

Appendix 10

Whale Tail MDRB Meeting No 24 + Agnico responses

October 24th, 2018

Mr. Luc Chouinard
General Manager
Agnico–Eagle Mines, Meadowbank Division
Baker Lake Office

Email: luc.chouinard@agnico-eagle.com

Dear Mr. Chouinard,

Report No 24B, Amaruq
Meadowbank Mine Dike Review Board
Meeting September 24-27, 2018

1.0 INTRODUCTION

The meeting of the Dike Review Board was held on site as planned from September 24th to 27th. The Board is comprised of three members, Mr. D. W. Hayley, Dr. N. R. Morgenstern and Mr. D. A. Rattue. All three members attended this meeting.

The objectives were to review the status of the design, construction and operation of water and tailings retention structures at Meadowbank and at Amaruq. This report covers the presentations, discussions and observations relating to the Amaruq project only. A companion report addresses the issues relating to the Meadowbank site.

The activities covered those outlined in the agenda which is included as Appendix A. The Board made a field visit, by helicopter, by vehicle and on foot, to observe conditions at Amaruq primarily the construction of the Whale Tail Dike.

The list of attendees at the meeting is given in Appendix B.

Paper copies of the various PowerPoint presentations were provided by Agnico-Eagle Mines (AEM), and SNC-Lavalin Inc (SLI) during the meeting. Digital versions were also supplied at the end of the meeting to facilitate archiving.

A selection of photographs taken during the visits is to be found in Appendix C.

In the report which follows, the subject matter is covered essentially in the same order as presented during the meetings. The recommendations are underlined in the text.

2.0 RESPONSES TO REPORTS Nos. 21, 22 AND 23

Several matters were raised during the meeting No. 21 with Board recommendations included in the report of that meeting. The subjects were re-visited during meeting No. 24 and are mentioned below.

The Board is content with the response to the single item referring to Amaruq that was part of report No. 22.

Meeting No. 23 consisted of a telephone conference call, the proceedings of which were covered in the minutes prepared by SLI. The Board report acknowledged these minutes and contained no further recommendations.

3.0 WHALE TAIL DIKE DESIGN

3.1 Dike

After an introduction by AEM, SLI provided a review of the site characterization, design criteria and current design for the Whale Tail Dike (WTD). There have been no substantive changes from previous presentations and the Board accepts the design as presented. However, for improved practice, the Board recommends that:

- All rock exposures be logged to establish rock structure in order to validate and complement the information available from the borehole core samples and televiewer images;
- Additional thermistor cable(s) be considered for acquiring temperature data in the lake upstream;
- Include a contingency for thermistor installations downstream of the cut-off wall to aid leakage detection should the wall instruments and/or toe seepage monitoring indicate an anomaly. Seepage through the wall would likely manifest as a plume of contrasting temperature.

3.2 South Whale Diversion Channel

No extra details of the channel design were presented at this meeting. The Board awaits further information in the future. However, the Board expresses its desire to see the following points covered in an Operation, Maintenance and Surveillance (OMS) manual to ensure compliance with the design intent:

- Potential for soil/sediment erosion and deposition; and
- Management of ice and snow, including mechanical removal as and when required.

4.0 CONSTRUCTION

A presentation was made on:

- The current status of the works;
- Observed foundation conditions including field adaptation to the same; and
- Quality Control and Quality Assurance (QC/QA).

Evidently, the practices draw on past Meadowbank dike expertise.

The Board has some concerns in the following areas.

Continuity of the cut-off wall is dependant on accurate survey of the individual caisson location and verticality. This is a contractor QC activity but, while not necessarily duplicating this work, QA observation of the entire procedure is required.

The Cement-Bentonite piles will be constructed so as to penetrate 1 m into rock, as determined by the longitudinal profile of the rock surface obtained through survey carried out subsequent to centreline trench excavation. Examination of the cuttings from the bedrock socket would be a valuable addition to the inspections.

There is considerable merit in the preparation of a formal Deviation Accountability Report to reconcile any conflicts between the design intent and the information from QC/QA. This will facilitate decision making and the determination of when the dike can be considered fit for purpose to initiate pump down.

It is understood that the need for grouting of the rock beneath the cut-off wall is being evaluated. It is believed, and the Board concurs, that embedment of the cut-off wall in bedrock is an improvement over grouting of the interface at the cut-off wall/rock contact. The need for grouting the rock beneath the cut-off then becomes an issue of addressing the potential for excessive seepage.

The site investigation boreholes revealed discontinuities (foliation and fracture joints) with openings up to 54 mm. Some joints may be open, others filled but possibly with erodible materials. On the abutments and in shallow water areas, ice is likely to be present in the discontinuities. Grouting is not possible in ice filled or material filled joints. A hydraulic gradient may lead to washing. Contact with warmer water may result in thaw of the ice. Both are situations where seepage may develop subsequent to the establishment of a hydraulic gradient across the dike.

In the case of the Meadowbank dewatering dikes, the gradient was generated by drawdown of the water downstream of the dikes and no new inundation occurred. In the case of the Whale Tail Dike, not only will the downstream pool be drawn down, but the upstream water level will be raised by 3.5 m.

One of the field adaptations involved excavation of the substantial thickness of ground ice encountered beneath the active zone. This reduces the potential for embankment settlement and facilitates the execution of the cut-off secant piles. However, the presence of crushed stone instead of frozen till will permit the incursion of “warm” water into the abutment area as the upstream pool is raised. The potential for thawing the rock beneath the cut-off is thus increased. Extending the nominal 1 m deep secant pile sockets to 2-3 m in the relatively soft rock on this abutment could be considered as a solution.

Examination of the Schmidt lower hemisphere representation of the rock discontinuities reveals a predominance of joints transversal to the dike centreline and dipping at 70° on the West abutment. A similar set is seen at the East abutment. An additional but strong set encountered at the East abutment is sub-parallel to the dike axis but dips at around 50° to the upstream and consequently may daylight beneath the downstream shell of the dike. A review of the rock grouting strategy needs to consider the rock quality and potential seepage pathways.

A risk analysis of the seepage potential is merited with an evaluation of the safe seepage that can be managed and what mitigation measures can be implemented if necessary. While seepage may not constitute a risk to the integrity of the Whale Tail Dike, satisfactory performance also implies limited and manageable seepage.

The Board recommends the addition of thermistor cables installed through the embankment fill on the upstream side of the cut-off wall at the East and West abutments and penetrating into the bedrock in order to monitor the evolution of temperatures and to determine whether freeze back or thaw is the dominant trend.

The Board was able to visit the dike and observe operations for the construction of the secant pile cut-off wall. The need for improved housekeeping with respect to management of overflow during tremie backfill of the casings was evident. There are two issues with this namely; environmental protection in the avoidance of water reaching the lake, and safety in the reduction of ice accumulation on the working platform during winter operations.

5.0 NEXT MEETINGS

No dates have been set for future discussions or for the next site meeting but early September is viewed as an appropriate time. The Board awaits instruction from AEM in this regard.

6.0 ACKNOWLEDGMENTS

The Board once again wishes to thank the personnel of AEM for the organization of logistics and for their participation in the meetings, and for the excellent documentation and presentations made by AEM and SLI which contributed to the efficiency and effectiveness of the proceedings.

Signed:



Norbert R. Morgenstern, P. Eng.



Don W. Hayley, P. Eng.



D. Anthony Rattue, P. Eng.

ATTACHMENT A

AGENDA FOR BOARD MEETING NO. 24

September 24th to 27th, 2018



Agnico Eagle Mines - Meadowbank Division
Meadowbank Dike Review Board
Meeting # 24 - September 24 to 27, 2018
Meeting Location : Meadowbank Mine Site, Nunavut
AGENDA

DAY 1 - September 24	Responsible	Time allocated	Presenters	Start	End
<i>Check in, room assignments and site H&S orientation, lunch</i>		1:30		11:30	13:00
P1 - Welcome, Review of the Agenda and Mine and Management Update [AEM]	FLB/AL	0:30	FLB	13:00	13:30
<i>Review of Answers to MDRB Report #22, #23</i>	FLB/AL	0:15	AL	13:30	13:45
<i>Corporate update on Engineer of Record (EoR)</i>	TL	0:15	TL	13:45	14:00
P2 - Overview of Dewatering Dike Performance [AEM]	PG/PEMD	1:00	PEMD	14:00	15:00
<i>Break</i>		0:15		15:00	15:15
P3 - Stormwater Dike Update - Instrumentation and dike performance review [AEM]	VD/PG/PEMD	0:45	PEMD	15:15	16:00
P4 - Central Dike Seepage Update - Instrumentation and dike performance review [AEM]	VD/FLB/AL	1:00	FLB	16:00	17:00
DAY 2 - September 25					
P5 - Design North Cell Internal Structure [GOLDER]	GAL	1:15	YB	7:30	8:45
P6 - Summary of TSF 2018 Construction Season (SD 3,CD, North Cell) [AEM]	GAL PG/PEMD	1:00	PEMD/YB	8:45	9:45
<i>Break</i>		0:15		9:45	10:00
P7 - Tailings Storage Facilities - Operation [AEM]	PP/EH	1:00	PP	10:00	11:00
P8 - Tailings Storage Facilities - Instrumentation Review [AEM]	VD/PP/EH	1:00	EH	11:00	12:00
<i>Lunch</i>		1:00		12:00	13:00
<i>Mine Site Tour (TSF, Pit E5, Dewatering Dikes)</i>		4:00		13:00	17:00
P9 - Overview of Pits Wall Stability and Geomechanics [AEM]	TD,VD	0:30	AL	17:00	17:30
DAY 3 - September 26					
P10 - WTD Design (including South Whale Tail Channel) and Construction Update [SNC]	SNC	2:00	YJ	7:00	9:00
P11 - Mammoth, WRSF and NE Dike Design Review [SNC]	SNC	1:30	YJ	9:00	10:30
<i>Break</i>		0:15		10:30	10:45
P12 - In pit deposition - Detailed Engineering Update [SNC]	SNC	1:30	GC	10:45	12:15
<i>Lunch</i>		1:00		12:15	13:15
<i>Amaruq Field Tour</i>		4:00		13:15	17:15
DAY 4 - September 27					
Deliberation by the Board Members		2:00		7:30	9:30
Preliminary Report by the Board Members		1:30		9:30	11:00
Meeting Closure					
<i>Lunch</i>		0:30		11:00	11:30
Approximate Time of Departure				11:30	

ATTACHMENT C

PHOTOGRAPHS



Photo No. 1 Caisson drilling machines on Whale Tail Dike



Photo No. 2 Auger for caisson clean-out



Photo No. 3 Rock socket drill



Photo No. 4 Tungsten carbide tipped hammer drill bits (7)



Photo No. 5 Overflow of water during tremie filling of secant piles with Cement-Bentonite slurry



AGNICO EAGLE

To: Norbert R. Morgenstern, D. Anthony Rattue and Don W. Hayley

From: Agnico Eagle Mines, Meadowbank, Nunavut Division

Date: January 6, 2019

RESPONSE TO COMMENTS, MEADOWBANK DIKE REVIEW BOARD No.24 – AMARUQ REPORT

The twenty-fourth meeting between the Meadowbank Dike Review Board (the Board) and Agnico Eagle Mines Limited (AEM) was held between September 24 and 27 2018 at the Meadowbank mine site.

The objective of the meeting was to have independent senior technical reviews on the design, construction and operation of water management structures and of the tailings management system at Meadowbank and Amaruq for the reference period of September 2017 to September 2018.

AEM Meadowbank Complex asked the Board to prepare two reports (one for the Meadowbank site and one for the Amaruq site) to reflect our operating licenses. On October 24 2018, the Board provided their reports (MDRB Meeting No.24 Meadowbank and MDRB Meeting 24 Amaruq) with their recommendations. This letter provides the response from AEM related to the Board recommendations for the Amaruq report.

1.0 Whale Tail Dike Design

MDRB Comment

There have been no substantive changes from previous presentations and the Board accepts the design as presented. However, for improved practice, the Board recommends that:

- *All rock exposures be logged to establish rock structure in order to validate and complement the information available from the borehole core samples and televiewer images ;*
- *Additional thermistor cable(s) be considered for acquiring temperature data in the lake upstream*
- *Include a contingency for thermistor installations downstream of the cut-off wall to aid leakage detection should the wall instruments and/or toe seepage monitoring indicate an anomaly. Seepage through the wall would likely manifest as a plume of contrasting temperature.*

AEM Answer

- On Whale Tail Dike, the only exposed bedrock during construction was on the West abutment above El. 156 m. No more bedrock will be exposed during the construction of this structure. This bedrock was not logged as this control was not part of the QA/QC program at that time. AEM asked to add the logging of bedrock exposure to the QA program for the other dikes to be built at Amaruq (Mammoth Dike, WRSF Dike, NE Dike).
- The instrumentation program of Whale Tail Dike will include at least one thermistor on the upstream side of the dike into the deepest portion of the South Whale Tail Basin to acquire lake temperature data. To follow up on the temperature in and around secant piles after pouring, a thermistor was installed on the upstream side of the key trench. Monitoring of the temperature inside the key trench with this instrument will continue as it will be connected to a data acquisition system in 2019.
- The majority of the thermistors installed on Whale Tail Dike will be located on the downstream side of the cut-off wall (2 m from centerline) to aid leakage detection. This location for the thermistors will limit drilling in the cut-off wall to promote the cut-off wall integrity.

2.0 South Whale Tail Diversion Channel

MDRB Comment

The Board awaits further information in the future on the channel design. The Board expresses its desire to see the following points covered in an Operation, Maintenance and Surveillance (OMS) manual to ensure compliance with the design intent:

- *Potential for soil/sediment erosion and deposition ;*
- *Management of ice and snow, including mechanical removal as and when required*

AEM Answer

The hydrological study indicates that this channel needs to be completed prior to freshet 2020. The detailed engineering design of the South Whale Tail Channel is planned to be completed in Q2 2019. Prior to its commissioning AEM Meadowbank will integrate this structure in the Amaruq water management structure OMS manual. The OMS for the South Whale Tail channel will cover the potential for soil/sediment erosion and deposition as well as the management of ice and snow.

3.0 Construction

MDRB Comment

Continuity of the cut-off wall is dependent on accurate survey of the individual caisson location and verticality. This is a contractor QC activity but, while not necessarily duplicating this work, QA observation of the entire procedure is required.

AEM Answer

The procedure developed by the contractor's surveyor to ensure accurate positioning of the pile and verticality was reviewed and approved by AEM and the QA. As part of the QA program, field data from the survey activity as well as periodic review of the survey data is performed on a weekly basis. Verification of the piles verticality data provided by Contractor was also part of the QA activity. Prior to the final approval of the wall, a review of the as-built data was done to ensure continuity of the cut-off wall. No discrepancies were noted during the data analysis.

MDRB Comment

The Cement-Bentonite piles will be constructed so as to penetrate 1 m into rock, as determined by the longitudinal profile of the rock surface obtained through survey carried out subsequent to centerline trench excavation. Examination of the cuttings from the bedrock socket would be a valuable addition to the inspections.

AEM Answer

Examination of the cuttings from the bedrock socket is part of the QA/QC program during construction. Pertinent observations are noted in the QA field report and communicated during construction meetings.

MDRB Comment

There is considerable merit in the preparation of a formal Deviation Accountability Report to reconcile any conflicts between the design intent and the information from QA/QC. This will facilitate decision making and the determination of when the dike can be considered fit for purpose to initiate pump down

AEM Answer

All design change and requests for modification are being documented during construction in a log communicated on a weekly basis as part of the weekly report. AEM Meadowbank also asked the designer for written approval by way of technical memorandum before initiating any change to the design during construction. The designer has also provided a technical memorandum on the conditions that need to be met before initiating dewatering. At the end of the dike construction a formal Deviation Accountability Report will be produced using the change log and the technical memorandum produced during construction.

MDRB Comment

One of the field adaptations involved excavation of the substantial thickness of ground ice encountered beneath the active zone. This reduce the potential for embankment settlement and facilitates the execution of the cut-off secant piles. However, the presence of crushed stone instead of frozen till will permit the incursion of 'warm' water into the abutment area as the upstream pool is raised. The potential for thawing the rock beneath the cut-off is thus increased. Extending the nominal 1 m deep secant pile sockets to 2-3 m in the relatively soft rock on this abutment could be considered a solution.

AEM Answer

Following the reception of this recommendation AEM decided to extend the nominal depth of the secant pile from 1 m to a minimum of 2 m in the zone where the ice lens was removed by excavation in the East abutment.

MDRB Comment

Examination of the Schmidt lower hemisphere representation of the rock discontinuities reveals a predominance of joints transversal to the dike centerline and dipping at 70 degree on the West abutment. A similar set is seen at the East abutment. An additional but strong set encountered at the East abutment is sub-parallel to the dike axis but dips at around 50 degree. A review of the rock grouting strategy needs to consider the rock quality and potential seepage pathways.

AEM Answer

The bedrock grouting program was reviewed by the dike designer prior to its implementation to ensure that it considers the rock quality and potential seepage pathways.

MDRB Comment

While seepage may not constitute a risk to the integrity of the Whale Tail Dike, satisfactory performance also implies limited and manageable seepage. A risk analysis of the seepage potential is merited with an evaluation of the safe seepage that can be managed and what mitigation measure can be implemented if necessary.

AEM Answer

AEM is planning to hold a risk analysis session on the operation of the attenuation pond prior to completion of dewatering of the Whale Tail North Basin (dewatering is planned from February 2019 to July 2019). The management of the Whale Tail Dike seepage will be included in this risk analysis.

MDRB Comment

The Board recommends the addition of thermistor cables installed through the embankment fill on the upstream side of the cut-off wall at the East and West abutments and penetrating into the bedrock in order to monitor the evolution of temperatures and to determine whether freeze back or thaw is the dominant trend.

AEM Answer

The instrumentation plan for Whale Tail Dike includes the installation of 2 thermistor on the upstream side of the cut-off wall at the East and 2 thermistors in the West abutment. All these instruments will penetrate into the bedrock to assess foundation temperature.

MDRB Comment

The Board was able to visit the dike and observe operations for the construction of the secant pile cut-off wall. The need for improved housekeeping with respect to management of overflow during tremie backfill of the casing was evident. There are two issues with this namely; environmental protection in the avoidance of water reaching the lake, and safety in the reduction of ice accumulation on the working platform during winter operations.

AEM Answer

This recommendation was transferred to the contractor responsible for the cut-off wall construction to improve the housekeeping in the work area. Additional safety procedures were put in place to ensure the safety of the worker (cleats were added as a mandatory PPE while working in the dike area). As for the environment protection, a water management plan has been put in place since the beginning of the dike construction and is followed in the field to ensure that the overflow tremie water does not reach the lake. Regular sampling of the lake water is conducted by the Environment Department and results are analyzed and communicated to the Engineering team.

Best Regards,

Frédéric L. Bolduc M.Sc.A, P.Eng. & Alexandre Lavallee, P. Eng.
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Agnico Eagle Mines