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Client: **AGNICO-EAGLE MINES LIMITED – MEADOWBANK MINE**

Project: TSFE PROJECT - IN-PIT TAILINGS DEPOSITION
DETAILED ENGINEERING STUDY

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NOTICE TO READER

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1.0 INTRODUCTION

Agnico Eagle Mines Limited (AEM) is planning to develop the Whale Tail Pit, a satellite deposit on Amaruq property, as a continuation of mine operations and milling at the Meadowbank Mine. The Amaruq property is about 408 km² located on Inuit Owned Land, approximately 150 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 presents the location of the Meadowbank Mines site.

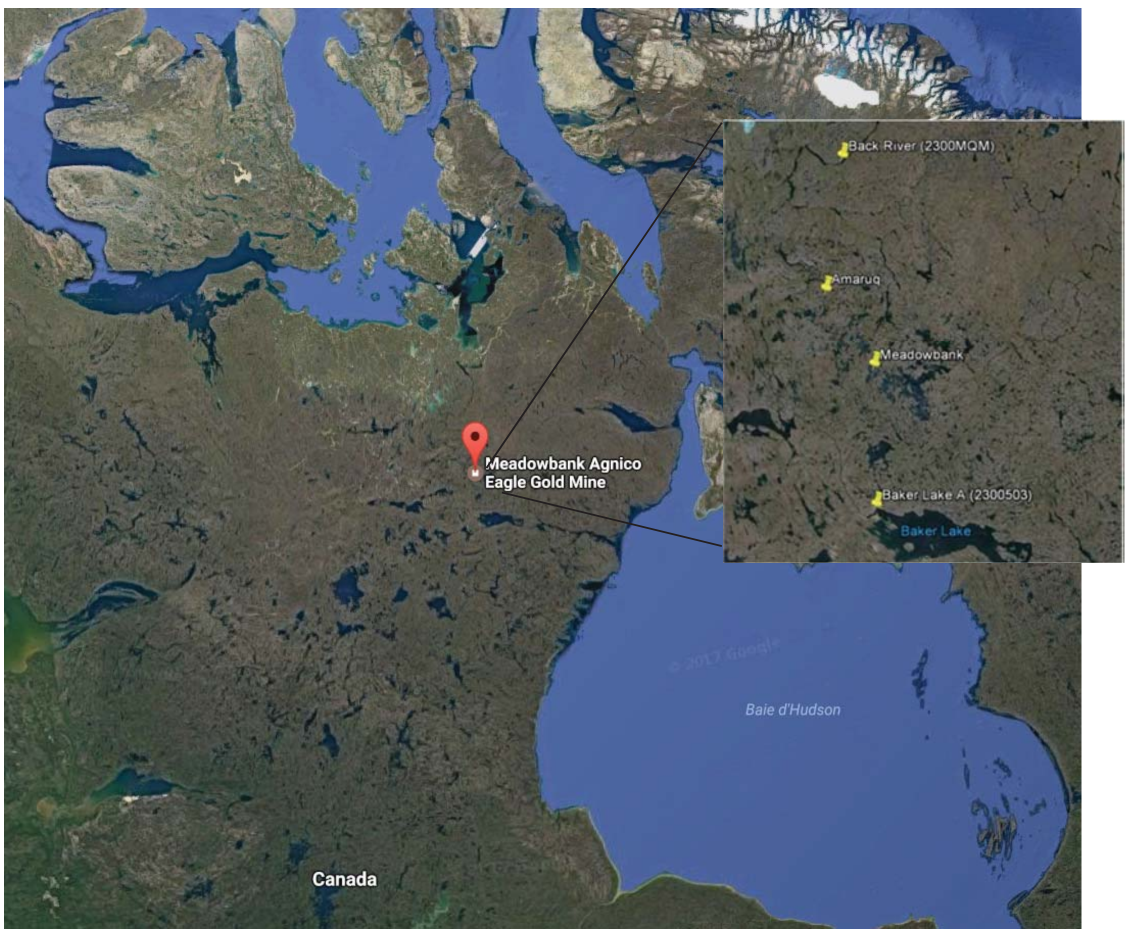

Figure 1 : Meadowbank mine site location

Meadowbank tailings are currently stored within the Tailings Storage Facilities (TSF), North and South Cells. To develop the Whale Tail Pit, additional tailings storage is required. Various studies have been carried out to explore options for storing the tailings waste generated from the Amaruq deposit. In 2016, SNC-Lavalin (SLI) was retained by AEM to conduct a scoping study for the Phase 2 of the TSF Expansion. A series of options were evaluated during the scoping study phase including in-pit tailings deposition in Portage Pits A&E (end-of-pipe deposition), internal structure tailings deposition over North and South Cells (end-of-pipe deposition); and filtered tailings deposition over North and South Cells. In-pit tailings deposition was selected as the preferred option to store tailings waste produced from the Whale Tail Mine. A prefeasibility study was conducted to develop a 3D hydrogeological numerical model to assess potential contaminant transport from in-pit tailings disposed in Portage Pit A, Pit E and Goose Pit. Field work has also been carried out to refine hydrogeological context of potential seepage areas.

SLI was retained by AEM to carry out the Detailed Engineering Study of the in-pit tailings deposition at Goose and Portage pits. The main objective of the study is to update the 3D hydrogeological model developed during the PFS with the latest field and laboratory results. The modelling work aims to assess the potential impacts from the in-pit tailings deposition on groundwater quality and the receptors.

The scope of work included the following objectives:

- Review past hydrogeological reports and studies carried out at Meadowbank site;
- Update the conceptual model (geology, hydrogeology and permafrost) with findings from the 2017 hydrogeological field investigation;
- Review the major geological structures, refine modelling parameters, and incorporate to the 3D model all relevant major geological structure data, and data obtained at identified potential seepage paths from Portage Pit A, Portage Pit E, Central Dump and Goose Pit;
- Update the hydrogeological 3D numerical FEFLOW model with findings from the 2017 field investigation program;
- Review tailings laboratory tests (lixiviation tests and geochemical tests data) and consider those results in the hydrogeological model;
- Update model calibration and sensitivity analysis for groundwater flow parameters including hydraulic conductivity of various lithology and lake levels.

Contaminant transport simulations following in-pit tailings deposition include:

- Update contaminant transport simulations based on the updated hydrogeological 3D model;
- Incorporate latest laboratory testing on Amaruq's tailings to the model;
- Review sensitivity analysis on transport parameters to evaluate their influence on predictive scenarios;
- Define the geochemical conceptual model and reaction kinetics for 2 main contaminants of concern (one which is considered as the most mobile contaminant and the other for the most toxic);
- Define water quality criteria and threshold limits for contaminants of concern;
- Carry out transport modelling in groundwater for 2 contaminants of concern, including retardation processes;
- Revise the groundwater monitoring program, considering the existing network.

This technical note presents background information, the hydrogeological conceptual model, the construction and calibration of the model, the contaminant transport modelling along with sensitivity analysis on selected hydrogeological parameters.

2.0 BACKGROUND INFORMATION

2.1 Climate and hydrology

The Meadowbank Mine site is located within the Low Arctic ecoclimatic zone known as one of the coldest and driest regions of Canada. Arctic winter conditions occur from October through May, with temperatures ranging from +5℃ to -40℃. Summer temperatures range from -5℃ to +25℃ with isolated rainfall increasing through September.

The topography of the area consists of low, rolling hills with a range of 70 m between approximately 130 and 200 m above sea level. Lakes and ponds are abundant occupying about 20% of the area. The vegetation includes lichens, mosses, shrubs, heaths, grasses and sedges (Cumberland Resources Ltd., 2005a).

For a typical average year, total rainfall and snowfall melt equivalents are 147 mm/yr and 102 mm/yr, respectively. After evapotranspiration (80 mm/yr) and snow sublimation (72 mm/yr), the net precipitation on ground surface was estimated to be 119 mm/yr for a typical year (SNC-Lavalin, 2016).

The long-term arithmetic mean annual air temperature for the Meadowbank site is calculated to be approximately -11.1℃. Air temperatures at the Meadowbank area are, on average, about 0.6℃ cooler than Baker Lake air temperatures, and extreme temperatures tend to be greater in magnitude. This climatic difference is thought to be the effect of a moderating maritime influence at Baker Lake.

The prevailing winds at the Meadowbank site for both the winter and summer months are from the northwest. A maximum daily wind gust of 93 km/h was recorded on September 1, 2009. Light to moderate snowfall is accompanied by variable winds up to 70 km/h.

2.2 Geological setting

2.2.1 Regional geology

The Meadowbank site is located in the Canadian Shield, the largest physiographic region of Canada. The project site is underlain by a sequence of Archaean greenstone (ultramafic and mafic flow sequences), and metasedimentary rock that has undergone polyphase deformation resulting in the superposition of at least two major structural events. Enclosed within the greenstone are volcaniclastic sediments, felsic-to-intermediate flows and tuffs, sediments (greywackes), and iron oxide formations. The sequence also contains sericite schists, which are believed to be altered felsic flows or dikes.

2.2.2 Local geology

2.2.2.1 Surficial geology

The project area is covered laterally by deposits of glacial till. This till unit can be described as a sandy till, having a fines (silt and clay) content of 30% to 40%, based on grain size analyses (Golder, 2005). In addition to till deposits, local occurrences of glaciofluvial sands and gravels have been noted. Till has been observed in the Central Dike area (Golder, 2008a) and at the lake bottoms. Lakebed sediments can reach several meters in thickness

(Cumberland Resources Ltd, 2005b). The available exploration borehole data obtained from AEM indicated that the till thickness at the contact zone of till and bedrock varies from 2.5 to 7 m, with an arithmetic mean value of 5.3 m.

2.2.2.2 Bedrock geology

Iron formations (IF), intermediate volcanics (IV) and ultramafic volcanics (UV) are the three main rock types which compose the Portage, Goose Island and Vault deposits. The fourth, less common rock type, quartzite (QTZ) may form portions of the upper west pit wall of the Goose Island and Portage deposits. The ore in the Portage deposit is hosted by the iron formation rocks whereas the ore in the Vault deposit is hosted in intermediate volcanic rocks. The ultramafic volcanic rocks are variably altered, containing serpentinite, chlorite, actinolite, and talc. The iron formations, intermediate volcanics, and quartzite have good rock mass quality. The ultramafic rock is expected to have fair to good rock mass quality.

According to AEM's observations on rock core drilled from the exploration boreholes, sheared and fractured rock was observed at the contact zones between rock units, for example quartzite and ultramafic volcanics at Goose Pit western wall. In addition, following AEM field observations of groundwater seepage from pit walls, water bearing fractures are mainly associated with the contact between the quartzite and the ultramafic formations, particularly in Goose Pit.

Figure 2 presents the bedrock geology at the Meadowbank site. Figure 3 to Figure 5 are the cross-sections generated from the AEM 3D geological model to illustrate the general lithology contacts and dips of the four rock types. The locations of these cross sections are also shown on Figure 2. The geological model is limited to the ore body zone.

2.2.3 Structural geology

Based on strong lineament trends through the bedrock outcrops (Golder, 2005), various geotechnical studies and Annual Review of Pit Wall Stability reports, two main faults have been identified for which the general dip and dip direction are described below:

- The Bay Fault, oriented north-south, is roughly parallel to East Dike and Goose Dike. This fault dips with a 70 degree angle to the west. Bay Fault extends northward along the western flank of the Portage Pit A deposit (Golder, 2005).
- The Second Portage Fault follows the former Second Portage Lake arm, beneath the North Cell, South Cell, Central Dike, Central Dump and East Dike. This fault trends to the southeast and dips at 70 degrees to the southwest.

As mentioned, other relevant water bearing features have been identified in the project area such as Quatzite/Ultramafic (Qz/UM) rock contact which outcrops mainly on western flank of Goose Pit as well as the North Channel zone which was identified at Pit E along the southeastern wall.

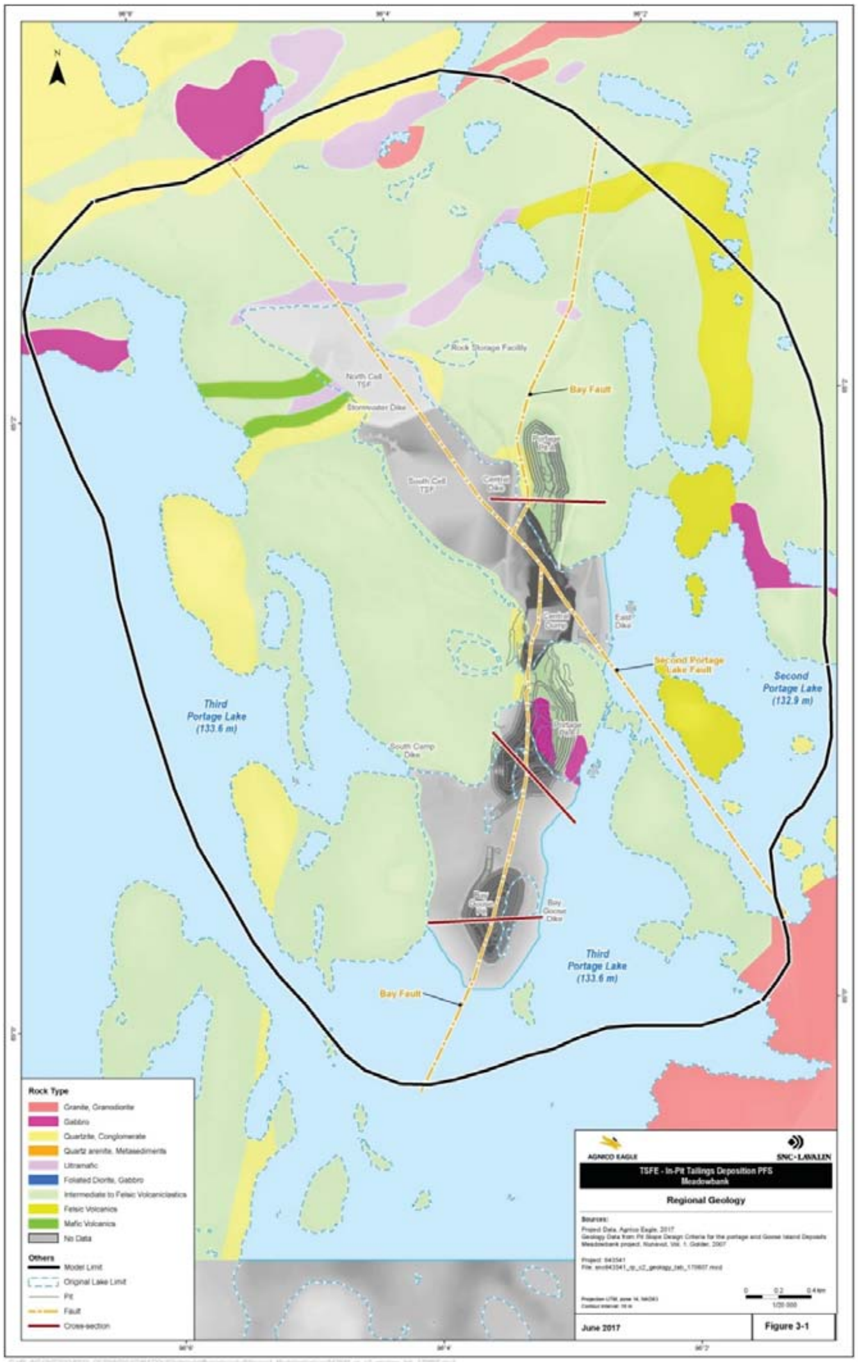

Figure 2 : Regional geology

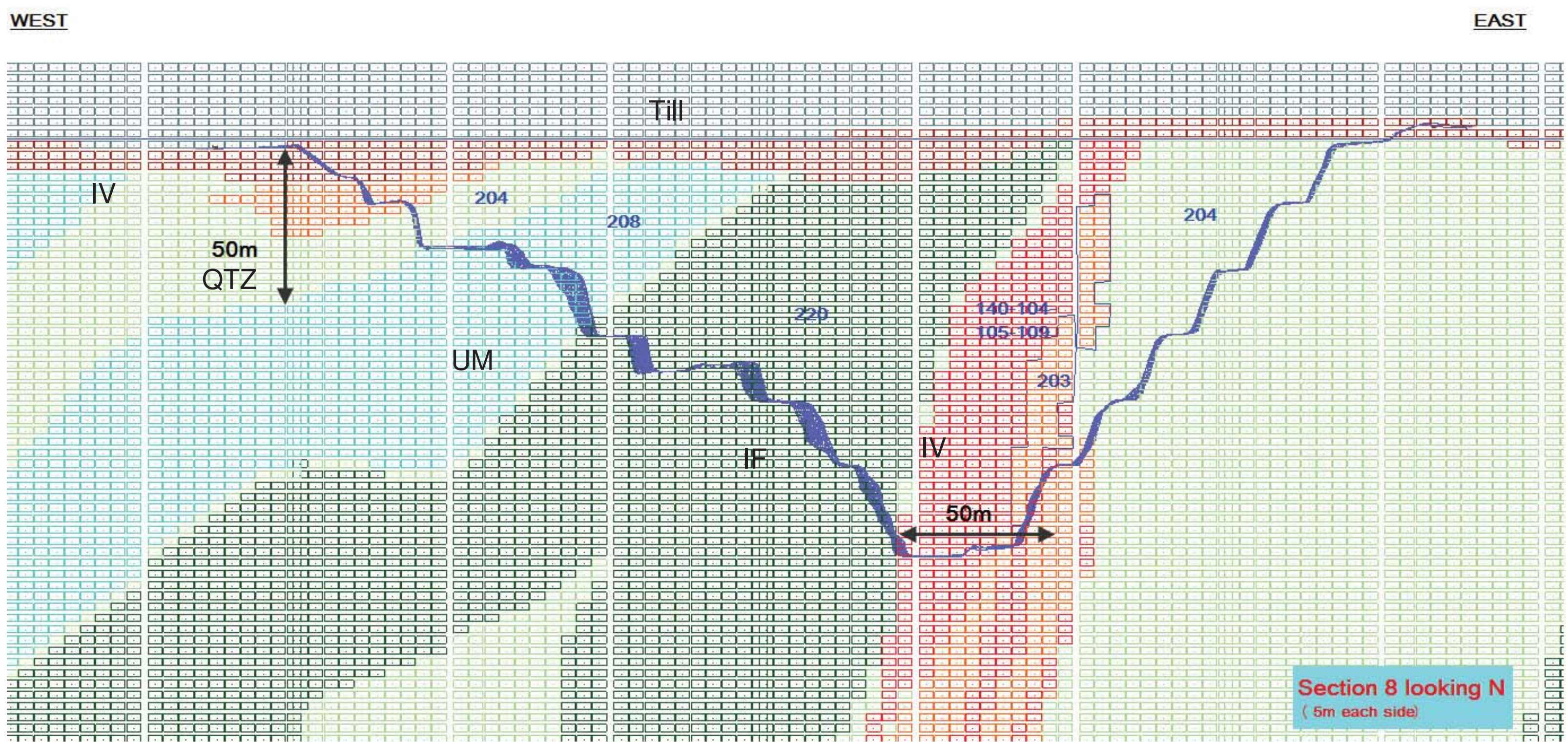

Figure 3 : Goose Pit west-east cross-section

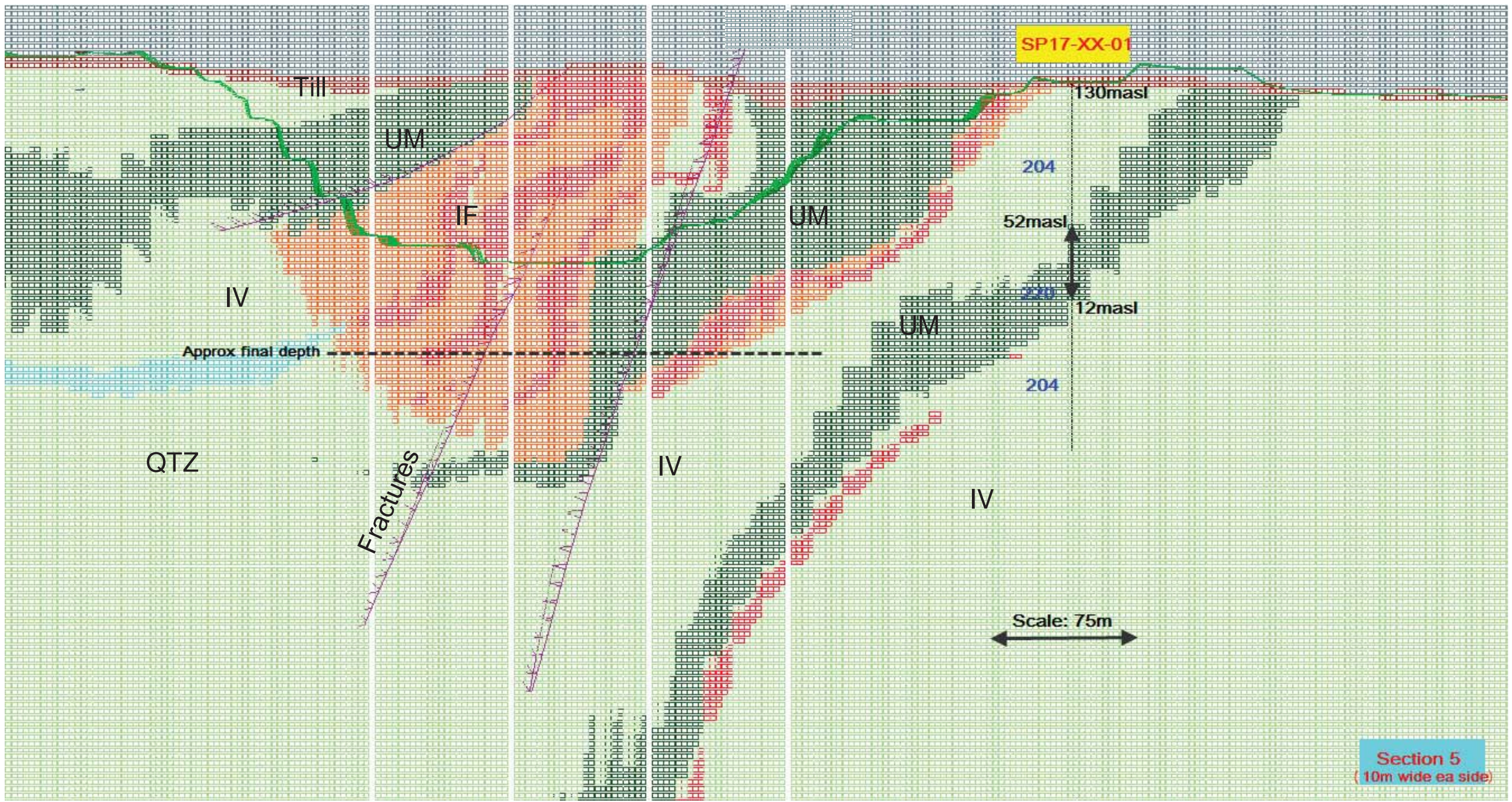

Figure 4 : Portage Pit E northwest-southeast cross-section

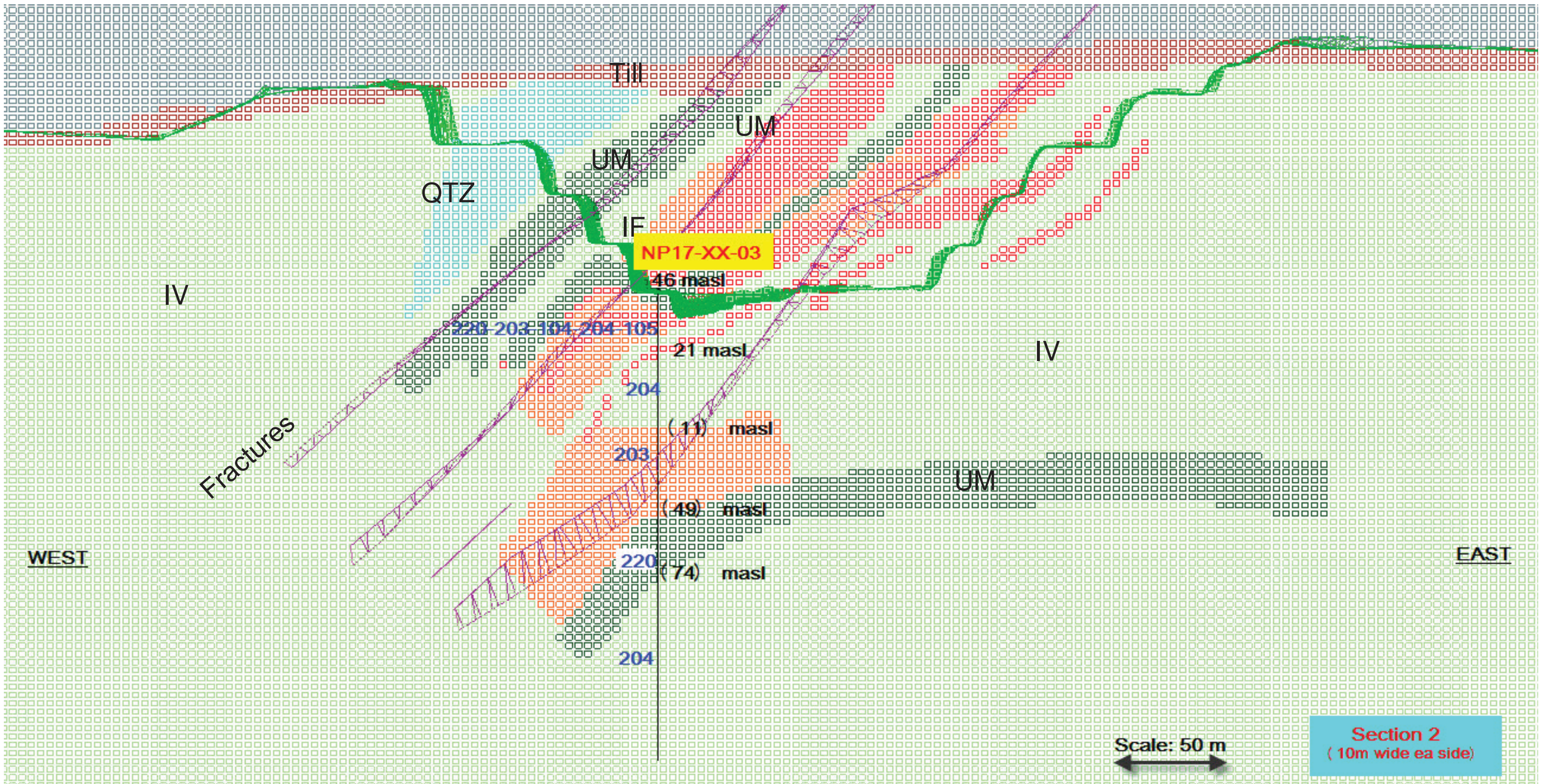

Figure 5 : Portage Pit A west-east cross-section

2.3 Permafrost and *in-situ* ground ice conditions

The Meadowbank mines site is located in an area of continuous permafrost where the average daily temperature is about -12°C. Taliks, zones of year-round unfrozen ground, are present in areas where the water depth is greater than 1.5 to 2.5 m. As presented in the Baseline Physical Ecosystem Report (Cumberland Resources Ltd., 2005a), the permafrost depth at the Meadowbank site was estimated to be in the range of 450 to 550 m depending on the proximity to lakes. In areas with shallow overburden, the depth of the active layer (seasonally thawed layer) is estimated to be about 1.3 m, up to about 4 m adjacent to lakes, and up to 6.5 m beneath the streams connecting Third Portage and Second Portage lakes. The in-situ ground ice content of permafrost soil and rock in the Meadowbank region is estimated between 0% and 10% (representing dry permafrost). Most of the Meadowbank project areas are underlain by dry permafrost. Taliks beneath the Third Portage Lake and Second Portage Lake are expected to extend down to the deep groundwater regime.

The permafrost lateral extension has been delineated during the prefeasibility study (SLI, 2017) assuming that the limit corresponds to the shoreline minus a 1.5 m water depth within large lakes. This assumption matches well with available thermistor data. Existing active and inactive thermistor data were also reviewed during the PFS to estimate the maximum depth of the permafrost areas. Figure 6 shows the location of these thermistors as well as permafrost extent and talik areas. Although most of the available thermistor data were limited in depth (maximum of 173 mbgs, average depth of 45 mbgs), in time (average record duration of 3.6 years, maximum 7.7 years) and in spatial cover, estimates of maximum permafrost depth, active layer depth and geothermal gradient were possible and can be found in the prefeasibility study SLI (2017). The depth of the active layer ranges from 1 to 1.5 m depending on overburden thickness, vegetation and organics, and proximity to lakes. The average geothermal gradient from these profiles is estimated to be 0.06°C/m, but it is normally inferred from deeper temperature profiles than those existing at Meadowbank. More recently, additional thermistors have been installed in potential seepage paths related to in-pit deposition project (4 thermistors in 2017 IPD boreholes and one in Central Dump) to improve characterization of the thermal and hydrogeological conditions.

The existing thermal regime at the Portage Pit area is complex due to the presence of surrounding lakes as well as the mine development including construction of the protection dikes, stockpiles and excavation of the open pits. Based on the data obtained from thermistors installed along the protection dikes and at discrete locations within the mine area, it appears that permafrost is more likely present at the north portion of Portage Pit E and Pit A, and on the eastern portion of Goose Pit (SLI, 2017a; SLI, 2018c).

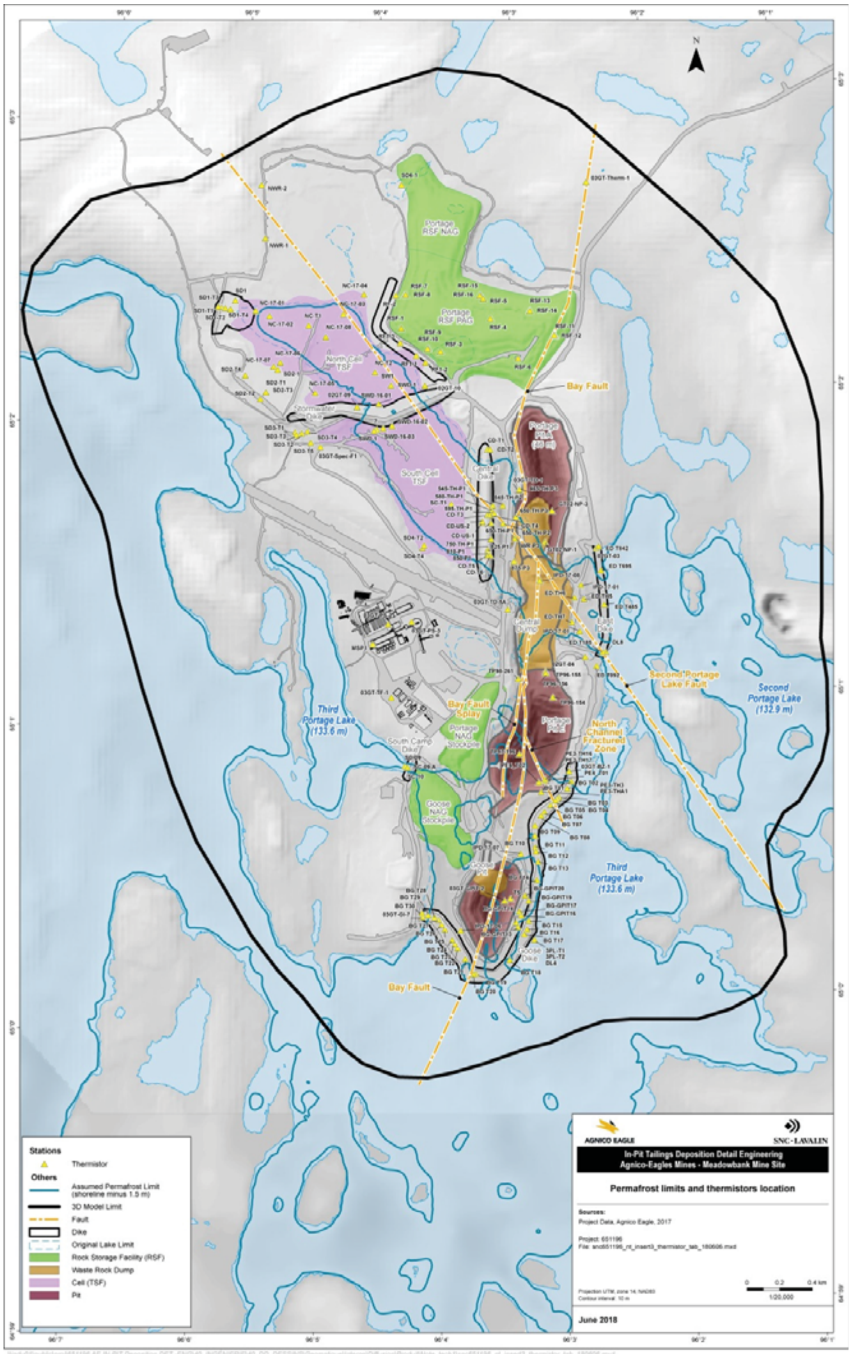

Figure 6 : Permafrost limits and thermistor locations

2.4 Previous hydrogeological and thermal studies

A hydrogeological overview was first presented in the Baseline Physical Ecosystem Report carried out by Cumberland Resources Ltd. (2005a).

Golder (2004b) completed a numerical groundwater flow model using MODFLOW, a finite-difference groundwater flow modelling program, to estimate groundwater inflow to Goose Pit, Portage Pit A and Pit E. The total mine groundwater inflow was estimated to be 900 m^3/d at the end of mining.

Various other studies (SLI 2015; AEM 2016a; Golder 2017) have recently been carried out at the Central Dike to evaluate seepage below the dike. A geophysical study undertaken by Willowstick Geophysical Investigation (2015) shows two (2) main seepage paths located at the till and bedrock contact beneath the Central Dike.

TetraTech (2016) conducted field investigations and a stability analysis of the south wall of Pit E. Field observations confirmed the existence of a talik area in contact with Third Portage Lake and located at the southeastern corner of Portage Pit E, leading to higher hydraulic pressure and instability in this portion of the wall. Coupled seepage and 2D thermal modelling was carried out to assess the impact of passive (pressure release horizontal boreholes) and active (vertical pumping well) depressurization mitigations. The south wall of Pit E remains a potential seepage path from pit to the Third Portage Lake.

AEM has developed a monitoring well network since 2003 for their Annual Groundwater Quality Report (AEM, 2003 to present). SLI (2017a; 2017b) has been recently involved in the 2016 and 2017 Annual Groundwater Quality Report and the Groundwater Quality Program.

Previous hydrogeological findings and comprehension have been integrated into this work.

2.5 Hydrogeological general context

Two (2) main groundwater flow regimes were previously identified at the Meadowbank site: (1) a shallow groundwater regime located in the active layer near the ground surface and (2) a deep groundwater regime beneath the permafrost (Cumberland Resources Ltd., 2005a). Sub-permafrost groundwater is also called regional groundwater.

2.5.1 Shallow groundwater flow regime

During the period of late spring to end of summer, the temperatures at the Meadowbank site are above 0^oC which causes the active layer to thaw, creating the shallow groundwater flow regime. Locally, groundwater in the active layer flows to local depressions and ponds that drain to Second and Third Portage lakes or flow directly to Second and Third Portage lakes. The shallow groundwater flows in the overburden till with the hydraulic conductivity ranges between $3x10^{-4}$ and $1x10^{-7}$ m/s (Cumberland Resources Ltd., 2005a). According to Anderson and Morgenstern (1973), permafrost reduces the hydraulic conductivity of the rock by at least one to two orders of magnitude. Thus, at Meadowbank, frozen rocks have very low permeability compared to that of the unfrozen rocks. As a result, the shallow groundwater flow regime has negligible hydraulic connection with the groundwater regime located below the permafrost, except where taliks exist.

Shallow groundwater flow is more likely associated to seasonal release of water from accumulated snow and surficial ground ice and thus, is considered as surface and sub-surface runoff components that are not taken into account in the subsequent hydrogeological modelling.

2.5.2 Deep groundwater flow regime

In areas of continuous permafrost, the deep groundwater regime is connected through taliks located beneath large lakes. According to Cumberland Resource Ltd (2005a), open taliks exist beneath Second and Third Portage lakes including the Second Portage Arm. The flow direction of the deep groundwater system is governed by the water elevation of major lakes to which it is connected. As such, groundwater flows from higher water elevations (hydraulic heads) to lower water elevations. Figure 7 shows large lakes elevation and gives a general appreciation of groundwater direction in Meadowbank area.

This deep groundwater flow regime context will thus be represented by the 3D hydrogeological model, developed below.

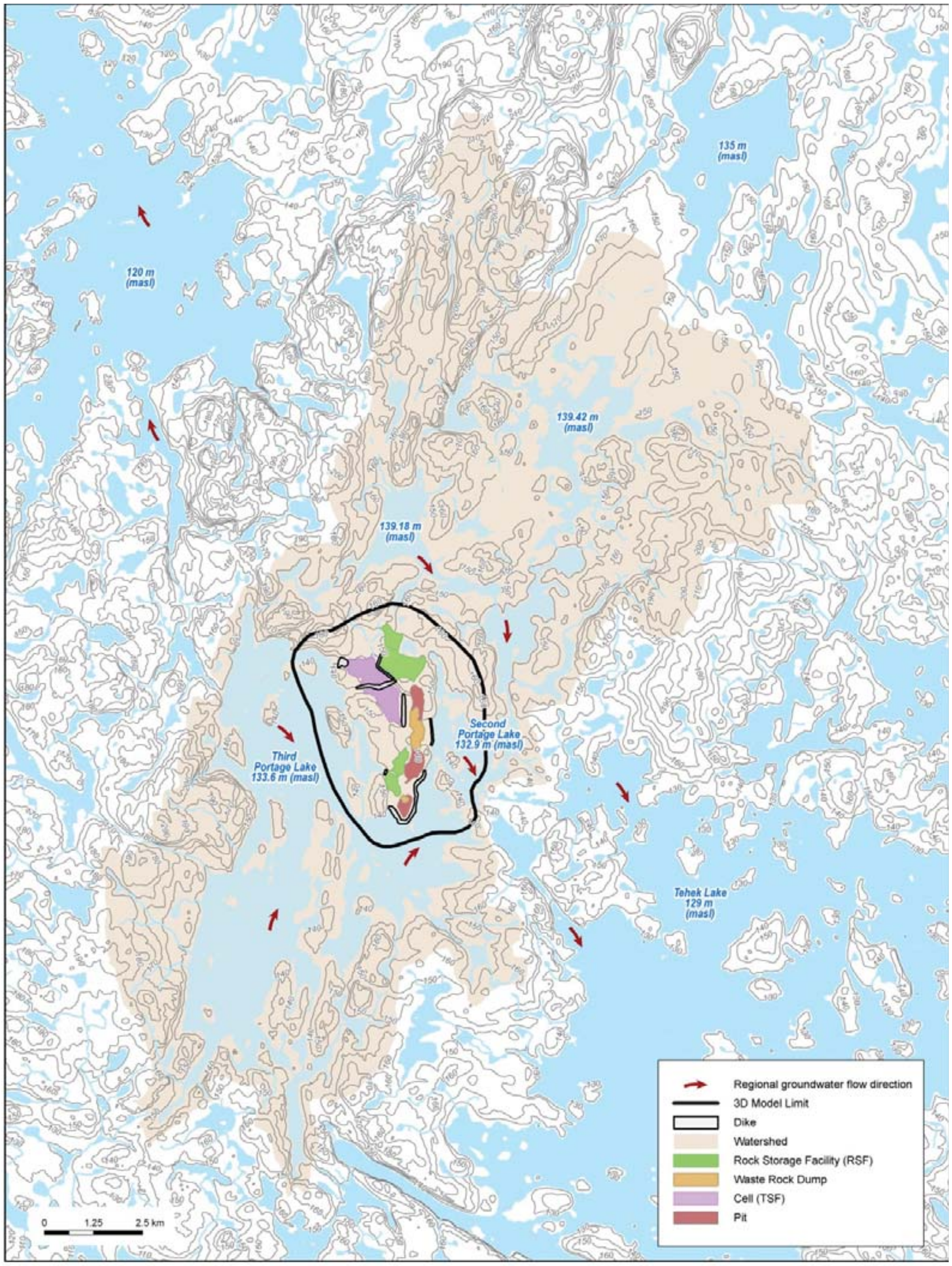

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Figure 7 : Large lakes level and regional groundwater flow paths

3.0 GROUNDWATER FLOW MODELLING

3.1 Groundwater flow conceptual model

A hydrogeological conceptual model gives the basic idea or constructed understanding of how systems and processes operate (Bredehoeft, 2005). As with all models, the quality of hydrogeological models depends on the quality of the information that can be gathered for its construction.

Two hydrogeological conceptual models were developed in this study:

- A first model was needed to represent groundwater flow during pits dewatering operations, and for calibration purposes; and
- A second model was developed for the mine post-closure period (after tailings in-pit deposition), to illustrate groundwater flow and contaminant transport patterns.

Both models were based on the available hydrological and hydrogeological information, as well as the up-to-date cryological information and knowledge obtained from previous hydrogeological studies. These data were complemented by geotechnical field investigation results collected over the years of mining and operations. Also, since hydrogeological conditions differ from one pit to the other, the hydrogeological conceptual model is presented, hereafter, by sector.

3.1.1 Open pit dewatering period

As mentioned, the first conceptual model representing the pit mining and dewatering period was used for calibration purposes with 2016 dewatering rates. Under pit dewatering, the natural groundwater flow pattern is temporarily modified and the flow converges toward the pits, which have the lowest piezometric levels of the groundwater system.

Portage Pit A and Central Dump

Portage Pit A is enclosed within the permafrost which limits groundwater inflow (Figure 8). The estimated permafrost depth in the area is more than 370 mbgs. During 2016, the Portage Pit A mining operation level was relatively stable, at an elevation of 46 masl (Figure 8 and Figure 9). The pit shell surface at this level will be imposed in the 3D model as a drainage surface where all water is extracted from the system.

Bay Fault follows the western wall of the pit but no significant seepage is expected here since the fault is entirely located in permafrost at the location of Pit A. The southeastern wall of Pit A, located on the border of the permafrost/open talik zone, is the main pathway for groundwater inflow as it is beside the open talik area of the former Second Portage Lake arm. This border is also in contact with the highly permeable material of Central Dump to a depth of 80 m (elevation of 60 masl) as shown in Figure 9, at the lowest point between Pit A and former Pit B. During the 2017 field study investigation, few water seepage zones were observed on the northern and southeastern pit walls which may confirm the presence of preferential groundwater flow paths.

However, thermistor data from IPD-17-08, located in Portage Central Dump (Figure 6), suggested that the dump material is partially frozen within the first 60 m (elevation of 70 masl). It also suggests that groundwater inflows from the talik zone (former Second Portage Lake arm) to Pit A might be relatively limited. The measured Central Dump water level was around 96 masl during the 2017 drilling campaign of IPD-17-08 and was under confining conditions, thus reinforcing the assumption of a partially frozen Central Dump material. The water level in Central Dump was therefore lower than in the Central Dike downstream (D/S) pond that is maintained by pumping at

115 masl and lower than the Second Portage Lake level (132.9 masl). It also shows that the dewatering of Pit A and Pit E on both sides of Central Dump is influencing its water level.

Portage Pit E

Portage Pit E is partially surrounded by permafrost (Figure 8) in its northern portion. Available thermistor data showed an extrapolated permafrost depth of 470 mbgs (-325 masl). The main talik area is located in the southeastern corner of the pit as confirmed in the pit wall stability analysis by TetraTech (2016) and with the review of thermistor data. At the beginning of 2016, Pit E mining was ongoing, but had stabilized at 4 masl. Groundwater level in Portage Pit E is assumed to be at the same level as its bottom depth. In the 3D hydrogeological model, a drain condition was fixed at that level to simulate pit dewatering.

Bay Fault and Bay Fault Splay extend from north to south of Pit E. Few hydraulic conductivity data were available specifically for the faults, but their hydraulic conductivities were generally assumed higher than the surrounding bedrock.

The north part of Pit E is located close to the former Second Portage Lake arm talik area. As was stated for Pit A, the upper part of the Central Dump is considered partially frozen which consequently limits groundwater inflow from this area. However, little groundwater seepages has also been observed on the north wall of Pit E beneath the dump/bedrock contact.

The main groundwater inflow is thus likely to come from the talik area in the southeastern part of Pit E which allows groundwater seepage from Third Portage Lake (Tetratech, 2016). This north-south oriented fractured area is later referred as the North Channel fractured zone (Figure 8).

Goose Pit

Goose Pit is almost completely located in the talik area, surrounded by Third Portage Lake. The island is a permafrost area observed on the east side of Goose Pit to a maximum depth of about 172 mbgs (-37 masl). This open-pit configuration, within a talik, explains the relatively higher rate of dewatering measured at Goose Pit, which is more than three times higher than the sum of Pit A and Pit E.

Goose Pit mining ended in April 2015 and dewatering operations have since ceased, inducing an increase in water level to 41 masl at the end of 2016. It is important to note that in the case of Goose Pit, the negative flow rates shown in Figure 17 represent the pit groundwater inflow, and not the pumping rate. In the 3D model, groundwater inflow was assumed equal to what would be the dewatering rate in Goose Pit.

Bay Fault crosses Goose Pit from north to south, offering a potential preferential flowpath from Third Portage Lake, as observed on the southern pit wall during summer, and a formation of an ice wall formation during winter. Based on rock mass quality studies, the contact between the ultramafic and the quartzite formation has been identified as a preferential flow path. Geological information (AEM 3D geological block model) located the contact roughly parallel to Bay Fault, along the western wall of Goose pit, cutting under Goose Dike. This contact may extend over 150 m in depth and is located in Figure 8.

North & South Cells and Central Dike

Meadowbank tailings were first stored in the Tailings Storage Facilities (TSF) North Cell and are currently stored in the TSF South Cell. TSFs include dikes/dams and are located in the area of the former northwest arm of Second Portage Lake.

The former Second Portage Lake arm is located beneath the North Cell, the South Cell, the Central Dike and the Central Dump. Based on the Central Dike Seepage study (AEM communication, 2017), North Cell Closure Strategy report (OCK, 2015) and interpretation of available thermistor data, the former Second Portage Lake arm is considered as an open talik.

For comparison purpose, the Central Dike downstream (D/S) pond pumping rates that are needed to maintain a water level of 115 masl are more than 10 times greater than the total 2016 combined dewatering rates of Goose and Portage open pits. The Central Dike D/S pond water level was maintained at 115 masl, while the North Cell elevation was stabilized at 148 masl. The South Cell elevation was around 130 masl during 2016 (Figure 9). The top elevation of the Central Dike is about 145 masl. These pumping rates will be reduced at closure, when TSF will be frozen and hydraulic heads will be lower.

Central Dike investigation study (Golder, 2007) showed that the high pumping rates needed at the Central Dike D/S pond were largely a result of a very permeable fractured bedrock layer located under the TSF Cells and the Central Dike. TSF North Cell and South Cell contain tailings and reclaim water and have higher hydraulic heads, creating higher hydraulic gradients and accelerating groundwater flow toward the Central Dike D/S pond and Central Dump (Figure 8 and Figure 9). Note that East Dike North and South pumping wells are also in operation and intercept groundwater mostly from the overburden and upper fractured bedrock.

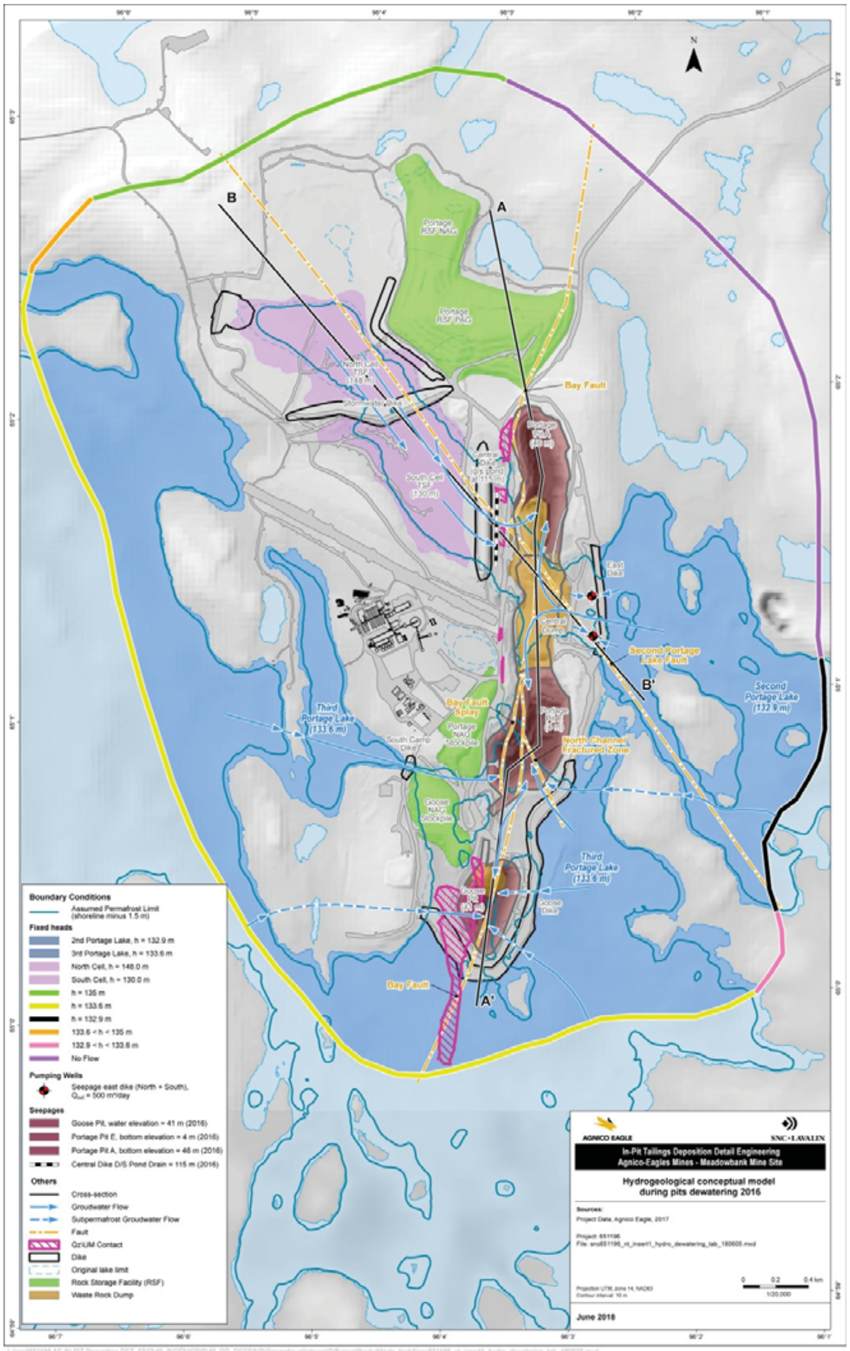

Figure 8 : Conceptual plan view during mine dewatering (actual conditions)

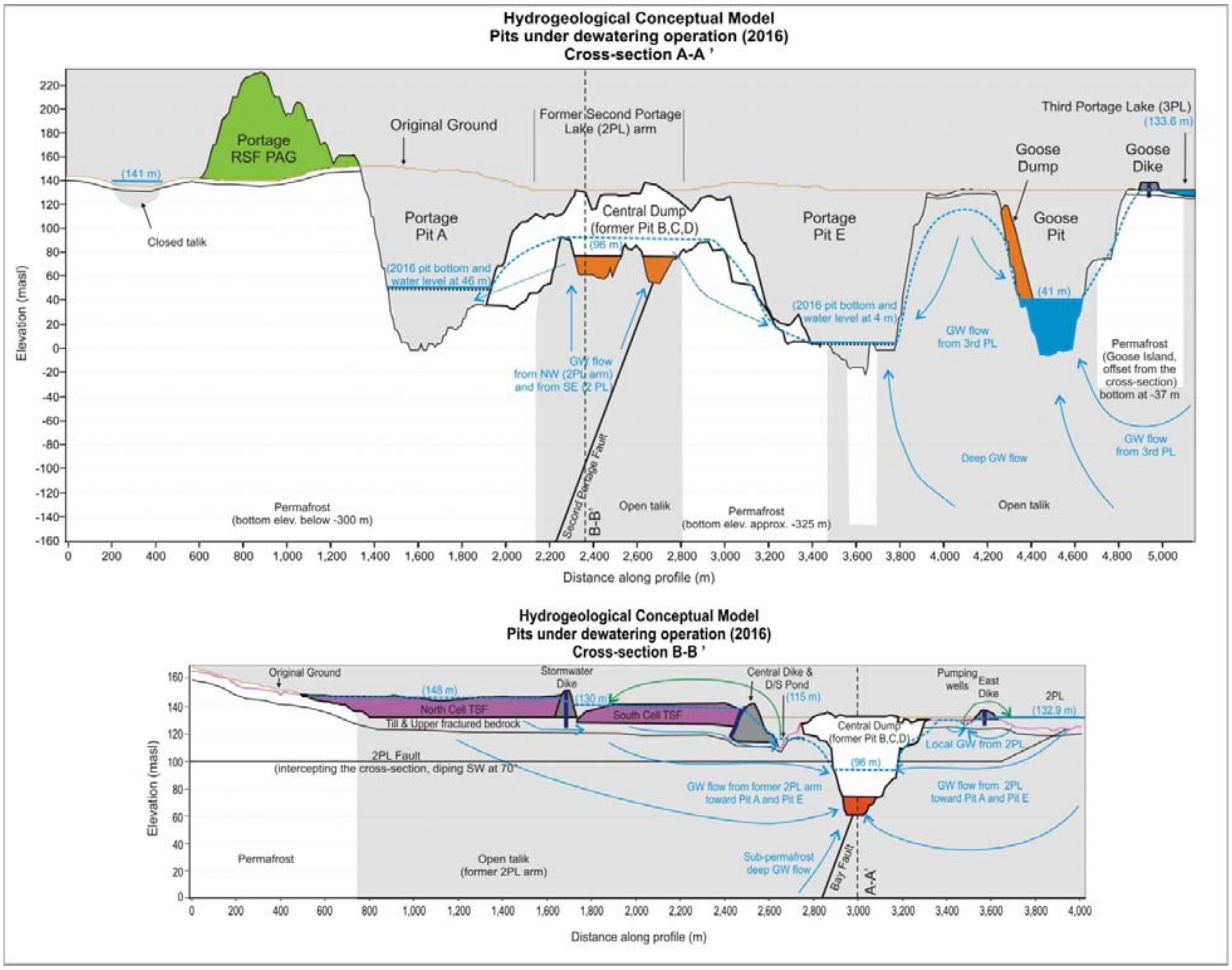

Figure 9 : A-A and B-B conceptual cross-section during mine dewatering (2016 conditions)

3.1.2 Post-closure period (after in-pit tailings deposition)

Developing the conceptual model for the post-closure period was an essential step for the transport simulations. The closure strategy consists of pit flooding with 8 m of water cover and dike breaching once the pit lake water quality meets regulatory criteria. The objective for closure is to return the existing surrounding lakes to their pre-mining state by joining the in-pit water bodies to the surrounding receiving environment. Hence, the natural regional groundwater flow regime will be re-established. In the model, the regional groundwater flow map was based on an interpolation of the surrounding talik lake levels (Figure 10). Based on the upstream (133.6 masl, Third Portage Lake) and downstream lake levels (132.9 masl, Second Portage Lake), it appears that the groundwater gradient will be very low, approximately 0.0001 m/m.

As part of the detailed engineering study, a thermal assessment was also done by SLI (2018c) to look at the impact of in-pit deposition and global warming on permafrost degradation. Ground thermal 2D analysis was done at each of the affected pits. Indeed, permafrost degradation on the pit rims and base is expected as seen in Figure 11. Figure 10 shows groundwater flow paths at post-closure from the pits to surrounding lakes. In the hydrogeological 3D model, the anticipated permafrost thaw has been considered in the conceptual and the numerical model.

Portage Pit A and Central Dump

Based on the Permafrost Degradation Assessment report (SLI, 2018c), permafrost degradation of Pit A walls will be minor because the pit is mostly enclosed within the permafrost. Only the opening on the south-eastern wall will be slightly enlarged. This location could thus represent the main contaminant pathway from Pit A because of its connection with the talik area.

Investigations at IP-17-08, located in Central Dump, suggested that during dewatering, the upper part of the Dump was partially frozen. However, after closure, we can assume that this area will return to an unfrozen state, since it is located in a talik area, and because it will be ultimately covered by lake water.

Portage Pit E

Impacts of in-pit deposition on permafrost degradation are expected to be more significant at Pit E, because the frozen area around the pit was already thinner than around Pit A. The Permafrost Degradation Assessment report (SLI, 2018) showed that the frozen frontier between Pit E and Central Dump would be superficially thawed creating a potential migration path for the contaminant. Moreover, the north portion of Pit E is also the crossing point of Bay Fault and Bay Fault Splay which present higher hydraulic conductivities. The permafrost will also be degraded on the eastern wall of Pit E leading to potential lateral migration from the pit to the lake.

Goose Pit

Following the in-pit tailings deposition, the permafrost degradation of Goose Island, located on the eastern wall of Goose Pit, will be significant. Goose Island permafrost could mostly disappear to a depth of 15 meters. The natural groundwater gradient at Goose Pit appears to be roughly from north to south. Consequently, the northern and eastern walls of Goose Pit could represent preferential contaminant pathways to Third Portage Lake.

North & South Cells and Central Dike

At post-closure, TSF North Cell and South Cell are assumed to be frozen as modelled by OCK (2016). The OCK study states that it will take 10 years for the cell to be entirely frozen if cell capping is carried out. Hydraulic heads will subsequently be much lower than those observed during mining operations and tailings deposition in those cells. Regional hydraulic heads will be re-established, leading to lower hydraulic gradients, slower groundwater flow and slower advective contaminant migration rates.

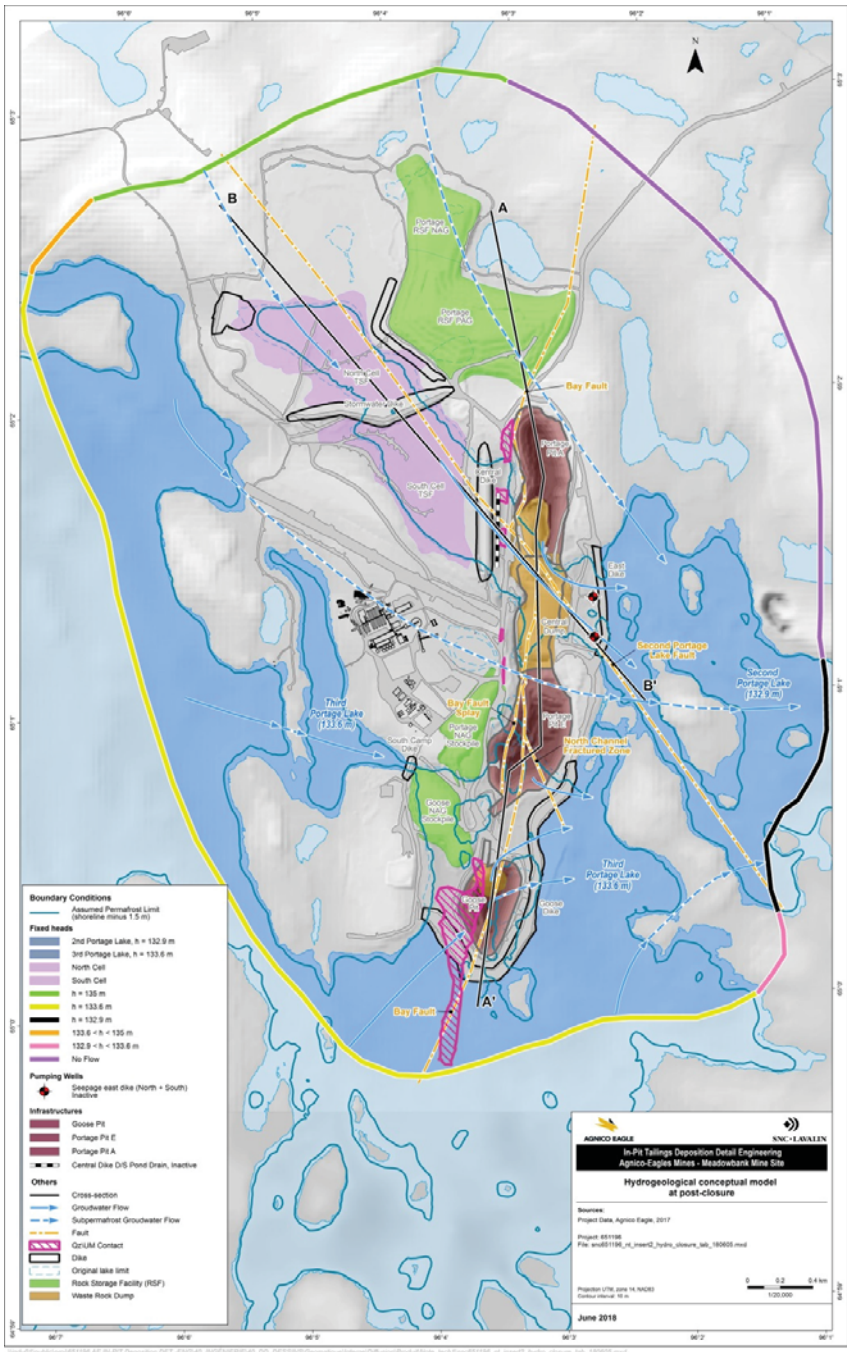

Figure 10 : Conceptual plan view after in-pit tailings deposition (at post-closure)

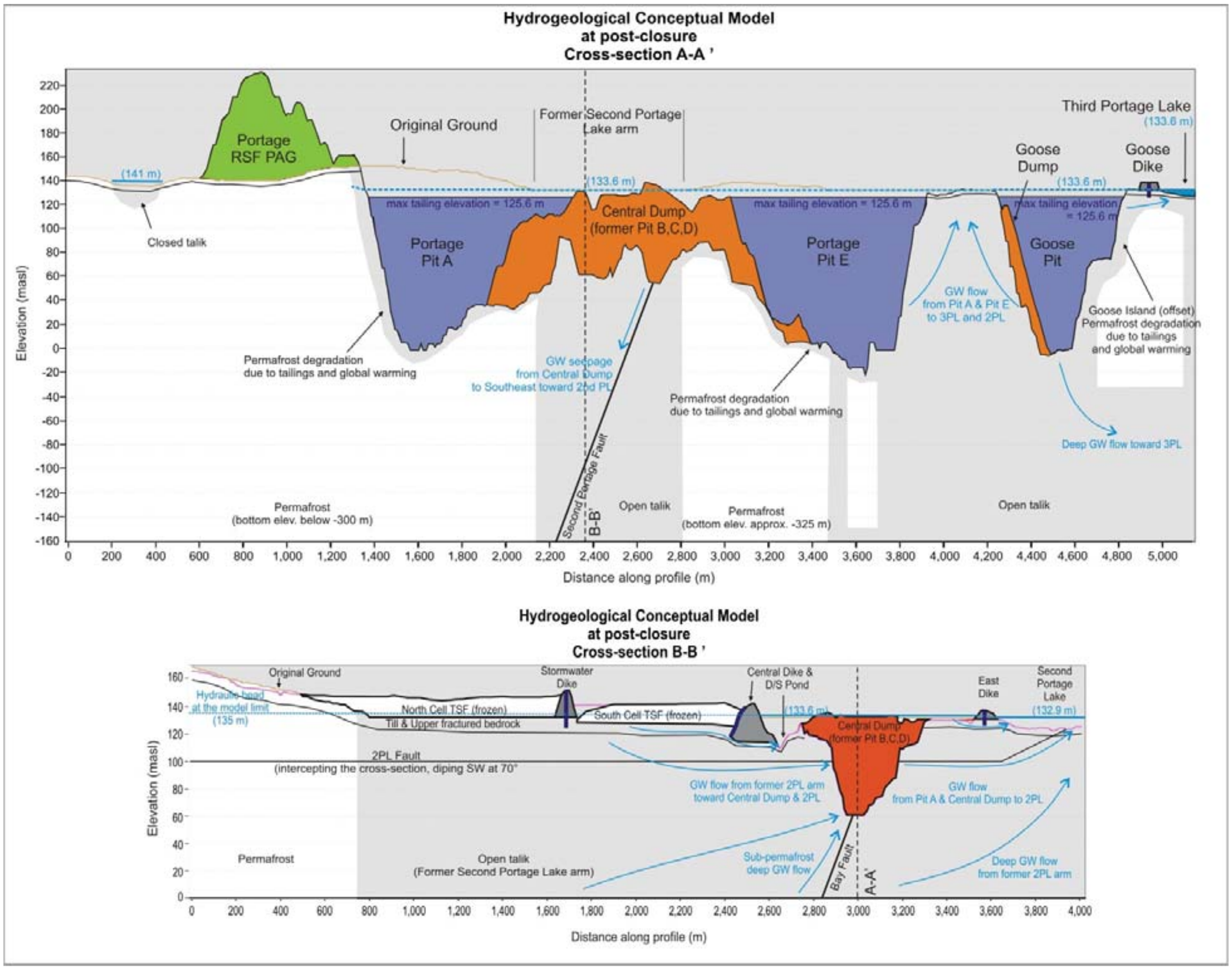

Figure 11 : A-A' and B-B, conceptual cross-section after in-pit tailings deposition (mine post-closure)

3.2 Domain boundaries and mesh

The modelling was carried out using the FEFLOW software, developed by WASY Institute in Germany (Diersch, 2008). FEFLOW is a robust numerical groundwater model capable of taking into account all aspects including mining, processing, mine waste management, and the management (diversion, impoundment, treatment) of groundwater.

The width of the hydrogeological model domain is approximately 4.4 km and its length is about 6.2 km. The total area covered by the model is approximately 22 km^2. Figure 13 presents the extent of the developed numerical model.

Model mesh

The model mesh consists of 5 568 948 triangular prism elements. Horizontally, meshing and cell sizes have been adapted to adequately represent the local site infrastructure and anticipated hydraulic gradients. Average cell sizes are about:

- 30 m outside the pit area;
- 15 m inside the pit area;
- 3 m around the dikes.

Vertically, the model is composed of 49 layers of variable and fixed thicknesses. The first layer represents the topography, and the last layer represents the bottom of the model with a fixed elevation of -800 masl. The mesh was also refined vertically for the overburden and also along the pit sections:

- The overburden is discretized into 4 layers of 2 m average thickness;
- The pit depth is discretized into 27 layers of less than 10 m average thickness; and
- The deeper part of the model is discretized into 16 layers of 50 meters average thickness.

A 3D view of the model is provided in Figure 12.