Monitoring Plan

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Abbreviations

AAQFMP	Ambient Air Quality Follow-up Monitoring Program
AAQS	Ambient Air Quality Standards
As	Arsenic
Ba	Barium
Be	Beryllium
Bi	Bismuth
CAAQS	Canadian Ambient Air Quality Standards
CCME	Canadian Council of Ministers of the Environment
Cd	Cadmium
CEPA	*Canadian Environmental Protection Act, 1999*
CO	Carbon monoxide
Co	Cobalt
Cr	Chromium
Cu	Copper
ECCC	Environment and Climate Change Canada
HCN	Hydrogen Cyanide
Hg	Mercury
Li	Lithium
LAA	Local Assessment Area
NAPS	National Air Pollution Surveillance Program
NH_3	Ammonia
Ni	Nickel
NL	Newfoundland and Labrador
NLAAQS	NL Ambient Air Quality Standards
NLDECC	NL Department of Environment and Climate Change
NLDMAE	NL Department of Municipal Affairs and Environment
NL EPA	*Newfoundland and Labrador Environmental Protection Act*
NO	Nitric oxide
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides

NPRI	National Pollutant Release Inventory
O_3	ozone
Pb	Lead
PM	Particulate matter
$PM_{2.5}$	Fine particulate matter with an aerodynamic diameter less than 2.5 µm
PM_{10}	Respirable particulate matter with an aerodynamic diameter less than 10 µm
RAA	Regional Assessment Area
Sb	Antimony
Se	Selenium
Sn	Tin
SO_2	Sulphur dioxide
TMF	Tailings Management Facility
TSP	Total Suspended Particulate Matter
US EPA	United States Environmental Protection Agency
VOC	Volatile organic compounds
Zn	Zinc

1.0 INTRODUCTION

Marathon Gold Corporation (Marathon) submitted an Environmental Impact Statement (EIS; Marathon Gold 2020) for the Valentine Gold Project (the Project) to the Impact Assessment Agency of Canada (IAAC) on September 29, 2020, and to the Environmental Assessment (EA) Division of the Newfoundland and Labrador of Environment and Climate Change (NLDECC) on November 3, 2020. The Project was released from the provincial and federal EA processes, with conditions, on March 17, 2022, and August 24, 2022, respectively.

The purpose of the Ambient Air Quality Follow-up Monitoring Program (AAQFMP) is to verify predictions and address commitments made in the EIS (Marathon 2020) as well as those developed through Information Requirements (IR) received as part of the regulatory review process. This document describes follow-up and monitoring activities for the construction, operation, and decommissioning/closure phases of the Project, based on regulatory compliance requirements and Project approvals and authorizations. This is a living document that will be reviewed, updated and improved upon based on policy and technology changes as the Project progresses through permitting, construction, operation and decommissioning of the Project.

The construction and operation of the Project are governed by an Environmental and Social Management System, which includes tools such as the corporate environmental and social policies, construction and operational environmental protection plans (EPPs), environmental management plans, and follow-up and monitoring programs, which will be updated as applicable throughout the life of the Project to reflect the latest project, regulatory and environmental information. An EPP for the construction phase of the Project has been approved by the NL Minister of Environment and Climate Change. The Construction EPP outlines protection and response measures associated with potential environmental effects related to Project construction activities, providing general environmental protection procedures related to Project construction activities and infrastructure such as air and greenhouse gas emissions, erosion and sedimentation control, rock and soils management, and traffic management, as well as specific protection procedures for caribou, avifauna, and other wildlife including bats and American marten; fish and fish habitat; historic resources; and the Victoria Dam.

The EPP is closely linked to the follow-up monitoring programs as it describes practical procedures to reduce or eliminate potential adverse environmental effects, as well as instructions for addressing planned and unplanned activities/events associated with Project construction. A process for the communication to Indigenous groups of potential adverse effects of planned Project activities upon the use of land and resources by Indigenous persons (including hunting, trapping, fishing and gathering, and access to lands and resources) is provided in the Current Use of Lands and Resources for Traditional Purposes Indigenous Communications Plan. Response measures in the event of an accidental event are described in Section 4 of the Accidents and Malfunctions Prevention and Response Plan (AMPRP). Additionally, communications and reporting requirements are provided in the Section 5 of the AMPRP as well as Appendix A with respect to communication specific to Indigenous groups.

Marathon has developed a grievance mechanism to afford a process for addressing grievances on the part of non-Indigenous and Indigenous groups or Indigenous persons resulting from the effects of the Project to these users, such as effects to land and resource use, health, socio-economic conditions and heritage resources. In the event that grievances are received, these will be logged and investigated.

The follow-up monitoring program presented herein will be implemented throughout Project construction and operation and has been developed to meet the associated requirements identified during the environmental assessment process. The monitoring program is subject to refinements based on consultation with regulators, Indigenous groups, and conditions of authorization.

1.1 PROJECT OVERVIEW

Marathon is developing the Valentine Gold Project (the Project), an open pit gold mine to be located in the west-central region of the Island of Newfoundland (NL), near Valentine Lake. The Project will use standard surface mining techniques to mine gold ore from the Leprechaun and Marathon open pits. Ore material will initially be mined and processed at a nominal rate of 6,850 tonnes per day (Tpd), increasing to 10,960 Tpd in Year 4. Current estimates are for a total Project mine excavation of 453 million tonnes of combined ore and waste material. The total ore to be mined from the open pits is estimated to be approximately 41 million tonnes.

Ore will be processed through the mill, where it will be crushed, milled and put through flotation and cyanidation processes to recover the gold. Separate stockpiles will be established for high-grade ore for priority processing and low-grade ore for processing later in the mine life. Tailings will be treated in the process plant area to remove the cyanide and subsequently deposited in an engineered tailings management facility (TMF) in Years 1 to 9, then pumped to the exhausted Leprechaun open pit in Years 10 through 12. Gold will be formed into doré bars, which will be shipped from site to refiners in secured trucks.

1.2 GOALS AND OBJECTIVES

This document has been developed and prepared using currently available information and will require updates based on further details regarding Project design, sequencing, and methods. It is anticipated that this monitoring program will be updated with further details such as specific equipment and sampling locations during the permitting stage of Project planning (i.e., following regulatory review) and will be completed prior to the start of the monitoring program.

1.2.1 Purpose

The purpose of the AAQFMP is to:

- Identify the regulatory requirements, air quality standards, and conditions relevant to air releases from the Project.
- Identify and describe the sources of air contaminant releases during Project construction, operation and decommissioning/closure.
- Describe the mitigation measures for reducing gaseous and fugitive dust emissions associated with mine activities during Project construction, operation and decommissioning/closure.
- Describe the ambient air quality monitoring to be conducted during Project construction, operation and decommissioning/closure, to meet federal and provincial ambient air quality standards and criteria.
- Apply the principles of adaptive management to dust emissions based on the results of the ambient particulate matter (PM) monitoring program to continually assess the effectiveness of dust mitigation measures and the corrective actions to further reduce dust emissions (e.g., implementation of additional mitigation measures).
- Describe the provincial and federal requirements for emissions reporting and air quality monitoring reporting.

The AAQFMP applies to Project activities and addresses only ambient air quality management and mitigation. Workplace (e.g., occupational) air quality and worker exposure assessments/monitoring, controls, and mitigation measures will be developed and addressed separate from the ambient requirements.

The management and mitigation measures for reducing GHG emissions are addressed in the Greenhouse Gas Emissions Follow-up Monitoring Program (GHGEFMP).

1.2.2 Objectives

Objectives and targets are established to drive continuous improvement in environmental performance through the adaptive management process and are consistent with the overall strategic goals of the Project. Objectives are measurable (where possible), monitored, communicated, and updated as appropriate.

The objectives of the AAQFMP are to:

- Implement ambient air quality monitoring program during Project construction and operation to monitor ambient PM and trace metals concentrations relative to regulatory ambient air quality criteria.
- Implement mitigation measures to reduce emissions from the Project activities to the extent feasible.
- Use the ambient air quality monitoring results for PM and trace metals to implement adaptive management for fugitive dust emissions.

1.3 REGULATORY SETTING

1.3.1 Federal Regulatory Requirements

The *Canadian Environmental Protection Act, 1999* (CEPA) sets ambient air quality standards as environmental quality objectives specifying goals or purposes for pollution prevention or environmental control that have the ultimate goal to improved air quality, healthier communities and the protection of the environment.

The Canadian Ambient Air Quality Standards (CAAQS; CCME 2017) were established under CEPA through a collaborative process involving the federal, provincial and territorial governments and stakeholders under the direction of the Canadian Council of Ministers of the Environment (CCME). The CAAQS were developed as part of the Air Quality Management System (CCME 2012a) with the objective of driving continuous improvement of air quality in Canada. The CCME describes the process for selecting monitoring stations, measuring pollutant concentrations, and determining achievement of the CAAQS (CCME 2019; CCME 2012b). The achievement of the CAAQS is based upon the measured air quality concentrations at community monitoring stations with comparison to the CAAQS and assigning air quality status to one of four management levels (CCME 2019b; CCME 2012b). The four air quality management levels (Table 1.1) require progressively more rigorous actions by jurisdictions as air quality approaches or exceeds the CAAQS, thereby allowing proactive management actions to be undertaken to reduce emissions and avoid exceedances of the CAAQS (CCME 2019a).

Table 1.1 Canadian Ambient Air Quality Standards Air Quality Management Levels

Air Quality Management Levels	8-hour Ozone (µg/m³)		24-hour $PM_{2.5}$ [a] (µg/m³)		Annual $PM_{2.5}$ [b] (µg/m³)		1-hour Sulphur Dioxide [c] (µg/m³)		Annual Sulphur Dioxide [d] (µg/m³)		1-hour Nitrogen Dioxide [e] (µg/m³)		Annual Nitrogen Dioxide [f] (µg/m³)	
	2020	2025	2015	2020	2015	2020	2020	2025	2020	2025	2020	2025	2020	2025
Red	>122	>118	>28	>27	>10.0	>8.8	>183	>170	>13	>10	>113	>79	>32	>23
Orange	>110 and ≤122	>110 and ≤118	>19 and ≤28	>19 and ≤27	>6.4 and ≤10.0	>6.4 and ≤8.8	>131 and ≤183	>131 and ≤170	>8 and ≤13	>8 and ≤10	>58 and ≤113	>58 and ≤79	>13 and ≤32	>13 and ≤23
Yellow	>98 and ≤110		>10 and ≤19		>4.0 and ≤6.4		>79 and ≤131		>5 and ≤8		>38 and ≤58		>4 and ≤13	
Green	≤98		≤10		≤4.0		≤79		≤5		≤38		≤4	

Notes:
[a] Achievement based on the 3-year average of the annual 98th percentile of $PM_{2.5}$ daily 24-hour average concentrations
[b] Achievement based on the 3-year average of the annual average of the $PM_{2.5}$ daily 24-hour average concentrations
[c] Achievement based on the 3-year average of the annual 99th percentile of the SO_2 daily maximum 1-hour average concentrations
[d] Achievement based on the average over a single calendar year of all 1-hour average SO_2 concentrations
[e] Achievement based on the 3-year average of the annual 98th percentile of the NO_2 daily maximum 1-hour average concentrations
[f] Achievement based on the average over a single calendar year of all 1-hour average NO_2 concentrations
Source: Canadian Council of Ministers of the Environment (CCME) website: http://airquality-qualitedelair.ccme.ca/en/

The CAAQS are based on three interrelated elements: an averaging time, a numerical value for each averaging time and a statistical note on the metric. This statistical note sets the method of calculation to determine how the ambient air contaminant concentrations are to be compared to the numerical value of the CAAQS, to determine whether the measured values have achieved or met the standard. The CAAQS and the year when each ambient standard comes into effect are presented in Table 1.1.

The CEPA also stipulates those owners or operators of facilities that meet published reporting requirements must report to the Environment and Climate Change Canada (ECCC) National Pollutant Release Inventory (NPRI) system. The NPRI reporting requirements apply to more than 300 substances. The need to report depends on the amount that was released (to air, water and land), disposed or recycled at the facility during each calendar year. The values must be reported if the release is greater than a specified threshold described in the NPRI documents. Reports are required to be submitted to the NPRI system for each calendar year by the end of May of the following year.

1.3.2 Provincial Regulatory Requirements

1.3.2.1 Regulations

Air quality in NL is regulated by the *Air Pollution Control Regulation (2022)* under the NL *Environmental Protection Act (*NL EPA). 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 (NLAAQS) apply to ambient air and were established under the NL EPA in 2004 and updated most recently in 2022. The NLAAQS (Government of NL 2022) applicable to the Project are presented in Table 1.2.

Table 1.2 Summary of NL Ambient Air Quality Standards (NLAAQS)

Air Contaminant	Average Period	Newfoundland and Labrador Ambient Air Quality Standard ($\mu g/m^3$)
Total Suspended Particulate Matter (TSP)	24-hour	120
	Annual	60
Respirable Particulate Matter (PM_{10})	24-hour	50
Fine Particulate Matter ($PM_{2.5}$)	24-hour	25
	Annual	8.8
Nitrogen Dioxide (NO_2)	1-hour	400
	24-hour	200
	Annual	100
Sulphur Dioxide (SO_2)	1-hour	900

Table 1.2 Summary of NL Ambient Air Quality Standards (NLAAQS)

Air Contaminant	Average Period	Newfoundland and Labrador Ambient Air Quality Standard (µg/m^3)
	3-hour	600
	24-hour	300
	Annual	60
Carbon Monoxide (CO)	1-hour	35,000
	8-hour	15,000
Ammonia (NH_3)	24-hour	100
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
Mercury (Hg)	24-hour	2
Nickel (Ni)	24-hour	2
Zinc (Zn)	24-hour	120

1.3.2.2 Guidelines

The NLECC has published a number of guidance documents and policies to support proponents operating in NL with meeting the regulatory requirements with respect to monitoring ambient air quality. In particular, Guidance Document GD-PPD-009.4, “Determination of Compliance with Ambient Air Quality Standards” (Government of NL 2012a) (the Compliance Guideline) defines the procedures that NLECC will follow when determining whether a facility is in compliance with the NL *Air Pollution Control Regulations*. This Guideline outlines conditions under which a facility shall complete air dispersion modelling, ambient air quality monitoring and/or stack emissions testing. The following documents provide the details under which dispersion modelling, ambient air quality and stack emissions testing should be conducted:

- Guidance Document, GD-PPD-019.2, “Guidance for Plume Dispersion Modelling” (Government of NL 2012b)
- Guidance Document, GD-PPD-065, “Ambient Air Monitoring Guidelines” (Government of NL 2010)
- Guidance Document, GD-PPD-016.1, “Procedure Guide for Source Emission Testing” (Government of NL 2004)

The Compliance Guideline defines five different emission source types and associated requirements with respect to demonstrating compliance with the NL *Air Pollution Control Regulation.* Based on the emissions estimated during Project operation (as presented in Chapter 5 of the EIS and Section 4 below), the Project would be considered a Type 1 Emissions Source, and would be subject to the following requirements:

- For a new facility:
  - Register a stack emission test and a dispersion model within the first 6 months of operation and register a second stack emission test and dispersion model within the last 6 months of the first 2 years of operation. After the first 2 years of operation, a new facility becomes an existing facility
- For an existing facility (i.e., following the first two years of operation):
  - Register a stack emission test and dispersion model once every 4 years if it has been shown, through a registered dispersion model, that the facility is compliant with the AAQS for all pollutants.
  - If a registered dispersion model indicates non-compliance with the AAQS for any pollutant, then the facility will normally complete and register a stack emission test and dispersion model, once every 2 years.
  - Under special circumstances, the Department reserves the right to require an existing facility to register a stack emission test, and a dispersion model at more frequent intervals.

The results of the air dispersion modelling (i.e., predicted ground level concentrations) are compared to the NL AAQS to determine compliance with the *Air Pollution Control Regulation*. If a facility is determined to be non-compliant (i.e., the dispersion model predicts exceedances of the NL AAQS), it would enter into a compliance agreement with NLECC, which may consist of establishing a compliance ambient air quality monitoring network. In addition to a compliance ambient air quality monitoring network, a facility may be required to establish a community ambient air quality monitoring network as part of a Certificate of Approval to operate.

2.0 ENVIRONMENTAL SETTING

2.1 BASELINE AIR QUALITY

2.1.1 Meteorology

Existing meteorology and climate in the Project Area are characterized using climate normals and wind data from representative meteorological stations located nearest to the Project, with sufficient data availability. Climate normals for the 30-year period from 1981 to 2010 and wind data from 2015 to 2019 were obtained and used in this assessment. The climate normals information was obtained from ECCC (ECCC 2019a) and the wind information was obtained from the United States based National Climatic Data Center (NCDC) (NCDC 2020).

Climate normals and hourly wind data for the 30-year period of 1981-2010 were obtained from the nearest meteorological stations to the mine site. These included: Buchans and Deer Lake (ECCC, 2019a, NCDC 2020). The thirty-year climate normals (1981-2010) were obtained from the Buchans station, which is located approximately 55 km north-northeast of the mine site. Hourly wind data covering the 2015 to 2019 period were obtained from the Deer Lake station, which is located approximately 95 km north of the site. Wind data were obtained from the Deer Lake station, as wind data are not available from the Buchans station, and Deer Lake is the nearest station to the mine site with wind data available.

The 1981 to 2010 climate normals for the Buchans station are shown in Table 2.1.

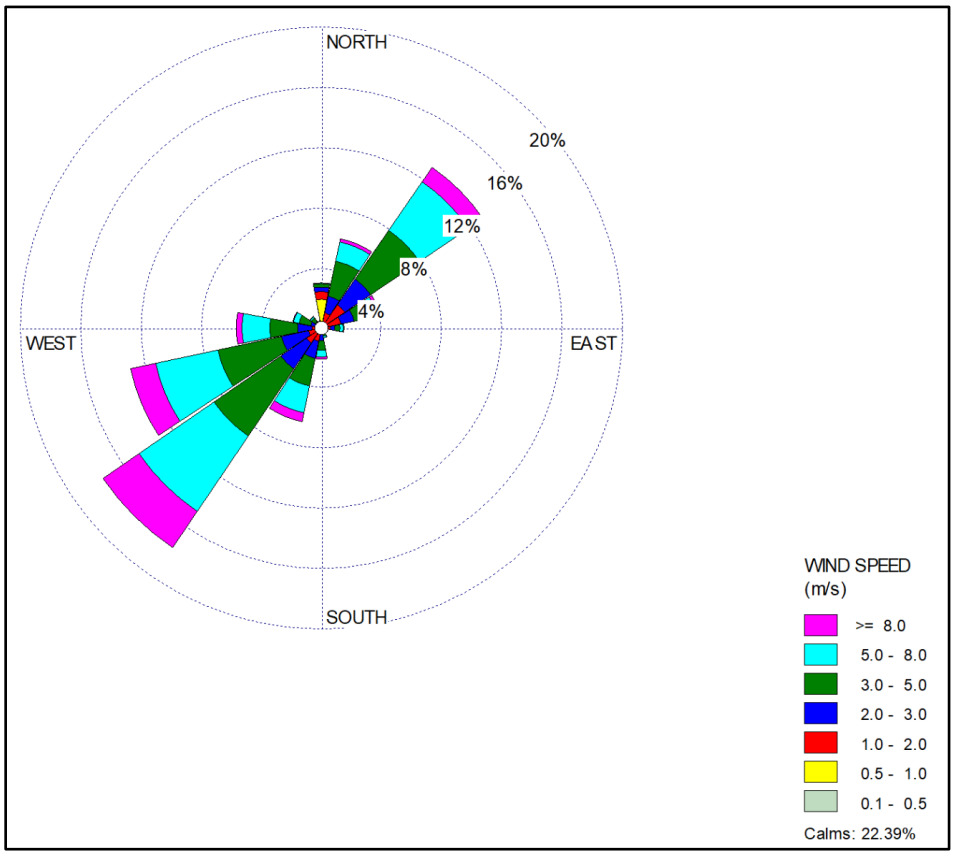
Table 2.1 Climate Normals, Buchans, Newfoundland and Labrador (1981 – 2010)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature													
Daily Mean (°C)	-8.2	-8.4	-4.8	1	7	12.1	16.3	16.2	11.9	6	0.5	-4.5	3.8
Daily Maximum (°C)	-4.6	-4.4	-0.9	4.6	11.5	17	21.1	20.9	15.8	9.1	3.1	-1.5	7.6
Daily Minimum (°C)	-11.8	-12.3	-8.7	-2.5	2.5	7.1	11.4	11.6	7.9	2.8	-2.1	-7.5	-0.1
Extreme Daily Maximum (°C)	13.5	10	17	20.6	27.5	32	33	32	30	22.5	15.6	12.8	--
Date of Occurrence (yyyy/dd)	2006/15	1976/02	1999/29	1979/29	1999/08	1999/14	1983/05	1995/11	2001/10	1994/09	1977/10	1969/04	--
Extreme Daily Minimum (°C)	-30	-33.5	-30.5	-22.5	-10	-3.3	1	1.1	-2.2	-8.3	-19	-26	--
Date of Occurrence (yyyy/dd)	2004/25	1993/07	1990/08	1995/06	1972/02	1974/01	1995/02	1976/19	1972/29	1972/22	1992/24	1993/29	--
Precipitation													
Rainfall (mm)	33.7	25.6	39.5	59.5	82.2	87.7	95.3	123	110.3	92.5	81.5	46.3	877
Snowfall (cm)	88.3	72.5	55.5	26.2	4.4	0.1	0	0	0.1	5	30.4	76.9	359.3
Precipitation (mm)	122	98.1	95	85.7	86.6	87.8	95.3	123	110.4	97.5	111.8	123.1	1,236.2
Extreme Daily Rainfall (mm)	58.4	47	52.4	54	63.6	72.8	74.6	139	69	66.8	68.6	66.3	--
Date of occurrence (yyyy/dd)	1983/13	1971/14	1983/22	1994/07	1993/15	1985/06	1996/14	1983/07	1998/05	1966/05	1995/26	1975/22	--
Extreme Daily Snowfall (cm)	40	38.1	70	20	17.8	10.2	0	0	3.8	28.4	25	30	--
Date of occurrence (yyyy/dd)	1984/11	1973/11	2005/30	1992/06	1972/11	1976/12	1965/01	1965/01	1971/28	1969/22	1994/28	2000/27	--
Extreme Daily Precipitation (mm)	58.4	47	70	54	63.6	72.8	74.6	139	69	66.8	68.6	73.4	--
Date of occurrence (yyyy/dd)	1983/13	1971/14	2005/30	1994/07	1993/15	1985/06	1996/14	1983/07	1998/05	1966/05	1995/26	1975/22	--
Source: ECCC 2019a													

Daily average temperatures at Buchans range between -8.4°C to 16.3°C, with the lowest average temperatures occurring in February and the highest occurring in July. Extreme daily maximum and minimum temperatures range between -33.5°C (February) to 33°C (July).

Total annual average precipitation at Buchans is 1,236 mm, with 359 cm of snow and 877 mm of rain. Monthly average precipitation ranges between 86 to 123 mm, with the least occurring in April and the most occurring in December.

A wind rose plot of the annual winds at Deer Lake from 2015 to 2019 is shown in Figure 2-1. Seasonal wind rose plots are also shown in Figure 2-2. Winds prevail from the southwest and northeasterly directions. The highest wind speeds occur most frequently from the southwest direction and the lowest wind speeds occur most frequently from the north and northeast directions. Calm periods are also common, with wind speeds less than 0.5 metres per second (m/s), accounting for more than 22% of the observed winds at Deer Lake over the 2015 to 2019 period. Generally, the seasonal winds are consistent, with winds prevailing from the southwest and northeast (i.e., there is limited seasonal variation in the winds at Deer Lake).



Data source: NCDC 2020

Figure 2-1 Winds at Deer Lake, Newfoundland and Labrador (2015 – 2019)

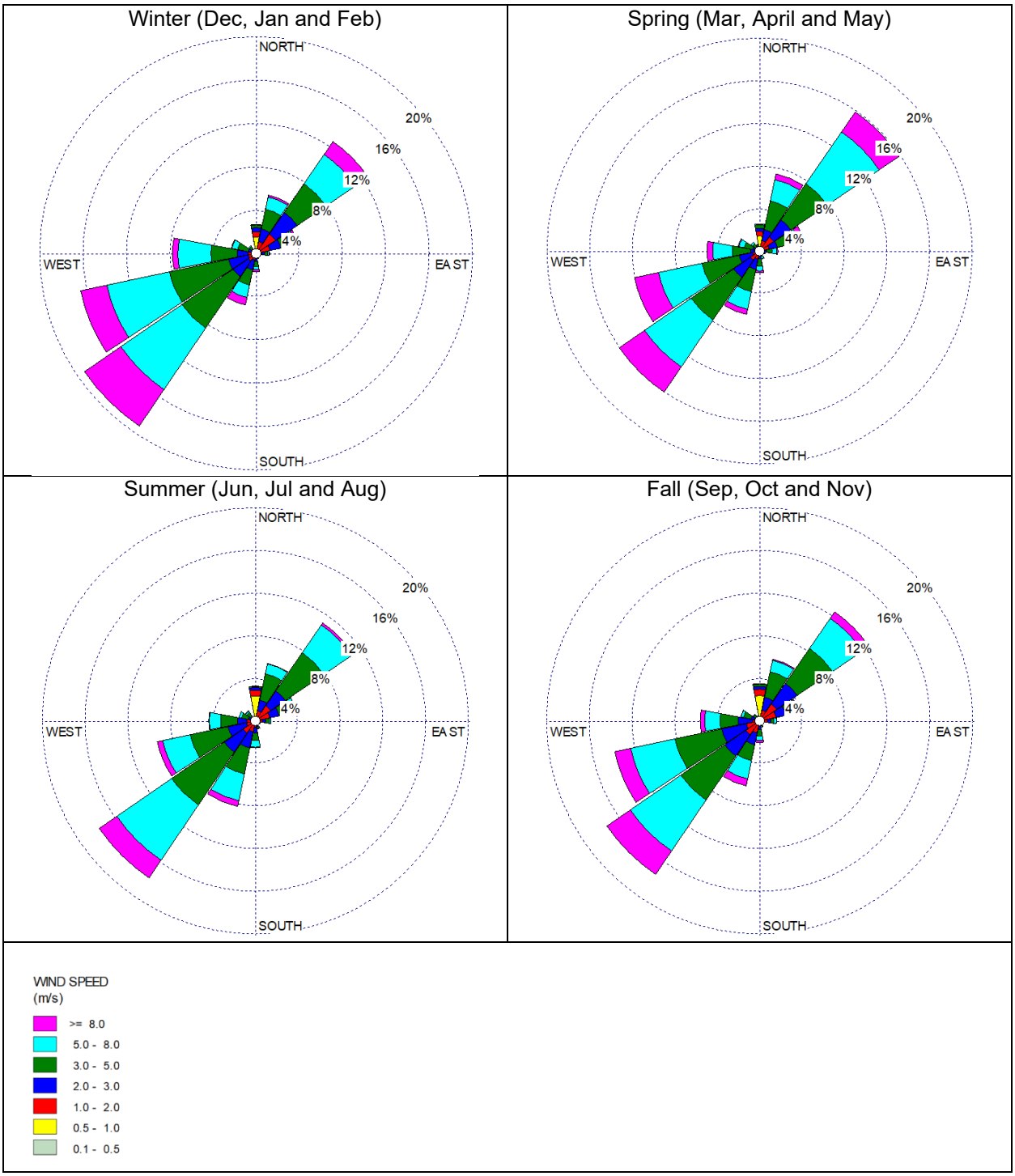


Figure 2-2 Seasonal Winds at Deer Lake, Newfoundland and Labrador (2015 – 2019)

2.1.2 Ambient Air Quality

Given the largely undeveloped nature of the Project Area, there are few sources of air contaminants from human activities in the area, nor are there large industrial emissions sources within the Project Area. Based on a review of NPRI data (ECCC 2018) for the Island of Newfoundland, the nearest sources of air contaminants to the mine site (but outside of the Project Area) consist of two mine sites which are no longer operational, and the Corner Brook Pulp and Paper Mill. The two mine sites are the Teck Resources Duck Pond Mine and Barite Mud Services which are located approximately 57 km and 41 km northeast of the mine site, respectively. The Duck Pond Mine is no longer operational and is in the closure and rehabilitation phase, while Barite Mud Services is operational on a seasonal basis. Although neither mine site remains fully operational, potential exists for fugitive dust to be generated at each site. In addition, decommissioning activities are on-going at the Duck Pond Mine, which could result in further fugitive dust emissions. The Corner Brook Pulp and Paper Mill is located approximately 90 km to the northwest of the mine site. Based on NPRI reporting data, substantive air contaminant emissions from the pulp and paper mill consist of combustion gases (nitrogen oxides [NO_X], carbon monoxide [CO], and SO_2), particulate matter (PM), volatile organic compounds (VOCs) and selected trace metals.

Given that the nearest sources of air contaminant emissions are outside of the Project Area and distant from the mine site, it is unlikely that these air contaminant releases would contribute in a substantive way to reduced air quality within the Project Area for this Project.

Existing air quality in the Project Area was characterized by obtaining and assessing measured ambient air quality data, as well as data for releases of air contaminants from existing sources within the Local Assessment Area (LAA). A baseline ambient air quality monitoring survey was conducted near the proposed mine site in June 2020. The survey consisted of measuring ambient concentrations of total suspended particulate matter (TSP), particulate matter less than 10 microns in diameter (PM_{10}), trace metals, sulphur dioxide (SO_2) and nitrogen dioxide (NO_2). The monitoring event was conducted from June 15-19, 2020.

In addition to the data collected within the Project Area, the most recently available ambient air quality data (2016 to 2017) from the National Air Pollutant Surveillance (NAPS) Program (ECCC 2019b) and the provincial air quality report for 2020 were obtained (Newfoundland and Labrador Department of Municipalities and Environment (NLDMAE) 2021).

The nearest and most representative NAPS ambient air quality monitoring (AAQM) station to the mine site is at Grand Falls-Windsor, approximately 120 km northeast of the mine site. There is also a NAPS station located at Corner Brook, which is closer to the mine site; however, this station is immediately adjacent to the Corner Brook Pulp and Paper Mill. Therefore, air contaminant concentrations measured at the Corner Brook station are likely to be less representative of existing ambient concentrations in the area of the Project than those measured at the Grand Falls-Windsor station, as there are no large emissions sources in close proximity the Grand Falls-Windsor station.

Concentrations of the following air contaminants are measured at the Grand Falls-Windsor station:

1. Particulate matter ≤ 2.5 microns ($PM_{2.5}$)
2. Ozone (O_3)
3. Nitric oxide (NO)
4. NO_2
5. NO_X
6. CO
7. SO_2

An overview of the 2016-2017 NAPS monitoring results for the Grand Falls-Windsor station, for those air contaminants relevant to the Project, are presented in Table 2.2.

Table 2.2 Ambient Air Quality Data as Measured at the Grand-Falls Windsor NAPS Monitoring Location (2016 – 2017)

Value	Measured Concentrations (ug/m^3)			
	SO_2	NO_2	$PM_{2.5}$	CO
Max Hourly	15.7	73.4	76.0	916
98th Percentile	2.62	11.3	16.0	286
90th Percentile	2.62	3.76	9.00	206
3-hour 90th percentile	2.62	-	-	-
8-hour 90th percentile	-	-	-	200
Max Daily	2.95	12.7	16.1	373
Max Daily (excl hourly values >90th percentile)	0	1.88	8.00	195
Daily 98th Percentile*	-	-	10.3	-
Daily Average	-	-	-	-
Max Annual Average	0.78	2.56	4.66	155
Annual Average (excl hourly values >90th percentile)	0.78	1.40	3.84	144

Notes:
* Average of 2016 and 2017 annual 24-hour 98th percentiles, for comparison with CAAQS for $PM_{2.5}$
NL AAQS for 24-hour time averaging period: SO_2 - 300 ug/m^3, NO_2 - 200 ug/m^3, $PM_{2.5}$ - 25 ug/m^3
NL AAQS for 8-hour time averaging period: CO – 15,000 ug/m^3
NL AAQS for the annual time averaging period: SO_2 - 60 ug/m^3, NO_2 - 100 ug/m^3, $PM_{2.5}$ – 8.8 ug/m^3
Source: ECCC 2019b

As presented in Table 2.2, the ambient air quality monitoring data collected at the NAPS monitoring location in Grand Falls-Windsor in 2016-2017, for those air contaminants of interest to the Project, were below applicable AAQS in NL.

In addition to the NAPS data presented above, according to the NL 2020 Ambient Air Quality Report (NLDMAE 2021), there were no measured concentrations that exceeded the provincial NL AAQS (for SO_2, NO_2 or CO) or the federal CAAQS (for $PM_{2.5}$ – 27 ug/m^3) in 2020 at the Grand Falls-Windsor NAPS station (NLDMAE 2021).

The results of the ambient air quality monitoring conducted within the Project Area in June 2020 for TSP, PM_{10} and speciated metals are presented in Table 2.3.

Table 2.3 Ambient Air Quality Monitoring Survey Results for TSP, PM_{10} and Metals within the Project Area, June 2020

Parameter	NL AAQS (µg/m^3)	Monitoring Results (24-hour Concentrations (µg/m^3)		
		June 15-16, 2020	June 16-17, 2020	June 17-18, 2020
Total Suspended Particulate Matter (TSP)	120	5.1	8.6	13.8
Particulate Matter less than 10 Microns (PM_{10})	50	5.1	7.5	13
Trace Metals				
Total Aluminum (Al)	-	<0.084	0.087	0.17
Total Antimony (Sb)	-	<0.0021	<0.0021	<0.0021
Total Arsenic (As)	0.3	<0.0021	<0.0021	<0.0021
Total Barium (Ba)	-	<0.0021	<0.0021	<0.0021
Total Beryllium (Be)	-	<0.0013	<0.0012	<0.0012
Total Bismuth (Bi)	-	<0.0021	<0.0021	<0.0021
Total Boron (B)	-	<0.042	<0.042	<0.042
Total Cadmium (Cd)	-	<0.00042	<0.00042	<0.00042
Total Calcium (Ca)	2.0	<0.21	0.21	0.24
Total Chromium (Cr)	-	<0.0021	<0.0021	<0.0021
Total Cobalt (Co)	-	<0.0013	<0.0012	<0.0012
Total Copper (Cu)	50	<0.0013	<0.0012	<0.0012
Total Iron (Fe)	-	<0.21	<0.21	<0.21
Total Lead (Pb)	2.0	<0.0013	<0.0012	<0.0012
Total Magnesium (Mg)	-	<0.042	0.050	0.11
Total Manganese (Mn)	-	0.0031	0.0032	0.0070
Total Molybdenum (Mo)	-	<0.0013	<0.0012	<0.0012
Total Nickel (Ni)	2.0	<0.0021	<0.0021	<0.0021
Total Potassium (K)	-	<0.21	<0.21	<0.21
Total Selenium (Se)	-	<0.0042	<0.0042	<0.0042
Total Silver (Ag)	-	<0.00042	<0.00042	<0.00042

Table 2.3 Ambient Air Quality Monitoring Survey Results for TSP, PM_{10} and Metals within the Project Area, June 2020

Parameter	NL AAQS ($\mu g/m^3$)	Monitoring Results (24-hour Concentrations ($\mu g/m^3$)		
		June 15-16, 2020	June 16-17, 2020	June 17-18, 2020
Total Sodium (Na)	-	<0.21	<0.21	0.44
Total Strontium (Sr)	-	<0.0021	<0.0021	<0.0021
Total Thallium (Tl)	-	<0.00042	<0.00042	<0.00042
Total Tin (Sn)	-	<0.0013	<0.0012	<0.0012
Total Titanium (Ti)	-	<0.0042	<0.0042	0.0043
Total Uranium (U)	-	<0.00042	<0.00042	<0.00042
Total Vanadium (V)	2.0	<0.0013	<0.0012	<0.0012
Total Zinc (Zn)	120	<0.021	<0.021	<0.021

Notes:
"<" indicates analysis below the reportable detection limit
"-"indicates no applicable criteria in the province of NL

The 24-hour measured concentrations of TSP, PM_{10} and trace metals were well below applicable ambient air quality criteria in NL. Measured concentrations of particulate matter (TSP and PM_{10}) ranged from 5.1 $\mu g/m^3$ to 13.8 $\mu g/m^3$ and the concentrations of TSP and PM_{10} were consistent, suggesting that the existing particulate matter within the Project Area is made up mostly of PM_{10}. Metals detected in the samples include aluminum, calcium, magnesium, manganese, sodium and titanium; the measured concentrations were below the regulatory standards where they exist. The remaining metals that were sampled were not detected above the analytical method reportable detection limits.

The results of the ambient air quality monitoring conducted within the Project Area in June 2020 for NO_2 and SO_2 are presented in Table 2.4.

Table 2.4 Ambient Air Quality Monitoring Survey Results for SO_2 and NO_2 within the Project Area, June 2020

Parameter	Monitoring Results, Concentration over Monitoring Period, June 15 – 19, 2020 ($\mu g/m^3$)	Monitoring Results, Converted to an estimated 24-hour Concentration* ($\mu g/m^3$)	NL AAQS ($\mu g/m^3$)
Sulphur Dioxide (SO_2)	2.62	3.84	300
Nitrogen Dioxide (NO_2)	<0.188	0.276	200

Note:
*Measured concentrations were converted to an estimated 24-hour concentration using guidance published in the "Air Dispersion Modelling Guideline for Ontario" (OMECC 2017)

The measured concentrations of SO_2 and NO_2 were below applicable ambient air quality criteria in NL and were consistent with data measured through NAPS at the Grand Falls-Windsor monitoring station.

2.2 PROJECT EMISSIONS

During construction, activities result in releases of air contaminants from fuel combustion in heavy equipment and fugitive dust due to earth moving and site preparation activities. During operation, air contaminants are released from mining activities, from fuel combustion in heavy equipment and from processing plant sources. The release estimates were prepared and summarized in an emissions inventory for both construction and operation. The inventories were prepared using operational and design information provided by the Marathon and published emission factors. Additional details on air contaminant release estimates for construction and operation are provided below. They were initially provided in Chapter 5 of the EIS (Marathon 2020) and were refined in response to Information Requirements (IRs). During the decommissioning, rehabilitation and closure phase of the Project, air contaminant releases will be similar to, or less than, those during construction and operation.

An air quality transport and dispersion model provides the link between the air contaminant releases and changes to ambient concentrations. For the air quality assessment, the CALMET / California Puff (CALPUFF) modelling system (Scire et al. 2000) was used to determine the potential effects of the air contaminant releases during operation of the Project on ambient air quality. The potential air contaminant releases during construction were estimated for the EA, and were not modelled, since these releases are expected to be short-term and lower in magnitude than during operation.

An overview of the air contaminant release estimates and results of the dispersion modelling are presented in the following subsections. Specific details can be found in Chapter 5 of the EIS (Marathon 2020).

2.2.1 Contaminant Releases

2.2.1.1 Construction

During construction, air contaminant releases are expected from the following activities:

1. Air contaminants generated from the combustion of fossil fuels (e.g., diesel and gasoline) by heavy mobile equipment and vehicles
2. Particulate matter (dust) generated by land clearing, earth moving activities, material handling, and blasting
3. Particulate matter (dust) generated by equipment movements, and vehicles on unpaved roads

The quantities of air contaminants that may be released during construction were estimated. Releases were estimated for blasting activities, fugitives from wind erosion of stockpile surfaces, material transfer (loading and unloading) at stockpiles, fugitives from travel on haul roads, and from fuel combustion in mobile heavy equipment. The air contaminant release estimates from construction activities are provided in Table 2.5.

Table 2.5 Air Contaminant Releases – Construction

Air Contaminant	CAS #	Emission Rate (tonnes/year)					
		Blasting	Stockpile Fugitives	Transfer Points at Stockpiles	Haul Route Fugitives	Mobile Combustion Sources - Heavy Equipment	Total
TSP	N/A-1	0.98	30.0	21.9	434	1.32	
PM_{10}	N/A-2	0.51	15.0	10.4	136	1.32	163
$PM_{2.5}$	N/A-3	0.15	6.00	1.57	17.2	1.32	26.2
NO_X	10102-44-0	17.4	-	-	-	112	129
SO_2	7446-09-5	2.17	-	-	-	37.9	40.1
CO	630-08-0	73.8	-	-	-	123	196
As	7440-38-2	9.81E-06	3.00E-04	6.08E-05	-	-	3.71E-04
Cd	7440-43-9	8.83E-07	2.70E-05	5.47E-06	-	-	3.34E-05
Cu	7440-50-8	9.81E-05	3.00E-03	6.08E-04	-	-	3.71E-03
Pb	7439-92-1	2.94E-05	8.07E-04	1.56E-04	-	-	9.92E-04
Hg	7439-97-6	2.94E-07	9.00E-06	1.82E-06	-	-	1.11E-05
Ni	7440-02-0	8.34E-06	2.41E-04	4.77E-05	-	-	2.97E-04
Zn	7440-66-6	2.39E-05	6.33E-04	1.20E-04	-	-	7.77E-04
Ba	7440-39-3	2.54E-05	6.44E-04	1.19E-04	-	-	7.89E-04
Sr	7440-24-6	3.50E-05	8.39E-04	1.51E-04	-	-	1.02E-03
Be	7440-41-7	1.08E-07	3.11E-06	6.16E-07	-	-	3.84E-06
Cobalt	7440-48-4	7.36E-06	2.02E-04	3.89E-05	-	-	2.48E-04
Li	7439-93-2	1.96E-05	6.00E-04	1.22E-04	-	-	7.41E-04
Sb	7440-36-0	1.96E-05	6.93E-04	1.48E-04	-	-	8.61E-04
Sn	7440-31-5	3.43E-05	1.10E-03	2.26E-04	-	-	1.36E-03
Se	7782-49-2	2.94E-05	9.00E-04	1.82E-04	-	-	1.11E-03
Cr	7440-47-3	4.78E-05	1.57E-03	3.27E-04	-	-	1.94E-03
Bi	7440-69-9	9.81E-06	3.00E-04	6.08E-05	-	-	3.71E-04

2.2.1.2 Operation

During operation of the Project, air contaminants may be released to the atmosphere as follows:

1. Particulate matter (TSP, PM_{10} and $PM_{2.5}$) and trace metals (within the dust) during ore handling and crushing (material loading / unloading and transfer, ore and material hauling, crushing and screening)
2. Fugitive releases of particulate matter (TSP, PM_{10} and $PM_{2.5}$) and trace metals (within the dust) due to wind erosion of ore stockpiles and waste rock pile surfaces; note: fugitive releases are characterized as those not originating from a stack or vent, and are released over an area or from an initial volume
3. Fugitive releases of particulate matter (TSP, PM_{10} and $PM_{2.5}$) and trace metals (within the dust) from the TMF due to wind erosion of dry, exposed tailings beach surfaces
4. Fugitive releases of NO_X, SO_2, CO, particulate matter (TSP, PM_{10} and $PM_{2.5}$), and trace metals (within the dust) from blasting at the Marathon and Leprechaun pits
5. Releases of NO_X, SO_2, CO, and particulate matter (TSP, PM_{10} and $PM_{2.5}$) from internal combustion engines associated with mobile heavy equipment for material loading, unloading and hauling
6. Releases of particulate matter (TSP, PM_{10} and $PM_{2.5}$), trace metals (within the dust), NH_3, and HCN from the processing plant sources

A summary of the estimated annual air contaminant releases during operation is provided in Table 2.6.

Table 2.6 Annual Air Contaminant Release Estimates – Operation

Source/Activity	Emissions (tonnes/year)											
	TSP	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	HCN	NH_3	As	Cd	Cu	Pb
Pit Blasting	4.04	4.04	4.04	143	17.9	607	-	-	4.04E-05	3.63E-06	4.04E-04	1.21E-04
Stockpiles	69.4	34.7	13.9	-	-	-	-	-	6.94E-04	6.25E-05	6.94E-03	2.03E-03
TMF	0.040	0.020	2.98E-03	-	-	-	-	-	6.23E-07	4.67E-08	3.76E-06	1.03E-06
Conveyors / transfer points	21.2	10.0	1.51	-	-	-	-	-	5.88E-05	5.29E-06	5.88E-04	1.50E-04
Loading / unloading at stockpiles	80.7	38.2	5.78	-	-	-	-	-	2.24E-04	2.02E-05	2.24E-03	5.74E-04
Ore Processing Equipment	99.1	36.8	5.58	-	-	-	-	-	9.91E-04	8.92E-05	9.91E-03	1.98E-03
Haul Route Fugitives	1,287	467	68.5	-	-	-	-	-	-	-	-	-
Processing Plant Sources	12.4	12.4	12.4	-	-	-	3.63	3.70	1.24E-04	1.12E-05	1.24E-03	3.17E-04
Mobile Combustion Sources - Heavy Equipment	7.54	7.54	7.54	639	216	698	-	-	-	-	-	-
Total	*1,581*	*611*	*119*	*782*	*234*	*1,306*	*3.63*	*3.70*	*2.13E-03*	*1.92E-04*	*2.13E-02*	*5.17E-03*

Source/Activity	Hg	Ni	Zn	Ba	Sr	Be	Cobalt	Li	Sb	Sn	Se	Cr
Pit Blasting	1.21E-06	3.43E-05	9.85E-05	1.05E-04	1.44E-04	4.44E-07	3.03E-05	8.07E-05	8.07E-05	1.41E-04	1.21E-04	1.96E-04
Stockpiles	2.08E-05	5.82E-04	1.64E-03	1.72E-03	2.34E-03	7.53E-06	5.07E-04	1.39E-03	1.44E-03	2.45E-03	2.08E-03	3.44E-03
TMF	1.19E-08	2.77E-07	2.00E-06	2.16E-06	1.61E-06	5.27E-09	2.08E-07	7.53E-07	8.26E-07	1.33E-06	1.62E-06	2.14E-06
Conveyors / transfer points	1.76E-06	4.61E-05	1.16E-04	1.15E-04	1.46E-04	5.95E-07	3.76E-05	1.18E-04	1.43E-04	2.19E-04	1.76E-04	3.16E-04
Loading / unloading at stockpiles	6.73E-06	1.76E-04	4.43E-04	4.40E-04	5.56E-04	2.27E-06	1.44E-04	4.48E-04	5.47E-04	8.34E-04	6.73E-04	1.21E-03
Ore Processing Equipment	2.97E-05	6.94E-04	1.37E-03	1.16E-03	1.08E-03	8.92E-06	4.95E-04	1.98E-03	2.97E-03	3.96E-03	2.97E-03	5.98E-03
Haul Route Fugitives	-	-	-	-	-	-	-	-	-	-	-	-
Processing Plant Sources	4.43E-05	9.72E-05	2.45E-04	2.43E-04	3.07E-04	1.25E-06	7.93E-05	2.48E-04	3.02E-04	4.61E-04	3.72E-04	6.67E-04
Mobile Combustion Sources - Heavy Equipment	-	-	-	-	-	-	-	-	-	-	-	-
Total	*1.05E-04*	*1.63E-03*	*3.91E-03*	*3.78E-03*	*4.58E-03*	*2.10E-05*	*1.29E-03*	*4.26E-03*	*5.49E-03*	*8.07E-03*	*6.40E-03*	*1.18E-02*

2.2.2 Dispersion Modelling

The maximum predicted concentrations (outside the Project Area) of the air contaminants of concern released during normal operation of the Project combined with measured background concentrations (to account for existing conditions) are provided in Table A-1 in Appendix A.

The maximum predicted concentrations, combined with measured background, at the camps (exploration camp, accommodations camp, outfitters camp) and cabin locations in the LAA and Regional Assessment Area (RAA) are provided in Table A-2 in Appendix A; these are the highest predicted concentrations that occur at camp / cabin locations within the LAA/RAA.

The predicted concentrations are also presented graphically in the form of isopleth plots (concentration contour plots) (refer to Appendix B). The highest predicted concentrations generally occur within 1-2 km of the Project Area boundary.

The maximum predicted concentrations of most air contaminants considered in this study when combined with background are below the provincial AAQS and the adopted AAQS outside the Project Area, with the noted exception of the 24-hour PM_{10} concentrations.

Maximum predicted 24-hour concentrations of PM_{10} due to Project-related releases combined with the measured ambient background concentration are above the ambient air quality standard (adopted for the assessment) as presented in Table A-1. The exceedances of the 24-hour PM_{10} standard are predicted to occur in a small area within 500 m of the eastern mine site boundary (near the TMF), at 119 receptor locations (out of nearly 15,000 modelled). Exceedances are expected to be infrequent and of short duration. For example, at the receptor location where the maximum point of impingement occurs, concentrations above the 24-hour standard are predicted to occur seven times over the three-year modelling period (or less than 1% of the time). The predicted exceedances of the PM_{10} standard are likely a result of the fugitive releases from the TMF, based on the location of occurrence of the maximum predicted concentrations (500-900 m to the east of the TMF).

Generally, the maximum predicted concentrations reach background levels within 10 to 15 km of the Project Area boundary. Maximum predicted air contaminant concentrations (including background) are also below the adopted standards at the camps (existing exploration camp, accommodations camp, outfitters camp) and cabin locations (at camp / cabin locations within the LAA/RAA).

The maximum predicted concentrations (including background) of $PM_{2.5}$, are also below the 24-hour CAAQS.

3.0 PROPOSED MITIGATION AND MANAGEMENT MEASURES

The air contaminant emissions mitigation measures were presented in Chapter 5, Atmospheric Environment, of the EIS under Section 5.4. No new air quality mitigation measures have been identified that were not already included in the EIS or subsequent Information Requests (IRs). The following mitigation measures, related to air quality, are to be applied throughout Project construction, operation and decommissioning, rehabilitation and closure.

Mitigation measures related to air quality include the following.

- During dry periods, water will be applied to the access road, site roads and haul roads as needed to mitigate dust emissions. The application of water will be limited to non-freezing temperatures to avoid icing that can present a safety hazard. Watering is most effective immediately after application, and repeated watering several times a day might be required, depending on surface and meteorological conditions. Water used for dust suppression will be sourced from site contact water, not natural waterbodies.
- The application of dust suppressants other than water to roads as an alternative option to watering will be considered in consultation with NLDECC. Dust suppression would be applied on an as-needed basis during high wind conditions or if measured ambient particulate matter (PM) or trace metal concentrations are in exceedance of the NLAAQS, and if an increase of watering is determined ineffective or unfeasible at the time. The chosen dust suppressant will be approved by the NLDECC prior to application. These suppressants, if required, will be applied, as per the manufacturer's recommendations.
- An ambient air quality monitoring program will be implemented throughout the life of the Project, as required and in accordance with Project permitting and conditions of approval.
- When loading stockpiles, drop heights will be reduced to be as close to the pile as possible.
- Surfaces of topsoil and overburden stockpiles will be stabilized during extended periods between usage by means of vegetating or covering the exposed surfaces.
- Conveyors will be covered to reduce fugitive dust emissions.
- Select exhaust sources will be equipped with emission control technologies to reduce contaminant emissions. Exhaust controls are listed as follows:
  - Lime silo: baghouse
  - Sodium cyanide mix tank: dust collector
  - Copper sulphate storage tank: dust collector
  - Sodium metabisulphite mix tank: dust collector
  - PAX storage tank: baghouse
  - Lime mix / storage: baghouse
  - Elution electrowinning: mist eliminator
  - ICU Electrowinning: mist eliminator
  - Barring furnace: baghouse
  - Carbon regeneration kiln: scrubber

- Engines and exhaust systems of construction and mining equipment will be subject to a comprehensive equipment preventative maintenance program to maintain fuel efficiency and performance. To reduce emissions, equipment and vehicle idling times, and cold starts will be reduced to the extent possible. Marathon will develop an idling policy to this effect
- Vehicles and heavy equipment will be maintained in good working order and will be equipped with appropriate mufflers to reduce noise.
- Haul roads and infrastructure will be designed to reduce transportation and haul distances where possible.
- Project vehicles will be required to comply with posted speed limits on the access road, site roads and haul roads to limit fugitive dust from vehicle travel on unpaved roads. Speed limits will be set in accordance with provincial regulations and industry standards (e.g., for haul roads). Additional speed restrictions will be implemented during caribou migration periods.

4.0 MONITORING PROGRAM

This AAQFMP is based on the results of the air quality assessment conducted to support the EIS, applicable provincial and federal regulations and guidelines, and the Project's provincial and federal conditions of approval.

The results of the dispersion modelling conducted in support of the EIS, based on the current design of the Project, demonstrated compliance of the proposed facility with the NLAAQS with the exception of particulate matter less than 10 microns in diameter, which was predicted to exceed provincial criteria in a small area within 500 m of the eastern mine site boundary (near the TMF).

As per the provincial Compliance Guidance Document (GD-PPD-009.4) (2012a), compliance ambient air quality monitoring will therefore be required during the operation of the Project to provide an understanding of the offsite contaminant concentrations and evaluate the need for more rigorous mitigation. Continuous, real-time, monitoring will include meteorological monitoring (wind speed and wind direction) and monitoring of ambient TSP, PM_{10} and $PM_{2.5}$ concentrations during the operation of the Project. In addition to the continuous particulate monitoring, periodic integrated sampling is proposed for trace metals during the first three years of operation.

The observed ambient air quality values would be compared with provincial air quality standards and objectives and used to verify predicted (modelled) residual effects on air quality associated with fugitive dust. The air quality assessment conducted to support the development of the EIS has identified fugitive dust from mining activities as the major contributor to predicted high ambient PM concentrations outside the Project boundary. More specifically, the elevated PM concentrations predicted during operation are due to fugitive releases from heavy equipment movements (along haul routes and around the pits and waste rock storage piles) as well as fugitive dust generated from wind erosion of dry areas within the tailing management facility.

Ambient PM and trace metal concentrations will be monitored in areas with predicted high concentrations and in proximity to sensitive receptors, including the accommodations camp.

Reports from the ambient air monitoring program will be submitted annually to the regulatory authorities and shared with interested Indigenous groups and local stakeholders. Further, notification will be provided in the event that elevated ambient concentrations are observed (where exceedances of air quality criteria occur). Monitoring data will be reviewed internally by the Environmental Supervisor on a regular basis and used to implement adaptive management for fugitive dust emissions.

The results of the ambient air quality monitoring program will also be used to assess the effectiveness of the dust mitigation and to evaluate the potential need for more rigorous dust mitigation. If the monitoring program indicates that ground-level TSP, PM_{10}, $PM_{2.5}$ or trace metals concentrations exceed the NLAAQS, additional mitigation measures to reduce PM emissions will be implemented and this monitoring program will be updated. If additional mitigation measures are implemented, IAAC will be

notified within 24 hours, and Marathon will follow-up with a detailed description of the measures within 7 days following implementation.

Details of the preliminary ambient air quality monitoring program are presented in the following sections and are based on the current Project design, the dispersion modelling conducted to support the development of the EIS, and the provincial and federal EA conditions of approval. The program will be finalized through the issuance of applicable industrial approvals.

4.1 MEASUREABLE PARAMETERS AND THRESHOLDS

4.1.1 Thresholds

4.1.1.1 Meteorology

There are no applicable regulatory thresholds applicable to meteorological monitoring. The objective of meteorological monitoring at the site is to provide representative data for precipitation and winds for use in evaluation of the effects of meteorology on dust levels and to support investigation of sources of dust in the event of ambient air quality threshold exceedances.

4.1.1.2 Ambient Air Quality

The measured concentrations of TSP, PM_{10} and $PM_{2.5}$ will be compared to the NLAAQS to determine compliance during the operation of the Project. The applicable NLAAQS are presented in Table 4.1.

Table 4.1 Monitoring Thresholds for TSP, PM_{10} and $PM_{2.5}$ and Trace Metals

Air Contaminant	Average Period	Newfoundland and Labrador Ambient Air Quality Standard ($\mu g/m^3$)
Total Suspended Particulate Matter (TSP)	24-hour	120
	Annual	60
Respirable Particulate Matter (PM_{10})	24-hour	50
Fine Particulate Matter ($PM_{2.5}$)	24-hour	25
	Annual	8.8
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
Mercury (Hg)	24-hour	2
Nickel (Ni)	24-hour	2
Zinc (Zn)	24-hour	120

Data Assessment and Response Framework

Monitoring data collected through the AAQFMP requires a systematic data evaluation process, as well as management responses that would be taken, in response to certain data evaluation outcomes. A common assessment (data evaluation) and management response framework will be implemented. This multi-step process includes the following:

Step 1 - Data Management and Evaluation

This step includes quality assurance and quality control (QA/QC); comparisons to the thresholds and to reference and/or baseline; and review of the data using various tools such as Exploratory Data Analysis (EDA) and Statistical Data Analysis (SDA), to determine if substantive change in air quality is occurring. A change may be detected statistically or qualitatively, relative to benchmarks, baseline values and/or spatial or temporal trends. A change may be statistically significant, but professional judgement may also be applied using the various evaluation tools to detect a change qualitatively.

If Step 1 does not detect change, then no action is required. If a change is observed, then further evaluation of the data for that/those indicator(s) will be carried out under Step 2.

Step 2 - Determining Whether the Observed Change is Project-Related

Step 2 involves determining if the changes in the indicator(s) of concern are due to the Project or due to natural variability or other causes. This will include, as needed, an evaluation of both Project-related and non-Project related activities to assess potential influences of these factors in the observed change. This question can be addressed using EDA and subsequently using SDA. EDA will be completed to visualize overall data trends, and could include evaluating spatial patterns, to examine the spatial extent and pattern of observed changes.

Exploratory data analyses could include comparisons of data from reference and potential impact areas and from baseline and operational monitoring programs. This can further assist with determining whether the observed changes were due to natural variability, other anthropogenic activities in the vicinity of the Project, or the Project.

If the Step 2 analysis concludes that the changes in monitoring parameters of concern are, or are likely, due to the Project, the assessment will proceed to Step 3. If it is concluded the observed differences relative to baseline conditions are not due to the Project, no management response will be required.

Step 3 - Determine Action Level

If the evaluation conducted in Step 2 has indicated with some certainly that the measured change is Project-related, Step 3 involves determination of the action level associated with the observed monitoring results through comparisons to the benchmark. Three (3) levels of action have been identified: low, moderate, and high; and the response actions range from increased monitoring and data analysis (e.g., trend analysis); identification of possible sources; to risk assessment and/or mitigation. The Trigger Action Response Plan (TARP) presented in Table 4.2 outlines the thresholds and responses for each action level. Where actions cannot be specified based on factors such as the number of potential sources, evaluation of project contribution, and severity of the action, the moderate and high level of action refer to the Mitigation Toolkit presented in below.

Trigger Action Response Plan

Table 4.2 AAQFMP Trigger Action Response Plan

Project Activity	Objectives	Performance Indicators	Monitoring Program / Plan	Condition Status / Threshold			Pre-defined Response(s)		
				Low Risk	Moderate Risk	High Risk	Low Risk	Moderate Risk	High Risk
Life of Project	Meeting particulate matter (PM_{10}, $PM_{2.5}$ and TSP) and metals air quality standards	Particulate matter (TSP, PM_{10} and $PM_{2.5}$) and trace metals monitoring data Project Standard(s); • 120 µg/m^3 averaged daily for TSP, • 50 µg/m^3 averaged daily for PM_{10} • 25 µg/m^3 averaged daily for $PM_{2.5}$ • Metals standards presented in Table 4.1	Continuous ambient air quality monitoring for TSP, PM_{10} and $PM_{2.5}$ near the site. Integrated sampling for trace metals.	Measured TSP, PM_{10}, $PM_{2.5}$, and/or metals concentrations are greater than 90% of the ambient air quality standards	Measured TSP, PM_{10}, $PM_{2.5}$, and/or metals concentrations are above the ambient air quality standards on occasion	Measured TSP, PM_{10}, $PM_{2.5}$, and/or metals concentrations are above the ambient air quality standards frequently	Env't Dept: Review whether increase is attributed to the Project. Continue monitoring to determine if elevated levels are sustained or continuing to increase. Review the level of compliance for mitigation measures that are associated with managing the amount of fuel burned (e.g., idling policy, speed limits, etc.). Operations: Review schedule and procedures for ongoing maintenance for stationary and mobile diesel-powered equipment. Review the effectiveness of the dust mitigation at potential source locations. Review schedule, procedures, and make improvements to the dust suppression program.	Env't Dept: Verify increase can be attributed to the Project. Identify the root cause for the measured concentrations. Continue monitoring to determine if elevated concentrations are sustained or continuing to increase. Operations: Implement responses from the Mitigation Toolkit (or new mitigation developed through investigation). Identify high risk mitigation measures for future implementation if needed	Env't Dept: Verify increase can be attributed to the Project. Identify the root cause for the measured concentrations. Identify impacts to the receiving environment and/or human health. Conduct a risk evaluation to determine if levels pose an immediate health risk. Operations: Implement responses from the Mitigation Toolkit (or new mitigation developed through investigation).

Mitigation Toolkit

The preliminary Moderate and High Action Pre-Defined Responses to be implemented in the event of an exceedance of a moderate risk or high risk threshold are outlined in Table 4.3 for Air Quality. These responses should not be considered exhaustive and may be supplemented pending the results of adaptive management investigations and subsequent approval.

Note: These Moderate and High Action Pre-Defined Responses are preliminary and subject to further review. Even when finalized these responses should not be considered exhaustive and may be supplemented pending the results of adaptive management investigations and subsequent QIA approval.

Table 4.3 Air Quality – Moderate and High Action Pre-Defined Responses

Air Quality
Dust and Particulate Emission Controls: • Spray (or respray piles) with approved dust suppressant • Research and implement alternate dust suppression methods and products • Surface watering and sprinkler system options via mister trucks or trailers • Increase surface watering and dust suppressant application frequency • Where applicable, install or redesign conveyor shrouding for fugitive dust • Review of new technology and engineering solutions available on the market for dust control • Enclosure of facilities or operations Reduction or cessation of activity: • Adapt production rate to environmental conditions • Modify timing or frequency of operational activities (e.g., blasting frequency)
Assessment and/or Monitoring (General) • Increase frequency of inspection and audits • Increase frequency of source emissions testing • Revisit number and locations of monitoring locations • Update country food risk assessment if the metals levels determined by the environmental monitoring program are trending upwards • Development of site specific risk based guidelines
Negotiation of compensation

4.1.2 Measurable Parameters

4.1.2.1 Meteorology

The installation of an on-site met station is required as the nearest publicly available ECCC stations are located in Buchans and Deer Lake (rainfall intensity information) more than 50 kms away. Weather data collected at the site can be used to confirm design parameters used in sizing infrastructure, update the site water balance through operation and to inform the implementation of the Water Management Plan. The provincial EIS guidelines require that precipitation monitoring be established at higher elevations (i.e., at the site) to assist and inform runoff assessments (p.52, Government of NL 2020). The implementation of this met station will address this requirement.

Therefore, the following variables are recommended be measured for monitoring purposes:

- Precipitation intensity
- Soil moisture
- Solar radiation
- Wind speed and direction
- Snow depth/snow water equivalent
- Temperature and relative humidity
- Barometric pressure

As noted above the instrumentation will be sited and installed following guidance information on siting criteria from the equipment manufacturer, the US EPA and the WMO, as applicable.

4.1.2.2 Ambient Air Quality

The criteria pollutants that will be measured under the ambient air quality monitoring program include:

- Total suspended particulate matter (TSP)
- Particulate matter less than 10 microns in diameter (PM_{10})
- Particulate matter less than 2.5 microns in diameter ($PM_{2.5}$)
- Trace metals

As the Project will not include the operation of major stationary combustion sources, monitoring for oxides of nitrogen and sulphur dioxide (SO_2) is not needed. This is further supported through the results of the air dispersion modelling conducted in support of the preparation of the EIS. The maximum predicted ground level concentrations of nitrogen dioxide (NO_2) and SO_2 were well below regulatory criteria.

4.2 METHODS

4.2.1 Meteorology

An automated meteorological (met) station will be installed within the Project area to measure relevant meteorological parameters (e.g., precipitation, wind speed and direction) to meet applicable operational requirements of the mine and the regulatory guidelines. The station will be sited and installed following applicable guidance from the instrumentation supplier and/or manufacturer, as well as the United States Environmental Protection Agency (US EPA) and the World Meteorological Organization (WMO).

The meteorological station will include a 10-metre tower for mounting the instrumentation for measurement of the required meteorological variables. The station will be controlled with a data logger capable of logging the required meteorological variables. The list of proposed measurement parameters is provided in Section 4.2.1.

4.2.2 Ambient Air Quality

Ambient air quality monitoring will be conducted in accordance with the provincial Guidance Document, GD-PPD-065 (Government of NL 2010).

Real-time, continuous ambient air quality monitoring will be conducted to measure relevant criteria pollutants using methods that are designated as US EPA “reference methods” or “equivalent methods”, in accordance with Title 40, Part 53 of the United States Environmental Protection Agency Code of Federal Regulations (40 CFR Part 53). The designated reference and equivalent methods are listed in the US EPA, Center for Environmental Measurements and Modeling, “List of Designated Reference and Equivalent Methods” document, which was last updated in June 2021 (List of Designated Reference and Equivalent Methods (epa.gov)).

Integrated sampling for trace metals in TSP will be conducted in accordance with the US EPA Compendium of Methods for the Determination of Inorganic Compounds in Ambient Air, Compendium Method IO-3.2 - Determination of Metals in Ambient Particulate Matter using Atomic Absorption (AA) Spectroscopy.

The AAQFMP will also follow the US EPA “Quality Assurance Handbook for Air Pollution Measurement Systems, Volume 11, Ambient Air Quality Monitoring Program” (EPA-454/B-08-003 January 2017).

The number and location of monitoring stations and frequency of sampling will be developed through the applicable permitting and in consultation with NLDECC, following guidance published by the Canadian Council of Ministers of the Environment (CCME) “Ambient Air Monitoring and Quality Assurance/Quality Control Guidelines” (2019).

5.0 REPORTING

Reports from the air quality monitoring program will be submitted annually, by March 31 of the following year, to regulatory authorities as required.

The meteorology and ambient air quality monitoring annual reports will include the results of the ambient air quality monitoring program following a standardized format, including:

- A map showing the location of emitting sources, property boundary and ambient air quality monitoring stations
- A summary of operations - parameters monitored, equipment model, frequency of site visits and calibrations, confirmation of data backups
- A summary of audits and audit outcomes
- Summary statistics for the meteorological monitoring data (e.g., ambient air temperature, precipitation, wind speed and direction (wind rose))
- Summary statistics for the measured ambient PM and trace metals concentrations (e.g., annual arithmetic mean, maximum and daily average 24-hour, percent of valid data)

- A summary of exceedances of the NLAAQS, number of times that exceedances occurred, the meteorology conditions that coincided with the exceedances, and additional mitigation measures used during exceedance periods.

Both a technical and a plain language summary will be provided as part of the annual reporting requirements.

In addition to the ambient air and meteorology monitoring, the CEPA, 1999 also stipulates those owners or operators of facilities that meet published reporting requirements must report to the ECCC NPRI reporting program. NPRI reporting applies to more than 300 substances and the amount that was released (to air, water and land), disposed or recycled at the facility during each calendar year must be reported if the release is greater than a specified threshold. Reports are required to be submitted to ECCC for each calendar year. Details pertaining to the reporting requirements are specified in “Guide for Reporting to the National Pollutant Release Inventory, 2020 and 2021” (ECCC 2020).

6.0 RELATED DOCUMENTS

Other environmental management plans and monitoring programs related to this follow-up monitoring program are described in Table 6.1.

Table 6.1 Related Management Plans and Monitoring Programs

Plan/Program	Details
Construction EPP	The Construction EPP provides general environmental protection procedures related to Project construction activities and infrastructure such as air and greenhouse gas emissions management; erosion and sedimentation control; rock and soils management; and traffic management. Also included are protection procedures specific to caribou, avifauna, and other wildlife (including bats and American marten); fish and fish habitat; historic resources; and the Victoria Dam. The Construction EPP also includes contingency plans for fuel and hazardous materials spills, failure of erosion and sediment control measures and/or dams, and forest fires.
Accidents and Malfunctions Prevention and Response Plan	The Accidents and Malfunctions Prevention and Response Plan outlines the mitigation measures and response measures for potential accidents and malfunctions. The Plan provides direction for communication and reporting requirements following an accident or malfunction. Potential accidents or malfunctions addressed include tailings management facility malfunction, stockpile slope failure, fuel and hazardous materials spill, unplanned release of contact water, fire/explosion, and vehicle accidents.
Greenhouse Gas Emissions Follow-up Monitoring Program	The Greenhouse Gas Emissions Follow-up Monitoring Program describes the management and mitigation measures to reduce GHG emissions associated with mine activities during Project construction, operation and decommissioning/closure.

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Appendix A DISPERSION MODELLING RESULTS

Table A-1 Maximum Predicted Ground-level Concentrations – Operation

Contaminant	Average Period	Background Concentrations (µg/m³)	Predicted Concentrations (µg/m³)	Predicted plus Background (µg/m³)	NL AQ Standard (µg/m³)	2020 CAAQS (µg/m³)	2025 CAAQS (µg/m³)	Ontario ACB (µg/m³)	Percent of NL/Adopted Standard
TSP	24-hour	13.8	105	119	120	-	-	-	99%
	Annual	2.6	2.3	4.9	60	-	-	-	8%
PM_{10}	24-hour	13.0	52.7	65.7	50	-	-	-	131%
$PM_{2.5}$	24-hour	10.3	11.0	21.3	25	27.0	NA	-	85%
	Annual	3.8	1.23	5.08	8.8	8.8	NA	-	58%
NO_2	1-hour	3.8	165	169	400	112.9	79	-	42%
	24-hour	1.9	70.7	72.6	200	-	-	-	36%
	Annual	1.4	7.13	8.5	100	32.0	28.2	-	9%
SO_2	1-hour	2.6	339	341	900	183.4	170	-	38%
	3-hour	2.6	203	206	600	-	-	-	34%
	24-hour	neg.	75.3	75.3	300	-	-	-	25%
	Annual	neg.	2.69	2.69	60	13.1	10.5	-	4%
CO	1-hour	206	1,428	1,634	35,000	-	-	-	5%
	8-hour	200	722	923	15,000	-	-	-	6%
NH_3	24-hour	neg.	3.42	3.42	100	-	-	-	3%
HCN	24-hour	neg.	3.87	3.87	-	-	-	8	48%
As	24-hour	2.1E-03	2.85E-03	4.95E-03	0.3	-	-	-	2%
Cd	24-hour	4.2E-04	2.14E-04	6.34E-04	2	-	-	-	<1%
Cu	24-hour	1.3E-03	1.72E-02	0.0185	50	-	-	-	<1%
Pb	24-hour	1.3E-03	4.70E-03	6.00E-03	2	-	-	-	<1%
	30-day	5.0E-04	1.81E-03	2.32E-03	0.7	-	-	-	<1%
Hg	24-hour	neg.	3.07E-04	3.07E-04	2	-	-	-	<1%

Table A-1 Maximum Predicted Ground-level Concentrations – Operation

Contaminant	Average Period	Background Concentrations (µg/m^3)	Predicted Concentrations (µg/m^3)	Predicted plus Background (µg/m^3)	NL AQ Standard (µg/m^3)	2020 CAAQS (µg/m^3)	2025 CAAQS (µg/m^3)	Ontario ACB (µg/m^3)	Percent of NL/Adopted Standard
Ni	24-hour	2.1E-03	1.27E-03	3.37E-03	2	-	-	-	<1%
Zn	24-hour	2.1E-02	9.14E-03	3.01E-02	120	-	-	-	<1%
Ba	24-hour	2.1E-03	9.86E-03	1.20E-02	-	-	-	10	<1%
Sr	24-hour	2.1E-03	7.37E-03	9.47E-03	-	-	-	120	<1%
Be	24-hour	1.3E-03	2.42E-05	1.32E-03	-	-	-	0.01	13%
Cobalt	24-hour	1.3E-03	9.52E-04	2.25E-03	-	-	-	0.1	2%
Li	24-hour	neg.	3.44E-03	3.44E-03	-	-	-	20	<1%
Sb	24-hour	2.1E-03	3.77E-03	5.87E-03	-	-	-	25	<1%
Sn	24-hour	1.3E-03	6.11E-03	7.41E-03	-	-	-	10	<1%
Se	24-hour	4.2E-03	7.41E-03	1.16E-02	-	-	-	10	<1%
Cr	24-hour	2.1E-03	9.77E-03	1.19E-02	-	-	-	0.5	2%
Bi	24-hour	2.1E-03	2.27E-03	4.37E-03	-	-	-	2.5	<1%

Table A-2 Maximum Predicted Concentrations – Camp / Cabin Locations – Operation

Contaminant	Average Period	Background Concentrations (µg/m³)	Predicted Concentrations (µg/m³)	Predicted plus Background (µg/m³)	NL Standard (µg/m³)	2020 CAAQS (µg/m³)	2025 CAAQS (µg/m³)	Ontario ACB (µg/m³)	Percent of NL/Adopted Standard
TSP	24-hour	13.8	56.9	70.7	120	-	-	-	59%
	Annual	2.6	1.93	4.58	60	-	-	-	8%
PM_{10}	24-hour	13.0	21.2	34.2	50	-	-	-	68%
$PM_{2.5}$	24-hour	10.3	9.04	19.3	25	27.0	NA	-	77%
	Annual	3.8	0.63	4.48	8.8	8.8	NA	-	51%
NO_2	1-hour	3.8	97.6	101	400	112.9	79	-	25%
	24-hour	1.9	43.8	45.7	200	-	-	-	23%
	Annual	1.4	7.13	8.53	100	32.0	28.2	-	9%
SO_2	1-hour	2.6	122	125	900	183.4	170	-	14%
	3-hour	2.6	60.3	62.9	600	-	-	-	10%
	24-hour	neg.	26.8	26.8	300	-	-	-	9%
	Annual	neg.	2.55	2.55	60	13.1	10.5	-	4%
CO	1-hour	206	729	935	35,000	-	-	-	3%
	8-hour	200	279	480	15,000	-	-	-	3%
NH_3	24-hour	neg.	2.65	2.65	100	-	-	-	3%
HCN	24-hour	neg.	2.65	2.65	-	-	-	8	33%
As	24-hour	2.1E-03	1.58E-03	3.68E-03	0.3	-	-	-	1%
Cd	24-hour	4.2E-04	1.19E-04	5.39E-04	2	-	-	-	<1%
Cu	24-hour	1.3E-03	0.0095	0.0108	50	-	-	-	<1%
Pb	24-hour	1.3E-03	2.61E-03	3.91E-03	2	-	-	-	<1%
	30-day	5.0E-04	1.01E-03	1.51E-03	0.7	-	-	-	<1%
Hg	24-hour	neg.	2.17E-04	2.17E-04	2	-	-	-	<1%

Table A-2 Maximum Predicted Concentrations – Camp / Cabin Locations – Operation

Contaminant	Average Period	Background Concentrations (µg/m³)	Predicted Concentrations (µg/m³)	Predicted plus Background (µg/m³)	NL Standard (µg/m³)	2020 CAAQS (µg/m³)	2025 CAAQS (µg/m³)	Ontario ACB (µg/m³)	Percent of NL/Adopted Standard
Ni	24-hour	2.1E-03	7.03E-04	2.80E-03	2	-	-	-	<1%
Zn	24-hour	2.1E-02	5.05E-03	2.61E-02	120	-	-	-	<1%
Ba	24-hour	2.1E-03	5.45E-03	7.55E-03	-	-	-	10	<1%
Sr	24-hour	2.1E-03	4.08E-03	6.18E-03	-	-	-	120	<1%
Be	24-hour	1.3E-03	1.34E-05	1.31E-03	-	-	-	0.01	13%
Cobalt	24-hour	1.3E-03	5.28E-04	1.83E-03	-	-	-	0.1	2%
Li	24-hour	neg.	1.91E-03	1.91E-03	-	-	-	20	<1%
Sb	24-hour	2.1E-03	2.34E-03	4.44E-03	-	-	-	25	<1%
Sn	24-hour	1.3E-03	3.40E-03	4.70E-03	-	-	-	10	<1%
Se	24-hour	4.2E-03	4.10E-03	8.30E-03	-	-	-	10	<1%
Cr	24-hour	2.1E-03	5.42E-03	7.52E-03	-	-	-	0.5	2%
Bi	24-hour	2.1E-03	1.26E-03	3.36E-03	-	-	-	2.5	<1%