land Use (Future)	1
Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons (Future)	1
Recreational Land Use (Future)	1
Planned Residential Development (Future)	1

Cumulative Environmental Effects

Notes:

Cumulative environmental effects were ranked as follows:

0 Project environmental effects do not act cumulatively with those of other Projects and Activities.

1 Project environmental effects act cumulatively with those of other Project and Activities, but are unlikely to result in significant cumulative environmental effects OR Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects but will not measurably change the state of the VEC.

2 Project environmental effects act cumulatively with those of other project and activities, and may result in significant cumulative environmental effects OR Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects and may measurably change the state of the VEC.

All of the projects or activities listed in Table 8.3.8 have some level of sound emissions, and therefore there is potential for environmental effects on the Acoustic Environment overlapping with those of the Project. However, for an overlap to occur, the sound emissions from these other projects or activities would have to overlap spatially and temporally with those of the Project. Table 8.3.8 relates primarily to present or future projects or activities, as past emissions are of no relevance.

Existing Industrial Land Use near the Project is limited to the veneer mill in Napadogan. Given the large distance between the mill and the Project (over 10 km), interactions between the mill and the Project with respect to a Change in the Acoustic Environment are expected to be minimal.

At this time, there are no known plans for future Industrial Land Use projects in close enough proximity to the Project for its sound emission to overlap with those of the Project.

With respect to Forestry and Agricultural Land Use, there is potential for present and future logging activities to cause elevated sound pressure levels near the Project. These sound emissions are transient as the logging operations move from site to site, and are limited to the operation of heavy equipment and related sound. As such, cumulative environmental effects from the Project and Forestry and Agricultural Land Use will not be substantive, most of the time.

Sound emissions from past, present or future Current Use of Land and Resources by Aboriginal Persons for Traditional Purposes, Recreational Land Use, and Residential Land Use are generally minimal and close to background sound and will not result in substantive interactions between their environmental effects and those of the Project.

8.3.6 Determination of Significance

8.3.6.1 Residual Project Environmental Effects

With the exception of blasting events, sound emissions from Construction and Operation will typically not be distinguishable from background sound levels at the receptor nearest to the Project (*i.e.,* the recreational campsites) or in Napadogan.

Sound pressure levels from blasting events will not exceed the significance criteria for blasting and will be infrequent and intermittent in nature. The PPVs at the nearest campsite during Construction and Operation will be below the significance criteria of 6 mm/s (equipment) and 12.5 mm/s (blasting).

Based on the above and with the proposed mitigation, the residual environmental effects of a Change in the Acoustic Environment during all phases of the Project are not significant. This conclusion has a high level of confidence.

8.3.6.2 Residual Cumulative Environmental Effects

The cumulative environmental effects of other projects or activities that have been or will be carried out in combination with those of the Project on the Acoustic environment are not expected to be substantive. High levels of sound emissions from other projects or activities will not occur proximal to the Project, thus with no substantive spatial overlap. Thus, the residual cumulative environmental effects of a Change in the Acoustic Environment in combination with other projects or activities that have been or will be carried out during all Project phases are rated not significant. This conclusion has a high level of confidence.

8.3.7 Follow-up or Monitoring

Follow-up to verify the environmental effects predictions or the effectiveness of mitigation will not be required.

During Construction, monitoring sound or vibration will confirm that sound pressure levels and PPVs at receptors are below the significance criteria where there are complaints. During Operation, Northcliff will conduct periodic sound and vibration monitoring at the recreational campsites to verify that levels are within acceptable ranges in accordance with Approval requirements.