AGNICO EAGLE

MELIADINE GOLD MINE

AMMONIA MANAGEMENT PLAN

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ᐊᒃᓃᑯᒃᑯᑦ ᖃᐅᔨᓴᐃᓂᐊᖅᑐᑦ ᐊᒨᓂᐊᒥᒃ (ammonia) ᓄᓇᐅᑉ ᖄᖓᓂᑦ ᑯᕕᖅᑕᐃᔾᔪᑎᓂᑦ, ᑯᕕᓂᖃᖅᑐᓂᑦ, ᑕᒪᒃᑯᓂᙳᐊᓗᒃ, ᒪᓕᒡᓗᒋᑦ ᐅᔾᔨᒃᑕᕆᐊᕐᒥᑦ ᐃᒪᕐᒧᑦ ᓚᐃᓴᓐᓯᖓᑦ, ᐊᑐᓕᖅᑎᑦᑎᓂᐊᕐᓗᑎᒃ ᐃᓗᐃᑦᑑᖓᔪᒥᒃ ᐊᒻᒪᓗ ᐊᑐᖅᑕᐅᖃᑦᑕᕐᓂᐊᖅᑐᒥᒃ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᖄᖅᑕᖅᑐᓕᕆᓂᕐᓄᑦ ᐅᔾᔨᒃᑕᕆᐊᕐᒥᑦ. ᐃᓚᐅᔪᑦ ᖃᐅᔨᓴᐃᓃᑦ ᖄᖅᑕᖅᑐᓕᐅᕆᕝᕕᖓᓐᓂᑦ ᖄᖅᑕᖅᑐᓂᒃ ᐱᕝᕕᐅᖃᑦᑕᖅᑐᓂᑦ ᐊᒻᒪᓗ **ᐅᔾᔨᒃᑕᕆᐊᕐᒥᑦ ᖄᖅᑕᖅᑐᓕᐅᖃᑦᑕᖅᑐᑦ** (Dyno Nobel) ᖄᖅᑕᖅᑐᓗᒃᑖᑦ ᑐᖅᑯᖅᑕᐅᓯᒪᑎᓪᓗᒋᑦ ᐊᒻᒪᓗ ᐱᓇᐃᖅᓯᒪᓗᒋᑦ, ᓂᐱᐅᓯᕐᓗᒋᑦ ᐆᖏᑦ ᐊᑐᖅᑕᐅᓂᐊᕌᖅᑎᓪᓗᒋᑦ ᐊᒻᒪᓗ ᕿᒥᕐᕈᔾᐅᖏᓐᓇᖃᑦᑕᕐᓗᑎᒃ ᖃᓄᐃᖓᓂᕐᓄᑦ ᓅᕐᓗ ᐊᖏᓗᐊᖏᑎᐊᖅᑎᑦᑎᓂᕐᒨᖓᔪᑦ ᐊᑐᖅᑕᐅᔪᓐᓇᖅᑐᑦ ᐊᒥᓲᙳᖅᐸᓪᓕᐊᓂᖃᕋᔾᖅᐸᑦ ᐊᒨᓂᐊ.

ᐱᓕᕆᐊᕐᒧᑦ ᑎᑎᖅᑲᖅ ᑐᓂᓯᔪᖅ ᒪᓕᒃᑕᐅᔫᓴᓂᒃ ᖃᐅᔨᓴᐃᓂᐊᕐᓗᑎᒃ ᐊᒨᓂᐊ ᓇᓃᓐᓂᖏᓐᓂᒃ ᐅᔾᔨᒃᑕᕆᐊᕐᒥᑦ, ᐃᓚᒋᔭᐅᓗᓂ ᖃᓄᐃᖓᔭᕆᐊᖃᕐᓂᐅᔪᑦ ᐊᑐᖅᑕᐅᔪᑦ ᐋᒃᑖᕆᓂᕐᓄᑦ ᐊᒻᒪᓗ ᐊᐅᓚᑦᑎᓂᕐᓄᑦ ᑎᑎᕋᖅᓯᒪᔪᑦ ᐃᒪᕐᒧᑦ ᓚᐃᓴᓐᓯᒥᑦ (NWB 2016) ᑕᒪᑐᒧᙵ ᐃᒪᐅᑉ ᖃᓄᐃᓐᓂᖓᓄᑦ ᑮᓕᐅᔪᒧᑦ.

EXECUTIVE SUMMARY

Agnico Eagle is committedto monitor Ammonia in all surface sumps, seeps, etc., in accordance with the site Water License, 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 technical note 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 (NWB 2016) for this water quality parameter.

DOCUMENT CONTROL

Version	Date (YMD)	Section	Revisionevision	Author
1	2017/03/10	All	Creation of Document	Jefrey Pratt, AEM Environemntal Coordinator
2	2020/03/20	All	General Update	Vanessa Smith, AEM Project Coordinator

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AGNICO EAGLE
MELIADINE

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1 INTRODUCTION

Agnico Eagle Mines Ltd (Agnico or the company) is committed to monitor Ammonia in all mine pit sumps, seeps, etc., in accordance with the site Water License, 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. It is important to note that Agnico has not exceeded any ammonia discharge criteria from Water License A, 2AM-MEL1631 in 2019. The Ammonia Management Plan (AMP) 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 used at Meliadine. Meliadine is presently using an emulsion based explosive.

Ammonia dissolved in water exists in equilibrium by interchanging un-ionized (NH_3) and ionized (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 (NO_2) and nitrate (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 (AMP) 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 AEMP, as both water quality parameters are signature compounds of AN based explosives. 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 License (NWB 2016).

2 EXPLOSIVE MANAGEMENT AND BLASTING PRACTICES

2.1 SITE DESCRIPTION

2.1.1 Explosive Storage

Surface storage of explosive products are located at the Raise Collar Storage Area Storage Area where a total of fourteen (14) explosive and detonator magazines, as indicated in Figure 1. Underground storage of explosive for underground mining operations are on levels 200, 300 and 400, for a total of six (6) active 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 storge 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 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.

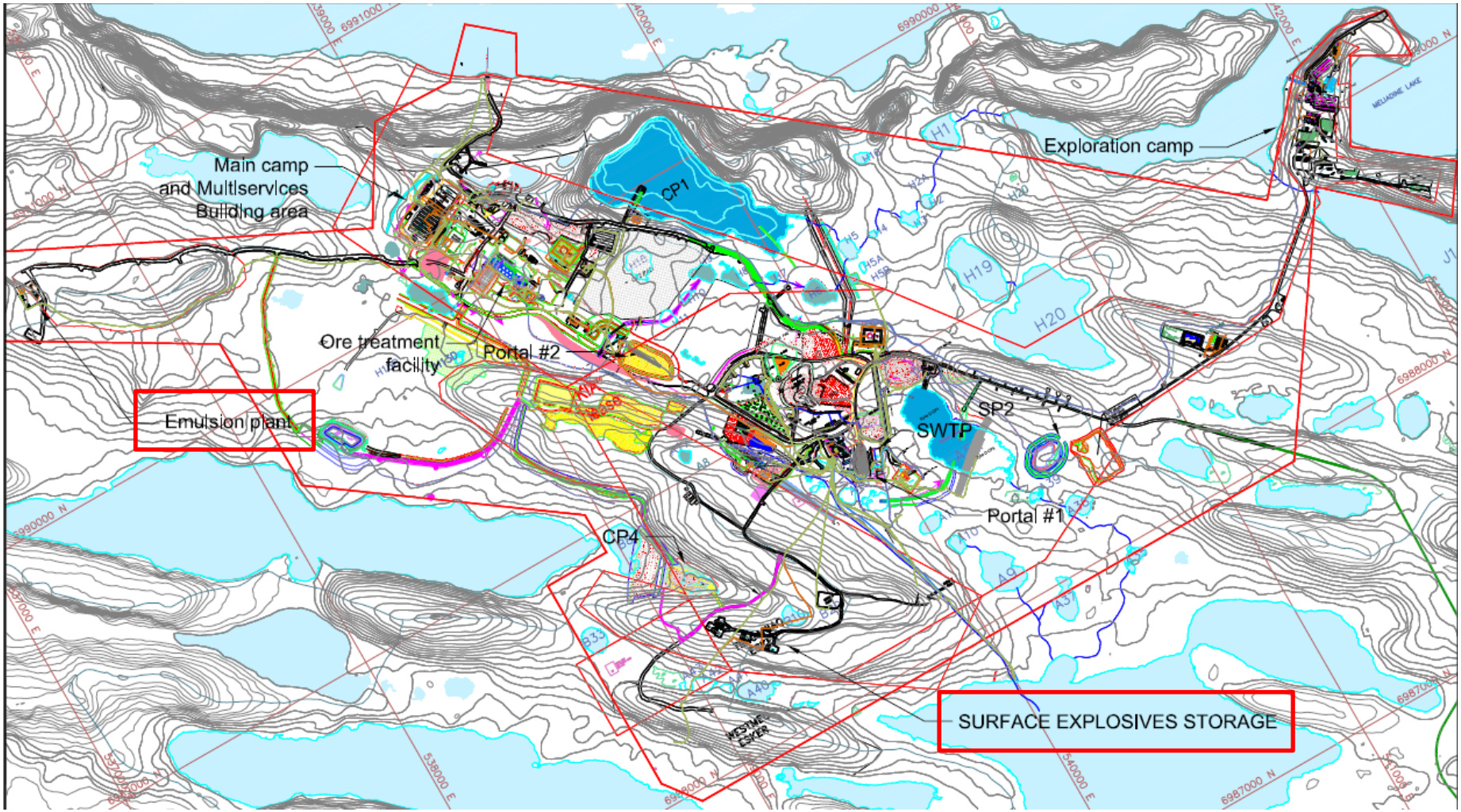
2.1.3 Mine

Explosives are used for the mining of surface infrastructure, waste rock and ore for surface and underground operations.

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 CP1-6. 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 and 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 determine 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

Water quantity and quality monitoring assist in the monitoring of ammonia loadings from explosive residuals. The Meliadine water license (NWB 2016) includes monitoring stations that are used for the monitoring of ammonia loadings. The stations that specifically monitor for ammonia are listed in Table 1. Table 2 lists the monitoring parameters for each group.

Table 1 Water Monitoring Station Included under the Meliadine Water License A, 2AM-MEL1631

Station	Description	Phase	Monitoring Parameters	Frequency
MEL-SR-1-TBD	Surface Runoff – runoff downstream of Construction areas at Meliadine Site and Itivia Site, Seeps in contact with the roads, earthworks and any Runoff and/or discharge from borrow pits and quarries	Construction, and Operations	As defined in the Water Management Plan referred to in Part D, Item 18 and Part I, Item 11	Prior to Construction, Weekly during Construction
			Group 1	Monthly during open water or when water is present upon completion
MEL-11	Water intake from Meliadine Lake	Construction, Operation, and Closure	Full Suite	Monthly during periods of intake
			Volume (m^3)	Daily during period of intake
MEL-12	Water treatment plant (pre-treatment) coming from CP1, off the pipe and not in the pond	Construction (prior to release), Operations, and Closure	Group 1	Monthly during periods of discharge
MEL-13 (and AEMP Stations)	Mixing zone in Meliadine Lake, Station 1; and MDMER exposure stations for final discharge point within mixing zone	Construction (prior to release), Operations, and Closure	Full Suite, Group 3 (MDMER)	Monthly during periods of discharge
MEL-14(a) (MEL-01 suggested by AEM in the Aplication)	Water treatment plant from CP-1 (post-treatment), end of pipe (before offsite release) in the plant before release.	Construction (upon effluent release), Operations, and Closure	Full Suite, Group 3	Prior to discharge and Weekly during discharge
			Volume (m^3)	Daily during periods of discharge
			Acute Lethality	Once prior to discharge and monthly thereafter
MEL-15	Local Lake E-3	Operations, and Closure	Group 2	Bi-annually during open water

MEL-16	Local Lake G2	Construction, Operations, and Closure	Group 2	Bi-annually during open water
MEL-17	Local Pond H1	Construction, Operations, and Closure	Group 2	Bi-annually during open water
MEL-18	Local Lake B5	Construction, Operations, and Closure	Group 2	Bi-annually during open water
MEL-19	CP-2 Collection of natural catchment drainage from the outer berm slopes of the Landfarm and industrial pad	Construction, Operations, and Closure	Group 1	Monthly during open water or when Water is present
MEL-20	CP-3 Collection of drainage from dry stacked tailings	Operations, and Closure	Group 1	Monthly during open water or when Water is present
MEL-21	CP-4 Collection of drainage from WRSF1	Operations, and Closure	Group 1	Monthly during open water or when Water is present
MEL-22	CP-5 Collection of drainage from WRSF1 and WRSF2	Construction, Operations, and Closure	Group 1	Monthly during open water or when Water is present
MEL-23	CP-6 Collection of drainage from WRSF3	Construction, Operations, and Closure	Group 1	Monthly during open water or when Water is present
MEL-24	Seepage from the Landfill between the landfill and Pond H3	Construction, Operations, and Closure	Group 1	Monthly during open water or when Water is present
MEL-25	Secondary containment area at the Itivia Site Fuel Storage and Containment Facility	Construction, Operation, Closure	Group 4, Volume (m^3)	Prior to discharge or transfer of Effluent

In addition to the monitoring listed in Table 1 any surface runoff locations identified as potention receptors for increased ammonia are sampled as well.

Table 2 - Monitoring Group (Meliadine Water License A, 2AM-MEL1631)

Group	Parameters
1	pH, turbidity, hardness, alkalinity, chloride, fluoride, sulphate, total dissolved solids (TDS), total suspended solids (TSS), total cyanide, ammonia nitrogen, nitrate, nitrite, phosphorus, orthophosphate, Total Metals (aluminum, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, and zinc).
2	**Total and Dissolved Metals**: aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, chromium, copper, iron, lead, lithium, manganese, mercury, molybdenum, nickel, selenium, silver, strontium, thallium, tin, titanium, uranium, vanadium, and zinc. **Nutrients**: ammonia-nitrogen, total Kjeldahl nitrogen, nitrate-nitrogen, nitrite-nitrogen, orthophosphate, total phosphorus, total organic carbon, dissolved organic carbon, and reactive silica. **Conventional Parameters**: bicarbonate alkalinity, chloride, carbonate alkalinity, turbidity, conductivity, hardness, calcium, potassium, magnesium, sodium, sulphate, pH, total alkalinity, TDS, TSS, total cyanide, free cyanide, and weak acid dissociable (WAD) cyanide.
3	**MMER parameters**: total cyanide, arsenic, copper, lead, nickel, zinc, radium-226, TSS, pH, sulphate, turbidity, and aluminum. **MMER additional requirements**: Effluent volumes and flow rate of discharge, Acutely Lethality tests (Rainbow Trout and Daphnia magna) and environmental effects monitoring (EEM).
4	Total arsenic, total copper, total lead, total nickel, TSS, ammonia, benzene, toluene, ethylbenzene, xylene, total petroleum hydrocarbons (TPH), and pH.
Full Suite	Group 2, TPH, and turbidity.
Flow	Flow data-logger.
Field measurements	Field pH, specific conductivity, dissolved oxygen, and temperature.

MMER - Metal Mining Effluent Regulations (SOR/2002-222).

4 REPORTING

Reporting of ammonia concentrations at the sampling stations listed in Table 1 is included as part of the requirement of the water license (NWB 2016). The reporting frequency is required by the water license (NWB 2016), and includes:

- Brief monthly reports of the compiled water quality monitoring results, sent to the Nunavut Water Board (NWB), Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) Water License 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 in Table 1 and from the monitoring action proposed under the AMP. 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 will notify the Nunavut Water Board as early as practical. Results of these further studies and/or changes to the AMP monitoring actions will be transmitted to the Nunavut Water Board for review.

5 INSPECTION

On a weekly basis, the engineering department conducts inspections in the blasting area to ensure that the loading procedures are being implemented (in order 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

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

7 REFERENCES

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

NWB (Nunavut Water Board License) (2016). Water License No: 2AM-MEL1631. Agnico- Eagle Mines Ltd. April 2016.

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