



REPORT

Human Health Risk Assessment

Meliadine Waterline Addendum

Submitted to:

Agnico Eagle Mines Limited

Submitted by:

Golder Associates Ltd.

6925 Century Avenue, Suite #100, Mississauga, Ontario, L5N 7K2, Canada

+1 905 567 4444

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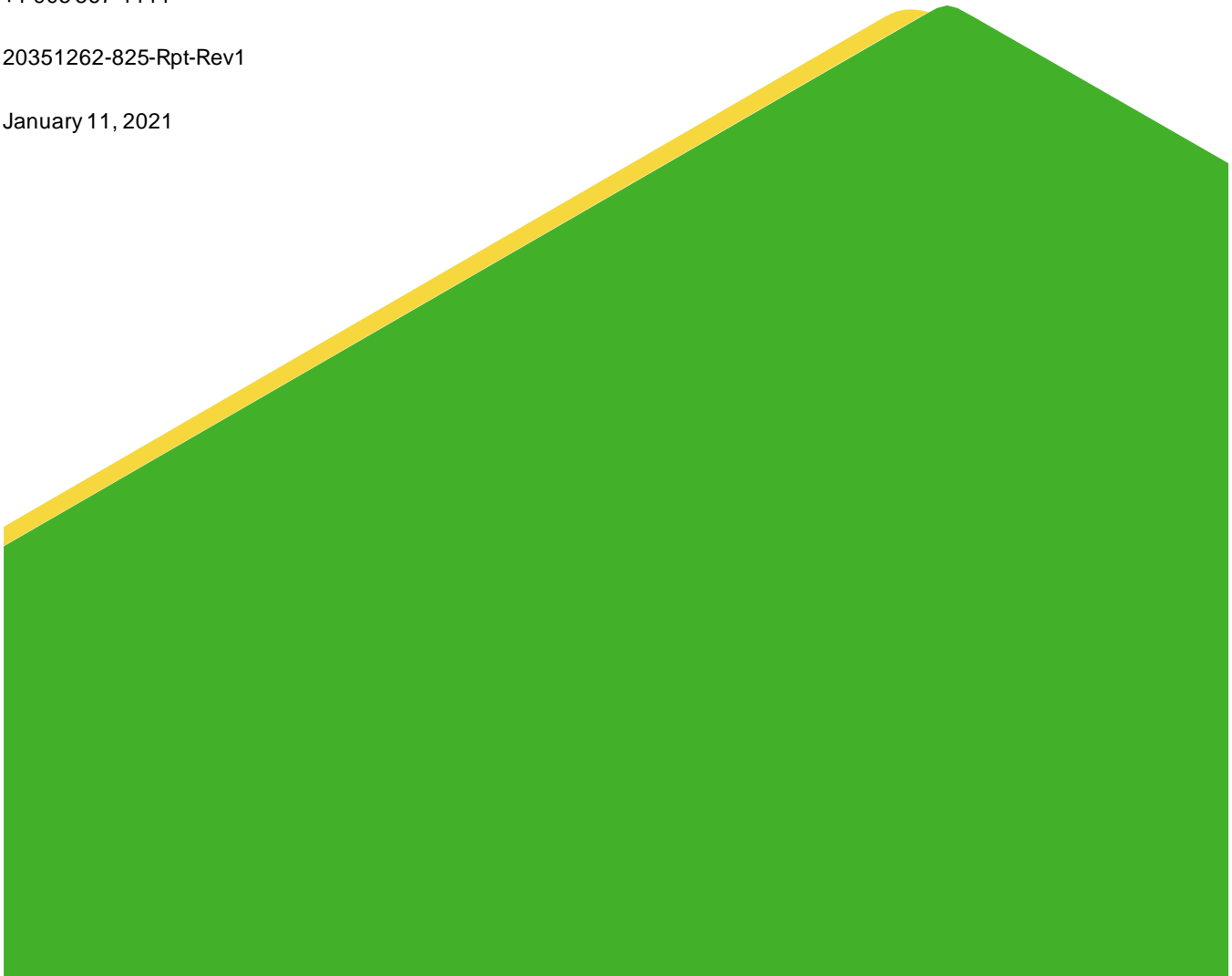


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1.0 INTRODUCTION

The purpose of the Human Health Risk Assessment (HHRA) is to assess the effects of the Agnico Eagle Mines Limited (Agnico Eagle) Waterline Addendum on human health. Agnico Eagle is currently approved to discharge saline water to the marine environment (i.e., Melvin Bay) and completed an assessment of activities in the 2018 FEIS Addendum (Agnico Eagle 2018). The current method of transporting the water is via water trucks along the All-weather Access Road (AWAR). Agnico Eagle submitted an Addendum in August 2020 for approval to allow higher volumes to be discharged and transported via a waterline from Meliadine mine site to Melvin Bay, with sections of the waterline to be buried. At the discharge point in Melvin Bay, there is a diffuser a few metres below the water surface to ensure the discharge water is well mixed with the marine environment. To determine the incremental changes in the environment due to discharges from the Project, the existing (or baseline) conditions of the environment must first be understood. This assessment is completed by first describing the baseline conditions and then evaluating the potential changes to environmental quality resulting from Project-related components and associated activities that may impact human health. This assessment includes the direct effects on air quality, water quality, sediment quality, and indirect effects to soil quality and country food quality (e.g., fish, caribou).

This HHRA follows the basic principles of risk assessment frameworks endorsed by Health Canada (e.g., Health Canada 2012, 2019), Canadian Council of Ministers of the Environment (CCME), and United States Environmental Protection Agency (US EPA). These principles are summarized in the remainder of this section.

Risk assessment is a scientific tool used to characterize the nature and magnitude of potential risks, if any, associated with the exposure of receptors (e.g., humans) to chemicals. For there to be a potential risk, the following three conditions must be met:

- a chemical must be present at levels that could be harmful;
- a receptor must be present; and
- there must be an exposure pathway by which the receptor can come into contact with the chemical.

These three conditions are illustrated in Figure 1, where risk is anticipated to occur when the three necessary conditions are met.

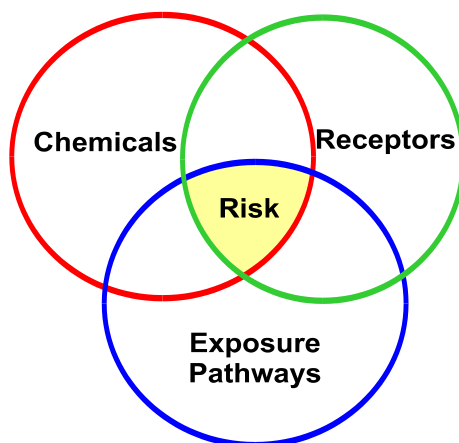


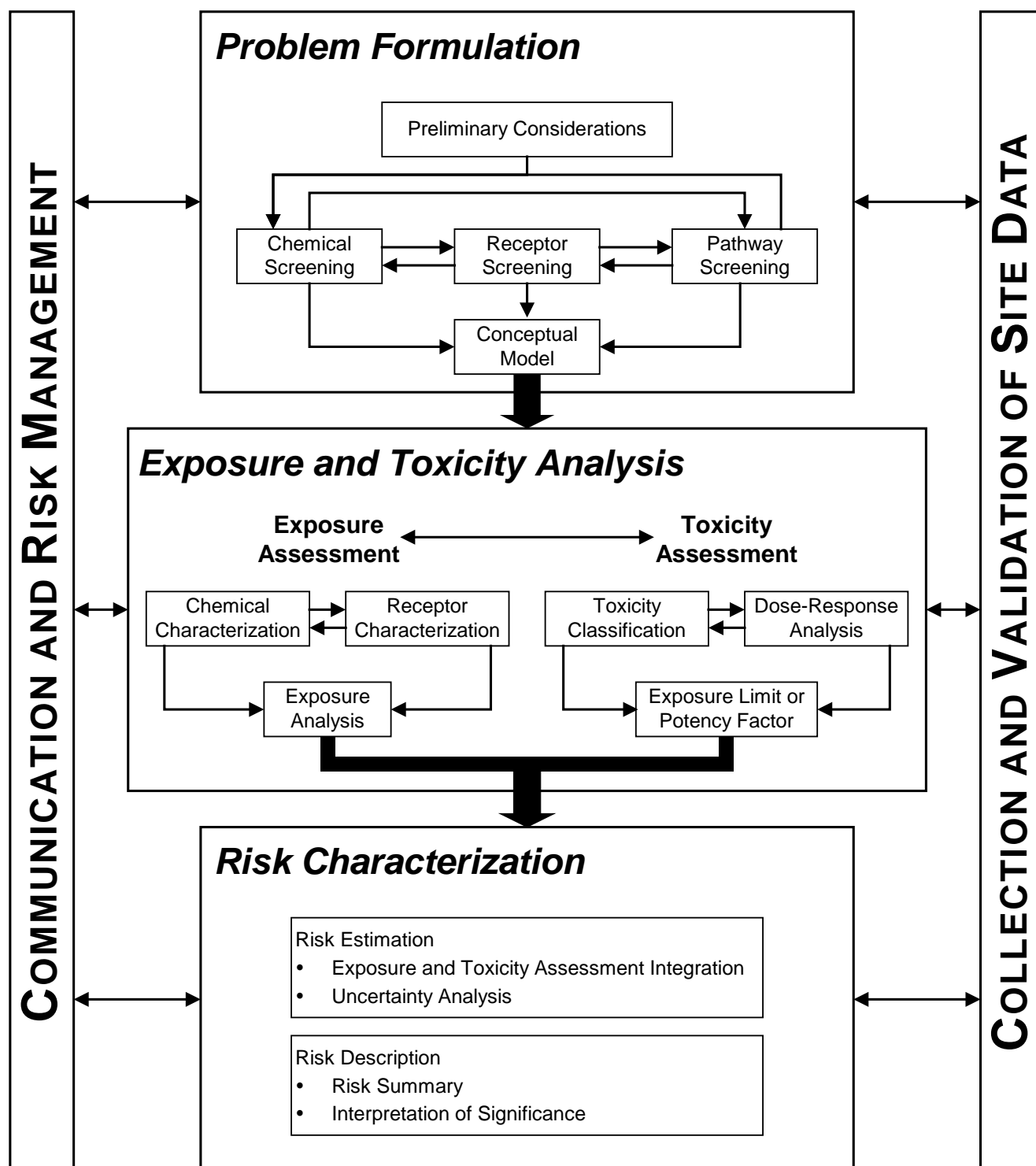
Figure 1: Venn diagram showing the three conditions that must exist for there to be a potential health risk (modified from Health Canada 2019)

To determine whether these conditions are present, the HHRA framework used in Canada typically involves four components, as described below and depicted in Figure 2:

- 1) **Problem Formulation:** The Problem Formulation involves developing a focused understanding of how environmental quality might affect the health of receptors (i.e., humans) near the proposed project. The problem formulation identifies the following:
 - a representative set of receptors (i.e., humans) that may be present in the vicinity of the project;
 - chemicals that may be present at levels that may be harmful to receptors (termed Chemicals of Potential Concern [COPCs]); and
 - pathways by which receptors may be exposed to COPCs (e.g., inhalation of COPCs in ambient air).

The information from the Problem Formulation is summarized in a Conceptual Site Model (CSM) which illustrates the pathways of the COPCs from their sources, through the relevant environmental media and to the receptors of interest. The approach to developing a CSM for an HHRA is outlined following Figure 2.

- 2) **Exposure Assessment:** The Exposure Assessment involves estimating the daily dose of a COPC received by the receptors for each relevant exposure pathway identified in the Problem Formulation. This value is called the Estimated Daily Intake (EDI) and is typically expressed as milligrams (mg) of a chemical per kilogram (kg) of body weight per day (mg/kg/day). The EDI is calculated from site-specific concentrations of COPCs in environmental media (e.g., water, sediment, fish, air, soil, or vegetation), the amount of time the receptor spends in the study area and receptor-specific parameters such as body weight, ingestion rate, and dietary preferences.
- 3) **Toxicity Assessment:** The Toxicity Assessment provides the basis for assessing what is an acceptable dose and what dose may adversely affect the health of receptors. This involves identification of the potentially toxic effects of a COPC and determination of the dose to which a receptor can be exposed without experiencing adverse health effects. This value is called the Toxicity Reference Value (TRV). For human health, the TRV is expressed as mg of a COPC per kg of body weight per day (mg/kg/day).
- 4) **Risk Characterization:** The final component of an HHRA determines the potential for adverse health effects to occur. This is determined by comparing the dose received by the receptors (i.e., the EDI from the exposure assessment) with the dose that is determined to be acceptable (i.e., the TRV from the toxicity assessment). The characterization of risks includes consideration of the uncertainty and conservatism in the HHRA.



Source: Health Canada [unpublished] 1995.

Figure 2: Risk Assessment Framework (modified from Health Canada 1995)

A CSM is developed in an HHRA to understand which substances (i.e., chemicals present at concentrations in excess of the applicable guidelines/standards and greater than site-specific background levels, referred to as COPCs) are present in the local study area (LSA) and regional study area (RSA), how human receptors may use the affected areas, and the pathways of contact that are possible between these substances and the receptors. These substances, receptors, and pathways (the environmental risk components) are examined in detail to identify the “reasonably anticipated” combinations corresponding to potentially complete (i.e., significant) exposure pathways. Incomplete pathways are eliminated from further consideration or are “screened out”. The combinations of the environmental components that remain subsequent to the screening process, form the basis of the conceptual model, and are used to focus the HHRA.

The CSM addresses the following questions to characterize the effect of COPCs on human receptors:

- What substances are a result of Project-related emissions and which are related to natural sources?
- Which substances are present at elevated concentrations relative to site-specific background levels?
- Which substances are present at elevated concentrations relative to applicable guidelines/standards?
- In which environmental media are they located (i.e., soil, groundwater, surface water, air, vegetation, etc.)?
- Is there a potential for the substances to migrate?
- In what concentrations are the substances present in the affected environmental media?
- How is and/or will the Project site be used?
- Who are the human receptors (current and future users) that may come into contact with the substances?
- How can the human receptors come in contact with the substances?

Where exposure scenarios can be reasonably assumed to be complete, a more detailed examination or quantification of potential risks is required. The detailed assessment involves the remaining stages of the risk assessment including exposure assessment, toxicity assessment, and risk characterization.

2.0 PROBLEM FORMULATION

2.1 Study Boundaries

Project activities and the potential changes that they may produce on the environment are subject to spatial and temporal boundaries. These boundaries are common to all environmental components but with some modifications. The overall assessment boundaries of the Project are defined in Volume 4, Section 4.4 of the FEIS (Agnico Eagle 2014). The spatial and temporal boundaries specific to the HHRA are described below.

2.1.1 Spatial Boundaries

The spatial boundaries for the HHRA were considered to be the same as those defined for the aspects of the environment that can directly affect human health, including air quality, water quality, and fish quality. In general, the spatial area under assessment includes the mine site area (defined as the disturbed site footprint, the area surrounding the mine site including the Discovery deposit [specifically defined by air quality, water quality, and fish quality], and the segment of the AWAR that is incorporated into this area), the AWAR including the area immediately adjacent to the AWAR as defined by the various disciplines, and the town of Rankin Inlet. The specific definitions of the LSA and RSA used by the other disciplines are provided in those respective sections of the FEIS.

The spatial boundaries for the HHRA were aligned with those identified by the Project disciplines that will predict potential Project-related changes to environmental quality, or that provided information relevant to human activities. These Project disciplines are as follows:

- Atmospheric environment (including air quality [Section 5.2 of the FEIS] and noise [Section 5.5 of the FEIS]);
- Freshwater environment (including surface water and sediment quality [Section 7.4 of the FEIS] and
- Socio-economic environment (including traditional knowledge and traditional land use [Section 9.3 of the FEIS]).

The spatial boundaries of the LSA and RSA are described further below.

- The LSA applicable for surface water quality and air quality are defined in the relevant sections of the FEIS. The LSA for the HHRA is consistent with the above noted LSA definitions. The LSA for human health generally encompassed the disturbed mine footprint, the water bodies identified within the LSA for surface water quality, and the cabin locations identified within the LSA for air quality. Additionally, the section of the AWAR that is incorporated into the LSA for surface water quality and air quality was included in the LSA for human health.
- The RSA applicable for surface water quality and air quality are defined in the relevant sections of the FEIS. The RSA for the HHRA is consistent with the above noted RSA definitions.

2.1.2 Temporal Boundaries

The approach used to determine the temporal boundaries of potential effects the same as the existing and approved FEIS Addendum (Agnico Eagle 2018).

The approach used to determine the temporal boundaries of potential effects was similar to the approach used to define spatial boundaries and are linked to two concepts:

- the development phases of the Project (i.e., construction, operation and maintenance, and closure), focused on the proposed Project changes
- the predicted duration of effects from the proposed Project changes on a valued ecosystem component (VEC) or valued socio-economic component (VSEC), which may extend beyond closure (i.e., post-closure)

The projected life of the proposed Project activities is anticipated to extend for the duration of the mine life (10 years) but may be extended as exploration continues. No change in the currently approved mine plan is proposed. This includes an estimated nine months of construction, 13 years of operations to coincide with mine life, and a two-month decommissioning period. For the purpose of this assessment, a conservative estimate of 25 years is considered as the temporal boundary to account for the mine life of the Meliadine Mine and potential mine expansion. The proposed Project activities associated with the construction phase are anticipated to be completed over a couple of months during the open water season (summer months), and for operations for the duration of the Mine life, but limited to open water season months, and through to decommissioning.

2.2 Human Receptors

Valued ecosystem components and VSECs represent physical, biological, cultural, social, and economic properties of the environment that are either legally, politically, publicly, or professionally recognized as important to a particular region, community, or by society as a whole.

Health and safety, namely public safety, was selected as a VSEC for the Project. Valued ecosystem components and VSECs were selected based on their role in the ecosystem, and value placed on them by humans for traditional use and cultural connection, where appropriate. Two valued components were selected to assess Project-related effects on human health: Inuit and non-Inuit members of the public (Table 1).

Factors considered when selecting VSECs included the following:

- traditional knowledge and traditional land uses of Inuit and other indigenous peoples (hereafter collectively referred to as Inuit) receptors in the area around the waterline;
- people that reflect the interests of regulatory agencies, Inuit groups, and communities;
- VSECs identified for previous affiliated Projects including the Meliadine Gold Mine Project (Agnico Eagle 2014) and the 2018 FEIS Addendum (Agnico Eagle 2018); and
- current experience with environmental assessments and effects monitoring programs in Nunavut and the Northwest Territories (NWT).

Health and safety of members of the public are important to the people of Nunavut. Assessment endpoints represent the key properties of the valued component that should be protected for their use by future human generations, while measurement endpoints are quantifiable expressions of changes to assessment endpoints. Assessment and measurement endpoints for human health valued components are presented below (Table 1).

Table 1: Summary of the Valued Components, Assessment Endpoints, and Measurement Endpoints for Human Health Risk

Valued Component	Assessment Endpoints	Measurement Endpoints
<ul style="list-style-type: none"> ■ Inuit members of the public ■ Non-Inuit members of the public 	<ul style="list-style-type: none"> ■ Protection of air quality ■ Continued opportunity for use of surface water, fish, and country foods for traditional and non-traditional human use. 	<ul style="list-style-type: none"> ■ Air quality ■ Soil quality ■ Country food quality (e.g., birds, mammals) ■ Water quality ■ Fish quality

2.3 Exposure Pathways

Pathway analysis identifies and assesses the linkages between Project components or activities, and the potential residual effects to human health. The first part of the analysis is to produce a list of all potential effects pathways for the Project. Each pathway is initially considered to have a linkage to potential effects on human health. This step is followed by the development of environmental design features and mitigation that can be incorporated into the development description to remove a pathway or limit (mitigate) the effects to human health. Environmental design features include Project design elements, environmental best practices, management policies and procedures, and social programs. Environmental design features are developed through an iterative process between the Project's engineering and environmental teams to avoid or mitigate effects.

Pathway analysis is a screening step that is used to determine the existence and magnitude of linkages from the initial list of potential effects pathways for the Project. This screening step is intended to focus the effects analysis on pathways that require a more comprehensive assessment of effects on human health. Pathways are determined to be primary, minor, or as having no linkage using scientific and traditional knowledge, logic, and experience with

similar developments and environmental design features. Each potential pathway is assessed and described as follows:

- No linkage – pathway is removed by environmental design features and mitigation so that the Project results in no detectable environmental change and residual effects to human health relative to baseline or guideline values;
- Minor – pathway could result in a minor environmental change, but would have a negligible residual effect on human health relative to baseline or guideline values; or
- Primary – pathway is likely to result in a measurable environmental change that could contribute to residual effects on human health relative to baseline or guideline values.

Primary pathways require further effects analysis to determine the environmental significance from the Project on human health. Pathways determined to have no linkage to human health, or those that are considered minor, are not predicted to result in environmentally significant effects on human health. No linkage and minor pathways are summarized in the HHRA but not carried through the effects assessment for quantitative analysis.

Potential pathways previously identified for the Meliadine Project and their applicability to the current Project are presented in Appendix A. Environmental design features and mitigation incorporated into the design of the Project to remove a pathway or limit the effects to human health are listed; design features and mitigation measures incorporated as part of the Meliadine Project are similarly incorporated in the current Project. The pathway is then determined to be primary, minor, or as having no linkage. The classification of pathways as primary, minor, or as having no linkage was determined by the disciplines that have assessed the pathway and provided predictions regarding changes to environmental quality. For example, pathways related to air emissions were assessed in the Air Quality section of the 2014 FEIS (Section 5.2) and those that were classified as primary were assessed further.

As a first step in the risk assessment, Agnico Eagle first considered the “primary” pathways from the 2014 FEIS for the Meliadine Project which may be bounding scenarios for the waterline application (Appendix A). As shown in the table of Appendix A, there were no primary pathways identified.

As the second step in the risk assessment, Agnico Eagle then considered additional pathways that would be unique to the waterline specifically. The primary pathways related to human health risk for the waterline application are as follows:

- Generation of dust during the construction and operations phases of the waterlines, specifically related to dust generated through excavating trenches for the placement of the buried waterline, placement of materials over the buried waterline, and operation of vehicles on the access road. Dusts can be inhaled by Inuit and non-Inuit members of the public.
- Saline effluent discharging into Melvin Bay and indirect exposure to Inuit (and potentially non-Inuit) via consumption of marine country foods (e.g., fish, geese, marine mammals).

The two primary pathways for the waterline application were considered further in the HHRA.

Table 2: Marine Fish, Birds and Mammals with Cultural, Economic or Subsistence Importance identified in the Local Study Area and/or Regional Study Area of the 2014 Final Environmental Impact Statement for the Meliadine Gold Project


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2.4 Contaminants of Potential Concern

The types of contaminants that may be associated with the two primary pathways identified for the waterline application include dust (i.e., particulate matter) and saline effluent (i.e., total dissolved solids).

2.4.1 Air Quality

The primary pathway identified for air quality is generation of dust during construction and operations phases of the waterline, specifically related to dust generated through excavating trenches for the placement of the buried waterline, placement of materials over the buried waterline, and operation of vehicles on the access road. Dusts generated through these project activities can be inhaled by Inuit and non-Inuit members of the public. The remainder of this section is reproduced from the response to Information Request #3 from Health Canada dated September 25, 2020 on the Impact Statement Addendum for the Saline Effluent Discharge to Marine Environment Project Proposal (Agnico Eagle 2020a).

In the original FEIS for the Meliadine Project (Agnico Eagle 2014), emissions during the operations phase of the project were predicted and evaluated with respect to potential adverse effects to human health as part of the risk assessment. All risks were acceptable with respect to PM₁₀ and PM_{2.5} during the operations of the Meliadine Mine including the AWAR considering that several air quality mitigation measures would be in place as listed below (reproduced from Table 10.1-3 of Volume 10 of the Meliadine FEIS, Agnico Eagle 2014):

- Best management practices to control fugitive particulate emissions from haul roads and material handling
- Sources of particulate emissions at the processing facility are controlled through the use of baghouses
- Enclosures are used to reduce fugitive emissions at the processing facility
- Exhaust emissions from non-road vehicles will be managed through purchasing equipment that meet Tier 3 emission standards
- Exhaust emissions from non-road vehicles will be managed through regular and routine maintenance of vehicles
- SO₂ emissions from non-road vehicles and stationary equipment will be reduced through the use of diesel fuel with less than 15 ppm of sulphur

The contributions from both the mine and the AWAR during operations were considered in the predicted dust emissions. The risk assessment (Volume 10, Agnico Eagle 2014) found that upon comparison to the Canada Wide Standard relevant at the time for PM_{2.5} (30 µg/m³; CCME 2000) and the World Health Organization air quality guideline for PM₁₀ adjusted using the site-specific ratio of PM₁₀/PM_{2.5} (40 µg/m³; WHO 2005) all concentrations in the LSA (cabins, a park and Rankin Inlet) and within the project footprint at the on-site worker camp met the standards. Specifically, at cabin locations around the mine site and along the AWAR, concentrations of both PM_{2.5} and PM₁₀ were all at least 10 times lower than their respective standard/guideline; at the on-site worker camp, concentrations were slightly lower than the selected guidelines.

The predicted emissions from the FEIS can be compared to monitoring data collected in 2018 (Agnico Eagle 2019) and 2019 (Agnico Eagle 2020b) from the mine site during operations phase, which includes use of the AWAR (note that operations phase was considered to be higher in emissions than the construction phase, including construction of the AWAR). Monitoring data were collected at the perimeter of the Site, and as such the on-site monitoring data are compared to the FEIS predictions for the on-site worker camp. As shown in Table 5 of the 2018 annual

monitoring report (Agnico Eagle 2019) and Table 5 of the 2019 annual monitoring report (Agnico Eagle 2020), the concentrations of suspended particulates (PM_{2.5} and PM₁₀) were well within the selected regulatory guidelines and the FEIS predictions as shown in Table 3 below.

Table 3: Summary of 2018 and 2019 Annual Air Quality Monitoring Results for PM_{2.5} and PM₁₀

Parameter	Regulatory Guideline	2018-2019 Monitoring Results (Min-Max)	FEIS Predictions for the On-Site Worker Camp
PM _{2.5}	28	1.12-2.67	26.5
PM ₁₀	50	2.1-4.92	32.8

All concentrations are provided in units of micrograms per cubic metre (µg/m³).

As shown above, the monitoring results are approximately 10 times lower than the FEIS predictions. Additionally, these monitoring stations are close to the mine site during operations, which is expected to be associated with higher emissions than the construction phase of the original Meliadine Project which includes construction of the AWAR. As a result, it is considered reasonable to conclude that particulate emissions during construction and operation of the waterline will be similarly low and well within regulatory guidelines, thus not necessitating further quantitative risk assessment.

As the only contaminant in air emissions was identified as particulate matter (or dust), and no specific contaminants such as metals were anticipated to be emitted at concentrations greater than regulatory guidelines (see Volume 10, FEIS [Agnico Eagle 2014]), potential deposition onto soils was not considered to be a complete pathway. Therefore, soils were not considered further in the problem formulation.

2.4.2 Water Quality including Bioaccumulative Substances

The primary contaminant released from the saline discharge is total dissolved solids (TDS). TDS is not expected to be associated with direct effects to human health; Health Canada has not identified any health effects associated with TDS, and therefore no guideline value based on health effects was derived. This also means that no health effects have been associated with TDS for swimming and other recreational uses.

The predicted concentration has been assessed to range from 2,200 to 39,600 mg/L TDS (Tetra Tech 2020a,b). Through these model scenarios, TDS concentrations are predicted to be less than the generic guidelines for protection of aquatic life at the edge of the mixing zone; for this reason, TDS has not been considered further.

However, as TDS is comprised of various inorganics such as metals, consideration as to whether concentrations of metals could be potentially bioaccumulative was carried out. The Contaminated Sites Approved Professionals (CSAP) Society report entitled “Bioaccumulation Research Project” (SLR 2015) provides a list of inorganic and organic constituent groups that have the potential for bioaccumulating and biomagnifying processes in the biological receptors receiving environment. CSAP (2015) is a reference to address and manage risk at contaminated sites where constituent concentrations are consistently above concentrations that may potentially pose unacceptable risk to human or ecological health in the environment.

Meliadine Mine and Melvin Bay are not contaminated sites; however, constituents in CSAP (2015) are referenced to consider how this document may inform the potential for bioaccumulation from discharge to Melvin Bay.

CSAP (2015) state that an evaluation of potential for bioaccumulation should only be conducted when there is reason to believe constituents in the receiving environment that are bioaccumulative have the potential to pose an unacceptable risk to human or ecological health. The constituents listed in CSAP (2015; Table 1) that have a bioaccumulation potential in aquatic and terrestrial environments include metals, pesticides and polychlorinated biphenyls, semi-volatile compounds, polycyclic aromatic hydrocarbons, dioxins, and chlorinated aromatic hydrocarbons. The majority of these groups (i.e., the pesticide, organic and hydrocarbon constituent groups) are unlikely to be present in the saline discharge to Melvin Bay. Metals are expected to be present in the saline discharge, but their concentrations in the discharge will be at levels that will not exert acute toxicity at the discharge point (end of pipe) or result in chronic toxicity effects at the edge of the mixing zone, and thus have no bioaccumulation potential (see Table 4 below). It should be highlighted that TDS is not part of the constituents listed in CSAP (2015; Table 1) because it does not have a potential to bioaccumulate in aquatic and terrestrial environments.

Discharge will meet Metal and Diamond Mining Effluent Regulations (MDMER) regulated concentrations for Schedule 4 constituents, which include arsenic, copper, lead, nickel, and zinc (also listed in Table 1 of CSAP [2015]), at the end of pipe. The remaining list of metals in Table 1 of CSAP (2015), excluding tributyl tin (which can be accounted for by monitoring tin), will be monitored in the discharge and receiving environment, with results in the receiving environment samples compared to CCME chronic (long-term) guidelines for protection of marine organisms.

Table 4: Comparison of Predicted and Measured Discharge Water at End of Pipe to Acute CCME Guidelines Protective of Marine Aquatic Life

Chemical ^(a)	Units	MDMER ^(b)	CCME ^(c)	Predicted Discharge ^(e)	Average Measured Discharge (2019 to 2020)
Arsenic	mg/L	0.5	NR	-	0.0128
Cadmium	mg/L	--	NGRA	0.0002	0.0002
Chromium	mg/L	--	0.0015C(d)	0.03	<0.01 to <0.05
Copper	mg/L	0.3	NR	-	0.007
Lead	mg/L	0.2	NR	-	0.004
Mercury	mg/L	--	0.000016 ^c	0.00001	<0.00001
Nickel	mg/L	0.5	NR	-	0.0396
Selenium	mg/L	--	--	0.02	0.0014
Silver	mg/L	--	0.0075A	-	0.0005
Thallium	mg/L	--	--	0.0001	0.0001
Zinc	mg/L	0.5	NR	-	<0.05 to <0.25

Notes:

-- = no guideline available; mg/L = milligrams per litre; NGR = no guideline required; NR = not required as MDMER guideline is applicable where available.

Acute guidelines are designated with superscript ^A; in the absence of acute guidelines, chronic guidelines are designated with superscript ^C.

(a) Bioaccumulative metals listed in SLR (2015).

(b) Schedule 4 MDMER, Maximum Authorized Monthly Mean Concentration

(c) Guidelines were adopted from CCME

(d) Chronic guideline for hexavalent chromium (CrVI) is shown; note that chronic guideline for trivalent chromium (CrIII) is 0.056 mg/L.

(e) Table 9 from the 2018 FEIS Addendum (Agnico Eagle 2018).

It is important to note that CSAP (2015) states that regardless of any bioaccumulative characteristics of constituents included in the monitoring, those with concentrations below the above stated limits at end of pipe or edge of mixing zone do not require further consideration in a bioaccumulative assessment as the environment is not considered to be at risk (i.e., contaminated) with those constituents.

Further, three-dimensional hydrodynamic modelling (Tetra Tech 2020a,b) of varying discharge scenarios has shown that the engineered diffuser will effectively disperse the discharge in the 100 m mixing zone, which will then attenuate rapidly with distance from the diffuser due to the depth of the bay and energy of the daily tidal regime. Discharge will make up less than 1% of the water volume at the edge of the 100 m mixing zone. Discharge is limited to the open water season, and the hydrodynamic modelling has also shown that following the cessation of each annual discharge period, residual discharge in the bay is fully flushed from the bay before the next open water discharge commences.

2.5 Conceptual Site Model

A CSM was developed for human health as described in Section 1.0 based upon the primary pathways identified above (Figure 1). The exposure pathways between project activities, intermediate residency media (i.e., the aspects of the environment that that may experience a change in quality due to project activities/emissions), and receptors are shown to be either complete or incomplete. Where pathways are incomplete, quantitative assessment was not carried out given that environmental quality was not anticipated to change as a result of the Project. All pathways were assessed as being incomplete.

2.5.1 Air Quality

Fugitive dusts from the construction and operation of the road along the waterline including the excavation of trenches to bury portions of the waterline were considered with respect to the potential to cause a potential adverse effect to Inuit or non-Inuit members of the public in the area via inhalation of dust. Upon consideration of the predicted dust emissions for the original Meliadine Project, which considered the operations phase of the gold mine and the construction/operation of the AWAR, the predicted concentrations were lower than regulatory guidelines. Furthermore, monitoring data during the operations phase indicates that concentrations are approximately 10x lower than those predicted in the 2014 FEIS (Agnico Eagle 2014). Given that dust generation expected for the waterline is expected to be lower than that of the operational mine and AWAR (and far lower than regulatory guidelines), risks to human health are considered to be negligible.

2.5.2 Water Quality including Bioaccumulative Substances

Discharge of saline water to the marine environment was evaluated for the potential to cause a potential adverse effect to marine country foods including fish and marine mammals and birds that are relied upon by the Inuit for cultural, or subsistence uses. Based upon the available baseline information (Nunami Stantec 2012), there is no evidence that country foods are currently harvested from the area in proximity to the discharge location (i.e., the pathway between the contaminant source and the receptor is incomplete, and the receptors (i.e., Inuit harvesters) are not expected to use the area). Furthermore, the concentrations of trace metals that may be potentially bioaccumulative in the saline discharge are below the criteria outlined in the CSAP (2015) guidance and as such the source of contamination is also incomplete. Therefore, considering the risk paradigm illustrated in Section 1.0, the contaminant source, pathway, and receptor are all inoperable for the discharge to saline water pathway and therefore no further risk assessment is warranted.

3.0 CONCLUSION

The HHRA completed for the Waterline Addendum followed the basic principles of risk assessment frameworks endorsed by Health Canada (e.g., Health Canada 2012, 2019), CCME, and the US EPA. For a potential risk to human health to be present three conditions must be met:

- a chemical must be present at levels that could be harmful;
- a receptor must be present; and
- there must be an exposure pathway by which the receptor can come into contact with the chemical.

Through the completion of the Problem Formulation phase it was determined that there were incomplete linkages of the above three conditions for the Waterline Addendum and thus negligible risk to human health from the Project. As a result, the subsequent stages of HHRA (i.e., exposure assessment, toxicity assessment and risk characterization) are not warranted.

Signature Page

Golder Associates Ltd.



Andrea Amendola, BSc(Hons), QPRA
Senior Risk Assessor and Toxicologist



Ruwan Jayasinghe, M.Sc., QPRA, DABT
Associate, Senior Risk Assessor

AA/RJ/jr

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https://golderassociates.sharepoint.com/sites/132380/project_files/5_technical_work/01_information_requests/03_ir_commitments/2380_hhra/20351262-825-r-meliadine_waterline_hhra-rev1.docx

4.0 REFERENCES

- Agnico Eagle (Agnico Eagle Mines Limited). 2014. Agnico Eagle. 2014. Final Environmental Impact Statement (FEIS) - Meliadine Gold Project, Nunavut from: [ftp://ftp.nirb.ca/02-REVIEWS/ACTIVE%20REVIEWS/11MN034-Agnico Eagle%20MELIADINE/2-REVIEW/09-FINAL%20EIS/FEIS](ftp://ftp.nirb.ca/02-REVIEWS/ACTIVE%20REVIEWS/11MN034-Agnico%20Eagle%20MELIADINE/2-REVIEW/09-FINAL%20EIS/FEIS).
- Agnico Eagle. 2018. Meliadine Gold Mine – Final Environmental Impact Statement Addendum, Environmental Assessment for Treated Groundwater Effluent Discharge into Marine Environment, Rankin Inlet. June 2018.
- Agnico Eagle. 2019. 2018 Air Quality Monitoring Report. In Accordance with NIRB Project Certificate No. 006. Prepared by Agnico-Eagle Mines Limited, Meliadine Division. March 2019.
- Agnico Eagle. 2020a. Waterline FEIS Addendum – Meliadine Mine Information Request Responses. Submitted to Nunavut Impact Review Board. October 13, 2020.
- Agnico Eagle. 2020b. 2019 Air Quality Monitoring Report. In Accordance with NIRB Project Certificate No. 006. Prepared by Agnico-Eagle Mines Limited, Meliadine Division. April 2020.
- CCME (Canadian Council of Ministers of the Environment). 2000. Canada-wide standards for particulate matter (PM) and ozone. CCME Council of Ministers. June 2000. Quebec City, QC.
- CCME. 2020. Water Quality Guidelines for the Protection of Aquatic Life (Marine, Short-Term). Accessed online: <http://st-ts.ccme.ca/en/index.html>. Current to 2020.
- Health Canada. 2012. Federal Contaminated Site Risk Assessment in Canada, Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA), Version 2.0. Revised 2012. Available by email request from: hc.ead-dee.sc@canada.ca
- Health Canada. 2019. Guidance for Evaluating Human Health Impacts in Environmental Assessment: Human Health Risk Assessment. Published 2019-06-25. Available by email request from: hc.ead-dee.sc@canada.ca
- Nunami Stantec (Nunami Stantec Ltd.). 2012. Meliadine Gold Project. Marine Baseline Report Itivia Harbour, Rankin Inlet, NU. April 2012. Project No. 1235-10575.
- SLR (SLR Consulting (Canada) Inc.). 2015. Bioaccumulation Research Project. SLR Proj. No. 201.02996.00018.
- Tetra Tech. 2020a. Melvin Bay Hydrodynamic Modelling and Characterization of the Fate and Behaviors of the Discharged Saline Effluent. Prepared for Agnico Eagle Mines Ltd. Submitted as Appendix IR-9 to the Nunavut Impact Review Board for the Waterline FEIS Addendum – Meliadine Mine Information Request Responses. October 2020.
- Tetra Tech. 2020b. Addendum to 3-D Hydrodynamic Modelling of Melvin Bay to Characterize the Long-term Mixing and Transport of the Release Effluent. Technical Memorandum. Prepared for Agnico Eagle Mines Ltd. Submitted as Technical Comment TC-02 to the Nunavut Impact Review Board for the Waterline FEIS Addendum – Meliadine Mine Technical Comment Responses. November 2020.
- WHO. 2005. Air Quality Guidelines Global Update. Report on Working Group Meeting. Bonn, Germany.

APPENDIX A

Risk Assessment Pathways

Attachment TC-05: Risk Assessment Pathways

From Table 10.2-4 in 2014 FEIS Chapter 10.0 (Human Health and Safety) (Agnico Eagle 2014)					For FEIS Addendum (Waterline)
Location	Project Activity	Effects Pathways	Environmental Design Features and Mitigation	Pathway Analysis	Applicability of Effects Pathways from 2014 FEIS to FEIS Addendum (Waterline)
Mine	Mine Site (construction)	Construction activities result in air emissions, which may cause short-term changes in air concentrations, which may directly affect human health Fuel combustion will result in air emissions, which may contribute to territorial and national greenhouse gas emissions, which may directly affect human health Short-term changes in air concentrations may also result in alterations to soil concentrations, which may affect human food and water sources	Best management practices to control fugitive particulate emissions Exhaust emissions from non-road vehicles will be managed through purchasing equipment that meet Tier 3 emission standards Exhaust emissions from non-road vehicles will be managed through regular and routine maintenance of vehicles SO ₂ emissions from non-road vehicles and stationary equipment will be reduced through the use of diesel fuel with less than 15 ppm of sulphur.	Minor (bounded by operation effects)	Minor (bounded by operation effects)
Mine	Mine Site (operations)	Project activities will result in air emissions, which may cause changes in air concentrations, which may directly affect human health Fuel combustion will result in air emissions, which may contribute to territorial and national greenhouse gas emissions, which may directly affect human health Changes in air concentrations may also result in alterations to soil concentrations, which may affect human food and water sources	Best management practices to control fugitive particulate emissions from haul roads and material handling Sources of particulate emissions at the processing facility are controlled through the use of baghouses Enclosures are used to reduce fugitive emissions at the processing facility Exhaust emissions from non-road vehicles will be managed through purchasing equipment that meet Tier 3 emission standards Exhaust emissions from non-road vehicles will be managed through regular and routine maintenance of vehicles SO ₂ emissions from non-road vehicles and stationary equipment will be reduced through the use of diesel fuel with less than 15 ppm of sulphur	Primary	Primary – Both project activities (mine site) and operation of the AWAR during operations phase were considered as a bounding scenario for dust generation during construction and operation of the waterline – see response to Health Canada Comment #3 (Agnico Eagle 2020)
AWAR	Phase II AWAR (construction)	Construction activities result in air emissions, which may cause short-term, localized changes in air concentrations, and as a result, soil concentrations, which may directly affect human health and their food and water sources	Best management practices to control fugitive particulate emissions from construction activities	Minor (bounded by operation effects)	Minor (bounded by operation effects)
AWAR	Phase II AWAR (operations)	Project vehicles along the AWAR will result in air emissions, which may cause changes in air concentrations, which may directly affect human health Fuel combustion will result in air emissions, which may contribute to territorial and national greenhouse gas emissions, which may directly affect human health Changes in air concentrations may also result in alterations to soil concentrations, which may affect human food and water sources	Best management practices to control fugitive particulate emissions from vehicles travelling along the AWAR	Primary	Primary – Both project activities (mine site) and operation of the AWAR during operations phase were considered as a bounding scenario for dust generation during construction and operation of the waterline – see response to Health Canada Comment #3 (Agnico Eagle 2020)
Rankin Inlet	Rankin Inlet	Activities associated with material receipt, storage and transfer to the Project will result in air emissions, which may cause short-term, localized changes in air concentrations which may directly affect human health Fuel combustion will result in air emissions, which may contribute to territorial and national greenhouse gas emissions, which may directly affect human health Changes in air concentrations may also result in alterations to soil concentrations, which may affect human food and water sources	Best management practices to control fugitive particulate emissions Exhaust emissions from non-road vehicles will be managed through purchasing equipment that meet Tier 3 emission standards Exhaust emissions from non-road vehicles will be managed through regular and routine maintenance of vehicles SO ₂ emissions from non-road vehicles and stationary equipment will be reduced through the use of diesel fuel with less than 15 ppm of sulphur. Best management practices to control fugitive emissions from fuel handling and storage	Minor	Minor – The same design features and mitigation will be implemented for the waterline project

Attachment TC-05: Risk Assessment Pathways

From Table 10.2-4 in 2014 FEIS Chapter 10.0 (Human Health and Safety) (Agnico Eagle 2014)					For FEIS Addendum (Waterline)
Location	Project Activity	Effects Pathways	Environmental Design Features and Mitigation	Pathway Analysis	Applicability of Effects Pathways from 2014 FEIS to FEIS Addendum (Waterline)
Rankin Inlet	Marine Shipping	Marine shipping will results in air emissions, which may contribute to territorial and national greenhouse gas emissions These effect pathways may cause changes to air quality and soil quality (as a result of particulate deposition), resulting in subsequent changes to human food and water sources	Marine vessels will remain on-station only as long as required for off-loading delivered materials	Minor	Minor – The same design features and mitigation will be implemented for the waterline project
Mine	General construction and operation of mine and supporting infrastructure	Sensory disturbance (i.e., noise) can directly affect human health	Project design will use conventional insulation, baffles and noise suppressors on equipment Stationary equipment will be housed inside buildings Regular maintenance of equipment to limit noise Use of personal protective equipment such as ear plugs	Primary	Effect pathways not applicable
Mine	General construction and operation of mine and supporting infrastructure	Sensory disturbance (i.e., noise) can indirectly affect human health by affecting migration patterns of wildlife populations (e.g. caribou) and subsequently human food sources	Project design will use conventional insulation, baffles and noise suppressors on equipment Stationary equipment will be housed inside buildings Regular maintenance of equipment to limit noise All employees will be provided with wildlife environmental awareness training	Primary	Effect pathways not applicable
Mine	General construction and operation of mine and supporting infrastructure	Spills on the mine site or along the AWAR can cause changes to chemical concentrations in surface water, soil and vegetation, which may affect human food and water sources	Equipment will be re-fueled, serviced, and washed away from stream crossings and on impermeable pads wherever possible. There will be a wash bay in the maintenance shop Emergency response and spill contingency plans will be developed and implemented	Minor	Effect pathways not applicable
Mine	General construction and operation of mine and supporting infrastructure	Physical hazards on the mine site would not be expected to change concentrations of chemicals in environmental media and, therefore, not affect human health	Not required for the protection of human health	No linkage	Effect pathways not applicable
Mine	Mine infrastructure footprint (e.g., open pits, dikes, mine pits, waste rock, mine plant, site roads, camps) during construction, operations, closure and post-closure	Project footprint, which will physically alter watershed areas and drainage patterns, rates and quantities of diverted non-contact water to new watersheds, may change downstream flows, water levels, channel/bank stability in streams and may affect water and sediment quality, which may affect human food and water sources	Compact layout of the surface facilities within local watersheds will limit the area that is disturbed by construction and operation Access roads will be as narrow as possible, while maintaining safe construction and operation practices; minimum haul road widths will follow that defined under the Mine Health and Safety Act Best management practices for erosion and sedimentation control (e.g., silt curtains, runoff management, armouring of banks, sloping of banks), where needed To reduce the potential for erosion in channels due to higher than normal water flows and levels, natural drainage courses will be surveyed to evaluate capacity and then modified if required Where practical, natural drainage patterns will be used to reduce the use of ditches and diversion berms A Surface Water Management Plan (SD 2-6) has been developed and describes designs to reduce changes to local flows, drainage patterns, and drainage areas Monitoring during activities and use of adaptive management where necessary	Primary	Effect pathways not applicable

Attachment TC-05: Risk Assessment Pathways

From Table 10.2-4 in 2014 FEIS Chapter 10.0 (Human Health and Safety) (Agnico Eagle 2014)					For FEIS Addendum (Waterline)
Location	Project Activity	Effects Pathways	Environmental Design Features and Mitigation	Pathway Analysis	Applicability of Effects Pathways from 2014 FEIS to FEIS Addendum (Waterline)
AWAR (main access road), haul roads, and Rankin Inlet Infrastructure	Road footprint during construction, operations, and closure	Project footprint, which will physically alter drainage patterns, may change downstream flows, water levels, and channel/bank stability in streams, and affect water and sediment quality, which may affect human food and water sources	Access roads will be as narrow as possible, while maintaining safe construction and operation practices; minimum haul road widths will follow that defined under the Mine Health and Safety Act Best management practices for erosion and sedimentation control (e.g., silt curtains, runoff management, armouring of banks), where needed Where practical, natural drainage patterns will be used to reduce the use of ditches and diversion berms A Surface Water Management Plan (SD 2-6) has been developed and describes designs to reduce changes to local flows, drainage patterns, and drainage areas	Minor	Effect pathways not applicable
Mine, AWAR, Rankin Inlet	Mine and supporting infrastructure during construction, operations, and closure	Sediment releases from infrastructure and road construction, including watercourse crossings, can affect quality of nearby surface waters and sediments, which may affect human food and water sources	Best management practices for erosion and sedimentation control (e.g., silt curtains, runoff management, armouring of banks), where needed Where applicable, construction runoff will be captured and managed to minimize suspended solids Proposed roads will be as narrow as possible, while maintaining safe construction practices	Minor	Effect pathways not applicable
Mine, AWAR, Rankin Inlet	Mine and supporting infrastructure during construction and operations	Fugitive dust sources and deposition of dust (including from blasting during mining) can change water and sediment quality, which may affect human food and water sources	Best management practices to control fugitive particulate emissions from haul roads and material handling Use of water or dust suppressants to manage dust; use of chemical suppressants will be in accordance with the Environmental Guidance for Dust Suppression published by the Government of Nunavut Department of the Environment Enforcing speed limits to suppress dust production Design roads as narrow as possible while maintaining safe construction and operation practices Crossings will be perpendicular to watercourse The running surface of the road will be maintained thereby reducing the generation of dust Sheds, enclosures, and covers will be used in major ore handling areas and most crushing areas For uncovered crushing areas, water or dust suppression will be used Dust control systems will be used to limit dust emissions, for example, processing equipment with high efficiency bag houses will be used Most personnel arriving at or leaving the site will be transported by bus, thereby reducing the amount of traffic (and dust) Operating procedures will be developed that reduce dust generation; for example, tailings deposition will be designed to limit dust generation	Primary	Primary – Both project activities (mine site) and operation of the AWAR during operations phase were considered as a bounding scenario for dust generation during construction and operation of the waterline – see response to Health Canada Comment #3 (Agnico Eagle 2020)

Attachment TC-05: Risk Assessment Pathways

From Table 10.2-4 in 2014 FEIS Chapter 10.0 (Human Health and Safety) (Agnico Eagle 2014)					For FEIS Addendum (Waterline)
Location	Project Activity	Effects Pathways	Environmental Design Features and Mitigation	Pathway Analysis	Applicability of Effects Pathways from 2014 FEIS to FEIS Addendum (Waterline)
Mine	Mine and supporting infrastructure during construction and operations	Air emission of sulphur dioxide, nitrogen oxides and particulates may change water and sediment quality, which may affect human food and water sources	Construction equipment and trucks will be equipped with industry-standard emission control systems Compliance with regulatory emission requirements will be met. Processing equipment will use dust collectors to limit emissions of particulate matter Exhaust emissions from non-road vehicles will be managed through regular and routine maintenance of vehicles SO ₂ emissions from non-road vehicles and stationary equipment will be reduced through the use of diesel fuel with less than15 ppm of sulphur Operating procedures will be developed that reduce dust generation Generator efficiencies and equipment will be tuned for optimum fuel-energy efficiency	Primary	Effect pathways not applicable
AWAR and Rankin Inlet	During construction and operations, air emissions from vehicles	Air emission of sulphur dioxide, nitrogen oxides and particulates may change water and sediment quality, which may affect human food and water sources	Construction equipment and transport trucks will be equipped with industry-standard emission control systems Compliance with regulatory emission requirements will be met	No Linkage	No Linkage
Mine	Mining activities and water management during construction, operations, and closure	Release of mine wastewater (including sewage) may cause changes to surface water quality and sediment quality (i.e., nutrient and metal concentrations), which may affect human food and water sources	Treated sewage will be piped to the tailings storage facility Mine wastewater will be treated and tested before released to Meliadine Lake; if water quality does not meet discharge limits, it will be circulated and re-treated Water quality will meet CCME aquatic life objectives or site-specific water quality objectives at the edge of the mixing zone in Meliadine Lake Underground water will be collected, contained, monitored, re-used in the underground, or collected, contained, monitored, or treated, if required, to meet discharge limits for release to Meliadine Lake A site Water Management Plan has been developed and describes containment of contact water through the use of diversions, attenuation ponds, and treatment facilities during construction, operations, and closure Other applicable design features and mitigation, as identified in the Project Mine Closure and Reclamation Plan (SD 2-17)	Primary	Effect pathways not applicable
Mine and Rankin Inlet	Construction and operation of camps	The construction and operation of camps may cause erosion and release of substances to surface water and could affect water and sediment quality, which may affect human food and water sources	Best management practices for erosion and sedimentation control; and storage and use of chemicals will be implemented Ditches will be constructed to route any runoff water to the attenuation pond Sewage will be directed to the tailings storage facility and will not be released to surface water	No Linkage	Effect pathways not applicable
Mine	Mine and supporting infrastructure during construction and operations	Process and potable water use resulting in reduced water levels can affect water quality in Meliadine Lake, which may affect human food and water sources	Manage pumping rates so total annual discharge from Meliadine Lake does not drop below the 10-year dry condition No water withdrawal during the 10-year dry condition Water withdrawal rate(s) will be controlled to avoid effects on the source water lake(s) Capture and reuse site water to reduce fresh water requirements	Minor	Effect pathways not applicable

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From Table 10.2-4 in 2014 FEIS Chapter 10.0 (Human Health and Safety) (Agnico Eagle 2014)					For FEIS Addendum (Waterline)
Location	Project Activity	Effects Pathways	Environmental Design Features and Mitigation	Pathway Analysis	Applicability of Effects Pathways from 2014 FEIS to FEIS Addendum (Waterline)
Mine and Rankin Inlet	Mine and supporting infrastructure during construction and operations	Spills and leaks during equipment operation can affect water and sediment quality of nearby surface waters, which may affect human food and water sources	Hazardous materials and fuel will be stored according to regulatory requirements to protect the environment and workers (i.e., Materials and Waste Management Plan) Storage tanks (e.g., fuel, engine oil, hydraulic oil, and waste oil and coolant) will be double walled, or located in lined and bermed containment areas Hazardous wastes will be stored on site in appropriate containers to prevent exposure until they are shipped off site to an approved facility Individuals working on site and handling hazardous materials will be trained in the Transportation of Dangerous Goods Soils from petroleum spill areas will be deposited and spread in a lined biopile for remediation A Spill Response Plan has been developed Emergency spill kits will be available wherever toxic materials or fuel are stored and transferred	No Linkage	Effect pathways not applicable
Mine	Site Water Management: seepage and runoff during operations and closure	Runoff and leaching from the waste rock storage facilities and mine footprint may change surface water and sediment quality (i.e., metal concentrations), which may affect human food and water sources	A site Water Management Plan has been developed and describes the containment and management of contact water on-site Runoff and seepage from the Project site will be diverted to sumps and attenuation ponds (and treated if required) prior to release into Meliadine Lake Water quality in attenuation ponds will be monitored and managed such that the discharge entering Meliadine Lake meets discharge limits Potential acid generating (PAG) rock and metal leaching waste rock will be segregated at source and placed into designated areas within waste rock locations	Minor	Effect pathways not applicable
Mine	Site Water Management: seepage and runoff during operations and closure	Vertical and lateral seepage from the tailings storage facility may enter nearby waterbodies and change water and sediment quality (i.e., metal concentrations), which may affect human food and water sources	A site Water Management Plan has been developed and describes the containment and management of contact water on-site Seepage will be captured at sumps and diverted to the tailings storage facility All ponds collecting seepage will be designed to prevent release into the surrounding aquatic environment Tailings facility discharge water will be monitored for water quality, and treated as required, prior to discharge	Minor	Effect pathways not applicable
Mine	Site Water Management: seepage and runoff during operations and closure.	Seepage of pore water through, or underneath, incompletely frozen dikes to adjacent watersheds may change water and sediment quality in local watersheds, which may affect human food and water sources	A site Water Management Plan has been developed and describes containment and management of contact water on-site The dikes will be designed and constructed to control seepage Performance of the dikes will be monitored and appropriate remediation applied if required	Minor	Effect pathways not applicable

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From Table 10.2-4 in 2014 FEIS Chapter 10.0 (Human Health and Safety) (Agnico Eagle 2014)					For FEIS Addendum (Waterline)
Location	Project Activity	Effects Pathways	Environmental Design Features and Mitigation	Pathway Analysis	Applicability of Effects Pathways from 2014 FEIS to FEIS Addendum (Waterline)
Mine	Site Water Management: Dewatering of Project Footprint Lakes to Downstream Receiving Lakes (e.g., to Lake A7, A1, B6, B34, Meliadine Lake) during construction and operations.	Dewatering of lakes may change flows, water levels, channel/bank stability, and water quality (e.g., suspended sediments, nutrients, metals) in receiving and downstream waterbodies, which may affect human food and water sources	During dewatering activities, TSS will be monitored, and if necessary, treated before release downstream Pumped water from the dewatered lakes will be directed through properly designed structures to the lake environment, and not to lake outlets, to prevent erosion in the receiving waterbodies and to attenuate flows Shoreline areas susceptible to extensive erosion will be armoured to reduce erosion and associated re-suspension of fine sediment Where practical, natural drainage patterns will be used to reduce the use of ditches or diversion berms	Primary	Effect pathways not applicable
Mine	Pit development and operations	Release of pit water inflows to local watersheds may affect water and sediment quality in local watersheds, which may affect human food and water sources	Groundwater inflow to the pits or other dewatered areas will not be directly released to local watersheds All pit water will be pumped to the TSF, re-used in process. Excess TSF water will be treated, if necessary, prior to release	No Linkage	Effect pathways not applicable
Mine	Pit development and operations	Removal of bedrock and ore material may change or alter existing faults and change contaminant transport processes in subsurface and surface water quality, which may affect human food and water sources	Groundwater model results suggest a travel time of 500 to 1000 years for water to move, via groundwater pathways, from the tailings storage facility to Meliadine Lake. A talik will have formed beneath the tailings storage facility before water can flow along this pathway	No Linkage	Effect pathways not applicable
Mine	Pit Development	Removal of saline groundwater inflows during pit development to local watersheds may affect water and sediment quality in local watersheds, which may affect human food and water sources	Water inflow to the dewatered areas will not be directly released to local watersheds; water will be treated and then diverted to a water management pond prior to release into Meliadine Lake	Minor	Effect pathways not applicable
Mine, AWAR, and Rankin Inlet	Construction and operation of roads	Cross-drainage structures for the mine site roads, AWAR, and Rankin Inlet bypass road may alter stream hydraulics and geomorphology, and alter water and sediment quality, which may affect human food and water sources	Cross-drainage structures will be designed and constructed such that structures will not create a hydraulic barrier to fish passage and will convey peak flows corresponding to 1:25 year 24-hour rainfall event	Minor	Minor – The same design features and mitigation will be implemented for the waterline project
Mine, AWAR, and Rankin Inlet	Construction and operation of roads	Freezing and plugging of culverts in the winter may result in over-topping and erosion of road surface releasing silt into watercourses during freshet and affect water and sediment quality, which may affect human food and water sources	Use of staggered culvert configuration to promote drainage during spring thaw and freshet Regular inspection of the road to identify any areas where ponding of water along the road represents a risk, and installing additional culverts or French drains to alleviate the risk	No Linkage	No Linkage
Mine, AWAR, and Rankin Inlet	Construction and operation of roads	Release of potential acid generating materials from road building materials at the watercourse crossings can alter water and sediment quality, which may affect human food and water sources	Use of non-acid generating material at all watercourse crossings. Testing will continue on new sources identified for road building Rock quarry activity will be at least 30 m from the high water mark of any waterbody	Minor	Minor – The same design features and mitigation will be implemented for the waterline project

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From Table 10.2-4 in 2014 FEIS Chapter 10.0 (Human Health and Safety) (Agnico Eagle 2014)					For FEIS Addendum (Waterline)
Location	Project Activity	Effects Pathways	Environmental Design Features and Mitigation	Pathway Analysis	Applicability of Effects Pathways from 2014 FEIS to FEIS Addendum (Waterline)
Mine, AWAR, and Rankin Inlet	Construction and operation of roads	Surface water drainage through quarries and transport of blasting residuals and metals directly into watercourses can affect surface water and sediment quality, which may affect human food and water sources	Where possible, stockpiling of rock and fill from quarries and borrow sites will be placed such that surface water is not diverted through the piles with runoff to surface waterbodies; drainage from quarries will not flow directly into any waterbodies or watercourses When there is seepage from a quarry that could enter a waterbody, a water quality sample will be collected and analyzed Quarries will be excavated and sloped for positive drainage Quarries will be inspected on a regular basis to monitor water ponding, particularly at spring melt Excavations will be at least 30 m away from any watercourses Best management practices for erosion and sediment control	Minor	Minor – The same design features and mitigation will be implemented for the waterline project
Mine	Ongoing exploration	Ongoing exploration, and uptake and release of water, can affect surface water and sediment quality, which may affect human food and water sources	Best management practices for erosion and sedimentation control (e.g., silt curtains, runoff management, armouring of banks, timing and location of releases), where needed Best management practices for storage and treatment, if necessary, of any release water Testing, as required by operational licence, before release of water Best management practices for withdrawal rates, withdrawal volumes, and timing of withdrawals Reuse of water, where applicable, to reduce water usage	Minor	Effect pathways not applicable
Mine, AWAR, and Rankin Inlet	Decommissioning (e.g., roads, buildings, infrastructure, underground workings) during closure	Removal of project infrastructure (e.g., roads, dikes, etc.) may change flows and cause of release sediment and contaminants and can affect water and sediment quality, which may affect human food and water sources	A preliminary Closure and Reclamation Plan has been developed and describes measures for permanent closure Best management practices for erosion and sedimentation control such as installation of rip-rap, if applicable, to prevent erosion after removal of the culverts Instream work will be limited to the minimum extent possible. Instream work will follow DFO operational guidance and timing windows All bridges and culverts will be removed and original drainage patterns restored. Stream crossings will be rehabilitated Dikes will be removed to a minimum depth of 1 m below average lake water level or back to original; removal of dikes will be timed to minimize release of sediments In the underground workings, seal all drill holes and openings connected to the surface Remove unused explosives and other chemicals from the mine site Roads will be scarified, allowing native plants to re-establish, and slopes will be stabilized against erosion	Minor	Effect pathways not applicable

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Location	Project Activity	Effects Pathways	Environmental Design Features and Mitigation	Pathway Analysis	Applicability of Effects Pathways from 2014 FEIS to FEIS Addendum (Waterline)
Mine	Decommissioning of tailings and waste rock storage facilities during closure	Activities required for covering and reclaiming the tailings and waste rock storage facilities may cause release of contaminants and can affect water and sediment quality, which may affect human food and water sources	A preliminary Closure and Reclamation Plan has been developed and describes measures for permanent closure The waste rock storage facilities have been designed for long-term stability A cover of non-potentially acid generating and non-metal leaching rockfill cover will be placed on the surface of the tailings to a thickness that will allow the tailings to remain frozen The pond in the tailings area will be drained and filled with waste rock to promote surface drainage to Tiriganiaq Pit The surface of the tailings and waste rock storage facilities will be graded to blend into the existing topography and to shed water from the surface	Minor	Effect pathways not applicable
Mine	Remediation of attenuation pond AP-01 during closure	Reconnection of attenuation pond (or Lake H17) to Meliadine lake can affect water and sediment quality, which may affect human food and water sources	A preliminary Closure and Reclamation Plan has been developed and describes measures for permanent closure Sediments will be analyzed, and if concentrations are higher than baseline or guidelines, sediments will be managed according to best practices	Minor	Effect pathways not applicable
Mine	Pits (closure and post-closure)	Water quality in flooded pits may be higher than objectives and reconnection of drainages may affect downstream water and sediment quality, which may affect human food and water sources	A preliminary Closure and Reclamation Plan has been developed and describes measures for permanent closure The pits are designed to have stable slopes during mining and post-closure The pits will be progressively reclaimed as excavation is completed The pits will be flooded, with water from Meliadine Lake, over a 10 year period following completion of pit operations Water quality in the pits will be monitoring continuously during the flooding process All diversion dikes will be kept intact as a barrier between open pits and surrounding lakes until the pit water meets acceptable concentrations for release to the environment; water will be treated if it is unacceptable for discharge	Primary	Effect pathways not applicable

References:

Agnico Eagle. 2014. Final Environmental Impact Statement (FEIS) - Meliadine Gold Project, Nunavut from: [ftp://ftp.nirb.ca/02-REVIEWS/ACTIVE%20REVIEWS/11MN034-Agnico Eagle%20MELIADINE/2-REVIEW/09-FINAL%20EIS/FEIS](ftp://ftp.nirb.ca/02-REVIEWS/ACTIVE%20REVIEWS/11MN034-Agnico%20Eagle%20MELIADINE/2-REVIEW/09-FINAL%20EIS/FEIS).

Agnico Eagle. 2020. Waterline FEIS Addendum – Meliadine Mine Information Request Responses. Submitted to Nunavut Impact Review Board. October 13, 2020.



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