

# **AGNICO EAGLE**

**MELIADINE GOLD MINE**

## **Ammonia Management Plan**

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**NOVEMBER 2021**

**VERSION 4\_NIRB**



**EXECUTIVE SUMMARY**

Agnico Eagle is committed to monitor ammonia in all surface sumps, seeps, etc., in accordance with the site Water Licence and to implement a comprehensive and routine inspection program related to explosives management within the mine. This includes regular inspections at the explosives manufacturing facility by the explosive supplier and on-site manufacture (Dyno Nobel) to ensure all explosive products are stored in locked, sealed containers prior to use and to perform continuous review of analytical results such that mitigation measures can be implemented when increasing trends of ammonia are determined.

This management plan provides guidance for monitoring ammonia levels at the mine site, as part of the conditions applying to waste disposal and management listed in the water licence (2AM-MEL1631) for this water quality parameter.

Nunavut Impact Review Board (NIRB) Project Certificate No.006 was issued in 2015 which included approval of a multi-phase approach to development, including mining of Tiriganiaq deposit using open pit and underground mining methods) and mining of the Pump, F Zone, Discovery and Wesmeg deposits using open pit methods.

The Meliadine Extension proposes to include underground mining and associated saline water management infrastructures at the Pump, F Zone, and Discovery deposits, development of a new portal and associated infrastructures in the Tiriganiaq-Wolf area, construction and operation of a windfarm, and use of additional borrow pits and quarries. The life of the mine would be extended by an additional 11 years until 2043. The same management strategy for ammonia will be used, as per the conditions of the Project Certificate and Water Licence.

**DOCUMENT CONTROL**

Version	Date (YMD)	Section	Revision	Author
1	2017/03/10	All	Creation of Document	Jeffrey Pratt, AEM Environmental Coordinator
2	2020/03/20	All	General Update	Vanessa Smith, AEM Project Coordinator
3	2021/02/26	All	2021 Annual review	Jawad Haloui, AEM Engineering Superintendent & Matthew Gillman, Water management General Supervisor
4_NIRB	November 2021		Updated to address Meliadine Extension application submission to NIRB for review and approval	Permitting Department

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## 1 INTRODUCTION

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Agnico Eagle Mines Limited (Agnico Eagle) is committed to monitor ammonia in all mine pit sumps, seeps, etc., in accordance with the site Water Licence. Agnico Eagle implemented a comprehensive and routine inspection program related to explosives management within the mine. This includes regular inspections at the explosives manufacturing facility by the explosive supplier and on-site manufacturer (Dyno Nobel) to ensure all explosive products are stored in locked, sealed containers prior to use and to perform continuous review of analytical results such that mitigation measures can be implemented when increasing trends of ammonia are determined. It is important to note that Agnico Eagle has not exceeded any ammonia discharge criteria from Water Licence A, 2AM-MEL1631 in 2019. The Ammonia Management Plan provides guidance for monitoring ammonia levels at the mine site, as part of the conditions applying to waste disposal and management listed in the water license for this water quality parameter.

### 1.1 AMMONIA

Blasting of ammonium-nitrate (AN) explosives is typically the primary source of ammonia in areas of mining operations. It is used in the blasting agent ANFO (ammonium nitrate, fuel oil). AN readily absorbs water and dissolves easily, thereby mobilizing ammonia in either groundwater or surface runoff. The commissioning of the Dyno Emulsion Plant in December, 2017 has eliminated the use of ANFO at Meliadine. Meliadine is presently using an emulsion based explosive.

Ammonia dissolved in water exists in equilibrium by interchanging un-ionized ( $\text{NH}_3$ ) and ionized ( $\text{NH}_4^+$ ) forms. The equilibrium is influenced by pH, temperature, and ionic strength (salinity) where the amount of un-ionized ammonia is favoured as the pH becomes more basic or as the water temperature or salinity increases. Un-ionized ammonia can readily pass across the gill surface and enter into the bloodstream of fish, while ionized ammonia passes with greater difficulty. Once inside the fish, both forms of ammonia can cause toxic effects (CCME, 2010). Furthermore, it should be noted that ammonia oxidizes to nitrite ( $\text{NO}_2^-$ ) and nitrate ( $\text{NO}_3^-$ ), the former being particularly toxic to fish and humans. Both nitrite and nitrate are regulated by the Canadian Council of Ministers of the Environment (CCME) for the Protection of Aquatic Life.

This Ammonia Management Plan proposes the monitoring of blasting practices for the assessment of explosive quantity used and blast performance, and monitoring of water quality to determine ammonia levels in waters within the mine site. The monitoring results can be used to review and adjust blasting practices or water management if ammonia levels need to be reduced.

In addition to ammonia, monitoring of nitrate and nitrite is also considered in the Aquatic Environment Monitoring Program (AEMP), as both water quality parameters are signature compounds of AN based explosives.  $\text{NO}_3^-$  is listed with a discharge level threshold in the conditions applying to waste disposal and management in the Nunavut Water Board (NWB) Water Licence 2AM-MEL1631.

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## 2 EXPLOSIVE MANAGEMENT AND BLASTING PRACTICES

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### 2.1 SITE DESCRIPTION

#### 2.1.1 Explosive Storage

The Surface Explosive Magazine has been re-localized in 2020 along a new access road in relative proximity to the emulsion plant, respecting a D4 distance of 360 m, as indicated in Figure 1.

Underground facilities include three Explosive Magazines and three Detonator Magazines located at Levels 200, 300, and 400 for a total of six active explosive and detonator magazines. These facilities are constructed following good engineering practice and are approved by the WSCC prior to their construction. It is anticipated that underground facilities associated with Meliadine Extension would follow a similar process for explosive and detonator magazines.

The explosive products arrive by barge at the Rankin Inlet Itivia port. On occasion, product must be flow up on dedicated cargos for unplanned work. They are then transported by ground to the Meliadine site and offloaded to their respective storage areas; explosives are stored in a timely manner in the designated magazines while raw materials are transported to the emulsion plant storage area.

The Emulsion Plant is located approximately 1.4 kilometers north-west of the mine site and is accessible via service roads. This area consists of the modular emulsion plant, commissioned on December 12, 2017, and the raw material storage and the garage. Seacan storage of Ammonium Nitrate is only allowed in this area. All raw material required for emulsion manufacturing are packed in sea containers, which limits the possibility of spillage. The products are only removed from these containers prior to use at the emulsion plant.

#### 2.1.2 Roads

The AWAR is a restricted access road constructed and operated by Agnico for ground transportation between the Meliadine mine site and Rankin Inlet. This road is used to transport explosive products from the Rankin Inlet Itivia port facilities to the emulsion plant area at the mine site. In preparation for blasting operations, explosive products are transported from the emulsion plant area to the appropriate blasting locations on surface and underground via local site roads.

#### 2.1.3 Mine

Agnico Eagle uses explosives for controlled blasting of overburden, waste rock, ore, construction rock, frozen ore stockpile, granular material on surface and underground during the construction and operations phases of the Meliadine Mine.

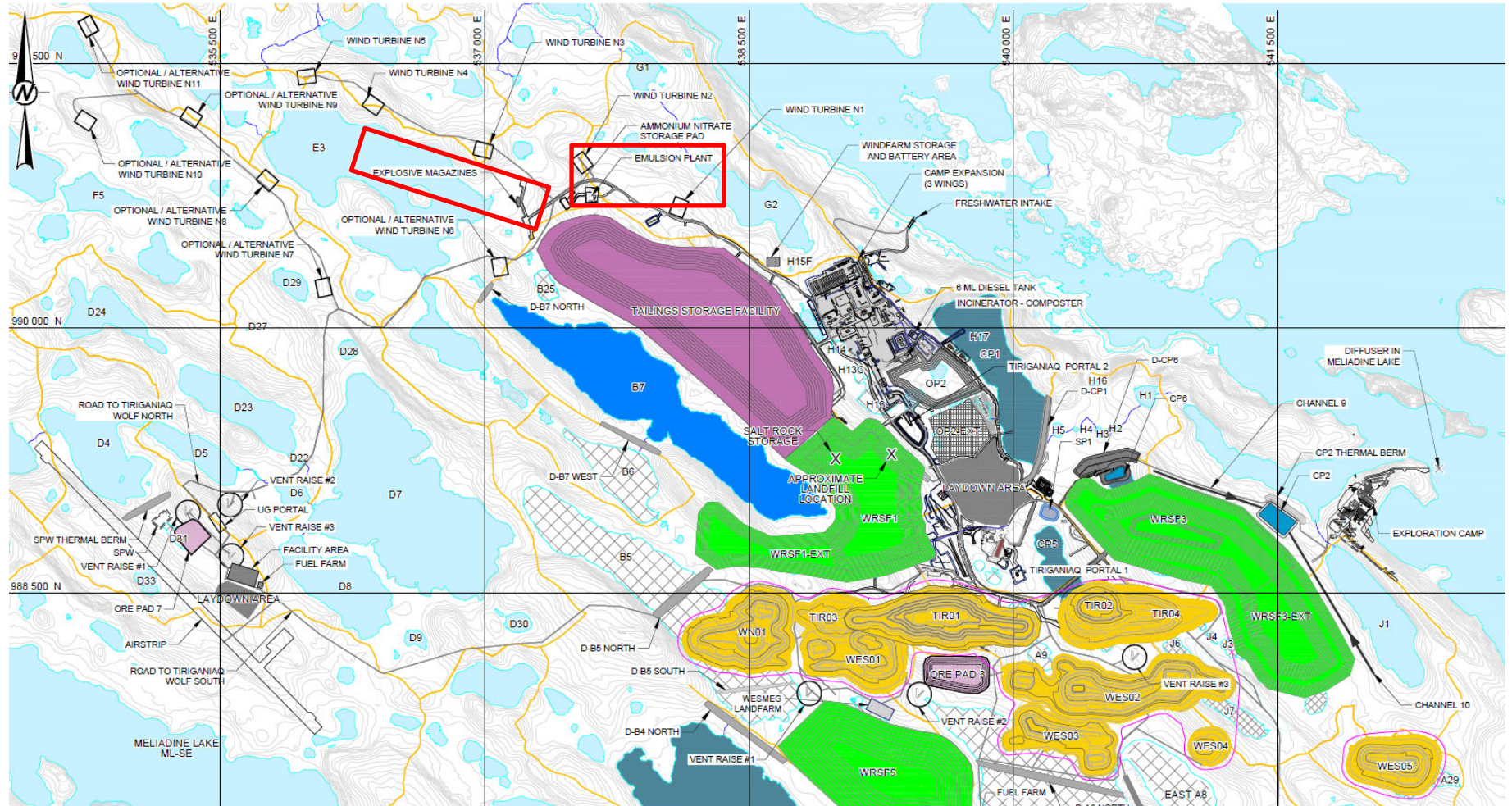
### 2.2 AMMONIA PATHWAYS

Ammonia not fully detonated within the blasting operations mobilizes through several pathways on the mine site. Water from drainage runoff is the primary mechanism of mobilization for ammonia residuals

remaining within the underground. This water is collected at underground sumps. Blasting residuals are also expected to be attached to waste rock and ore materials, which are transported from the underground to their respective storage and processing facilities. Residuals from waste rock may be washed off by precipitation and be ultimately conveyed to any of the collection ponds CP1 to CP6 that are currently operational as well as CP7-12 proposed for Meliadine Extension. All of these pathways are monitored in accordance with the Water License requirement. No contact water from the waste rock or ore will be drained towards watercourses.



Figure 1. Location of Cap Magazine, Powder Magazine, and Emulsion Plant



## 2.3 EXPLOSIVES AND BLASTING

Based on experience at other open pit mines in the Canadian Arctic, the largest potential source of ammonia in mine water will be from explosive residue from blasting. Depending on the wetness of the site, water may leach explosives from blastholes prior to the blast. Other forms of ammonia release from AN are explosives flowing into cracks and fissures in the rock and not detonating, or from an incomplete detonation of the explosive column and misfired blastholes. Emulsion is an AN based explosive (66-84% AN) is used as a blasting agent at the Meliadine site. Emulsion breaks down slower than Ammonia Nitrate Fuel Oil (ANFO) and less product is dissolved in wet environments. Emulsion is the preferred blasting agent at Meliadine.

Blasting operations on site include monitoring of explosive quantities, blast design, procedures and practices. Combined with water monitoring, the compilation of these data is used to assess blasting performance. The results of this assessment are used to adjust blasting practices as needed to:

- a) Optimize the use of explosives; and
- b) Increase the completion and efficiency of explosive detonations.

Any modifications to blast design are intended to decrease the amount of ammonia that may become available for mobilization in mine water.

This section summarizes the explosive products and blasting design parameters, procedures and practices employed at Meliadine. Associated monitoring is also discussed.

### 2.3.1 Explosive Products

Explosive products used at the mine site include Emulsion, packaged explosives, cast boosters, detonating cords, non-electric delay detonators and non-electric lead lines. Of these products, the greatest potential for water contamination comes from the bulk explosives. Presently, Meliadine uses Emulsion as the primary explosive for its blasting operations.

Although bulk explosives, including both surface and underground Emulsion, are water resistant, contaminants can be leached from the product if it is left in contact with standing or flowing water for extended periods of time. The performance of the explosive, and hence the potential for post-blast contaminations, deteriorates with the length of time that the explosive remains loaded (i.e., sleep time). Blast procedures currently in use are designed to minimize sleep time so that standing or flowing water is not in contact with the explosive for extended periods of time.

### 2.3.2 Procedures and Practices

Quality control procedures are in place to verify AN content in bulk explosives. Quality control procedures for the Emulsion occur at the plant.

The primary factors that may reduce the amount of ammonia available for mobilization in mine water are:

- Explosives handling

- Completeness of detonation

Emulsion spillage during loading could (as emulsion is resistant to water) be a source of ammonia that could be carried by water collected in the sumps. Spillage control protocols, procedures and handling of spilled material, and explosive management for storage and transport, are in place at the Meliadine site. Incomplete detonation results in higher ammonia residue on the blasted rock. Evidence of incomplete detonation is often observed as an orange fume after a blast and sometimes an orange pigment on the blasted rock. Explosives that have failed to detonate may be observed in the muckpile. Muckpiles are routinely inspected by Meliadine staff for signs of incomplete detonation.

## 2.4 MONITORING

Monitoring of explosive handling and blasting is as follows:

- a) Explosive quantities: Records of explosive quantities used for blasting are kept for each blasting event and will be conserved throughout the mine life.
- b) Design parameters: Blast design parameters are in place. Blast design at the face is determined by the jumbo operator as required.

Loading standards are in place for the Meliadine Division for both surface and underground operations. These standards are followed when loading explosives.

### **3 WATER MANAGEMENT**

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Water quantity and quality monitoring assist in the monitoring of ammonia loadings from explosive residuals. The Meliadine Type A Water Licence (2AM-MEL1631) includes monitoring stations that are used for the monitoring of ammonia loadings. Further monitoring stations will be implemented, as required, for Meliadine Extension.

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## 4 REPORTING

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Reporting of ammonia concentrations at the sampling stations listed in the Type A Water Licence 2AM-MEL1631 is included as part of the requirement of the water licence. The reporting frequency is required by the water license and includes:

- Brief monthly reports of the compiled water quality monitoring results, sent to the NWB, Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) Water Licence Inspector and to the Kivalliq Inuit Association (KIA); and
- An annual report submitted to the NWB, KIA, CIRNAC, Nunavut Impact Review Board (NIRB), Government of Nunavut, and other interested parties. This report summarizes monitoring results for each sampling station, annual seep water chemistry results, receiving water monitoring results, spills and any accidental releases, measured flow volumes, effluent volumes and loadings, and results of QA/QC analytical data.

Mine operation and environment personnel reviews on a monthly basis the data gathered from the sampling stations as outlined in the Type A Water Licence 2AM-MEL1631 and from the monitoring action proposed under the Ammonia Management Plan. If the data indicates that further studies and/or significant changes to the water management infrastructure are required to assess or control ammonia concentrations, Agnico Eagle will notify the NWB as early as practical. Results of these further studies and/or changes to the Ammonia Management Plan monitoring actions will be transmitted to the NWB for review.

## 5 INSPECTION

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On a regular basis, the Engineering department conducts inspections in the blasting area to ensure that the loading procedures are being implemented (to minimize blasting residues). In addition, environmental inspections are undertaken at explosive product storage facilities (Dyno Nobel) to ensure that explosives products are stored in sealed containers and there is no spillage. If any non-conformities are observed follow up actions are undertaken and corrective measures are put in place.

## **6 REVIEW OF AMMONIA MANAGEMENT PLAN**

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Review of the results of the site water quality and Ammonia Management Plan monitoring during the year may provide new information, and/or indications that changes to the Ammonia Management Plan are necessary. When revisions are warranted, an updated Ammonia Management Plan will be submitted to the NWB for review.

## 7 REFERENCES

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CCME (2010), Canadian Water Quality Guidelines for the Protection of Aquatic Life, Ammonia.

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