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Joyce Lake Direct Shipping Iron Ore Project:

Chapter 10:

Atmospheric Environment and Climate

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10.0 ATMOSPHERIC ENVIRONMENT AND CLIMATE

As detailed in chapter 1, Joyce Direct Iron Inc. succeeded Labec Century Iron Ore Inc. ("Labec Century") as the Project Proponent on February 18, 2021 following an internal reorganization. All references to Labec Century as the Project proponent may be interpreted as now referring to Joyce Direct Iron Inc.

10.1 VC Definition and Rationale for Selection

Atmospheric Environment and Climate includes air quality, acoustics, greenhouse gases (GHGs), vibration, and lighting. These components constitute a VC due to:

- Provisions under the *Air Pollution Control Regulations* of the *Newfoundland and Labrador Environmental Protection Act* (NLEPA).
- The function of the atmosphere as a pathway for the transport of air contaminants to the freshwater, marine, terrestrial and human environments.
- Health Canada guidelines for noise emissions and their potential impact on community health.
- Potential interaction between human health and infrastructure, and ground-borne vibrations.
- The possible degradation of aesthetics from air contaminants, lighting, and noise.
- GHG emissions accumulation in the atmosphere and contribution to the greenhouse effect that is believed to influence climate.

The atmosphere has an intrinsic or natural value, in that its constituents are needed to sustain life and maintain the health and well-being of humans, wildlife, vegetation and other biota. Other VCs that are therefore closely linked to the assessment of Project effects on Atmosphere and Climate include: Chapter 13, Terrain and Acid Rock Drainage/Metal Leaching; and Chapter 16, Birds, Wildlife and their Habitat.

10.2 Scope of the Assessment

10.2.1 Regulatory Setting

10.2.1.1 Air Quality

Air quality in Newfoundland and Labrador (NL) is regulated by the *Air Pollution Control Regulation* under the NLEPA. This Regulation and Act provide measures to regulate the release of air contaminants to the atmosphere from “sources”, provide testing and monitoring provisions, and establish maximum permissible ground-level concentrations of specified air contaminants in ambient air, among other requirements. The NL Ambient Air Quality Standards (Government of NL 2004) apply to ambient air and were established under the NL EPA in 2004. These values are also shown in Table 10.1.

Table 10.1 Summary of Federal Canadian Ambient Air Quality Standards and NL Air Quality Standards

Air Contaminant	Average Period	Newfoundland and Labrador Ambient Air Quality Standard (µg/m^3)	2025 CAAQS (µg/m^3)
Total Suspended Particulate Matter (TSP)	24-hour	120	-
	Annual	60	-
Respirable Particulate Matter (PM_{10})	24-hour	50	-
$PM_{2.5}$	24-hour	25	NA
	Annual	8.8	NA
NO_2	1-hour	400	79 [4]
	24-hour	200	-
	Annual	100	28.2 [5]
SO_2	1-hour	900	170 [2]
	3-hour	600	-
	24-hour	300	-
	Annual	60	10.5 [3]
Carbon Monoxide (CO)	1-hour	35,000	-
	8-hour	15,000	-
Arsenic (As)	24-hour	0.3	-
Cadmium (Cd)	24-hour	2	-
Copper (Cu)	24-hour	50	-
Lead (Pb)	24-hour	2	-
	30-day	0.7	-
Nickel (Ni)	24-hour	2	-
Zinc (Zn)	24-hour	120	-

Notes:
[1] The $PM_{2.5}$ standard applied to the 98th percentile over three consecutive years
[2] The 3-year average of the annual 99th percentile of the SO_2 daily maximum 1-hour average concentrations
[3] The average over a single calendar year of all the 1-hour average SO_2 concentrations
[4] The 3-year average of the annual 98th percentile of the NO_2 daily maximum 1-hour average concentrations
[5] The average over a single calendar year of all the 1-hour average NO_2 concentration
CAAQS = Canadian Ambient Air Quality Standards
Source: CCME (2014)

The applicable federal air quality criteria considered in the assessment are the Canadian Ambient Air Quality Standards (CAAQS). The CAAQS were implemented to reduce emissions and ground-level concentrations of various air contaminants nationally. The CAAQS have been endorsed by the Canadian Council of Ministers of the Environment (CCME) for sulfur dioxide (SO_2), particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), ozone and nitrogen dioxide (NO_2). These CAAQS are adopted for the 2020 to 2025 period. The CAAQS values are shown in Table 10.1.

The CCME has yet to publish a guidance document on the procedures and methodologies that should be followed to assess whether measured concentrations of SO_2 or NO_2 exceed the CAAQS. However, it is understood that model predictions should not be directly compared to the

CAAQS because these are intended to be compared with measured ambient air quality data and are not considered directly applicable to industrial fence-line concentrations. Therefore, although the predicted ground-level concentrations of criteria air contaminants (CACs) (including SO_2, $PM_{2.5}$, and NO_2) are compared to both the CAAQS and the NL *Air Pollution Control Regulations* in this assessment, only exceedances against the NL regulations are considered in the residual effects assessment as a compliance standard.

10.2.1.2 Acoustics

There are no regulations regarding noise emissions in the province. Health Canada provides noise targets for annoyance, sleep disturbance and low-frequency noise effects in their Guidance Document, *Guidance for Evaluating Human Health Impacts in Environmental Assessment* (Health Canada 2017). Health Canada's approach to acoustic assessments is based on international standards and technical publications, including the World Health Organization's (WHO) *Guidelines for Community Noise* (1999) and *Night Noise Guidelines for Europe* (2009). The Health Canada guidance is typically followed when conducting Noise Impact Assessments to support federal environmental assessments.

The primary target recommended by Health Canada for use in acoustic assessments for activities longer than 12 months is the change in percent highly annoyed (%HA). The %HA is an estimate of the percentage of people who are potentially annoyed by noise emissions and is based on studies completed by the United States Environmental Protection Agency (US EPA). To calculate the %HA, the daytime equivalent sound levels (or L_d, a 15-hour time average of sound levels over the daytime period from 7:00 AM to 10:00 PM) and nighttime equivalent sound levels (or L_n, a 9-hour time average over the nighttime period from 10:00 PM to 7:00 AM) are combined to calculate an adjusted day-night average sound level (or L_{dn}). In the L_{dn} calculation, the L_n value is increased by 10-dB to account for higher sensitivity to noise emissions at night. The L_{dn} is then used to calculate the change in %HA due to project-related noise emissions.

Health Canada recommends that the maximum change in %HA due to project activities be no more than 6.5%. If the change in %HA threshold is exceeded, effects are considered to be of concern and may require mitigation.

The noise guidance from Health Canada (Health Canada 2017) references the guidelines and recommendations of the WHO for community noise (WHO 1999) and *Night Noise Guidelines for Europe* regarding sleep disturbance (WHO 2009). The WHO guideline recommends a target for sleep disturbance as being an indoor sound level of no more than 30 dBA L_{eq} for continuous noise during the sleep period (WHO 1999). Health Canada recommends that an outdoor-to-indoor transmission loss with windows at least partially open is 15 dBA and fully closed windows are assumed to reduce outdoor sound levels by approximately 27 dBA (Health Canada 2017). The corresponding outdoor sound level targets for sleep disturbance is 45 dBA and 57 dBA for partially open windows and fully closed windows, respectively.

More recently, the WHO (2009) has published nighttime noise guidelines that are intended to protect the public, including the most vulnerable groups, from adverse health effects associated with sleep disturbance due to nighttime noise. The recommended annual average is 40 dBA L_n to be considered outdoors.

10.2.1.3 Greenhouse Gases

The management of GHG emissions takes place at provincial, national, and international scales. The existing acts and accords are primarily related to operational emissions above specified thresholds or are related to emission reductions on provincial and federal scales.

The Government of NL has set the following emission reduction targets in the provincial Climate Change Action Plan (Government of NL 2019):

- a 35% to 45% reduction in regional GHG emissions below 1990 levels by 2030
- a 30% reduction in provincial GHG emissions below 2005 levels by 2030

On a federal level, Canada has committed to GHG emission reduction targets as follows (ECCC 2019a):

- a 17% reduction of national GHG emissions below 2005 levels by 2020 (under the 2009 Copenhagen Accord)
- a 40% to 45% reduction of national GHG emissions below 2005 levels by 2030 (2021 Earth Day Summit, ECCC 2021) replacing the former target of a 30% reduction of national GHG emissions below 2005 levels by 2030 (2015 submission to the United Nations Framework Convention on Climate Change, under the Paris Agreement)
- Net zero emissions by 2050 (Strategic Assessment of Climate Change [ECCC 2020a])

To support the initiatives and facilitate achieving the GHG reduction targets, the federal government developed the Pan-Canadian Approach to Pricing Carbon Pollution, providing flexibility to provinces and territories to develop carbon pollution pricing systems of their own, and outlining the required criteria for these systems (ECCC 2019b). For provinces and territories that have not implemented jurisdictional carbon pollution pricing systems that would meet the federal benchmark requirements, they are required to comply with the federal carbon pollution pricing system.

The province of NL created the Made-in-Newfoundland and Labrador Carbon Pricing Plan, which was approved by the federal government to meet the requirements of the Pan-Canadian Approach to Pricing Carbon Pollution in October 2018 (Newfoundland and Labrador Department of Municipal Affairs and Environment 2018). The plan consists of a hybrid system containing performance standards for large emitting facilities and large-scale electricity generation, and a carbon tax on fuel combustion, as outlined below:

- Performance standards based on sector benchmarks for industrial facilities emitting more than 25,000 tonnes carbon dioxide equivalent (CO_{2eq}) annually under the Newfoundland and Labrador *Management of Greenhouse Gas Act* (2016). GHG emission reduction requirements are 8% in 2020, 10% in 2021 and 12% in 2022

- Carbon tax imposed by authority under the Newfoundland and Labrador *Revenue Administration Act* (2011) and the *Revenue Administration Regulations* (NL Reg. 73/11). The carbon price was introduced on January 1, 2019 at $20 per tonne of CO_{2eq}

In addition to the GHG reduction targets and carbon pricing, there are GHG emission reporting requirements both federally and provincially. Federally, under the authority of CEPA, the GHG Emission Reporting Program requires operators of facilities to report their annual GHG emissions to ECCC if their emissions are above 10,000 tonne CO_{2eq} per year (ECCC 2019a). Provincially, under the authority of the Newfoundland and Labrador *Management of Greenhouse Gas Act* (2016) and the *Management of Greenhouse Gas Reporting Regulations* (NL Reg 14/17), there are provincial GHG emission reporting requirements. There are three provincial levels of GHG reporting as follows:

- Facilities emitting 15,000 tonnes of CO_{2eq} or more annually must report their emissions to the provincial government in accordance with the *Management of Greenhouse Gas Reporting Regulations*
- Facilities emitting between 15,000 and 25,000 tonnes of CO_{2eq} annually may apply to be designated as opted-in facilities, in which the facility opts to performing a third-party verification of emissions in compliance with ISO 14064-3 and ISO 14065
- Facilities emitting more than 25,000 tonnes of CO_{2eq} are subject to annual GHG reduction targets and require third-party verification of emission quantifications in compliance with ISO 14064-3 and ISO 14065

Depending on the annual quantity of GHG emissions released to the atmosphere, the Project may be required to report annual GHG emissions to both the provincial government and federal government.

10.2.1.4 Vibration

There are no IAAC EIS guidelines or NLDOEC EIS guidelines for ground vibration. The Federal Transit Administration (FTA) in the United States has published guidelines on acceptable thresholds for ground-borne vibration to sensitive receptors which provide useful assessment criteria for the propagation of vibration (FTA 2006) (Table 10.2).

Table 10.2 Characterization of Vibration Criteria

Description	Ground-borne Vibration		Ground-borne Noise
	V (dB re 10^{-6} inch/sec)	V (dB re $5x10^{-8}$ m/sec)	dBA (re $20x10^{-6}$ Pascals)
Residences and cabins where people can normally sleep (frequent use of tracks also assumed)	72	66	35
Federal Transit Administration (2006); Transit Corporative Research Program (2009)			

Excessive vibration can also lead to ground-borne noise. The FTA has also published guidelines on acceptable thresholds for ground-borne noise (Table 10.2).

10.2.1.5 Lighting

Most lighting guidelines and regulations have been directed toward the provision of suitable lighting for the safe and efficient activities of humans. For example, street lighting, indoor lighting and lighting around industrial plants are subjects of various guidelines to facilitate a safe work environment. Currently there are no legally binding requirements (e.g., regulations, orders) in Newfoundland and Labrador to regulate obtrusive light from industrial facilities.

Various international organizations, including the International Dark Sky Association and the Commission Internationale de L'Éclairage (CIE), also known as the International Commission on Illumination, have developed guidelines and recommendations to limit light pollution and associated effects to humans and wildlife. The Illuminating Engineering Society of North America have adopted such guidelines and recommendations for use in designing new outdoor lighting systems.

The CIE is an independent non-profit organization serving member countries on a voluntary basis. Since its inception in 1913, the CIE has become a professional organization and is currently recognized by the International Organization for Standardization (ISO) as an international standardization body relating to matters on light and lighting, color and vision, photobiology, and image technology (CIE 2017). The CIE has established guidelines for light trespass and glare for various levels of urbanization. These guidelines have been adopted in Great Britain, in particular by the Scottish Executive in their guidance document *Controlling Light Pollution and Reducing Lighting Energy Consumption* (Scottish Executive 2007).

The values represented in the guidelines are based on environmental zones and time of day. Five environmental zones have been established by the CIE (CIE 2017) as a basis for outdoor lighting. The five zones are listed in Table 10.3.

Table 10.3 Environmental Lighting Zones

Zone	Lighting Environment	Examples
E0	Intrinsically Dark	International Dark Sky Association Dark Sky Parks
E1	Dark	Relatively uninhabited rural areas
E2	Low district brightness	Sparsely inhabited rural areas
E3	Medium district brightness	Well inhabited rural and urban settlements
E4	High district brightness	Town and city centres and other commercial areas
Source: CIE 2017		

The maximum values recommended by CIE for light trespass (vertical illuminance) on properties by environmental lighting zone and time of day are presented in Table 10.4.

Table 10.4 Recommended Maximum Values of Light Trespass (Vertical Illumination) on Properties per Environmental Zones

Application Conditions	Environmental Lighting Zones				
	E0	E1	E2	E3	E4
Pre-curfew (19:00 – 23:00)	NA	2 lux	5 lux	10 lux	25 lux
Post-curfew (23:00 – 6:00)	NA	0.1* lux	1 lux	2 lux	5 lux

Notes:
NA – Not Applicable
*if the installation is for public (i.e., road) lighting then this value be up to 1 lux.
Source: CIE 2017

The maximum values recommended by CIE for glare (intensity of luminaires) in designated directions by environmental lighting zone and time of day are presented in Table 10.5. The limits are dependent on the distance (*d*) between the observer and the luminaire and the projected area (A_p) of the bright part of the luminaire in the direction of the observer.

To limit the potential for sky glow, the CIE recommends maximum values for the upward light ratio (ULR) of luminaires and for the upward flux ratio (UFR) of installations (four of more luminaries). The UFR takes into account the light that is reflected upwards based on the reflecting surface as well as from the luminaire, whereas the ULR only considers the light directed upwards from the luminaire itself. For this purpose of this assessment the ULR is considered, as the Project will contain multiple luminaires with the potential to contribute to sky glow.

Table 10.5 Recommended Maximum Values for Glare (Intensity of Luminaires) in Designated Directions

Light Parameter	Application Conditions	Luminaire Group (projected area A_p in m^2)				
		$0 < A_p \leq 0.002$	$0.002 < A_p \leq 0.01$	$0.01 < A_p \leq 0.03$	$0.03 < A_p \leq 0.13$	$0.13 < A_p \leq 0.50$
Maximum Luminous Intensity Emitted by Luminaire (cd)	E0 Pre-curfew Post-curfew	0 0	0 0	0 0	0 0	0 0
	E1 Pre-curfew Post-curfew	0.29 * *d* 0	0.63 * *d* 0	1.3 * *d* 0	2.5 * *d* 0	5.1 * *d* 0
	E2 Pre-curfew Post-curfew	0.57 * *d* 0.29 * *d*	1.3 * *d* 0.63 * *d*	2.5 * *d* 1.3 * *d*	5.0 * *d* 2.5 * *d*	10 * *d* 5.1 * *d*
	E3 Pre-curfew Post-curfew	0.86 * *d* 0.29 * *d*	1.9 * *d* 0.63 * *d*	3.8 * *d* 1.3 * *d*	7.5 * *d* 2.5 * *d*	15 * *d* 5.1 * *d*
	E4 Pre-curfew Post-curfew	1.4 * *d* 0.29 * *d*	3.1 * *d* 0.63 * *d*	6.3 * *d* 1.3 * *d*	13 * *d* 2.5 * *d*	26 * *d* 5.1 * *d*

Note:
d is the distance between the observer and the glare source in meters
Source: CIE 2017

The CIE maximum values of UFR are presented in **Error! Reference source not found.**.

Table 10.6 Maximum Values of Upward Flux Ratio of Installation

Light Parameter	Type of Installation	Environmental Lighting Zones				
		E0	E1	E2	E3	E4
Upward Flux Ratio (%)	Road	NA	2	5	8	12
	Amenity	NA	NA	6	12	35
	Sports	NA	NA	2	6	15
Note: NA – Not Applicable Source: CIE 2017						

Sky glow levels have been established for zones of various levels of urban development (Berry 1976) (Table 10.7). Sky glow is the result of illumination that is directed upward, typically as a result of the use of lighting that has significant upward directivity, or is omnidirectional, such as “bare bulbs”. Reference values are arranged so that decreasing values are associated with more night sky lighting sourced from anthropogenic sources.

Table 10.7 CIE Reference Levels for Sky Glow

Sky Glow (mag/arcsec^2)	Corresponding Appearance of the Sky
21.7 (Rural)	The sky is crowded with stars that appear large and close. In the absence of haze, the milky way can be seen to the horizon. The clouds appear as black silhouettes against the sky.
21.6	The above with a glow in the direction of one or more cities is seen on the horizon. Clouds are bright near the city glow.
21.1	The milky way is brilliant overhead but cannot be seen near the horizon. Clouds have a greyish glow at the zenith and appear bright in the direction of one or more prominent city glows.
20.4	The contrast of the milky way is reduced and the detail is lost. Clouds are bright against the zenith sky. Stars no longer appear large and near.
19.5	Milky way is marginally visible, only near the zenith. Sky is bright and discoloured near the horizon in the direction of cities. The sky looks dull grey.
18.5 (Urban)	Stars are weak and washed out and reduced to a few hundred. The sky is bright and discoloured everywhere.
Note: Mag/arcsec^2 = magnitude per square second of arc Source: Berry 1976	

10.2.2 Influence of Consultation and Engagement on the Assessment

Labec Century conducted a consultation and engagement program as part of the issues scoping exercise for the Project. The program focused primarily on the area(s) most likely to be affected by the Project, including the Town of Schefferville in the province of Québec and local Indigenous groups. Specific issues or concerns regarding Atmospheric Environment and Climate informed baseline data collection and are addressed in this assessment; these are listed in Table 10.8.

Table 10.8 Issues Raised by Indigenous Groups and Stakeholders

Issue	Community / Organization	Summary of Comments Raised During Consultation and Engagement Activities	Response
Noise	Naskapi of Kawawachikamach Elders and Band Council	Questions related to blasting and how far away it would be heard	Blasting is not considered as part of the worst case scenario for the chapter. Blasting activities are interrupted within a large security perimeter. Many factors can influence the noise produced during blasting, including the type and amount of explosives and the sequence.
Noise	Naskapi – anonymous	Concern about operation noise affecting cabin owners but stakeholder thought that they would be open to finding a fair solution to the problem	Based on the current anticipated production rate, blasting will likely occur once every five to six days. Blasting will involve a comprehensive blast design and will be implemented under a strictly controlled environment. Typical assessments of vibration effects on sensitive receptors due to blasting is expected to be below the limit due to the setback
Dust	Naskapi of Kawawachikamach	What about the dust? How will they control dust on the road?	Appropriate dust management will be in place including vehicle speed restrictions on both the haul road which will not be accessible to the public and as necessary on the Iron Arm service road which is accessible for use by the public.

10.2.3 Temporal and Spatial Boundaries

The temporal boundaries for the environmental assessment include the Project phases of Construction, Operations and Maintenance, and Closure and Decommissioning. The temporal boundary for Construction is one year (pre-operation), for Operation and Maintenance is approximately seven years, and for Closure and Decommissioning is approximately one year.

The spatial boundaries for the environmental effects assessment of the Atmospheric Environment and Climate are defined below.

Project Development Area (PDA): The PDA is limited to the area of physical disturbance during construction, operation, and decommissioning of the project. The mine area covers 413 ha in Labrador, and includes open pit mines, a mainland processing plant, hauling and access roads, rock causeway, an accommodations camp, and a rail spur to an existing rail line owned by Tshiuetin Rail Transportation Inc.

Local Study Area (LSA): The LSA is the maximum extent to which effects to the atmospheric environment can be predicted or measured with a reasonable degree of accuracy. The LSA includes the PDA and adjacent areas where effects may reasonably be expected to occur (Figure 10.1). When assessing the effects of the Project on air quality, the LSA is defined as an area that is 14 km (west-east) by 14 km (north-south) for the mine site and 8 km (west-east) by 9 km (north-south) for the rail yard area. When assessing the effects of the Project on the acoustic environment, the LSA was defined to encompass an area 11.8 km by 8.9 km for the mine site and 8.7 km by 9.6 km for the rail yard area. These areas are analogous to the modelling domains used for air and acoustic modelling. The LSA for assessing the effects of the Project on vibration and lighting fall within the areas outlined above.

Regional Study Area (RSA): Areas which might sustain cumulative effects on the Atmospheric Environment and Climate are incorporated into the RSA. The RSA includes the LSA and other current or planned projects which could also adversely affect the Atmospheric Environment and Climate near the proposed Project, including the Houston 1 & 2 and the DSO Iron Ore Projects (Figure 10.2).

For a change in GHG emissions, since the environmental effect of GHG on the environment is a global concern, the spatial boundary is provincial, national and global.

10.2.4 Selection of Environmental Effects and Measurable Parameters

10.2.4.1 Air Quality

Changes to air quality as a result of the Project will be assessed in the context of potential Project-related CACs and their ground-level concentrations. For the purposes of this environmental assessment, the Project-related CACs are nitrogen oxides (NO_x), SO_2, total suspended particulate matter (TSP), particulate matter less than 10 microns in diameter (PM_{10}), and $PM_{2.5}$. Nine metals are also considered in this assessment, as constituents of the particulate matter, and include arsenic (As), cadmium (Cd), copper (Cu), lead (Pb), nickel (Ni), chromium (Cr), selenium (Se), uranium (U) and zinc (Zn).

The ground level concentrations of air contaminants will be predicted using the air dispersion modeling techniques outlined by the Newfoundland and Labrador in the Guidance for Plume Dispersion Modeling (GD-PPD-019.2) (DOEC 2012a). Compliance with provincial regulations will be evaluated following guidance found in Determination of Compliance with the Ambient Air Quality Standards (GD-PPD-009.4) (DOEC 2012b).

10.2.4.2 Acoustic Environment

Changes to the acoustic environment can be quantified by calculating changes to the percent highly annoyed (%HA) due to noise emissions from project activities. Differences between baseline and projected sound pressure levels at sensitive receptors due to project activities determine the change in %HA. Health Canada has indicated changes to %HA exceeding 6.5% constitute a negative effect on human health and should therefore be avoided.

Baseline sound pressure levels were collected at 1-hour intervals to quantify the current ambient noise levels within the LSA. Anticipated sound pressure levels in the LSA from Project activities were predicted using noise modeling software SoundPLAN v7.1 (www.soundplan.eu). The baseline and predicted sound pressure levels can be compared to calculate the change in %HA from project activities. An increase in %HA beyond 6.5% at a sensitive receptor therefore constitutes a significant adverse effect on the acoustic environment.

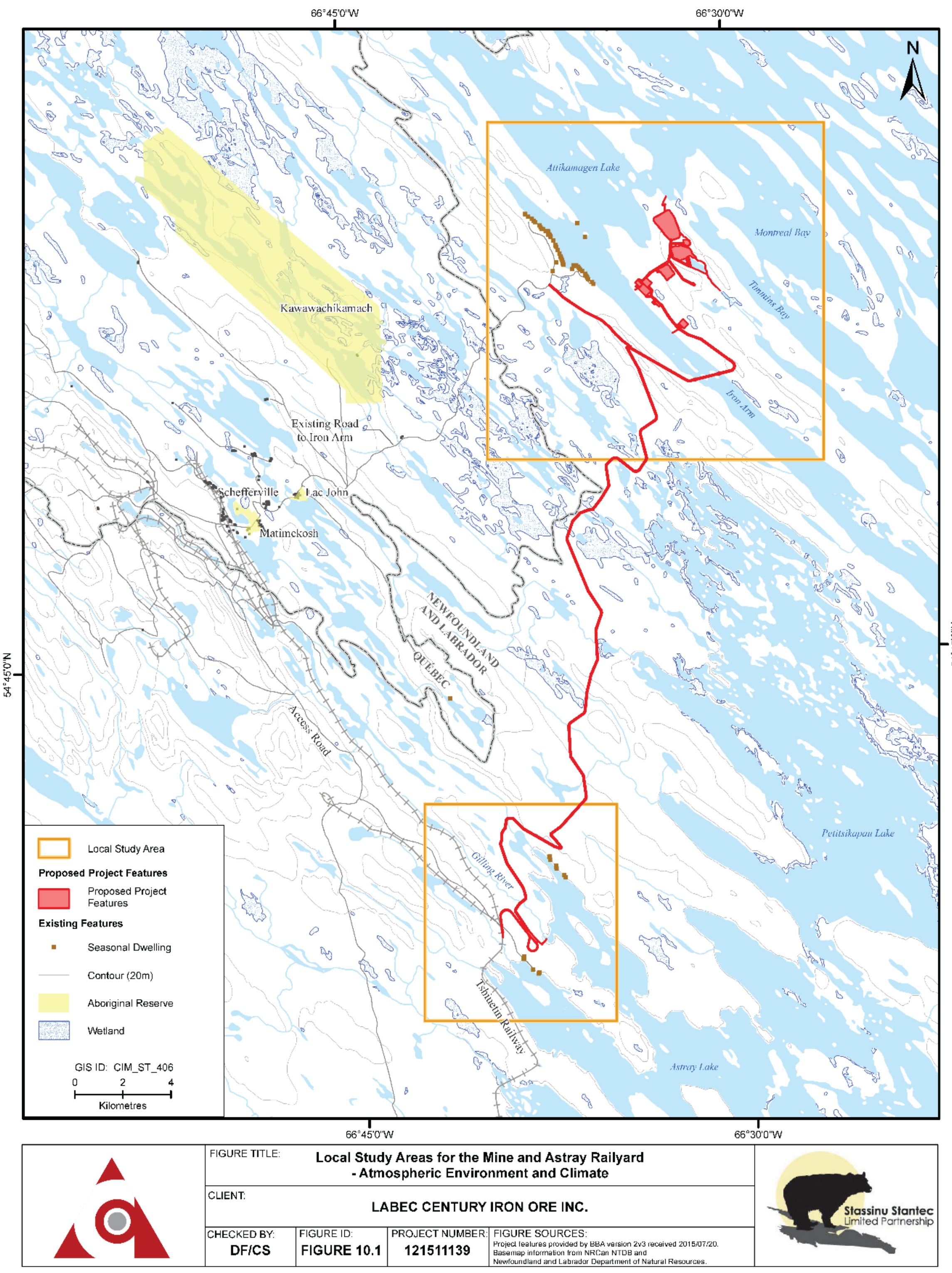


Figure 10.1 Project LSA for the Atmospheric Environment & Climate

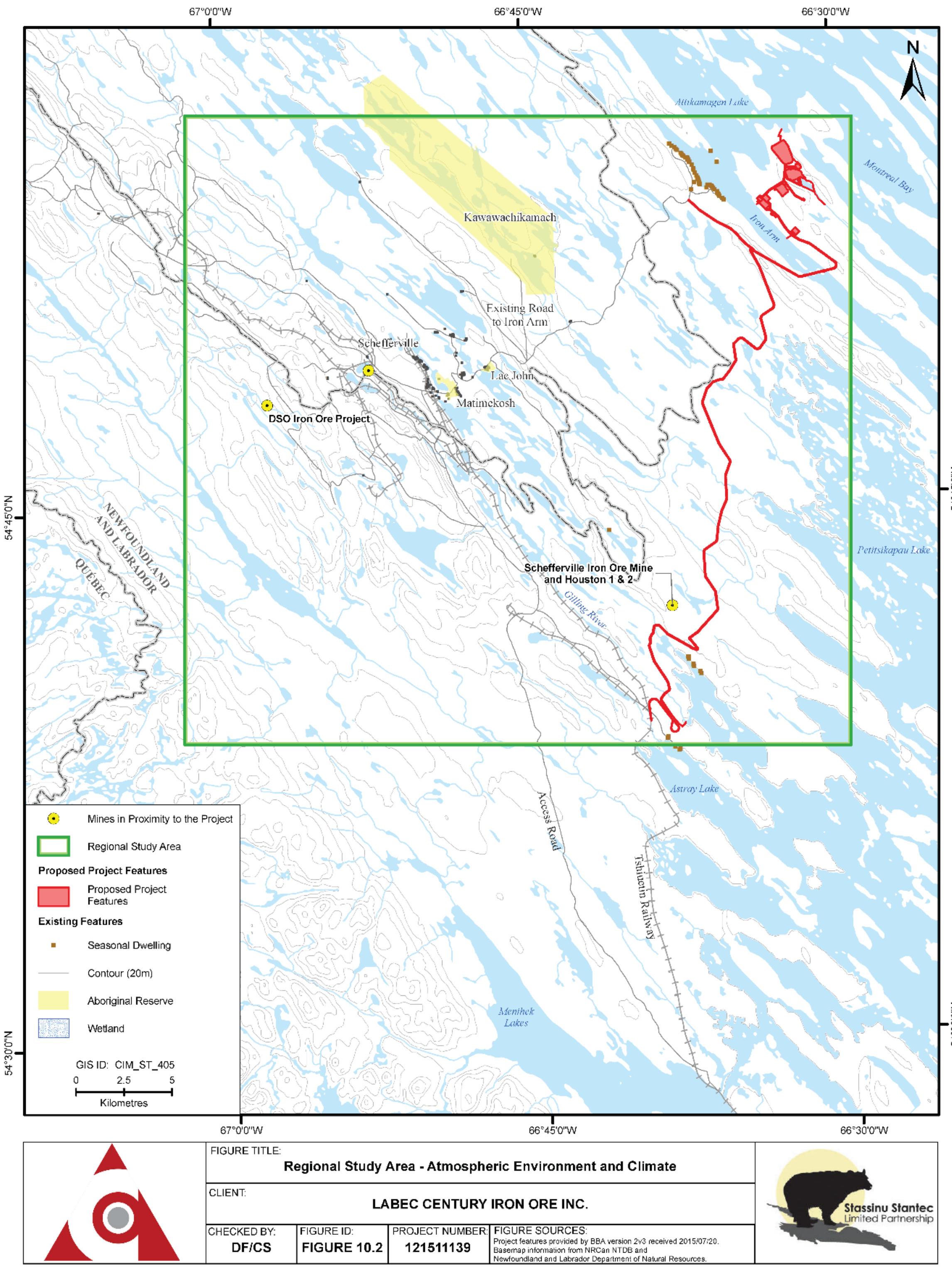


Figure 10.2 Project RSA for the Atmospheric Environment & Climate

10.2.4.3 Greenhouse Gases

Mining operations can result in a substantial release of GHGs throughout the lifetime of the Project. Mining equipment and vehicles release carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) which have varying climate global warming potentials or GWPs.

Provincial and federal policies and regulations do not identify specific thresholds or standards that could be used to determine significance when assessing the residual effects of a single project's GHG emissions. The assessment considers the Strategic Assessment of Climate Change (ECCC 2020a) guidance by comparing estimated Project GHG emissions to the current provincial and federal GHG emission totals and targets to assess whether the Project will contribute to or hinder Canada's ability to meet international commitments. Project GHG emissions will also be compared to emissions from the metal mining sector.

The IAAC guidance (CEA Agency 2003) also recommends ranking Project emission contributions into low, moderate or high, as defined in Section 10.3.

In addition, the magnitude of the GHG emission estimates will be used to predict whether the Project is expected to meet provincial thresholds for reporting and emission reduction targets under the authority of the Newfoundland and Labrador's *Management of Greenhouse Gas Act* (2016) and the *Management of Greenhouse Gas Reporting Regulations* (NL Reg 14/17).

10.2.4.4 Vibration

Vibration consists of oscillatory waves, which could propagate from a project's construction or operation through the ground to adjacent buildings. Vibration from construction projects is caused by general equipment operations (e.g., blasting, pile driving, soil compacting). Sometimes ground-borne vibration originating from project construction and operation could cause damage to nearby buildings or cause perceptible vibration on people within occupied spaces. There are no structures within the immediate vicinity of the Project; therefore, structural damage from the Project is not a concern. However, potential effects of vibration on human health are considered.

Typically, vibration can be described in terms of the displacement, velocity and acceleration. The peak particle velocity (PPV) is defined as the maximum instantaneous positive or negative peak of the vibration signal, and is often used to monitor blasting and vibrations related to structural damages. Human response to vibration is typically assessed using the root mean square (RMS) amplitude, which tracks the average vibration as opposed to peak particle velocity.

Both PPV and RMS vibration can be described as either a velocity (metres per second) or in decibel notation, with a reference velocity of $5x10^{-8}$ m/s. The FTA guidelines (FTA 2006) indicate that oscillations greater than 66 dB or ground-borne noise greater than 35 dB(A) constitute a substantial effect.

10.2.4.5 Lighting

Light is a Project emission originating from a project's lighting units, including all Project lamps and their associated parts for light distribution and positioning. Proper lighting during all phases of the Project is necessary for safe and productive mining operations. Improperly designed lighting can result in adverse effects ranging from a minor social nuisance to environmental disruption. Lighting effects can be broadly grouped into three categories: light trespass, sky glow, and glare.

Based on CIE guidelines, lighting levels from the Project beyond 5 lux during the day and 1 lux during the night at the closest receptor would constitute an adverse environmental effect. CIE guidelines for glare consider the projected area of a luminaire and the distance to the nearest receptor. The maximum luminous intensity (glare) emitted by the Project should not exceed the levels recommended for a E2 Environmental Zone (refer to Tables 10.3 and 10.5). Sky glow reduces the aesthetic quality of the night sky, and can reduce or eliminate the ability to resolve stars or other sky features at night, and has been thought to affect the navigational ability of birds.

A summary of the environmental effects for air contaminants, acoustics, GHGs, vibration and lighting, and their associated measurable parameters, including rationale used for the assessment of the environment effects on the Atmospheric Environment and Climate, are presented in Table 10.9.

Table 10.9 Environmental Effects and Measurable Parameters for Atmospheric Environment

Environmental Effect	Measurable Parameter	Rationale for Selection of the Measurable Parameter
Change in Air Quality	Emissions and ambient ground-level concentration of air contaminants of concern.	Air contaminants are associated with negative effects on human health and have established thresholds in provincial regulations and federal objectives.
Change in Acoustic Environment	Change in the percentage of highly annoyed individuals based on a change in sound pressure level	Increases in sound pressure level which increase the percentage of highly annoyed individuals by more than 6.5% is suggested by Health Canada to cause adverse human health effects.
Change in GHGs	Emissions of CO_2, CH_4, or N_2O resulting from Project activities	Increases in GHG emissions have the potential to have an effect on climate and GHG inventories are widely undertaken to assess such an effect.
Change in Vibration Environment	PPV or RMS velocity (in m/s or dB), and ground-borne noise (in dBA).	Can compare to US FTA guidelines on acceptable thresholds of vibration and ground-borne noise to determine adverse effects from the Project.
Change in Lighting Environment	Light spill (in lux), sky glow (in mag/acrsec^2), and glare (in candela)	Captures the three pathways in which lighting can adversely affect aesthetic expectations of nearby receptors or compromise human health and safety or compromise the natural environment.

10.3 Standards or Thresholds for Determining the Significance of Residual Environmental Effects

Terms that will be used to characterize residual environmental effects for Atmospheric Environment and Climate are:

- Direction
  - Adverse: a deterioration in atmospheric environment conditions compared to baseline;
  - Positive: an improvement in atmospheric environment conditions compared to baseline; or
  - Neutral: no net change compared to baseline
- Magnitude (for air quality, lighting, and noise):
  - Negligible: no measurable adverse effect anticipated;
  - Low: effect occurs that is detectable but within normal variability of baseline conditions;
  - Moderate: effect occurs that would cause an increase with regard to baseline but is within regulatory limits and objectives; or
  - High: effect occurs that would singly or as a substantial contribution in combination with other sources cause exceedances of objectives or standards beyond the Project boundaries.
- Magnitude (for GHGs):
  - Negligible: no measurable change in GHG emissions anticipated;
  - Low: although a change is measurable, based on Agency guidance (CEA Agency 2003; ECCC 2020a) and professional judgment, relatively small changes are expected in provincial and national GHG emissions;
  - Moderate: based on Agency guidance (CEA Agency 2003) and professional judgment, notable changes are expected in provincial and national GHG emissions; or
  - High: based on Agency guidance (CEA Agency 2003) and professional judgment, material changes are expected in provincial and national GHG emissions.
- Geographic Extent
  - Site-specific: effects are restricted to the PDA;
  - Local: effect restricted to the LSA;

  - Regional: effect restricted to the RSA; or
  - Global: Provincial, National or Global scale (GHG Emissions only).

- Frequency
  - Unlikely: Unlikely to occur
  - Once: Effect occurs once per month or less during the life of the Project;
  - Sporadic: Effect occurs sporadically at irregular intervals;
  - Regular: effect occurs on a regular basis and at regular intervals;
  - Continuous: Effect occurs continuously throughout the Project life.
- Duration
  - Short Term: Effect restricted to site-preparation or construction phase of the Project (i.e., 1 year);
  - Medium Term: Effect extends throughout the construction and operation phases of the Project (1 and 6 years);
  - Long Term: Effect extends beyond closure (i.e., beyond 6 years).
- Reversibility
  - Reversible: effect ceases when Project operations cease; or
  - Irreversible: effect continues after Project operations cease.
- Ecological/Socio-economic Context
  - Undisturbed: effect occurs in an area that has not currently been affected by human activity; or
  - Disturbed: effect occurs in an area previously disturbed by human activity.

The threshold criteria for significance of residual effects on Atmospheric Environment and Climate are described below.

A significant adverse residual environmental effect on air quality is defined as a Project-related activity that degrades ambient air quality such that the maximum Project-related ground level concentration being assessed repeatedly exceeds the respective air quality objectives, guidelines, or standards.

For GHGs, provincial and federal policies and regulations do not identify specific thresholds or standards that could be used to determine significance when assessing the residual effects of a single project's GHG emissions on climate change. The assessment considers the Strategic Assessment of Climate Change (ECCC 2020a) guidance by comparing estimated Project GHG emissions to the current provincial and federal GHG emission totals and GHG reduction targets to assess whether the Project will contribute to or hinder Canada's ability to meet international commitments. The IAAC (formerly the CEA Agency) guidance (CEA Agency 2003) also recommends ranking Project emission contributions into low, moderate or high as presented in the magnitude definition in Section 10.3.

A significant adverse residual environmental effect on the acoustic environment is defined as a project-related environmental effect that changes the %HA at the nearest sensitive receptor by more than 6.5%.

For a change in vibration, a significant adverse residual environmental effect would be associated with intermittent vibration levels that are high in magnitude, or persistent vibrations with medium-term duration that occur at sensitive receptors. Such vibrations would result in an exceedance of the vibration criteria presented in Table 10.9.

For a change in lighting, a significant adverse residual environmental effect is defined as an increase in Project related light emissions such that the guidelines for light trespass and glare are exceeded and where the Project related sky glow would change from rural to urban environment.

10.4 Potential Project-VC Interactions

Each Project activity and physical work for the Project is listed in Table 10.10, and each interaction potentially resulting in an environmental effect is rated as 0, 1, or 2 based on the level of interaction with each activity or physical work.

The rating was made using a precautionary approach, whereby interactions with a meaningful degree of uncertainty will be assigned a rate of 2.

10.4.1 Interactions Rated as 0

During all phases of the Project, waste management, expenditures and employment activities are not expected to result in a change in air quality. Those interactions have therefore been rated as 0 in Table 10.10.

During the construction phase of the Project vehicle and equipment operation, the transportation of goods and personnel on site and the installation of water supply infrastructure are not expected to result in a change in vibration. Those interactions have therefore been rated as 0 in Table 10.10.

Table 10.10 Project Activities and Physical Works

Project Activities and Physical Works	Potential Environmental Effect				
	Change in Air Quality	Change in GHG Emissions	Change in Acoustic Environment	Change in Vibration	Change in Lighting
Construction					
Site Preparation (including clearing, grubbing, excavation, material haulage, grading, removal of overburden, ditching, and stockpiling)	2	2	2	1	1
Construction of Roads	2	2	2	1	1
Construction of Causeway	2	2	2	1	1
Construction of Site Buildings and Associated Infrastructure	2	2	2	1	1
Construction of Rail Loop and Associated Infrastructure	2	2	2	1	1
Construction of Stream Crossings	1	1	1	1	1
Installation of Water Supply Infrastructure (wells, pumps, pipes)	1	1	1	1	1
On-site Vehicle/Equipment Operation	1	1	1	0	1
Waste Management	0	1	0	0	0
Transportation of Personnel and Goods to Site	1	1	1	0	1
Expenditures	0	0	0	0	0
Employment	0	0	0	0	0
Operation and Maintenance					
Maintenance of Causeway	1	1	1	0	0
Dewatering Joyce Lake	0	0	1	1	0
Open Pit Mining (including drilling, blasting, ore and waste haulage, stockpiling, dewatering)	2	2	2	2	2
Ore Processing (including crushing, conveying, storage, grinding, screening)	2	2	2	2	2
Waste Rock Disposal on Surface	1	1	1	1	1
Water Treatment (including mine water and surface runoff) and Discharge	1	1	1	1	1
Rail Load-Out and Transport	2	2	2	2	2
On-site Vehicle/Equipment Operation and Maintenance	1	1	1	1	1
Waste Management	0	1	0	0	0
Transportation of Personnel and Goods to Site	1	1	1	0	1
Fuel Transport	1	1	1	0	1
Fuel Storage and Dispensing	1	1	1	0	1
Progressive Rehabilitation	1	1	1	0	0
Expenditures	0	0	0	0	0

Table 10.10 Project Activities and Physical Works

Project Activities and Physical Works	Potential Environmental Effect				
	Change in Air Quality	**Change in GHG Emissions**	**Change in Acoustic Environment**	**Change in Vibration**	**Change in Lighting**
Employment	0	0	0	0	0
Closure and Decommissioning					
Site Decommissioning	1	1	1	1	1
Site Reclamation (building demolition, grading, scarifying)	1	1	1	1	1
Accidents and Malfunctions					
Hydrocarbon Spill	2	2	2	0	1
Train Derailment	2	2	2	0	1
Forest Fire	2	2	2	0	1
Settling/Sedimentation Pond Overflow	1	1	1	0	1
Premature or Permanent Shutdown	1	1	1	0	1

Key:

0 No interaction (i.e., no potential for activity to result in the effect).

1 Interaction may occur; however, based on past experience and professional judgment, the resulting effect is well understood and can be managed to negligible or acceptable levels through standard operating procedures or through the application of management or codified practices. No further assessment is warranted.

2 Interaction may occur and the resulting effect may exceed negligible or acceptable levels without implementation of project-specific mitigation. Further assessment is warranted.

During the operational phase of the Project, the dewatering of Joyce Lake and progressive rehabilitation, are not expected to result in a change in lighting. These interactions are therefore rated as 0 in Table 10.10. Progressive reclamation, transportation of personnel and goods, fuel transport, fuel storage and dispensing and waste management are not expected to result in a change in vibration and these interactions have been rated as 0 in Table 10.10.

The accidents and malfunctions identified in Table 10.10 are not anticipated to result in a change in vibration or lighting; those interactions are therefore rated as 0.

10.4.2 Interactions Rated as 1

Construction of stream crossings and the installation of water supply infrastructure will involve the use of heavy machinery and pumps; these activities are therefore expected to result in changes in air quality, GHG emissions, sound levels, vibration and lighting. However, adherence to well-established best management practices during these construction activities will reduce any adverse effects to acceptable levels. The residual environmental effects on air quality, GHG emissions, acoustic environment, vibration and lighting are therefore not likely to be significant and do not require further assessment.

Site preparation, road and building construction, construction of the rock causeway and railway construction are expected to result in changes in vibration and lighting through the use of heavy machinery and intermittent blasting as required. However, buffer distances inherent in site design and adherence to well-established best management practices during construction activities will reduce any adverse effects to acceptable levels. These interactions are therefore rated as a 1, and are not likely to result in significant adverse environmental effects.

The transportation of personnel and goods to and from the site and the on-site vehicle/equipment operation are expected to result in changes in air quality, acoustics, GHGs and lighting due to the operation of heavy machinery operation and vehicle exhaust. These activities are not typically a substantial part of air contaminant, noise, or GHG emissions based on previous experience. Such activities will likely occur primarily during daylight hours (limiting effects on lighting) and the residual adverse environment effect on air quality, GHG emissions, noise and lighting are not likely to be significant. They have therefore been rated as a 1 in Table 10.10 and do not require further assessment.

During both construction and operation phase of the Project, waste management will result in a change of GHGs from equipment and decomposition of waste. Emissions from these activities will be low and have therefore been rated as a 1 in Table 10.10 and do not require further assessment.

During the operation phase of the Project, the disposal of waste rock, and water treatment and discharge include heavy dump trucks, pumps as well as vehicle and exterior lighting resulting in changes in air quality, GHGs, noise, vibration and lighting. Emissions from these activities can be controlled using well established best management practices, and interactions have therefore been rated as a 1. As the residual adverse environmental effects from these activities are not likely to be significant, they have not been further assessed.

Large pumps will progressively dewater Joyce Lake, and potentially result in a change in acoustics and vibration. The pumps will generate a negligible part of overall noise emissions and vibration from operations and maintenance, and will be intermittent in use. This interaction has therefore been rated as a 1 and not likely to result in adverse residual environmental effects, and does not require further assessment.

Activities such as maintaining the rock causeway and progressive rehabilitation will result in changes in air quality, GHGs and noise by the use of onsite vehicles, heavy equipment and through the handling and moving of large quantities of rock and overburden. Based on past experience, these effects are localized, and do not cause effects beyond the property boundary; the change in air quality, GHGs and noise are likely not significant, are rated as 1, and do not require further assessment.

Transportation of personnel and goods onsite, fuel transport, fuel storage and dispensing, and onsite vehicle/equipment operation and maintenance are expected to result in changes in air quality, acoustics, GHGs and lighting. These interactions will result from vehicle exhaust releases and light and noise emissions. Past experience indicates that these processes constitute a negligible part of total emissions, and can be mitigated with standard operating procedures employed within the mining industry. These effects are therefore not likely to result in significant adverse environmental effects; they have therefore been rated as 1, and do not require further assessment.

The closure and decommissioning of the mining project is expected to result in changes to air quality, acoustics, GHG emissions, vibrations, and lighting. The earth moving and reclamation required to decommission the mine will require heavy machinery and result in vehicle exhaust emissions, intermittent vibration and noise emissions, and lighting emissions during the night time. The temporary nature of decommissioning, and the use of progressive rehabilitation, combined with standard best management practices for site reclamation is expected to mitigate these adverse effects. These effects are therefore not likely to be significant and have be rated as 1, and do not require further assessment.

Possible accidents and malfunctions resulting from a fuel spill, train derailment, forest fire, settling/sedimentation pond overflow, and premature or permanent shutdown could all result in a change in lighting if emergency response and reclamation activities are conducted at night. The duration of the exposure will be short and confined to the area of the emergency itself. These effects are likely to be not significant and therefore rated as 1 and do not require further assessment. The overflow of the settling pond and premature closing or permanent shutdown of the mine and associated facilities could also result in a change to air quality, GHGs and noise through the operation of emergency response vehicles and equipment required to respond to such an incident. The duration of the exposure will be short and confined to the area of the emergency itself. These effects are likely to be not significant and therefore rated as 1 and do not require further assessment.

10.4.3 Interactions Rated as 2

During the Construction phase, site preparation, including clearing, grubbing, excavating, grading, ditching, stockpiling and materials handling, the construction of buildings, roads, the rock causeway and the rail line and the operations of vehicles and equipment on-site are expected to result in a change in air quality, acoustic environment, and GHGs. Completing the site preparation and construction of infrastructure will require numerous vehicles and machinery which will generate air emissions. The operation of on-site vehicles and machinery could therefore interact with the atmospheric environment and cause an adverse change beyond acceptable levels without application of specific mitigation measures. These activities have therefore been rated as a 2, and are further assessed in Section 10.6.

During the Operation phase, open-pit mining (including drilling, blasting, ore and waste haulage, stockpiling and dewatering), ore processing (including crushing, storage, grinding, screening), on-site vehicle and equipment operations and the operation of the rail load out and transport are all expected to result in changes to the atmospheric environment. The operation phase will require the use of heavy equipment and diesel generators operating continuously throughout the lifetime of the Project. Air emissions from these activities could interact with the atmospheric environment beyond the acceptable thresholds without the application of specific mitigation measures. Blasting will introduce substantial vibrations which may cause adverse effects. Ore and waste rock hauling will also possibly introduce adverse effects through vibrations through the road, and through nighttime road lighting. The night time movements of on-site vehicles and operation of lighted equipment could also lead to substantial adverse effects on lighting through changes in sky glow or glare from headlights and exterior building lighting. These activities are therefore rated as a 2, and are further assessed in Section 10.6.

Releases from accidental events and response activities such as fuel spills, a train derailment, or a forest fire could all result in changes in air quality, acoustic environment, or GHGs. The extent and duration of a forest fire, or the possible release of substantial amounts of fuel through an on-site spill or from a train derailment, could lead to substantial releases of air contaminant and GHGs. These events could lead to a change in air quality, acoustic environment, or GHGs which exceeds acceptable level. These events have therefore been rated as a 2, and are further assessed in Section 10.8.

10.5 Existing Environment

10.5.1 Information Sources

The primary sources of information used to characterize existing conditions for Atmospheric Environment and Climate include

- Field surveys and data collected by WSP in support of the Project (Appendices E and F); and
- Environment and Climate Change Canada climate data.

While traditional knowledge pertaining specifically to Atmospheric Environment and Climate was not identified, the traditional knowledge results identified in Chapter 3: Engagement and Traditional Knowledge have been considered and integrated throughout the assessment.

10.5.2 Method for Characterization of Baseline Conditions

10.5.2.1 Climate

There are a number of regional climate monitoring stations in and surrounding the RSA (Table 10.11). Of these stations, only the Schefferville Airport and Wabush Airport stations provide comprehensive year-round monitoring with a period of record that is sufficient for characterizing long-term climate conditions in the RSA and LSA. Data from the closest station, Schefferville Airport, were used to characterize the climate conditions at the Project site.

Table 10.11 Environment and Climate Change Canada Climate Stations

Name	Station ID	Location		Elevation (m)	Period
Indian House Lake, QC	7113280	56º14’00”N	64º44’00”W	310.9	1944-1964
Border Airport, QC	7110830	55º20’00”N	63º13’00”W	464.8	1965-1979
Border (AUT), QC	7110831	56º14’00”N	64º44’00”W	464.8	1993-1998
Schefferville, QC	7117821	54º48’00”N	66º48’00”W	518.2	1992-1993
Schefferville, QC	7117823	54º48’19”N	66º48’19”W	520.9	2012-2021
Schefferville Cote-Nord, QC	7117824	54°48'09"N	66°48'16"W	517.2	2019-2021
Schefferville Airport, QC	7117825	54º48’00”N	66º49’00”W	521.8	1948-2010
Schefferville Airport, QC	7117827	54º48’00”N	66º48’00”W	521.0	2005-2018
Nitchequon, QC	7095480	53º12’00”N	70º54’00”W	536.1	1953-1985
Menihek Rapids, NL	8501548	54º28’00”N	66º37’00”W	489.2	1952-1961
Esker 2, NL	8501548	53º52’00”N	66º25’00”W	487.7	1972-1978
Sandgirt, NL	8503630	53º50’00”N	65º30’00”W	452.6	1939-1948
Twin Falls, NL	8504050	53º30’00”N	64º31’00”W	483.1	1960-1967
Twin Falls, NL	8504060	53º38’00”N	64º29’00”W	456.9	1967-1968
Churchill Falls, NL	850A131	53º32’00”N	63º58’00”W	488.5	1993-1998
Churchill Falls Airport, NL	8501132	53º33’00”N	64º06’00”W	439.5	1969-1993
Churchill Falls, NL	8501130	53º33’28”N	64º05’38”W	439.5	2006-2021
Churchill Falls, NL	8501131	53º33’43”N	64º06’23”W	439.5	2011-2021
Wabush Airport, NL	8504175	52º55’38”N	66º52’27”W	551.0	1961-2013
Wabush A, NL	8504176	52°55'22"N	66°51'53"W	551.4	2013-2021
Wabush A, NL	8504177	52°55'22"N	66°51'53"W	551.4	2014-2021

The Schefferville Airport climate data were analyzed using standard statistical methods to characterize climate conditions using long-term averages and climate normals.

10.5.2.2 Air Quality

The PDA is located in a rural area with no other industrial facilities within 25 km. The NLDOECC compiles an annual ambient air quality monitoring report for many communities and industrial sites across the Province. The closest monitoring sites to the Project site are in Labrador City and Wabush, greater than 200 km from the Project site and where background air quality is influenced by several mining projects.

To characterize the existing air quality in and surrounding the LSA, data was acquired from three recent studies conducted in the Schefferville area for particulate matter levels. These studies include: the New Millennium Capital Corp. EIS for the Elross Lake Area Iron Ore Mine at the Howells River site (2009); the Labrador Iron Mines EIS for the Schefferville Area Iron Ore Mine at Silver Yards (2009); and the Labrador Iron Mines Project Registration for the Houston 1 and 2 Deposits Mining Project (2011).

There are no major emitters of combustion gases, including carbon monoxide (CO), NO_x or SO_2, in the area; therefore, background concentrations of these air contaminants were assumed to be zero (WSP 2015a).

10.5.2.3 Acoustic Environment

The LSA for the Project is situated in a rural area, where the acoustic environment is likely dominated by the sounds of natural phenomena including running water, meteorological events (e.g., wind or rain), and wildlife calling. There are no major settlements or other industrial operations of similar scope within the LSA. Several cabins are situated in the vicinity of the mine site, haul roads and to the railway and loading site. According to the Alberta Utilities Commission Rule 012 (2009) and field testing in Nova Scotia and Labrador, sound pressure levels for such rural areas can be as low as 35 dB for extended periods of time, compared to levels of 45 dB or higher in more settled areas.

To characterize the existing acoustic environment within the LSA, an ambient sound pressure level monitoring program was implemented between September 26, 2012 and September 30, 2012 at five sensitive receptors located near the PDA. The locations of the monitoring sites and dates of monitoring events are summarized in Table 10.12 and illustrated in Figure 10.3.

Table 10.12 Summary of Baseline Acoustic Monitoring Time Periods and Coordinates

Receptor	Date	Coordinates
P1	September 26 to 27, 2012	54°54’29.82’’ N – 66°36’55.98’’ W
P2	September 29 to 30, 2012	54°53’20.40’’ N – 66°35’15.72’’ W
P3	September 28 to 29, 2012	54°40’17.70’’ N – 66°37’26.40’’ W
P4	September 28 to 29, 2012	54°38’18.06’’ N – 66°38’51.30’’ W
P5	September 29 to 30, 2012	54°54’42.54’’ N – 66°35’48.84’’ W

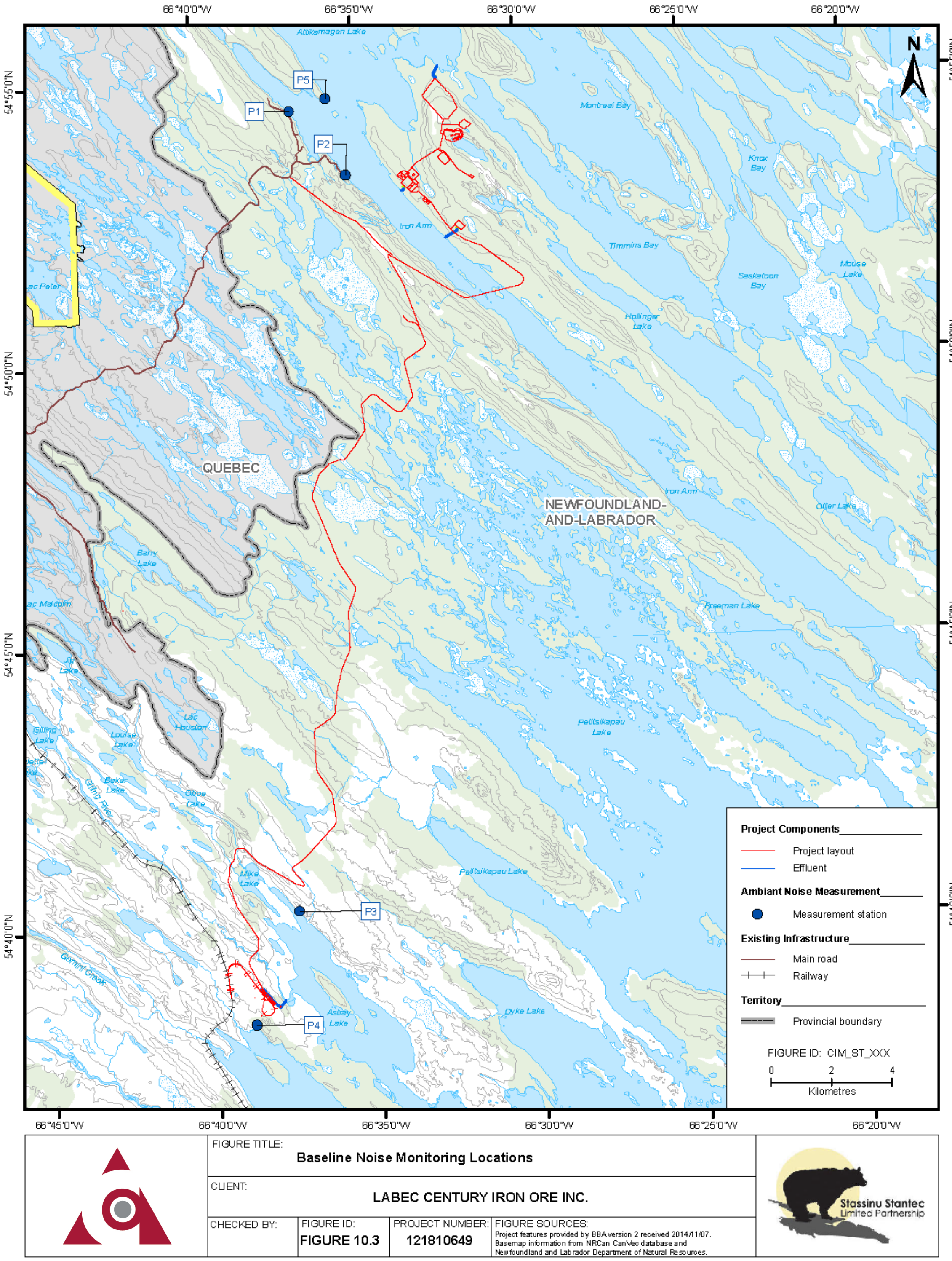


Figure 10.3 Baseline Noise Monitoring Locations

Each measurement station was equipped with a Type-1 sound pressure level meter with a wind screen, mounted to a tripod at 1.5 m height, and a digital voice recorder synchronized to the sound meter. The digital voice recorder was used to filter anomalous data that would otherwise misrepresent observed sound pressure levels at each site. The sound meters were successfully calibrated before each measurement period. Data used to calculate the baseline sound pressure levels were collected under conditions of low wind (<14 km/h) and no precipitation (WSP 2015b). For more details pertaining to the baseline noise study conducted in support of the Joyce Lake Direct Shipping Iron Ore Project refer to the Noise Modelling Study contained in Appendix E.

The raw data at each on-site location was collected for 24 hours. Post-processing of the sound pressure level measurements averaged the raw data to 1-hour L_{eq} values used for reporting the daytime (L_d) and nighttime (L_n) sound pressure levels. The hourly L_d and L_n values were used to calculate the overall day-night sound pressure level (L_{dn}) at each receptor used to determine the baseline %HA.

10.5.2.4 Greenhouse Gases

In March 2004, the Government of Canada implemented the Greenhouse Gas Emissions Reporting Program (GHGRP), which required mandatory reporting for any facilities in Canada emitting more than 100 kilotonne (kt) of CO_{2eq}. The reporting threshold was subsequently lowered to 10 kt CO_{2eq} in 2017.

Environment and Climate Change Canada is also responsible for submitting an annual GHG inventory report under the United Nations Framework Convention on Climate Change (UNFCCC), known as the National Inventory Report (NIR) (ECCC 2020c). Provincial, territorial, and national GHG emissions data are included in the annual NIRs. UNFCCC GHG reporting includes stationary combustion sources (e.g., electricity production, fossil fuel production, mining, and oil and gas extraction), transportation (e.g., road, railways, and navigation) and fugitive sources (e.g., coal mining) within the energy sector.

Existing releases of GHGs in the LSA are characterized by summarizing provincial and national inventory data. Data published for the 2018 reporting year were used, as this dataset presents the most recently available information. The GHG release information was obtained from the ECCC 2020 NIR (ECCC 2020b).

10.5.2.5 Vibrations

Baseline vibration levels can be monitored using accelerometers at sensitive receptors in the Project LSA. The accelerometers detect ground borne vibration in the form of acceleration, which can readily be converted into velocity. The measured velocity can be used as the baseline to compare the changes due to the introduction of a project.

Typically, industrial and rail related vibrations occurring over larger distances (e.g. > 200 m) are likely to fall below the existing baseline vibration from the natural environment.

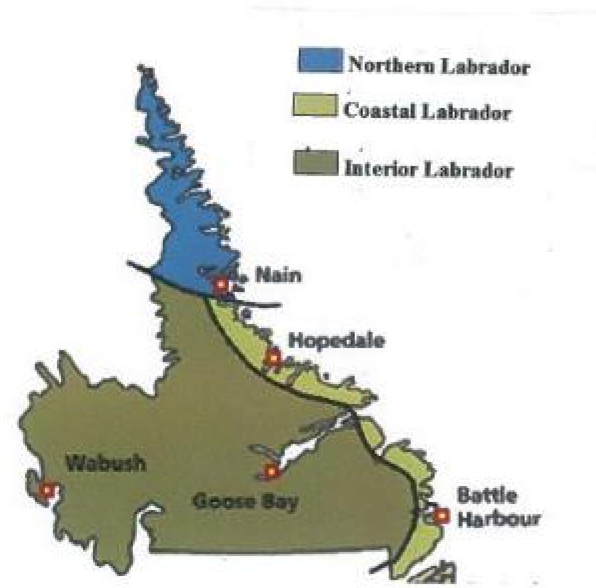
10.5.2.6 Lighting

Lighting can be assessed based on current development in the LSA for trespass, glare, and sky glow. The lack of development within the LSA suggests that trespass and glare are minimal, and that sky glow values are consistent with rural values.

10.5.3 Baseline Conditions

10.5.3.1 Climate

Three climate zones are identified in the Atlas of Newfoundland and Labrador (Figure 10.4). The Project site is located within the Interior Labrador climate zone. The Interior Labrador zone is characterized by a continental climate with lengthy, very cold winters with deep snow cover but relatively more settled weather patterns.



Source: Modified from Heritage Newfoundland and Labrador n.d.
Figure 10.4 Climate Zones of Labrador

The nearest Environment and Climate Change Canada climate station with long-term record is located at the Schefferville Airport located 20 km southwest and west of the PDA. It was therefore selected to provide the basis for characterizing climate conditions in the LSA and RSA.

10.5.3.2 Temperature

The Project Area has a continental climate with significant seasonal variations in temperature. A summary of the monthly temperature distribution throughout the year for the record period of 1948 to 2010 is presented in Table 10.13. The average daily temperatures typically drop below freezing by the end of October and remain below zero until April. Monthly mean temperature extremes in the area can range from -29°C in the winter to 17°C in the summer, with a mean annual temperature of -5.3°C.

Table 10.13 Air Temperature Statistics for LSA and RSA

Month	Average Temperature (°C)[1]		
	Maximum	Mean	Minimum
January	-19.0	-24.1	-29.2
February	-16.9	-22.6	-28.1
March	-9.8	-16.0	-22.2
April	-1.5	-7.3	-13.1
May	6.0	1.2	-3.6
June	13.7	8.5	3.3
July	17.2	12.4	7.6
August	15.8	11.2	6.5
September	8.9	5.4	1.7
October	1.3	-1.7	-4.6
November	-6.1	-9.8	-13.5
December	-15.9	-20.6	-25.2

Note:
[1] Based on period of record 1948 – 2010.

Environment and Climate Change Canada has also published Climate Normals over thirty year periods for the data collected at the Schefferville Airport station. The most recent thirty year period for which data is available is 1971-2000. A summary of the daily average, daily maximum and daily minimum temperatures on a monthly basis for this period is provided in Table 10.14.

Table 10.14 Schefferville Area: Daily Average, Maximum and Minimum Temperatures (1971 to 2000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Daily Average (°C)	-24.1	-22.6	-16.0	-7.3	1.2	8.5	12.4	11.2	5.4	-1.7	-9.8	-20.6	-5.3
Daily Maximum (°C)	-19.0	-16.6	-9.8	-1.5	6.0	13.7	17.2	15.8	8.9	1.3	-6.1	-15.9	-0.5
Daily Minimum (°C)	-29.2	-28.1	-22.2	-13.1	-3.6	3.3	7.6	6.5	1.7	-4.6	-13.5	-25.2	-10.0

10.5.3.3 Precipitation

Mean and extreme monthly precipitation estimates for the LSA and RSA are presented in Tables 10.15 and 10.16. Average annual precipitation is approximately 780 mm based on period of record 1948 – 2010 and 823 mm based on the climate normal period of 1971 - 2000. These annual precipitations are typical of western Labrador. Based on climate normal data, annual precipitation occurs approximately 49.5% (408 mm) as rainfall and 50.5% (415 mm) as snow. The annual snowfall is estimated to be 440 cm/year occurring mainly between October and May.

Table 10.15 Monthly Precipitation

Month	Precipitation (mm)[1]		
	Maximum	Mean	Minimum
January	136.4	45.4	9.2
February	92.9	37.5	1.8
March	121.5	45.1	6.7
April	144.4	46.2	8.4
May	107.0	51.0	12.5
June	159.5	73.5	22.1
July	189.4	100.2	27.0
August	170.8	93.6	42.6
September	194.0	91.6	46.1
October	150.4	77.8	21.9
November	151.7	69.4	23.2
December	117.1	48.1	15.0
Note: [1] Based on period of record 1948 – 2010.			

Table 10.16 Rainfall, Snowfall, Precipitation, Snow on Ground for the 30-year Period (1971 to 2000) at Schefferville Airport Station (Station # 7117825)

Parameter	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Rainfall (mm)	0.2	0.2	1.6	8.4	27.7	65.4	106.8	82.8	85.3	24.4	4.5	0.9	**408**
Snowfall (cm)	57.4	42.6	56.6	54.8	22.9	8	0.5	1.7	12.7	57.2	70.7	55.4	**441**
Precipitation (mm)	53.2	38.7	53.3	61.4	52.1	73.7	107.2	84.5	98.4	80.5	69.4	50.7	**823**
Snow on Ground (cm)	62.0	70.0	71.0	69.0	18.0	0.0	0.0	0.0	0.0	7.0	26.0	49.0	**31.0**
Source: Environment Canada 2013													

10.5.3.4 Wind

The average wind speed and directionality as recorded at the Schefferville station is presented in Table 10.17 based on climate normal data for the period of 1971-2000. The annual average wind speed is about 17 km/h, and the most frequent wind direction, on an annual basis, is from the northwest.

Table 10.17 Schefferville Area: Average Wind Speed/Direction (1971 to 2000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Speed (km/h)	16.4	16.8	17.4	16.5	16.0	16.2	15.1	15.6	16.9	17.8	17.3	16.0	16.5
Most Frequent Direction	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW
Maximum Hourly Speed (km/h)	85	97	83	77	66	97	65	61	80	89	84	80	80
Maximum Gust Speed (km/h)	134	148	148	130	101	126	103	117	137	137	142	153	131
Direction of Maximum Gust	W	W	SW	W	W	W	W	W	SW	SW	SW	SW	SW
Days with Winds ≥ 52 km/h	0.7	1.4	1.9	1.1	0.9	0.4	0.6	0.4	0.8	1.1	1.8	2.1	13.9
Days with Winds ≥ 63 km/h	0.7	0.5	0.4	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.3	0.6	3.3
Source: Environment Canada 2013													

10.5.3.5 Air Quality

To identify the background levels of particulate matter within the Project's LSA, data was acquired from three recent studies conducted within the Schefferville area. This data is summarized in Table 10.18.

Table 10.18 Background Particulate Matter Levels Recorded Near the Project Site

Pollutant	Standards (µg/m^3)		Measurement Site	Measurements (µg/m^3)		% of Standard	
	24 Hour	Annual		Daily Max.	Average	24 Hour	Annual
TPM	120	60	Howells River	35.9	7.9	30	13
			Silver Yard	42	21	35	35
			Houston Deposits[1]	49.2	-	41	-
$PM_{2.5}$	25	-	Howells River	7	4	28	-

Notes:
[1] All but one of the nine samples were no more than 41% of the standard. The one sample, collected on October 7th, 2009, was slightly above the NLDOECC TPM standard (139 µg/m^3)
TPM = Total particulate matter
Source: New Millennium Capital Corp. 2009; Labrador Iron Mines 2009; Labrador Iron Mines 2011; WSP 2015a

The results of the monitoring conducted in this area indicate that particulate matter concentrations fall well below the provincial ambient air quality standards for total particulate matter (TPM) and $PM_{2.5}$, except for the one TPM sample collected on October 7, 2009 near the proposed Houston 1 and 2 Deposits Mining Project.

As noted in Section 10.5.2, the background levels of CO, NO_x and SO_2, have been assumed to be zero because of distance from any substantive sources of these air contaminants.

Background concentrations of the metals of concern for this Project were acquired from the recent studies conducted near the proposed Project site, as discussed above. These data are presented in Table 10.19.

Table 10.19 Background Concentrations of Airborne Metals

Metal	Averaging Period	Background Concentration (µg/m^3)
Arsenic	24-hour	0.02
	1 year	0.02
Cadmium	24-hour	0.00014
	1 year	0.000082
Chromium	24-hour	0.0053
	1 year	0.0027
Copper	24-hour	NA
	1 year	NA
Lead	24-hour	0.0034
	1 year	0.0017
Nickel	24-hour	0.32
	1 year	0.035
Selenium	24-hour	0.03
	1 year	0.03
Uranium	24-hour	0.53
	1 year	0.17
Zinc	24-hour	0.057
	1 year	0.02
Note: No data were available for copper Source: New Millennium Capital Corp. 2009; Labrador Iron Mines 2009; WSP 2015a		

10.5.3.6 Acoustic Environment

Table 10.20 presents the L_d, L_n and the L_{dn} of the ambient noise measured at the sensitive receptors (see Table 10.13 and Figure 10.3).

Table 10.20 Baseline Sound Pressure Levels at Sensitive Receptor Sites near Project

Receptor Point	Measured Sound Level (dBA)[a]		
	Daytime Sound Level (L_d - 7 am to 10 pm)	Night-Time Sound Level (L_n - 10 pm to 7 am)	Day-Night Sound Level (L_{dn})
P1	29	27	34
P2	32	28	35
P3	30	30	36
P4	32	24	33
P5	34	33	40
Note: [a] Noise level rounded to 1 dBA, ref: $2x10^{-5}$ Pa. Source: WSP 2015b			

Limited activity was recorded during the baseline monitoring at each receptor point. The ambient noise at the five receptors points was low, and at times it was possible to hear to the sound of waves on the shore (WSP 2015b). The monitoring results indicate that the acoustic environment near the Project site is relatively pristine, and that current noise emissions are primarily generated by natural meteorological or wildlife phenomena.

10.5.3.7 Greenhouse Gases

In 2018, total GHG emissions in Canada were estimated to be 729 million tonnes CO_{2eq}, of which 430 million tonnes CO_{2eq} (59%) was attributed to the energy sector. Stationary combustion accounted for 75% of reported emissions, contributing 221 million tonnes CO_{2eq} of a reported 295 million tonnes CO_{2eq} total (ECCC 2018). A summary of Canada's estimated GHG emissions by selected sectors for 2016 through 2018 is provided in Table 10.21.

Table 10.21 Summary of Canada's Estimated GHG Emissions 2016-2018 (million tonnes CO_{2eq})

GHG Emission Category	2016	2017	2018
Energy			
Stationary Combustion	318	321	324
Transport	201	207	217
Fugitive Sources	54.9	55.3	55.5
Industrial Process			
Mineral Products	7.9	8.5	8.9
Chemical Industry	7.7	6.9	7.7
Metal Production	15.4	15.1	15.0
Production and Consumption of Halocarbons and Sulfur Hexafluoride	11.3	11.5	12.6
Other & Undifferentiated Productions	12.6	12.8	12.7
Solvent & Other Product Use	12.2	11.3	11.5
Agriculture	59.3	58.4	59.4
Waste	18.0	17.9	17.7
Land Use, Land-use Change and Forestry[1]	-18.5	-16.4	-12.9
National Total	**706.2**	**713.8**	**729.3**

Note:
[1] Net reduction in GHG emissions from this category.
Source: ECCC 2018

Sixteen facilities in Newfoundland and Labrador reported under the GHGRP in 2018 for a total of 5,433,760 tonnes $CO_{2\,eq}$ (ECCC 2020). The 2018 NIR estimates that 10.8 million tonnes of CO_{2eq} were released from activities in Newfoundland and Labrador. This represents approximately 1.5% of national GHG emissions in 2018. GHG emissions from the metal mining sector in Canada were estimated by ECCC to be approximately 4,500,000 tonnes of CO_{2eq} in 2018, or approximately 0.6% of national GHG emissions.

10.5.3.8 Vibration

There are no known vibration generation sources identified near the proposed rail line or other areas within the proposed Project site. Any existing vibration is expected to be negligible, generally originating from natural sources nature with some minor influence form distant anthropogenic activities. Ambient vibration is expected to be well below average human perception.

10.5.3.9 Lighting

The Project is proposed to occur in a relatively pristine environment over 20 km away from the nearest town of Schefferville. Sensitive receptors in the area are cabins over 1 km from the components of the Project, but are not expected to produce substantial light levels. The Project baseline conditions are deemed to be similar to an E1 region as defined by the CIE (refer to Table 10.3), or a relatively uninhabited rural area. The existing levels of light pollution are therefore assumed to be very low for trespass, glare, and sky glow.

10.6 Assessment of Project-Related Environmental Effects

The change in air quality, GHG emissions, acoustic environment, vibration and lighting are assessed for those interactions rated as a 2 in Section 10.4. All other interactions rated as 0 or 1 were determined to be not significant and are not assessed further.

Except for GHG emissions, modelling assumptions were based on the Project Preliminary Economic Analysis (PEA) published May 8, 2013. The Project description was modified in 2014 to match the FS published April 14, 2015. Project characteristics used as inputs for this assessment may have since changed as a result of the updated description.

10.6.1 Assessment of Project-Related Environmental Effects on Air Quality

Construction

Project Construction will result in emissions of air contaminants from site preparation activities (including clearing, grading, grubbing, excavation, material haulage, ditching and stockpiling) and through the construction of roads, a rock causeway, site buildings and associated infrastructure and the railway and load out facilities. These emissions include particulate matter (TPM, PM_{10} and $PM_{2.5}$) and combustion gases (CO, NO_x, SO_2) through the combustion of fuel in construction equipment and emissions of particulate matter, or “dust” (TPM, PM_{10} and $PM_{2.5}$) through the operation of heavy earth moving equipment handling overburden and traveling on unpaved roads. On-road vehicle traffic associated with onsite activities will also generate air emissions through the combustion of fuel and travel on unpaved roads.

The areas of the Project that will require site preparation include the waste rock disposal areas, mine infrastructure area, process plant site, rail loop, rail loading year, all new roads and ancillary infrastructure. Site preparation activities will involve site clearing and grading with earth moving and excavating equipment. Construction of site roads and infrastructure will use mobile cranes, boom trucks, generators, dump trucks and numerous pick-up trucks. Site grading activities will be required to support the installation of site facilities and all necessary sedimentation and erosion control measures.

Power for Construction activities will be supplied by local diesel generators, with fuel for the generators to be stored on site near the processing plant area.

Operation and Maintenance

Project operation and Maintenance will include the following activities:

- Open pit mining (drilling and blasting);
- Ore, waste rock and overburden loading, haulage and dumping;
- Processing of the extracted ore (crushing and screening);
- Stockpiling;
- Power generation;
- Truck haulage of iron ore products to the rail loop; and
- Rail load out and rail transport.

The main sources of air emissions from Operation and Maintenance activities are the combustion of diesel fuel in the mining equipment, locomotives, vehicles, and generators which produces emissions of particulate matter (TPM, PM_{10}, $PM_{2.5}$) and combustion gases (SO_2, CO, NO_x), and the fugitive releases of particulate matter from drilling, blasting, material handling and haul truck and vehicle travel on unpaved roads. Blasting operations will also result in emissions of combustion gases including SO_2, CO, and NO_x.

As defined by the US EPA (1995), fugitive dust is dust that is released to the atmosphere from open sources, instead of being discharged to the atmosphere via a confined flow stream, and is created from the mechanical disturbance of granular material. Fugitive dust generally consists of three size ranges of particulate matter including, TPM (particulate matter 30 µm or less in diameter), PM_{10} and $PM_{2.5}$. At particle diameters greater than TPM, the dust settles by gravity within a short distance of the emission source.

During Project Operation, fugitive releases of dust will occur through the following operational activities:

- Drilling and blasting within the open pit mine;
- Material handling – through the loading and unloading of extracted ore, overburden and waste rock, feed to processing plants, stockpiling, reclaiming and rail loading;

- Processing of the ore – crushing and screening;
- Travel on unpaved roads – Vehicle and haul truck travel on unpaved roads; and
- Wind erosion –waste rock and overburden disposal areas and the ore stockpiles.

The amounts of dust created from the above activities can vary depending on a number of factors including, but not limited to, the size of the matter being disturbed, local climatic conditions including wind speed and direction and precipitation, frequency of disturbance, the moisture and silt content of the material being disturbed, as well as mechanical stresses, including factors like material drop height and vehicle speed on unpaved roads (Golder Associates 2010). The typical distance that dust travels from its source are mostly dependent on the size of the matter being disturbed and the local climatic conditions. In general, larger particulate matter will tend to be deposited closer to the source of the emissions than that of finer particulate (Golder Associates 2010).

10.6.1.1 Mitigation of Project Environmental Effects

Construction

Several measures are planned to mitigate air contaminant emissions during Project Construction; these include:

- Use of dust suppressants (e.g., water and/or chloride based suppressants) during activities and situations that have an increased potential to generate airborne dust
- Adherence to a comprehensive equipment preventative maintenance program to maintain the vehicles, and achieve high fuel efficiency and vehicle performance

Operation and Maintenance

Several measures are planned to mitigate air contaminant emissions during Project Operation and Maintenance; these include:

- Use of dust suppressants (e.g., water and/or chloride based suppressants) on all road segments, as required (in particular near cabins)
- Proper road maintenance to control silt content
- Limiting the speed of vehicles on the service road
- Implementing an idling policy for vehicles
- Minimizing material drop height when loading or unloading ore

- Selecting stockpile locations that are far away from sensitive receptors, as practically feasible
- General housekeeping around areas prone to accumulation of fine particulate, i.e., around the crushing and screening activities.

The majority of the air emissions related to Project Operation and Maintenance will consist of fugitive releases of dust due to material handling and haul truck and vehicle travel on unpaved roads. In particular, dust control measures will be implemented on sections of the product haul road in the immediate vicinities of the seasonal cabins during periods when generation of dust is high and to ensure the regulatory standards are not exceeded at the cabins.

10.6.1.2 Characterization of Residual Project Environmental Effects

Construction

A detailed emissions inventory for the construction phase of the Project was not prepared as specifics pertaining to the type and quantity of various pieces of construction equipment that would be in use, were not available at the time.

The emissions of CACs expected from the combustion of fuel in various pieces of construction equipment will be temporary, are expected to be well within the regulatory objectives, standards and guidelines and would be comparable in magnitude to other similar construction projects. Therefore, the effect of Project construction on a change in air quality is predicted to be moderate in magnitude, local in geographic extent, short term in duration, will occur regularly, and is reversible.

Operation and Maintenance

To assess the residual project environmental effects from a change in air quality during Project Operation and Maintenance, a detailed emission inventory of Project-related CAC emissions was prepared. Dispersion modelling was also conducted to predict the ground level concentrations of particulate matter (TPM, PM_{10}, $PM_{2.5}$), combustion gases (SO_2, CO, NO_x) and metals (As, Cd, Cu, Pb, Ni, Zn, Cr, Se, U) . For the purposes of modelling, the following measures were assumed: application of chloride-based dust suppressant to the unpaved road segments; and maintaining haul roads to minimize silt content.

This following section provides a summary of the emissions inventory and findings from the dispersion modelling, conducted by WSP in support of the Project. More details pertaining to the methodologies and assumptions used to prepare the model and the results obtained are presented in the Air Quality Modelling Report in Appendix F (WSP 2015 – Air Modelling Report). Modelling was conducted in accordance with the requirements of the provincial *Air Pollution Control Regulations* and the following two guidance documents; “Guidance for Plume Dispersion Modelling (GD-PPD-019.1)”; and “Determination of Compliance with the Ambient Air Quality Standards (GD-PPD-009.3)”. The results obtained are compared to the provincial ambient air quality standards and the CAAQS. However, as presented in Section 10.2.1.1, it is understood that model predictions should not be directly compared to the CAAQS because these are intended to be compared with measured ambient air quality data that are representative of a region or air zone and are not considered directly applicable to industrial fence-line concentrations. Therefore, only exceedances against the Newfoundland and Labrador regulations are considered in the residual effects assessment as a compliance standard.

The emissions inventory and dispersion modelling were based on an operating scenario that represented the worst case (i.e., highest emissions), which corresponded to Year 1 of operation. This year was identified as being the worst case as it will involve the maximum extraction of material and because mining operations will occur at or near the surface (i.e., no barrier effects from the depth of the mine).

A summary of the average annual totals of particulate matter and combustion gases that will be released to the atmosphere from the operation of the Project in Year 1 is presented in Table 10.22.

Table 10.22 Average Annual Totals of CACs, Project Operation Year 1

Group	Average Emissions (tonnes/year)					
	$PM_{2.5}$	PM_{10}	TPM	SO2	NOx(1)	CO
Drilling and blasting	7.5	16.7	21.4	0.161	8.9	64.0
Handling	4.8	15.6	35.7	-	-	-
Hauling (Mine and Plant)	18.0	180	633	-	-	-
Hauling (Plant to Railyard)	55.6	556	1,955	-	-	-
Dozing	2.6	5.3	24.9	-	-	-
Crushing and screening Plant	31.5	66.0	164	-	-	-
Wind Erosion	16.1	40.4	80.9	-	-	-
Tailpipe - Genset	1.7	1.8	1.8	0.14	196.4	20.1
Tailpipe - Locomotives	0.5	0.6	0.6	0.057	15.1	2.3
Tailpipe - Mining Vehicles	21.0	21.6	21.6	0.478	315	139
Total	159	904	2,938	0.863	535	226

Notes:
1. Expressed as NO_2 equivalents
2. WSP Personal Communication, February 12, 2015

To evaluate the effect that the emissions of CACs and combustion gases from the Project could have on areas surrounding the proposed mine site and rail yard, air dispersion modelling was conducted, as described above. Modelling was conducted by WSP using methods presented in the *Guideline for Plume Dispersion Modelling, 2nd revision,* as developed by the Government of Newfoundland and Labrador, Department of Environment and Conservation (DOEC 2012b), refer to Appendix F – Air Quality Modelling Report.

Modelling was accomplished using the CALPUFF modelling system, an advanced non-steady state meteorological and air quality modelling system developed by the Atmospheric Studies Group at TRC Companies Inc. This system has three main components, including CALMET (meteorological modelling package), CALPUFF (puff dispersion model) and CALPOST (post processing). Additional details pertaining to the model system and its individual components and inputs can be found in Appendix F – Air Quality Modelling Report.

The following operational activities were incorporated into the modelling: drilling and blasting, material handling (loading and dumping), material hauling on unpaved roads, dozing, ore crushing and screening, vehicle and haul truck tailpipe emissions, wind erosion, power generation, rail car loading and rail transit. Details pertaining to the sources, source types, physical parameters and contaminant emission rates can be found in Appendix F – Air Quality Modelling Report. Two modelling domains were selected based on the Project layout; one covering the mine and plant area, and the other the rail yard. These areas correspond to the LSA for change in air quality (refer to Figure 10.1).

Background concentrations were also identified and added to the predicted concentrations prior to determination of compliance with the applicable standards. Existing air quality in and surrounding the PDA was previously described in Section 10.5.3.5. In the case of particulate matter (TSP, PM_{10} and $PM_{2.5}$), values equal to 35 % of the provincial standard were taken as the background level which was then added to the predicted concentrations (WSP 2015a).

The overall maximum predicted concentrations of particulate matter, combustion gases and metals at the closest cabins for each area modelled are presented in Tables 32 and 33 in Appendix F – Air Quality Modelling Report. A summary of these results is represented below in Table 10.23.

For TPM, PM_{10}, $PM_{2.5}$, CO, NO_x and SO_2, results show that the provincial ambient air quality standards are met within the vicinity of all cabins for both domains. During the 24-hour time averaging period there is potential for slight exceedances of provincial regulations for TPM, PM_{10} and $PM_{2.5}$ on the south side of Iron Arm. These exceedances do not occur in the vicinity of the cabins.

The maximum predicted 24-hour ground level concentrations of metals (As, Cd, Ni, Pb, Zn, Cr, Se, U, Cu) also met applicable provincial standards for both modelling domains, as noted in Table 10.23.

The maximum predicted 24-hour concentrations of TSP, PM_{10} and $PM_{2.5}$ for the mine area and rail yard are graphically illustrated in Figures 10.5 through 10.10. The maximum predicted 1-hour concentrations of NO_x for the mine area and rail yard are illustrated in Figures 10.11 and 10.12.

Additional figures illustrating the maximum predicted ground level concentrations of TSP, PM_{10}, $PM_{2.5}$ and NO_x over other time averaging periods and for the other contaminates modelled are contained within Appendix F – Air Quality Modelling Report.

The effect of the Project Operation and Maintenance on a change in air quality is predicted to be moderate in magnitude, local in extent, medium term in duration, continuous in frequency and reversible.

Table 10.23 Maximum Concentrations Modelled at Cabins - Mine and Rail Yard

Air Contaminant	Averaging Time	Assumed Background Concentration (µg/m³)	Mine Area		Rail Yard		Provincial Standard (µg/m³)[1]	CAAQS (µg/m³)[2]
			Maximum Predicted Concentration (µg/m³)	Background + Predicted (µg/m³)	Maximum Predicted Concentration (µg/m³)	Background + Predicted (µg/m³)		
TSP	24-hour	42	36	78	21	63	120	-
	Annual	21	1.62	22.62	3.34	24.3	60	-
PM_{10}	24-hour	17.5	28	46	18.7	36.2	50	-
$PM_{2.5}$	24-hour	8.75	13	22	7.48	16.2	25	-
NO_x	1-hour	0	93	93	44.1	44.1	400	79[3]
	24-hour	0	23	23	16.2	16.2	200	-
	Annual	0	1.05	1.05	0.48	0.48	100	28.2[4]
SO_2	1-hour	0	0.76	0.76	0.16	0.16	900	170[5]
	3-hour	0	0.38	0.38	0.13	0.13	600	-
	24-hour	0	0.053	0.053	0.058	0.058	300	-
	Annual	0	0.0011	0.0011	0.0012	0.0012	60	10.5[6]
CO	1-hour	0	314	314	7.77	7.77	35000	-
	8-hour	0	61	61	4.95	4.95	15000	-
As	24-hour	0.02	0.001850	0.02185	0.001120	0.02112	0.3	-
	Annual	0.02	0.000084	0.0200843	0.000174	0.020174	-	-
Cd	24-hour	0.00014	0.000031	0.0001713	0.000019	0.0001589	2	-
	Annual	0.000082	0.000001	0.00008343	0.000003	0.00008494	-	-
Cr	24-hour	0.0053	0.006760	0.01206	0.004070	0.00937	-	-
	Annual	0.0027	0.000308	0.003008	0.000634	0.003334	-	-
Cu	24-hour	NA	0.049800	4.98E-02	0.030000	3.00E-02	50	-
	Annual	NA	0.002270	2.27E-03	0.004670	4.67E-03	-	-
Pb	24-hour	0.0034	0.000498	0.003898	0.000300	0.0037	2	-
	Annual	0.0017	0.000023	0.0017227	0.000047	0.0017467	-	-
Ni	24-hour	0.32	0.001530	0.32153	0.000922	0.320922	2	-
	Annual	0.035	0.000070	0.0350697	0.000144	0.035144	-	-

Table 10.23 Maximum Concentrations Modelled at Cabins - Mine and Rail Yard

Air Contaminant	Averaging Time	Assumed Background Concentration (µg/m³)	Mine Area		Rail Yard		Provincial Standard (µg/m³)[1]	CAAQS (µg/m³)[2]
			Maximum Predicted Concentration (µg/m³)	Background + Predicted (µg/m³)	Maximum Predicted Concentration (µg/m³)	Background + Predicted (µg/m³)		
Se	24-hour	0.03	0.000352	0.030352	0.000212	0.030212	-	-
	Annual	0.03	0.000016	0.030016	0.000033	0.030033	-	-
U	24-hour	0.53	0.000164	0.530164	0.000099	0.5300987	-	-
	Annual	0.17	0.000007	0.17000746	0.000015	0.1700154	-	-
Zn	24-hour	0.057	0.003560	0.06056	0.002140	0.05914	120	-
	Annual	0.02	0.000162	0.020162	0.000334	0.020334	-	-

Notes:
1 Newfoundland and Labrador *Air Pollution Control Regulations*
2 2025 CAAQS
3 The average over a single calendar year of all the 1-hour average NO_2
4 The 3-year average of the annual 98th percentile of the NO_2 daily maximum 1-hour average concentrations
5 The average over a single calendar year of all the 1-hour average SO_2 concentrations
6 The 3-year average of the annual 99th percentile of the SO_2 daily maximum 1-hour average concentrations
Source: WSP 2015a

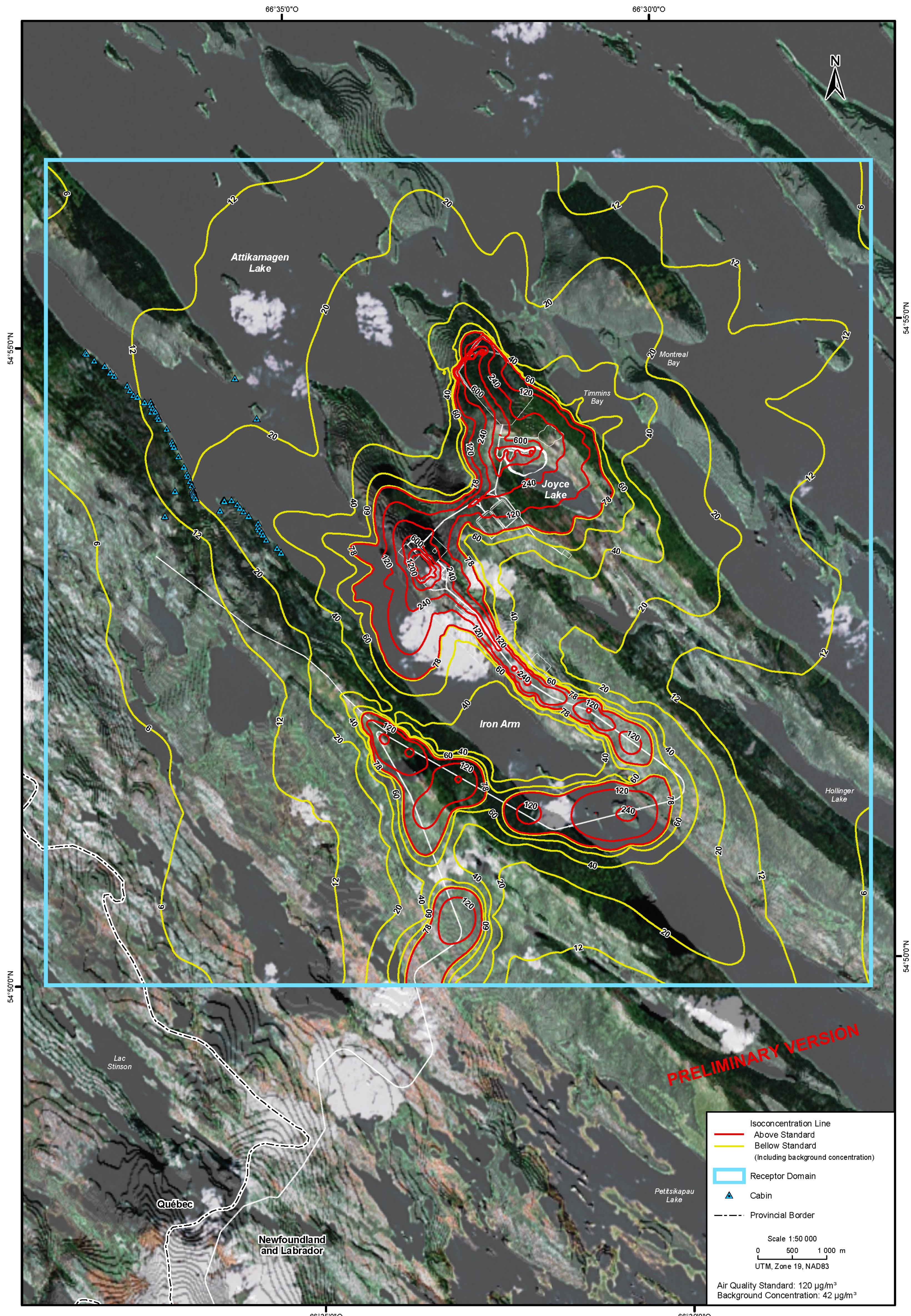


FIGURE TITLE: Maximum 24-hour Average TPM Concentration - Mine Area				
CLIENT: LABEC CENTURY IRON ORE INC.				
CHECKED BY:	FIGURE ID: 10.5	PROJECT NUMBER: 121810649	FIGURE SOURCES: WSP 2015. Joyce Lake Direct Shipping Iron Ore Project. Air Quality Modelling (Revision 1).	Stassinu Stantec Limited Partnership

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Figure 10.5 Maximum 24-hour Average TPM Concentration – Mine Area

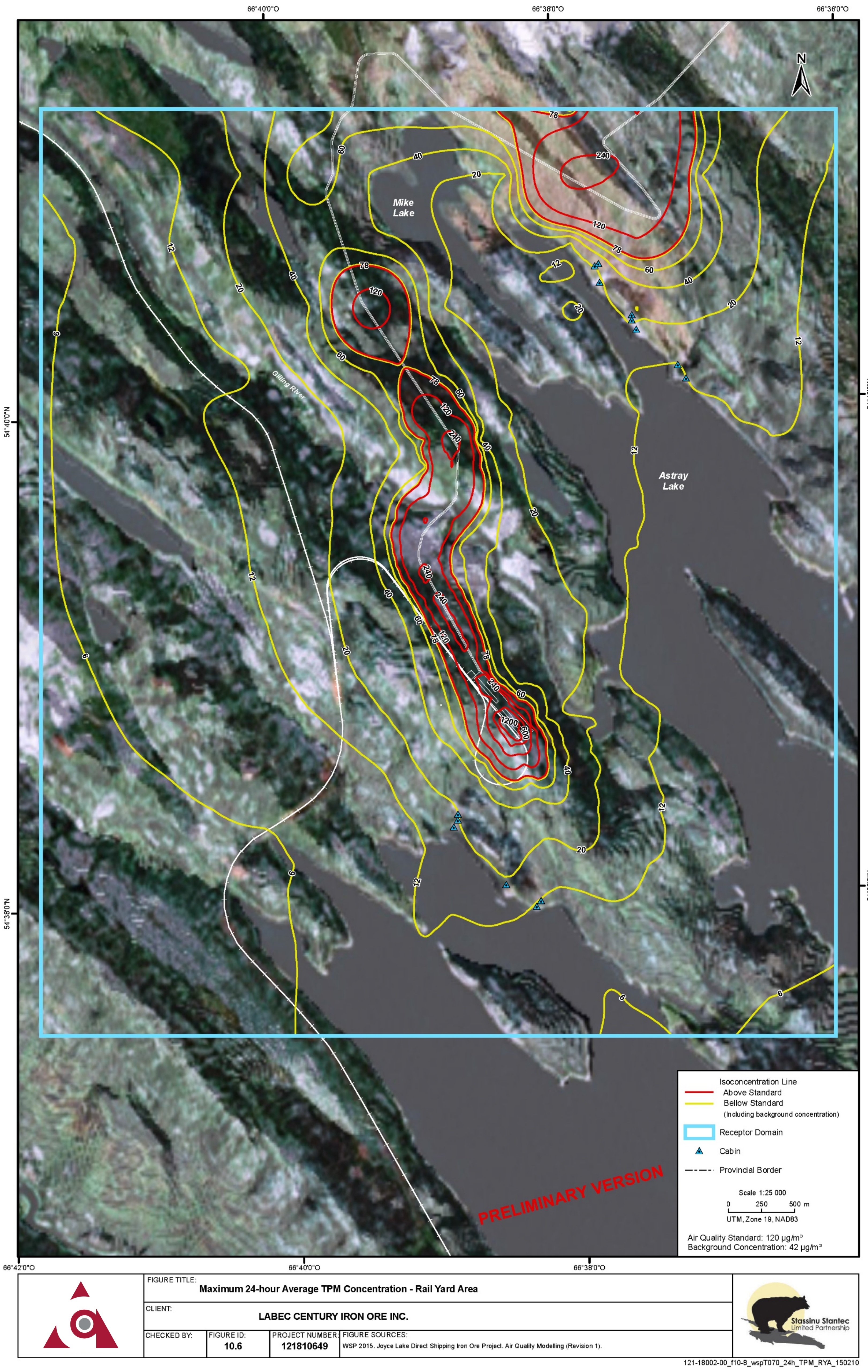

Figure 10.6 Maximum 24-hour Average TPM Concentration – Rail Yard Area

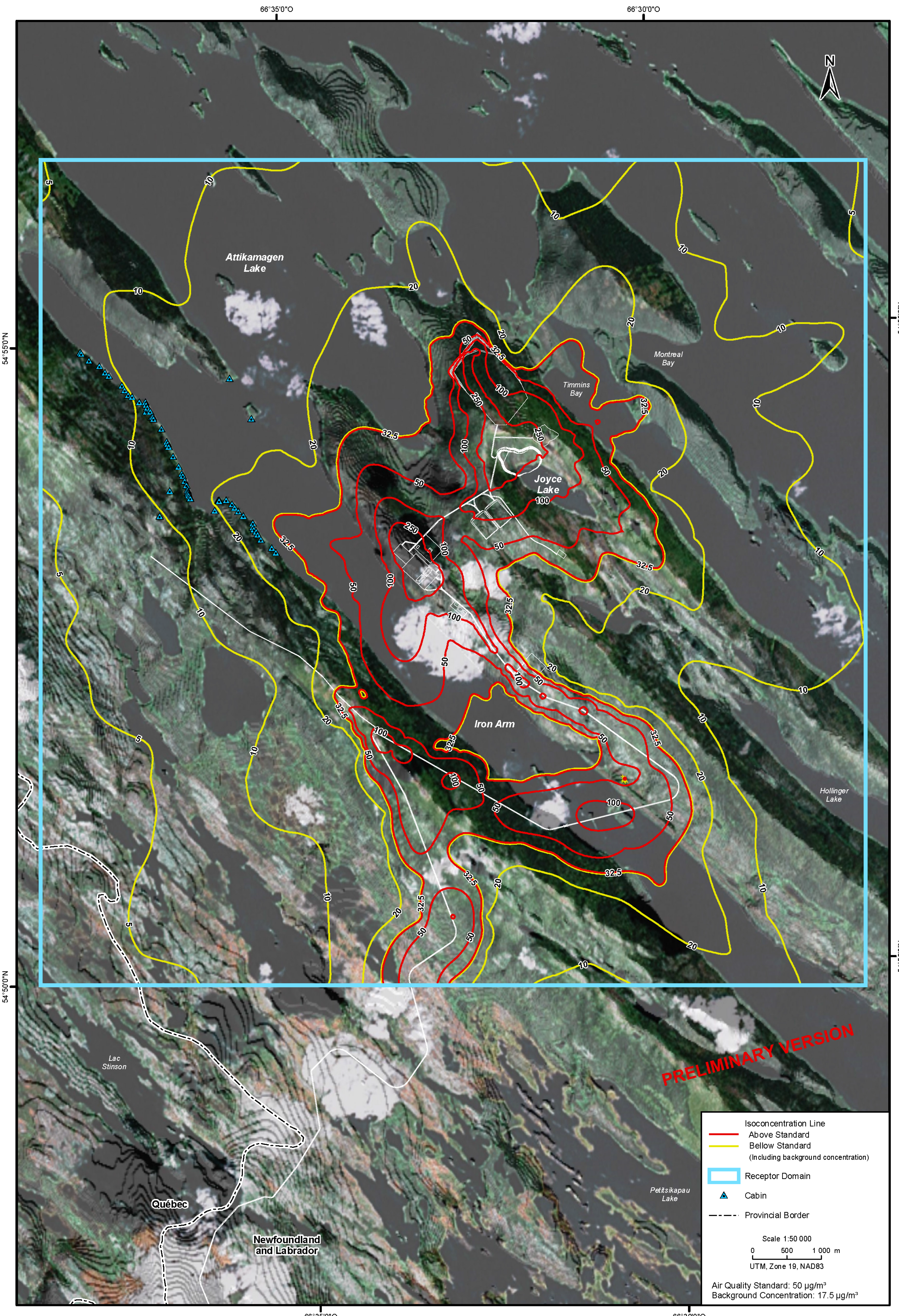

FIGURE TITLE: Maximum 24-hour Average PM_{10} Concentration - Mine Area			
CLIENT: LABEC CENTURY IRON ORE INC.			
CHECKED BY:	FIGURE ID: 10.7	PROJECT NUMBER: 121810649	FIGURE SOURCES: WSP 2015. Joyce Lake Direct Shipping Iron Ore Project. Air Quality Modelling (Revision 1).

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Figure 10.7 Maximum 24-hour Average PM_{10} Concentration – Mine Area