BACKGROUND AIR QUALITY INFORMATION
AND
CLIMATE DATA
FOR
THE PROPOSED WABUSH 3 MINE SITE
LABRADOR CITY, NEWFOUNDLAND AND LABRADOR

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1.0 AIR QUALITY

1.1. Labrador West Climate

Labrador West experiences a sub-Arctic, continental climate which is characterized by warm short summers and long cold winters.

The description of the climate for the region surrounding the proposed Wabush 3 Project site is based upon climate normals and climate extremes from the Wabush Lake A Station (Table 1.1) for 1971-2000 (EC, 2012a). The Wabush Lake A climate data are considered to be an accurate representation of average climate conditions for the assessment area. The Wabush Lake A Station is located at an elevation of 555.10 m asl with latitude 52° 55' 38.000" N and longitude 66° 52' 27.000"W and is approximately seven km from the proposed Project site. The highest area of the Project site is just east of the crest of Smokey Mountain at an elevation of 840 m asl.

1.1.1 Temperature

Winter temperatures in Labrador are extremely cold and summers are warm. Daily average temperatures range from a low of -22.7°C in the month of January to a high of 13.7°C for the month of July. The extreme maximum and minimum temperatures recorded are 33.3°C and -28.4°C, recorded during June and January, respectively (EC, 2012a).

While the climate normals show monthly averages of daily temperatures to be below freezing from October to April, temperatures do fluctuate above freezing and rainfall has been recorded in all months of the year. Similarly snow has been recorded at the Wabush weather station in all months except July.

Table 1.1: Monthly Climate Normals for Wabush Lake A (1971 – 2000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature												
Daily Average (°C)	-22.7	-20.7	-13.5	-4.6	3.6	10.3	13.7	12.4	6.8	-0.4	-8.6	-18.6
Standard Deviation	2.6	3.4	3.3	2.4	1.8	1.6	1.1	1.2	1.5	1.7	2	3.1
Daily Maximum (°C)	-17	-14.2	-7	0.9	8.8	15.9	18.9	17.5	10.8	2.9	-4.7	-13.5
Daily Minimum (°C)	-28.4	-27.1	-20	-10.1	-1.8	4.6	8.5	7.3	2.8	-3.7	-12.4	-23.6
Extreme Maximum (°C)	14.3	6.2	14.7	16.7	28.4	33.3	32.6	30.6	27.8	21.1	12.2	5.6
Date (yyyy/dd)	1999/15	1981/24	1999/29	1984/28	2001/27	1983/16	2002/01	1976/21	1999/02	1961/08	1967/03	1973/18
Extreme Minimum (°C)	-43.9	-47.8	-46.7	-37.2	-21.7	-11.1	-6.7	-0.6	-7	-21.7	-33.1	-46.1
Date (yyyy/dd)	2002/30	1973/17	1964/10	1969/07	1963/02	1961/30	1961/07	1965/26	1993/30	1962/31	1986/20	1964/21
Precipitation												
Rainfall (mm)	0.5	1.6	3.1	11.9	40.4	82.3	111.5	95.4	89.3	36.9	6.8	2.9
Snowfall (cm)	66.4	48.7	64.8	52.5	16.5	2.6	0	0.1	6.8	42	75.3	70.2
Precipitation (mm)	54	41.7	57.4	56.7	55.8	84.8	111.5	95.4	95.8	73.5	68.2	56.8
Extreme Daily Rainfall (mm)	7.6	12.6	11.7	16.2	46.7	39.4	61.4	45.6	48.8	23.6	36.1	11.7
Date (yyyy/dd)	1996/19	1996/25	1976/21	1983/25	1964/25	1978/13	1981/21	1991/17	1972/04	1991/25	1967/24	2000/18
Extreme Daily Snowfall (cm)	34.4	36.3	35	32	21	10	0.3	1	23.9	33.2	47.5	53.7
Date (yyyy/dd)	1995/15	1995/05	1998/03	2000/09	1980/09	1990/05	1969/07	1986/30	1963/30	2003/23	1971/10	1980/03
Extreme Daily Precipitation (mm)	36.6	34.5	36.3	27.2	46.7	39.7	61.4	45.6	48.8	34.3	43.4	39.6
Date (yyyy/dd)	1983/11	1976/02	1999/10	1989/07	1964/25	1978/13	1981/21	1991/17	1972/04	1964/21	1971/10	1971/11
Extreme Snow Depth (cm)	218	211	193	201	164	4	0	0	10	49	122	170
Date (yyyy/dd)	1969/11	1969/12	1964/31	1982/22	1982/01	1994/01	1961/01	1961/01	1980/30	2003/30	1964/26	1968/26
Days with Rainfall												
>= 0.2 mm	0.45	0.7	1.5	3.9	11.5	16.3	19.4	19	18.8	8.9	3	104.2
>= 5 mm	0	0.1	0.13	0.97	2.8	5.5	7.3	6.4	5.9	2.6	0.29	0.23
>= 10 mm	0	0.03	0.03	0.2	0.93	2.5	3.5	2.8	2.8	0.93	0.18	0.07

Table 1.1: Monthly Climate Normals for Wabush Lake A (1971 – 2000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
>= 25 mm	0	0	0	0	0	0.37	0.47	0.4	0.23	0	0.04	0
Days With Snowfall												
>= 0.2 cm	17.5	14.4	16.1	13.3	6.1	1.4	0.03	0.07	3.4	15.5	19.5	19.2
>= 5 cm	4.2	3	4.2	3.5	0.93	0.17	0	0	0.3	2.6	4.8	4.5
>= 10 cm	1.4	1	1.8	1.6	0.27	0.03	0	0	0.03	0.76	2	1.6
>= 25 cm	0.18	0.10	0.20	0.10	0	0	0	0	0	0	0.21	0.23
Days with Precipitation:												
>= 0.2 mm	17.5	14,4	16.3	15.1	14.7	16.9	19.4	19	20.3	20.2	20	19
>= 5 mm	3.3	2.4	3.6	4	3.9	5.7	7.3	6.4	6.4	4.9	3.9	3.3
>= 10 mm	0.93	0.73	1.5	1.7	1.6	2.6	3.5	2.8	2.9	1.7	1.6	1.3
>= 25 mm	0.14	0.10	0.13	0.07	0.07	0.37	0.47	0.40	0.27	0.03	0.18	0.17
Degree Days												
Above 24 °C	0	0	0	0	0	0.1	0.1	0	0	0	0	0
Above 18 °C	0	0	0	0	0	3.5	4.9	3.5	0.3	0	0	0
Above 15 °C	0	0	0	0	0.4	11.9	24	17	1.5	0	0	0
Above 10 °C	0	0	0	0	6.3	59.1	121.2	90.1	15.6	0.3	0	0
Above 5 °C	0	0	0.1	1.4	34.8	164.7	270.6	230.5	78.6	5.4	0.4	0
Above 0 °C	0.1	0.4	2.7	19.4	125.8	308.6	425.6	385.2	206.1	43.7	4.1	0.1
Below 0 °C	702.4	585.2	421.7	151.7	15.6	0.1	0	0	1.1	55.7	263.5	576.7
Below 5 °C	857.3	726.1	574.1	283.7	79.7	6.2	0	0.3	23.5	172.4	409.8	731.6
Below 10 °C	1012.3	867.5	728.9	432.3	206.2	50.7	5.6	14.9	110.5	322.3	559.4	886.6
Below 15 °C	1167.3	1008.8	883.9	582.3	355.3	153.4	63.4	96.7	246.4	477	709.4	1041.6
Below 18 °C	1260.3	1093.6	976.9	672.3	447.9	235	137.3	176.2	335.2	570	799.4	1134.6

Table 1.2: Monthly Climate Normals for Wabush Lake A (1971 – 2000) – Wind[1]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind												
Speed (km/hr)	14	14.5	15.7	15	13.9	14.3	13.5	13.3	14.9	15.8	15.1	13.3
Most Frequent Direction	W	W	W	N	N	N	S	SW	W	S	W	W
Maximum Hourly Speed (km/hr)	72	65	59	60	61	64	56	51	55	65	80	65
Date (yyyy/dd)	1965/09	1979/14	1987/06	1963/01	1976/04	1967/23	1975/08	1965/06	1965/11	2002/14	1965/15	1991/01
Direction of Maximum Hourly Speed	W	NW	W	W	W	W	W	NW	SW	NW	W	W
Maximum Gust Speed (km/hr)	111	130	89	87	78	87	113	130	94	102	104	89
Date (yyyy/dd)	1982/18	1991/06	1971/05	1963/01	1989/19	1967/23	1969/17	1991/27	1980/30	2002/05	1991/30	1979/18
Direction of Maximum Gust	S	W	NE	W	W	W	W	W	W	W	W	NW

Note: (1) Source: EC, 2012a.

1.1.2 Precipitation

The average annual precipitation in the assessment area is 851.2 mm with rain accounting for approximately 55% of the total. Precipitation is greater in the summer compared to the rest of the year, with almost half of the precipitation falling in the June to September period.

The extreme daily precipitation recorded between 1971 and 2000 was 61.4 mm, which occurred in July (Table 1.1). Total monthly precipitation ranges from 41.7 mm in February to 111.5 mm in July (EC, 2012a).

1.1.3 Fog and Sunshine

Each year there is an average of 13 days with fog at Wabush Lake. In general, fog is present one day a month spread out over the year (EC, 1993).

On average, the total number of sunshine hours per year is 7098. July and August are the sunniest months. On average, measureable sunshine occurs on 285 days per year at Wabush Lake (The Weather Network, 2012).

1.1.4 Winds

The prevailing winds are westerlies with an average wind speed of 14.4 km/hr over the year. Winds prevail from the north for the months of April, May and June (Table 1.2). The average monthly wind speed is fairly consistent throughout the year ranging from a low monthly average of 13.3 km/hr in August and December to a high of 15.8 km/hr in October. The maximum gust over the 30 year period was 130 km/hr during two months; from the west direction during the month of February, 1991 and from the west direction during August, 1991 (EC, 2012a).

2.0 REGIONAL AIR QUALITY BASELINE

There exists a significant amount of air quality information for the Labrador City and Wabush area resulting from ambient air monitoring programs operated by the Iron Ore Company of Canada (IOC) and Wabush Mines since the 1990s. In 1998, IOC established four monitoring stations throughout Labrador City in consultation with the Department of Environment and Conservation. The monitoring program included sampling on a 6 day National Air Pollution Surveillance (NAPS) schedule for total particulate matter (TPM), particulate matter less than 2.5 microns ($PM_{2.5}$) and sulfur dioxide (SO_2). In late 2010, IOC undertook a major upgrade of this network which included monitoring for more pollutants on a continuous basis, the addition of new monitoring locations and the relocation of existing ones. The upgraded program also includes monitoring for nitrogen oxides (NOx) and meteorological information from two new meteorological stations. The monitoring stations are located near Smokey Mountain, Indian Point, Town Depot / Tamarack Drive, Bartlett Drive and Hudson Drive as identified in Figure 1.1. Similarly, Wabush Mines has a monitoring program established in Wabush with three monitoring stations located at Bond Street, Shea Street and the Wabush Substation.

The air quality monitoring network helps track changes in air quality in Labrador City and Wabush. Government regulatory agencies have real-time access to the air monitoring data to ensure compliance with air quality standards.

The following sections provide a discussion on the sources of criteria air contaminants in Labrador West and a summary of ambient air monitoring results for the two programs. In addition, results for a comprehensive dispersion modeling study performed for the IOC operations are also summarized.

2.1. Sources of Criteria Air Contaminant Emissions

The examination of existing releases of air contaminants from local sources in the assessment area serves as a benchmark for comparing the emissions related to the proposed Wabush 3 Project and to assist in the assessment of cumulative environmental effects. These existing releases of air contaminants are generally classified into two categories: criteria air contaminants (CACs) and greenhouse gases (GHGs). CACs include particulate matter, SO_2, NOx, and CO. Greenhouse gases and climate change are discussed in Section 3.0.

There are two main communities located in the vicinity of the proposed Wabush 3 Project location: the Town of Labrador City (borders the IOC property to the south) with a 2011 population of 7,367, and the Town of Wabush (approximately five km to the south-southeast) with a 2006 population of 1,861. Both communities were built in the early 1960's to accommodate the employees of IOC and Wabush Mines.

Since the mid 1950s the regional economy has been based on mineral extraction, processing and services to the mining and exploration sectors. Iron ore mining is the primary industrial base for both towns. There are approximately 250 businesses operating in Labrador West, many of which service the mining companies (New Millennium Iron, 2012).

The municipalities are serviced by a regional airport. They are also connected by rail to Schefferville and Sept-Îles, and by road to central Labrador to the east and to Québec (Baie-Comeau) to the south.

The main industrial sources that are located close to the IOC property include Wabush Mines, which is located approximately four km to the south of the IOC property, and another IOC operation, the Plateau dolomite quarry, which is located on the eastern side of Wabush Lake approximately four km from the IOC property. The operation of IOC contributes emissions to the airshed from mining, concentrating and pelletizing of the ore, tailings disposal and handling and transport of the pellets and concentrate. The Wabush Mines operation is similar with the exception that it does not have a pellet plant. Table 2.1 provides a list of typical sources of CAC emissions from iron ore operations:

Table 2.1: Sources of CAC Emissions – Iron Ore Mining

Source of Emissions	Type of Emission
Use of large trucks and excavators to mine iron ore	Particulate, NO_2, SO_2 and CO
Blasting	Particulate, NOx and SO_2
Fugitive emissions from active quarries and tailings piles	Particulate
Rock crushers	Particulate
Concentrator Plants	Particulate, metals, NO_2, SO_2 and CO
Pelletizing Plants	Particulate, metals, NO_2, SO_2 and CO
Transport – Rail	Particulate, NO_2, SO_2 and CO
Use of smaller service trucks onsite	Particulate, NO_2, SO_2 and CO

IOC has some challenges with air quality, with the main contributor being the pelletizing operation. IOC has realized improvements in air quality over the past 20 years with the following pollution abatement projects:

- A significant reduction in particulate emissions with the decommissioning of ten dry aerofall autogenous mills and their replacement with three wet grinding mills in the concentrator building.
- Significant reduction in fugitive dust from the tailings disposal area through its annual rehabilitation program that includes re-vegetation of the sections of the tailings disposal area that have become inactive.
- Dust management improvements in the pellet plant loadout area where the installation of a dust suppression system has mitigated the fugitive dust issue in that area.

In addition to emissions originating from mining operations located around the Labrador City – Wabush area, the communities and the general area contain anthropogenic and natural sources that produce similar types of emissions to those emitted from the mining operations. While emissions from these sources have not been quantified, they do contribute to the ambient air quality results as measured in the communities. A reconnaissance by AMEC staff in the Towns of Labrador City and Wabush in July and August observed the following sources:

- Vehicle emissions: A large proportion of personal vehicles in the communities are heavy duty pick-up trucks. These and other vehicles, including commercial and industrial trucks will contribute emissions to the environment from both vehicle exhaust and from road dust creation on non-site related dirt roads;
- Particulate sources: A noticeable amount of fine sand was observed on paved roads in Labrador City and Wabush which likely originated from a combination of dustfall from the mine site operations; dustfall from several construction projects in the area; and dust from unpaved roads located in the general area. The combination of these sources, coupled with dry and windy weather conditions, will contribute to particulate levels in the communities.
- Airport exhaust: The operation of the local airport that is located close to both communities will contribute exhaust emissions to the airshed.
- Forest fires: The occurrence of forest fires in western Labrador and nearby Quebec is a source of air pollutants that can impact a large area.

It was noted that it appears most of the residences in Labrador West are space heated by electricity and not fossil fuels. The use of electricity will result in less particulate, PAH, NO_x and SO_2 emissions to the airshed compared to areas that heavily use fossil fuels (oil) to space heat residences.

There are other planned or operating mines located in western Labrador and in Quebec, close to the western Labrador border. Operating mines include an open pit mine at Mont-Wright, Quebec operated by ArcelorMittal Mines Canada (30 km from IOC) and an open pit mine near Bloom Lake in Quebec operated by Cliffs Natural Resources Inc. (25 km from IOC). In addition, there are a number of iron ore claims that could possibly result in future operation of open pit mines, including Alderon Iron Ore Corporation’s Kami project (20 km from IOC) which is currently in the Provincial and Federal Environmental Assessment processes.

The following section provides a discussion on each of the existing and potential mining operations near the IOC property.

IOC's Plateau Dolomite Quarry

IOC has mined dolomite for making fluxed pellets in Labrador West since 1986. In 2009, the company started mining at the Plateau dolomite quarry near the Javelin Road. In 2011, production was 135,000 tonnes. Forecast production for 2012 is 160,000 tonnes (NLDNR, 2012).

Wabush Mines

Wabush Mines started mining ore from the Scully Mine in Labrador in 1965. The mine is still operating and produces ore for a concentrator plant at Wabush and a pellet plant and shipping facilities in Point Noire, Quebec. Wabush Mines is 100% owned and operated by Cliffs Natural Resources Inc. Its annual production is approximately 3.2 million tonnes of iron concentrate and, depending on market conditions, will gradually increase production to 5 million tonnes annually over the next four to five years. Substantial ore resources at the mine contain manganese in quantities that make the resulting iron concentrates unattractive to steel plant customers. Wabush mines is addressing this problem by installing mill components that reduce the manganese content in the final ore concentrate to an acceptable level. The final plant reconfiguration will likely require 4 to 6 independent manganese reduction circuits. Two circuits were installed at the end of 2011. The manganese reduction program could help extend the mine life beyond 2030 (NLDNR, 2012).

ArcelorMittal Mines Canada

ArcelorMittal Mines Canada operates one of the largest open pit mines in North America as well as an iron ore concentrator plant in Mont-Wright, Quebec, which is located approximately 30 km to the southwest of Labrador City. Its annual concentrate production ranges from 13 to 19 million tonnes (NLDNR,2012).

Cliffs Natural Resources Inc. - Quebec

In addition to Wabush Mines, Cliff Natural Resources Inc. operates an iron ore mine and concentrator plant near Bloom Lake in Quebec, which is located approximately 25 km to the west of Labrador City. Its annual concentrate production is 8 million tonnes (NLDNR, 2012).

Alderon Iron Ore Corp.

The proposed Kami iron ore mine and concentrator is located approximately 20 km south of the Wabush 3 Project. It is currently within Environmental Assessment processes of the Provincial and Federal governments. It is proposed to produce 8 million tonnes per year of concentrate upon startup and eventually increase production to 16 million tonnes per year (Alderon Iron Ore, 2012).

2.2. Emission Inventories

This section provides a summary of CAC emissions for all sources in Newfoundland and Labrador (Table 2.2) and for major regulatory permitted industrial sources (Table 2.3) in the area that submit emissions information to the National Pollutant Release Inventory (NPRI). The NPRI is a legislated, nation-wide, publicly accessible inventory of pollutants released, disposed of, and recycled by facilities in Canada. Facilities which meet reporting requirements are required to report to the NPRI under the *Canadian Environmental Protection Act* (CEPA).

Table 2.2: NPRI 2010 CAC Emissions of Newfoundland and Labrador (tonnes)

Category	TPM	PM_{10}	$PM_{2.5}$	SO_2	NOx	VOC	CO	NH_3
Industrial Sources	18,441	4,107	1,689	23,470	13,195	7,884	9,918	33
Non Industrial Fuel Combustion	5,589	5,065	4,960	5,612	4,913	7,543	29,259	77
Transportation	2,683	2,601	2,360	15,835	33,990	9,319	108,789	383
Incineration	362	350	325	7	8	178	534	1
Open Sources	185,613	46,402	8,529	16	44	734	423	451
Total	218,009	63,071	21,627	44,946	54,672	510,409	191,686	1,063

Note: (1) Extracted from NPRI 2010 (EC, 2012b).

Table 2.2 indicates that the majority of particulate matter and NH_3 emissions in the province originate from open sources. Open sources include agriculture, construction activities, paved and unpaved roads, forest fires, landfill sites, mine tailings, and prescribed burning. Industrial sources emitted the most SO_2 followed by transportation sources. Transportation sources generated the most NOx and CO for the Province. Transportation sources include air and marine transportation, diesel and gas vehicles and rail transportation (EC, 2012b).

Table 2.3 provides a summary of CAC emissions from regulatory permitted point sources in the area.

Table 2.3: Emissions from Permitted Point Sources in the Immediate Assessment Area - 2010

Source	Criteria Air Contaminant Emissions (tonnes/year)					
	CO	NO_X(1)	SO_2	TPM	PM_{10}	$PM_{2.5}$
Iron Ore Company of Canada - Carol Project (5013)	6,757	5,298	7,488	10,267	2,384	655
Wabush Mines - Scully (5460)	215	234	197	1,946	484	291
Town of Wabush – Incinerator (5622)(2)	103	-	-	65	65	60

Note: (1) Nitrogen oxides (expressed as NO_2).
(2) The Town of Wabush incinerator was permanently closed in June of 2010.
(3) "—" denotes emissions not present.
(4) Source: Extracted from NPRI 2010 (EC, 2012b).

In 2010 there were three industrial sources in the immediate assessment area: IOC, Wabush Mines and the Town of Wabush Incinerator. The Town of Wabush Incinerator was permanently closed in June of 2010. A comparison of the NPRI total CAC emissions for Newfoundland and Labrador (Table 2.2) with CAC emissions from the existing IOC operations indicates that IOC emissions represent 4.7% of the total particulate emissions; 3.8% of the particulate matter less than 10 microns (PM_{10}) emissions; 3% of the particulate matter less than 2.5 microns ($PM_{2.5}$); 16.7% of the SO_2 emissions; 9.7% of the NO_x emissions and 3.5% of the CO emissions for the Province (EC, 2012b).

The NPRI also reports emissions that are not CACs. For the Newfoundland and Labrador and the Labrador City area, the NPRI reports on metals emissions for IOC and Wabush Mines.

Table 2.4 summarizes metals emissions for both Newfoundland and Labrador and industrial sources in the Labrador City area.

Table 2.4: NPRI 2010 Metals Emissions of Newfoundland and Labrador (tonnes)

Category	Arsenic	Lead	Cadmium	Manganese
Industrial Sources	-	2021.5	66.9	-
Iron Ore Mining	-	1,904.0(2)	51.4	-
Non Industrial Fuel Combustion	-	134.4	20.6	-
Transportation	-	696.8	14.0	-
Incineration	-	6.5	0.9	-
Open Sources	-	-	-	-
Total	-	2,859.2	102.4	-

Note: (1) Extracted from NPRI 2010 (EC, 2012b).
(2) The estimated emissions for iron ore mining is included in the estimated emissions value provided for industrial sources.

Table 2.4 indicates that the majority of lead and cadmium emissions in the Newfoundland and Labrador originate from industrial sources.

Table 2.5 provides a summary of metals emissions from regulatory permitted point sources in the Labrador City-Wabush area.

Table 2.5: Metals Emissions from Permitted Point Sources in the Immediate Assessment Area - 2010

Source	Criteria Air Contaminant Emissions (tonnes/year)			
	Arsenic	Cadmium	Lead	Manganese
Iron Ore Company of Canada - Carol Project (5013)	1,048	50	1,890	21
Wabush Mines - Scully (5460)	14	1	14	4.9

Note: (1) Source: Extracted from NPRI 2010 (EC, 2012b).

Although arsenic and manganese are not reported in the Provincial totals (Table 2.4), these metals are reported, along with cadmium and lead, for both IOC and Wabush Mine facilities (EC, 2012b).

2.3. Ambient Air Quality Monitoring

2.3.1. Ambient Air Quality Criteria

Table 2.6 shows the applicable federal and objectives and provincial regulatory standards relating to ambient air quality.

The Government of Canada (2004) National Ambient Air Quality Objectives (NAAQO) are based on a three-tier structure and defined as follows:

The Maximum Desirable Level is the long-term goal for air quality and provides a basis for an anti-degradation policy for unpolluted parts of the country and the continuing development of control technology.

The Maximum Acceptable Level is intended to provide adequate protection against effects on soil, water, vegetation, materials, animals, visibility, personal comfort and well-being.

The Maximum Tolerable Level denotes time-based concentrations of air contaminants beyond which, because of a diminishing margin of safety, appropriate action is required to protect the health of the general population.

The Canadian Council of Ministers of the Environment (CCME) has developed a Canada-Wide Standard (CWS) for $PM_{2.5}$ of 30 μg/m^3, based on a 24-hour average over three consecutive years. The CWS is to be achieved by 2010 (CCME, 2000).

Newfoundland and Labrador has established ambient air standards for ambient air quality under the *Air Pollution Control Regulations, 2004*, *Environmental Protection Act* .

Table 2.6: Federal and Provincial Ambient Air Quality Criteria

Pollutant	Averaging Time Period	NEWFOUNDLAND AND LABRADOR	Canada			
		Ambient Air Regulatory Standards(1)	Canada Wide Standards(2)	Ambient Air Quality Objectives(3)		
				Maximum Desirable	Maximum Acceptable	Maximum Tolerable
Nitrogen Dioxide (μg/m^3)	1 hour	400	-	-	400	1000
	24 hour	200	-	-	200	300
	Annual	100	-	60	100	-
Sulphur Dioxide (μg/m^3)	1 hour	900	-	450	900	-
	3 hour	600	-	-	-	-
	24 hour	300	-	150	300	800
	Annual	60	-	30	60	-
Total Particulate Matter (μg/m^3)	24 hour	120	-	-	120	400
	Annual	60	-	60	70	-
PM_{10} (μg/m^3)	24 hour	50	-	-	-	-
$PM_{2.5}$ (μg/m^3)	24 hour	25	30	-	-	-
Carbon Monoxide (μg/m^3)	1 hour	35,000	-	15,000	35,000	-
	8 hour	15,000	-	6,000	15,000	20,000

Note: (1) Source: Government of Newfoundland 2004.
(2) Source: CCME 2000.
(3) Source: NLDOEC 2004

In October 2012 jurisdictions, with the exception of Quebec, agreed to begin implementing a new air quality management system (AQMS). AQMS is a comprehensive approach for improving air quality in Canada and is the product of collaboration by the federal, provincial and territorial governments and stakeholders. It includes:

- New Canadian Ambient Air Quality Standards (CAAQS) to set the bar for outdoor air quality management across the country;

- Industrial emissions requirements that set a base of performance for major industries in Canada;
- A framework for air zone air management within the provinces and territories that enables action tailored to specific sources of air emissions in a given area;
- Regional airsheds that facilitate coordinated action where air pollution crosses a border; and
- Improved intergovernmental collaboration to reduce emissions from the transportation sector.

The CAAQS will be established as objectives under the *Canadian Environmental Protection Act 1999*, and will replace the existing Canada-Wide Standards under CCME. Standards for fine particulate matter and ground-level ozone have been developed and work has begun on standards for NO_2 and SO_2. Table 2.7 provides a list of the CAAQS fine particulate matter and ozone standards.

Table 2.7: Canadian Ambient Air Quality Standards (CAAQS) for Fine Particulate Matter ($PM_{2.5}$) and Ozone

Pollutant	Averaging Time	Standards (numerical values)		Metric
		2015	2020	
$PM_{2.5}$	24-hour (calendar day)	28 µg/m^3	27 µg/m^3	The 3-year average of the annual 98th percentile of the daily 24 hour average concentrations.
$PM_{2.5}$	Annual (calendar year)	10 µg/m^3	8.8 µg/m^3	The 3-year average of the annual average concentrations.
Ozone	8-hour	63 ppb	62 ppb	The 3-year average of the annual 4th highest daily maximum 8 hour average concentrations.

Note: (1) Extracted from CAMS, A Proposed Framework to Improve Air Quality Management. 2012.

Under the new AQMS there is a Comprehensive Air Management System (CAMS) that is designed to address the challenges of air quality management, including cross-jurisdictional issues, and deliver a Canada-wide approach that provides flexibility to deal with regional differences in air quality issues while, at the same time, ensuring a level of consistency so that Canadians can be assured of good air quality outcomes.

For industry, CAMS proposes establishing base-level industrial emissions requirements (BLIERS) in major industrial sectors, initially for SO_2, NOx, VOCs and TPM. Eventually other pollutants will be addressed. BLIERS are intended to ensure that all significant industrial sources in Canada, regardless of where facilities are located, meet a good base-level of environmental performance. Over time, this will result in reducing emissions and improving air quality. Wherever possible, the BLIERS would build on existing pollution controls, agreements and protocols that assure the appropriate standard of emissions performance.

The BLIERS would be based on what leading jurisdictions inside or outside Canada are requiring of industry in "attainment" areas, adjusted as needed for Canadian circumstances.

More stringent industrial requirements could be imposed where needed as part of managing all sources of pollution in air zones.

BLIERS would be set as quantitative performance requirements, with qualitative requirements being adopted on an exceptional basis, including in sectors where quantitative standards were not feasible. BLIERS would apply to new and existing facilities. However, existing facility requirements might initially be less stringent than requirements for new facilities, due to the more complex and costly demands of performance improvement in existing plants. New facilities would have to meet their BLIERS beginning the first day of operation. Existing facilities would be expected to meet the BLIERS for their sector by a specified date.

Implementation would begin in 2015. Achieving that goal for new and existing facilities would require finalizing the standards early enough to give industry sufficient lead time for necessary capital planning and replacement.

BLIERS would be set under a federally lead, time-limited federal/provincial/territorial consensus process, with stakeholder involvement, and will be reviewed regularly to ensure they reflect technological improvements.

Foundational work was undertaken for the development of BLIERS for a number of industrial sectors. One sector is the iron ore pelletizing and Table 2.8 provides a summary of the work done to date. Significant work still remains to be done in achieving agreement on preliminary BLIERS, validating them and determining additional BLIERS (CAMS, 2010).

The iron ore pelletizing sector comprises facilities engaged in the production of iron ore pellets from iron ore concentrate and includes processes for the addition and blending of additives. BLIERS development focused on existing facilities as no new growth is expected in the sector by 2015. Domestic and international benchmarks in line with world class standards were reviewed. SO_2 reductions are focused on reducing sulphur content in fuels. Part of industry's concern regarding SO_2 was that jurisdictional analyses did not consider different fuel types (natural gas versus heavy fuel). No consensus for NOx BLIER could be reached as NOx formation in the process was not clearly understood. Industry will continue to research TPM and $PM_{2.5}$.

2.3.2. Ambient Air Quality Monitoring Historical Data

IOC and Wabush Mines have ambient air quality monitoring programs with monitoring stations established throughout both Labrador City and Wabush. Details of both monitoring programs are given in Section 2.0.

Table 2.9 provides a summary of TPM, $PM_{2.5,}$ SO_2 and NO_2 data for the calendar year of 2011 for all monitoring sites in Labrador City and Wabush. As shown in Table 2.9, not all parameters are monitored at all of the nine sites. Three of the IOC stations (Indian Point, Smokey Mountain and Town Depot) monitor for TPM, $PM_{2.5}$, SO_2 and NO_2. The other three IOC stations monitor TPM only. The three Wabush stations monitor as follows - Bond Street station for SO_2 and $PM_{2.5}$, Shea Street station for TPM and Substation station for TPM and $PM_{2.5}$. Reference method sampling for TPM is performed on a 6 day NAPS schedule at the following locations: Bartlett Drive, Hudson Drive, Tamarack Drive, Vanier Street, Shea Street, and the Substation. The remaining stations measure TPM using BAM units that measure TPM continuously in real time. The Town Depot/Tamarack Drive location measures TPM with both methods. Figure 2.1 provides a plan view of the station locations and the various sources of CACs at both IOC and

Table 2.8: Iron Ore Pelletizing BLIER

CAC	Industry Contribution 2006 CAC	Subsector and/or Sources	Preliminary BLIER	% of Sector Emissions Covered by BLIER	% of Sector Emissions Not Covered as of March 2010	Emissions Reductions from 2006 Baseline	Reduction from Industrial Contribution 2006 CAC	Basis of BLIER	Comments/ Recommendations
SO_2	2%	Induration (thermal treatment machine stacks)							
		Liquid Fuels	Fuel based standard, facility level 1.5% sulphur content by 2012 as a national standard required of all Canadian Industry	30%		4%	<1%	Proposed QC regulation and proposed improvements international bench marks	Consensus on incremental reduction in sulphur content but not on timeframe. Effect on induration process must be verified.
		Solid Fuels			50%				No consensus achieved if BLIER should be developed. Availability of low sulphur fuels and impact on process needs research.
		Other Sources			20%				
NOx	2%	Induration Machine Stacks			100%				No consensus on form of BLIER. Data required to determine if quantitative BLIER possible.
TPM	1%								
		Induration Machine Stacks	Range from 75 g/t (QC) to greater than 200 g/t (NL)	>90%				QC existing and proposed regulation	No consensus achieved on TPM. Engineering studies are underway.
		Fugitive and Other Sources			<10%				

Wabush Mines. Also included is the site of the Town of Wabush incinerator which was shut down in June 2010.

The reference method high volume samplers collect samples over a 24 hour period every 6 days. These samplers differ from the Met One Model BAM1020 Beta Attenuation unit since they sample particulate on a filter which is sent to an analytical laboratory for gravimetric analysis, while the BAM unit measures particulate in real time continuously by capturing particulate on tape and converting a beta-ray signal to a particulate concentration. The advantage to the using the BAM unit is measurements can be provided in real time and data can be continuously collected. The USEPA considers use of the BAM unit as an equivalent method to the reference method for determining the 24 hour average concentration of PM_{10}. The USEPA does not provide an equivalency method designation for TPM or $PM_{2.5}$.

The monitoring station locations were chosen by the two mining companies in consultation with the NL Department of Environment and Conservation and their placements are based on emissions modelling analyses. Information on each station is provided:

- The IOC Smokey Mountain station location is a wooded area near Beverly Lake which has the Route 500 Trans Labrador Highway located 100 m to the south; the IOC concentrator and pelletizing plants located approximately two km to the east; and the center of Labrador City located approximately one km to the south. It is also the closest station to the proposed Wabush 3 project, within three km of the center of the open pit.
- The IOC Indian Point station location is on the southern edge of Labrador City close to Little Wabush Lake, approximately three km to the southwest of the IOC concentrator and pelletizing plants; two km to the north of the Wabush Mines open pit area and three km to the north of the Wabush Mines concentrator plant. This is the closest station to an operating open pit.
- The IOC Town Depot station is located on the south eastern edge of Labrador City, close to Little Wabush Lake. It is located approximately two km to the south of the IOC concentrator and pelletizing plants and four km to the north of the Wabush Mines concentrator plant.
- The IOC Hudson Drive station is located approximately equidistant between the Smokey Mountain and Town Depot stations and approximately two km to the southwest of the IOC concentrator and pelletizing plants.
- The IOC Bartlett Drive station is located near the center of Labrador City and approximately one km north of the Indian Point Station.
- The Wabush Mines Substation station is in the Town of Wabush approximately 1.5 km west of the municipal incinerator and is the closest station to the incinerator.
- The Wabush Mines Bond Street station is approximately three km west of the Wabush Mines concentrator plant and approximately two km east of the Wabush Mine tailings disposal area. This is the closest station to a tailings disposal area.
- The Wabush Mines Shea Street station is approximately 1.5 km south of the Bond Street station and 2.5 km southwest of the Wabush Mines tailings disposal area.

Figure 2.1: IOC and Wabush Mines Air Monitoring Station Locations

Table 2.9 provides a summary of ambient air monitoring program data for both monitoring programs for the Year 2011.

Table 2.9: 2011 Monthly Ranges of Maximum Average Values and Annual Averages of CACs Measured in Labrador City and Wabush

Town	Monitoring Location	SO_2				NO_2			TPM		$PM_{2.5}$
		1-hr	3-hr	24-hr	1 year	1-hr	24-hr	1 year	24-hr	1 year	24-hr
Labrador City	Indian Point[3]	15.8 - 74.7	11.3 -53.2	2.6 – 24.0	1.8	28.7 – 83.1	8.1 – 39.5	7.0	37.8 – 95.4	26.2	6.2 – 18.6
Labrador City	Town Depot / Tamarack Drive[4]	18.9 - 370.5	12.8 – 129.5	3.6 – 42.4	2.2	26.7 – 85.1	9.3 – 43.8	8.6	44.5[7] – 145.6	22.3	6.1 – 19.9
Labrador City	Smokey[5] Mountain	2.0 – 44.9	2.0 – 36.3	1.2 – 10.6	1.3	26.4 – 89.0	0 – 69.7	19.4	30.8 – 93.5	13.8	3.4 – 10.0
Labrador City	Bartlett Drive								8.5 – 98.3	22.5	
Labrador City	Hudson Drive[6]								16.2 – 83.3	18.2	
Labrador City	Vanier Avenue								13.36 – 111.3	16.6	
Wabush	Bond Street	11.1 – 49.2	6.4 – 30.6	3.4 – 11.9	2.8						4.6 – 14.0
Wabush	Shea Street								3.5 – 100.3	10.5	
Wabush	Substation								23.0 – 258.0	21.9	2.9 – 16.9
NL Regulatory Standards		900	600	300	60	400	200	100	120	60	25
# of Exceedances of Standard		0	0	0	0	0	0	0	6	0	0

Notes: (1) All values in units of µg/m^3
(2) Information obtained from NL Department of Environment and Conservation's 2011 Ambient Air Monitoring Report.
(3) SO_2 data is available from May to end of December, 2011 and TPM data is available from June to end of December, 2011.
(4) TPM data is available from June to December, 2011.
(5) NO_2 data is not available for the months of May, September and October, 2011. TPM data is available from June to the end of December, 2011.
(6) TPM data is available from June to December, 2011.
(7) TPM is collected with both reference method samplers and BAM samplers at this location. The values in the table represent results for the BAM sampler. Maximum 24 hour values for the reference method ranged from a low of 35.6 µg/m^3 to a high of 206.6 µg/m^3 at this location.

During the Year 2011, the maximum 24-hour average TPM concentrations for the continuous monitoring stations were 95.4 µg/m^3, 93.5 µg/m^3 and 145.6 µg/m^3 for the Indian Point, Smokey Mountain, and Town Depot locations, respectively. There was one exceedance of the 24 hour TPM standard in December measured by the BAM unit and one exceedance in June measured using the reference method sampler at the Town Depot/Tamarack Drive location. There were four exceedances to the twenty-four hour TPM standard at the Wabush Substation in each of the following months: May, June, July and October. A review of the program results for the SO_2, NO_2, and $PM_{2.5}$ determined that there were no exceedances to the criteria at any of the locations reported for the Year 2011. It should be noted that a full year of TPM, SO_2, NO_2, and $PM_{2.5}$ data was not collected at some of the locations.

A review of the available data for the Year 2011 indicates that there were no exceedances at the two monitoring locations (Smokey Mountain and Hudson Drive) located closest to the existing IOC open pit quarry. The parameters TPM, SO_2, NO_2, and $PM_{2.5}$ are monitored at the Smokey Mountain location and TPM is sampled at the Hudson Drive location.

The two monitoring stations, Town Depot/Tamarack and Substation, which had TPM exceedances, are both located central to the main industrial sources in and around Labrador City and Wabush.

Silica

For iron ore mining operations, silica is a parameter that is requires mitigation and monitoring. IOC has implemented significant measures on its property to address silica emissions for both occupational health and ambient air quality. This section provides a background discussion on silica and the measures that have been implemented to date.

Silica is an occupational exposure concern when iron ore is mined. Silica is the most abundant mineral in the Earth's crust and it forms an important constituent of practically all rock bearing minerals. The iron ore that is mined by IOC is 38 percent silica on average. Occupational exposures to silica are legislated under a 2006 Newfoundland and Labrador Silica Code of Practice (NL, 2006). IOC follows the code of practice and all sampling results for silica are reported to the government on a monthly basis to ensure compliance to the code of practice. IOC worker medicals include chest x-rays and lung function tests which are mandated by this code. The code's standard for occupational air quality for silica is 0.025 ug/m^3 and IOC monitors existing controls to determine if compliance is achieved without the requirement for masks. IOC is continuously taking actions to minimize silica emissions. In recent years a team consisting of management and unionized mine employees has been working on improving occupational air quality. The team's efforts have resulted in the addition of a second water/sand truck, a quick water fill stand pipe and a reliable year round drill dust suppression system (IOC, 2009). The second water/sand truck and the quick fill water stand pipe were completed in 2009. Improvements made to suppress drill dust included:

- Improved air filtration system inside the cabs of the BE drills by installation of a 0.5 micron high efficiency particulate air (HEPA) filter;
- Operator cab seals repaired;
- Manometers installed in the cabs allowing operators to verify positive pressure; and
- Winterization through improved air swivels to reduce leaks and tank insulation to reduce freezing.

Subsequent air quality testing after these improvements determined that the air quality in the drill cabs was in compliance with the silica standard. In order to further reduce silica from entering vehicles, IOC has mandated that mine equipment must never be operated with the windows down (including the light vehicle fleet) (IOC, 2009).

Silica levels are also being monitored throughout the milling processes in the following areas: loading pockets, crushers, drive house, shuttle gallery, feed tunnels and concentrator and pellet plants. The following actions have been implemented to reduce worker exposure:

- Respiratory protection is mandatory and enforced in the crusher, drive house, shuttle and feel tunnels;
- Additional clean-up in target areas including the walls and conveyor structure;
- Re-assigned shift cleanup accountabilities;
- Audited material transfer points and material conveying systems to identify deficiencies;
- Ongoing preventive maintenance requirements (both mechanical and operational) for the existing dust collection and suppression systems;
- Improved sealing around 3rd floor surge pit doors;
- During crusher mantle and concave changes, applied additional sealing to minimize the potential for dust leaks;
- Completed air velocity checks on the existing dust collection system;
- Verified that the crusher control room is under positive pressure;
- Sealed holes in the crusher control rooms floor;
- Increased air quality sampling to pinpoint problem areas;
- Setup operational preventative maintenance for the crushers dust collection systems that will be set up for automatic triggering based upon time.

Tailings also contain silica and are pumped to the tailings disposal area in Wabush Lake. This area can be a source of fugitive dust and silica emissions to the environment (IOC, 2009). IOC has done a significant amount of work to improve dust control in the tailings area since the 1980s:

- Re-vegetation is completed on a yearly basis of inactive areas and these re-vegetated areas are key to reducing airborne dust levels in the tailings area;
- The discharge from the concentrator goes to an active area which is kept wet and controlled;
- Air sampling is performed in the tailings area on a seasonal basis.

2.3.3. Ambient Air Quality Assessment – Dispersion Modelling Study

In 2011, IOCC retained RWDI Air Inc. (RWDI) to perform a comprehensive dispersion modelling study to assess potential impacts to air quality from the operation of the IOC processing facility and pelletizing plant. It should be noted that the study did include site roads, quarry activities or blasting. In accordance to NLDOEC *Air Pollution Control Regulations Regulation 39/04*, the dispersion model CALPUFF was used to predict ground level concentrations of particulate matter (TPM, PM_{10}, $PM_{2.5}$), SO_2, NO_x, and CO at the facility boundary and these results were compared to NLDOEC ambient air quality standards.

Emissions were estimated for TPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x, and CO using stack testing reports spanning from 2003 to 2010 that were provided by IOC. The emissions sources used in the modeling included all significant point, area and volume sources, which included all normal operating equipment as well as fugitive dust emissions from stockpile wind erosion and material handling emissions. A normal operations scenario was modeled and was based on full 2011 production capacity of 17 million tonnes/year of iron concentrate with additional processing of a portion of the concentrate to produce 13 million tonnes/year of iron pellets (RWDI, 2011).

Predicted concentrations at the “administrative property boundary” indicated that the IOC facility was out of compliance with regard to the following NL ambient air quality standards:

- TPM, 24-hour;
- PM_{10}, 24-hour;
- $PM_{2.5}$, 24-hour;
- SO_2, 1-hour;
- SO_2, 3-hour; and
- SO_2, 24-hour;

Table 2.10: Summary of Predicted Maximum Ground Level Concentrations(1)

Source Group	Averaging Period	Maximum Offsite Concentration (ug/m^3)	POI Limit (ug/m^3)	Percentage of Limit (%)
TPM	24-hour	652.5	120	543.8
	Annual	32.7	60	54.6
PM_{10}	24-hour	133.9	50	268
$PM_{2.5}$	24-hour	38.1	25	152.8
CO	1-hour	1,294.0	35,000	3.7
	8-hour	645.6	15,000	4.3
NO_2	1-hour	205.3	400	51.3
	24-hour	127.4	200	63.7
	Annual	9.6	100	9.6
SO_2	1-hour	1,813.6	900	201.5
	3-hour	1,203.7	600	200.6
	24-hour	609.9	300	203.3
	Annual	24.8	60	41.4

Note (1) Source: RWDI, 2011.

These contaminants (Table 2.10) are predicted to be out of compliance only with their standards for maximum short-term concentrations (1-hour; 3-hour, and 24-hour) and are in compliance with standards for annual average concentrations for TPM, and SO_2 (RWDI, 2011).

IOC has acknowledged that there is a predicted compliance issue and is currently working to explore abatement options and develop an Air Quality Management Plan that will bring the Labrador City facility into compliance (RWDI, 2011).

3.0 GREENHOUSE GASES

Greenhouse gases including carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) can be emitted from a number of natural and anthropogenic sources. Emissions from biogenic or other sources generally exhibit little variation from one year to the next.

Total GHG emissions are normally reported as CO_2-equivalents (CO_2e). This is accomplished by multiplying the emission rate of each compound by the global warming potential (GWP) relative to CO_2. CO_2e considers the global warming potential of the three main greenhouse gases: CO_2, CH_4 and N_2O. The global warming potential of these gases are as follows: CO_2 = 1.0, CH_4 = 21 and N_2O = 310. Therefore, the carbon dioxide equivalency factor (CO_2e) is equal to ((CO_2 mass x 1.0) + (CH_4 mass x 21) + (N_2O mass x 310)).

The Newfoundland and Labrador total GHG emissions for the years 1990, 2004 and 2010 are presented in Table 3.1.

Table 3.1: Greenhouse Gas Emissions: Newfoundland and Labrador(1)

Sector	1990 Emissions (kt CO_2e)	2004 Emissions (kt CO_2e)	2010 Emissions (kt CO_2e)
Total	10,100	10,500	8,900

Note: (1) Source: EC 2012c.

Between 1990 and 2004, Newfoundland and Labrador saw GHG emissions rise by 400 kilotonnes (kt) CO_2e (approximately 4%). GHG emissions decreased by 2,200 kt between the years 1990 and 2010.

The total GHG emissions for both IOC and Wabush Mines for the Year 2010 are presented in Table 3.2.

Table 3.2: GHG Emissions from Permitted Point Sources in the Immediate Assessment Area – 2010(2)

Point Sources	CO_2	CH_4	N_2O	Total
Wabush Mines - Scully (5460) Sum (tonnes)	95,253.7	1.91	197	
Sum (tonnes CO_2e)	95,254	40	765	96,058
Iron Ore Company of Canada - Carol Project Sum (5013) (tonnes)	1,123,040	23.51	14.98	
Sum (tonnes CO_2e)	1,123,041	494	4,644	1,128,178

Note: (1) Nitrogen oxides (expressed as NO_2).
(2) Source: Extracted from NPRI 2010 (EC, 2012c).

The 2010 total Newfoundland and Labrador greenhouse gas emissions expressed as CO_2e is 8.9 megatonnes (EC, 2012c). A comparison of the total CO_2e emissions for Newfoundland and Labrador (Table 3.1) with CO_2e emissions from the existing IOC operations indicates that IOCC emissions represent 12.6% of the CO_2e emissions for the province.

The 2010 total Canada greenhouse gas emissions expressed as CO_2e is 692 megatonnes (EC, 2012c). A comparison of the total CO_2e emissions for Canada with CO_2e emissions from the existing IOC operations indicates that IOC emissions represent 0.16% of the CO_2e emissions for Canada.

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