



# **AGNICO EAGLE**

**MELIADINE GOLD MINE**

## **Air Quality Monitoring Plan**

**DECEMBER 2021  
VERSION 4\_NIRB**



## EXECUTIVE SUMMARY

Agnico Eagle Mines Limited (Agnico Eagle) has developed the Meliadine Gold Mine (Meliadine Mine or Mine), located approximately 25 kilometres (km) north of Rankin Inlet, and 80 km southwest of Chesterfield Inlet in the Kivalliq Region of Nunavut.

This document presents the Air Quality Monitoring Plan (Plan) for the Meliadine Mine. The overall monitoring strategy objective is to confirm the effectiveness of mitigation measures assumed in the Final Environmental Impact Statement (FEIS) and the Meliadine Extension FEIS Addendum, and in doing so, determine if alternative mitigation strategies are required to minimize emissions from the Mine and their impacts.

This Air Quality Monitoring Plan identifies the:

- goals of the air quality monitoring program;
- regulatory considerations and environmental impact predictions;
- air quality and incinerator emissions monitoring programs;
- mitigation and adaptive management strategies; and
- procedures for reporting and plan review.

Based on the air quality impact assessment and Project Certificate No. 006 and subsequent Amendments, issued by the Nunavut Impact Review Board (NIRB), air quality monitoring is performed for: suspended particulates (including trace metals), dustfall, NO<sub>2</sub> and SO<sub>2</sub>. Emission monitoring for waste incineration is conducted to ensure compliance with regulatory standards for dioxins, furans and mercury. In addition, as meteorological data are a critical input to air dispersion models and emissions estimation, a real time meteorological station has been installed at the site.

For this program, Agnico Eagle will ensure that monitoring is conducted in accordance with the appropriate sampling reference methodologies. Standardized quality assurance/quality control requirements will be followed. In siting the proposed stations, factors such as topography, infrastructure and power supply, and site accessibility have been considered.

Agnico Eagle will provide annual reports to the NIRB summarizing the data collected under this Air Quality Monitoring Plan. In addition, Agnico Eagle will report greenhouse gas emissions to Environment and Climate Change Canada under the Greenhouse Gas Emissions Reporting Program. Air emissions are reported to Environment and Climate Change Canada separately under the National Pollutant Release Inventory program.

This Plan has been prepared in accordance with NIRB Project Certificate No.:006 and will be reviewed and updated as necessary, to reflect changes in site conditions, monitoring methods, and regulatory requirements. Changes will be documented and updated plans will be provided to the NIRB for review.

## Document Control

Version	Date	Section	Revision	Author
1	November 2015	All	The Air Quality Monitoring Plan as Term and Condition No.1 of Project Certificate No.: 006, submitted to Nunavut Impact Review Board for review and approval	Golder Associates Ltd. AEM Environmental Coordinator
2	April 2020	All	General update of the document language to reflect current period of operations	AEM Environment Department
		1.2	Added conformity table	
		2.1	Updated figure and expanded description of existing monitoring locations	
		2.2.1 2.3.1	Supplemental details of Partisol and dustfall sampling methods	
		2.2.4	Addition of trace metals analysis in suspended particulates	
		2.3.2	Addition of dustfall monitoring transects along the AWAR, By-pass road, and background dustfall analysis	
		2.3.3	Description of dustfall monitoring frequency, including rationale for reduction in AWAR sampling frequency from year-round to summer-only	
		2.3.4	Rationale for change from analysis of metals in AWAR dustfall jars to analysis in water samples under the Aquatic Effects Monitoring Program	
		2.2.5 2.3.5 2.4.4	Supplemental details for data analysis – specific comparisons to regulatory guidelines and FEIS predictions provided	
		2.5	Description of snowpack monitoring	
		5	Description of incinerator stack testing report, to be appended to Air Quality Monitoring Report	
		6	Added indication of GHG and NPRI reporting to ECCC	
		7	Updated list of management plans related to fugitive dust and emissions	
3	June 2020	2.2.2	Threshold added to increase suspended particulate monitoring stations	AEM Environment Department
		2.2.5.1	Threshold added to start further investigation and increase monitoring efforts	
		2.3.2	Threshold added to increase dustfall monitoring stations	
		2.3.5	Threshold added to start further investigation and increase monitoring efforts	
4_NIRB	December 2021		Updated to address Meliadine Extension application submission to NIRB for review and approval	Permitting Department



**ABBREVIATION AND ACRONYM LIST**

AENV	Alberta Environment
FEIS	Final Environmental Impact Statement
EPA	Environmental Protection Agency
GHG	Greenhouse gas
LSA	Local study area
NAPS	National Air Pollution Surveillance Network
NIRB	Nunavut Impact Review Board
NO <sub>2</sub>	Nitrogen dioxide
NPRI	National Pollutant Release Inventory
PM <sub>10</sub>	Particles nominally smaller than 10 µm in diameter
PM <sub>2.5</sub>	Particles nominally smaller than 2.5 µm in diameter
PM <sub>coarse</sub>	PM <sub>10-2.5</sub>
QA	Quality assurance
QC	Quality control
SSA	Site study area
SO <sub>2</sub>	Sulphur dioxide
TSP	Total suspended particulate matter

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# 1 INTRODUCTION

## 1.1 Background

Agnico Eagle Mines Limited (Agnico Eagle) has developed the Meliadine Gold Project (Meliadine Mine or the Mien), located approximately 25 kilometres (km) north of Rankin Inlet, and 80 km southwest of Chesterfield Inlet in the Kivalliq Region of Nunavut. As part of Meliadine Extension, the operation of several other pits and underground mines will extend the life of mine until 2043, as well as addition of a windfarm consisting of 11 turbines, and the alternative of an on-site airstrip.

This document presents the Air Quality Monitoring Plan (Plan) for the Meliadine Mine. This Plan is designed according to the scale of the Meliadine Mine and the effects identified through the environmental impact assessment process. The predicted ambient air quality concentrations were considered in the design of an appropriate monitoring program and the development of mitigation and adaptive management strategies.

The overall objective of the monitoring program is to confirm the effectiveness of mitigation measures assumed in the Project's environmental assessment by measuring key air quality parameters, and in doing so, determine if alternative mitigation strategies are required to minimize emissions from the Project and their impacts.

This Plan identifies the:

- goals of the air quality monitoring program;
- regulatory considerations and environmental impact predictions;
- air quality and incinerator emissions monitoring programs;
- mitigative and adaptive management strategies; and
- procedures for reporting and plan review.

This Plan has been prepared in accordance with Terms & Conditions 1, 2, 3 & 27b of the NIRB Project Certificate No.: 006. The Plan will be reviewed and updated on a regular basis as necessary, to reflect changes in site conditions and regulatory requirements.

## 1.2 Conformity with Terms & Conditions of the NIRB Project Certificate

Components of the Plan that are included to comply with Terms and Conditions of the Project Certificate No.:006 related to air quality monitoring and dust management are described in Table 1-1.

**Table 1-1. Conformity Table.**

Project Certificate No.:006 Term & Condition		Document Location
1 a	Description of real-time air monitoring stations including proposed timing of installation, location, and any factors considered with regards to planning for the installation;	Section 2.2
1b	Plans for the collection of total suspended dust samples year round, including sampling for metals content relevant to the Project;	Section 2.2
1c	Description of snowpack surveys and dustfall collectors;	Snowpack - Section 2.5 Dustfall – Section 2.3



Project Certificate No.:006 Term & Condition		Document Location
1d	Description of lichen surveys;	See Terrestrial Environment Management and Monitoring Plan (November 2015)
1e	Identification of near field, far field and reference sites that are located with consideration of ambient wind conditions;	Section 2.2.2 & 2.3.2 & 2.4.2
1f	Baseline data collected prior to significant construction activity;	See 2016 Air Quality Monitoring Report, Fig. 4 & 5 for baseline/pre-construction dustfall results (2012 – 2016). Monitoring for gaseous compounds and suspended particulates began during the construction phase.
1g	A description of the proposed annual reporting mechanism and response framework.	Section 8
2	The Proponent shall demonstrate through monitoring of air quality at the aboveground emissions points at the mine site and at the Tiriganiaq site that sulphur dioxide (SO <sub>2</sub> ) and nitrous dioxide (NO) emissions remain within predicted levels and, where applicable, within limits established by all applicable guidelines and regulations. In cases where exceedances occur, the Proponent shall provide an explanation for the exceedance, a description of planned mitigation, and shall conduct additional monitoring to evaluate the effectiveness of mitigative measures.	Section 2.4
3a	Align plan requirements with commitments made in the FEIS and during the Final Hearing to monitor dust along the all-weather access road and associated roads and trails.	Section 2.3 and see Road Management Plan and Dust Management Plan
3b	Verify commitments to the utilization of dust suppressants along the all-weather access road including and associated roads and trails, including a description of the type of suppressant to be utilized, the frequency and timing of applications to be made throughout the various seasons of road use	See Road Management Plan and Dust Management Plan
3c	Outline the specific adaptive management measures to be considered should monitoring indicate that dust deposition is higher than predicted, specifically where traffic along the all-weather access road is greater than initially predicted	See Road Management Plan and Dust Management Plan
27b	A description of measures to be undertaken as relate to dustfall monitoring, designed in accordance with the following: <ul style="list-style-type: none"> <li>i. To establish Phase 1 all-weather access road baseline data and a description of plans for data collection during Project operations for comparison;</li> <li>ii. To facilitate comparison with existing guidelines;</li> <li>iii. To assess the seasonal deposition (rates, quantities) and chemical composition of dust entering aquatic systems along representative distance transects of the all-weather access road and Rankin Inlet by-pass road</li> </ul>	Section 2.3

## 2 AIR QUALITY MONITORING PROGRAM

### 2.1 Summary of Monitoring Methods and Locations

Table 2-1 summarizes the components of the proposed air quality monitoring program. Air quality monitoring will focus on measuring airborne particulates, dustfall, and the gaseous compounds NO<sub>2</sub> and SO<sub>2</sub> during the construction and operations phases. Monitoring locations are shown in Figure 2-1, and described in Table 2-2. There are no proposed changes or additions to the monitoring stations as a result of Meliadine Extension.

**Table 2-1. Summary of air quality monitoring program components.**

Project Phase	Program Objective	Monitoring Equipment
Construction	<ul style="list-style-type: none"> <li>• To verify compliance with applicable standards</li> <li>• To apply mitigation measures if necessary</li> </ul>	<ul style="list-style-type: none"> <li>• One continuous TSP/PM<sub>10</sub> sampling unit (Partisol model 2025)</li> <li>• One passive NO<sub>2</sub> – SO<sub>2</sub> monitor (Maxxam equipment)</li> <li>• Up to six dustfall jars (passive) onsite</li> <li>• Four dustfall transects along AWAR, Bypass road and Discovery Road</li> </ul>
Operations	<ul style="list-style-type: none"> <li>• To verify the predicted concentrations of TSP, PM<sub>10</sub>, and PM<sub>2.5</sub></li> <li>• To verify that the mitigation measures considered integral to the Project are being incorporated as planned, and are effective</li> </ul>	<ul style="list-style-type: none"> <li>• Two TSP sampling units (Partisol model 2025) (DF-5, DF-7)</li> <li>• Two PM<sub>coarse</sub>/PM<sub>2.5</sub> sampling units (Partisol Model 2025-D) (DF-5, DF-7)</li> <li>• Two passive NO<sub>2</sub>–SO<sub>2</sub> monitors (Maxxam equipment) (DF-5, DF-7)</li> <li>• Up to six dustfall jars (passive) onsite</li> <li>• Three dustfall monitoring transects along AWAR, Bypass road and Discovery Road</li> </ul>

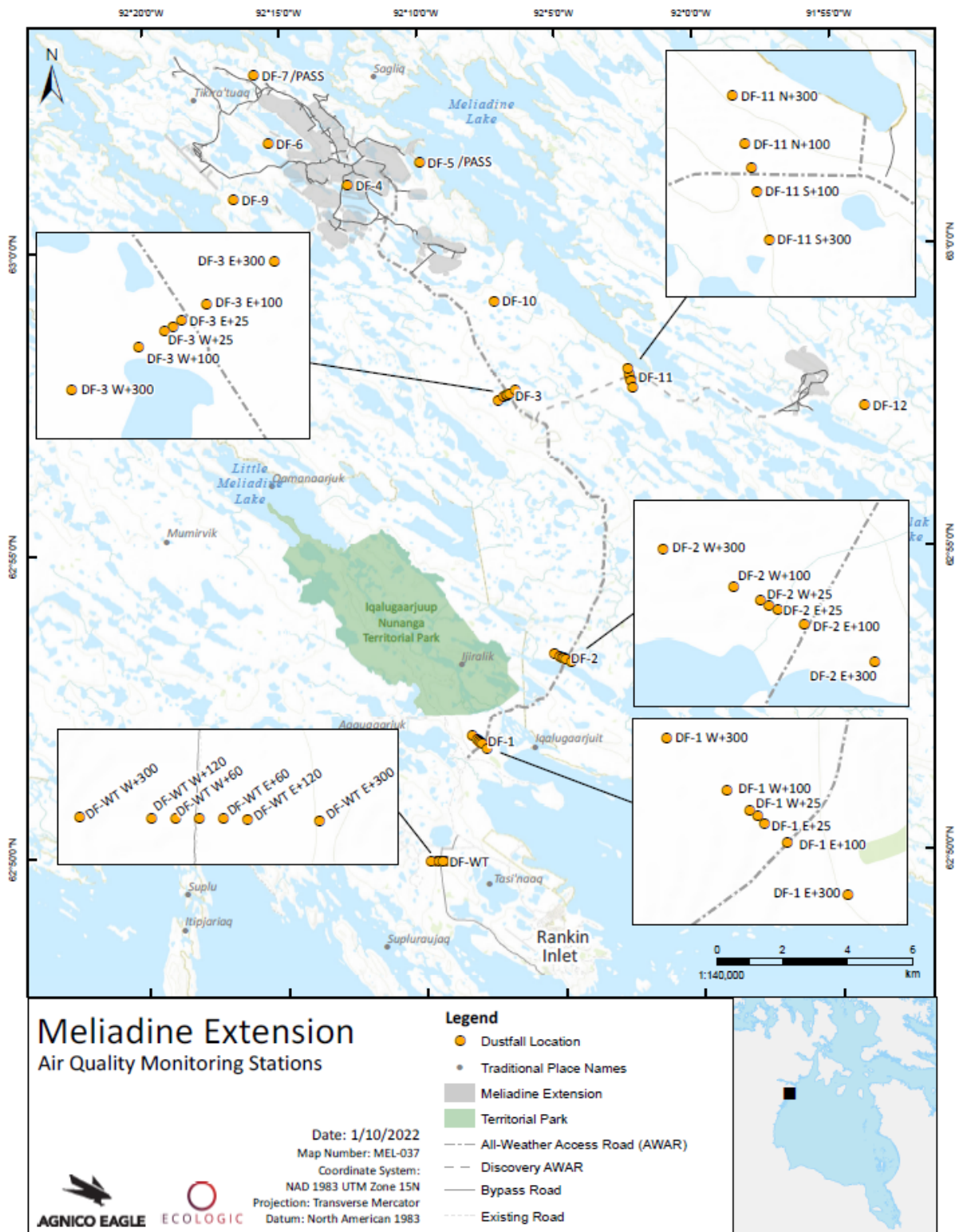


Figure 2-1. Air quality monitoring locations for the Meliadine site.

Table 2-2. Description of air quality monitoring stations.

Monitoring Station	UTM (15V)	Parameters	General Location	Location Description
DF-WT	542890E 6967093N	Dustfall transect	Rankin Inlet By- Pass Road	1.3 km northwest of Nipissar Lake and ~500m southeast (downwind) of community quarry sites. Samples at 60, 120, and 300 m on each side of the road.
DF-1	544073E 6970759N	Dustfall transect	AWAR	AWAR km 4 South of Iqalugaarjuup Nunanga Park Samples at 25, 100, and 300 m on each side of the road.
DF-2	546621E 6973334N	Dustfall transect	AWAR	AWAR km 10 East of Iqalugaarjuup Nunanga Park Samples at 25, 100, and 300 m on each side of the road.
DF-3	544899E 6981387N	Dustfall transect	AWAR	AWAR km 23 North of Iqalugaarjuup Nunanga Park Samples at 25, 100, and 300 m on each side of the road. Transect to be superseded by DF-11 once Discovery Road construction commences.
DF-4	540014E 6987836N	Dustfall	Onsite	Adjacent to freshwater pumphouse on Lake A8 Downwind of main mine site. Station to be superseded by DF-10 once construction commences at F-zone deposit.
DF-5	542226E 6988507N	Dustfall NO <sub>2</sub> , SO <sub>2</sub> TSP, PM <sub>10</sub> , PM <sub>2.5</sub>	Onsite	500 m south-east of the mine camp Downwind of main mine site Within Air Quality Impact Assessment Site Study Area
DF-6	537586E 6989096N	Dustfall	Onsite	Adjacent to Lake B5, approx. 600 m southwest of main mine site (direction perpendicular to dominant wind). Station to be superseded by DF-9 once construction commences at Tiriganiaq-Wolf mining area.
DF-7	537143E 6991176N	Dustfall NO <sub>2</sub> , SO <sub>2</sub> TSP, PM <sub>10</sub> , PM <sub>2.5</sub>	Onsite	Adjacent to emulsion plant, approx. 2 km northwest (upwind) of the camp complex. Within Air Quality Impact Assessment Local Study Area (just outside of Site Study Area)
DF-8	525656E 7001656N Or alternative	Dustfall	Reference	North end of Meliadine Lake near AEMP Reference Area 2 (MEL-04). UTM approximate.  Reference stations may be rotated to establish a range of background dustfall values, which are expected to vary significantly depending on local site conditions.
DF-9		Dustfall	Onsite	Southeast of Tiriganiaq-Wolf mining area and airstrip. Approximately 500 m from proposed infrastructures. Station will be active (and replacing DF-6) when construction commences at Tiriganiaq-Wolf mining area.
DF-10		Dustfall	Onsite	Southeast of F-zone deposit. Approximately 500 m from proposed infrastructures. Station will be active (and replacing DF-4) when construction commences at F-Zone.

Monitoring Station	UTM (15V)	Parameters	General Location	Location Description
DF-11		Dustfall transect	Onsite	Discovery Road Southeast of Meliadine Lake Samples at 25, 100, and 300 m on each side of the road. Station will be active (and replacing DF-3) when Discovery Road construction commences.
DF-12		Dustfall	Onsite	Southeast of Discovery Deposit. Approximately 500 m from proposed infrastructures. Station will be active when construction commences at Discovery Deposit.

## 2.2 Suspended Particulates

### 2.2.1 Monitoring Methods

The U.S. Environmental Protection Agency (EPA) has described standard methods for collection of particulate matter air samples in Section 40 Parts 53 and 58 of the U.S. Code of Federal Regulations (U.S. EPA, 1997). Accordingly, dynamic particulate monitoring for the Meliadine site includes intermittent 24-h sampling for TSP, PM<sub>10</sub> and PM<sub>2.5</sub> using Partisol Sequential Air Samplers.

Suspended particulates (TSP, PM<sub>10</sub>, PM<sub>2.5</sub>) are sampled over 24-h periods every six days using a Partisol Plus Model 2025i Sequential Air Sampler (TSP) and a Partisol Plus Model 2025-D Dichotomous Sequential Air Sampler (PM<sub>2.5</sub> and PM<sub>coarse</sub>) at each monitoring station. Partisol samplers draw in a stream of ambient air at a controlled flow rate, and particulates are collected on a pre-weighed filter supplied by an accredited laboratory. The exposed filter is then shipped back to the laboratory and re-weighed to measure the total accumulated particulates.

In addition to analysis of mass, total suspended particulates collected on Partisol filters will be analyzed for trace metals relevant to the Project (see Section 2.2.5.2).

### 2.2.2 Monitoring Locations

The specific locations of the monitors are shown in Figure 2-1 and have been determined by following standard siting criteria defined in the amended Air Monitoring Directive (Alberta Environment 1989). Specifically, consideration has been given to the following:

- site accessibility;
- power supply;
- effects of topography;
- local interferences (e.g., buildings);
- security;
- local meteorological conditions (wind speed);
- dispersion patterns as predicted within the FEIS Volume 5, Section 5.2; and
- location of potentially sensitive receptors.

Based on the above noted criteria, the dynamic air samplers are sited adjacent to the production lease boundary, both upwind (DF-7) and downwind (DF-5) of the main mine site facilities. The location of these stations may be altered in the future based on changes in operations or monitoring methods.

### 2.2.3 Monitoring Frequency

The monitoring of TSP, PM<sub>10</sub>, and PM<sub>2.5</sub> concentrations will be carried out at a minimum of every 6 days. This frequency aligns with the National Air Pollution Surveillance (NAPS) schedule, whereby a single 24-hour sample is collected every 6<sup>th</sup> day. In addition, by operating on a 6-day cycle, different days are sampled each week, which allows for the monitoring of differing production intensities or other variations.

Analysis of trace metals in particulate samples will be conducted monthly from September through June to capture seasonal variation, and 2x/month in July and August (at least 12 days apart) when the maximum potential for fugitive dust is expected due to lack of snow cover and increased traffic rates.

Particulate sampling will be conducted year-round. However, sampling during extreme winter conditions (-20 degrees Celsius [°C] and colder) with the potential for blowing snow, which frequently occur during winter months, allows the possibility for snow to be drawn through the inlet resulting in a void sample and possible damage to the electronic components of the sampler. Historically, extreme cold weather in this area at or beyond the operating limit of the Partisol (-40°C) has resulted in difficulty maintaining the equipment, and some data loss is expected during the winter. Climate-controlled shelters are used to house the equipment to minimize this problem, which can result in differences between ambient and filter temperatures that exceed the optimal range described by the manufacturer and service provider. Implications are discussed as required in the annual data report. Agnico continues to work on optimizing maintenance schedules to minimize data loss and to look for alternative sampling solutions if necessary.

### 2.2.4 Monitoring Parameters

Individual Partisol filters will be analyzed by the commercial analytical laboratory to determine the sampled mass of PM<sub>2.5</sub>, PM<sub>coarse</sub>, and TSP, accordingly.

In addition, total suspended particulate matter (TSP filters) are analyzed for trace metals of relevance to the Project, in accordance with Term and Condition 1b of the Project Certificate No.:006 to understand general air quality concerns. Based on the contaminants of potential concern (COPCs) for air quality identified in the Human Health Risk Assessment, these metals include cadmium and iron.

### 2.2.5 Data Analysis

#### 2.2.5.1 Suspended Particulates

Laboratory-reported results for mass of particulates will be used to calculate associated concentrations of TSP, PM<sub>10</sub> and PM<sub>2.5</sub> (µg/m<sup>3</sup>) according to the Partisol operating manual.

The TSP, PM<sub>10</sub>, and PM<sub>2.5</sub> data from the monitoring locations will be analyzed for indications of air quality concerns (e.g., increasing trends or measured concentrations above the FEIS predictions or applicable ambient air quality standards). Specifically, results of suspended particulate monitoring will be compared primarily to available Government of Nunavut (GN) Environmental Guidelines for Ambient Air Quality (October, 2011). Where GN

guidelines are not available (i.e., for PM<sub>10</sub>) results will be compared to the BC Air Quality Objective Guidelines (May, 2018). Regulatory guidelines for the measured parameters are provided in Table 2-3.

Results will additionally be compared to FEIS predictions for maximum concentrations of suspended particulates, to ensure estimates were sufficiently conservative, and related impact assessment results continue to be representative.

It should be noted that FEIS air quality modelling results presented in Table 2-3 do not include background concentrations, which were unavailable for remote sites in the North. Predicted background concentrations from a more recent impact assessment for the nearby Whale Tail Pit Project (Golder, 2016) may be considered in the interpretation of results. These background concentrations were estimated from comprehensive analysis of available air quality measurements in Arctic Canada, including results of the 2008 NASA ARCTAS airborne field campaign (see Golder, 2016 for complete details). It should also be noted that air quality modeling for TSP is based on well-established published emission factors, and typically includes particle sizes <44 µm. Larger particle sizes are assumed to be deposited very close to the source, without any significant period of suspension, and therefore limited impact on air quality. However, the upper particle size for TSP collected through Partisol samplers is not specifically limited, and therefore it is possible that particles larger than 44 µm will be included in measured TSP, resulting in discrepancies between measured and modeled values.

If FEIS predictions for particulates are exceeded in multiple monitoring events, Agnico will explore other means of analysis to confirm results, such as follow-up dispersion modelling, and/or alternative sampling or analytical methods. If confirmed, an investigation into implications for air quality or human health impacts will be initiated and/or supplemental mitigation measures will be implemented as necessary. Adaptive management and mitigation measures are described in associated management plans (see Section 7).

Suspended particulate results will be further assessed for spatial and temporal trends. The analysis of spatial particulate trends will allow Agnico Eagle to assess differences between locations site-wide. There is the possibility that unusual events in the region (e.g., a dust storm transporting airborne particulate) could result in higher measured particulate concentrations at specific locations. Any such unusual event will be analyzed in conjunction with the on-site meteorological data to investigate the cause of the event. Comparisons of Meliadine monitoring data to FEIS-predicted peak concentrations (which include influence of meteorological anomalies) may be conducted if such a situation occurs. The analysis of temporal trends will look for consistent trends in the measured particulate concentrations on an annual basis. In addition to the annual trend analysis, ongoing visual observation at the site is one mechanism for identifying high dust events and triggering remedial actions. The potential cause(s) of the condition and the mitigation action available will be evaluated and implemented as appropriate.

**Table 2-3. Comparison of Guidelines and FEIS predictions for suspended particulate matter at Meliadine along with the representative monitoring station (DF-5/DF-7)**

Parameter	Averaging Time	Regulatory Guideline		FEIS Prediction* ( $\mu\text{g}/\text{m}^3$ )	
		Jurisdiction	Guideline ( $\mu\text{g}/\text{m}^3$ )	SSA (represented by DF-5)	LSA (represented by DF-7)
PM <sub>2.5</sub>	24-h	GN <sup>(a)</sup>	30	55.2	19.6
PM <sub>10</sub>	24-h	BC <sup>(b)</sup>	50	104.0	58.2
Total Suspended Particulate (TSP)	24-h	GN <sup>(a)</sup>	120	213.7	122.3
	Annual	GN <sup>(a)</sup>	60	16.8	17.0

a) Government of Nunavut Environmental Guidelines for Ambient Air Quality (October 2011)

b) BC Ambient Air Quality Objectives (May 2018)

Note: \*Maximum predicted values anywhere within the SSA/LSA according to Table 5.2-15 in Golder (2014)

### 2.2.5.2 Trace Metals

In accordance with Term and Condition 1b of the Project Certificate, concentrations of particulate-bound metals of relevance to the Project (iron and cadmium – see Section 2.2.4) are measured in TSP samples to understand implications for human health, as predicted in the Project's Human Health Risk Assessment (FEIS Volume 10). For terrestrial wildlife, inhalation was not considered as an exposure pathway for the identified contaminants of concern. This is a common practice, since inhalation of metals for wildlife is generally considered to be insignificant in comparison to ingestion (USEPA, 2005). See Section 2.3 (dustfall monitoring) for a discussion of how impacts from contaminants in deposited dust are monitored with regards to environmental health.

Since no regulatory criteria are available in Nunavut, the Northwest Territories or Alberta for 24-hour concentrations of inorganic trace elements in ambient air, results are compared to the FEIS-selected health-based screening values (Golder, 2014, Volume 10, Appendix 10-2), as shown in Table 2-4, as well as FEIS-predicted maximum concentrations of contaminants for monitoring-site locations Receptor 1 (DF-7) and Camp (DF-5). FEIS health-based screening values were generally selected as the most conservative air quality guideline from a wide range of jurisdictions, as described in Golder, 2014, Volume 10, Appendix 10-2. These guidelines will provide context for interpreting the results of trace metals analysis in particulate samples, since air emissions of metals for the Meliadine site are expected to be almost exclusively associated with fugitive dust and particulates (FEIS Volume 5, Appendix 5.2-A).

**Table 2-4. FEIS-selected health-based thresholds for chronic inhalation (24-h) from the Project's Human Health Risk Assessment (Golder, 2014, Volume 10), and FEIS-predicted maximum concentrations of contaminants for monitoring-site locations Receptor 1 and Camp (Golder, 2014, Volume 10).**

Contaminant	FEIS Values		
	Selected Health-Based Threshold ( $\mu\text{g}/\text{m}^3$ )	Prediction – Camp (DF-5) ( $\mu\text{g}/\text{m}^3$ )	Prediction – Receptor 1 (DF-7) ( $\mu\text{g}/\text{m}^3$ )
Cadmium	0.025	0.0181	0.0030
Iron	4	3.87	2.92



## 2.3 Dustfall

### 2.3.1 Monitoring Methods

In addition to the dynamic monitoring for suspended particulates, a dustfall monitoring program has been implemented at the mine site to measure deposition rates of particulate matter. Unlike the active samplers, dustfall collection is a passive program that provides a measure of all particulates that would be directly deposited onto vegetation, soil, and water in the vicinity of the Project.

Dustfall is collected in open vessels, generally referred to as canisters or jars, containing a purified liquid matrix (de-ionized water and isopropanol), supplied by a commercial analytical laboratory. According to ASTM 1739-98, canisters are placed on a 2 m stand with an open bucket-style holder fitted with wires around the rim to deter birds (see Figure 2-2). Dustfall canisters are each exposed in the field for a nominal period of 30 days. Particles are deposited and retained in the vessel, which is then sealed in the field and returned to the supplying laboratory where total and fixed dustfall are quantified ( $\text{mg}/\text{m}^2/30\text{d}$ , according to ASTM 1739-98). This sampling method is widely used in air quality studies in Nunavut and elsewhere for dustfall monitoring (e.g. Baffinland, 2014; Sabina, 2012; Pretium, 2013; Taseko, 2011).



Figure 2-2. Dustfall monitoring station.

### 2.3.2 Monitoring Locations

To monitor rates of dust deposition on site, four static samplers are continuously installed at the following locations (see Figure 2-1):

- one at each of the dynamic sampler locations (DF-5 and DF-7; located at the edge of the production lease predominant upwind and downwind directions, respectively);
- one sampler in between lakes B5 and B6 (DF-6);
- one sampler at A8 (Pump lake) near pumping station (DF-4);

Additional stations are being proposed as part of Meliadine Extension (Table 2-2).

To monitor rates of dust deposition along the Meliadine All Weather Access Road (AWAR), dustfall monitoring stations and transects have been established at kilometers 4, 10, and 23 (DF-1, DF-2, and DF-3, respectively). Each transect includes samples at 25 m, 100 m, and 300 m on the east (downwind) and west (upwind) side of the road. Results of transect monitoring along the Meadowbank AWAR in areas where dust suppressant (Tetra Flake) is applied indicates that rates of dustfall tend to decline below Alberta Environment Ambient Air Quality Guidelines for recreational areas within 25 - 100 m of the road, even during the second month after application. Supplemental stations at 500 m will be added to the program if the Alberta Environment Ambient Air Quality Guideline for dustfall in industrial areas (1.58 mg/cm<sup>2</sup>/30d) is exceeded for two consecutive months. Exceedances of that threshold at 500 m for two consecutive months will trigger management action (see Dust Mitigation Plan, June 2020). Transect monitoring began in 2019, augmenting the single canisters that were previously used at each AWAR location (DF-1 – DF-3).

One transect has been similarly established to assess deposition rates for the Rankin Inlet By-Pass road (DF-WT). For this transect, samplers are located at 60, 120, 300, and 1000 m on the east (upwind) and west (downwind) sides of the road. These locations were chosen to correspond with historical (pre-construction) monitoring that was conducted at several of these stations.

Additional stations and changes to existing ones are being proposed as part of Meliadine Extension.

Background dustfall rates prior to major construction were measured from 2012 – 2016, and historical comparisons are provided in the annual Air Quality Monitoring Report. However, to ensure measured values continue to be representative of current conditions, background rates of dustfall in the area will be determined through a two year (initial) study period, during which two dustfall samplers will be deployed at a far field reference site (DF-8) during one or two 30-d periods annually (summer season). This site is initially located at the north end of Meliadine Lake, adjacent to AEMP Reference Area 2, but alternate sites may be sampled to establish a range of background dustfall values, which are expected to vary significantly depending on local site conditions.

### 2.3.3 Monitoring Frequency

Dustfall monitoring at onsite locations (DF-4, DF-5, DF-6, DF-7, new proposed locations) will occur year-round, with each sampler deployed for a nominal period of 30 days, after which it will be retrieved and replaced, according to laboratory instructions.

For reference sites (DF-8) and transects at locations DF-1, DF-2, DF-3, DF-12, and DF-WT along the AWAR and By-Pass Road, dustfall samples will be collected twice during the summer season over nominal 30-day averaging periods (generally throughout July and August). Maximum rates of dustfall are expected to occur during these

months, when roads are not snow-covered and traffic reaches peak volume. A 2012 study (Golder, 2012) at two northern mines indicated that road dust is naturally mitigated by 94 – 96% as a result of winter conditions, compared to summer conditions). Therefore, conservative estimates of year-round dustfall can be determined based on summer sampling results. If results exceed reference values, the sampling window will be expanded to better understand trends. This approach is supported by results of year-round dustfall monitoring in 2017 and 2018, which indicated no exceedances of Alberta Environment's dustfall guideline for recreational areas (AENV, 2019) at 100 m from the AWAR during any month (Agnico Eagle, 2017 & 2018).

### 2.3.4 Monitoring Parameters

Dustfall samples will be analyzed for total and fixed dustfall according to procedures of the commercial analytical laboratory and ASTM 1739-98.

As a condition of the Project Certificate (No.:006, Term and Condition 27b-iii), NIRB has indicated a requirement to monitor the rates of deposition and chemical composition of dust entering aquatic systems along the AWAR, under the Aquatic Effects Monitoring Program (see Conformity Table, Section 1.2 above). While rates of deposition are determined through this dustfall monitoring program, Agnico believes it is more effective to quantify impacts of contaminants in dustfall to aquatic systems directly through water and/or sediment quality monitoring programs. If chemical composition of dust is measured, subsequent impacts to aquatic systems would need to be extrapolated from those results through modelling exercises which incorporate many assumptions, whereas water quality analyses under the AEMP would measure impacts directly. Since contributions from contaminants in dustfall are expected to represent only a minor component of any predicted changes in water quality site-wide, direct water quality analyses would better capture all inputs, thereby providing a more comprehensive assessment of impacts. This monitoring approach to assess water quality in surface water adjacent to the AWAR was described in the Aquatic Environment Impact Assessment (FEIS Volume 7, Section 7.4.11), and will be incorporated into the next update to the AEMP.

This is a similar approach to monitoring conducted under the Terrestrial Environment Management & Monitoring Program (TEMMP) to measure impacts of dust and contaminants on soil, vegetation, and wildlife. The Terrestrial Environment Impact Assessment (FEIS Volume 6) considered exposure to contaminants from emissions and fugitive dust through direct contact and ingestion of soil. These predictions are therefore assessed through soil and vegetation sampling conducted under the TEMMP, not analysis of dustfall samples. This approach provides a more direct measure of impacts to the terrestrial environment, since it eliminates assumptions such as soil mixing rates and uptake into plants.

### 2.3.5 Data Analysis

Dustfall rates measured at the monitoring stations will be compared to applicable air quality guidelines and analyzed for indications of spatial or temporal trends. The conclusions of this analysis will be presented each year in the annual report (see Section 8).

Specifically, dustfall results will be compared to the Alberta Environment Ambient Air Quality Guideline (AENV, 2019) for recreational areas for total dustfall of 0.53 mg/cm<sup>2</sup>/30d and commercial/industrial guideline of 1.58 mg/cm<sup>2</sup>/30d, to provide context and identify management actions. These guidelines are based on aesthetic or nuisance concerns, and are to be used for airshed planning and management, as a general performance indicator, and to assess local concerns. IA threshold of 1.58 mg/cm<sup>2</sup>/30d at 500 m from the road will be used to identify

areas where supplemental dust mitigation measures are implemented. Dust thresholds and related management actions are fully described in the Dust Management Plan (June 2020).

Analysis of spatial trends will include comparisons between the various monitoring stations to look at differences between transect locations, upwind and downwind locations, and distance from the road. A temporal analysis will also check for consistently increasing trends in the measured dustfall rates on an annual basis.

No quantitative predictions for total dustfall were presented in the Project FEIS for comparison to monitoring results. However, impacts of dust deposition on the aquatic and terrestrial environments are further assessed and compared with FEIS predictions through the AEMP (water and sediment quality monitoring) and TEMMP (soil and vegetation sampling through the ecological risk assessment program).

## 2.4 Gaseous Compounds

In accordance with Condition 2 of the Project Certificate, Agnico Eagle will monitor NO<sub>2</sub> and SO<sub>2</sub> at two onsite locations throughout the construction and operations phase of the project.

### 2.4.1 Monitoring Methods

Passive NO<sub>2</sub>-SO<sub>2</sub> samplers, provided by a commercial analytical laboratory, are used for this monitoring program. The monitors are suitable for this type of program as they require no electricity, and can be left unattended for extended periods. The samplers are deployed by Agnico Eagle technicians according to laboratory-identified procedures, and mounted to a support pole co-located with dustfall samplers (Figure 2-3). The passive samplers are exposed for a nominal period of 30 days before they are retrieved, replaced, and sent to the laboratory for analysis.



Figure 2-3. NO<sub>2</sub>-SO<sub>2</sub> sampler at the Meliadine site.

## 2.4.2 Monitoring Locations

Two passive ambient air monitors for NO<sub>2</sub> and SO<sub>2</sub> are installed for the construction and operation phases of the Project. The NO<sub>2</sub>-SO<sub>2</sub> monitoring stations are co-located with dustfall and suspended particulate monitoring stations at DF-5 and DF-7. These stations are within the Air Quality Impact Assessment Site Study Area (DF-5) and Local Study Area (DF-7), in downwind and upwind locations from the mine site, respectively.

## 2.4.3 Monitoring Frequency

Monitoring for NO<sub>2</sub>-SO<sub>2</sub> is conducted year-round on an approximate 30-d cycle. Passive samplers are exposed in the field for a nominal period of 30 days, collected for analysis, and replaced. As passive sampling is done over a longer period to allow for a sufficient sample size for analysis, it provides an indication of longer-term air quality trends.

## 2.4.4 Data Analysis

The analysis of the NO<sub>2</sub> and SO<sub>2</sub> monitoring data will include a comparison of results with the GN Environmental Guidelines for Ambient Air Quality (October, 2011) for these compounds. Concentrations measured on a monthly basis will be averaged, and compared to the annual average guidelines for NO<sub>2</sub> (60 µg/m<sup>3</sup> or 32 ppb) and SO<sub>2</sub> (30 µg/m<sup>3</sup> or 11 ppb) (Table 2-6).

In order to determine the accuracy of assumptions and predictions made during the Project environmental assessment phase, a comparison to NO<sub>2</sub> and SO<sub>2</sub> concentrations described in the revised air quality modeling predictions supporting the Meliadine Extension FEIS Addendum (ERM 2021) will also be included (Table 2-5). For the Site Study Area (SSA), where the sampling station DF-5 is located, the FEIS Addendum predicted a maximum annual average of 3.1 µg/m<sup>3</sup> (1.6 ppb @ 25°C) for NO<sub>2</sub>, and 0.1 µg/m<sup>3</sup> (0.04 ppb @ 25°C) for SO<sub>2</sub>. For the Local Study Area (LSA), where the sampling station DF-7 is located, the FEIS predicted a maximum annual average of 3.2 µg/m<sup>3</sup> (1.7 ppb @ 25°C) for NO<sub>2</sub>, and 0.1 µg/m<sup>3</sup> (0.04 ppb @ 25°C) for SO<sub>2</sub>. It should be noted that model predictions were for emissions produced by mine site activity, which do not include background values, which are included in monitoring results. The background values assumed in the FEIS (Table 5.2-6) are 0.1 µg/m<sup>3</sup> (0.05 ppb) for NO<sub>2</sub> and 0.5 µg/m<sup>3</sup> (0.2 ppb) for SO<sub>2</sub>. Therefore, results of the monitoring program at Meliadine are compared to the sum of these assumed background values and the predicted concentrations from site activity, as summarized in Table 2-6.

**Table 2-5. Summary of GN guidelines and FEIS predictions (plus assumed background concentrations) for annual average concentrations of NO<sub>2</sub> and SO<sub>2</sub>.**

Compound	GN Guideline (Annual Average)	FEIS Prediction + Background (Annual Average)	
		SSA (DF-5)	LSA (DF-7)
NO <sub>2</sub>	32 ppb	1.65 ppb	1.75 ppb
SO <sub>2</sub>	11 ppb	0.24 ppb	0.24 ppb

The measured ambient NO<sub>2</sub> and SO<sub>2</sub> concentrations will also be analyzed for indications of spatial and temporal trends.

## **2.5 Snowpack Contaminants**

In accordance with Term & Condition 1c of the Project Certificate No.:006, snowpack monitoring for contaminants will be conducted annually. The intent of the condition is to assist in predicting the impact of contaminants released in snowmelt on the water quality in Meliadine Lake, as described in the GN's Final Written Submission to the NIRB regarding the FEIS for the Meliadine Project (GN, 2014; Section 4.1.1). Therefore, contaminants in melted snowpack samples for Meliadine Lake locations will be analyzed for AEMP constituents of potential concern, and results will be interpreted in the context of potential impacts to Meliadine Lake water quality.

### 3 QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

Quality Assurance (QA) refers to plans or programs that encompass a wide range of internal and external management and technical practices designed to ensure the collection of data of known quality that matches the intended use of the data. Quality Control (QC) is a specific aspect of QA that refers to the internal techniques used to measure and assess data quality). As QC procedures are variable and program-specific, the procedures have been summarized in this section on a program component basis.

#### 3.1 Total Suspended Particulate, PM<sub>10</sub>, and PM<sub>2.5</sub> Monitoring

QA/QC procedures for the dynamic particulate monitoring program include the following:

- Travel blanks (laboratory prepared samples that travel with the samples but are not exposed to the atmosphere) will be used with each shipment;
- Samplers will be calibrated and maintained at least annually by appropriately trained personnel;
- Quarterly field audits of samplers will be performed in accordance where possible with the sampler operating manual;
- An accredited laboratory will be used for pre-sample preparation and determining sample weights;
- Samples and data will be collected by appropriately trained personnel; and
- Qualified personnel will interpret the flow data and confirm ambient particulate concentrations based on laboratory results.

#### 3.2 Dustfall Monitoring

QA/QC procedures for the dustfall monitoring program include the following:

- Travel blanks (laboratory prepared samples that travel with the samples but are not exposed to the atmosphere) will be used with each shipment;
- An accredited laboratory will be used for pre-sample preparation and analysis; and
- Samples will be collected by appropriately trained personnel.

#### 3.3 Passive NO<sub>2</sub>-SO<sub>2</sub> Monitoring

- Travel blanks (laboratory prepared samples that travel with the samples but are not exposed to the atmosphere) will be used with each shipment;
- An accredited laboratory will be used for pre-sample preparation and analysis;
- Samples will be collected by appropriately trained personnel consistent with detailed written operating instructions from qualified personnel; and
- Qualified personnel will interpret ambient NO<sub>2</sub>-SO<sub>2</sub> concentrations based on laboratory results.

## 4 METEOROLOGICAL MONITORING

Meteorological data are a critical input to air dispersion models and emissions estimation that will be required throughout the life of the Project. These data allow for site-specific meteorological conditions to be included in emissions and modelling assessments, which can assist in developing trends.

A single meteorological monitoring station is installed at the site to meet international meteorological installation standards. The station continuously measures the following parameters:

- wind speed;
- wind direction;
- temperature;
- solar radiation; and
- total precipitation (to be added).

A summary of meteorological data will be included in the annual report (see Section 8.0), with a discussion of extreme events as necessary.



## 5 WASTE INCINERATION

In addition to the monitoring programs, Agnico Eagle has committed that the Project will meet CCME emission requirements for waste incinerators. These requirements are summarized as follows:

- Canada-Wide Standards for Dioxins and Furans (CCME, 2001): This document sets out the emission limits from incinerators. Emission limits are expressed as a concentration in the exhaust gas exiting the stack of the facility and will be met using generally available incineration and emission control technology and waste diversion. An emission concentration limit of 80 picograms of International Toxic Equivalency Quotients per cubic metre (pg I-TEQ/m<sup>3</sup>) is applicable to the Project for hazardous waste and sewage sludge incineration.
- Environmental Guideline for the Burning and Incineration of Solid Waste (Nunavut, 2012): This document sets out practices, methods and limits with respect to the combustion of solid waste in Nunavut. The guideline includes a specific limit of 80 picograms of International Toxic Equivalency Quotients per cubic metre (pg I-TEQ/m<sup>3</sup>), which is consistent with the CCME limit above. The guideline also sets a limit of 20 micrograms per cubic metre (µg/m<sup>3</sup>).

An Incinerator and Composter Management Plan for the Mine has been developed, which includes a stack testing program for mercury as well as dioxins and furans. The stack testing report will be provided as an appendix of the Air Quality Monitoring Report annually.

## **6 GREENHOUSE GAS EMISSIONS**

Agnico Eagle reports greenhouse gas emissions annually to Environment and Climate Change Canada's Greenhouse Gas Emissions Reporting Program (GHGRP), and further reports air emissions to the National Pollutant Release Inventory program.

## 7 MITIGATION AND ADAPTIVE MANAGEMENT

Design aspects, operational measures, and other mitigation measures have been incorporated into the current Project plans, which will minimize associated air emissions. Mitigation measures that will be applied to the Project can be classified into 3 stages:

- Design-based mitigation;
- General mitigation; and
- Activity-specific mitigation.

Through its Project design, Agnico Eagle has identified a series of best management practices that will be employed to minimize potential air quality changes. For example, within the Project, design specifications, such as the purchase of vehicles that meet Tier III emission standards, have been incorporated. Other mitigation will include the development of general mitigation practices, such as routine maintenance and housekeeping programs, as well as activity specific mitigation, such as incinerator management programs. The following management plans which have been submitted to the NIRB further describe mitigation measures related to air quality:

- Dust Management Plan
- Incinerator and Composter Waste Management Plan
- Ore Storage Management Plan
- Mine Waste Management Plan
- Roads Management Plan
- Borrow Pits and Quarries Management Plan
- Greenhouse Gas Reduction Plan

## 8 REPORTING

Agnico Eagle will provide an annual air quality report that summarizes the air quality monitoring data collected during each year. In addition, Agnico Eagle will report annual emission estimates to the National Pollutant Release Inventory (NPRI) and Greenhouse Gas (GHG) emissions to the appropriate federal program.

The following items will be included in the annual air quality monitoring report:

- Description of the monitoring programs;
- Description of mitigation efforts undertaken in the previous year;
- Monitoring locations;
- Instrumentation;
- Weather conditions during sample collection;
- Time and duration of monitoring, including dates;
- Partisol sampler inspection reports;
- Relevant standards/guidelines;
- Results of monitoring (raw and averaged as appropriate for comparison to standards);
- Comparison of results to relevant standards, FEIS predictions, and analysis of spatial and temporal trends;
- Discussion of results, including possible reasons for non-compliance with reference values or exceedance of FEIS predictions; and
- Mitigation measures for reducing non-compliance incidents in the future.

## 9 REFERENCES

- AENV (Alberta Environment) (2019). Alberta Ambient Air Quality Objectives and Guidelines Summary. AEP, Air Policy, 2016, No.2. Updated January, 2019.
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## APPENDIX A – PARTISOL OPERATION AND MAINTENANCE

Agnico Eagle will be responsible for managing and operating the air quality monitoring stations. Operation and monitoring of the stations will come under the responsibility of the Environment Superintendent or designate. Designation of training requirements is the responsibility of Meliadine Environment Department.

The Environment Department will be responsible to ensure that the Partisol samplers are operated in accordance with the equipment operating manual and that samples will be collected by appropriately trained personnel consistent with detailed written operating instructions from qualified personnel (i.e. air quality specialist familiar with the equipment). An SOP will be kept up to date and communicated to personnel. It will also ensure that proper QAQC practices are followed.

As recommended by the manufacturer and to ensure results are in compliance with good practices, the following items will be part of the regular maintenance and care of the Partisol sequential air samplers. This will allow flow values and temperature compensation to be constant with time.

<b><u>Maintenance Procedures</u></b>	<b><u>Interval</u></b>
Exchanging particle trap filter	6 months
Testing batteries–exchange if necessary	6 months
Exchanging fuses	As needed
Cleaning Air Intake Filters	6 months
Inspect “V” Seals and O-rings	3 months
Rebuilding piston pump(s)	18 months

<b><u>Audit Procedures</u></b>	<b><u>Interval</u></b>
Ambient Air Temperature audit	4 weeks
Filter Temperature(s) audit	4 weeks
Ambient Pressure audit	4 weeks
External Leak Check	4 weeks
Flow controller audit	4 weeks

<b><u>Calibration Procedures</u></b>	<b><u>Interval</u></b>
Analog I/O calibration	Automatic
Ambient Air Temperature calibration	1 year
Filter Compartment Temperature calibration	1 year
Filter Temperature(s) calibration	1 year
Ambient Pressure calibration	1 year
Ambient Relative humidity calibration	1 year
External Leak Check	1 year
Flow controller calibration	1 year