APPENDIX 6-A

Hydrogeology Baseline Report

June 2016
Report No. 1541520

June 2016

AGNICO EAGLE MINES LIMITED: MEADOWBANK DIVISION

Hydrogeology Baseline Report - Whale Tail Project

Submitted to:
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Environment Superintendent

REPORT

Report Number: Doc 055-1541520

Distribution:

1 copy: Agnico Eagle Mines Limited
1 copy: Golder Associates Ltd.

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1.0 INTRODUCTION

Agnico Eagle Mines Limited – Meadowbank Division (Agnico Eagle) is proposing to develop Whale Tail Pit, a satellite deposit located on the Amaruq property, in continuation of mine operations and milling of the Meadowbank Mine. The Amaruq Exploration property is a 408 square kilometre (km^2) site located on Inuit Owned Land approximately 150 kilometres (km) north of the hamlet of Baker Lake and approximately 50 km northwest of the Meadowbank Mine in the Kivalliq region of Nunavut (Figure 1-1). The property was acquired by Agnico Eagle in April 2013 subject to a mineral exploration agreement with Nunavut Tunngavik Incorporated.

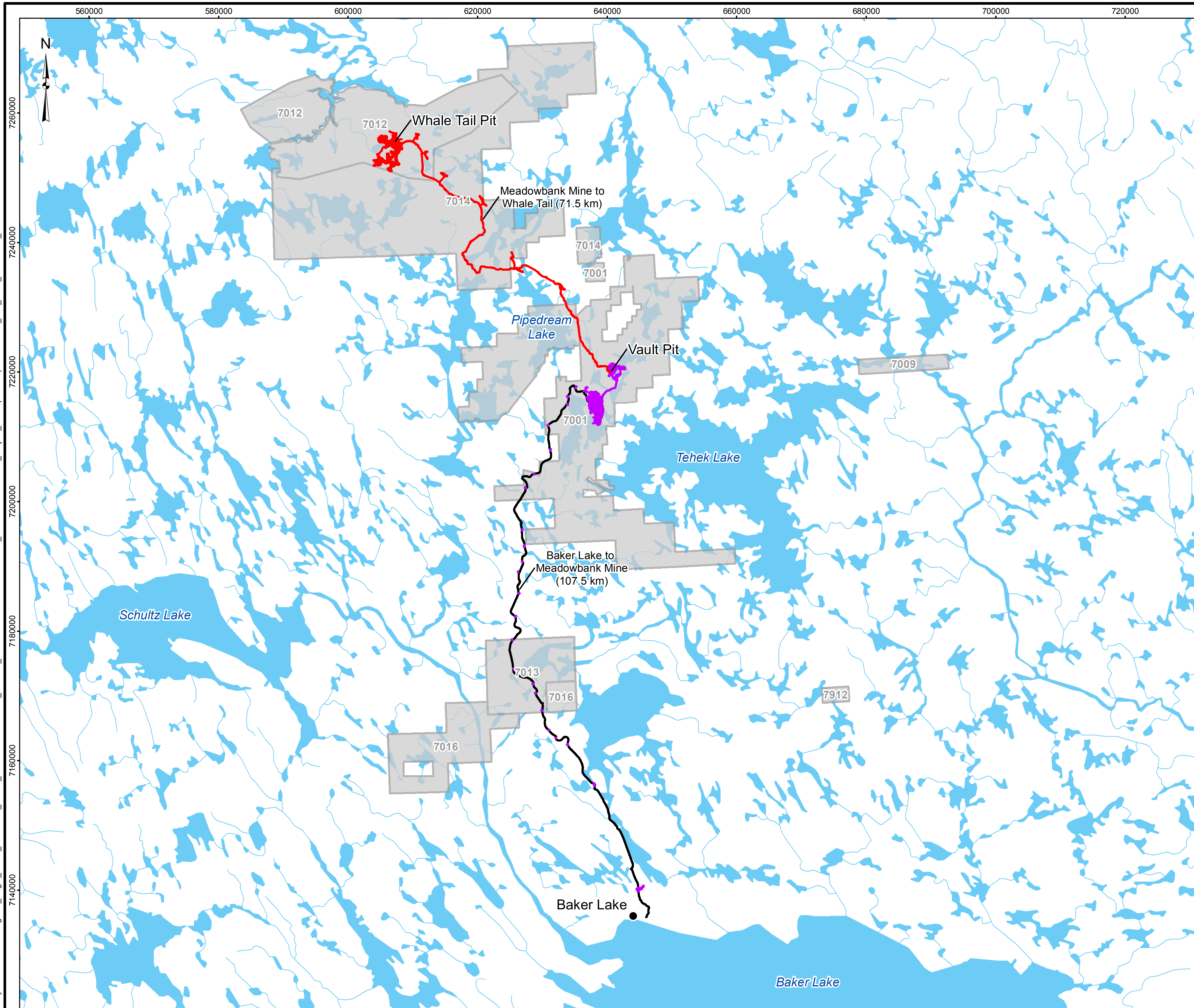
The Meadowbank Mine is an approved mining operation and Agnico Eagle is looking to extend the life of the mine by constructing and operating Whale Tail Pit and Haul Road (the Project), which is located on the Amaruq Exploration property. As an amendment to the existing operations at the Meadowbank Mine, the Project is subject to an environmental review established by Article 12, Part 5 of the *Nunavut Land Claims Agreement* (NLCA). Baseline data have been collected in support of the Environmental Review to document existing conditions and to provide the foundation for a qualitative and quantitative assessment of Project operations and the extension of the mine development, to be evaluated in the Environmental Impact Statement (EIS) for the Project.

This report presents the results of the hydrogeology baseline conditions for the Project. The baseline conditions presented in this report represent an update to the initial characterization conducted by Knight Piésold (2015a, b).

1.1 Hydrogeology Study Area

The hydrogeology baseline study area (Hydrogeology BSA) for the Project forms an irregular polygon approximately 24,000 hectares in area (Figure 1-2). Whale Tail Lake and the site of the proposed Whale Tail Pit are located in the central-eastern area of the Hydrogeology BSA.

The elevations of large lakes within the Hydrogeology BSA range from approximately 99.8 metres above sea level (masl) at DS1, located over 5 km to the north of Whale Tail Lake, to 170.5 masl at A60, located approximately 750 metres (m) southeast of Whale Tail Lake.



Y:\burnaby\CAD-GIS\Client\Agnico_Eagle_Mines_Ltd\Whale_Tail\99_PROJECTS\1541520_FEIS\02_PRODUCTION\FEIS\MXD\1300_Documentation\1340_Project_Description\Report\1541520_FIG_1.1-1_PROJECT_LOCATION.mxd

LEGEND

- ● COMMUNITY
- PROPOSED HAUL ROAD
- ALL WEATHER ROAD
- WHALE TAIL PIT
- MEADOWBANK OPERATION AND INFRASTRUCTURE
- CLAIM BOUNDARY
- WATERCOURSE
- WATERBODY

REFERENCE

1. HAUL ROAD OBTAINED FROM AGNICO EAGLE MINES LIMITED. 2015-10-14 FROM 6103-117-230-200_R0.dwg
2. CLAIM BOUNDARIES OBTAINED FROM AGNICO EAGLE MINES LIMITED.
3. WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
4. INSET MAP DATA OBTAINED FROM ESRI.

DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

12 0 12
KILOMETRES

PROJECT
AGNICO EAGLE

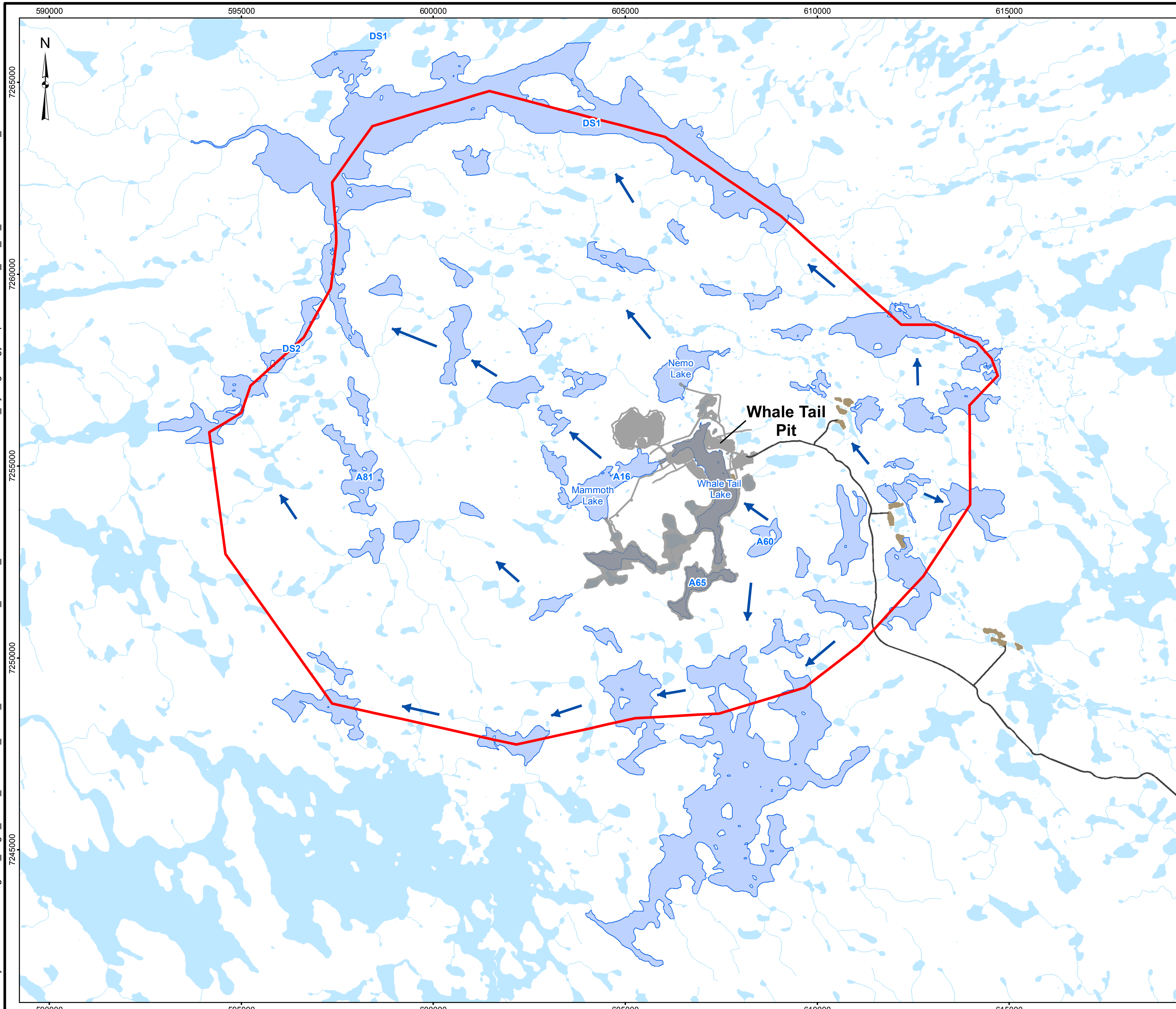
AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

PROJECT LOCATION

Golder Associates

PROJECT		1541520	FILE No.	
DESIGN	JR	24 Mar. 2016	SCALE AS SHOWN	REV. 0
GIS	CDB	24 Mar. 2016		
CHECK	JR	09 May 2016	FIGURE 1.1	
REVIEW	LY	09 May 2016		



LEGEND

- HYDROGEOLOGY BASELINE STUDY AREA
- LAKES WITH TALIK
- WATERBODY (NO TALIK OR OUTSIDE STUDY AREA)
- WATERCOURSE

WHALE TAIL

- BORROW SOURCE
- INFRASTRUCTURE
- PROPOSED HAUL ROAD
- GROUNDWATER FLOW DIRECTION

REFERENCE

1. WHALE TAIL INFRASTRUCTURE OBTAINED FROM AGNICO EAGLE MINES LIMITED ON DECEMBER 21, 2015.
3. WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
4. INSET MAP DATA OBTAINED FROM ESRI

DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

2 0 2

KILOMETRES

PROJECT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

HYDROGEOLOGY BASELINE STUDY AREA

Golder Associates

PROJECT		1541520	FILE No.	
DESIGN	JL	06 Apr. 2016	SCALE AS SHOWN	REV. A
GIS	MH	06 Apr. 2016		
CHECK	JR	06 Jun. 2016	FIGURE 1-2	
REVIEW	JL	08 Jun. 2016		

Y:\burnaby\CAD-GIS\Client\Agnico_Eagle_Mines_Ltd\Whale_Tail\99_PROJECTS\1541520_FEIS\02_PRODUCTION\FEIS\MXD\2100_Hydrogeology\Report\1541520_FIG_01_HYDROGEOLOGY_LSA.mxd

2.0 METHODS

The baseline study presents the hydrogeological conditions before Project initiation. Baseline conditions are also used for future reference in identifying environmental changes and for qualitative and quantitative evaluation of potential changes to groundwater regimes. The methods used to characterize the baseline conditions consisted of the following:

- compilation and review of hydrogeological testing data collected near the Project area;
- review existing baseline studies;
- review available data collected at the Meadowbank Mine because these operations provide relevant site analogues;
- review pertinent studies published in the literature; and
- interpretation of information to develop the conceptual hydrogeological model of the area surrounding the Whale Tail Pit.

2.1 Data Review

2.1.1 Review of Existing Baseline Studies

Knight Piésold (2015a, b) completed an initial assessment of permafrost and hydrogeological conditions in the area of the Whale Tail Pit and developed a conceptual model to provide preliminary predictions of groundwater inflow in the open pit during operations. Data collected by Knight Piésold and used in this updated baseline study included hydraulic conductivity test results, depth to permafrost, and groundwater quality, as documented in Sections 2.1.3, 2.1.4, and 3.1, respectively.

Primary changes that were made to Knight Piésold's conceptual model included the expansion of the conceptual model to the regional study limits and some modification to the hydrostratigraphy. Modifications to the hydrostratigraphy included the incorporation of overburden, from which groundwater storage can significantly affect groundwater inflow/outflow predictions during pit dewatering and pit refilling, and refinement in the estimated hydraulic conductivity of the competent bedrock with depth. Where changes were made to the hydrostratigraphy, these changes were designed to provide conservative estimates with respect to the prediction of groundwater inflow and the prediction of potential project impacts on groundwater during closure.

2.1.2 Lake Elevations and Bathymetry Data

Where available, approximate elevations of lakes near the Project were obtained from the local topographic survey data as documented in the Whale Tail Baseline Hydrology Report (Golder 2016a). Where local survey data were not available, approximate lake elevations were obtained from the National Topographic System (NTS) map sheets published by the Government of Canada.

Lake bathymetric data (measured as lake bottom depth below water surface) for select lakes were provided by Agnico Eagle.

2.1.3 Hydrogeologic Testing

Knight Piésold (2015a, b) completed a site investigation program to characterise the hydrogeological and thermal regime in the vicinity of the proposed open pit. The program consisted of the following installations/tests:

- Three 200 m long multi-point thermistor strings targeting the potential talik below Whale Tail Lake in the immediate vicinity of the open pit. A vibrating wire piezometer was installed at the base of the each thermistor.
- One 450 m long multi-port thermistor string installed in an area approximately 350 m away from the influence of the lake. This instrument was installed to assess the baseline permafrost conditions.
- Two 500 m long multi-port thermistor strings targeting the potential talik below the centre of Whale Tail Lake and the expected base of permafrost.
- An electrical conductivity (EC) data logger installed in conjunction with one of the 200 m thermistor strings in drillhole AMQ15-349A. The EC logger was installed to attempt to measure in-situ Total Dissolved Solids (TDS) and salinity.
- Three wells targeting the potential talik below Whale Tail Lake in the immediate vicinity of the open pit. The wells ranged in length from approximately 180 to 255 m.
- Eighteen constant head hydraulic conductivity packer tests were completed in six drill holes. Testing was completed using an HQ-sized standard wireline packer system.

Results of the 2015 field program are documented in Knight Piésold (2015a, b; included in Attachment A). In addition, a subsequent summary table was provided by Knight Piésold that indicated which of the packer tests potentially intersected faults. This summary table, which provides details on the wells, packer test intervals, and reported hydraulic conductivity, is included in Attachment A.

2.1.4 Groundwater Quality

Knight Piésold (2015b) installed three drill holes to collect representative groundwater samples from the Project. One well was developed following installation, but the heat trace was damaged, the drill hole froze, and sampling could not be conducted. Despite repeated well development from the other two drill holes, inflow rates were low and therefore groundwater samples collected from these locations had high salinity concentrations that are attributed to the brine solution used to install the monitoring wells. The samples collected, therefore, are not representative of the natural groundwater quality, likely due to the low permeability and frozen conditions in areas presumed to be an active talik.

Based on the similar geology and permafrost conditions, Knight Piésold considered the groundwater quality data from the Meadowbank Mine are likely to be similar to the groundwater conditions in the vicinity of the Whale Tail Pit; although, it is recognized that on a parameter-by-parameter basis, groundwater quality at Whale Tail may differ from Meadowbank Mine due to site-specific geology.

Agnico Eagle began a new groundwater sampling program during the winter of 2016. To improve the chance of successfully recovery of representative groundwater samples, a Westbay multi-level well system was installed in April 2016 and is currently being developed. This monitoring device will be used to provide long-term monitoring of groundwater quality over the life of mine and following closure.

3.0 HYDROGEOLOGICAL SETTING

The information presented in this section incorporates information presented in Knight Piésold (2015a, b) and the Terrain, Permafrost, and Soils Baseline Report (Golder 2016b).

3.1 Permafrost

The Project is located in an area of continuous permafrost. In this region, the layer of permanently frozen subsoil and rock is generally deep and overlain by an active layer that thaws during summer. The depth of the active layer is typically expected to range between one and three metres (Golder 2012). Depending on lake size, depth, and thermal storage capacity, the talik beneath lakes may fully penetrate the permafrost layer resulting in an open talik. The thickness of the permanently frozen permafrost was estimated to be 425 m (Knight Piésold 2015b). Knight Piésold further estimated that a layer of perennially cryotic but unfrozen ground at the base of the permafrost that could extend to a depth of 460 m; however, this analysis was partially based on a TDS measurement from a well impacted by brine used during well installation. Considering the uncertainty in the analysis of the basal cryopeg and to be conservative with respect to predictions of groundwater quantity and quality, a permafrost thickness of 425 m was used in hydrogeological assessment of the Project.

In areas of continuous permafrost, there are two groundwater flow regimes: a deep groundwater flow regime beneath permafrost, and a shallow groundwater flow regime located in the active (seasonally thawed) layer near the ground surface. Because of the thick layer of low permeability permafrost, there is little to no hydraulic connection between these two flow regimes in areas where there are no open taliks.

3.2 Shallow Groundwater Regime

The shallow groundwater flow regime is active only seasonally during summer, and the magnitude of the flow in this layer is expected to be several times less than runoff from snowmelt (Woo 2011). Within the active layer, the water table is expected to be generally a subdued replica of topography and roughly parallel to the topographic surface. Hydraulic gradients in the Project area are estimated from topography to range from approximately 0.005 to 0.09 m/m and the annual groundwater velocities are in the order of 0.004 to 0.08 m per day. Groundwater in the active layer primarily flows to local depressions and ponds that drain to larger lakes; therefore, the total travel distance would generally extend only to the nearest pond, lake, or stream.

During winter, land is underlain by seasonal frost, which is in turn underlain by permafrost. From late spring to early autumn, when temperatures are above 0^0C, the seasonal frost in the active layer becomes thawed. Water in the active layer is stored in ground ice during the cold season, and then released when it thaws in late spring or early summer, thus providing flow to surface waterbodies (Woo 2011). During the warm season, groundwater in the active layer is recharged primarily by infiltration of precipitation falling on the land surface.

The thickness of the active layer is variable and depends on several factors. The most important factors are the thaw index, thermal resistance of the vegetative cover, moisture content, and composition of soil or rock. In general the active layer thickness at the end of the summer season is expected to range from 1 to 3 m of the ground surface.

Permafrost reduces the hydraulic conductivity of the bedrock by several orders of magnitude (Burt and Williams 1976; McCaultey et al. 2002). Consequently, the permafrost in the rock would be virtually impermeable to groundwater flow. The shallow groundwater flow regime, therefore, has little to no hydraulic connection with the deep groundwater regime which is overlain by massive and continuous permafrost.

3.3 Deep Groundwater Regime

Water levels in lakes overlying open taliks provides the driving force for groundwater flow in the deep groundwater regime. Taliks (areas of unfrozen ground) exist beneath lakes that have sufficient depth so that they do not freeze to the bottom over the winter. If the lake is sufficiently large and deep, the talik can extend down to the deep groundwater regime. These taliks are referred to as open taliks. If the talik does not extend down to the deep groundwater, it is referred to as a closed or an isolated talik. Recharge to the deep groundwater flow regime is predominantly limited to open taliks.

Generally, deep groundwater will flow from higher-elevation lakes with open taliks to lower-elevation lakes with open taliks. To a lesser degree, groundwater beneath the permafrost is influenced by density differences due to saline water conditions (density-driven flow).

Taliks are to be expected where lake depths are greater than 2 m. Formation of an open-talik, which penetrates through the permafrost, would be expected for lakes that exceed a critical depth and size. The salinity of groundwater also influences the temperature at which the groundwater will freeze.

The permafrost and talik conditions below Whale Tail Lake and near the Whale Tail Open Pit have been characterised by Knight Piésold (2015a, b). Thermistors were installed in six drillholes around the periphery of the proposed open pit and Whale Tail Lake to collect data on the ground thermal regime. Knight Piésold concluded the following:

- Permafrost is expected below the land and the shallowest parts of Whale Tail Lake. The depth of the permafrost is estimated to be approximately 425 m.;
- Based on data for Baker Lake (120 km to the south), and from experience ice auguring within the Meadowbank Project Lakes in the winter, the mean maximum lake ice thickness over Whale Tail Lake is expected to be 2.25 m. During the winter collection of water quality baseline data in Whale Tail Lake in April 2016, ice thickness was confirmed to be 2.0m (Eric Franz of Azimuth pers. comm).
- A talik is expected below the central portions of Whale Tail Lake. In the shallower and narrower parts of Whale Tail Lake, the talik is likely underlain by permafrost (closed talik).
- Talik conditions within the vicinity of the proposed open pit are likely to be between 100 to 200 m in depth and underlain by permafrost.
- The talik is expected to form a continuous channel that is closed in the northern portion of Whale Tail Lake below the open pit and becomes open towards the south and central portion of the lake.

The width and shape of other lakes in the Hydrogeology BSA were reviewed to estimate if open taliks could be present below the lakes. Based on 1-D analytical solutions presented in Burn (2002), Golder estimated that open taliks could be present for circular lakes with a radius of approximately 300 m and for elongated lakes with a half-width of approximately 150 m. Beneath smaller lakes that do not freeze to the bottom over the winter, a talik bulb may form; however the talik bulb is not expected to extend to the deep groundwater flow system (i.e., a closed talik will form). Based on these criteria, all lakes in the Hydrogeology BSA meeting the minimum radius or half width are assumed to be underlain by open taliks that connect these lakes to the deep groundwater flow regime. This assumption is conservative as some lakes within sufficient radius/width may be shallow and, therefore, may not be underlain by taliks. Figure 1-2 presents the assumed locations of lakes with open taliks.

3.4 Groundwater Usage

Groundwater sources from the active layer and from the deep groundwater below the permafrost are not currently used for drinking water or a project-related use in the Project area; nor are they currently used in other continuous permafrost regions in Canada. Due to the presence of deep permafrost, the seasonal nature of the active layer, and the availability of good-quality drinking water from surface water sources near the Project, groundwater will not be used as a drinking water source in the future.

4.0 HYDROSTRATIGRAPHY

The Project is underlain by three main hydrostratigraphic units composed of overburden, weathered rock, and competent rock. In addition to these three units, enhanced permeability zones (EPZs) may potentially be present. Relatively competent bedrock is assumed to comprise the majority of the rock domain, and the hydraulic conductivity of the competent rock is assumed to decrease with depth.

The information presented in this section incorporates information presented in Knight Piésold (2015a, b) and the Terrain, Permafrost, and Soils Baseline Report (Golder 2016b).

4.1 Overburden

The Project area is dominated by veneers and blankets of till overlying undulating bedrock. The till has a silty sand matrix and clasts that range from granule gravel to large boulders in size. Glaciofluvial deposits in the form of eskers and terraces are found in the northeast section of the satellite deposit study area and they continue in a southeast direction intersecting the haul road study area in several locations. The deposits are composed of well sorted fine- to coarse-grained sand and varying amounts of granule, pebble and cobble gravel. These deposits tend to be thick but are often found adjacent to exposures of bedrock. Organic and fluvial deposits are rare, but where they do exist, they are thin (less than 1 m) and overlie till (Golder 2016b).

Overburden thickness in test holes completed by Knight Piésold near the peripheral of Whale Tail Lake ranged from approximately 4 to 13 m, as inferred from the reported depth to bedrock relative to the top of the borehole casing. In the area of the planned dikes, the combined thickness of lakebed sediments and the glacial till ranges from less than 1 m and up to 5 m (Agnico Eagle 2015b). An average thickness of 6 m was estimated based on both sets of data.

Hydraulic conductivity testing of the overburden has not been conducted in the Project area. The hydraulic conductivity of the shallow overburden beneath Whale Tail was estimated to be 2 x 10^{-6} metres per second (m/s) (Cumberland 2005) based on testing in the Meadowbank area. Overall, this assumed hydraulic conductivity is greater than the underlying bedrock and, therefore, is not expected to restrict groundwater flow from the overlying lakes.

4.2 Bedrock

The bedrock geology in the Project region consists of Archean and Proterozoic supercrustal sequences and plutonic rocks. In the study area, the Woodburn Lake Group (Archean supercrustal sequence) was intruded by orogenic granites, which in turn were unconformably overlain by a Proterozoic basin deposit known as the Amer Group (Sherlock et al. 2001; Zaleski 2005).

The Woodburn Lake Group is a sequence of Archean supercrustal rocks which are thought to have been deposited in a continental rift setting (Zaleski 2005). The group is composed of:

- a variety of ultramafic to felsic volcanic and volcaniclastic rocks, iron-formation, and related sedimentary rocks;
- quartz arenite, conglomerate, and related sedimentary rocks; and
- arkosic wacke and mudstone that are interlayered with iron formation (NRCAN 2015).

Although the Woodburn Lake Group is Archean, several phases of deformation have affected the stratigraphy, with four events recognised regionally (Sherlock et al. 2001).

The Amer Group was formed during the Early Proterozoic and is a succession of terrestrial and marine sedimentary rocks which outcrop in the north part of the study area near the satellite deposit. This group is composed of quartzarenite, carbonate rock, carbonaceous shale, siltstone, mudstone and sandstone, and tectonized mafic volcanic rock. It overlies the Neoarchean granite and lesser supercrustal rocks of the Woodburn Lake Group (NRCAN 2015).

4.3 Shallow Bedrock

In the Canadian Shield, the uppermost 10 to 30 m of bedrock is generally more highly fractured and correspondingly has greater hydraulic conductivity than the deeper underlying more competent rock, as has been observed where hydrogeologic testing data have been collected in shallow unfrozen bedrock (De Beers 2010; Golder 2005). This greater level of fracturing in the shallow rock is present as a result of the formation of stress relief joints due to isostatic rebound following glacial retreat. These stress relief joints are preferentially oriented horizontally, likely resulting in greater horizontal than vertical hydraulic conductivity in shallow rock.

The hydraulic conductivity of the shallow bedrock was assumed to be 1×10^{-7} m/s; one order of magnitude higher than the competent bedrock, where testing has been conducted (Section 4.4).

4.4 Competent Bedrock

Results of the packer testing conducted by Knight Piésold (2015a) indicate the hydraulic conductivity of the bedrock ranges from less than 1×10^{-9} m/s (the reported precision of the packer tests) to 5×10^{-8} m/s. Knight Piésold reported that there was uncertainty as to whether all of the tests were completed in talik and indicated that two of the packer tests (completed in AMQ15-349A) were thought to be completely within the talik. These two tests had a reported hydraulic conductivity estimate of 1×10^{-8} m/s and 5×10^{-8} m/s. The latter of these tests, 5×10^{-8} m/s, was also reported to be conducted in a depth interval that may have intersected a fault (NW / EW Brittle Fault; Table 1 of Attachment A). Two other packer tests that potentially intersected faults had reported hydraulic conductivity estimates of 1×10^{-9} m/s.

The geometric mean of all packer tests with measurable hydraulic conductivity values was 4×10^{-9} m/s (i.e., excluding tests with a reported hydraulic conductivity below the precision of the test method [1×10^{-9} m/s]). In general, single-well response tests have been found to underestimate large-scale hydraulic conductivity. This effect is observed as singe single-well response tests are conducted over a small-scale volume of rock near the well screen and are more often representative of the lower-permeability rock composed of poorly connected and small aperature discontinuities. It was therefore considered reasonable to conservatively assume the hydraulic conductivity of the competent bedrock was up to three times higher (approximately 1×10^{-8} m/s). This value is also the maximum of the measured packer test results that were not inferred to intersect faults or potential EPZs.

The shallowest hydraulic conductivity measurement was between 50 and 100 m along hole; whereas, the deepest measurement was between approximately 328 and 425 m along hole. Further reduction in hydraulic conductivity with depth is expected below the tested intervals, however, the hydraulic conductivity of competent bedrock has been assumed to remain constant at greater depths. Based on experience at Meadowbank, potential higher hydraulic conductivities could be present at shallower depths. Between the base the weathered bedrock and 60 mbgs, the hydraulic conductivity of the bedrock was therefore assumed to be up to three times higher (3×10^{-8} m/s).

4.5 Enhanced Permeability Zones with Associated Faults

In crystalline rocks, fault zones may act as groundwater flow conduits, barriers, or a combination of the two in different regions of the fault depending on the direction of groundwater flow and the fault zone architecture (Gleeson and Novakowski 2009). Agnico Eagle has identified evidence of large scale structures at the Project based on the results of geophysical surveys, exploration drilling, surface mapping and topographic interpretation. The dominant structural orientation is east north east (ENE) – west south west (WSW), which is the trend of the deposit lithologies. Knight Piésold (2015a) also identified the presence of a series of diffuse ductile structures that trend northeast (NE) – southwest (SW), which offset both the lithologies and the mineralization near the Project, and a sub-horizontal set of structures.

The faults are typically less than one metre thick (though some may be in the order of ten metres thick) and consist of zones of broken rock and fault gouge. Limited hydraulic conductivity testing has been conducted to assess the continuity and permeability of these structures, and it is unknown if these features would act as EPZs. Although multiple EPZs associated with structural features may be present near the Project, it is expected that the hydrogeologic importance of each individual EPZ will be variable. Of the three tests that may have intersected structures, the hydraulic conductivity ranged between 1×10^{-9} m/s and 5×10^{-8} m/s, which does not indicate enhanced permeability above the surrounding competent bedrock.

For the purpose of assessing the potential groundwater quality and quantity of inflow to the Whale Tail Pit, the potential impact of EPZs will be assessed on groundwater inflow and quality. Two EPZs generally trending in a similar direction to the observed structure will be incorporated in the analysis. The faults will be assumed to be vertical and 10 metres wide with a hydraulic conductivity of 2×10^{-7} m/s. One fault is assumed to strike northwest – southeast and hydraulically connect Whale Tail Lake to the Whale Tail Pit. The second fault was assumed to strike northeast – southwest. The EPZs were assumed to be continuous and hydraulically connected over large distances (kilometres) from the open pit.

4.6 Summary of Hydrostratigraphy and Estimated Hydraulic Properties

The conceptual model for the site consists of three hydrostratigraphic units composed of overburden, weathered rock and competent rock. Areas of enhanced permeability associated with structures such as fault zones may also be present, although present packer test data do not indicate the permeability of the structures intersected to date are higher than the surrounding competent bedrock. In developing the conceptual model, a reasonably conservative approach was taken so that the actual magnitudes of groundwater inflows (quantity and quality) to the open pits during operations are expected to be less.

Overburden and weathered bedrock are limited to the near surface, whereas relatively competent bedrock is assumed to comprise the majority of the rock domain. The hydraulic conductivity of competent rock is assumed to decrease with depth. The assumed hydraulic properties of hydrostratigraphy units near the Whale Tail Pit, and the potential EPZs, are summarized in the Table 4-1. Permafrost is assumed to be essentially impermeable.

Table 4-1: Hydrogeological Parameters

Hydrostratigraphic Unit	Depth Interval (m)	Base Case Hydraulic Conductivity (m/s)[(a)]	Specific Storage (1/m)[(b)]	Specific Yield (-)[(b)]	Effective Porosity (-)[(b)]	Longitudinal Dispersivity (m)[(d)]	Transverse Dispersivity (m)[(d)]	Effective Diffusion Coefficient (m^2/s)
Overburden	0 to 6	2×10^{-6}	1×10^{-4}	0.2	0.2	10	1	2×10^{-10}
Weathered bedrock	6 to 34	1×10^{-7}	2×10^{-4}	0.03	0.03	10	1	2×10^{-10}
Competent bedrock	34 to 60	3×10^{-8}	1×10^{-05}	0.0006	0.001	10	1	2×10^{-10}
Competent bedrock	>60	1×10^{-8}	1×10^{-05}	0.0006	0.001	10	1	2×10^{-10}
EPZ[(c)]	-	5×10^{-7}	1×10^{-4}	0.01	0.01	10	1	2×10^{-10}

a) Derived from hydraulic testing results as presented in Golder (2016). Ratio of vertical to horizontal hydraulic conductivity assumed to 1:1.

b) Parameter values within ranges documented in literature (Maidment 1992; Stober and Bucher 2007).

c) The EPZs are included as their effect, if present, on groundwater inflow quantity and quality will be assessed as part the Environmental Assessment for the Project. Two EPZs are assumed to be potentially present, both are assumed to be vertical and 10 m wide. One EPZ was assumed to strike northwest – south east and hydraulically connect the Whale Tail Pit to Whale Tail Lake. The second EPZ was assumed to strike northeast – southwest. The EPZs were assumed to be continuous and hydraulically connected over large distance (kilometres) from the Project area. Hydraulic conductivity estimated from maximum packer test value of 5×10^{-8} m/s and the width of the packer test within the tested interval.

d) Values are consistent with literature values (Schulze-Makuch 2005).

m = metre; m/s = metres per second; m^2/s = metres squared per second.

5.0 GROUNDWATER QUALITY

5.1 Water Quality Summary

Groundwater quality was evaluated by Knight Piésold; however, the water quality was contaminated by drilling fluids and deemed to not be representative of the formation water. Knight Piésold used the dataset from Meadowbank to infer groundwater quality, until site specific groundwater samples can be collected. The following water quality information is summarized from Knight Piésold (2015b), which is included in Attachment A.

Knight Piésold (2015b) extracted groundwater chemistry data from Appendix A of the Meadowbank Gold Mine – 2014 Groundwater Monitoring Report (Agnico Eagle 2015a). The Meadowbank groundwater data have been collected since 2003 from monitoring wells targeting talik zones in the vicinity of the mine facilities. Summary statistics are provided in Table 2 of Knight Piésold (2015b) for general parameters (pH, conductivity, alkalinity, sulphate, hardness and total dissolved solids [TDS]), dissolved metals, dissolved anions, nutrients, and cyanide. The groundwater data were compared to the Canadian Environmental Quality Guidelines for the Protection of Freshwater Aquatic Life (CEQG; CCME 2015) and the Health Canada Guidelines for Canadian Drinking Water (HC-DW; Health Canada 2014).

Groundwater quality at the Meadowbank Mine is generally described as being hard to very hard, with neutral to slightly basic pH and good buffering capacity. TDS concentrations range from 193 to 1,900 mg/L. Concentrations of fluoride, copper, iron, and selenium were elevated in comparison to guidelines for the protection of aquatic life and drinking water. Only the higher percentile values for nitrogen-containing compounds, aluminum, arsenic, boron, hexavalent chromium, molybdenum, and zinc exceeded the CEQGs.

Additionally, several of these parameters, as well as chloride, manganese and sodium, exceeded aesthetic drinking water guidelines.

5.2 Total Dissolved Solids

In the Canadian Shield, TDS in groundwater increase with depth, primarily in response to upward diffusion of deep-seated brines. The chemicals that contribute to TDS in shield brines are typically chloride and calcium, with sodium to a lesser degree. By comparison, sea water is mostly composed of chloride and sodium.

At the Project, a representative sample of deep groundwater has not been collected; data collected at the Meadowbank Mine was used to infer the TDS profile at the Project. Figure 5-1 presents the TDS profiles with depth from sites in the Canadian Shield and that of the Meadowbank Mine. The Frape and Fritz profile (1987) was developed based on chemical analyses of deep saline water collected by various investigators from several sites in the Canadian Shield. The Diavik Profile is based on site-specific data from Diavik, supplemented by information from the Lupin Mine site located about 200 km north of Diavik (Blowes and Logsdon 1997). The assumed Meadowbank profile presented in Figure 5-1 is based on site-specific data collected from depths up to 177 m and parallels the Diavik profile at deeper depths (Golder 2006).

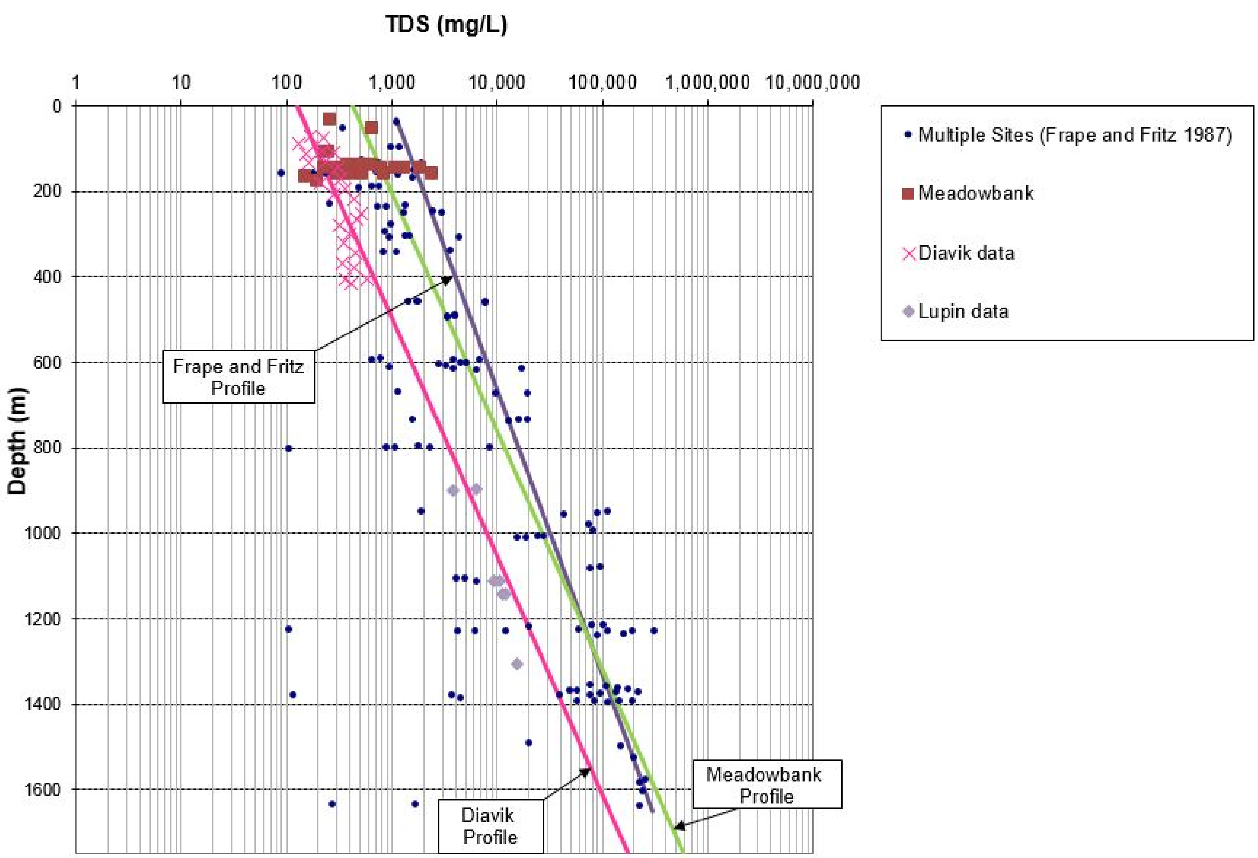


Figure 5-1: Baseline TDS versus Depth

6.0 SUMMARY OF CONCEPTUAL HYDROGEOLOGICAL MODEL

Available hydrogeological data collected at the site, together with the information collected elsewhere in the Canadian Shield, were used to develop a conceptual understanding of groundwater conditions at the Project site. A conceptual hydrogeological model is a pictorial and descriptive representation of the groundwater regime that organizes and simplifies the site conditions so they can be readily modelled. The conceptual model must retain sufficient complexity so that the analytical or numerical models developed from it adequately reproduce or simulate the actual components of the groundwater flow system to the degree necessary to satisfy the objectives of the modelling study. The baseline conceptual model has been developed to describe key features of the hydrogeological regime in the baseline study area before mining. The key features include the groundwater flow, groundwater quality, and dominant groundwater flow direction, all of which are described in more detail below. The baseline conceptual model is presented in Figure 6-1 and described below.

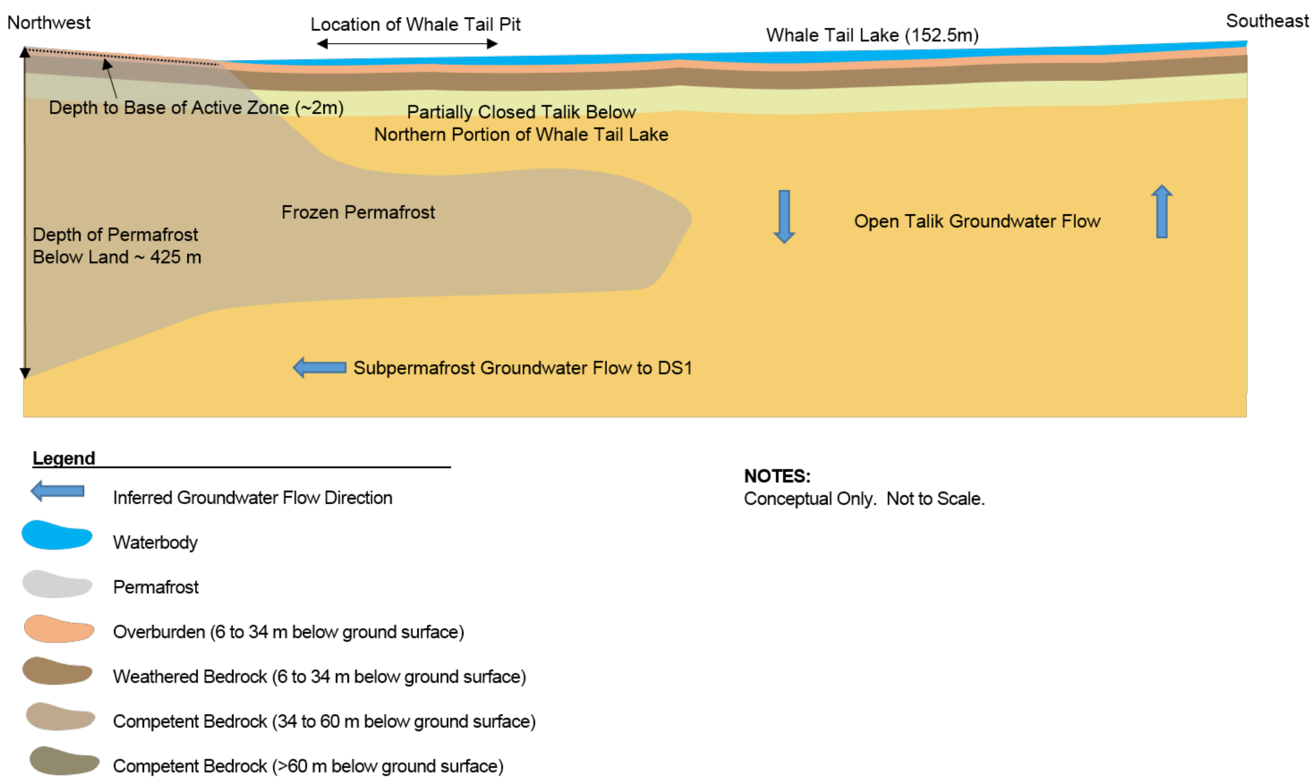


Figure 6-1: Conceptual Model of Deep Groundwater Flow Regime - Pre-mining Cross-Section View

The conceptual model for the site consists of three hydrostratigraphic units composed of overburden, weathered rock and competent rock. Areas of enhanced permeability associated with structures such as fault zones may also be present. Overburden and weathered bedrock are limited to the near surface, while relatively competent bedrock is assumed to comprise the majority of the rock domain.

Two groundwater flow regimes occur at the Project: a deep groundwater flow regime beneath permafrost, and a shallow groundwater flow regime located in the active (seasonally thawed) layer near the ground surface. With the exception of areas of taliks beneath lakes, the two groundwater regimes are isolated from one another by thick permafrost. The depth of the active layer is estimated to range between 1 to 3 m. Permafrost thickness in the baseline study area is expected to be approximately 425 m. Below Whale Tail Lake, the talik is expected to form a continuous channel that is closed at the base of the talik in the northern portion of Whale Tail Lake below the open pit and becomes an open talik towards the south and central portion of the lake.

Groundwater flow within the deep groundwater flow regime is limited to the sub-permafrost zone. This deep groundwater flow regime is connected to the ground surface by open taliks underlying larger lakes. The elevations of these lakes are expected to be the primary control of groundwater flow directions in the deep groundwater flow regime, with density gradients providing a secondary control. The elevations of these lakes in the baseline study area indicate that Whale Tail Lake is likely both a groundwater recharge and discharge zone.

Groundwater quality at the Project has been inferred to be similar to the Meadowbank Mine based on the similar geology and permafrost conditions (Knight Piésold 2015b); however, it is recognized that on a parameter-by-parameter basis, groundwater quality at the Project may differ from the Meadowbank Mine due to site-specific geology. Consistent with other sites in the Canadian Shield, concentrations of TDS in groundwater are inferred to increase with depth, primarily in response to upward diffusion of deep-seated brines. The Meadowbank TDS profile is considered applicable to the Project and is based on the site-specific data from the Meadowbank Mine up to depths of 177 m, and parallels the Diavik profile at greater depths (Golder 2006). Agnico Eagle began a new groundwater sampling program during the winter of 2016. A Westbay multi-level well system was installed in April 2016 and is currently under development. The water samples taken for this instrument will allow the development of a site specific TDS profile and confirmation of inferred groundwater quality for the Project.

Report Signature Page

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.https://capws.golder.com/sites/p1524321amaruqwhaletailbaselineandeis/eis/documentation/vol_6_freshwater/appendices/appendix 6-a baseline hydrogeology.docx

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ATTACHMENT A

Knight Piésold Reports and Packer Test Summary Table

Knight Piésold CONSULTING

TABLE 1

AGNICO EAGLE MINES LTD. MEADOWBANK DIVISION
WHALE TAIL PIT

2015 GEOMECHANICAL AND HYDROGEOLOGICAL SITE INVESTIGATION SUMMARY
DRILLHOLE PACKER TESTING SUMMARY

Print Jan/29/16 17:07:42

Drillhole Name	Surveyed Drillhole Details						Hydraulic Testing				
	Collar Coordinates [1]			Azimuth [2] (Average)	Dip [2] (Average)	Final Length	Along-Hole Packer Testing Interval		Constant Head Test Results [3]	Test Interval Lithology	Fault Intersection
	Easting	Northing	Elevation								
	(m)	(m)	(m)	(˚)	(˚)	(m)	From (m)	To (m)	(m/s)		
AMQ15-294	607,073.2	7,255,676.1	10,155.9	321	-46	221	100.3	150.0	1×10^{-9}	Altered Ultramafics, Ultramafics, Quartz Veins	Yes (RQD Corridor)
							201.8	220.5	9×10^{-9}	Ultramafics, Graphitic Chert and Chert	No
AMQ15-306	606,714.8	7,255,363.8	10,154.9	98	-47	201	52.3	100.5	$< 1 \times 10^{-9}$	Greywacke	Yes
							103.3	162.0	$< 1 \times 10^{-9}$	Greywacke	No
							178.3	201.0	$< 1 \times 10^{-9}$	Greywacke	Yes
AMQ15-316	606,655.1	7,255,428.2	10,154.1	5	-55	189	181.3	189.0	$< 1 \times 10^{-9}$	Ultramafics	No
AMQ15-326A	606,430.9	7,255,330.8	10,154.6	288	-57	180	160.3	180.0	No Take	Ultramafics	No
AMQ15-349A	607,064.9	7,255,627.5	10,155.3	202	-47	203	97.3	141.0	5×10^{-8}	Ultramafics and Greywacke	Yes (NW/East Brittle Fault)
							136.3	180.0	1×10^{-8}	Mafic Volcanics, Greywacke and Ultramafics	Yes
							178.3	202.5	$< 1 \times 10^{-9}$	Mafic Volcanics	Yes
AMQ15-421	607,098.3	7,255,490.8	10,155.1	283	-49	501	94.3	150.0	1×10^{-9}	Diorite and Greywacke	Yes (NW/ East Brittle Fault)
							148.3	201.0	$< 1 \times 10^{-9}$	Greywacke and Ultramafics	Yes
							199.3	225.0	$< 1 \times 10^{-9}$	Greywacke	Yes
							298.3	330.0	1×10^{-9}	Ultramafics	No
							328.3	455.6	$< 1 \times 10^{-9}$	Ultramafics and Quartz Veins	Yes
							469.3	501.0	$< 1 \times 10^{-9}$	Greywacke and Ultramafics	No
AMQ15-452	606,627.2	7,255,687.9	10,156.2	165	-49	501	127.3	177.0	$< 1 \times 10^{-9}$	Greywacke	Yes
							469.3	501.0	$< 1 \times 10^{-9}$	Graphitic Chert, Ultramafics, and Greywake	No

\\NB4\project$\1\01\00622\04\A\Data\Packer Testing Across Faults\[AEM - Amaruq - Packer Testing Summary.xlsx]Table 1 Packer Testing Summary

NOTES:
1. COLLAR COORDINATES SURVEYED AND PROVIDED BY AEM. COORDINATES ARE IN UTM ZONE 14N; ELEVATIONS ARE TRANSLATED TO THE MINE GRID.
2. REPORTED AZIMUTH AND DIPS ARE BASED ON AN AVERAGE FOR THE DRILLHOLE.
3. 1E-09 m/s IS LOWER LIMIT OF SWiPS PACKER TESTING PRECISION.

A	29JAN'16	ISSUED FOR INFORMATION	ATJ	BDP
REV	DATE	DESCRIPTION	PREP'D	RVW'D

November 24, 2015

File No.:NB101-00622/04-A.01
Cont. No.:VA15-03393

FS 64925
EMS 550121
OHS 550122

Mr. Serge Ouellet
Senior Project Engineer
Agnico Eagle Mines Ltd. Meadowbank Division
10 - 200 Route de Preissac
Rouyn-Noranda, Québec
Canada, J0Y 1C0

Dear Serge,

Re: Agnico Eagle Mines Ltd.: Meadowbank Division – Whale Tail Pit – Permafrost and Hydrogeological Characterization

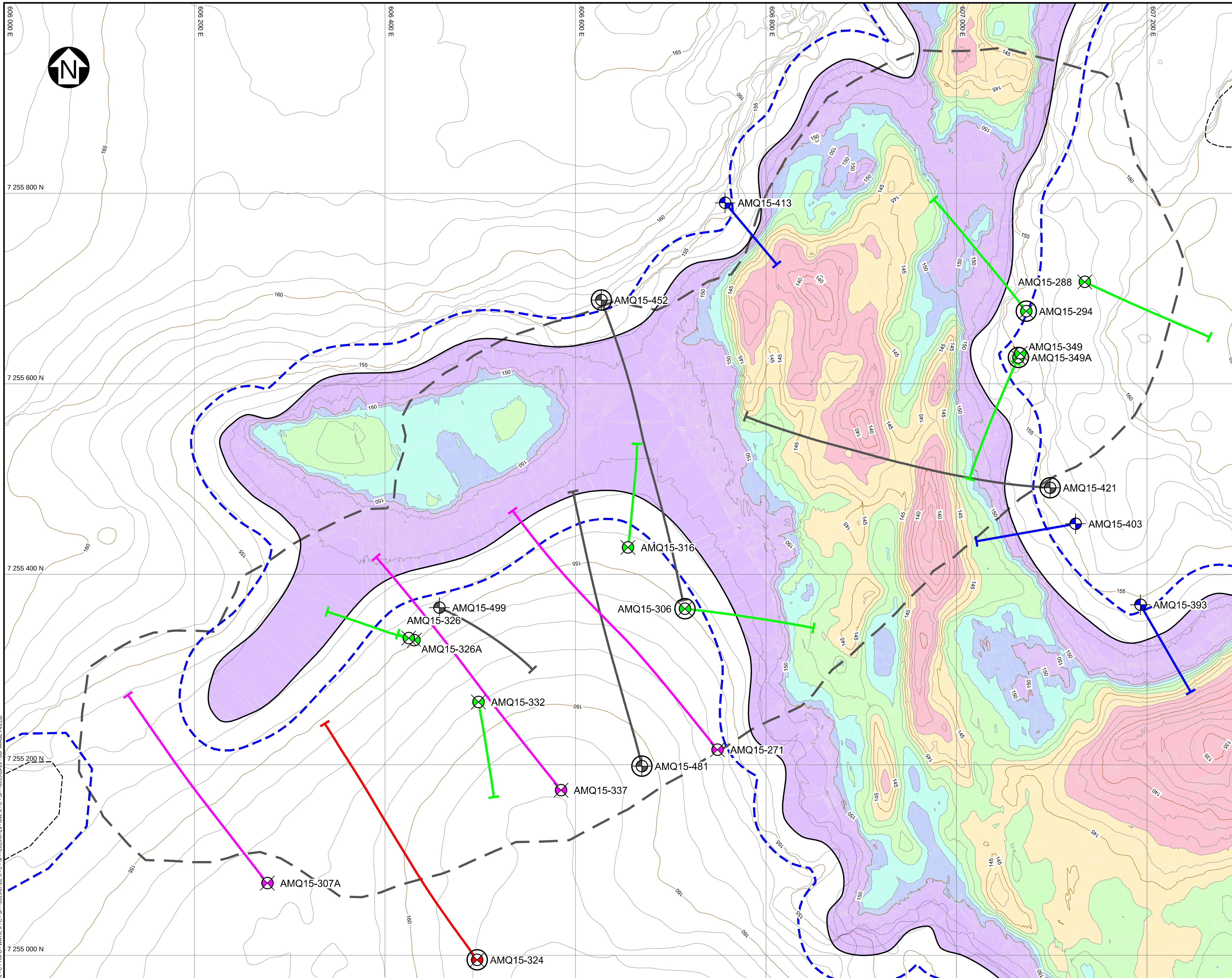
1 – INTRODUCTION

Agnico Eagle Mines Ltd. Meadowbank Division (AEM) is developing the Whale Tail Pit (the Project) in Nunavut, Canada. The Project is located 50 km northwest of AEM's Meadowbank Mine and 160 km northwest of Baker Lake. AEM is currently evaluating the potential for mining the satellite Whale Tail deposit using open pit mining methods.

Knight Piésold Ltd. (KP) was retained to conduct a geomechanical and hydrogeological site investigation to support permitting and engineering for the open pit mine design. The deposit lies within the northern section of Whale Tail Lake, as shown on Figure 1. A key objective of this work was to characterize the permafrost and talik conditions below the lake by:

- Planning and conducting a site investigation program to characterize the hydrogeological and permafrost conditions in the vicinity of the proposed open pit.
- Reviewing the collected data and using it to develop a conceptual permafrost / talik model.
- Using analytical and numerical methods to confirm the conceptual model and predict the potential for talik to develop both spatially and with depth below Whale Tail Lake.
- Installing, developing, and sampling groundwater monitoring wells that were targeted to intercept the talik, if present, in the vicinity of the open pit.

The results of the permafrost and hydrogeological assessment as well as the supporting data and analyses are summarized in this letter. It is important to note that the permafrost and talik characterization was conducted using a preliminary dataset (<4 months of monitoring) and that the interpretation will be refined as additional data becomes available. The results of the groundwater quality characterization of the talik are also summarized in this letter and supplemented with available data from the AEM Meadowbank Gold Mine.



LEGEND:

- SHALLOW / DEEP — BATHYMETRY
- GEMECHANICAL DRILLHOLE FOR OPEN PIT
- PROPOSED GEOMECHANICAL DRILLHOLE FOR UNDERGROUND
- EXPLORATION DRILLHOLE
- GROUNDWATER WELL
- EXPLORATION DRILLHOLE WITH GEOMECHANICAL LOGGING
- INSTRUMENTATION INSTALLED IN DRILLHOLE
- 30 m BUFFER FROM WHALE LAKE
- ULTIMATE PIT BOUNDARY

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 14N.
2. PIT DESIGN, TOPOGRAPHY AND BATHYMETRY PROVIDED BY AEM (SEPTEMBER, 2015).
3. CONTOUR INTERVAL IS 1 METRE.
4. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

SCALE A 40 20 0 40 80 120 160 200 m

AGNICO EAGLE MINES LTD. MEADOWBANK DIVISION

WHALE TAIL PIT

PERMAFROST AND TALIK CHARACTERIZATION STUDY

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB101-622/4	VA15-03393

FIGURE 1 REV 0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	20NOV'15	ISSUED WITH LETTER	BDP	SIR	BDP

SAVED: I:\1\01\00622\04\A\cad\FIGS\B06_r0, 11/20/2015 3:36:46 PM, ASIMPSON PRINTED: 11/20/2015 3:37:13 PM, FIG_2, ASIMPSON

2 – PROJECT SETTING

2.1 CLIMATE

The Project is located in the Canadian Sub-Arctic and cold winter conditions predominate for the majority of the year. There is an on-site meteorological station at the Meadowbank mine located approximately 50 km to the south. Three years of hourly and daily data (2013 to 2015) are available to characterize the meteorological conditions at the Project site, including temperature, pressure, relative humidity, wind speed and direction, and precipitation. The annual daily average temperature is -11.4°C. The annual average daily maximum and minimum temperatures are 2.7°C and -22.4°C, respectively.

2.2 TOPOGRAPHY AND LAKE CHARACTERISTICS

The topography surrounding the Project is generally flat with local surface relief of up to 20 m. The low terrain of the area has resulted in a diffuse drainage pattern. High flows are observed during spring runoff, while low flows and dry stream channels are typical in late summer. Whale Tail Lake drains to the south via a network of low lying lakes.

The following characteristics of Whale Tail Lake are based on a bathymetry survey completed in 2015 (provided by Groupe Conseil Nutshimit-Nippour, 2015). The bathymetry is shown on Figure 1.

- The lake elevation was measured at 152.4 meters above sea level (masl) in August 2015.
- The depth of the lake in the northwest end of the lake, in the vicinity of the open pit, ranges from 1 to 16 m.
- The lake bottom is terraced. The terraces extend out from the shoreline for a distance of between 1 m and 150 m. Beyond the terrace is an abrupt drop-off.

Mean annual temperatures from the bottom of the lakes in Nunavut and North West Territories (that do not freeze in winter) are 4°C (Burn, 2002).

Regional lake ice characteristics were reviewed using the Canadian Ice Database (Lenormand et al., 2002). The closest reference to Whale Tail Lake is Baker Lake (120 km to the south), which records a mean maximum lake ice thickness of 2.25 m (data from 1957 to 1990). It is expected that the mean ice thickness over Whale Tail Lake is within this range.

2.3 REGIONAL PERMAFROST CONDITIONS

The land surface near the project is underlain by continuous permafrost, with the exception of waterbodies in the area that are too deep to freeze to the bottom in the winter. Taliks (see glossary included as Appendix A) are expected beneath a waterbody where the water depth is greater than the ice thickness. Formation of open taliks that penetrate through the permafrost may be expected for relatively deeper and larger lakes in the Project area.

Site characteristics of specific interest to the current study include:

- The permafrost is expected to be at least 300 m deep and may be over 400 m deep in locations that are not affected by waterbodies (Golder, 2012). The base of the permafrost is expected to be irregular and spatially variable.
- Open or closed taliks are expected below large and deep lakes.
- The permafrost is overlain by an active layer that thaws during summer. The depth of the active layer is typically expected to range between 1 m and 3 m (Golder, 2012).

The conceptual cross section presented on Figure 2 demonstrates the interaction of surface water bodies and groundwater systems in a continuous permafrost environment.

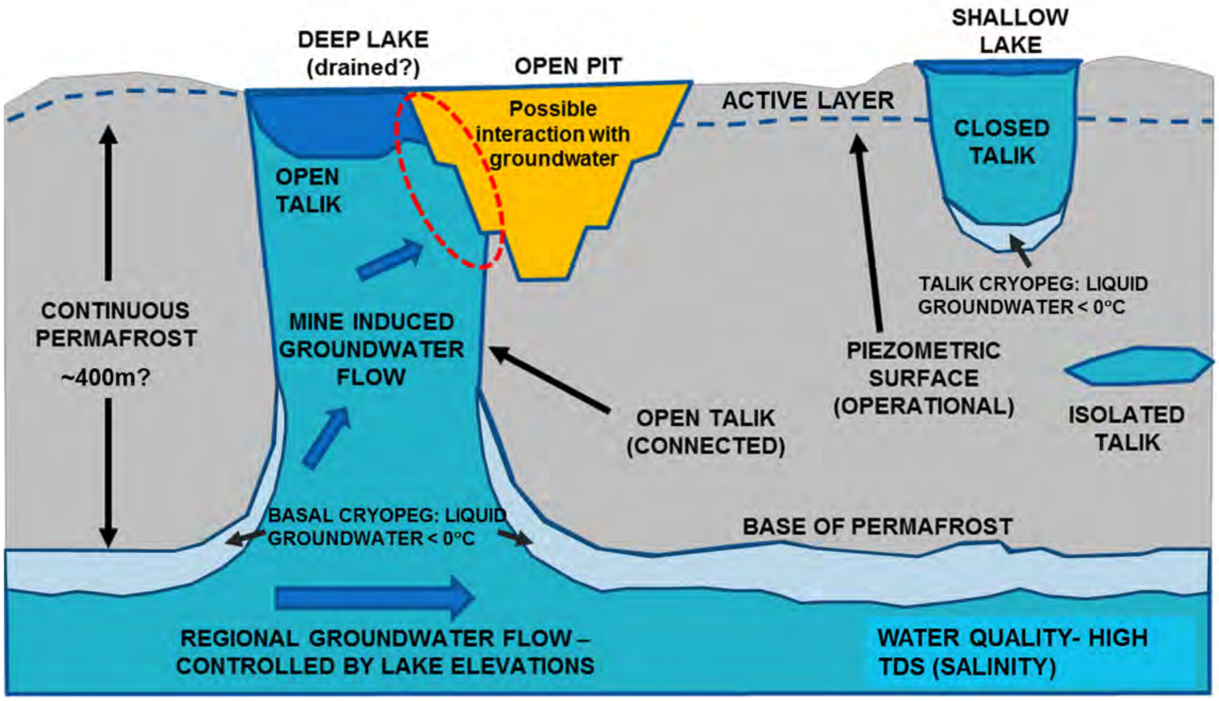


Figure 2 **Conceptual Cross Section Presenting the Components of a Permafrost Region**

3 – SITE INVESTIGATION PROGRAM

A geomechanical and hydrogeological site investigation program was completed by KP at the Project site between June and October, 2015. As part of the program, instrumentation was installed in six drillholes around the periphery of the proposed open pit and Whale Tail Lake in order to collect data on the ground thermal regime. Groundwater monitoring wells were also installed in three drillholes. The installed instrumentation is summarized in Table 1 and Figure 1 and includes:

- Three 200 m long multi-point thermistor strings targeting the potential talik below Whale Tail Lake in the immediate vicinity of the open pit. A vibrating wire piezometer (VWP) was installed at the base of each thermistor string to record changes in water pressure and to help assess the cryopeg-permafrost boundary.
- One 450 m long multi-point thermistor string installed in an area approximately 350 m away from the influence of the lake. This instrument was installed to assess the baseline permafrost conditions.
- Two 500 m long multi-point thermistor strings targeting the potential talik below the centre of Whale Tail Lake and the expected base of permafrost. These thermistors were installed later in the program, once the initial results of the other instruments had been reviewed.
- An electrical conductivity (EC) data logger installed in conjunction with one of the 200 m thermistor strings in drillhole AMQ15-349A. The EC logger was installed to allow the in-situ Total Dissolved Solids (TDS) and salinity to be estimated.
- Three groundwater quality monitoring wells were installed, targeting the potential talik below Whale Tail Lake in the immediate vicinity of the open pit. The wells ranged in length from approximately 180 m to 255 m.

Bathymetry data were used to identify the wider and deeper sections of Whale Tail Lake where talik development is expected to be greatest.

The instrumentation was installed by attaching the thermistor string, vibrating wire piezometer cable and/or EC logger cable to a 1-inch schedule 80 PVC guide-pipe that was lowered into the drillhole. This ensured that the instruments reached their intended depths. The drillhole, initially filled with brine to prevent freezing, was then flushed with freshwater through the PVC pipe to encourage freezing of the water around the thermistor string. A data logger was then installed at each drillhole so that regular measurements could be taken. Initially, the data was used to confirm that the instruments were working properly and that the readings stabilized to reasonable in-situ temperatures.

The groundwater monitoring wells installed in AMQ15-393 and AMQ15-403 were constructed with external heat trace clamped to 1.5-inch schedule 80 stainless steel riser pipe. The monitoring well installed in AMQ15-413 was constructed with continuous HDPE pipe with an integrated self-regulating heating cable. Two 3 m lengths of standard 1.5-inch schedule 40 PVC slotted screen were used to construct the screened interval. Two 1.5 m lengths of schedule 80 PVC bentonite pre-packs (3 m total length) were attached above the screened interval in order to isolate it from the remainder of the drillhole. The drillholes were drilled with hot water, but were flushed with a brine solution (50% $CaCl_2$) prior to installation in order to ensure that they remained unfrozen during the installation process. A known concentration of uranine (a fluorescent dye tracer) was added to the brine solution in AMQ15-393 and AMQ15-413 (it was unavailable for the installation of AMQ15-403). The dye was added to the brine solution to monitor the progress of well development (removal of residual water from drilling and installation). The monitoring wells were developed using an airlift methods and the objective was to purge as much water as possible from the well in order to reduce the effects of the brine used for installation on the future groundwater samples. Samples were collected using a double valve pump installed at the top of the screened interval and low-flow sampling techniques. The monitoring well installation depths required that the pump control system be manually over-ridden.

Table 1 Summary of Instrumentation Installations

Drillhole ID	Drillhole Details					Target	Instrumentation Type
	Northing (m)	Easting (m)	Length (m)	Azimuth (°)	Dip (°)		
AMQ15-294	607,073	7,255,676	323	221	-45	Lake Talik	Thermistor & VWP
AMQ15-349A	607,065	7,255,628	203	204	-45	Lake Talik	Thermistor, VWP & EC
AMQ15-306	606,715	7,255,364	201	96	-45	Lake Talik	Thermistor & VWP
AMQ15-324	606,497	7,254,995	501	300	-45	Permafrost base	Thermistor & VWP
AMQ15-421	607,098	7,255,491	501	274	-51	Deep talik. Permafrost base	Thermistor & VWP
AMQ15-452	606,627	7,255,688	501	106	-50	Deep talik. Permafrost base	Thermistor & VWP
AMQ15-393	607,193	7,255,368	261	147	-65.3	Lake Talik	Monitoring Well
AMQ15-403	607,120	7,255,461	261	260	-65.3	Lake Talik	Monitoring Well
AMQ15-413	606,757	7,255,790	210	139	-65.4	Lake Talik	Monitoring Well

NOTES:
1. ALL UTM COORDINATES ON MINE GRID.
2. ALL DEPTHS ARE PRESENTED AS DOWNHOLE.
3. METERS DOWN HOLE IS REPRESENTED AS "mdh".
4. DRILLHOLE ID REFERENCES ON FIGURE 1: AMQ15-393 is PDH15-03; AMQ15-403 is PDH15-02; AMQ15-393 is PDH15-01.

The full details of the instrumentation and groundwater well installations are included in Appendix B.

4 – INSTRUMENTATION DATA

The most recent temperature data from the thermistor installations (collected on September 30, 2015) is plotted on Figure 3.

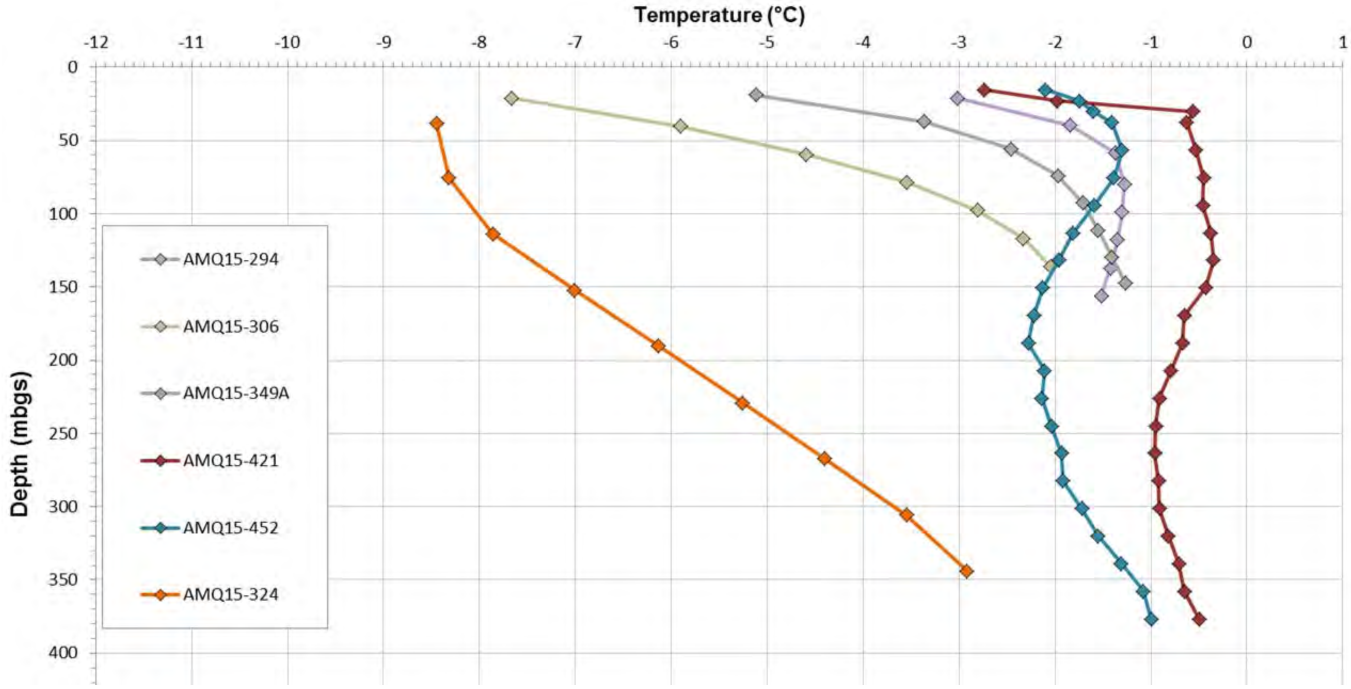


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Figure 3 September 30, 2015 Thermistor Data

The data generally show cold near-surface conditions, followed by a warming geothermal gradient with increasing depth. It should be noted that the drillholes are drilled at an incline towards a water body, complicating the interpretation of the data.

Drillhole AMQ15-324 is located away from the influence of the lake. The geothermal gradient from the thermistor in drillhole AMQ15-324 was used to estimate the depth to permafrost. The temperature profiles from the other thermistors were used to characterize the conditions beneath different sections of the lake and to help calibrate the analytical and numerical models.

The data from the EC logger installed in drillhole AMQ15-349A are shown on Figure 4. High salinity was initially measured as the logger was lowered into the brine in the drillhole. This is followed by an abrupt reduction in salinity as the drillhole was flushed with fresh water. Over time, the temperature gradually falls and the salinity increases. The increasing salinity may be due to the influx of saline groundwater from the talik. However, given the low temperatures, it may also be evidence of a gradual phase change from water to ice, with the salinity concentration increasing as less water is available as liquid. The highest conductivity recorded by the EC logger prior to freezing was 7.96 mS/cm. This can be converted a freezing point of approx. -0.35°C at the instrument depth of 150 mbgs.

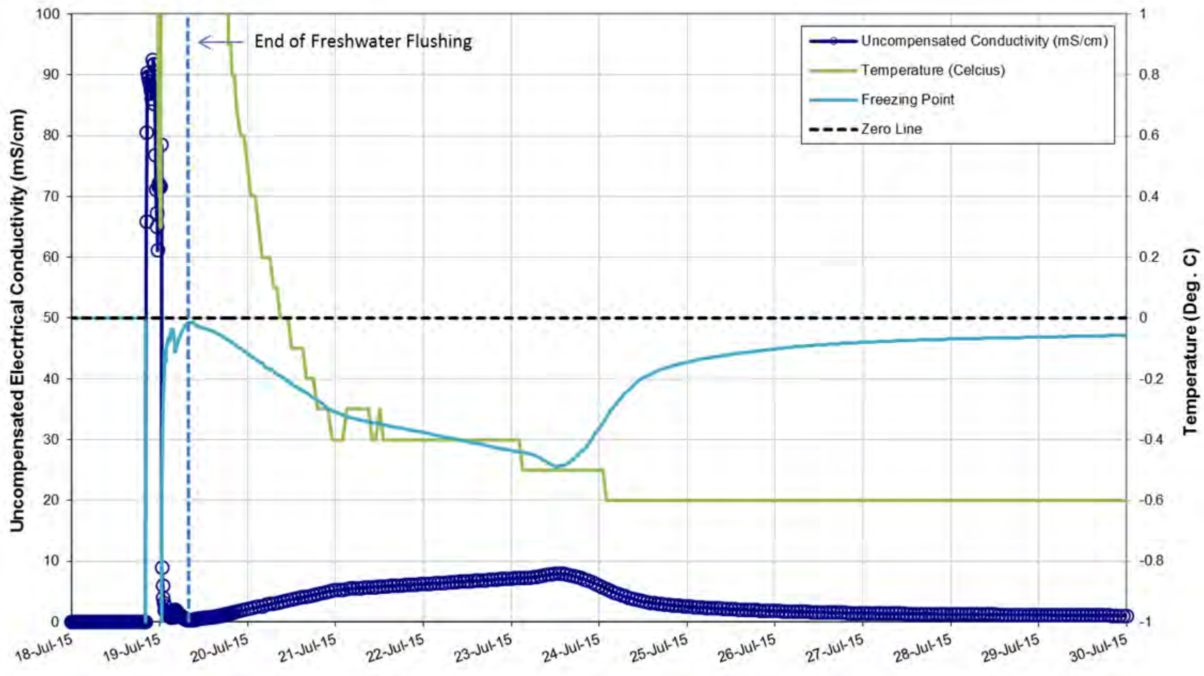

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Figure 4 EC Logger Data (Drillhole AMQ15-349A)

5 – GEOTHERMAL PROPERTIES

The following geothermal properties were estimated from the instrumentation data or regional studies:

- A baseline regional geothermal gradient of 0.0214°C/m was estimated using the thermistor data from AMQ15-324. The gradient is shown on Figure 5.
- The Mean Annual Surface Temperature (MAST) of -10.5 °C was estimated using the geothermal gradient from AMQ15-324 and extrapolating the temperature data to surface. This was compared to the MAST of -11.4°C recorded by the climate station at the Meadowbank Mine. As the thermistor data is still considered to be stabilizing and has not yet recorded data from the winter period, the lower MAST from Meadowbank was used for this assessment.
- A freezing point depression curve was developed to estimate permafrost depth for the Project using data from the EC logger installed in drillhole AMQ15-349A and TDS and temperature vs depth relationship curves developed for other studies completed in the region. The developed relationship defines a freezing point of -0.35 °C at 150 m and a freezing point of -1.0 °C at 500 m. A detailed discussion of the approach used to estimate the freezing point depression curve is presented in Appendix C.

The regional geothermal gradient and the estimated freezing point depression line for the site are shown on Figure 5. The intersection point of these two curves suggests that the base of the permafrost is approximately 425 mbgs outside of the influence of waterbodies. The intersection of the geothermal gradient with the 0°C isotherm suggests that the basal cryopeg is at a depth of approximately 460 mbgs.

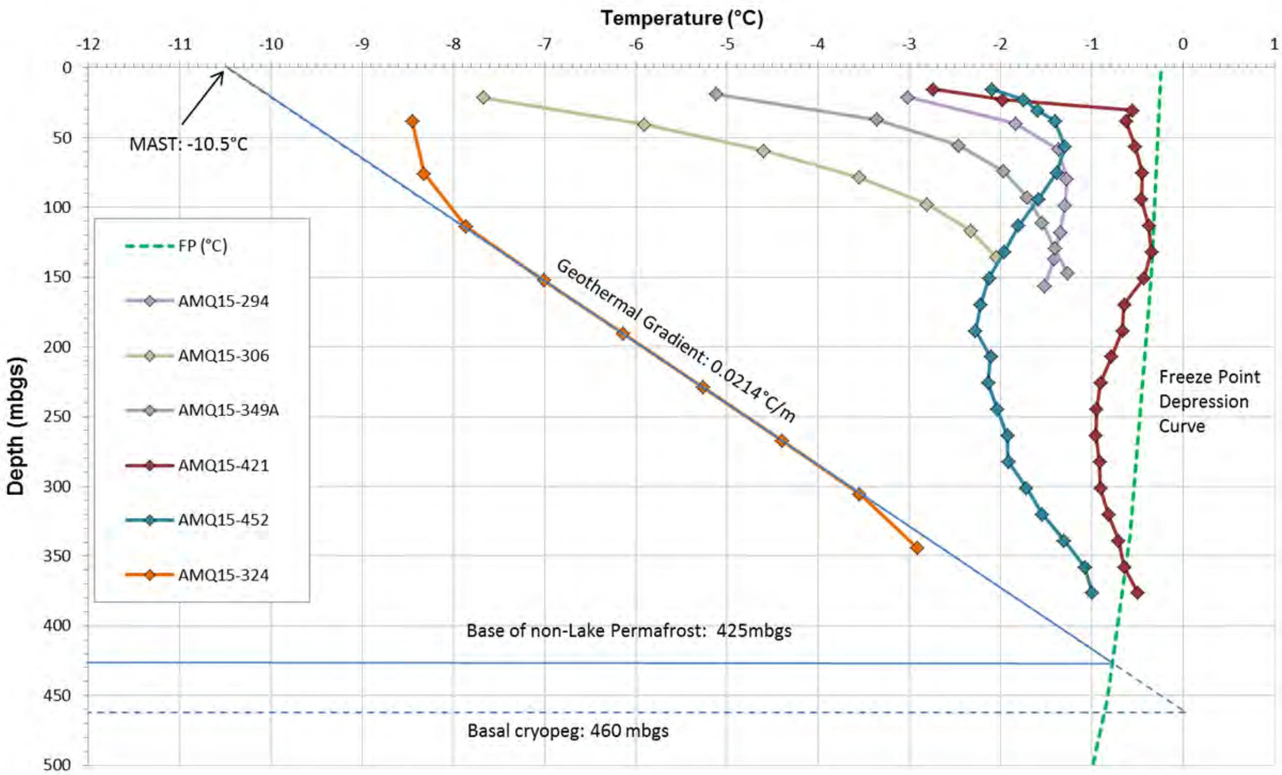

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Figure 5 Geothermal Properties Derived from AMQ15-324

6 – ANALYSIS OF LAKE TALIK FORMATION

6.1 ANALYSIS APPROACH

The initial approach used to assess the potential for talik development under Whale Tail Lake was an empirical analysis carried out to support the early planning for the geomechanical and hydrogeological site investigation program. The approach assumed that lakes with a half width of 100 m or more and with depths of greater than 1 m had the potential to form a talik. This approach was not able to discern whether the talik would be open or closed.

This initial assessment was refined once the data from the installed instrumentation became available. Two different types of analyses were completed: analytical solutions and numerical models. Each method is briefly described below and described in detail in Appendix D.

- **Analytical Solution:** Burn (2002) developed a series of 1D analytical solutions to describe talik development under surface water bodies. The solutions were developed to match the lake shape (circular or elongate), and to acknowledge the presence of a shallow terrace around the lake perimeter.
- **Numerical Models:** 2D numerical modeling was carried out using the finite element code Temp/W (Geo-Slope, 2014). This model was used to further assess the potential for an open talik beneath sections across and along Whale Tail Lake. The modelling estimates represent a first-order assessment of ground temperatures under equilibrium conditions and assume no transient (time-dependent) conditions, such as the timing of lake formation and temporal changes in water and ground temperature.

Three cross sections across Whale Tail Lake, shown on Figure 6, were analyzed using both methods. The results are summarized below and described in detail in Appendix D.

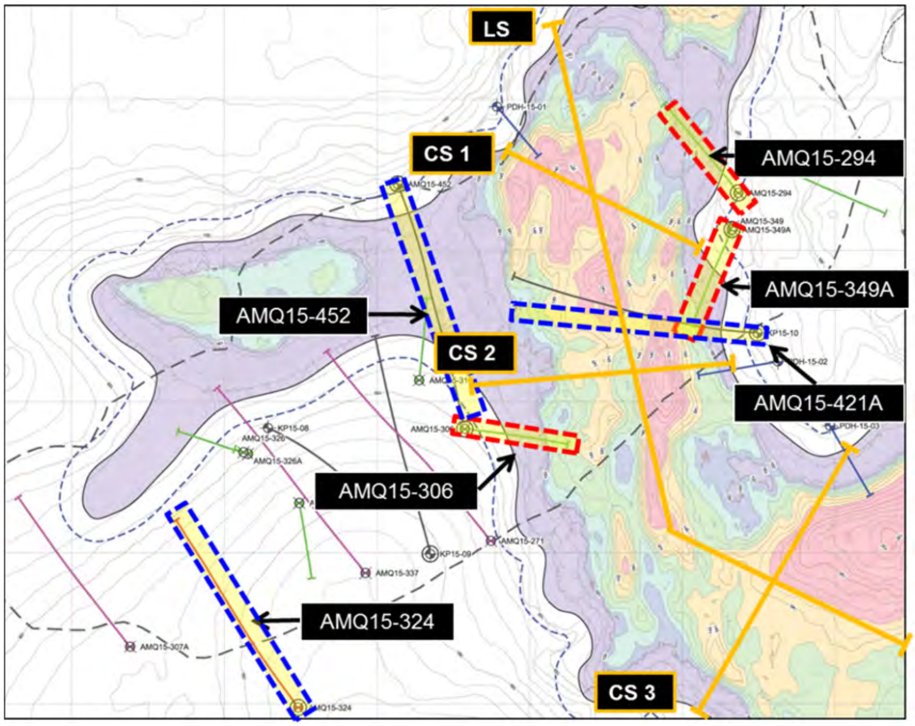

Figure 6 Location of Cross Sections for Analytical and Numerical Models

6.2 ANALYSIS RESULTS

6.2.1 Cross Section 1

Cross section 1 (CS1) lies across the northern section of Whale Tail Lake and cuts through the central-northern section of the proposed final open pit. The section is across a relatively narrow portion of the lake with a wide variation in depth.

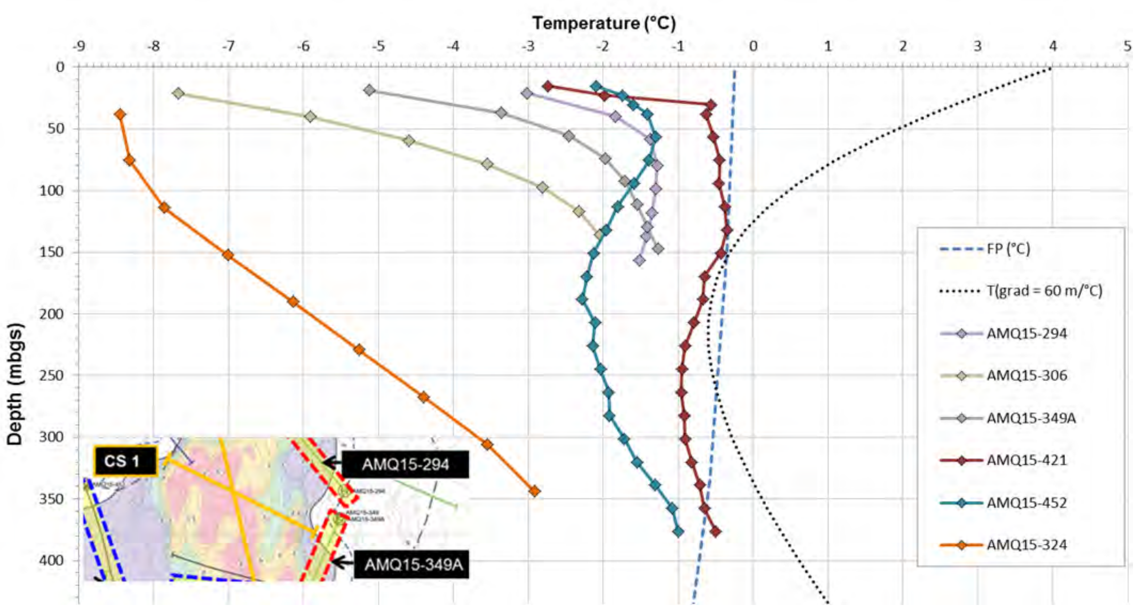

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Figure 7 Results of Analytical and Numerical Solutions for CS1

The analytical solution for this section (Figure 7) suggests that talik is present, but that it is likely underlain by permafrost between 150 and 250 mbgs (i.e., where the analytical solution is to the left of the freezing point depression curve). This is supported by the results of the 2D numerical model, which suggests permafrost will be present between 100 and 280 mbgs (see Appendix C for details). The talik along this section is thought to represent a shallow channel underlain by permafrost rather than a depression. Both to the north and to the west of this section, where the lake is shallower, permafrost is more likely to dominate.

6.2.2 Cross Section 2

Cross Section 2 (CS2) roughly coincides with the southern limit of the proposed open pit as well as the path of the proposed exploration decline. CS2 is in close proximity to the thermistor installed in drillholes AMQ15-306, AMQ15-349A and AMQ15-421, allowing the results of the analyses to be compared to the instrument data.

The interpretation of the results of the analytical solution (Figure 8) and numerical model (Figure 9) is inconclusive. Whether or not the talik is open to depth is sensitive to a change of less than 0.5 °C in the freezing point depression. The analytical solution suggests the talik is just open, while the numerical modelling suggests that there may be 40 m of permafrost beneath the talik. This section is thought to approximate the southern limit of the talik channel before it becomes open to the sub-permafrost aquifer.

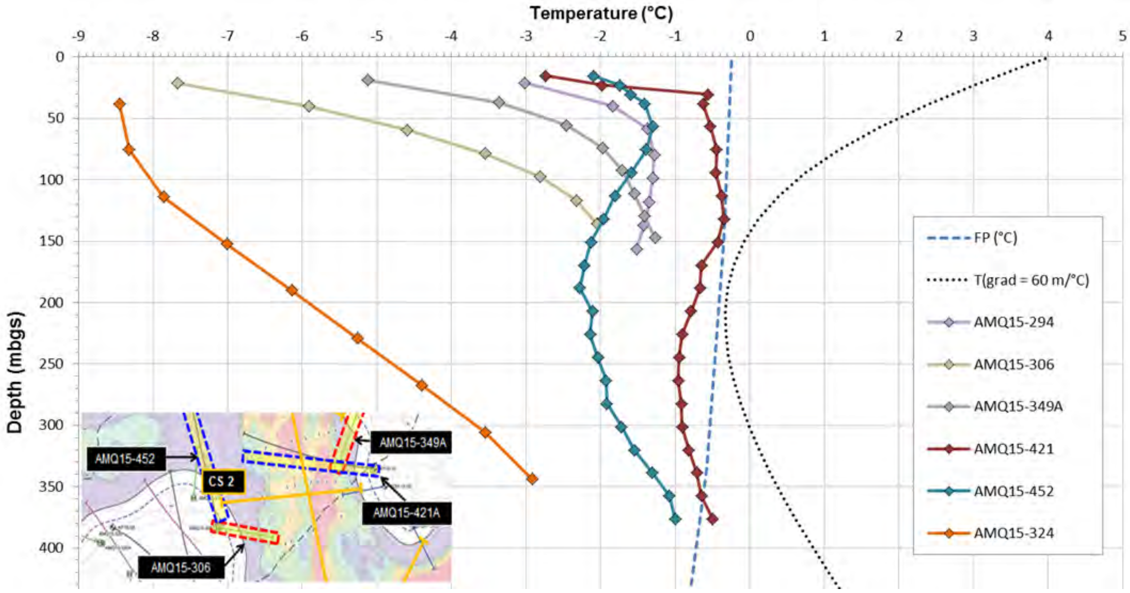

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Figure 8 Results of Analytical and Numerical Solutions for CS2

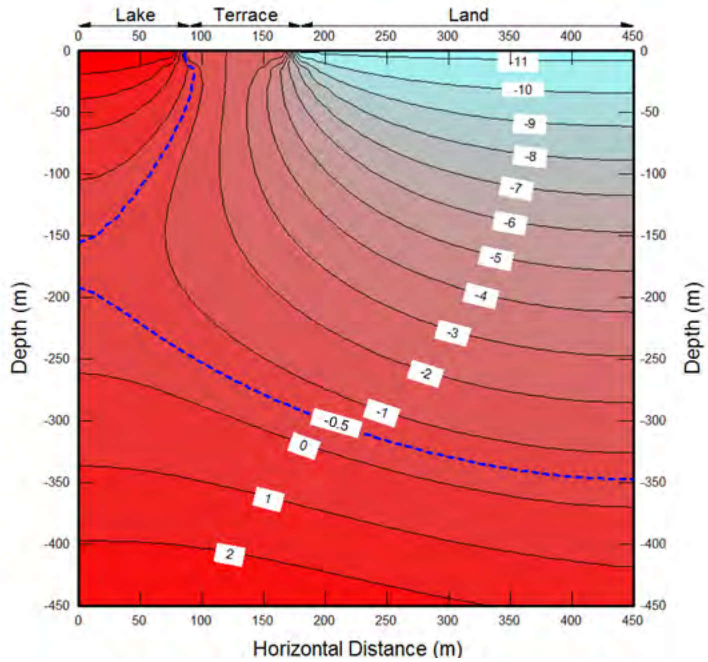

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Figure 9 Temp-W Thermal Model of CS2

6.2.3 Cross Section 3

Cross Section 3 (CS3) was selected to assess the wider, deeper portion of the lake, south of the proposed open pit and exploration decline. The results of the analytical solution (Figure 10) and numerical model (Appendix C) are in agreement and suggest that the talik is open and connected to the sub-permafrost aquifer in this portion of the lake.

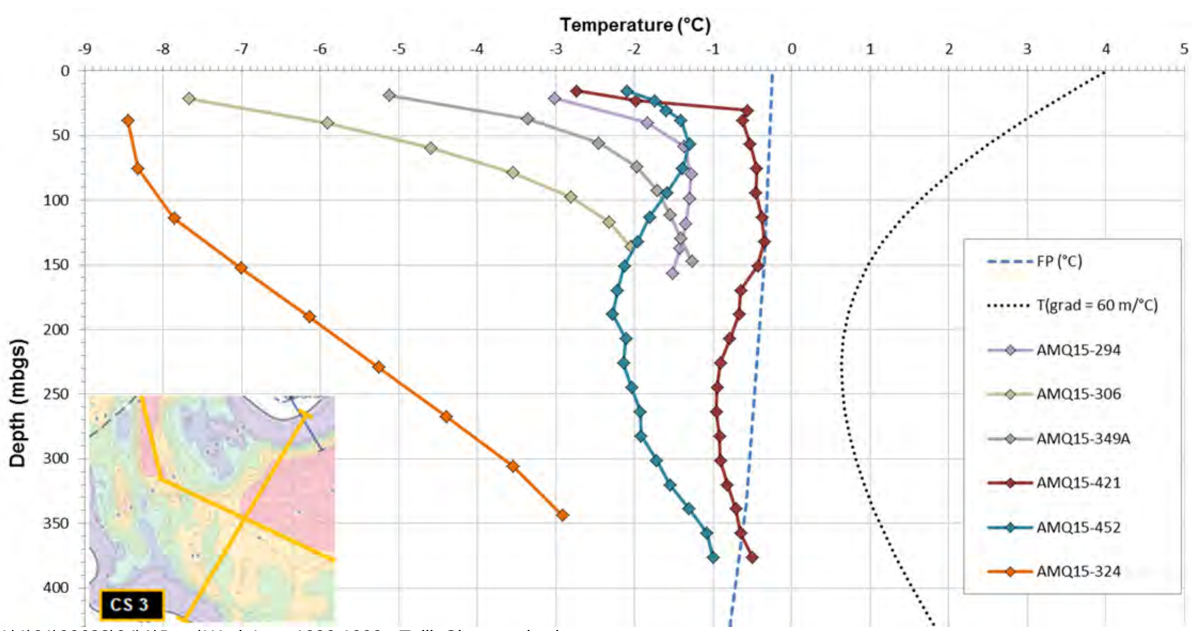

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Figure 10 Results of Analytical and Numerical Solutions for CS3

6.3 SUMMARY OF RESULTS

A progressive modeling approach was used for the study. An initial empirical assessment of talik potential identified that talik was likely to develop under parts of Whale Tail Lake where the lake was greater than 200 m in width and was deeper than 1 m. The initial assessment was followed by 1 D analytical solutions and 2D steady-state thermal modelling. The results of the 1D analytical solutions and the 2D numerical models are in general agreement and suggest that:

- Permafrost is expected below the land and in the shallowest areas of Whale Tail Lake.
- Talik is expected below the central portions of the lake.
- The talik is most likely underlain by permafrost in the shallower, narrower parts of Whale Tail Lake. This is expected to include most of the lake in the immediate vicinity of the proposed open pit.
- The talik is expected to connect vertically with the sub-permafrost aquifer in the deeper, wider parts of the lake, such as section CS3.
- Overall, the likely talik is expected to form a continuous channel that is closed in the northern portion of Whale Tail Lake below the open pit and becomes open as it moves to the south towards the central portion of the lake (Figure 11).

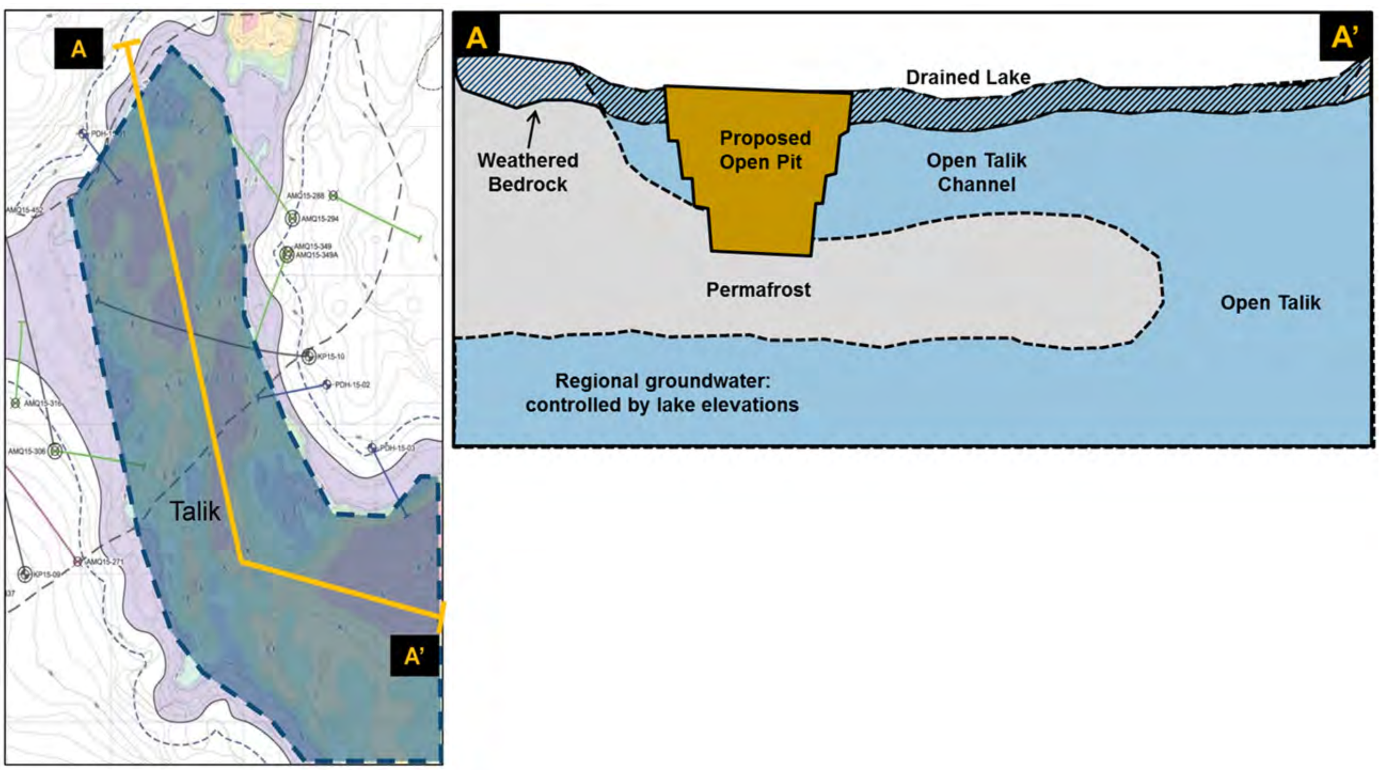

Figure 11 Interpretation of Permafrost and Talik Distribution through Whale Tail Lake

The thermal modeling does not account for transient conditions or complex subsurface stratigraphy, both of which may influence talik formation beneath Whale Tail Lake.

7 – TALIK WATER QUALITY CHARACTERIZATION

7.1 GROUNDWATER SAMPLING

Monitoring wells were installed in three drillholes (AMQ15-393, AMQ15-403 and AMQ15-413). Monitoring well AMQ15-403 was developed following installation, but the heat trace was damaged, the drillhole froze, and no further development or sampling could be completed. Water quality samples were collected from monitoring wells AMQ15-393 and AMQ15-413 for the purposes of characterizing the chemistry of the groundwater, following two rounds of well development.

Despite repeated well development, the groundwater samples collected to date from these monitoring wells have high salinity concentrations that are due to residuals of the brine solution used to install the monitoring wells. The samples are not representative of the natural groundwater quality. The continued presence of brine residuals in the groundwater wells following extensive purging has occurred at the Meadowbank Mine and at other northern sites. Repeated purging and monitoring over time at these sites has eventually allowed the collection of representative groundwater quality results. This approach will be used at the Whale Tail Pit Study Area.

In the interim, a larger groundwater quality dataset from the Meadowbank Mine has been reviewed and is believed to provide a reasonable representation of groundwater conditions within the talik beneath Whale Tail Lake. The Project and AEM's Meadowbank Mine are underlain by the same sequence of Archean supra crustal rocks of the Woodburn Lake Group (AEM, 2015a). Based on the similar geology and permafrost conditions (i.e., within taliks), the groundwater quality data from the Meadowbank Mine are likely to be similar to the groundwater conditions in the vicinity of the Whale Tail Open Pit.

7.2 GROUNDWATER QUALITY CHARACTERIZATION

Groundwater chemistry data was extracted from Appendix A of the *Meadowbank Gold Mine - 2014 Groundwater Monitoring Report* (AEM, 2015b). The groundwater quality data for this mine have been collected since 2003 from monitoring wells targeting talik zones in the vicinity of the mine facilities. The data have been collected for the purposes of characterizing groundwater quality. The number of samples represented in the dataset ranges from 18 to 43, depending on the parameter considered.

Summary statistics calculated using the Meadowbank Mine groundwater quality dataset for general parameters (pH, conductivity, alkalinity, sulphate, hardness, and TDS), dissolved metals, dissolved anions, nutrients, and cyanide are presented in Table 2. In order, to calculate the summary statistics presented in Table 2, KP removed all of the high non-detect values from the dataset so that the statistics were not biased high. All remaining non-detect values were incorporated into the statistics based on a value equal to half the method detection limit (MDL). Several parameters were consistently below the MDL or that had only one value reported above the MDL. These parameters were assigned a single value equivalent to half of the lowest MDL. The original and adjusted sample sizes for each parameter are listed in Table 2.

Quality assurance and quality control (QA/QC) of the dataset was conducted by AEM (2015b). In addition to the AEM data quality assessment, an ion balance check was conducted on the individual sample results and the summary data. The ion balance check was inconclusive for many of the individual samples because specific parameters such as sodium and potassium were not included in all of the analytical results. The ion balance results for the summary statistics are as follows: Less than a10% error for the average, median (50^{th} P), 70^{th} P, 75^{th} P, and maximum summary data; between 10% and 20% for the minimum, 80^{th} P, and 95^{th} P summary data; and between 20% and 35% difference for the 25^{th} P, 85^{th} P and 90^{th} P summary data. There are excess cations in the upper percentile summary data and excess anions in the lower percentile summary data.

There are no specific water quality guidelines for groundwater in Nunavut. The groundwater data have been compared to the Canadian Environmental Quality Guidelines for the Protection of Freshwater Aquatic Life (CEQG) (CCME, 2105) and the Health Canada Guidelines for Canadian Drinking Water Quality (HC-DW)

(Health Canada, 2014), for reference. Hardness dependent guidelines were calculated using the hardness for the same statistical category as summarized in Table 2.

The following is a summary of the parameters with statistical values that exceed the CEQG:

- Fluoride – all but the minimum values exceed the 0.12 mg/L CEQG.
- Nitrate, Nitrite, and Ammonia – the upper 95^{th} P results for these nitrogen-based parameters exceed their respective CEQGs. However, these results may be influenced by residual nitrogen associated with explosives residues originating in the operating open pits of the Meadowbank Mine. It is also important to note that the ammonia exceedances are strongly influenced by the pH conditions. The ammonia guideline is 12.56 mg/L N for pH of 7 and temperature of 5^{o}C and 1.27 mg/L N for pH of 8 at the same temperature; there would be no exceedances in the current dataset if the *in situ* pH was assumed to be 7.The upper percentile values for nitrate, nitrite, and ammonia are not expected for the Project baseline groundwater quality.
- Aluminum – the upper 90^{th} P of the data for aluminum exceed the 0.1 mg/L CEQG.
- Arsenic - the upper 90^{th} P of the data for arsenic exceed the 0.005 mg/L CEQG.
- Boron – the maximum data for boron exceed the 1.5 mg/L long-term exposure CEQG for boron (95^{th} P are below the guideline), but all remain well below the 29 mg/L short-term exposure value.
- Chromium – none of the measured chromium concentrations exceed the 0.0089 mg/L CEQG for trivalent chromium, which is the most likely form of chromium to be found in deep groundwater (reducing conditions). The upper 70^{th} P of the chromium results exceeded the 0.001 mg/L CEQG for hexavalent chromium.
- Copper – the upper 80^{th} P of the copper data exceed the hardness dependent CEQG.
- Iron – the upper 95^{th} P of the iron data exceed the 0.3 mg/L CEQG.
- Molybdenum – the upper 95^{th} P of the molybdenum data exceed the 0.073 mg/L CEQG.
- Selenium – the mean and the upper 80^{th} P selenium results exceed the 0.001 mg/L CEQG.
- Zinc – maximum zinc concentrations just exceed the 0.03 mg/L CEQG; however, the 95^{th} P data are below the guideline.

The following are the parameters with statistical values that exceed the HC-DW guidelines:

- Chloride – the upper 75^{th} P of the chloride data exceed the 250 mg/L HC-DW aesthetic objective.
- TDS – the upper 70^{th} P of the TDS data exceed the 500 mg/L HC-DW aesthetic objective.
- Nitrate and Nitrite – the upper percentile results for nitrite and nitrate exceed their respective heath-based HD-DW guidelines; however, the results are from an operating mine as noted above, and therefore should not be considered representative of the baseline groundwater quality for the Project
- Arsenic – the maximum measured arsenic concentrations exceed the 0.01 mg/L HD-DW guideline, though the 95^{th} P results do not.
- Iron - the upper 95^{th} P of the iron data exceed the 0.3 mg/L HC-DW aesthetic objective.
- Manganese – the majority of the manganese data exceed the 0.05 mg/L HC-DW aesthetic objective.
- Selenium – the maximum measured selenium concentration exceeds the 0.01 mg/L HC-DW guideline, though the 95^{th} P value does not.
- Sodium – the upper 95^{th} P of the sodium data exceed the 200 mg/L HC-DW aesthetic objective.

In summary, the groundwater quality at the Meadowbank Mine is generally described as being hard to very hard, with neutral to slightly basic pH and good buffering capacity. TDS concentrations range from 193 mg/L to 1,900 mg/L (mean 625 mg/L; median 496 mg/L). Concentrations of fluoride, copper, iron, and selenium were elevated in comparison to guidelines for the protection of aquatic life and drinking water. Only the higher percentile values for nitrogen-containing compounds, aluminum, arsenic, boron, hexavalent chromium, molybdenum and zinc exceeded the CEQGs. Additionally, several of these parameters as well as chloride, manganese and sodium exceeded aesthetic drinking water guidelines.

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TABLE 2

AGNICO EAGLE MINES LIMITED - MEADOWBANK DIVISION
WHATE TAIL PIT

PERMAFROST AND HYDROGEOLOGICAL CHARACTERIZATION
GROUNDWATER QUALITY DATASET

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Parameters	Units	Sample Size				Summary Statistics											Water Quality Guidelines	
		Number of Samples	Number of Samples After High Non-Detect Values	Number of Samples Below MDL	% Below MDL	Minimum	25th Percentile	Mean	Median	70th Percentile	75th Percentile	80th Percentile	85th Percentile	90th Percentile	95th Percentile	Maximum	CEQG[1]	HC-DW [2]
General Parameters																		
pH	s.u.	38	38	0	0%	6.71	7.26	7.51	7.55	7.75	7.81	7.87	7.95	7.97	8.10	8.20	6.5 to 9.0	6.5 to 8.5
Conductivity	uS/cm	21	21	0	0%	281	583	1322	930	1270	1280	2900	3100	3200	3300	3400		
Total Alkalinity	mg/L	40	40	0	0%	15	42.6	71.9	76	95.66	102.25	103	104.15	105.5	111.15	147		
Bicarbonate Alkalinity HCO3		18	18	0	0%	33.3	46.3	88.7	61.55	104.8	108	111.6	118.95	136.1	189.45	345		
Carbonate Alkalinity CO3		***18***	***16***	***15***	***94%***	***0.25***	***0.25***	***0.25***	***0.25***	***0.25***	***0.25***	***0.25***	***0.25***	***0.25***	***0.25***	***0.25***		
Hydroxide Alkalinity OH		29	29	15	52%	0.25	0.3	71.7	0.25	52	113	176.4	245.9	301.4	308.5	317		
Dissolved Sulphate	mg/L	33	33	0	0%	3	5.9	45.9	15.9	43.04	46.4	52.08	64.19	130.2	210	263		*500 AO*
Hardness CaCO3	mg $CaCO_3$/L	20	20	0	0%	75.9	107.5	200.5	166	266.5	284.25	300.8	324.65	345.6	351.95	380		
Hardness (Total)	mg $CaCO_3$/L	38	38	0	0%	77	170.0	258.6	240	313	316	318	324	388	440	850		
Total Dissolved Solids	mg/L	30	30	0	0%	193	391.5	625.1	495	650	680	793	907.25	1217.5	1758.75	1900		*500 AO*
Dissolved Metals																		
Aluminum	mg/L	39	29	6	21%	0.00005	0.0041	0.0740	0.011	0.03	0.04	0.0456	0.0526	0.3	0.402	0.71	0.1 (pH > 6.5)	
Antimony	mg/L	16	6	3	50%	0.0001	0.0001	0.0005	0.00015	0.00025	0.000275	0.0003	0.000725	0.00115	0.001575	0.002		0.006
Arsenic	mg/L	39	33	12	36%	0.00005	0.0005	0.0024	0.002	0.003	0.003	0.0035	0.00384	0.00504	0.007	0.013	0.005	0.01
Barium	mg/L	39	39	2	5%	0.015	0.029	0.107	0.045	0.086	0.125	0.1628	0.25	0.318	0.42	0.44		1
Beryllium	***mg/L***	***16***	***5***	***5***	***100%***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***		
Bismuth	***mg/L***	***16***	***5***	***5***	***100%***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***		
Boron	mg/L	16	16	2	13%	0.025	0.095	0.434	0.205	0.405	0.4625	0.53	0.8375	0.985	1.37	2.39	1.5 / 29 (short-term/long-term exposure)	5
Cadmium	mg/L	39	12	4	33%	0.00001	0.00002	0.00007	0.00004	0.000105	0.00012	0.00012	0.000134	0.000156	0.000178	0.0002	0.000036 to $10^{(0.83*(log(H)-2.46)}$/1000 to 0.000373 [9]	0.005
Calcium	mg/L	35	35	0	0%	17.6	37.45	61.10526	49	67.9	72.875	73.3	79.635	89.23	99.15	340		
Chromium	mg/L	16	6	0	0%	0.0002	0.0003	0.0007	0.0007	0.0011	0.00115	0.0012	0.0012	0.0012	0.0012	0.0012	0.0089/0.001 (Cr III/Cr VI)	0.05
Cobalt	mg/L	16	8	0	0%	0.0003	0.0004	0.0017	0.0009	0.001	0.00175	0.0028	0.00385	0.0046	0.0053	0.006		
Copper	mg/L	39	24	2	8%	0.0002	0.0010	0.0039	0.0016	0.00309	0.003925	0.0044	0.00665	0.008	0.0097	0.033	$e^{(0.8545*ln(H)-1.465)}$ 0.2/1000 to 0.004 [9]	*1 AO*
Iron	mg/L	39	34	21	62%	0.005	0.020	0.145	0.025	0.032	0.05	0.074	0.2	0.2	0.8435	1.91	0.3	*0.3 AO*
Lead	mg/L	39	16	5	31%	0.00005	0.0001	0.0008	0.00027	0.001	0.001025	0.0011	0.001175	0.0013	0.002325	0.0051	$e^{((1.273*ln(H)-4.705))}$ /1000 to 0.007 [9]	0.01
Lithium	mg/L	16	16	2	13%	0.002	0.0027	0.0119	0.00755	0.017	0.0175	0.019	0.0235	0.0265	0.02925	0.033		
Magnesium	mg/L	35	35	1	3%	0.5	12.70	22.21	23.8	27	30.15	31	32.045	35.22	37.16	47		
Manganese	mg/L	37	37	2	5%	0.0015	0.0602	0.2480	0.153	0.2984	0.32	0.3768	0.436	0.5752	0.768	0.98		*0.05 AO*
Mercury	***mg/L***	***37***	***21***	***19***	***90%***	***0.000005***	***5E-06***	***5E-06***	***5E-06***	***5E-06***	***5E-06***	***5E-06***	***5E-06***	***5E-06***	***5E-06***	***0.000005***	0.000026	0.001
Molybdenum	mg/L	39	35	6	17%	0.00025	0.0063	0.0258	0.012	0.02382	0.0265	0.0406	0.0457	0.0628	0.105	0.14	0.073	
Nickel	mg/L	39	34	8	24%	0.0005	0.0019	0.0081	0.0025	0.005	0.00575	0.009	0.01729	0.019	0.038105	0.05	$e^{((0.76*ln(H)+1.06))}$ /1000 to 0.15 [9]	
Phosphorus	mg/L	16	16	7	44%	0.015	0.03	0.19	0.075	0.155	0.195	0.3	0.3	0.55	0.825	0.9		
Potassium	mg/L	35	35	0	0%	1.3	2.20	4.58	4.3	5.92	6.35	7.504	7.98	8.46	9.292	11		
Selenium	mg/L	39	39	32	82%	0.0001	0.0005	0.0013	0.0005	0.0005	0.00075	0.0022	0.0025	0.003	0.0051	0.011	0.001	0.01
Silicon	mg/L	16	16	0	0%	0.32	1.975	2.985	2.985	3.845	3.9425	4.1	5.3	5.79	6.405	7.98		
Silver	***mg/L***	***38***	***6***	***5***	***83%***	***0.000025***	***2.5E-05***	***2.5E-05***	***2.5E-05***	***2.5E-05***	***2.5E-05***	***2.5E-05***	***2.5E-05***	***2.5E-05***	***2.5E-05***	***0.000025***	0.00025	
Sodium	mg/L	29	29	0	0%	1.8	15.60	68.24	32	49.18	55.9	58.52	60.6	137	382.8	430		*200 AO*
Strontium	mg/L	16	16	0	0%	0.111	0.215	0.452	0.265	0.585	0.6225	0.72	0.732	0.748	0.935	1.46		
Tellurium	***mg/L***	***16***	***16***	***16***	***100%***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***		
Thallium	***mg/L***	***38***	***16***	***16***	***100%***	***0.00001***	***0.00001***	***0.00001***	***0.00001***	***0.00001***	***0.00001***	***0.00001***	***0.00001***	***0.00001***	***0.00001***	***0.00001***		
Thorium	***mg/L***	***16***	***16***	***14***	***88%***	***0.00005***	***0.00005***	***0.00005***	***0.00005***	***0.00005***	***0.00005***	***0.00005***	***0.00005***	***0.00005***	***0.00005***	***0.00005***	0.0008	
Tin	***mg/L***	***16***	***16***	***16***	***100%***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***		
Titanium	mg/L	16	16	10	63%	0.0003	0.00050	0.00421	0.0005	0.0005	0.000575	0.0008	0.0137	0.0185	0.02025	0.024		
Uranium	mg/L	16	16	3	19%	0.00025	0.00053	0.00326	0.00095	0.00465	0.007775	0.008	0.008	0.00835	0.009525	0.012	0.015	0.02
Vanadium	mg/L	16	16	12	75%	0.0001	0.00050	0.00050	0.0005	0.0005	0.000525	0.0006	0.0006	0.0008	0.001	0.001		
Zinc	mg/L	39	39	16	41%	0.001	0.0025	0.0072	0.0035	0.009	0.012	0.013	0.014	0.0146	0.0191	0.033	0.03	5
Zirconium	***mg/L***	***16***	***16***	***16***	***100%***	***0.0005***	***0.0005***	***0.0005***	***0.0005***	***0.0005***	***0.0005***	***0.0005***	***0.0005***	***0.0005***	***0.0005***	***0.0005***		
Anions																		
Dissolved Fluoride	mg/L	43	43	6	14%	0.01	0.145	0.281	0.3	0.354	0.37	0.392	0.448	0.54	0.597	1.1	0.12	1.5
Dissolved Chloride	mg/L	43	43	0	0%	3.3	33.6	233.0	127	173.4	255	297.2	534	801.2	950	990	120 / 640 (short-term/long-term exposure)	*250 AO*
Nutrients																		
Total Nitrogen	mg/L	4	4	1	25%	0.1	0.25	0.36	0.395	0.494	0.5	0.506	0.512	0.518	0.524	0.53		
Nitrate and Nitrite	mg/L	28	28	19	68%	0.005	0.01	2.14	0.0375	0.195	0.21	0.43	0.57	1.723	18.1555	27		45
Nitrate	mg/L	33	33	19	58%	0.005	0.01	1.74	0.025	0.122	0.125	0.192	0.316	1.468	11.42	26	3	10
Nitrite	mg/L	32	28	9	32%	0.001	0.003	0.093	0.005	0.0097	0.0125	0.026	0.03	0.06	0.736	1.2	0.06	1
Ammonia Nitrogen	mg/L	30	30	2	7%	0.005	0.063	0.527	0.16	0.213	0.3325	0.406	0.5295	2	2.99	3.8	0.017 to 192 (temperature and pH specific)	
Total Kjeldahl Nitrogen	mg/L	12	12	1	8%	0.1	0.2	0.375	0.3	0.54	0.6	0.6	0.6	0.6	0.645	0.7		
Total Phosphorus	mg/L	13	13	0	0%	0.01	0.040	0.085	0.07	0.088	0.1	0.1	0.126	0.204	0.238	0.25		
Cyanide																		
WAD Cyanide (CN-)	***mg/L***	***2***	***2***	***1***	***50%***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***		
Total Cyanide	***mg/L***	***12***	***12***	***11***	***92%***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***		
Free Cyanide	***mg/L***	***22***	***22***	***22***	***100%***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	0.005	

I:\1\01\00622\04\A\Correspondence\VA15-03393 - Permafrost and Hydrogeology Baseline Summary\Final\Tables and Figures\[Table 2 GWQ Dataset Rev 0.xlsx]Table 2 KP Format

NOTES:

1. CEQG - CANADIAN ENVIRONMENTAL QUALITY GUIDELINE FOR THE PROTECTION OF FRESHWATER AQUATIC LIFE (CCME 2015); AO - AESTHETIC OBJECTIVE.
2. HC-DW - HEALTH CANADA - GUIDELINES FOR CANADIAN DRINKING WATER QUALITY.
3. DATA SOURCED FROM MEADOWBANK GOLD MINE 2014 GROUNDWATER MONITORING REPORT. PREPARED BY AGNICO EAGLE MINES LIMITED - MEADOWBANK DIVISION, MARCH 2015.
4. DATA EXCLUDED FROM SUMMARY STATISTICS: MW-08-03 SAMPLE COLLECTED 23-SEP-13 (SALT ADDED TO THAW WELL), MW-03-04 SAMPLE COLLECTED 18-SEP-03 (SINGLE SAMPLE FOR THIS MONITORING WELL), MW11-01 AND MW14-01 (ALL SAMPLES) DUE TO SUSPECT SAMPLING OF BRINE RESIDUALS FROM MONITORING WELL INSTALLATIONS, AND OUTLIER DATA POINT FOR MW08-02 FOR DISSOLVED LEAD 20-AUG-14.
5. VALUES REPRESENTED IN BOLD ITALICS ARE INDICATIVE OF PARAMETERS THAT WERE NEVER MEASURED ABOVE THE MDL OR HAD ONLY ONE SAMPLE (INCLUDING A DUPLICATE PAIR) MEASURED ABOVE THE MDL: A VALUE EQUIVALENT TO HALF THE LOWEST MDL WAS SELECTED TO REPRESENT THE DATA WHEN ALL OF THE RESULTS WERE BELOW THE MDL
6. GREEN SHADING INDICATES THAT THE VALUE EXCEEDS THE CANADIAN ENVIRONMENTAL QUALITY GUIDELINE FOR THE PROTECTION OF FRESHWATER AQUATIC LIFE.
7. BLUE SHADING INDICATES THAT THE VALUE EXCEEDS THE HEALTH CANADA GUIDELINES FOR CANADIAN DRINKING WATER.
8. PURPLE SHADING INDICATES THAT THE VALUE EXCEEDS BOTH OF THE REFERENCE GUIDELINES.
9. HARDNESS (H) DEPENDENT GUIDELINE.

REV	DATE	DESCRIPTION	PREP'	RVW'D
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8 – SUMMARY AND CONCLUSIONS

The general characteristics of the permafrost in the vicinity of Whale Tail Lake are summarized below:

- A freezing point depression curve was developed for this site using data from the EC logger installed in drillhole AMQ15-349A and TDS and temperature vs depth relationship curves developed for other studies completed in the region. The developed relationship defines a freezing point of -0.35 °C at 150 m and a freezing point of -1.0 °C at 500 m.
- A mean annual surface temperature (MAST) of -11.4°C was used based on data from the Meadowbank Mine climate station. This is similar to the MAST of -10.4°C estimated from the thermistor installed in drillhole AMQ15-324.
- The geothermal gradient was calculated as 0.021°C/m based on the data from the thermistor installed in drillhole AMQ15-324.
- The depth of permafrost beneath the land mass at the Project is estimated to be approximately 425 m, based on the intersection of the geothermal gradient and the freeze point depression curve.

The available data and the results of thermal modeling suggest that the pre-mining permafrost and talik conditions in the vicinity of the deposit are as follows:

- The majority of the proposed open pit is expected to be in permafrost
- A talik is expected in the central section of Whale Tail Lake, where lake half-widths are greater than 300 m and the water is >5 m deep.
- Talik conditions within the vicinity of the proposed open pit are likely to be between 100 to 200 m in depth and underlain by permafrost. The talik takes the form of a channel, running along the middle of the lake to the southern limit of the open pit. The southern portions of the talik are expected to be vertically open to depth as the lake broadens and deepens.

It is important to note that the permafrost and talik characterization was conducted using a preliminary dataset, as the temperature data are still stabilizing and cooling. The current permafrost and talik interpretation should be refined as the data stabilizes and as additional data are collected.

The likely groundwater quality for the Project has been based on a long-term dataset from groundwater wells installed in the talik zone at the AEM Meadowbank Mine. The Meadowbank Mine is underlain by the same sequence of Archean supra crustal rocks of the Woodburn Lake Group as the Project area. The groundwater quality at the Meadowbank Mine is generally described as hard to very hard with neutral to slightly basic pH and good buffering capacity. The groundwater quality data have been compared against the CEQG and the HC-DW guidelines for reference purposes, as there are no specific guidelines for groundwater quality in Nunavut. Aquatic life guideline exceedances were noted for fluoride, nitrate, nitrite, ammonia, aluminum, arsenic, boron, chromium, copper, iron, molybdenum, selenium, and zinc. The upper percentile nitrate, nitrite and ammonia concentrations are likely a result of explosive residues and are therefore not considered representative of baseline groundwater quality for the Project. The aquatic life guideline exceedances were typically limited to the upper 85th to 90th percentile concentrations for the majority of these parameters. However, fluoride and selenium concentrations were more frequently above the guidelines. Aesthetic objectives for drinking water quality were exceeded for chloride, TDS, iron, manganese, and sodium and health-based drinking water guidelines were exceeded for nitrate, nitrite, arsenic and selenium.

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Please direct any questions or comments to the undersigned.

Yours truly,
Knight Piésold Ltd.

REGISTERED PROFESSIONAL ENGINEER S.R. AIKEN LICENSEE Nov 25/15 NWT/NU

Prepared:	Jessica Mackie, EP Senior Environmental Scientist	Reviewed:	Steven Aiken, P.Eng. Manager, Environmental Services
Prepared:	Ben Green, MSc., P.Geo. Senior Scientist	Reviewed:	Kevin Hawton, P.Eng. Specialist Engineer

PROFESSIONAL GEOSCIENTIST PROVINCE OF BRITISH COLUMBIA M. B. GREEN #40677 25 NOV 2015

Approval that this document adheres to Knight Piésold Quality Systems:

PERMIT TO PRACTICE
KNIGHT PIESOLD LTD.
Signature
Date Nov 25 / 2015
PERMIT NUMBER: P 547
The Association of Professional Engineers, Geologists and Geophysicists of NWT/NU

Attachments:

Appendix A	Permafrost Terminology
Appendix B	Thermistor Installations & EC Logger
Appendix C	Calculation of Freezing Point Depression Point
Appendix D	Analytical and Numerical Thermal Modeling

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APPENDIX A

PERMAFROST TERMINOLOGY

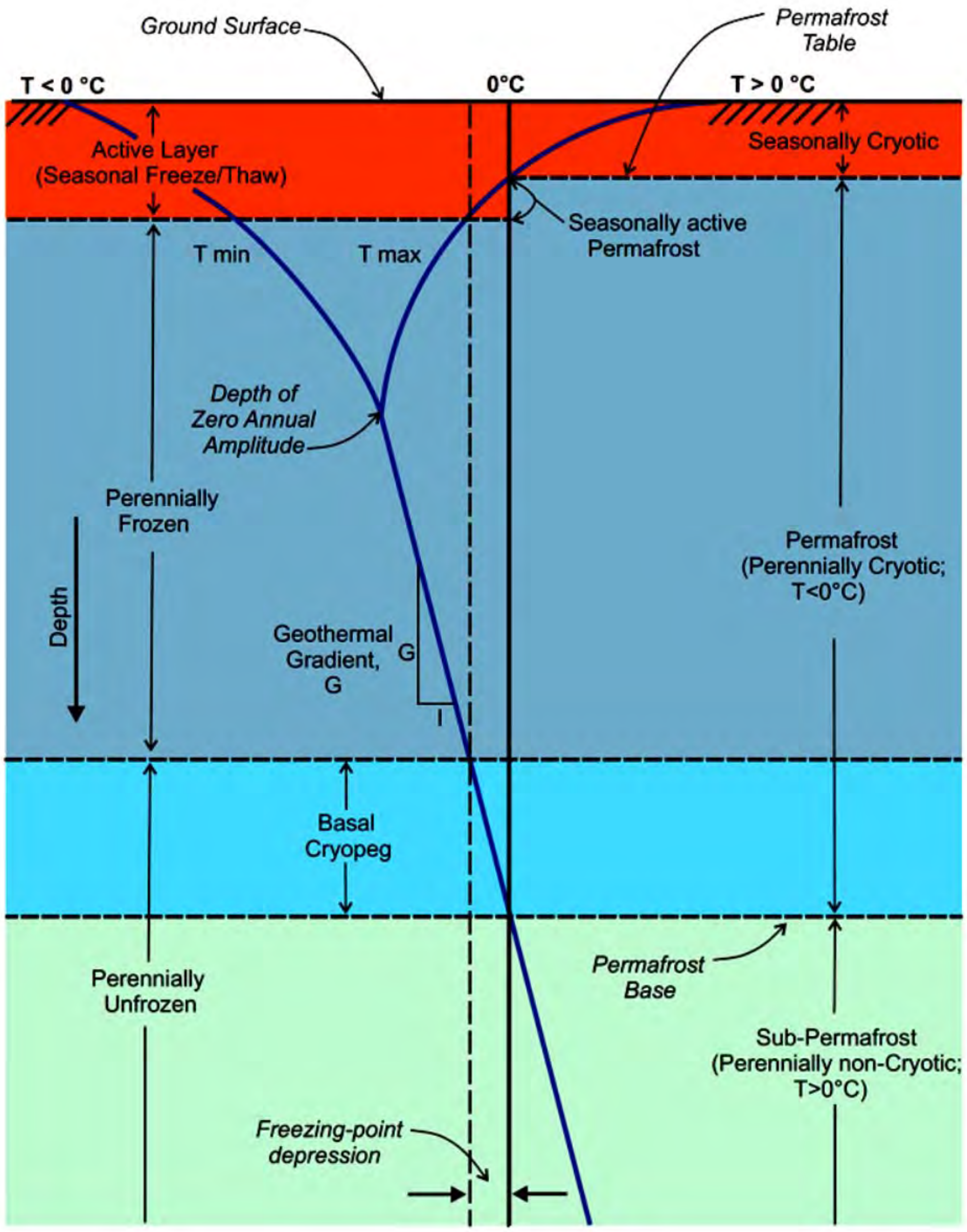
(Pages A-1 to A-2)

APPENDIX A- PERMAFROST TERMINOLOGY

Permafrost refers to subsurface soil or rock where temperatures remain at or below 0°C for two or more consecutive years. This condition is synonymous with perennially cryotic ground, which may be frozen, partially frozen, or non-frozen depending on the ice or water content of the ground and on the salinity of the included water. Permafrost is typically described throughout this baseline study by the following terminology, which relates to the ground temperature profile (Harris et al, 1988):

- Active layer: The active layer is the layer of ground subject to annual freezing and thawing in areas underlain by permafrost. The depth of the active layer can vary based on material type and water content, presence or absence of vegetation, proximity to water, and general topographic aspect.
- Permafrost table: The permafrost table is the upper boundary of permafrost, at the base of the active layer. The ground temperature above the permafrost table is above 0°C for at least a portion of each year; the ground temperature below the permafrost table is less than 0°C year-round.
- Permafrost base: The permafrost base is the lower boundary of permafrost, and its surface is typically undulating and uneven. The ground temperature above the permafrost base is less than 0°C, and below the permafrost base the ground temperature is above 0°C. The depth of the permafrost base varies with latitude, elevation, and proximity to large bodies of water. The depth of the permafrost base also depends on the thermal history of an area.
- Geothermal gradient: The geothermal gradient is the increase in ground temperature with depth, below the depth of zero annual amplitude. The geothermal gradient is typically a linear relationship. The permafrost base can be estimated if the geothermal gradient is known at a given temperature by projecting the linear relationship down until it crosses from negative ground temperature to positive ground temperature.
- Mean annual ground temperature: The mean annual ground temperature is the temperature at the ground surface. It can be measured or estimated based on a projection upward of the geothermal gradient to intersect the ground surface and compared with weather station data.
- Basal cryopeg: Basal cryopeg is layer of perennially cryotic (temperature less than 0°C) ground with liquid saline or pressurized pore water that forms the base of permafrost. The thickness of this layer is related to the salinity of the groundwater regime, which can result in depression of the freezing point several degrees below zero.
- Talik: A talik is defined as a layer or body of unfrozen ground in a permafrost area, and includes several types based on the relationship to the permafrost and the mechanism related to the unfrozen conditions (Harris et al. 1988). The three most common types of talik are defined as follows:
    - closed talik: a talik occupying a depression in the permafrost table below a lake or river (also called lake talik and river talik); its temperature remains above 0°C because of the heat storage effect of the surface water;
    - open talik: a talik that penetrates the permafrost completely, connecting a waterbody above the permafrost to the sub-permafrost aquifer (e.g., below large rivers and lakes); and,
    - isolated talik: a talik entirely surrounded by perennially frozen ground.

Figure 1: Typical Ground Thermal Profile in Permafrost



T = temperature; min = minimum; max = maximum; °C = degrees Celsius; <= less than; >= greater than.

(Martin, 2013)

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APPENDIX B

THERMISTOR INSTALLATIONS & EC LOGGER

(Pages B-1 to B-47)

VA15-03393
November 24, 2015

Contractor: Orbit Garant	**Drillhole No.:** AMQ15-393	**Page:** 1 of 1	
Location: Whale Tail Lake, East of Pit	Drill Type: Fly 4 Duralite 1000	Date Started: 31 Jul 15	
Coordinates: 607,193 E , 7,255,368 N	Total Depth: 261.0m	Date Completed: 5 Aug 15	
Coordinate System: Mine Grid NAD 83 UTM Zone 14N	Elevation: 10154.643 m	Logged by: AMB	
	Azimuth , Inclination: 146.48 , -65.3	Reviewed by: BG	

DEPTH - (mdh) | ELEVATION - (m) | GRAPHIC LOG

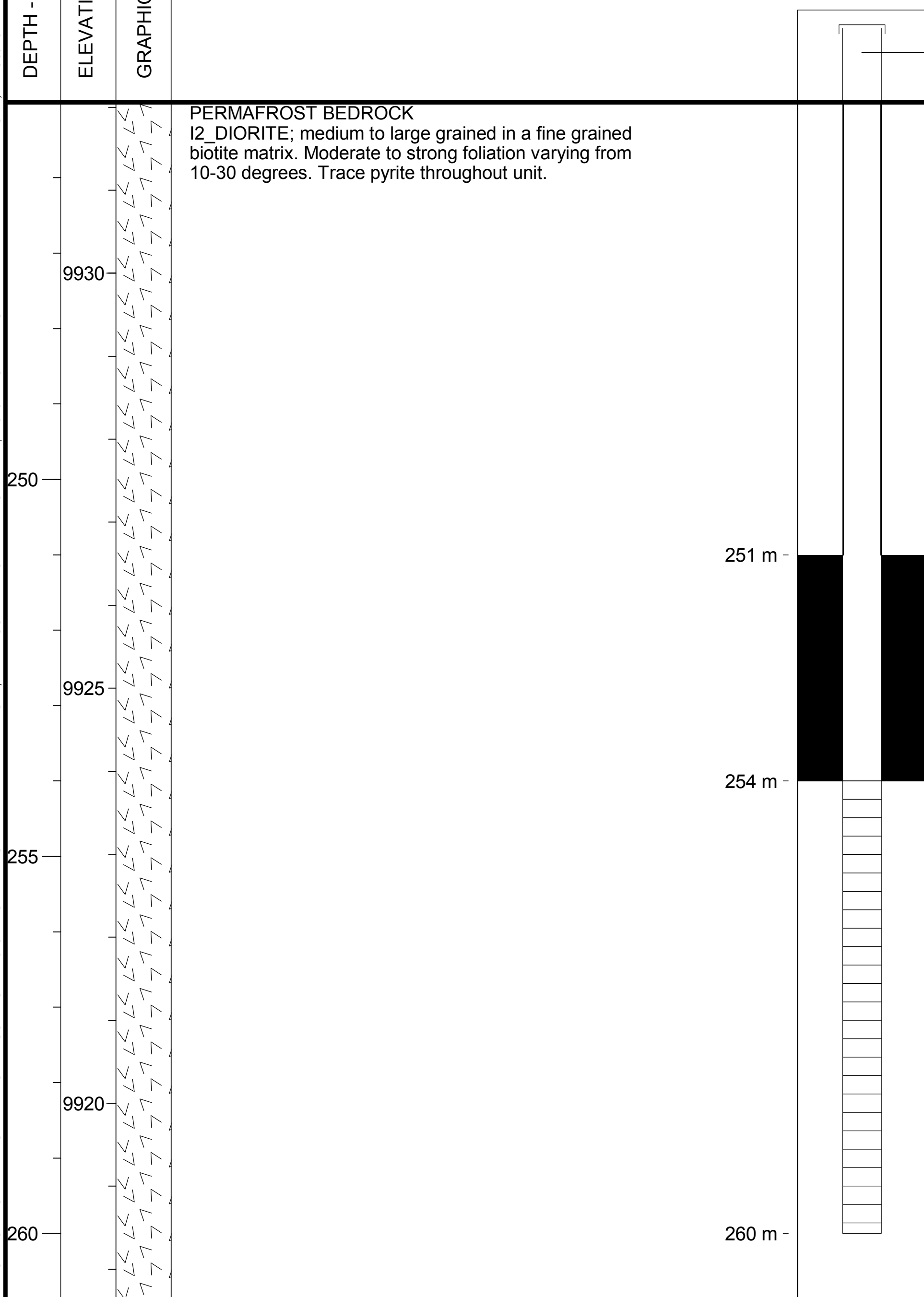
Groundwater Level = 110 mbgs

Date of Groundwater Measurement = 11/09/2015

PVC Stick-up = 0.65 m

NOTES

PERMAFROST BEDROCK
I2_DIORITE; medium to large grained in a fine grained biotite matrix. Moderate to strong foliation varying from 10-30 degrees. Trace pyrite throughout unit.



	Notes
Stainless Steel Riser	Stainless steel riser (1.25" ID) was installed to surface. No backfill material was used for the installation. An external and internal Raychem PetroTrace MI downhole heat trace system provided by Pentair was installed from the well screen to surface.
Pre-Pack Bentonite	Pre-pack bentonite was installed in two 1.5 meter sections.
Slotted PVC	1.25" ID PVC10 slot well screen. Installed in two 3.0 m sections and capped.
Open Hole and Slough	

GENERAL REMARKS:
All measurements are from ground surface. Depths are represented as meters downhole (mdh). The monitoring well was installed in an HQ (96.1 mm) drillhole inclined at approximately 65°.

AGNICO EAGLE MINES LTD. MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

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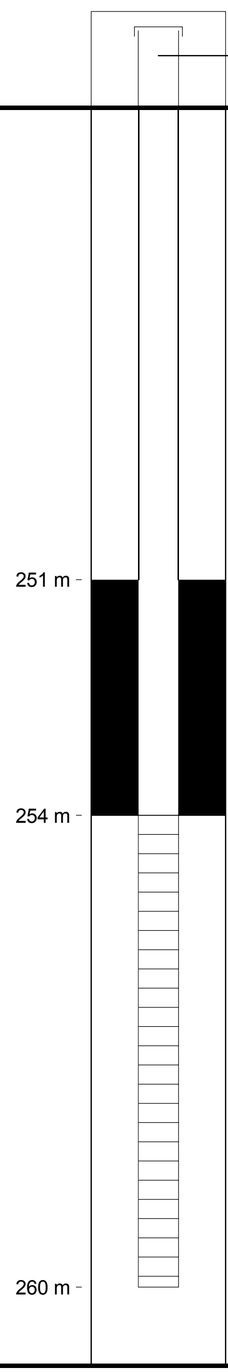
Project No.	Ref. No.	Rev.
NB101-00622/4	VA15-03393	0

FIGURE - B1

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Contractor: Orbit Garant	**Drillhole No.:** AMQ15-403	**Page:** 1 of 1
Location: Whale Tail Lake, East of Pit	Drill Type: Fly 4 Duralite 1000	Date Started: 5 Aug 15
Coordinates: 607,120 E , 7,255,461 N	Total Depth: 261.0m	Date Completed: 9 Aug 15
Coordinate System: Mine Grid NAD 83 UTM Zone 14N	Elevation: 10155.86 m	Logged by: AMB
	Azimuth , Inclination: 259.73 , -65.3	Reviewed by: BG

DEPTH - (mdh)	ELEVATION - (m)	GRAPHIC LOG	DESCRIPTION	NOTES
			PERMAFROST BEDROCK V4A_KOMATIITE; fine to coarse grained. Strong talc, carbonate and cloritization alteration. Trace pyrite mineralization.	
	9930			Stainless steel riser (1.25" ID) was installed to surface. No backfill material was used for the installation. An external and internal Raychem PetroTrace MI downhole heat trace system provided by Pentair was installed from the well screen to surface.
250				
				Pre-pack bentonite was installed in two 1.5 meter sections.
	9925			
255				
				1.25" ID PVC10 slot well screen. Installed in two 3.0 m sections and capped.
	9920			
260				



GENERAL REMARKS:
All measurements are from ground surface. Depths are represented as meters downhole (mdh). The monitoring well was installed in an HQ (96.1 mm) drillhole inclined at approximately 65°.

AGNICO EAGLE MINES LTD. MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

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Project No.	Ref. No.	Rev.
NB101-00622/4	VA15-03393	0

FIGURE - B2

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Contractor: Orbit Garant		**Drillhole No.:** AMQ15-413	**Page:** 1 of 1
Location: Whale Tail Lake, North of Pit		Drill Type: Fly 4 Duralite 1000	Date Started: 9 Aug 15
Coordinates: 606,757 E , 7,255,790 N		Total Depth: 210.0m	Date Completed: 13 Aug 15
Coordinate System: Mine Grid NAD 83 UTM Zone 14N		Elevation: 10156.616 m	Logged by: AMB
		Azimuth , Inclination: 138.77 , -65.4	Reviewed by: BG

DEPTH - (mdh) | ELEVATION - (m) | GRAPHIC LOG

Groundwater Level = 6 mbgs

Date of Groundwater Measurement = 17/09/2015

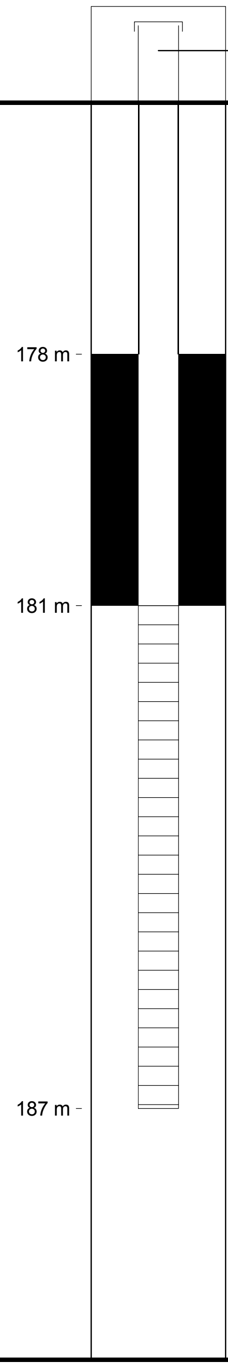
PVC Stick-up = 1.91 m

NOTES

Depth (mdh): 180, 185

Elevation (m): 9995, 9990, 9985

PERMAFROST BEDROCK
S3_GREYWACKE; fine to medium grained. Weak to strong cloritization and carbonate alteration close to quartz veins.



	Notes
Carapace HDPE Heat Line	Heat Line's Carapace™ system. A continuous HDPE 200m pipeline with a self-regulating heating cable extruded directly onto the outer surface of the pipe was installed to surface. No backfill material was used for the installation.
Pre-Pack Bentonite	Pre-pack bentonite was installed in two 1.5 meter sections.
Slotted PVC	1.25" ID PVC10 slot well screen. Installed in two 3.0 m sections and capped.

GENERAL REMARKS:
All measurements are from ground surface. Depths are represented as meters downhole (mdh). The monitoring well was installed in an HQ (96.1 mm) drillhole inclined at approximately 65°.

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WHALE TAIL PIT PROJECT

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Project No.	Ref. No.	Rev.
NB101-00622/4	VA15-03393	0

FIGURE - 4

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

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Appendix B1

AGNICO EAGLE MINES LTD. MEADOWBANK DIVISION
WHALE TAIL PROJECT

THERMISTOR INSTALLATION DEPTHS

Print Oct-22-15 12:16:59

Drillhole ID	Thermistor Number	Thermistor Depth (m along hole)	Thermistor Depth (mbgs)	Comments
AMQ15-294	1	8.9	6.3	
	2	27.5	19.4	
	3	51.9	36.7	
	4	76.4	54.0	
	5	104.1	73.6	
	6	129.0	91.2	
	7	154.0	108.9	
	8	179.0	126.5	
	9	204.2	144.4	
AMQ15-306	1	-0.5	-0.4	Installed above ground
	2	27.7	19.6	
	3	52.7	37.2	
	4	77.6	54.9	
	5	102.5	72.5	
	6	127.5	90.1	
	7	152.4	107.8	
	8	177.4	125.5	
	9	200.1	141.5	
AMQ15-324	1	1.3	0.9	
	2	49.7	35.1	
	3	98.7	69.8	
	4	148.7	105.1	
	5	198.8	140.6	
	6	248.3	175.6	
	7	298.9	211.4	
	8	348.9	246.7	
	9	398.9	282.1	
	10	448.8	317.4	
AMQ15-349A	1	0.5	0.4	
	2	25.4	17.9	
	3	50.2	35.5	
	4	75.3	53.3	
	5	100.3	70.9	
	6	125.2	88.5	
	7	150.2	106.2	
	8	175.1	123.8	
	9	198.9	140.6	
AMQ15-421	1	10.3	8.0	
	2	20.3	15.8	
	3	30.3	23.5	
	4	40.3	31.3	
	5	50.3	39.1	
	6	75.2	58.5	
	7	100.2	77.8	
	8	125.1	97.2	
	9	150.1	116.6	
	10	175.0	136.0	
	11	199.9	155.4	
	12	224.9	174.8	
	13	249.9	194.2	
	14	274.8	213.6	
	15	299.8	233.0	
	16	324.8	252.4	
	17	349.7	271.8	
	18	374.7	291.2	
	19	399.6	310.6	
	20	424.6	330.0	
	21	449.6	349.4	
	22	474.6	368.8	
	23	499.6	388.3	
AMQ15-452	1	9.8	7.5	
	2	19.9	15.2	
	3	29.8	22.8	
	4	39.8	30.5	
	5	49.8	38.1	
	6	74.7	57.2	
	7	99.6	76.3	
	8	124.5	95.4	
	9	149.4	114.5	
	10	174.4	133.6	
	11	199.4	152.7	
	12	224.4	171.9	
	13	249.4	191.1	
	14	274.4	210.2	
	15	299.4	229.3	
	16	324.3	248.4	
	17	349.3	267.5	
	18	374.2	286.7	
	19	399.2	305.8	
	20	424.2	324.9	
	21	449.1	344.1	
	22	474.1	363.2	
	23	499.1	382.3	

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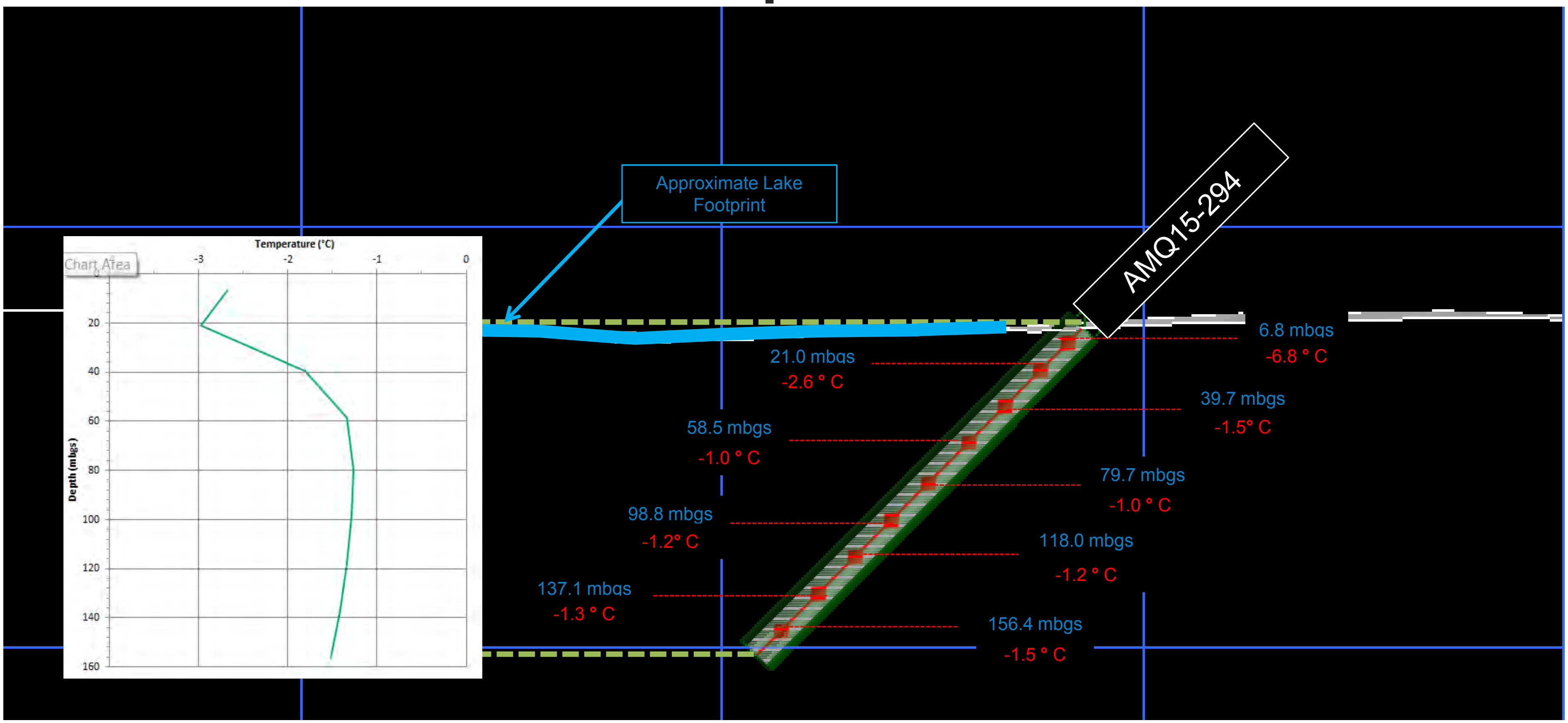
NOTES:

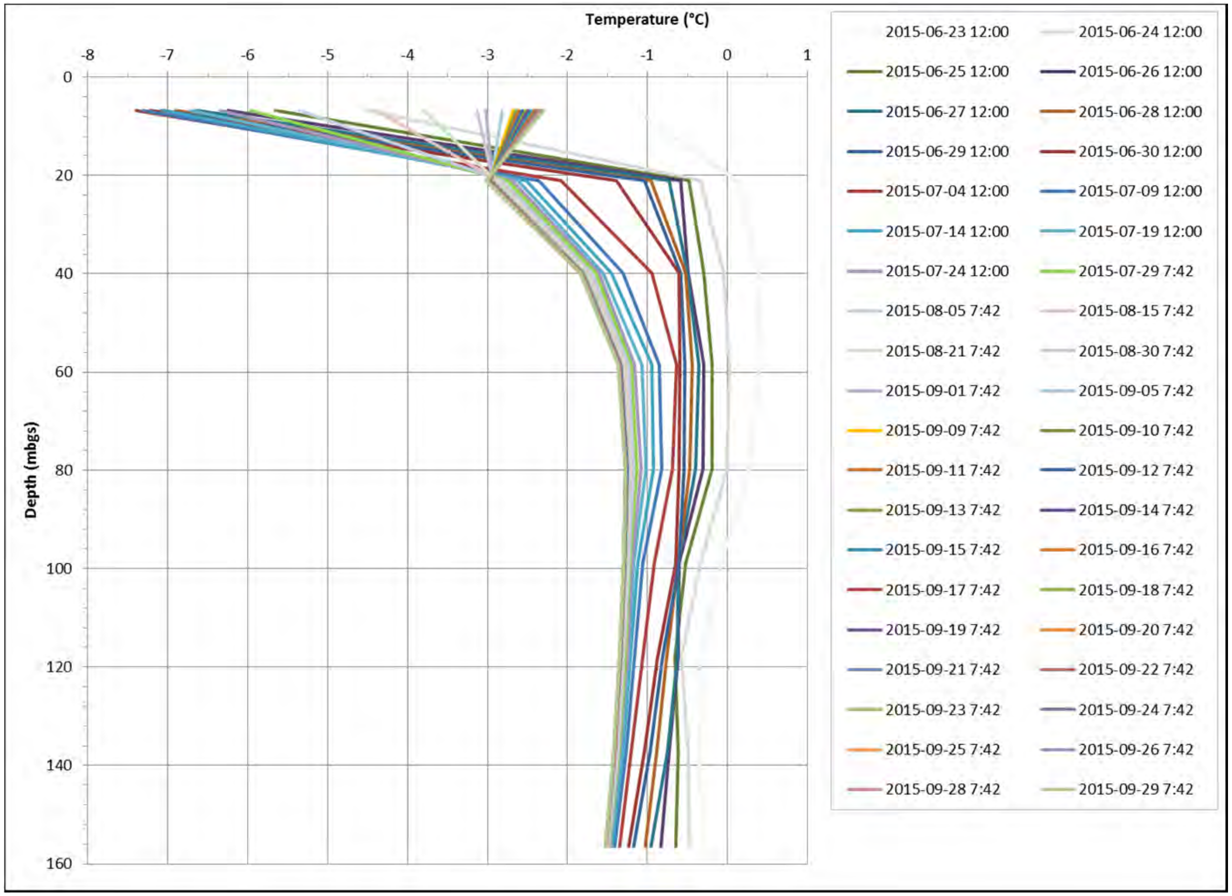
1. Thermsitor holes are all inclined: AMQ15-295 (-45 deg); AMQ15-306 (-45 deg); AMQ15-324 (-45 deg); AMQ15-349A (-45 deg); AMQ15-421 (-51 deg); AMQ15-452 (-50 deg);

0	23SEPT'15	ISSUED WITH LETTER	REW	MBG
REV	DATE	DESCRIPTION	PREP'D	RVW'D

AMQ15-294 – Ground Temperature Profile

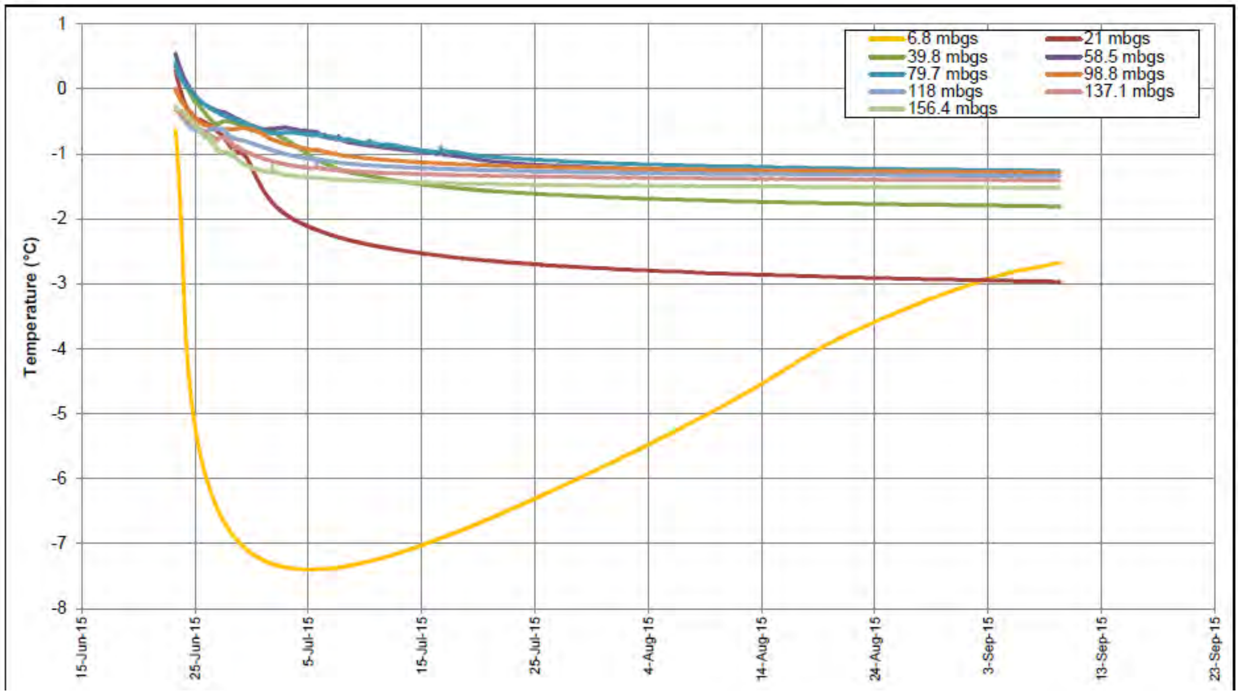


AMQ15-294 – Ground Temperature with Depth



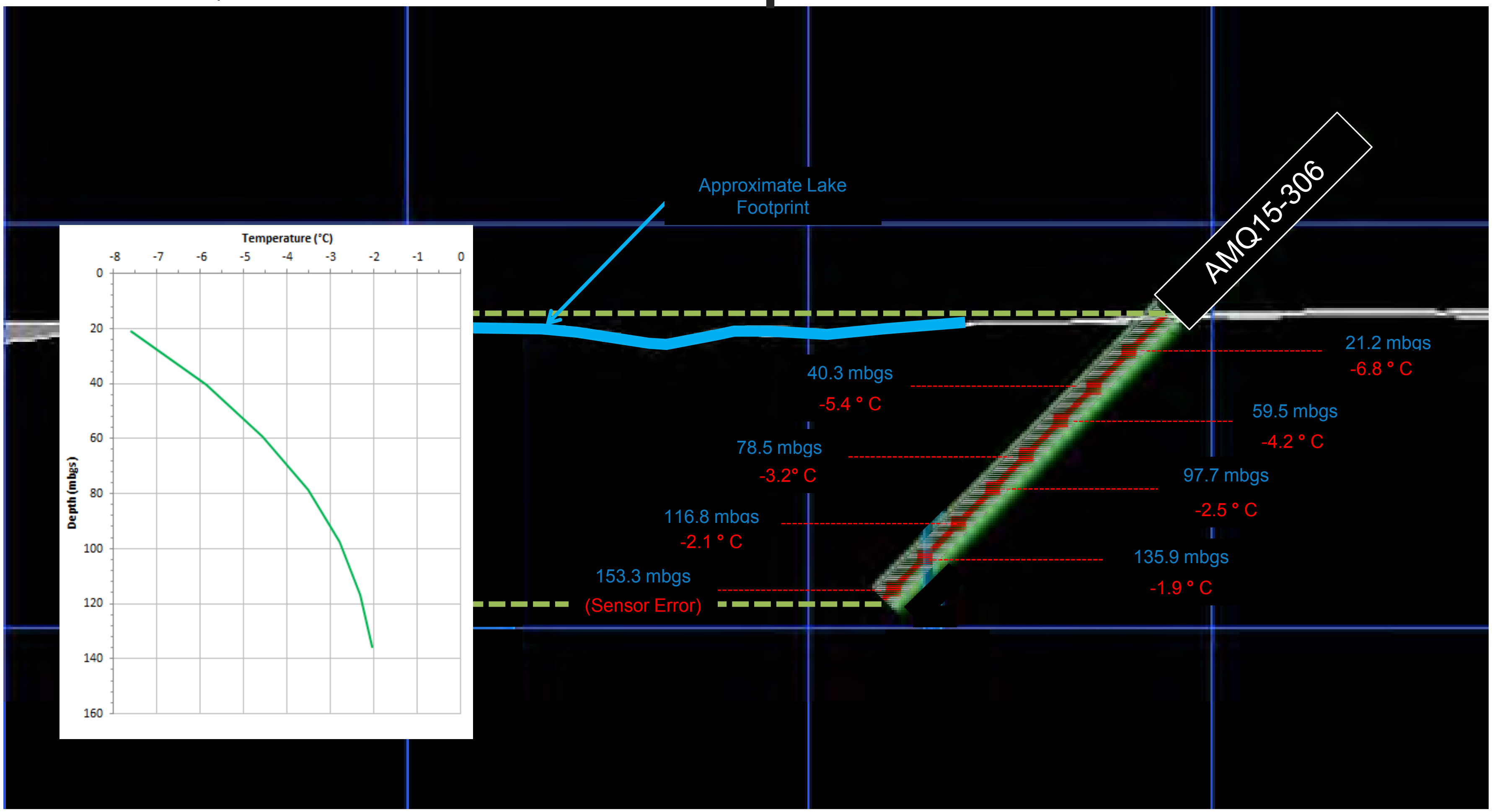
Knight Piésold

AMQ15-294 – Ground Temperature with Time



Knight Piésold

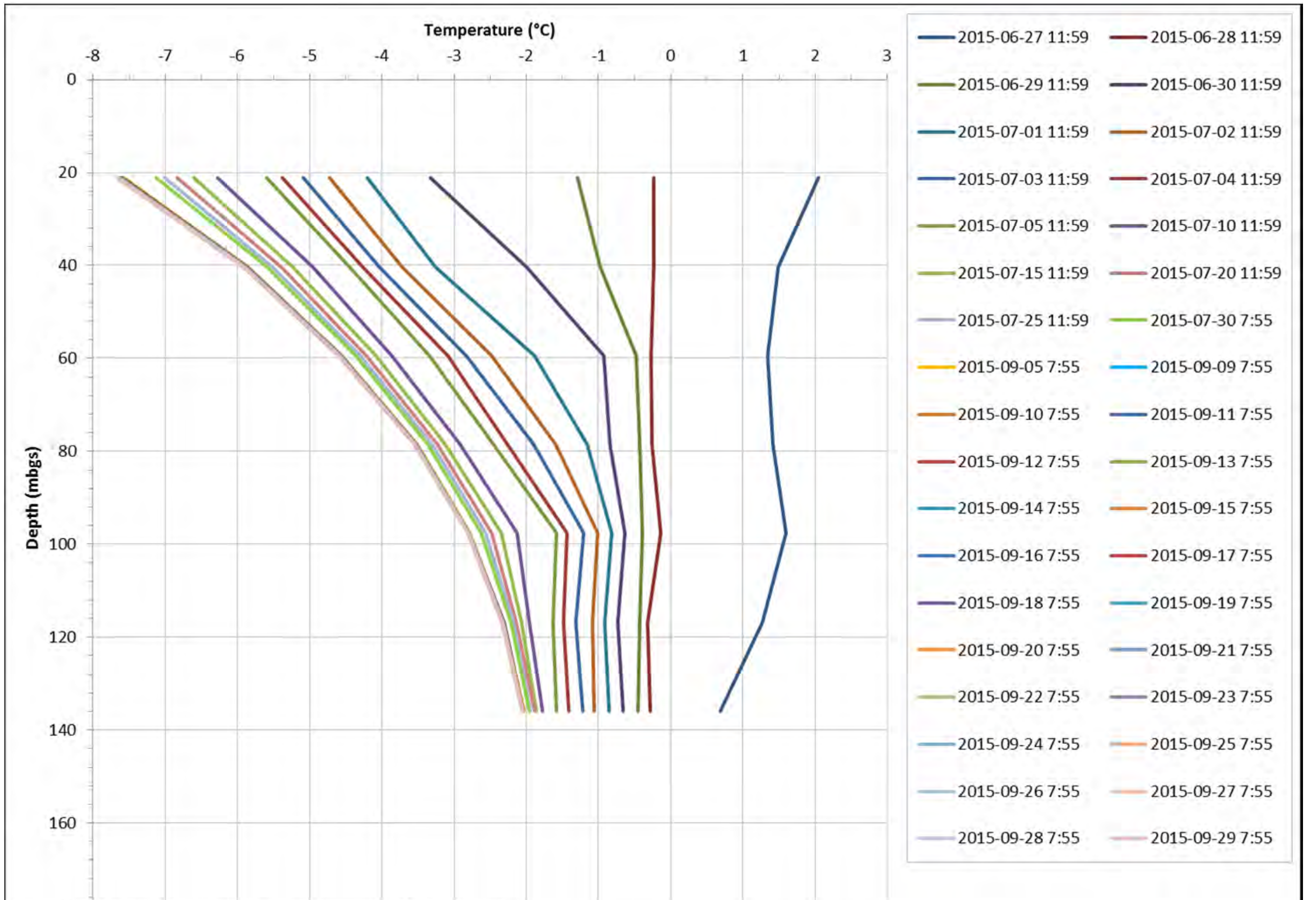
AMQ15-306 – Ground Temperature Profile



Knight Piésold

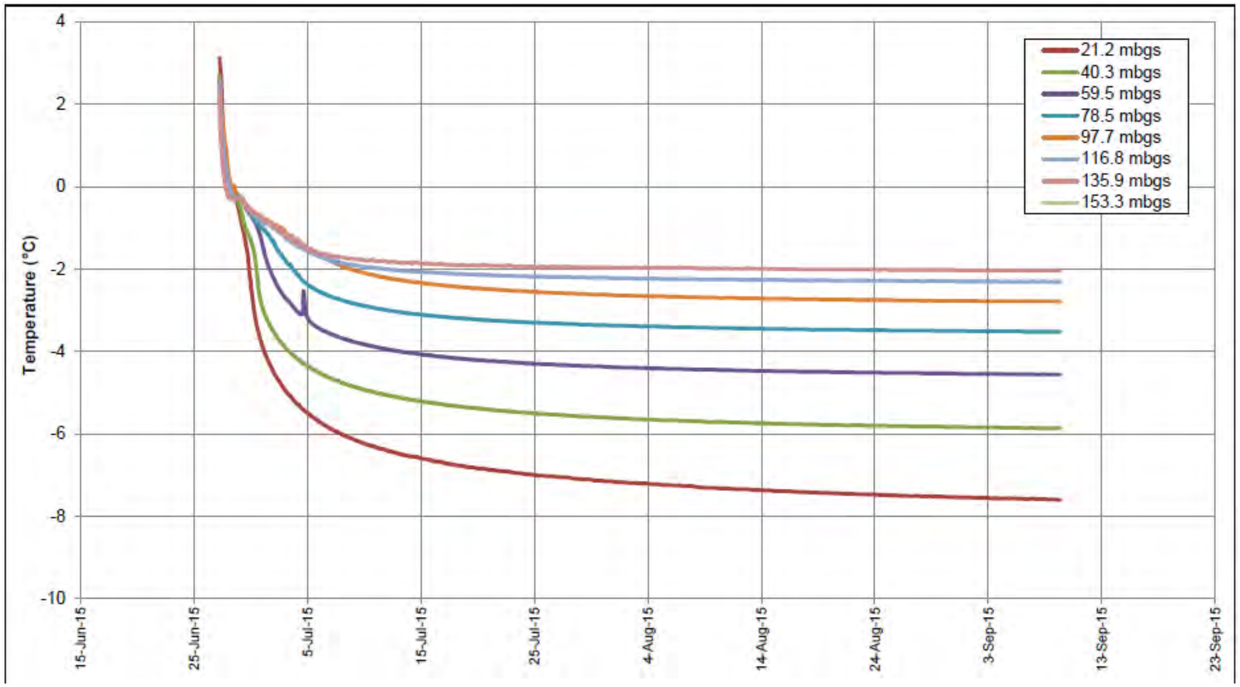
Knight Piésold

AMQ15-306 – Ground Temperature with Depth

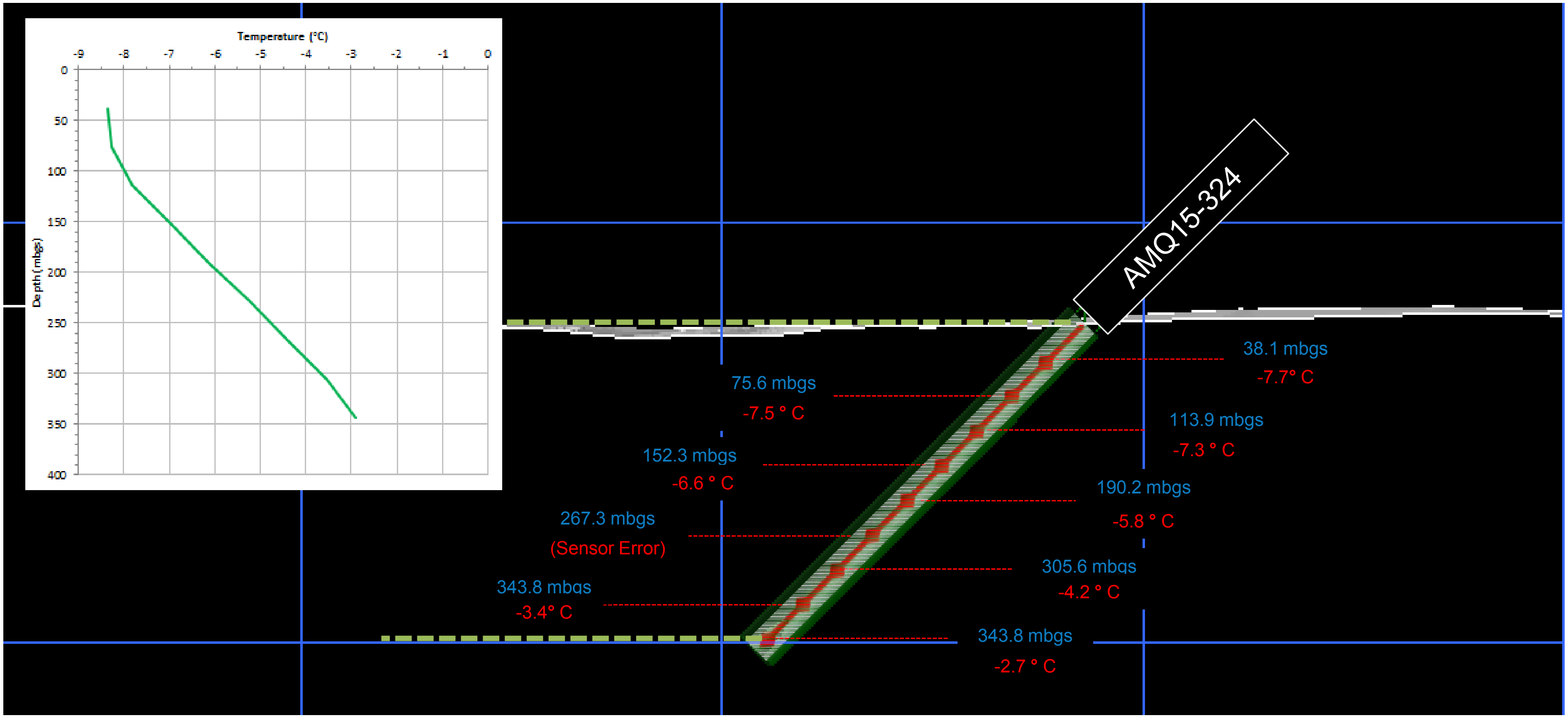


A	02OCT'15	ISSUED FOR INFORMATION	REW	-
REV	DATE	DESCRIPTION	PREP'D	REV'D

AMQ15-306 – Ground Temperature with Time

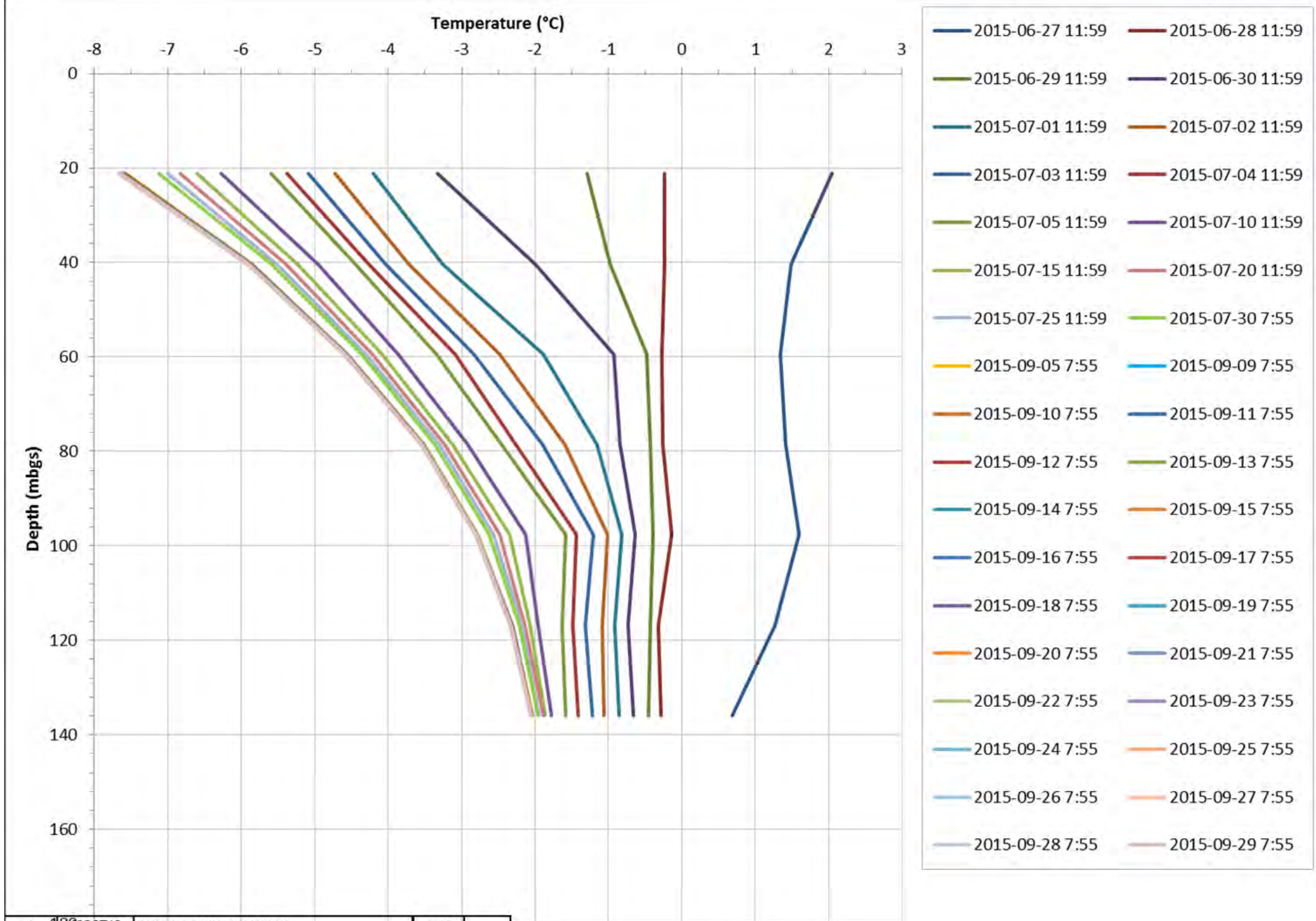


AMQ15-324 – Ground Temperature Profile



Knight Piésold

AMQ15-324 – Ground Temperature Profile

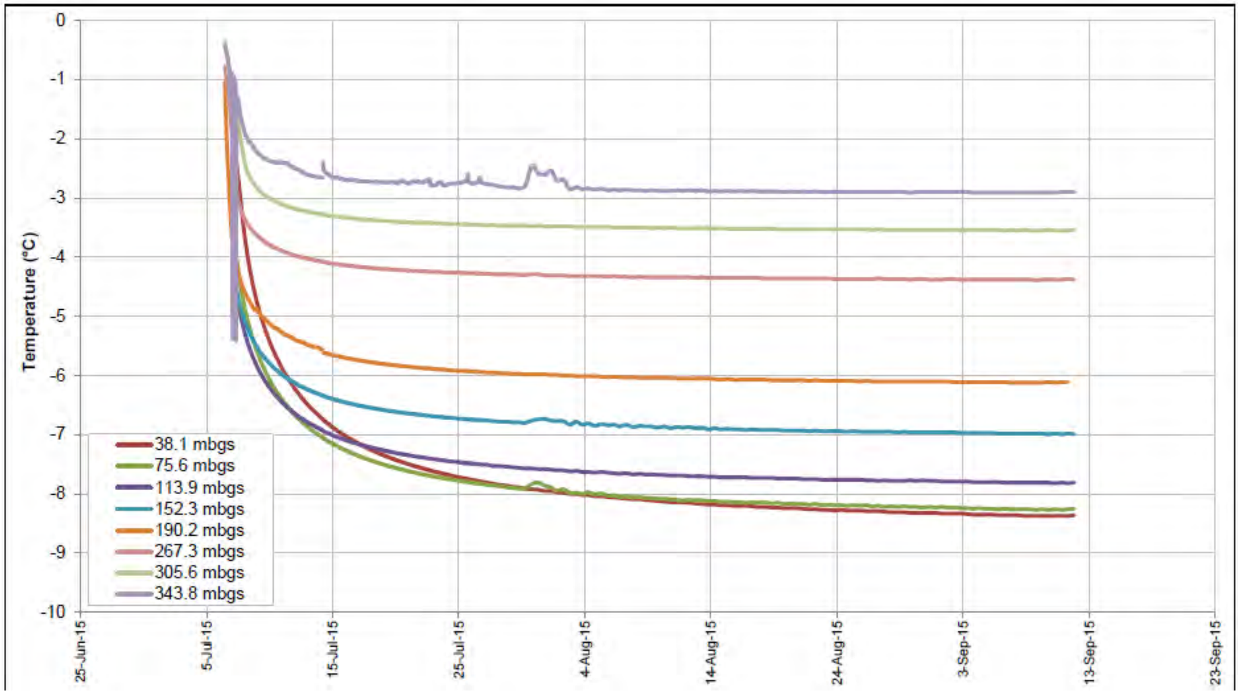


A	19OCT'15	ISSUED FOR INFORMATION	REW	-
REV	DATE	DESCRIPTION	PREP'D	REV'D

Knight Piésold

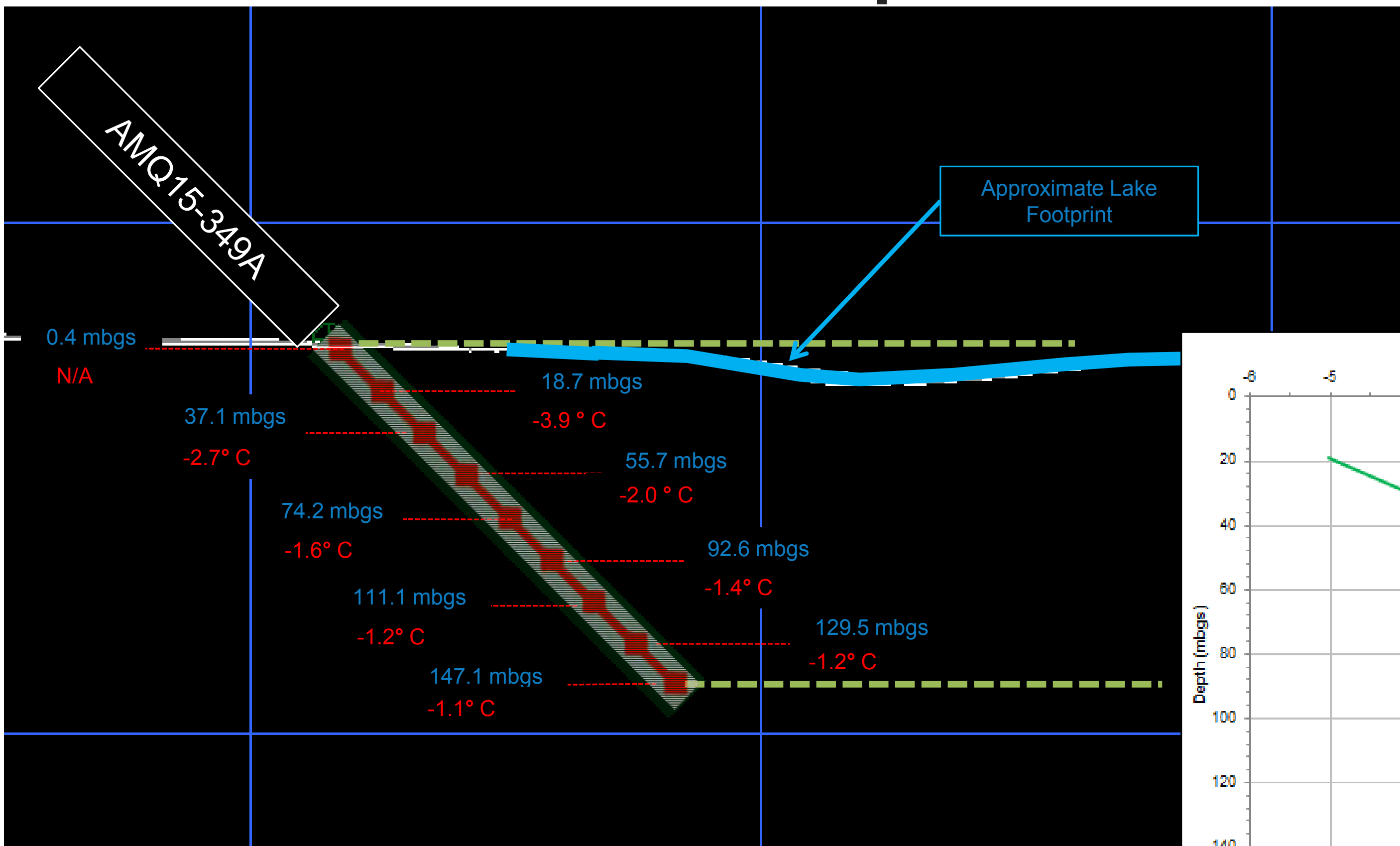
AMQ15-324 – Ground Temperature with Time

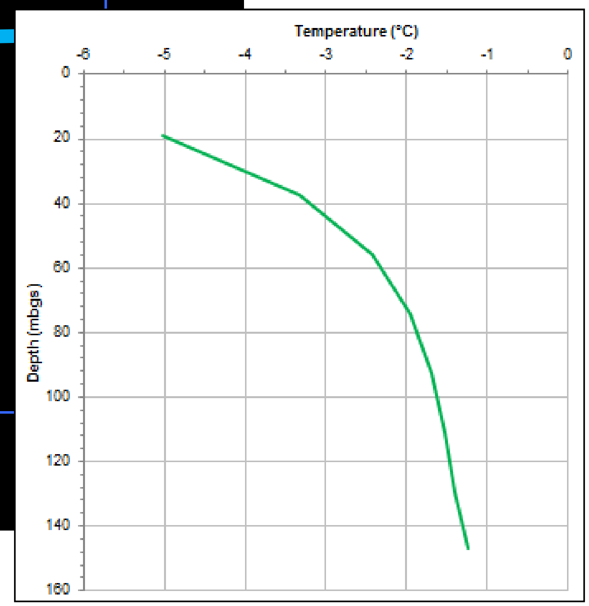
BP2



Knight Piésold

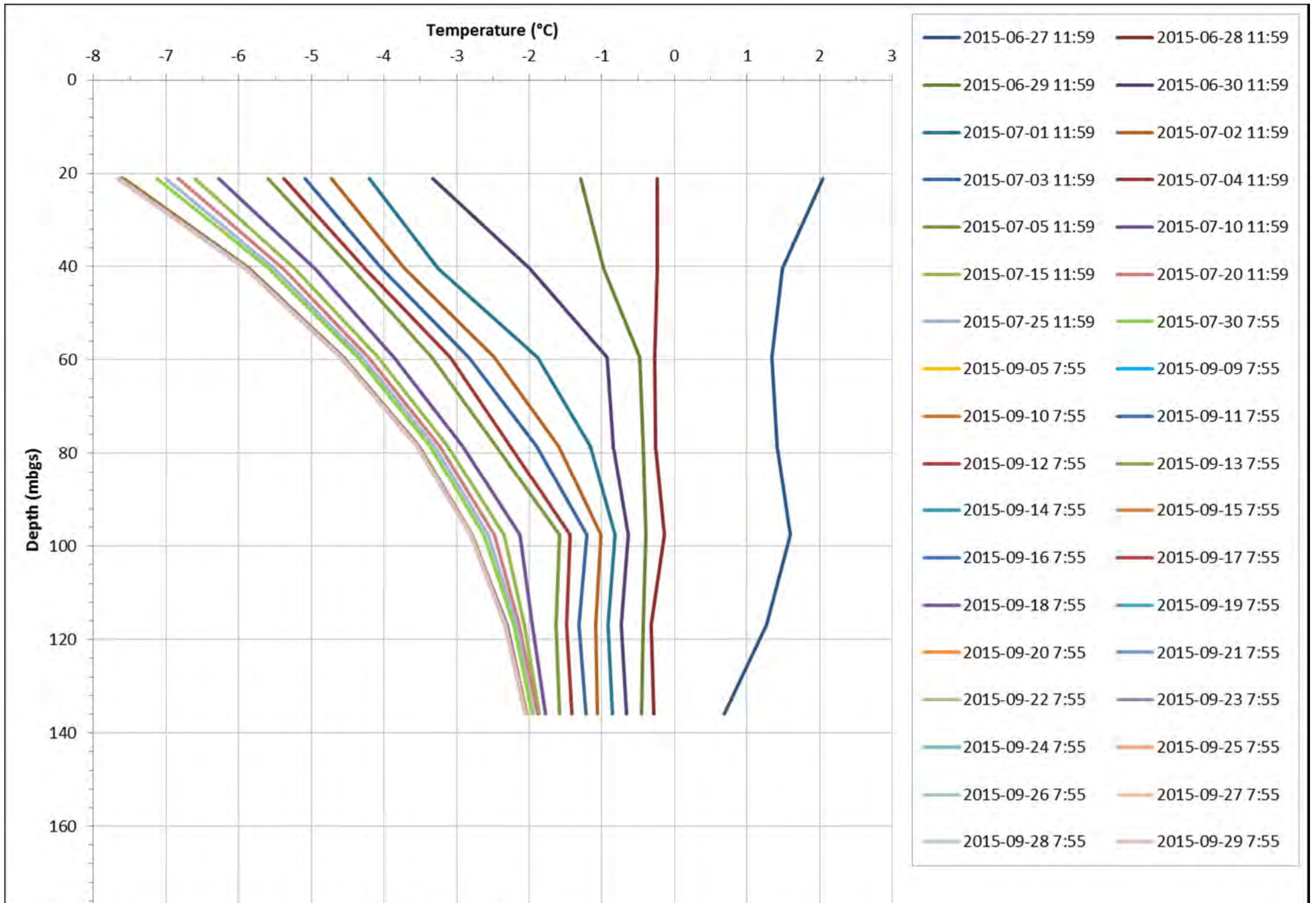
AMQ15-349A – Ground Temperature Profile





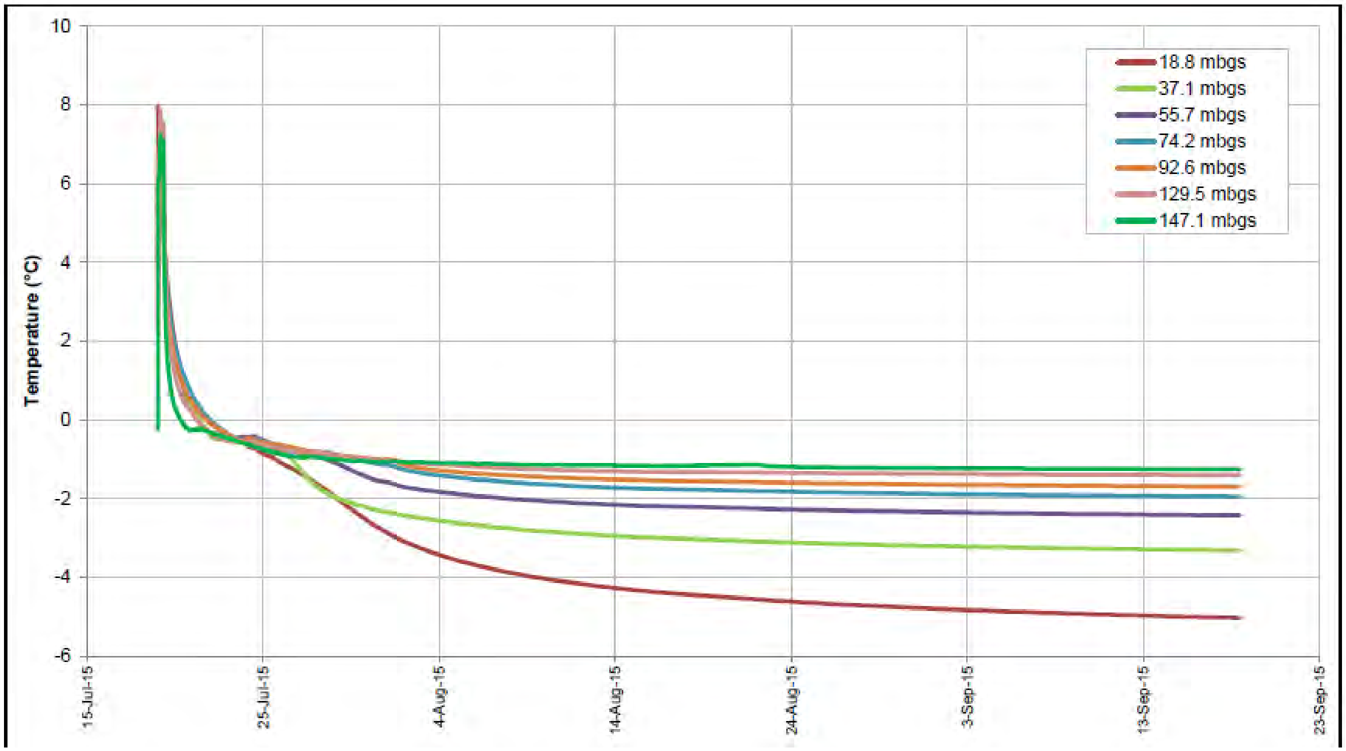
Knight Piésold

AMQ15-349A – Ground Temperature Profile



A	20OCT'15	ISSUED FOR INFORMATION	REW	-
REV	DATE	DESCRIPTION	PREP'D	REV'D

AMQ15-349A – Ground Temperature with Time



Knight Piésold