



MEADOWBANK GOLD MINE

Operational ARD/ML Testing and Sampling Plan

In Accordance with Water License 2AM-MEA0815

Prepared by:
Agnico Eagle Mines Limited – Meadowbank Division

Version 2
November 2013

EXECUTIVE SUMMARY

Agnico Eagle Mines Ltd. owns and operates the Meadowbank gold mine, which lies approximately 70 km north of Baker Lake, NU. Operation of this facility is subject to Water License 2AM-MEA0815/TR/B5 issued by the Nunavut Water Board (NWB) on June 9, 2008 and signed into effect by the Minister of Indian and Northern Affairs Canada (INAC) on July 10, 2008.

In accordance with this Water License, Agnico Eagle Mines Ltd. - Meadowbank Division maintains a detailed sampling, analysis and segregation plan to describe the management techniques used for the disposal of potentially acid-generating and/or potentially metal leaching waste rock and till.

This Operational ARD/ML Sampling and Testing Plan was initially developed in August, 2008 (Version 1) during the project development phase. This update/revision (Version 2) incorporates changes to procedures adopted as a result of testing prescribed in Version 1, as well as additional considerations based on feasibility of construction designs.

IMPLEMENTATION SCHEDULE

As required by Water License 2AM-MEA0815, Part B, Item 16, the proposed implementation schedule for this Plan is outlined below.

This Operational ARD/ML Sampling and Testing Plan is to be implemented by mine staff effective immediately.

DISTRIBUTION LIST

AEM - General Mine Manager

AEM - Mine Superintendent

AEM - Mine Engineer and the Mine Engineering Department

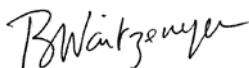
AEM - Chief Assayer

AEM - Environmental Superintendent and Environmental Department

DOCUMENT CONTROL

Version	Date (YMD)	Section	Page	Revision
1	08/08/08	All		Comprehensive plan for Meadowbank project
2	13/11/06	All		Updated plan for Meadowbank Mine

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1 INTRODUCTION

The Meadowbank gold mine, owned and operated by Agnico Eagle Mines Ltd., is located 70 km north of the Hamlet of Baker Lake, NU. The mine consists of three main gold-bearing deposits (Portage, Goose Island and Vault; see Figure 1-1) that are being mined through a truck and shovel, open pit operation. The Portage and Goose Island deposits are adjacent to the main mine facilities, and the Vault deposit is located approximately 8 km to the north.

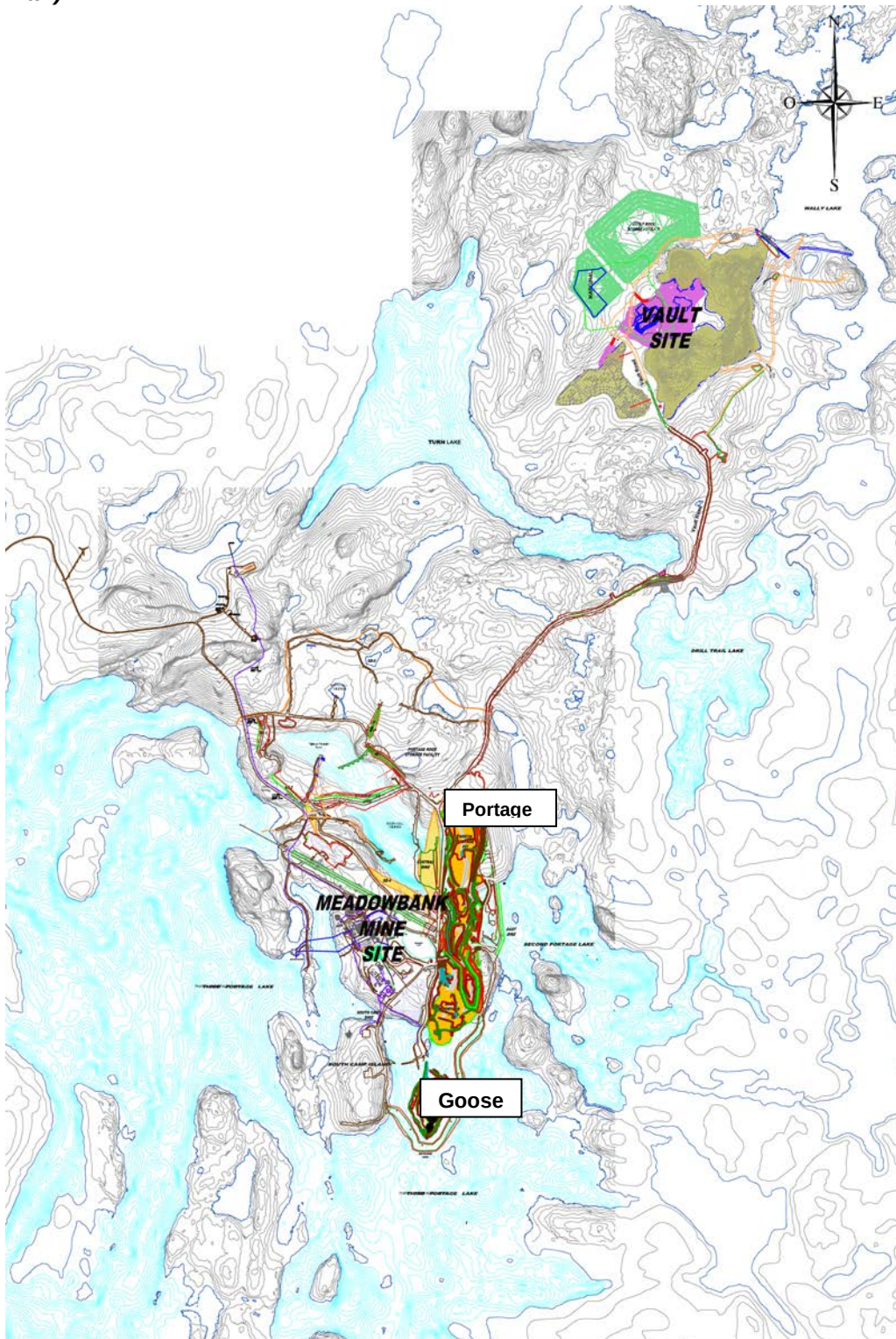
Operation of this facility is subject to Water License 2AM-MEA0815 issued by the Nunavut Water Board (NWB) on June 9, 2008. Under this license, AEM maintains an Operational ARD/ML Sampling and Testing Plan to reduce the potential for acid rock drainage (ARD) or metals leaching (ML) from waste rock to the receiving environment. The Plan was initially developed as required under Part I, Item 14 of AEM's Water License in August, 2008 (Version 1). The Plan is further updated/revised here (Version 2) to clarify current methods of sampling and analysis, which have been amended based on experience during the early stages of operation.

1.1 OBJECTIVES

The objectives of the Plan are to define the sampling, analysis and testing procedures that are to be implemented by staff at the Meadowbank mine to define the acid generating and metals leaching potential of waste rock. This characterization is to be used by mine staff to ensure that waste rock and till are identified, managed, segregated and disposed of in an environmentally appropriate manner, as designated in the Plan.

The Plan is closely associated with the Updated Mine Waste Rock and Tailings Management Plan (AEM, 2013a) and the Water Management Plan 2012 (SNC Lavalin, 2013).

FIGURE 1-1 – LOCATION OF THE PORTAGE, GOOSE AND VAULT DEPOSITS (General Site Plan)



2 WASTE ROCK MANAGEMENT

2.1 LITHOLOGIES

There are four major bedrock types (or lithologies) found at Meadowbank: intermediate volcanic (IV), iron formation (IF), ultramafic (UM), and quartzite (QZ). Each of these rock types is present in both the Portage and Goose Island Pits. The Vault Pit, however, consists almost exclusively of IV. With all deposits, a variable layer of overburden (OVb) is present.

During the early stages of the Project, the ARD and ML potential of each Meadowbank waste rock lithology was evaluated through both static and kinetic testing. Details on the test methods used and results obtained are provided in Golder, 2005a and 2005b (summarized in Appendix A). Anticipated ARD/ML potentials for each rock type based on exploration drill core tests are shown in Table 2-1.

Table 2-1 Anticipated ARD/ML potential of waste rock types at Meadowbank (Cumberland, 2005)

Pit	Waste Type	ARD Potential	ML Potential
All Pits	Till	None	Low
	Tailings	High	High
	Lake Sediment	Variable	High
Portage and Goose	UM	None	Low
	IV	Variable	Moderate
	IF	High	High under PAG, low when buffered
	QZ	High	Low
Vault	IV	Low	Variable

2.2 WASTE ROCK SEGREGATION

Under the life-of-mine (LOM) Plan (2012) approximately 193 million tonnes of waste rock and till will be generated from the Portage, Goose and Vault Pits. Till is used in site construction or placed in the RSF. Characterization of ARD/ML potential in the excavated waste rock is required in order to properly segregate it for use or disposal, as follows:

- **General Construction** - Only rock that has been certified as non-potentially acid generation (NPAG) can be used for site construction, including dewatering dikes. It is the responsibility of the Geology Superintendent to ensure that all waste rock being used for construction has been characterized and verified as being NPAG. The only exceptions are for select components of the tailing storage facility.

- **Pit Backfill** - Waste rock is currently being placed in pits, reducing the final depth of end pit lakes which act as fish habitat compensation (see AEM, 2012 - NNLP). Waste rock used as backfill in pits will be under water after flooding, thereby limiting air contact and reducing or eliminating further oxidation. Under the current mine plan, the central portion of the Portage Pit, and the Phaser portion of the Vault Pit (if constructed) will be partially backfilled with waste rock.
- **RSF** - All other waste rock will be placed within the Portage or Vault Rock Storage Facility (RSF) for permanent storage.

2.3 RSF DESIGN

The majority of waste rock generated at the Meadowbank site will be placed in the Portage or Vault Rock Storage Facility. The general locations of these RSFs have been previously selected based on environmental impacts, costs and operational constraints. Under the current plan, each RSF has an area of approximately 80 hectares.

RSFs are designed to minimize the potential for ARD and ML. The Portage RSF is constructed to encapsulate PAG waste rock inside a layer NPAG material as a control measure for ARD. The soluble NPAG rock that is placed on the top and sides of the storage pile is needed in the long term to host the thawed layer and prevent liquids from contacting the centre of the cell that contains the PAG waste rock. Presently it is estimated that at least 4 m of capping is required to ensure freezeback occurs. Based on the results of thermal modeling, it is expected that the material within the RSFs will freeze within two years of placement (BGC, 2004). Rock oxidation can still occur in frozen material but will likely proceed at a slower rate than predicted by laboratory testing because of the cold temperature prevalent for much of the year. Permafrost will retain water as ice, so it was predicted that contaminants will not be transported away from the RSF. Testing will be conducted to measure temperatures throughout the waste rock pile, and to measure the depth of the annual surface thaw (see Section 5.2.3). This information will be used to confirm the need for the 4m thickness of rock cover required to close out the Portage RSF. The Vault RSF is not expected to require capping, as the bulk of the material from this deposit is expected to be NPAG (Golder, 2005a). Further details of RSF design and management are provided in the Mine Waste Rock and Tailings Management Plan (AEM, 2013a).

3 ASSESSMENT OF ARD POTENTIAL

Sampling and testing of waste materials for ARD is conducted during mine operation in order to segregate PAG waste from NPAG waste, so that waste materials can be assigned to specific locations.

3.1 ACID BASE ACCOUNTING

The ARD potential of waste rock is traditionally characterized through acid-base accounting (ABA) analyses. ABA analysis involves a suite of analytical tests that include paste pH, total sulphur, sulfate sulphur, neutralization potential, and carbonate neutralization potential based on total inorganic carbon. As the name suggests, ABA accounts for both acid generation potential (assumed to be due to sulfide sulphur content, or total sulphur minus sulfate sulphur) as well as acid-buffering potential (referred to as neutralization potential). These factors are then used to determine the net potential ratio (NPR) of the rock sample.

3.1.1 Onsite Analyses

ABA analyses are relatively slow to complete (the average turn-around time at a commercial laboratory is approximately 2 to 4 weeks), and require several different types of equipment. In consideration of the mining rate at Meadowbank, alternate analytical methods were investigated.

The Draft Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Mine sites in British Columbia (Price, 1997) provide factors for the conversion of total sulphur and total inorganic carbon to maximum potential acidity (MPA) and carbonate neutralization potential (NP), respectively, which are then used to classify material as PAG/NPAG (see Section 3.2). Since it was possible to equip Meadowbank's onsite assay lab with the equipment required for these analyses, their use as a surrogate for the complete suite involved in traditional ABA testing was assessed and confirmed using exploration drill cores (Golder, 2005a).

As a result of these analyses, the Meadowbank onsite assay lab has been equipped to analyze total sulphur and total inorganic carbon in waste rock, allowing for the characterization of acid generating potential onsite, with overnight turn-around times.

3.1.2 QA/QC

The onsite lab carries out a quality control quality assurance (QA/QC) program that includes the following elements:

- Use of certified reference materials to verify the precision of analytical methods; and
- Quarterly analysis of a minimum of 75 duplicate samples by an accredited external lab for full ABA to verify the onsite lab's accuracy with these determinations and confirm correlations.

This includes samples of IF, IV and UM rock types. This analysis is conducted by the Geology Department, and results are reported to the Geology and Environment Superintendents. Data is available for annual reporting, as required.

3.2 WASTE ROCK CHARACTERIZATION

The most conventional method of characterizing the acid generation potential of waste rock is to classify it as potentially acid generating (PAG), non-potentially acid generating (NPAG), or of uncertain acid generating potential (uncertain ARD potential) based on its Net Potential Ratio (NPR). The NPR of a material is calculated as the ratio of its measured carbonate neutralization potential (NP) to its calculated maximum potential acidity (MPA). Mine staffs apply the following procedures to characterize the waste rock at Meadowbank.

Samples of drill cuttings are analyzed on-site for total sulphur and total inorganic carbon. The results from these analyses are used to calculate the Net Potential Ratio which defines NPAG from PAG materials. The following steps lead to the calculation of the **NPR**:

- i. Total sulphur is converted into a maximum potential acidity (**MPA**) value by multiplying the total S wt% by 31.25 which yields an MPA value in kg CaCO₃ equivalent.
- ii. Total inorganic carbon is similarly converted into a carbonate neutralization potential (**NP**) by multiplying the total wt% inorganic carbon (reported as %CO₂) by 83.34 which yields an NP value in kg CaCO₃ equivalent. $NP = ((\%C \times 100.09)/12.01) \times 10$.
- iii. The Net Potential Ratio (**NPR**) for the blast hole drill cutting sample is then calculated as **NPR = NP/MPA**.

3.2.1 PAG/NPAG

The ARD potential of waste rock, till (overburden) and tailings materials from the Meadowbank mine were previously classified by Golder Associates (2005a) using the NPR-based guidelines published by Indian and Northern Affairs Canada (INAC, 1992), now known as Aboriginal Affairs and Northern Development Canada (AANDC), which are summarized in Table 3-1. The NPR guideline value to differentiate between uncertain and NPAG has been adjusted from 3 to 2 (Golder, 2006b) using the criteria described in the AANDC reference guide (knowledge of rock chemistry, mineralogy and reactivity of neutralizing minerals). For example, the use of carbonate NP as a surrogate for bulk NP was examined (Golder, 2006b) using data obtained from exploration drilling. Carbonate NP and bulk NP correlate well, which suggests that NPR values calculated using carbonate NP would be comparable to NPR values calculated using bulk NP. It also emphasizes that at Meadowbank measured NP is equal to carbonate NP and is thus fully available for neutralization of any acid generated (i.e., there does not appear to be any carbonate that is lost as iron carbonate or other mineral forms that cannot provide neutralization potential).

The NPR ratio adjustment was accepted during the NIRB environmental assessment process (Golder, 2006b).

Table 3-1 Summary of ARD guidelines used to classify Meadowbank waste rock and overburden (based on INAC, 1992).

Initial Screening Criteria	ARD Potential
$\text{NPR} < 1$	Likely acid generating (PAG)
$1 < \text{NPR} < 2$	Uncertain
$2 > \text{NPR}$	Non-potentially acid generating (NPAG)

3.3 FIELD METHODS

3.3.1 Waste Rock Sampling

Field sampling of rock material for use in NPR analyses proceeds according to the following guidelines:

- Drill holes are sampled in accordance with the frequency set out in writing by the Geology Superintendent. The default sampling frequency is the sampling of every fourth drill hole in each drill hole pattern. The Geology Superintendent will vary this frequency based on his knowledge from previous drilling and from visual inspections depending on where the drill pattern is situated.
 - o For example, in the Goose Island Pit, data from the drill holes has been compiled for the first 4 benches and compared to the block model for each bench. The PAG/NPAG areas from blast holes consistently conform to the lithology (UM/quartzite and UM/IF) in the model. Thus, the area of UM waste rock on the western side of the pit will be treated as NPAG and sampling will be reduced in this area to every sixteenth drill hole. Sampling at the default frequency will continue for the Portage pit, and eastern side of Goose Island pit.
 - o Alternatively, in areas where the Geology Superintendent has already characterized the rock as PAG and directed that this block be sent to segregation as PAG material no sampling at all may be required as the whole pattern has been classified as PAG and treated accordingly.
- Each sample should weigh no less than 1 kg.
- The sample is labeled using a convention that is readily traceable back to the production drill hole numbers.
- Composite samples are not to be used because they confuse the data and render it more difficult for use in model creation or comparison.

3.3.2 Waste Rock Delineation

Following laboratory analysis, geology staff will classify waste rock and overburden as NPAG if the NPR value is greater than 2; PAG if the NPR value is less than 1 and uncertain for NPR values between 1 and 2 (Table 3-1). These criteria can be re-evaluated when judged relevant by the Geology Superintendent in consultation with the Mine Engineer, as additional test data become available. ARD classifications of all samples are logged in Meadowbank's GEMCOM database, and are available as required for annual reports or upon request.

In some cases it may be appropriate to calculate a weighted bulk average NPR for the whole block of rock and use the blended NPR to classify the rock. In such cases the Geology Superintendent should be consulted and the calculation of the weighted average NPR documented. In these cases the blended material should only be classified as being NPAG with the written informed approval of the Geology Superintendent.

NPR values will be transferred to the mine plans for that specific blast. Once blasting is complete the mine surveyor will use NPAG and PAG outlines from the drill pattern to outline the respective dig limits in the open pit. Different material categories are separated into packets, identified in the field using stakes, wire flags and flagging tape so that each packet can be excavated and sent to the appropriate destination (see Section 2.2). Packets classified as NPAG should include no more than one acid-generating sample ($\text{NPR} < 1$) for every 8 non-acid-generating samples ($\text{NPR} > 2$). Neither should they include more than one sample of uncertain acid-generating potential ($1 < \text{NPR} < 2$) for every 4 non-acid-generating samples ($\text{NPR} > 2$).

4 ASSESSMENT OF ML POTENTIAL

Waste rock and overburden materials can also potentially leach metals when they come into contact with water and air. This release of metals, otherwise referred to as metal leaching (ML) potential, can occur even if the materials are non-acid generating. The ML potential of all rock lithologies and overburden materials at the Meadowbank mine was initially evaluated by Golder Associates (Golder, 2006b) on samples taken from exploration drill cores. Four metals of potential concern were identified (As, Cu, Ni and Zn) but in general, ML at Meadowbank is low.

Standard techniques for analysis of ML potential include Shake Flask Extraction (SFE) and humidity cell tests. Both of these types of tests involve exposing the samples to water, and measuring the metal content of the water after a prescribed period of contact time (24 hours for SFE tests and weekly 24 hour trickle leaches over a minimum of 20 weeks for humidity cell tests), and are thus time-consuming by design. Consequently, it is not feasible to segregate waste materials based on measured ML potentials derived from either of these types of leaching tests. The turn-around time for analytical results is too long for either of these tests to be used as a decision making tool on a day-to-day basis as required during mine operations.

As a result, Version 1 of this plan indicated that ML potential would be determined through development of a predictive relationship between humidity cell leachate results, SFE leachate results and total metals concentrations in rock samples. Analyses for total metals would then occur onsite, and ML potential would be classified using the previously established relationship. However, a reliable model could not be developed. This is in accordance with Golder (2005), which indicated that for both arsenic and copper, the total concentration in the SFE test leachates was not proportional to the total arsenic and copper concentrations in the rock. For example, some waste rock from the Goose Island deposit contains relatively high total As concentrations but shows low As concentrations in the SFE test leachates. This indicates that As in this rock type is associated with relatively stable arsenopyrite and thus does not leach.

Consequently, ML potential is confirmed through quarterly analyses of SFE leachate on a minimum of 75 samples sent to an external accredited laboratory. This includes 25 samples each of IV, IF and UM rock types.

A surface runoff water monitoring program ensures rapid detection of ML in RSF and dike sumps (see Water Quality and Flow Monitoring Plan, 2009). In addition, all RSF sump water is transferred to the TSF, and is not released to the environment. Further details on this monitoring program are provided in Section 5.2.

5 PLAN REVIEW, PERFORMANCE MONITORING & REPORTING

5.1 PLAN REVIEW

The Mine Geology Superintendent is responsible for implementing the Operational ARD/ML Sampling and Testing Plan. The overall Plan is to be reviewed as required by the Geology Superintendent and updated if necessary to reflect any adaptive changes made in the operational sampling and testing procedures. The changes should be made in consultation with the mine engineer and chief assayer. Revised versions should be sent according to the Distribution List (pg. iii).

5.2 PERFORMANCE MONITORING

The Operational ARD/ML Sampling & Testing Plan is the primary tool to ensure that all overburden and waste rock generated on the Meadowbank site is appropriately characterized and segregated to prevent the future release of contaminants from the RSF and overburden stockpiles into the receiving environment.

In addition to the analytical QA/QC procedures outlined in Section 3, the following performance monitoring activities are conducted:

5.2.1 RSF Water Quality Monitoring

The water quality of the drainage from the RSFs and pits is sampled and monitored by the Meadowbank environmental team in accordance with the Meadowbank Type A water License (2AM MEA0815). Water quality predictions (Golder, 2005c) indicated that arsenic, copper, nickel, zinc, nitrate and ammonia may be found in the Portage RSF drainage, and that arsenic may be found in the Vault RSF drainage. The details of this monitoring program are described in the Meadowbank Gold Project Water Quality and Flow Monitoring Plan (2009). The data from this monitoring is provided to the Nunavut Water Board through annual reporting, as per the Type A Water License.

5.2.2 Dike Face Water Quality Monitoring

In order to ensure that waste rock used in the construction of in-water features (e.g. dewatering dikes) provides acceptable fish habitat, water quality of samples from interstitial spaces is analyzed as a component of Meadowbank's Habitat Compensation Monitoring Plan (AEM, 2013b). To date, sampling has been conducted along the East Dike in 2009 and 2011, and along the Bay-Goose Dike in 2011.

Water samples are collected from between the rocks of the dike face using a tube sampler and electronic pump, and analyzed for conventional parameters (hardness, conductivity, pH, and total dissolved and suspended solids), anions (alkalinity, chloride and sulphate), nutrients (ammonia, nitrate, nitrite, total Kjeldahl nitrogen, orthophosphate and total phosphate), organic parameters (chlorophyll-a, dissolved and total organic carbon) and total and dissolved metals at an accredited facility. In accordance with DFO authorizations, sampling and analysis of dike face interstitial water

will continue every 5 years until closure as part of the fish habitat compensation monitoring. Results from this program are provided to the Nunavut Water Board.

5.2.3 Permafrost Development

Thermistors have been installed within the RSF to determine if permafrost is forming as predicted. AEM will be installing additional thermistors in the RSF in late 2013 and 2014 to better define permafrost development. More information regarding the thermal monitoring plan is provided in the version 1 Mine Waste Rock and Tailings Management Plan (Section 8). Thermal monitoring results are provided in AEM's annual report submitted to the NWB.

6 LITERATURE CITED

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Appendix A

ARD/ML Potential of Meadowbank Mine Wastes – Summary

APPENDIX A

Summary of the ARD/ML Potential of Meadowbank Mine Wastes.

The acid rock drainage (ARD) and metal leaching (ML) potential of waste materials to be produced at Meadowbank has been evaluated through both static and kinetic testing (Golder, 2005a and Golder, 2005b). The static tests conducted for this purpose included the following:

- Mineralogy;
- Whole rock analysis;
- Elemental solid phase analysis (multi-acid digestion);
- Acid base accounting (ABA); and
- Shake flask extraction (SFE).

Test methods and results are provided in (Golder, 2005a).

Kinetic testing was conducted on representative samples of waste rock from each lithology using standard 1 kg humidity cell tests, 100 kg composite column tests, and approximately 250 kg composite field cells. Test methods and results are provided in (Golder, 2005b).

Table A.1 summarizes the ARD/ML potential of the till, lake sediments and pit rock, based on the results of static and kinetic testing (Golder, 2005a and 2005b). ARD potential was evaluated by comparing ABA results to the guidelines presented in INAC (1992). ML potential was evaluated based on exceedances of the Metal Mining Effluent Regulations (MMER, 2002) in kinetic test leachate.

TABLE A.1: Summary of ARD/ML Potentials of Meadowbank Waste Types

Deposit	Waste Type	ARD Potential			MMER Metal Exceedances in Kinetic Test Leachate
		% PAG	% Uncertain	% NPAG	
-	Till	9	-	91	N/A
-	Lake Sediments	73	-	27	N/A
Vault	IV	11	14	75	None ¹
Portage/Goose	IV	20	14	66	None ¹
	IF	67	13	20	Zn
	UM	2	2	96	As
	Q	86	-	14	N/A

Notes:

1. Based on the results corresponding to the 100 kg composite sample (Golder, 2005b).

PAG - potentially acid-generating

NPAG – not potentially acid-generating

N/A – not analyze

INAC (Indian and Northern Affairs Canada), 1992. Guidelines for ARD Prediction in the North – Northern Mine Environment Neutral Drainage Studies No. 1. Department of Indian Affairs and Northern Development, Ottawa, 1993.

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