APPENDIX 5C-1

BASELINE AIR QUALITY REPORT

FINAL REPORT

AIR QUALITY BASELINE STUDY
BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

Project Number: #W07-5226A **December 2, 2008**

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1. INTRODUCTION

RWDI AIR Inc. (RWDI) was retained by Knight Piésold to conduct a baseline air quality monitoring program to support the development of the Baffinland Iron Mines Corporation (Baffinland) Mary River Project (the Project) on Baffin Island. Ambient air concentrations of selected air contaminants were measured in the vicinity of the proposed Mary River mine site over the course of two weeks in July, 2007. Monitoring results for the Mary River area are expected to be representative of baseline air quality in the region, including the proposed port site at Steensby Inlet. Air contaminants monitored as part of the program included:

- total suspended particulate (TSP);
- inhalable particulate matter (PM_{10});
- total particulate deposition (dustfall);
- sulphur dioxide (SO_2);
- nitrogen dioxide (NO_2);
- ozone (O_3);
- dust deposition; and
- metals deposition.

The selection of air contaminants was made in consultation with Knight Piésold, and took into consideration air contaminants typically associated with mining operations and with the anticipated activities of the Project.[1] In addition, RWDI consulted with an Environment Canada representative based in Yellowknife who is generally consulted on air quality assessments by regional government authorities for such projects.[2]

Historically, air quality assessments for new mining operations in the north of Canada have relied on long-term ambient quality data from monitoring stations elsewhere in the north, and site-specific monitoring has not always been done. The purpose of the monitoring program conducted by RWDI was to determine the background air quality for the region where

[1] $PM_{2.5}$ measurements were not performed because – based on experience in such pristine environments, where particulate matter levels are very low – short-term monitoring would yield results below the levels of detection.
[2] Personal communication with Dave Fox, Environment Canada, Yellowknife, NWT: July 4, 2007.

Baffinland activities will occur, *i.e.*, north Baffin Island. The air quality monitoring program provides only a brief snapshot in time, but its results may be more representative of site-specific background levels than long-term data from the Northwest Territories Environmental Protection Division (EPD) monitoring stations, which are located near human activities that impact the environment (especially for the Yellowknife monitoring station).

The ambient air quality monitoring program had two components; an active monitoring program and a passive monitoring program. Both of these were conducted in July 2007.

- **Active Monitoring Program**: This program focused on the measurement of ambient concentrations of total suspended particulate matter (TSP). Samples were collected simultaneously from two locations near the proposed mine site using battery-powered Airmetrics "MiniVol" samplers. Each sample was collected over a 72-hour period. Samples are typically collected over a 24-hour period, but it was decided to increase the sampling time to ensure adequate capture of particulate and to increase the accuracy of the measurements, as low particulate levels were anticipated. This program also involved the use of a DustTrak to monitor particulate matter with aerodynamic diameters less than 10 µm (*i.e.*, PM_{10}).

- **Passive Sampling Program**: This program involved the collection of SO_2, NO_2 and O_3 samples simultaneously at two different locations near the proposed mine site. Passive monitors (duplicate monitors for each contaminant) were installed at each location for a 49-day period. This program also involved collection of particulate deposition (dustfall), including metals at the same locations also over the same monitoring period.

This report describes the monitoring program and provides the results collected. The findings are compared to relevant ambient air quality criteria and to other measurements taken in the Canadian Arctic.

2. AMBIENT AIR QUALITY CRITERIA

There are currently no regulated air quality criteria specific to Nunavut. The criteria used to assess background ambient air quality for Baffin Island included:

- Federal Air Quality Objectives (AQOs) defined under the Canadian Environmental Protection Act (CEPA 1999);
- Canada-Wide Standards (CWS) established by the Canadian Council of Ministers of the Environment); and,
- AQOs from the Northwest Territories and from other provincial jurisdictions.

The Federal AQOs are divided into three categories (Health Canada, 2005):

1. "**Maximum desirable level** is the long-term goal for air quality and provides a basis for an anti-degradation policy for the unpolluted parts of the country, and for continuing development of control technology."

2. "**Maximum acceptable level** is intended to provide adequate protection against effects on soil, water, vegetation, materials, visibility, personal comfort and well-being."

3. **Maximum tolerable level** denotes time-based concentrations of air contaminants beyond which, due to a diminishing margin of safety, appropriate action is required without delay to protect the health of the general public."

Table 1 identifies and compares the Federal AQOs, the Northwest Territories criteria and the CWS. The criteria refer to different averaging periods to account for potential short-term acute exposures and long-term chronic exposures. Further explanation of the criteria for particulate matter, ozone, dust deposition and metals is provided below.

Particulate matter is typically classified by aerodynamic diameter size fractions of $PM_{2.5}$, PM_{10} and TSP (total suspended particulates). $PM_{2.5}$ is a subset of PM_{10} which is in turn a subset of TSP. PM_{10} is referred to as inhalable particulate matter, while $PM_{2.5}$ is referred to as respirable particulate matter, the difference being that the latter is capable of penetrating deep into the lungs and have greater ability to cause adverse health effects.

The Canadian Council of Ministers of the Environment (CCME) has developed a Canada Wide Standard (CWS) for $PM_{2.5}$. In December 2002, the Northwest Territories adopted the 24-hr CWS as the Northwest Territories ambient air quality standard for $PM_{2.5}$. The CWS standard is more applicable in relating PM concentrations to human pulmonary effects than the other measures of PM (e.g., TSP, PM_{10}). Achievement of the CWS for $PM_{2.5}$ is based on the average of the 98^{th} percentile concentrations for each year, averaged over three consecutive years from monitoring locations within an identified area. In determining CWS compliance, natural sources and long-range transport contributions can be discounted.

For PM_{10}, a 24-hour average threshold of 50 µg/m³ has been selected based on the Ontario Interim Ambient Air Quality Criteria (AAQC) (Ontario Ministry of the Environment, September 2001). This threshold is provided for reference purposes as there are no criteria from the applicable jurisdictions.

For TSP, there is a 24-hour standard from the Northwest Territories that has been selected to assess measured concentrations.

The CWS for tropospheric ozone O_3 is 127 µg/m^3, based on an eight-hour average. Achievement is based on the 4^{th} highest daily value for a year, averaged over three consecutive years. In determining compliance, natural sources or long-range contributions can be discounted.

No criteria for metals deposition were located for comparison with the deposition monitoring data.

Table 2 identifies dust deposition criteria for Alberta and Ontario. The basis for these criteria appears to be based on nuisance considerations. The Ontario values have been recalculated to be in the same units as the Alberta criteria. All dust deposition criteria are used to assess the project.

Table 1: Ambient Air Quality Criteria, Standards and Objectives

Contaminant	Averaging Time	Federal Air Quality Objectives			Canada Wide Standard	NWT	Indicator Threshold
		Desirable	Acceptable	Tolerable			
TSP ($\mu g/m^3$)	24 hr	-	120	400	-	120	**120**
	Annual	60	70	-	-	60	**60**
PM_{10} ($\mu g/m^3$)	24 hr	-	-	-	-	50*	**50**
$PM_{2.5}$ ($\mu g/m^3$)	24 hr	-	-	-	30	30	**30**
SO_2 ($\mu g/m^3$)	1 hr	450	900	-	-	450	**450**
	24 hr	150	300	800	-	150	**150**
	Annual	30	60	-	-	30	**30**
NO_2 ($\mu g/m^3$)	1 hr	-	400	1,000	-	-	**400**
	24 hr	-	200	300	-	-	**200**
	Annual	60	100	-	-	-	**60**
CO ($\mu g/m^3$)	1 hr	15,000	35,000	-	-	-	**15,000**
	8 hr	6,000	15,000	20,000	-	-	**6,000**
O_3 ($\mu g/m^3$)	1 hr	100	160	300	-	-	**-**
	8 hr	-	-	-	127	127	**-**
	24 hr	30	50	-	-	-	**-**
	Annual	-	30	-	-	-	**-**

*Ontario Interim Ambient Air Quality Criterion (AAQC). Ontario Ministry of the Environment, September 2001.

Table 2: Dust Deposition Criteria

Averaging Time	Alberta Residential and Recreation Areas	Alberta Commercial and Industrial Areas	Ontario Ambient Air Quality Criteria	Indicator Threshold
1 Month	53 mg/100cm^2/30 d	158 mg/100cm^2/30 d	70 mg/100 cm^2/30 d	**5.3 g/m^2/30 d**
	5.3 g/m^2/30 d	15.8 g/m^2/30 d	7 g/m^2/30 d	**15.8 g/m^2/30 d**
Annual	-	-	4.6 g/m^2/30 d	**4.6 g/m^2/30 d**
	-	-	46 mg/100 cm^2/d	

Note: Annual criteria are based on the geometric mean of 12 monthly values.

3. REGIONAL AMBIENT AIR QUALITY MEASUREMENTS

Ambient air quality monitoring results from the July 2007 Mary River monitoring program are compared to long-term monitoring data from monitoring locations in the Northwest Territories operated by the Environmental Protection Division of the Northwest Territories Department of Environment and Natural Resources http://www.enr.gov.nt.ca/eps/environ.htm). Tables 3 and 4 summarize ambient monitoring data for the seven year period from 2000 to 2006. These stations include:

- **Yellowknife:** This monitoring station has been in operation since 1992. Yellowknife is the largest community in the NWT with a population of approximately 18,000. The Giant Mine and its operational emissions influenced air quality in Yellowknife until its closure in 1999.
- **Fort Liard:** The Hamlet of Fort Liard has a population of about 600. Oil and gas developments in this area prompted the need to initiate monitoring at this location in 2000.
- **Norman Wells:** Norman Wells is a community with a population of about 800 and has oil and gas processing facilities in the area. The monitoring station was commissioned in February 2003.
- **Daring Lake:** Short-term PM monitoring during summer months was undertaken in 2002 for PM_{10} and in 2003 and 2004 for $PM_{2.5}$.
- **Fort Simpson:** Short term $PM_{2.5}$ monitoring was undertaken in the spring/summer of 2003 and 2004.

The results of the above air quality monitoring program are summarized in the following sub-sections on a parameter-by-parameter basis.

3.1 Total Suspended Particulate (TSP) Concentrations

TSP measurements can be influenced by local sources (*e.g.*, traffic and dusty roads) and by distant events (*e.g.*, forest fires). TSP concentrations have been measured in Yellowknife since 1994 using a high volume (hi-vol) sampler and have decreased since the commencement of the monitoring program. The monitoring consisted of one 24-hour sample taken every 6 days, as per standard practice for monitoring of TSP. The reduction is reportedly due to Yellowknife's on-going efforts to reduce fugitive emissions of road dust through road cleaning and on-going paving of gravel areas (NWT, 2004). The greatest source of TSP is dust from roads, especially in the spring and during the summer fire season. In Yellowknife, the maximum 24-h values in any year tend to be in the 90 to 400 $\mu g/m^3$ range and the annual average values tend to range from 19 to 47 $\mu g/m^3$.

In addition to the monitoring at Yellowknife, TSP has been measured at Fort Simpson using a Mini-Partisol sampler from May 2003 to 2004. Maximum 24-h values are in the 50 to 109 $\mu g/m^3$ range, and the annual average values tend to range from 7 to 22 $\mu g/m^3$.

3.2 $PM_{2.5}$ Concentrations

$PM_{2.5}$ is measured continuously at Yellowknife, Fort Liard, Norman Wells and Daring Lake. Maximum 24-h values higher than the $PM_{2.5}$ CWS of 30 $\mu g/m^3$ have been measured at all of the sites. These events, however, have been attributed to forest fire activity, and 2004 was a year with strong forest fire influences. Annual average $PM_{2.5}$ concentrations have ranged from 2 to 12 $\mu g/m^3$.

3.3 SO_2 Concentrations

SO_2 is measured continuously at Yellowknife, Fort Liard and Norman Wells. The recent measurements indicate that background maximum 1-h SO_2 concentrations have ranged from 3 to 39 $\mu g/m^3$. Similarly, the annual average SO_2 concentrations range from <1 to 7 $\mu g/m^3$.

3.4 NO_2 Concentrations

NO_2 is measured continuously at Yellowknife and Norman Wells. Maximum 1-h NO_2 concentrations of 54 to 105 µg/m^3 were measured. Corresponding annual average concentrations ranged from 1 to 12 µg/m^3. These levels may be attributable to combustion sources near the monitoring stations (e.g., vehicles, residential heating etc).

3.5 O_3 Concentrations

O_3 is measured at continuously at Yellowknife and Normal Wells. Maximum hourly values have ranged from 79 to 120 µg/m^3, with annual average values of about 40 µg/m^3. Monthly average O_3 values vary from a maximum of 62 µg/m^3 in April to a minimum of 27 µg/m^3 in July (NWT 2005).

Table 3: Ambient TSP and $PM_{2.5}$ Concentrations in Northern Locations

Contaminant	Value	Year	Monitoring Site				
			Yellowknife	Fort Liard	Norman Wells	Daring Lake	Fort Simpson
TSP	Maximum 24-h ($\mu g/m^3$)	2000	333	n/a	n/a	n/a	n/a
		2001	400	n/a	n/a	n/a	n/a
		2002	229	n/a	n/a	n/a	n/a
		2003	297	n/a	n/a	n/a	109
		2004	188	n/a	n/a	n/a	50
		2005	151	n/a	n/a	n/a	n/a
		2006	90	n/a	n/a	n/a	n/a
	Number of Exceedances of 24-h NWT Standard	2000	7	n/a	n/a	n/a	n/a
		2001	3	n/a	n/a	n/a	n/a
		2002	2	n/a	n/a	n/a	n/a
		2003	1	n/a	n/a	n/a	0
		2004	3	n/a	n/a	n/a	0
		2005	2	n/a	n/a	n/a	n/a
		2006	0	n/a	n/a	n/a	n/a
	Annual Average ($\mu g/m^3$)	2000	47	n/a	n/a	n/a	n/a
		2001	34	n/a	n/a	n/a	n/a
		2002	27	n/a	n/a	n/a	n/a
		2003	31	n/a	n/a	n/a	22
		2004	31	n/a	n/a	n/a	7
		2005	20	n/a	n/a	n/a	n/a
		2006	19	n/a	n/a	n/a	n/a
$PM_{2.5}$	Maximum 24-h ($\mu g/m^3$)	2000	26	n/a	n/a	n/a	n/a
		2001	9	n/a	n/a	n/a	n/a
		2002	12	n/a	n/a	n/a	n/a
		2003	15	12	n/a	15	n/a
		2004	125	46	96	42	n/a
		2005	107	32	200	3	n/a
		2006	36	12	13	n/a	n/a
	Number of Exceedances of 24-h NWT Standard	2000	0	n/a	n/a	n/a	n/a
		2001	0	n/a	n/a	n/a	n/a
		2002	0	n/a	n/a	n/a	n/a
		2003	0	0	n/a	0	n/a
		2004	8	2	9	-	n/a
		2005	3	1	3	-	n/a
		2006	1	0	0	-	n/a
	Annual Average ($\mu g/m^3$)	2000	3	n/a	n/a	n/a	n/a
		2001	3	n/a	n/a	n/a	n/a
		2002	4	n/a	n/a	n/a	n/a
		2003	5	5 to 12	n/a	-	n/a
		2004	6	2 to 12	7	7	n/a
		2005	-	3	6	-	n/a
		2006	-	3	3	5	n/a

Source: Northwest Territories Environmental Protection Division

Notes: n/a = not measured.

Dash (-) = not reported.

Table 4: Ambient SO_2, NO_2, and O_3 Concentrations in Northern Locations

Contaminant	Value	Year	Monitoring Site				
			Yellowknife	Fort Liard	Norman Wells	Daring Lake	Fort Simpson
SO_2	Maximum 1-h ($\mu g/m^3$)	2000	39	-	n/a	n/a	n/a
		2001	24	14	n/a	n/a	n/a
		2002	29	29	n/a	n/a	n/a
		2003	13	11	28	n/a	n/a
		2004	12	11	11	n/a	n/a
		2005	14	11	3	n/a	n/a
		2006	11	3	5	n/a	n/a
	Annual Average ($\mu g/m^3$)	2000	4	5.1	n/a	n/a	n/a
		2001	5	6	n/a	n/a	n/a
		2002	7	6	n/a	n/a	n/a
		2003	2	4 to 6	<3	n/a	n/a
		2004	2	<5	<1	n/a	n/a
		2005	3	<5	<1	n/a	n/a
		2006	<1	<1	3	n/a	n/a
NO_2	Maximum 1-h ($\mu g/m^3$)	2003	70	n/a	n/a	n/a	n/a
		2004	70	n/a	n/a	n/a	n/a
		2005	105	23	54	n/a	n/a
		2006	80	25	57	n/a	n/a
	Annual Average ($\mu g/m^3$)	2003	12	n/a	n/a	n/a	n/a
		2004	9	n/a	n/a	n/a	n/a
		2005	8	<1	1	n/a	n/a
		2006	8	<1	2	n/a	n/a
O_3	Maximum 1-h ($\mu g/m^3$)	2000	79	n/a	n/a	n/a	n/a
		2001	110	n/a	n/a	n/a	n/a
		2002	99	n/a	n/a	n/a	n/a
		2003	98	n/a	n/a	n/a	n/a
		2004	98	n/a	n/a	n/a	n/a
		2005	118	n/a	105	n/a	n/a
		2006	120	n/a	100	n/a	n/a
	Annual Average ($\mu g/m^3$)	2000	41	n/a	n/a	n/a	n/a
		2001	38	n/a	n/a	n/a	n/a
		2002	-	n/a	n/a	n/a	n/a
		2003	-	n/a	n/a	n/a	n/a
		2004	-	n/a	n/a	n/a	n/a
		2005	-	n/a	n/a	n/a	n/a
		2006	-	n/a	n/a	n/a	n/a

Source: Northwest Territories Environmental Protection Division
Notes: n/a = not measured.
Dash (-) = not reported.

4. MARY RIVER BASELINE AIR QUALITY MEASUREMENTS

4.1 Sampling Locations

Two sampling locations were selected to represent baseline air quality in the area. Both sampling locations were approximately 1.5 km south-west of the Mary River camp. Figure 1 indicates the location of the monitoring sites.

The selection of baseline monitoring locations in the Mary River area posed several challenges. The monitoring locations were selected to minimize the influence of local activities, including dust emissions from the sand airstrip and combustion emissions from the incinerator, aircraft and other equipment.

Contamination from on-going activities at the Mary River site was prevented by locating the monitoring stations at a significant distance from the site (1.5 km), and by avoiding locations that are downwind for prevailing winds. Wind data from the on-site meteorological station was analyzed to determine the prevailing wind direction. A wind rose showing prevailing wind direction is presented in Figure 2. Based on the available meteorological data, the prevailing winds come from the east through southeast. Initially, it was considered desirable to locate the monitors in that direction relative to the camp. However, the orientation of the airstrip made air quality samplers located east of the camp vulnerable to contamination from aircraft emissions. Furthermore, the steep topography in the area southeast of the camp would have made the monitoring equipment inaccessible for daily maintenance. As a compromise, the stations were located to the south west of the camp. Figure 1 and Table 5 indicate the final monitoring locations.

Table 5: Monitor Locations (UTM Zone 17, NAD83)

Monitor Location	Easting (m)	Northing (m)	Comments
Location 1A and 1B	557296	7913006	On flat area south of Camp Lake
Location 2A and 2B	556800	7913300	

4.2 Sampling Methods

4.2.1 Active Monitoring Program: PM_{10} and TSP

A DustTrak monitor was used to measure particulate matter with aerodynamic diameter less than 10 µm (PM_{10}). Duplicate instruments were installed at each monitoring site. The instruments were housed in an enclosure with the sample inlet located 2 m above grade. Hourly averages of one-second concentration measurements were recorded, and 24-hour averages were calculated from the 1-hour average recorded data. The instruments operated on a continuous basis throughout the program. The sampling dates are summarized in Table 6.

Table 6: PM_{10} Sampling Locations and Dates

Location	Start Date	End Date
1A	July 12, 2007	July 21, 2007
1B	July 12, 2007	July 21, 2007
2A	July 12, 2007	July 21, 2007
2B	July 12, 2007	July 21, 2007

Active sampling for Total Suspended Particulate (TSP) was based on the U.S. EPA Compendium Method IO-2.3 "Sampling of Ambient Air for Total Suspended Particulate Matter and PM_{10} Using a Low-Volume Sampler" (U.S. EPA Compendium Method IO-2.3, 2005).

A battery-powered Airmetrics "MiniVol" sampler was used to collect TSP samples as 110 VAC power was not available. It was also more practical for shipping and deployment than the more conventional 110 VAC based samplers that tend to be larger. While MiniVol samplers do not have accreditation as U.S. EPA equivalent method devices, they have been widely accepted by regulatory agencies in a number of jurisdictions.

Duplicate samplers were installed at each monitoring location. A tripod assembly was used to support the sampler. The inlet height of the samplers was approximately 2 m above grade.

All MiniVol samples were collected on filters at a flow rate of approximately 5 litres/min for a duration of approximately 72 hours. Samples were collected for a two-week period. Four duplicate samples were collected at each monitoring site. Coincident real time PM_{10} measurements were recorded by DustTrak throughout the monitoring program for quality assurance purposes. Due to the low PM_{10} concentrations measured at the sampling locations the duration of the TSP samples were extended to 72 hours. The collected TSP samples (filters) were sent to Alberta Research Council (ARC) for analysis. The TSP sampling locations and dates are summarized in Table 7. Metals analysis for TSP and PM_{10} was not performed because sampling volumes for such a short-term monitoring activity would yield levels below detection limits, based on experience in similar pristine environments.

Table 7: Summary of TSP Sampling Locations and Dates

Location	Sample No.	Start Date	Stop Date	Sample Duration (hrs)
1A	P6068328	July 12, 2007	July 15, 2007	74.3
	P6068319	July 15, 2007	July 18, 2007	66.9
	P6068333	July 18, 2007	July 21, 2007	74.2
	P6068342	July 21, 2007	July 24, 2007	75.9
1B	P6068327	July 12, 2007	July 15, 2007	73.6
	P6068320	July 15, 2007	July 18, 2007	67
	P6068832	July 18, 2007	July 21, 2007	73.7
	P6068341	July 21, 2007	July 24, 2007	75.7
2A	P6068326	July 12, 2007	July 15, 2007	NA
	P6068321	July 15, 2007	July 18, 2007	6.7
	P6068331	July 18, 2007	July 21, 2007	74.5
	P6068340	July 21, 2007	July 24, 2007	76.2
2B	P6068324	July 12, 2007	July 15, 2007	74.8
	P6068823	July 15, 2007	July 18, 2007	67.1
	P6068330	July 18, 2007	July 21, 2007	74.5
	P6068337	July 21, 2007	July 24, 2007	76.3

Notes: NA Sample duration not available due to equipment malfunction

4.2.2 Passive Sampling Program (SO_2, NO_2, O_3 and Total Dustfall (Deposition)

Sampling for SO_2, NO_2 and O_3 were conducted using passive monitors from Maxxam Analytics Inc. Active (real time) sampling was not practical for this monitoring program because of the requirement for power to the monitors. Passive monitors are devices that collect

gaseous pollutants through diffusion or permeation onto a specially designed substrate. No power is required for these monitors. The monitors were deployed at two locations for a 49-day period (duplicates for each contaminant *i.e.*, 1B is a duplicate sample for 1A). A duplicate monitor was installed at each location, for a total of 4 monitors. Monitors were supported by a tripod at a height of 2 m above grade. Duplicate samples were collected at each monitoring site. A total of two samples for each contaminant were collected at each monitoring site. One blank sample for each parameter was submitted to the laboratory for quality control purposes.

Duplicate particulate deposition (dustfall) samplers were also placed at each of the sampling locations. These samplers collect total deposited particulate and metals. The dustfall samplers were also deployed for a 49-day period. The samples were submitted to ARC for total deposition and metals analysis.

Samples using passive monitors and deposition samplers were collected at the locations and dates indicated in Table 8 (locations also shown in Figure 1).

Table 8: Passive Sampling Locations and Dates

Location	Monitor	Start Date	End Date
1	A	July 12, 2007	August 30, 2007
	B	July 12, 2007	August 30, 2007
2	A	July 12, 2007	August 30, 2007
	B	July 12, 2007	August 30, 2007

4.3 Calibrations and Calculations

4.3.1 Active Monitoring Program

Calibration sheets for the MiniVol sampler were provided by the supplier, which related air-flow at standard conditions to actual conditions [Airmetrics, September 2007]. Equations were applied along with meteorological observations to calculate the actual 24-hour air-flow through the sampler and the resulting contaminant concentration ($\mu g/m^3$). Detailed calibration data can be found in Appendix A.

4.3.2 Passive Monitoring Program

SO_2, NO_2 and O_3 samples were sent to Maxxam Analytics Inc. for analysis. The results were provided in units of parts per billion (ppb) and were converted to µg/m³ assuming standard conditions of 25 ºC and 101.325 kPa.

Deposition samples were also collected using a dustfall jar. The dustfall samples were sent to Alberta Research Council (ARC) for analysis. The results were provided as total mass in grams. Deposition rates were calculated in units of $g/m^2/30$ days.

4.4 Quality Assurance Measures

A number of quality assurance measures were implemented during the sampling program to ensure the integrity of the results. These measures included detailed documentation of all field activities, analyses of unexposed samples (blanks), duplicate sampling (for the passive monitoring program) and a number of laboratory related measures including sample handling procedures and instrument calibrations. Chain of custody forms were completed and submitted with the samples to the laboratory.

5. RESULTS OF BASELINE MONITORING PROGRAM

5.1 TSP Concentrations

Table 9 shows the ambient TSP concentrations measured at each monitoring location. The samples were taken over a 72-hour time period and are compared to the 24-hour threshold value. Given that there are virtually no local sources of TSP, there would be very little variability between 72-hour and 24-hour concentrations. Therefore the comparison is considered appropriate in this setting. Ambient concentrations for all samples are well below the indicator threshold of 120 $\mu g/m^3$.

Table 9: TSP Concentrations

Sampling Location	Maximum TSP Concentration ($\mu g/m^3$)
24-hour Indicator Threshold	**120**
Mary River 1A	3.5
Mary River 1B	3.0
Mary River 2A	7.0
Mary River 2B	5.5

TSP measurements taken in the Mary River area were found to be much lower than the 24-hour measurements from all sites in the NWT, but are somewhat more consistent with annual average concentrations measured at Fort Simpson (Table 3).

The background levels of 3.0 to 7.0 $\mu g/m^3$ measured in the Mary River area represent low, pristine levels that can be viewed as typical for remote Arctic areas.

5.2 PM_{10} Concentrations

Table 10 shows the ambient PM_{10} concentrations measured at each monitoring location. Ambient concentrations for all samples are well below the indicator threshold of 120 $\mu g/m^3$.

Table 10: PM_{10} Concentrations

Sampling Location	Maximum 24-hr PM_{10} Concentration ($\mu g/m^3$)
24-hour Indicator Threshold	***50***
Mary River 1A	3.0
Mary River 1B	1.5
Mary River 2A	1.8
Mary River 2B	3.8

There are no other PM_{10} data from northern sites for direct comparison. However, when compared to historical $PM_{2.5}$ data from locations in the Northwest Territories, measurements taken in the Mary River area were found to be much lower than maximum 24-hour measurements, but more consistent with annual average concentrations (Table 3).

The background levels of 1.5 to 3.8 µg/m³ measured in the Mary River area represent low, pristine levels that can be viewed as typical for remote Arctic areas.

5.3 SO_2, NO_2 and O_3 Concentrations

Table 11 shows ambient SO_2, NO_2 and O_3 concentrations at each monitoring location for the nominal 30-day averaging period. These concentrations are compared to 1-h, 24-h and annual threshold indicators. The area's limited human activity means that ambient concentrations of SO_2 and NO_2 are likely to vary less over time than is typically the case in less remote sites. As a result, their respective 1-h, 24-h and annual average concentrations will be relatively similar to each other. Therefore, it is possible to make approximate comparisons of the measured 30-day average with 1-h, 24-h and annual threshold indicators.

Table 11: SO_2, NO_2 and O_3 Concentrations

Monitor Location	**SO_2 (µg/m³)** 30-day average	**NO_2 (µg/m³)** 30-day average	**O_3 (µg/m³)** 30-day average
24-hour Indicator Threshold	450 (1-h) 150 (24-h) 30 (annual)	400 (1-h) 200 (24-h) 60 (annual)	100 (1-h) 127 (8-h) 30 (24-h) 30 (annual)
Mary River 1A	0.262	<0.188	45.9
Mary River 1B	<0.262	<0.188	44.0
Mary River 2A	0.262	0.188	52.8
Mary River 2B	<0.262	0.188	47.1

5.4 Total Dust and Metals Deposition

Table 12 shows the ambient total dust deposition rate at each monitoring location for the nominal 30-day averaging period. Table 13 summarizes the total metals deposition for each monitoring location. Total dustfall deposition rates are compared to 30-day dustfall indicators where applicable. There are no applicable indicators for metal deposition.

Table 12: Total Dust Deposition Results

Parameter	1A ($mg/100cm^2/30days$)	1B ($mg/100cm^2/30days$)	2A ($mg/100cm^2/30days$)	2B ($mg/100cm^2/30days$)
Total Dustfall	0.135	0.306	0.300	0.398

Table 13: Total Metals Deposition Results

Parameter	1A ($ng/100cm^2/30days$)	1B ($ng/100cm^2/30days$)	2A ($ng/100cm^2/30days$)	2B ($ng/100cm^2/30days$)
Ag	0.819	0.939	0.573	2.72
Al	7617	11843	16675	26946
As	7.92	9.77	5.25	6.33
B	149	190	151	177
Ba	191	267	329	435
Be	0.590	1.25	0.641	0.759
Bi	0.655	1.37	1.09	0.715
Ca	12479	25727	13584	25584
Cd	2.44	12.0	14.6	30.8
Cl	154929	192403	48756	18365
Co	441	547	331	375
Cr	159	300	153	214
Cu	213	235	144	264
Fe	19005	22316	10982	30602
Hg	1.63	3.67	1.18	0.464
K	24995	57359	74424	69994
Li	9.90	17.1	11.7	86.6
Mg	10917	23936	16616	23137
Mn	899	1723	939	1123
Mo	9.92	5.13	5.15	5.68
Na	26648	33345	27503	20647
Ni	144	162	55.2	123
P	9005	21928	56089	66746
Pb	28.8	54.4	39.9	114
S	29727	121083	71175	35195
Sb	3213	6655	3577	3544
Se	14.7	31.9	8.75	5.85
Si	34423	50943	61156	78067
Sn	782	38.7	15.8	16.2
Sr	91.9	306	298	2832
Th	2.53	4.63	7.61	10.1
Ti	28833	54411	31361	31620
Tl	0.187	0.367	0.281	0.370
U	0.737	1.38	1.33	2.34
V	31.6	50.1	25.5	36.8
Zn	470	560	385	708

5.5 Overall Baseline Results

The maximum measured result for each parameter was selected as the baseline concentration. The results did not vary significantly between samples, but the maximum value was selected as a conservatism to account for the relatively short monitoring period. Overall baseline results for each air quality parameter are summarized in Tables 14, 15 and 16.

Table 14: Measured Baseline Concentrations

Parameter	Baseline Concentration ($\mu g/m^3$)
24-hour TSP	7.0
24-hour PM_{10}[2]	3.8
30-day SO_2[3]	0.262
30-day NO_2[3]	0.188
30-day O_3[3]	52.8

Table 15: Baseline Dustfall Deposition Rates

Parameter	Baseline Deposition Rate ($mg/100cm^2$/30 days)
Total Dustfall	0.398

Table 16: Baseline Metals Deposition Rates

Parameter	Baseline Deposition Rate ($ng/100cm^2/30$ days)
Ag	2.72
Al	26946
As	9.77
B	190
Ba	435
Be	1.25
Bi	1.37
Ca	25727
Cd	30.8
Cl	192403
Co	547
Cr	300
Cu	264
Fe	30602
Hg	3.67
K	74424
Li	86.6
Mg	23935
Mn	1723
Mo	9.92
Na	33345
Ni	162
P	66745
Pb	114
S	121083
Sb	6655
Se	31.9
Si	78067
Sn	782
Sr	2832
Th	10.1
Ti	54411
Tl	0.370
U	2.34
V	50.1
Zn	708

6. SUMMARY AND CONCLUSIONS

Ambient air quality samplers were deployed at the proposed Mary River mine site in July 2007 to measure baseline ambient TSP, PM_{10}, SO_2, NO_2, O_3 and dust deposition levels. The monitoring results from this short-term air quality baseline monitoring program indicate that all the parameters measured are well below applicable indicator thresholds, as one would expect in such a pristine environment.

Monitored data from the Mary River program were generally lower – and often significantly lower – than values for the Northwest Territories Environmental Protection Division long-term monitoring stations, and in particular the Yellowknife monitoring station (the monitoring site with greatest population and activity). This is expected, given that the long-term monitoring stations were established to provide information on impacts from existing activities. Although new mining projects in the north have sometimes relied on the data from these stations in the absence of other data more representative of remote northern locations, the site-specific data collected at Mary River were considered to be more appropriate for establishing baseline air quality levels, even though the monitoring program at Mary River was completed over a short period of time.

Maximum values from the baseline ambient air quality data from the Mary River monitoring program will be used to as background levels.

7. REFERENCES

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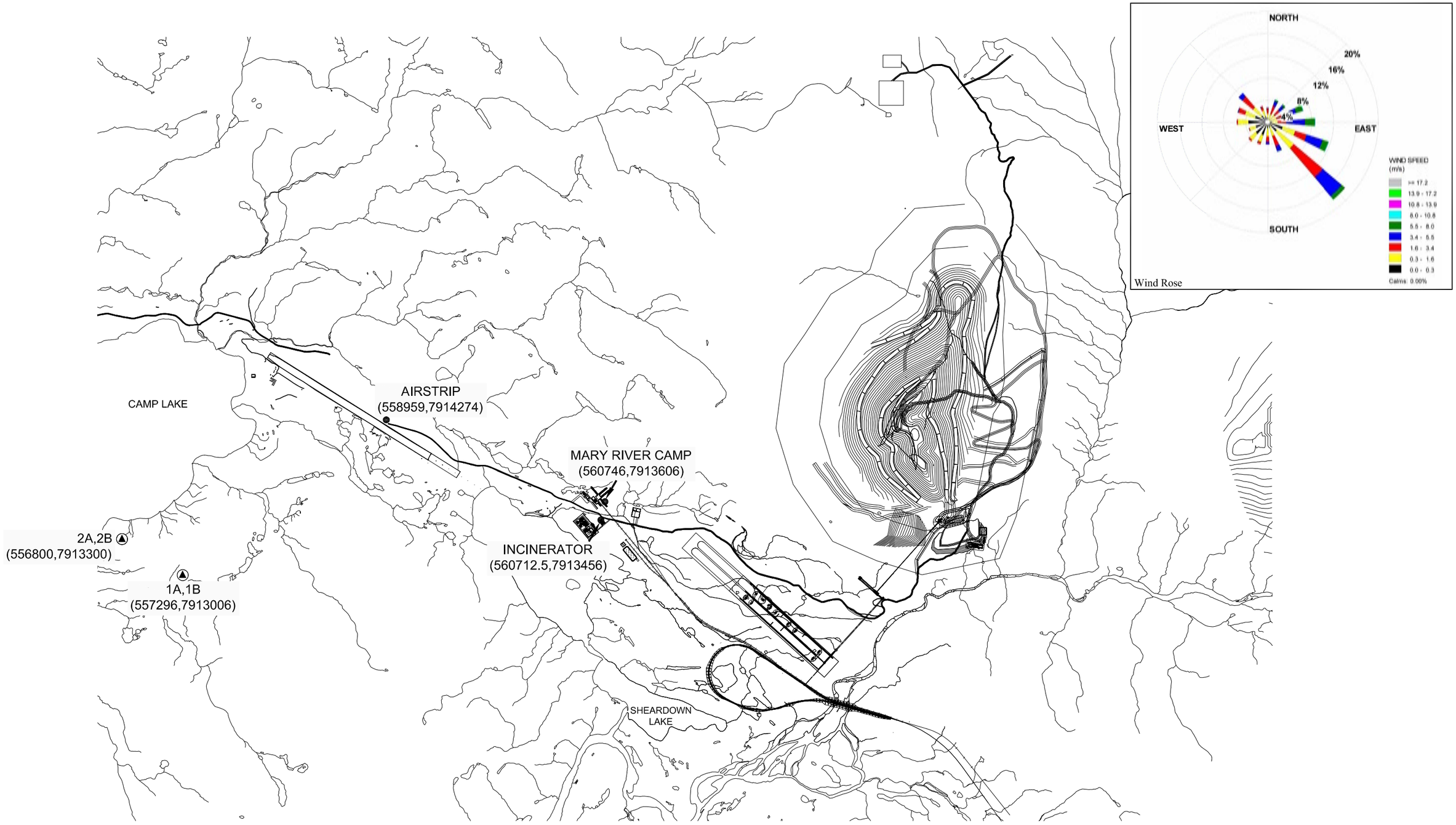
FIGURES



LEGEND:

▲ Sampling Location

Mary River Baseline Air Quality Sampling Location

True North

Air Quality Baseline Study - Mary River Project - Baffin Island

Project #W07-5226A

Drawn by: NTN	Figure:	1
Approx. Scale:	1:30 000	
Date Revised:	Nov. 28, 2008	

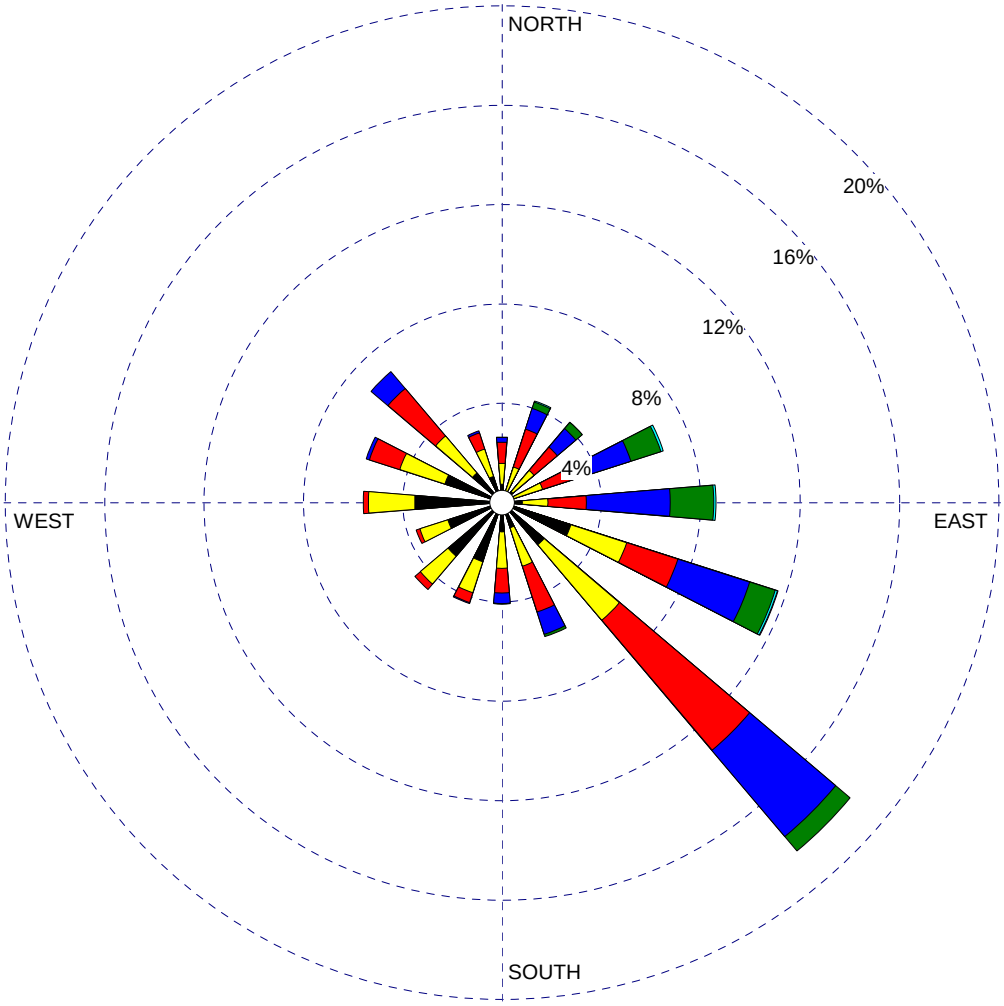
RWDI

WIND ROSE PLOT:

Figure 2
Mary River

DISPLAY:

Wind Speed
Direction (blowing from)



WIND SPEED
(m/s)

- >= 17.2
- 13.9 - 17.2
- 10.8 - 13.9
- 8.0 - 10.8
- 5.5 - 8.0
- 3.4 - 5.5
- 1.6 - 3.4
- 0.3 - 1.6
- 0.0 - 0.3

Calms: 0.00%

COMMENTS: Hourly averages recorded from June 13, 2005 to September 12, 2005 and June 3, 2006 to September 18, 2007	DATA PERIOD: **2005-2007** **Jan 1 - Dec 31** **00:00 - 23:00**	COMPANY NAME:	
		MODELER:	
	CALM WINDS: **0.00%**	TOTAL COUNT: **11437 hrs.**	
	AVG. WIND SPEED: **1.99 m/s**	DATE: **18/10/2007**	PROJECT NO.: **W07-5226A**

APPENDIX A

Appendix A: Active Monitoring Program Detailed Calibration Data

Table 1: Calibration Data for the Airmetrics MiniVol Sampler

MiniVol Unit ID	Calibration Data					
	m_{vol}	b_{vol}	r^2	T_{std} (K)	P_{std} (mm Hg)	Q_{ind} (lpm)
4586	1.0027	0.2656	0.9998	298	760	5.00
4587	0.9641	0.3356	0.9998	298	760	5.00
4588	0.9975	0.2666	0.9997	298	760	5.00
4589	0.9335	0.1373	0.9998	298	760	5.00

The following equation was used to calculate air flow through each sampler (Airmetrics, June 2001):

$$Q_{act} = (m_{vol} Q_{ind} + b_{vol}) \times \sqrt{\frac{P_{std}}{P_{act}} \times \frac{T_{act}}{T_{std}}}$$

Where:

Q_{act} = actual flow rate (liters/minute)

m_{vol} = calibration multiplier constant

Q_{ind} = MiniVol indicated flow rate (liters/minute)

b_{vol} = calibration constant

P_{std} = standard atmospheric pressure (760 mm Hg)

P_{act} = actual ambient pressure (mm Hg)

T_{std} = standard temperature (298 K)

T_{act} = actual ambient temperature (K)