Appendix B-1

Annual geotechnical inspection report

REPORT

2018 Annual Geotechnical Inspection

Meliadine Gold Project, Rankin Inlet, Nunavut

Submitted to:

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Distribution List

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Executive Summary

Agnico Eagle Mines Limited (AEM) retained Golder Associates Ltd. (Golder) to conduct the 2018 annual geotechnical inspection of the Meliadine Gold Project to comply with the requirements of AEM's Water Licence Permit No. 2AM-MEL1631. The inspection was conducted between 10 and 14 of September 2018 and covered the geotechnical aspects for the water management infrastructure, roads, waste facilities, underground portals, infrastructure pads, fuel storage facilities, in the following areas:

- main site
- exploration camp site
- all-weather access road (AWAR)
- Itivia site and by-pass road

This report describes the geotechnical aspects of the areas inspected, presents general observations, recommendations, and provides comments on instrumentation data, where available. In addition, a description of the geophysical and permafrost conditions for the site is provided.

Infrastructure for the mine is progressively being built, including some of the water management collection ponds, associated dikes, the tailings storage facility, open pits, waste rock storage facilities, diversion berms and channels. The inspection was carried out in accordance with the requirements of the Water Licence, for the facilities in existence at the time of the inspection.

The inspection occurred when there was no snow or ice on the lakes or land, following the freshet, and when surface water flows were generally low. Peak surface water flows typically occur during the freshet (May and June). During the inspection the weather was generally clear with some periods of rain. Daily temperatures varied between 0°C and 8°C. Water levels were considered to be normal for this period of the year, and the flow observed at water crossings was low.

AEM's environmental department monitors the water levels and quality in the collection ponds and collects instrumentation data.

The results of the 2018 annual geotechnical inspection carried out at the Project site, along the AWAR, at the Itivia site, and along the Itivia by-pass road indicate that the infrastructure was generally in good condition and performing as designed.

The following presents a summary of the recommendations from the 2018 geotechnical inspection for the infrastructure in each of the areas inspected. The recommendations have been grouped based on the type of recommendation and have also been given a rating of High (L), Medium (M), or Low (L) priority.

The following recommendations are related to surveillance and monitoring:

The recommendations for surveillance and monitoring don't currently require a maintenance action but may warrant future maintenance if conditions worsen.

Main Site

- Geotechnical inspections should be carried out and documented for D-CP1 and D-CP5 following the schedule developed in the OMS manual. In addition, instrumentation should be monitored, and the data should be plotted and reviewed, following the schedule developed in the OMS manual. These activities were completed by AEM in 2018; however, not quite to the schedule in the OMS. The OMS manual indicates that daily inspections should be completed and documented using the same form as the weekly inspection, which were not completed in 2018. The OMS manual does not indicate if there is seasonal variability to the frequency of documented inspections. It may be acceptable to seasonally vary the frequency of inspections, but this should be reviewed with the Engineer of Record (EoR) for the dikes and the OMS manual should be updated, as required. The OMS manual should be reviewed and updated annually and is next due for review in June 2019. (H)
- If the P-Area dikes will continue to be used, they should be added to the OMS manual that was developed for D-CP1 and D-CP5. Geotechnical inspections and instrumentation monitoring should be carried out and documented following the schedule developed in the OMS manual. (H)
- Implement a road and culvert monitoring program for site roads, as is done for the AWAR, which is tied to a maintenance program. (M)
- Conduct inspections along Itivia by-pass road, as per the Road Management Plan (AEM 2015b), now that the road is complete. (M)
- Monitor the cracking adjacent to Channel 5. If cracking gets worse, recontouring and/or compacting the areas of cracking to close the cracks will reduce the potential for water to infiltrate into the cracks leading to warming of the permafrost and additional thaw settlement and cracking. (M)
- Monitor the cracking observed in the D-CP1 downstream sump berms and adjacent to the downstream collection channel. Recontouring and/or compacting the areas of cracking to close the cracks will reduce the potential for water to infiltrate into the cracks leading to warming of the permafrost and additional thaw settlement and cracking. (M)
- Ponding upstream of Berm 3 should be monitored to determine how much and how often ponding occurs and if Berm 3 can perform as required with the ponding. (M)
- The Berm 3 cover materials may be susceptible to erosion. This should be monitored, and if there is erosion, consideration should be given to placing coarser material on Berm 3 to reduce the potential for erosion. (M)

Exploration Site

- The cracks in fuel storage pad should be monitored; however, they are not considered to be a geotechnical concern. (L)

All-weather Access Road

- Continue to monitor culverts and hydraulic effectiveness to assess if current culverts provide adequate capacity and if any changes are required. Evaluate if any culverts need to be installed at a lower elevation to reduce ponding, and downstream erosion. (M)
- Monitor areas that have ponding, but no culverts and consider installing culverts to manage water. (M)
- Conduct inspections and document observations and recommendations as laid out in the Road Management Plan (AEM 2015b). Road inspections were completed and documented in 2018, but documentation indicates that the frequency of the inspections did not quite meet what is laid out in the Road Management Plan. (H)

Itivia Site and By-pass Road

- The locations of some of the culverts through the Itivia by-pass road do not correlate with the design drawings (Tetra Tech 2017e) due to changes made during construction. The culvert locations should be referenced to the as-built report and drawings during the 2019 annual geotechnical inspection. (M)
- The as-built report should confirm culvert sizes, locations, and invert elevations have been constructed to the design. The as-built report should also confirm that safety berms have been constructed where required based on road fill height and confirm that road slopes have been constructed to the design. (M)
- The section of the road and safety berm that is constructed with esker material may be susceptible to erosion. This should be monitored and maintenance completed as required. (L)
- Ponding of water along the road should be monitored and if it is impacting the condition of the road, mitigation measures should be implemented, such as, lowering the culverts or ditching or placing fill to direct water to the culvert inlets. (M)

The following recommendations are related to operational procedures:

Main Site

- Water volumes within containment ponds should be managed to the levels defined in the OMS manual, including maintaining the water level below the elevation defined for the end of October in the OMS manual over the winter to promote freezing of the dikes. (H)
- The D-CP1 sump and downstream collection channel should be emptied in the fall/early winter to refreeze the ground around these facilities. During the open water season, keeping the water level in the downstream channel and sump low will reduce the potential for thaw of the ground around the channel and sump and associated settlement. (M)
- Consider adding data loggers to thermistors for easier collection of data, especially in the winter when access may be more limited. (L)
- Where possible, try not to allow seepage water from DP3-A to pond against the Saline Pond berm to avoid permafrost degradation. (M)

- Monitor slopes above Portal No. 2 for rockfill instability during backfill placement. (H)
- Snow management around Portal No. 1 and 2 may be advisable prior to freshet to reduce inflows to the underground. (L)

Exploration Site

- Minimize the amount of water contained within the exploration landfarm until it is decommissioned and remediated. (M)

The following recommendations relate to maintenance or repairs that are required:

Main Site

- Cracks and areas of settlement in the containment pond dikes should be filled and/or recontoured to close the cracks and reduce the potential for infiltration and erosion. (M)
- Ponding of water adjacent to roads should be avoided. Disturbed areas from road construction should be recontoured to promote drainage away from the road and consideration should be given to installing culverts if ponding occurs in naturally low areas. This was most notable along the Emulsion Plant and Wesmeg Borrow access roads. (M)
- If the Wesmeg Borrow access road is blocking drainage near Lake B33A that is leading to ponding adjacent to the road, a culvert should be installed to allow drainage so that there isn't permafrost degradation and settlement. (M)
- Consider adding a crushed surface material to the Emulsion Plant and storage area pads if trafficability continues to be an issue. (M)
- Survey monitoring plate M-3 on D-CP5 should be replaced. (M)
- Where erosion is occurring on slopes of pads, the existing materials should be regraded and compacted, and a coarser material should be placed to further reduce erosion potential. Higher priority should be given to areas where erosion is encroaching on sea containers or other facilities placed close to the slope. The most significant pad erosion was observed at the north side of the main camp/industrial pad and the Emulsion Plant pad. (M)
- The cracking and sloughing along Channel 1 should be assessed to determine if the channel is too steep and riprap is sloughing over geotextile or if it is caused by thermal degradation of permafrost adjacent to the channel. If possible, the channel should be kept empty through the winter to promote freezing of the permafrost around the channel. (M)
- Where access is feasible, removal of snow from the water collection pond dikes (temporary and permanent) is recommended to reduce the insulating effects of the snow, thereby allowing the temperature of the core material in the dikes and the foundations to drop as low as possible. Snow removal is more important if thermistor data is indicating that the dike and/or foundation temperatures are warmer than expected. (M)

- Make sure thermistors in the water management dikes are well marked so they can be located and maintained during the winter and are not damaged during snow removal operations. (H)
- The slopes of the Operation Landfill should be monitored, particularly the northeast corner where water was observed to be ponding downstream and there was some possible sloughing on the slope. Regrading and compacting the slope in this area will reduce the potential for erosion. (M)
- Consider adding rockfill material to cover the till berm in P1, to protect the till and maintain its integrity if this berm is required for water management. (L)
- The Wesmeg Borrow Area should be recontoured and either capped with a coarser material or revegetated to reduce erosion. (M)
- A coarser rockfill layer should be placed over the decommissioned exploration landfill to reduce erosion and cracking. (M)
- Snow management around and above Portal No. 1 and 2 may be advisable, especially prior to freshet, to reduce the potential for larger surface water inflows entering the underground. (L)

Exploration Camp Site

- Repair surface erosion along south slope of exploration camp pad. Grade surface to reduce channelization of surface water flows and therefore reduce the potential for the erosion to reoccur. In this area, a coarser surfacing layer could be placed to help reduce the potential for future erosion. (L)
- The exploration camp access road should be regraded and consideration given to placing some coarser rockfill on the slopes where there is erosion. (M)
- The culverts through the exploration camp access road should be cleared of material. Large boulders should be removed from above culverts to prevent potential damage to the culverts and appropriately sized riprap should be added to the road fills around he culverts for erosion protection where there isn’t any. (M)
- The diffuser access road could be regraded to close up the cracks and reduce the potential for future cracking. (L)

All-weather Access Road

- The kilometre markings on the AWAR culverts should be checked and replaced with accurate numbers. At the time of the 2018 site visit, AEM indicated that new markers had been ordered, but had not arrived. (M)
- Specific recommendations for the AWAR culverts and bridges are summarized in Table 9.

Itivia Site and By-pass Road

- Cover material should be re-established over the liner that has been exposed on the south containment berm of the Itivia fuel storage facility to protect the liner. (M)
- The culverts should be cleared of all materials prior to freshet. (H)

The following recommendations relate to future construction:

- Road and pad materials should be compacted to reduce the potential of the material being eroded, and if necessary a coarser, well graded, cover material should be placed to further reduce erosion potential.
- When culverts are installed, ensure bedding material surrounding culverts is of a suitable gradation (e.g., sandy) and compacted. Large boulders should not be placed in direct contact with the culverts within the road fills; however, the slopes of the road around the outlets of the culverts should be armoured with appropriately sized material (e.g., cobbles) to reduce erosion.

Study Limitations

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1.0 INTRODUCTION

Agnico Eagle Mines Limited (AEM) is developing the Meliadine Gold Project (the Project). It is located approximately 25 km north of Rankin Inlet, in the Kivalliq Region of Nunavut. A series of open pits as well as underground development will be used to extract gold.

AEM retained Golder Associates Ltd. (Golder) to conduct the 2018 annual geotechnical inspection for the Project, pursuant to the requirements of the Type A Water Licence Permit No.2AM-MEL1631 (Nunavut Water Board 2016).

Under Part I, Item 14 (page 21) and Schedule I, Item 1 (page 39) of the Water Licence, AEM is required to undertake an annual geotechnical inspection of its facilities between the months of July and September. The inspection is to be carried out by a geotechnical engineer, and to be in accordance with the Canadian Dam Association (CDA) *Dam Safety Guidelines* (CDA 2013), where applicable. The inspection occurred between 10 and 14 September 2018, and was conducted by Allison Isidoro, a geotechnical engineer, holding professional registration in Nunavut, and employed by Golder.

Construction of the infrastructure for the Project has commenced and will continue in stages as development and mining progresses. The following structures were inspected:

- main site including
  - P-Area temporary collection ponds (P1, P2, and P3) and associated dikes (DP1-A, DP1-B, DP2-A, DP3-A)
  - permanent water collection ponds CP1 and CP5 and their associated dikes (D-CP1 and D-CP5) and jetties
  - diversion Berm 3
  - diversion channels 2, 3, and 5, and partially completed diversion channel 1 (including Culvert 16)
  - saline pond
  - site roads
    - main site pad area roads, including culverts 2, 3, and 4
    - Tiriganiaq Esker access road
    - Wesmeg access road, Wesmeg Borrow and vent raise
    - magazine storage access road
    - main site water intake access road
    - emulsion plant pad access road, including Culvert 13
    - CP4 access road
    - landfill access road, future TSF area, including Culvert 1

- pads
  - main camp pad
  - industrial pad
  - east ventilation raise pad
  - temporary cyanide storage pad
  - effluent water treatment plant pad
  - explosives (ANFO plant) pad and magazine storage
  - emulsion plant pad
- ore and waste rock storage areas
- landfarm
- exploration and operations landfills
- underground Portals No. 1 and No. 2
- industrial fuel storage and mine site fuel storage

- exploration camp site including
  - site pad and diffuser access road
  - genset storage area
  - fresh water intake
  - access road
  - landfarm
  - fuel storage
- all-weather access road (AWAR)
- Itivia site
  - fuel storage
  - bypass road

The facilities at the main mine site and exploration camp areas that had been constructed at the time of the 2018 inspection are shown in Figure 1. At the time of the inspection, the P-Area had been completed in addition to permanent water management pond dikes D-CP1 and D-CP5. Diversion Channels 2, 3, and 5 were complete and Channel 1 was partially complete. Berm 3 was constructed. Berm 2 was under construction and was not inspected. Some site service roads were in place with the associated culverts and ditches constructed to manage water around infrastructure and roads. Construction of the industrial pad and infrastructure was ongoing. Underground Portal No. 1 was operational. Underground development was occurring, with associated waste rock and ore being hauled to the surface and placed in stockpiles. The culvert over the entrance to underground Portal No. 2 was being backfilled and the drift was being advanced. The operations landfill and landfarm facilities had been constructed. The effluent water treatment plant and associated intake had been constructed. The fresh water intake pump and associated pipeline were in place and an access road had been constructed to within a few metres of the lake. The pipeline was running along the toe of the road. The mine site and industrial site fuel storage facilities had been constructed. The saline water pond had been constructed and was storing water. The emulsion plant and access road had been constructed.

The exploration camp site was the first area of the Project to be developed. The exploration site was inspected, including the site pad, fresh water intake, diffuser access, landfarm, fuel storage, and access road.

Many other aspects of the future development for the Project had not been constructed at the time of the visit including: the water management collection ponds (CP3, CP4, and CP6) and associated dike (D-CP6) and thermal Berms for CP3 and CP4, tailings storage facility, open pits, waste rock storage facilities, ore storage facilities, Diversion Berm 1, several diversion channels (4, 6, 7, and 8). Diversion Berm 2 was partially completed and Ore Storage Pad 2 (OP2) was under construction at the time of the inspection. The final layout of the main site, including water management structures, is shown on Figure 2. A modification was made to the plan for CP3 and CP4 in 2018 to excavate to create storage for these ponds along with construction of thermal berms on the downstream sides of the ponds. This modification was made after the 2018 Water Management Plan (AEM 2018) was issued so Figure 2 still shows dikes D-CP3 and D-CP4 which are no longer planned. This modification will be incorporated into the 2019 Water Management Plan.

The AWAR connecting Rankin Inlet to the Project provides one-way traffic access (with pull-outs to allow vehicles to pass) and was in use.

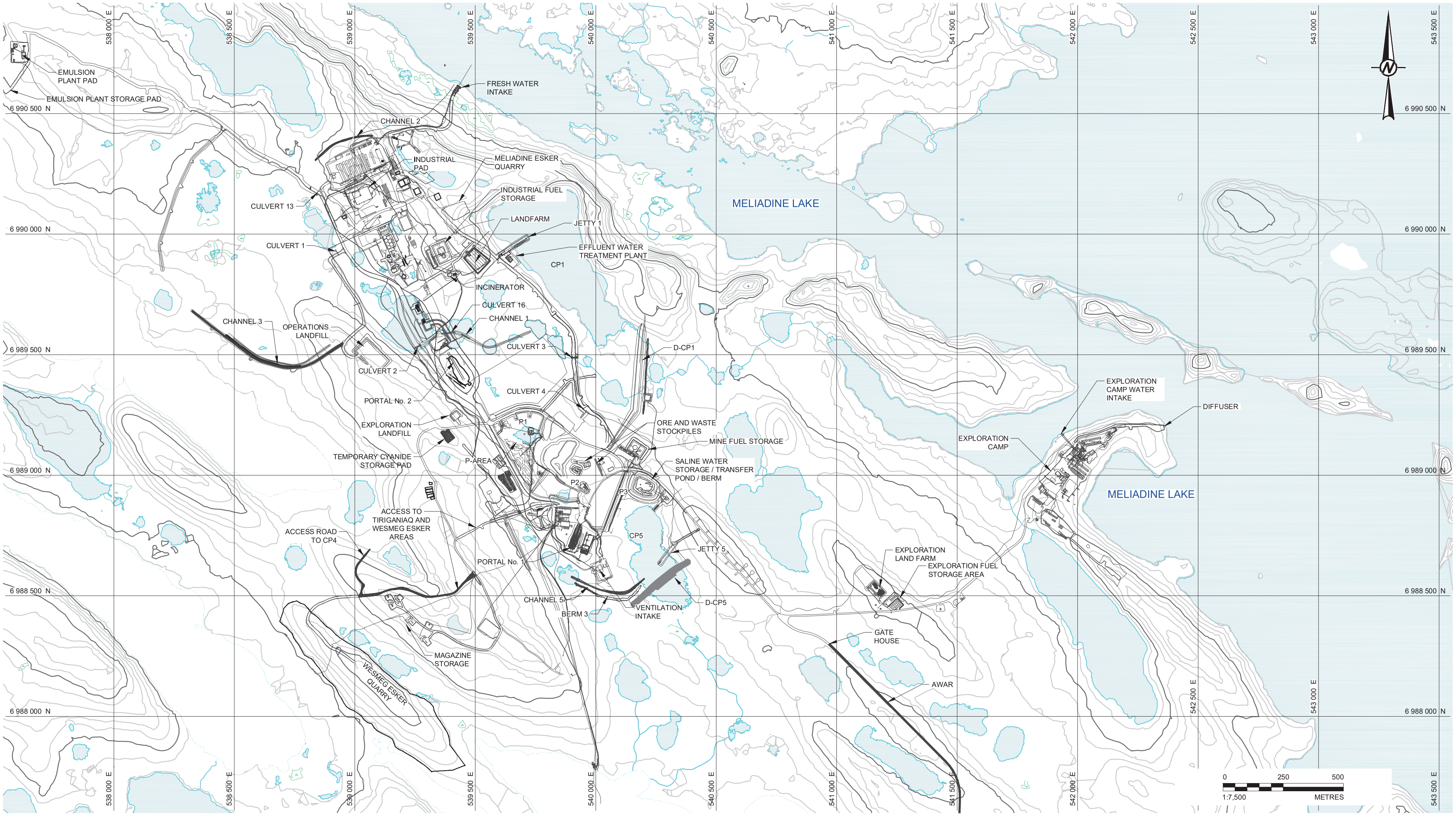
The Itivia shipping and fuel storage site in Rankin Inlet was complete. The Itivia bypass road was completed the week of the inspection.

Where applicable, the inspection was performed consistent with the principles set out by the CDA (2013). The inspection consisted of visually observing each of the facilities listed above; taking photographs to document the conditions at the time of the inspection (Appendix A, Appendix B, and Appendix D); reviewing instrumentation data (Appendix C), inspection reports, and other relevant files and reports (listed in the reference section of this report); communication with AEM on-site staff (Ms. Jennifer Pyliuk, Mr. Jeffrey Pratt, and Mr. Daniel Gorton); and preparation of this report to document the inspection.

The inspection occurred when there was no snow or ice on the lakes or land, following the freshet, and when surface water flows were generally low. Peak surface water flows typically occur during the freshet (May and June). During the inspection, the weather was generally clear with some periods of rain. Daily temperatures varied between 0°C and 8°C. Water levels were considered to be normal for this period of the year, and the flow observed at water crossings was low.

The site water management plan (AEM 2018) provides a summary of the water management infrastructure and the overall water management approach.

This report describes the geotechnical aspects of the areas inspected and presents general observations and recommendations. In addition, a description of the geophysical and permafrost conditions for the site is provided.



LEGEND

WATER BODY

EXISTING GROUND CONTOURS

NOTE(S)

1. ALL UNITS ARE IN METRES UNLESS OTHERWISE IS NOTED.
2. COORDINATE SYSTEM UTM15 NAD83.
3. CONTOUR INTERVAL EVERY 2m.

REFERENCE

1. GENERAL ARRANGEMENT SURVEY PROVIDED BY AGNICO EAGLE MINES LTD. RECEIVED 13 DECEMBER 2018.

CLIENT
AGNICO EAGLE MINES LTD.

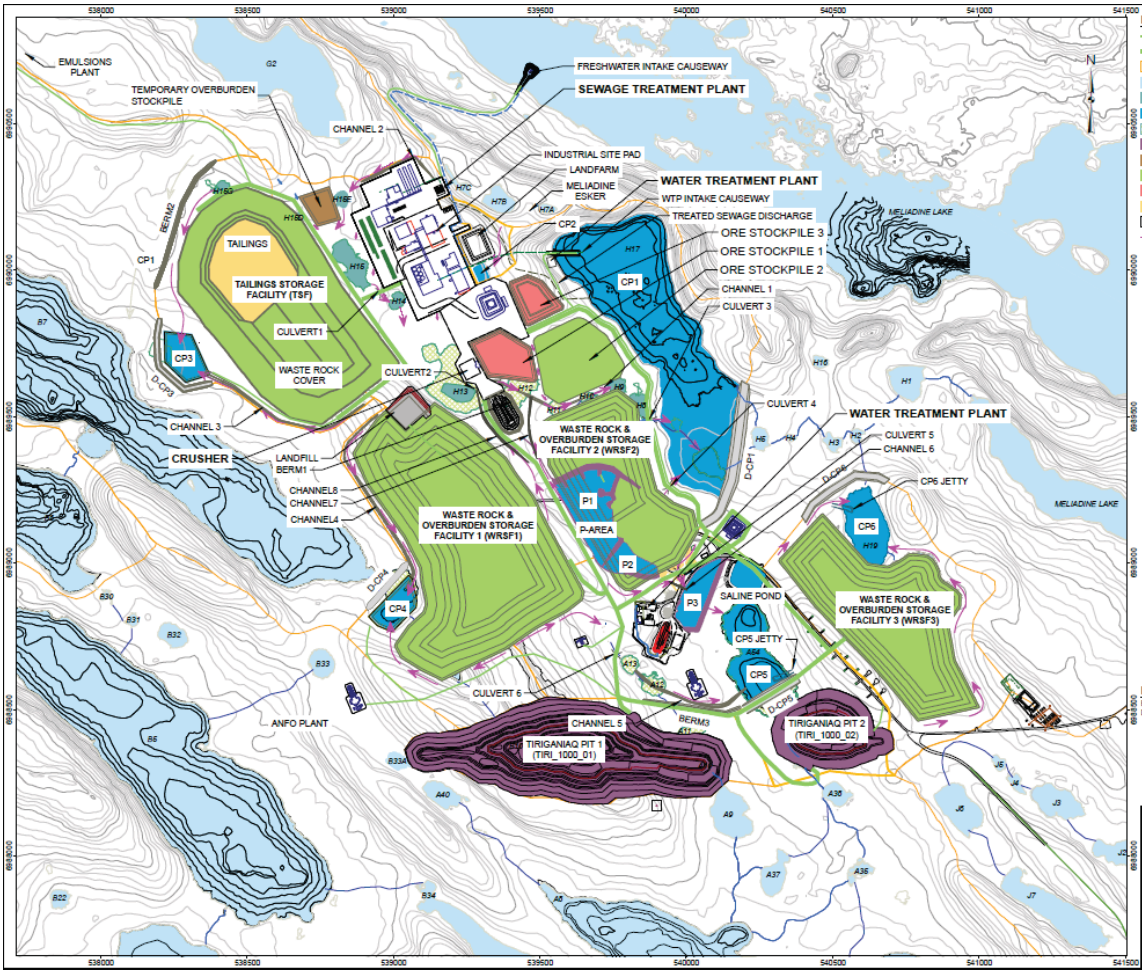
PROJECT
MELIADINE GOLD PROJECT

CONSULTANT
GOLDER

YYYY-MM-DD	2019-02-14
DESIGNED	ACI
PREPARED	JK
REVIEWED	FE
APPROVED	ACI

TITLE
GENERAL SITE PLAN LAYOUT (SEPTEMBER 2018)

PROJECT NO.	PHASE/DOC#	REV.	FIGURE
1810719	3000/002	0	1



Source: AEM 2018.

Figure 2: Main Site General Layout and Water Management Infrastructure

1.1 Scope Limitations

The scope of the inspection is limited to observation of the geotechnical aspects of each of the facilities listed above and review of the associated instrumentation data. The inspection did not include other assessments such as structural, mechanical, or environmental.

For additional information related to the limitations of this scope, reference should be made to the Study Limitations at the beginning of this report.

2.0 GEOPHYSICAL AND PERMAFROST CONDITIONS

The Project is located in the Kivalliq Region, near the northern border of the southern Arctic terrestrial eco-zone, and within the Arctic tundra climate region. It is located within the Churchill geological province, which forms part of the northern Canadian Shield.

The landscape is dominated by features characteristic of glaciated terrain and exposed bedrock. Primarily underlain by Precambrian granitic bedrock, the terrain consists of broadly rolling uplands and lowlands. The Project is located at an approximate elevation of 60 metres above sea level (masl) with a maximum topographic relief of 20 m. There are numerous small lakes, wetlands, and creeks, indicating poorly drained conditions. The upland areas are generally well drained. A series of low relief ridges composed of glacial deposits oriented northwest–southeast control the regional surface drainage pattern. Periodic ice blockages at outlets of small lakes and wetlands occur during the freshet, these can temporarily increase the downstream flood peak discharges and affect the flood characteristics. High flows are observed during the freshet, while low flows and dry stream channels are typical in late summer.

Soils are typically Cryosols. Glacial moraine deposits are predominant, ranging in thickness from veneers (less than 2 m) to blankets (2 to 5 m) to hummocky deposits (5 to 15 m). Glaciofluvial deposits are also present, with the most prominent being a network of sinuous eskers. Lacustrine deposits occur in association with the numerous lakes. Near the coast of Hudson Bay, finer textured marine sediments cover the ground surface.

The Project is located in a zone of continuous permafrost and has an annual average air temperature of -10.4°C, based on climate data from Rankin Inlet. Within the permafrost there are intervening taliks (areas of unfrozen ground) and thaw bulbs induced by lakes. The permafrost in the region is considered to be “cold” (i.e., has an average annual surface temperature and zero amplitude temperature of less than -4°C). The depth of permafrost and of the active layer varies based on the proximity to lakes, soil thickness, vegetation, climate conditions, and slope direction. Based on thermal studies and measurements of ground temperatures, the depth of permafrost is generally between 360 to 495 metres below ground surface (mbgs). The depth of the active layer ranges from about 1 mbgs in areas with shallow surficial soils, up to about 3 mbgs adjacent to the lakes (AEM 2014b). The typical permafrost ground temperatures at the depths of zero annual amplitude are in the range of -5.0°C to -7.5°C in the areas away from lakes and streams, and generally are reached at a depth of 15 to 35 mbgs. The geothermal gradient ranges from 0.012°C/m to 0.02°C/m (Golder 2014). The ground ice content in the region is expected to be between 0% and 10% (dry permafrost) based on the regional scale compilation data and the Canada Permafrost Map published by Natural Resources Canada (NRC 1993). However, areas of local higher ground ice content occur and are generally associated with low lying areas of poor drainage.

Taliks may occur where lake depths are greater than about 1 to 2.3 m. The presence and extent of each talik is influenced by the geometry (size and shape) of the lake. As the depth and size of lakes increase, the extent of the talik increases. Formation of an open-talik, which penetrates through the permafrost, would be expected for lakes that exceed a critical depth and size. It is anticipated that open-taliks exists below Meliadine Lake, Lake B7, and Lake D7 based on their depth and geometry (Golder 2013).

The salinity of groundwater also influences the temperature at which the groundwater freezes. Testing has indicated that the salinity of the groundwater in the Project area generally increases with depth. Test results on two deep groundwater samples collected below the base of the permafrost as part of the baseline study indicated salinity level leads to a freezing point depression of about 3.2°C (AEM 2014a, Volume 7, Appendix 7.2-A).

Thermistor cables have been installed to monitor natural ground temperatures in the vicinity of the Project. Data are presented in Appendix C along with plan views of thermistor installation locations (Figure C1 and C2). Several of these thermistors have stopped working over the last several years, mainly due to damage as construction of mine facilities expands into the areas where these thermistors have been installed. Readings taken in 2018 in the remaining operational thermistors are generally consistent with previous trends. There were some erroneous readings that have been removed from the plots for GT09-07, GT09-08, GT11-02, GT14-03, and GT14-27. These thermistors showed large jumps in temperature for one set of readings, which then returned to be in line with previous temperatures when they were read the next month. Most of the erroneous readings were on 6 September 2018. Thermistor GT14-03 also had erroneous readings on 19 June 2018 and GT14-27 had erroneous readings on 25 May 2018 and was then reported to be damaged.

Priorities and frequencies for reading these thermistors are summarized in AEM (2015c) and are based on the development sequence for the mine. Thermistors located in close proximity to the process plant and other mine infrastructure have the highest priority and are read more often. Thermistors located in the Tiriganiaq open pit area are given the next priority. The thermistors installed to monitor the deep permafrost are given the lowest priority as the conditions within the deep permafrost do not fluctuate seasonally, so fewer readings are required.

3.0 P-AREA TEMPORARY DIKES AND COLLECTION PONDS

During the winter of 2016, it was recognized by AEM personnel, as an interim measure to manage an emergency situation, that temporary water collection ponds were required to collect and manage surface runoff water near underground Portal No. 1 and the waste rock storage area (AEM 2016a). The concern related to the potential that surface runoff water from the ore and waste rock stockpiles could contain elevated chloride and ammonia concentrations, above the permitted discharge criteria standards per the Metal Mining Effluent Regulations under the Fisheries Act and/or Canadian Council of Ministers of the Environment guidelines for the protection of aquatic life.

Therefore, prior to the 2016 freshet, four temporary containment dikes (referred to as DP1-A, DP1-B, DP2-A, and DP3-A) were constructed between 25 March and 10 May 2016 to create three temporary ponds (P1, P2, and P3) to manage the runoff near Portal No.1 and from the waste rock storage area (Figure 3). Representatives from Tetra Tech EBA were on site during the majority of dike construction to provide geotechnical assistance, monitor the construction, and prepare the construction record report (Tetra Tech EBA 2016c).

The collection ponds are referred to collectively as the P-Area. The dikes do not completely enclose the ponds. Portions of the pond boundaries are associated with natural areas of higher ground, the ore and waste stockpile area, and/or existing roads. These roads were not built as water containment structures. Similarly, the stockpiles of ore and waste are granular in nature and do not function as water containment structures on a year-round basis.

In general, the P-Area receives direct precipitation, runoff from the site roads immediately surrounding the area and runoff and pore water from the ore and waste rock stockpiles near Portal No. 1. Water from underground is also pumped to the P-Area, typically via the Saline Pond. Pipelines and associated pumping systems exist to allow water to be transferred from P2 and P3 to P1. Five evaporator units have been installed within P1, including two new evaporators installed since the 2017 inspection. The new evaporators were installed on the east berm of the snow melt pond and on a jetty constructed off the north slope of DP1-A. A pumping station within P1 connects to the evaporators.

In accordance with the CDA (2013), dam classification is assigned based on an assessment of the consequence of failure, evaluated on the basis of potential incremental losses of life, environmental and cultural values, and third party infrastructure and economics. The class is determined by the highest potential consequence ranking. Although these dikes are less than 2.5 m in height (to the top of the water retaining element, the frozen core), and therefore do not meet the definition of a dam (CDA 2013), A consequence classification of significant was initially assigned to these structures in 2016 for the purpose of operation and monitoring. This classification was based on the following: failure of the dikes would not be anticipated to cause any loss of life, loss to cultural values, nor loss to third party infrastructure and economics. The environmental consequence, if any, to downstream fish-bearing lakes, which is Lake A8 for this particular situation, would be expected to be short term, with restoration or compensation in kind highly possible. Since dikes: DCP-1 and DCP-5, and Berm 3 have been constructed, any potential breach or seepage from the P-Area dikes would be expected to report to either CP1 or CP5, and therefore, the associated potential short-term environmental risk to Lake A8 has been eliminated. Based on the containment of a potential failure these structures are no longer considered as dams in accordance with the CDA classification (CDA 2013). However, as these structures serve a purpose for the mine operation, AEM have been regularly managing water within the ponds, and visually monitoring the containment structures associated with the P-Area.

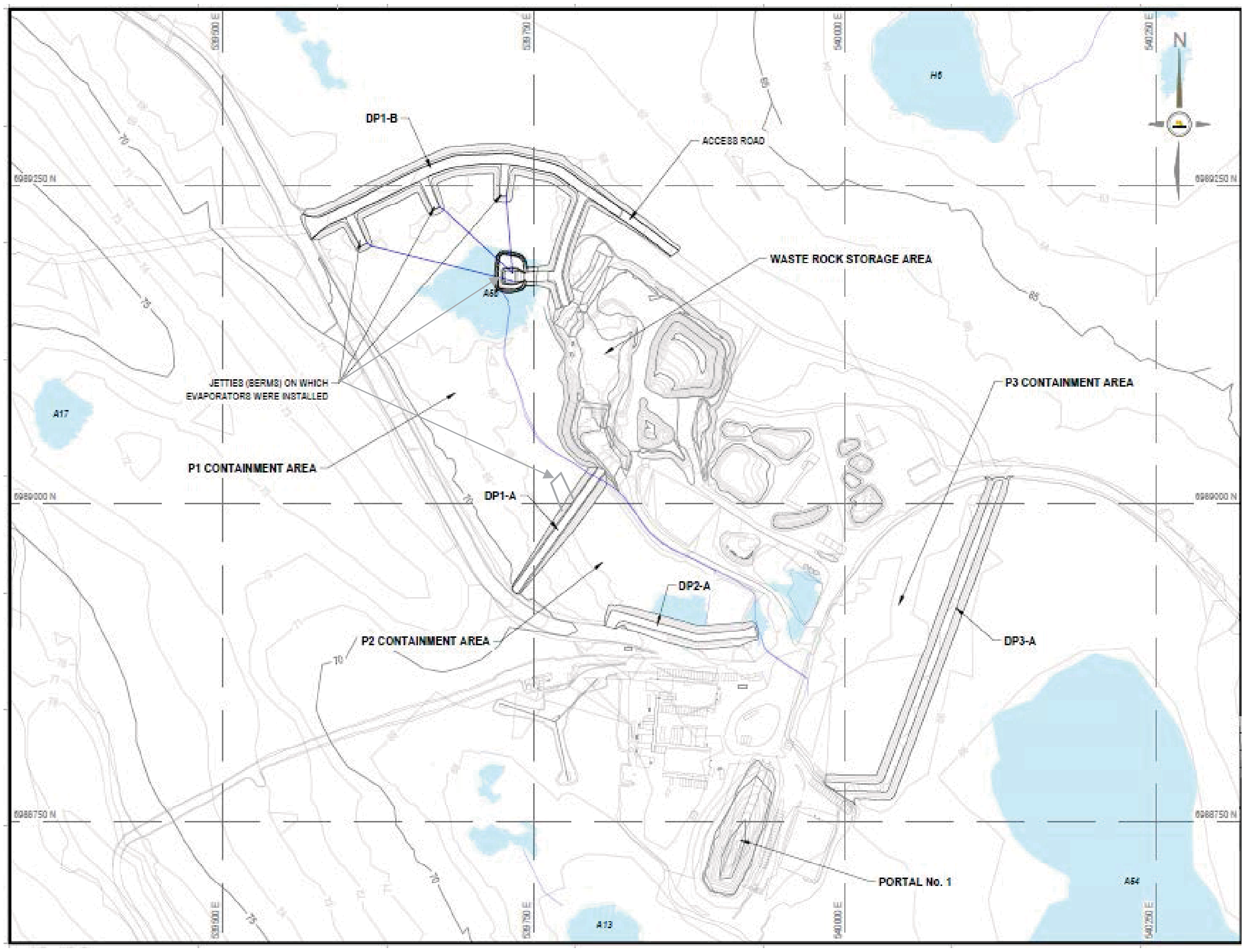
The central zone of each of the four P-Area containment dikes was intended to be constructed of saturated crushed (30 mm minus) material that was to freeze and become a frozen core, thereby forming the water-retaining element of each dike. Due to construction delays, temperatures became too warm to freeze the core part way through the construction, so the central cores were not frozen to the planned elevations and in some cases not frozen at all during construction. The thermal conditions of the cores of the dikes during operation is further discussed in Section 3.2. The following is a summary of the frozen cores that were completed during construction:

- DP1-A minimum saturated and frozen core elevation was 67.9 masl at the time of construction
- DP1-B entire core unsaturated
- DP2-A entire core unsaturated
- DP3-A saturated core elevation varied along the length of the dike, with a minimum elevation of 65.7 masl at the time of construction

Transition material (200 mm minus) was placed on the upstream and downstream sides of the core, with additional coarser grained rockfill placed further upstream and downstream and above the core. The upstream and downstream slopes are approximately 2 horizontal to 1 vertical. The maximum height of the core of any of the dikes is approximately 2.5 m, and the maximum height of the entire dike (core and thermal cover) is 4 m. Figure 4 shows a typical section through one of the dikes (DP3-A).

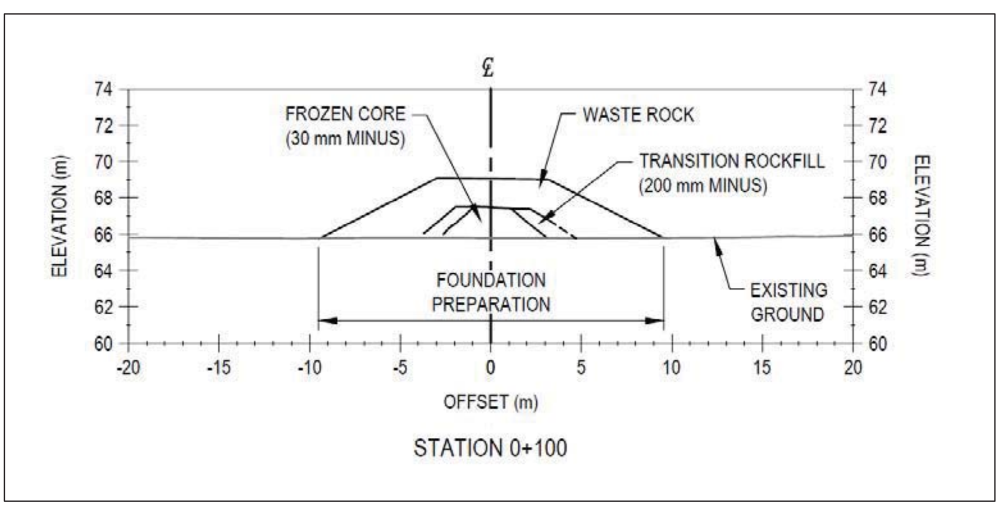
Temporary single bead thermistor cables were installed at selected locations at the crest of the frozen core to monitor the initial thermal conditions at these locations. These instruments functioned for a few months after installation. Six new vertical thermistors were installed in 2017. Their locations are shown in Figure C3 (Appendix C). Additional information regarding the thermal conditions and monitoring of the dikes is provided in Section 3.2 and thermistor data is provided in Appendix C.

Appendix A1 contains a summary of photographs of the temporary dikes and collection ponds from the 2018 inspection.



Source: Tetra Tech EBA 2016c.

Figure 3: P-Area and Dikes DP1-A, DP1-B, DP2-A, DP3-A



Source: Tetra Tech EBA 2016c.

Figure 4: Typical Section through Temporary P-Area Dike DP3-A

There are no spillways in the dikes. Water levels within each pond are controlled through pumping and the use of the evaporators installed within P1. P1 was subdivided into two areas by an internal berm constructed after the completion of P1. Details regarding the internal divider berm are not included within the P-Area construction record report, nor is its location shown on the drawings. As the divider berm is internal, the lack of information is not a concern.

A lined pond was constructed in the northwest corner of P1 in May 2017 to contain contaminated snow from a fuel spill at the exploration camp fuel farm. The snow melt water was treated with an oil water separator in September 2017 and the clean water was pumped to CP1. The snow and rain that collects in the snow melt pond has continued to be treated. The snow melt pond will be decommissioned.

The P-Area area temporary dikes and collection ponds are intended to be an interim measure during development of the site to manage the runoff water until permanent water management dikes and collection ponds are constructed and operating to the design and the saline water treatment plant is operational. As the project advances, the P-Area will become covered by waste rock and soil as Waste Rock Storage Facility 2 is developed.

Table 1 provides a summary of key information regarding the construction of each dike and thermistor installation locations.

Table 1: Summary of Key Dike Information and Thermistor Locations

Dike Structure	Minimum Elevation of Core	Minimum Saturated Elevation of Core [(a)]	Minimum Dike Rockfill Crest Elevation	Maximum Pond Operating Elevation [(b)]	Thermistor Location
DP1-A	68.9 m	67.9 m	70.3 m	68.5 m	no instrumentation
DP1-B	68.9 m	none	70.5 m	68.5 m	DCP1B-1: Stn 0+150 DCP1B-2: Stn 0+220
DP2-A	67.9 m	none	69.5 m	67.25 m	DCP2A-1: Stn 0+090
DP3-A	67.4 m	65.7 m	69.0 m	66.35 m	DCP3A-1: Stn 0+050 DCP3A-2: Stn 0+150 DCP3A-3: Stn 0+250

(a) At the time of construction.

(b) Water level associated with a 24-hour duration extreme rainfall event with a return period of 1:100 years, which would bring the elevation to within 300 mm of the top of the core. (File: 20160530 P1_P2_P3 Water Balance for 2016.xlsm, P1-Area Water Balance, Tetra Tech 2016c).

Stn = Station (distance) along centreline of each dike from the starting reference point.

3.1 Visual Observations

The inspection involved walking along the crest of the dikes (DP1-A, DP1-B, DP2-A, and DP3-A), examining the condition of the upstream and downstream slopes of the dikes for visual signs of deformation and instability, cracking, and uneven surfaces. Due to ponded water and saturated conditions it was not possible to walk along the downstream toes of DP1-B and DP3-A. Each pond contained water at the time of the site visit, so it was not possible to walk the upstream toe of the dikes. Seepage occurrences and/or indications of seepage were noted along the downstream toes. A photographic record of the inspection, with annotations added, where appropriate, is included in Appendix A1 (Photograph 1 through 37).

At the time of the inspection, the following general observations were made:

- Overall, the dikes appear stable, with no significant geotechnical concerns identified.
- The dikes do not completely enclose the ponds. The ore and waste stockpile area and existing roads form a portion of the pond boundaries. Neither the stockpiles nor the roads function as water containment structures, on a year-round basis. Collectively, the ponds and the associated dikes appear to capture the majority of the surface water runoff from the area of concern.
- The P1 divider berm appears to have been constructed of till with some rockfill on the downstream slope, as shown in Photograph 22 (Appendix A1).
- Water was ponded in the seepage collection channels and sumps constructed downstream of DP1-B and DP3-A and water was being actively pumped back into the ponds from the downstream collection systems at the time of the site visit. Water in the collection channels was clear. Seepage from DP1-B was slightly less than in 2017 and the water level in the seepage collection channel was also slightly lower. The ground between the downstream dike toes and the seepage collection channels was saturated at DP1-B and DP3-A and water was ponded along the toe, over the tundra at DP3-A which was more substantial than in 2017 (e.g., Photographs 13 through 16 and Photographs 30, 35, and 36, Appendix A1). Due to the ponded water and saturated tundra, it was not possible to walk directly along the toes of DP1-B and DP3-A.
- As noted in previous annual inspection reports (Golder 2017 and 2018), the rockfill used as thermal cover above the core and on the upstream and downstream slopes of the dikes was of variable grain size, particularly for DP2-A and DP3-A (e.g., Photograph 24 and Photograph 36 Appendix A1). Finer rockfill was observed on the crest of DP3-A (e.g., Photographs 32 and 34, Appendix A1). The crest of DCP1-B was also observed to have a cap of finer material which may have been placed or may be due to traffic on the dike crest.
- There was some minor erosion and/or sloughing on the slopes (e.g., Photograph 10), particularly where cables are laid along the slope and where water has been pumped into the pond. Cracks and periodic small depressions were observed in selected areas of DP1-A (e.g., Photographs 3 and 4, Appendix A1), DP1-B evaporator jetty 2 (e.g., Photograph 12, Appendix A1), DP2-A (e.g., Photograph 26 and 27, Appendix A1), and DP3-A (e.g., Photographs 31 and 33, Appendix A1). The cracks observed in the DP1-B jetty 2 and the east end of DP2-A were the most substantial and had increased in size since the 2017 inspection; these areas should be the priority for remediation and ongoing monitoring.

- Circular cracks with settlement (vertical displacement or slump) and small circular voids were observed during the 2016 inspection along the upstream slope of DP2-A, near Stn 0+40. The observed settlement and cracking may have been associated with 1) thawing of the foundation soils, in particular, if the soils were ice-rich, and/or 2) melting of snow or ice that may have been entrapped within the transition and rockfill material at the time of construction. At the time of the 2017 inspection, fine rockfill was observed to have been used to remediate the slope in the area of the settlement. There were no additional signs of instability in the immediate vicinity of this area; however, there was some minor slumping observed along the upstream crest near Stn. 0+60 (Photograph 26).
- Water levels within each pond are measured daily during the open water season, and the pond levels were generally maintained below the maximum design water elevation except for P3, which was above the design maximum pond elevation for most of June and July 2018 and P2 which rose above the maximum elevation for a few days at the end of July and beginning of September 2018.

3.2 Geotechnical Instrumentation and Monitoring Data

Single bead thermistors were installed by Tetra Tech EBA at the crest of the core (30 mm minus) material, at selected stations along each dike during construction. These thermistors stopped working in August 2016 (a few months after installation).

Six vertical thermistors were installed in the P-Area dikes on 30 September and 2 November 2017. Two were installed in DP1-B, one was installed in DP2-A, and three were installed in DP3-A (Figure C3, Appendix C2). The thermistors were read by AEM staff after installation and throughout 2018. After the completion of installation, the instruments were read between 23 and 25 times through to 4 November 2018. The instruments were typically read 2 times per week during freshet, weekly through the rest of the open water season and then approximately monthly through the winter. Updated plots of the thermistor data are provided in Appendix C2.

Initially after installation of the instruments, the data indicated that the dikes, and the foundation materials directly below the dikes, were at or below 0°C by late October to early November 2017. All instrument nodes remained at or below 0˚C throughout the winter until early June 2018 when temperatures rose above 0˚C. Although the cores of the P-Area dikes were not constructed to the saturated frozen condition intended, it appears that following the initial construction and first summer of operation, the temperatures within the cores of the dikes have been below zero for most of the year, as indicated by the thermistor data (Appendix C). It is likely that portions of the core have become saturated due to seepage through the dikes that freezes in the winter. The performance of the dikes, as frozen core structures, is more important during the freshet, when water levels tend to rise within the ponds. In the fall, when temperatures within the core tend to be the warmest or thawed, water levels within the facilities tend to be lower, and therefore less seepage through them is anticipated.

The complete set of data received by Golder represents a range for one seasonal cycle (14 months from September 2017 to November 2018). As discussed in Section 2.0, the salinity of the groundwater at the Project site can result in freezing point depression of up to 3.2˚C at depth. The salinity of the groundwater increases with depth so the freezing point depression near surface is expected to be less, but frozen conditions may not occur at 0˚C. The review of the data provided in the following bullets represent the thermal conditions for 2018:

- DP1B thermistor (DP1B-1 and DP1B-2) data shows a maximum depth of temperatures above 0˚C of 2.8 m (elevation 68.0 m) recorded on 30 September 2018. The nodes within the dike foundation remained below -1˚C during 2018.

- DP2A thermistor (DP2A-1) data shows a maximum depth of temperatures above 0˚C of 3.6 m (66.04 m) recorded on 30 September 2018. The nodes within the dike foundation remained below -1˚C in 2018.
- DP3A thermistor data (DP3A-1, DP3A-2, and DP3A-3) shows the maximum depth of temperatures above 0˚C varies between the three instruments. The data indicates that the greatest depth of 0˚C was measured at the central thermistor (DP3A-2 at station 0+150); this thermistor recorded temperatures greater than 0°C to its full depth (4.5 m) for four readings during the month of September 2018. Thermistors DP3A-1 (station 0+050) and DP3A-3 (station 0+250) identify a maximum depth of 0˚C measured at 4.4 m (elevation 64.67 m), and 2.7 m (elevation 66.37 m), respectively. The data from DP3-3 on 17 September 2018 is considered erroneous based on the readings collected before and after. The nodes within the dike foundation remained below 0˚C at DP3A-3, but temperatures rose above 0˚C to a depth of approximately 1.4 m into the foundation below DP3A-1. Data from thermistor DP3A-2 shows that temperatures above 0˚C extend into the foundation from 19 July to 4 November 2018.
- In general, all thermistors showed all beads at or below 0˚C by 4 November 2018. The exception is thermistor DP1B-1 in which the last recording provided was for 30 September 2018; node 4 of this thermistor located within the dike fills remained at 1.0˚C. This may be an erroneous reading as the nodes within the dike above and below node 4 showed consistent temperatures near 0˚C.

Table 2 provides a summary of the key thermal observations at the P-Area thermistors in 2018.

Table 2: Summary of P-Are Dike Instrumentation

Dike Structure	Instrument Name	Instrument Location	Maximum Depth of 0 C Temperature (m)	Minimum Elevation of 0˚C Temperature (m)
DP1-B	DP1B-1 DP1B-2	Station 0+150 Station 0+220	2.8 2.8	68.05 68.05
DP2-A	DP2A-1	Station 0+090	3.6	66.04
DP3-A	DP3A-1 DP3A-2 DP3A-3	Station 0+050 Station 0+150 Station 0+250	4.4 > 4.5 2.7	64.67 64.67 66.37

In 2018, AEM staff performed the following monitoring activities:

- Recorded the daily volumes of water pumped from underground to the P-Area.
- Recorded the daily volumes of water transferred between the ponds.
- Measured and recorded water elevations within each pond during the open water season on a graph with the maximum allowable pond elevation.
- Performed daily inspections of pond and seepage water condition (e.g., frozen or thawed, clear or cloudy) at water management facilities during the freshet (11 May to 14 June 2018).

- Collected samples from the P-Area approximately every one to two weeks for water quality analysis from 10 June to 8 September 2018
- Geotechnical inspections were completed and documented twice for each of the P-Area dikes, one in July and one in September. The inspections included observations of cracking, sloughing, and seepage, and included photographs. AEM prepared visual tracking sheets for each dike by adding sketches of the locations of their observations to plan drawings of the dikes. The observations made by AEM were consistent with the observations from the 2018 annual inspection.

The information collected is contained within various spreadsheets and reports, which were provided to Golder for review.

An operation, maintenance, and surveillance (OMS) manual, including an emergency response plan and emergency preparedness plan, has been prepared for D-CP1 and D-CP5 (AEM 2018) but it does not include the P-Area dike structures.

3.3 Recommendations

The following recommendations are provided regarding the temporary dikes and ponds, for the period of their operation:

- Cracks with settlement (vertical displacement or slump) and small circular voids evident along the dikes should continue to be monitored. If the dikes continue to be used, consideration for filling in the cracks, with additional fine rockfill or granular fill, regrading, and re-compacting the slopes and crests may be warranted. This work could reduce the potential for infiltration into the dikes that could lead to thermal degradation of the frozen core and foundation and could also lead to further instability of the jetty and dike thermal cover materials that could result in material sloughing into the pond. The slumping and cracking along DP2-A and the jetty for Evaporator #2 was more substantial than observed in 2017; there was more settlement observed at the crest of DP2-A and the cracks in the dike and jetty were wider and deeper than in 2017. These areas should be monitored closely as there is the potential for the jetty or dike to slump into the P1 or P2, respectively. A failure of the evaporator jetty or upstream slope of DP2-A are not a risk to a release of water from the ponds but a failure could affect operations and would require repair. There was no cracking or substantial slope movement observed on the downstream slopes of the dikes that would be a concern for potential release of water from the ponds.
- The thermistor data available provides just over one year of monitoring and indicates that the dikes are not fully functioning as frozen core dams through the summer and early fall. DP3-A was fully thawed and the data for the other P-Area dikes indicates only the lower 0.5 to 1 m of the dikes remained below 0°C through the summer and early fall. To maintain the thermal integrity of the frozen cores of the dikes, the following should be implemented:
  - The water levels in the ponds should be reduced as much as possible in the winter to promote freezing of the dam cores. This would also increase the capacity within the ponds to manage water during the freshet, if necessary. The water levels should also be maintained as low as possible in the summer to reduce thermal warming due to water over the upstream toe of the dikes.

  - Where access is feasible, removal of snow from the water collection pond dikes is recommended to reduce the insulating effects of the snow, thereby allowing the temperatures of the core materials in the dikes and the foundations to drop as low as possible with the potential that temperatures could get cold enough to maintain frozen conditions throughout the following summer. Snow removal is more important if thermistor data indicates that temperatures within the dikes and/or foundation are warmer than expected.

- Make sure each thermistor cable is well marked so they can be located and maintained during the winter and are not damaged during snow removal operations. Consider adding data loggers to record the temperatures to facilitate data collection, particularly in the winter.
- Consider adding rockfill material to cover the till berm in P1, to protect the till and maintain its integrity if this berm is required for water management.
- If the P-Area ponds and associated dikes continue to be used by AEM, then it is recommended that they are added to the OMS manual for D-CP1 and D-CP5.
- AEM personnel should continue to conduct geotechnical inspections and document visual observations such as, cracking, slumping, and/or seepage. Thermistor data should continue to be collected, plotted and reviewed, and pond water levels should continue to be measured and tracked. Inspection reports should continue to be prepared for documentation. It is recommended that the frequency of visual geotechnical inspections be conducted weekly during freshet and monthly during the open water period.
- Continue to collect and pump back seepage water, as deemed necessary, in areas where seepage could impact downstream areas.

4.0 PERMANENT WATER COLLECTION POND DIKES, JETTIES, BERMS, AND CHANNELS

The permanent water management facilities for the Meliadine Gold Project will be constructed as the Project develops. This section presents a summary of the permanent water collection ponds and associated dikes, berms, and channels that had been constructed prior to the 2018 inspection, including Collection Pond 1 (CP1) and its associated dike (D-CP1), Collection Pond 5 (CP5) and its associated dike (D-CP5), Berm 3, Channel 1 (partially complete), Channel 2, Channel 3 (partially complete), Channel 5, and the saline pond.

The following subsections provide a description of the structures, visual observations, a summary of geotechnical instrumentation (if any exists), followed by recommendations.

4.1 Water Collection Ponds and Associated Dikes

At the time of the site visit in September 2018, two of the permanent water collection pond dikes had been constructed, D-CP1 and D-CP5. These dikes were constructed between October 2016 and July 2017. Both dikes are composed of rockfill and transition shells with a geomembrane liner anchored into a key trench within the permafrost foundation (soil or bedrock).

D-CP1 is approximately 600 m long with a maximum height of 6.6 m (Tetra Tech 2017g) and is located northeast of the P-Area, as shown in Figure 1. It is oriented approximately south–north with a slight inflection 200 m from the south abutment. D-CP1 was constructed across the outlets of lakes H6 and H17, which combine to form CP1. The CDA (2013) dam consequence classification for D-CP1 is *Significant* (Tetra Tech 2016a). A downstream collection sump and two channels were constructed approximately 5 m downstream of the D-CP1 toe to collect surface run-off and any possible dike seepage for pump back to CP1. CP1 is the final water management facility on site, and water from various parts of the site will be pumped to CP1 for treatment and discharge to Meliadine Lake.

D-CP5 is approximately 300 m long with a maximum height of 3.3 m (Tetra Tech 2017f) and is located southeast of the P-Area, as shown in Figure 1. It is oriented approximately southwest–northeast and was constructed across the south portion of Lake A54 such that the northern portion of the lake now forms CP5. The CDA (2013) dam consequence classification for D-CP5 is *Significant* (Tetra Tech 2016b). A small collection sump is located in a natural depression downstream of D-CP5 to collect surface run-off and any possible seepage through the dike for pump back to CP5. CP5 will be used seasonally for temporary water storage with active pumping to CP1.

4.1.1 Visual Observations

The inspection involved walking along the crests and toes of the dikes and examining the condition of the slopes of the dikes for visual signs of deformation and instability, cracking, and uneven surfaces. There was water in CP1 and CP5 at the time of the site visit, so it was not possible to walk along the upstream toes of the dikes. A photographic record of the inspection, with annotations added where appropriate, is included in Appendix A2.

Dike D-CP1

At the time of the inspection of D-CP1, the following general observations were made:

- Overall, the dike appeared stable, with no significant geotechnical concerns identified.
- Minor cracking and small settlement was observed along significant portions of the upstream slope and crest (e.g., Photographs 4 and 5 and Photographs 9 and 10, Appendix A2). The largest cracks were up to 2 to 3 cm wide. The cracking was generally in about the same condition to what was observed in 2017 with minor increases in the width and depth of some cracks.
- There was some cracking on the downstream crest near Stn 1+145 (Photograph 19). The cracks were wider and deeper than observed in 2017.
- There was no seepage observed from the downstream toe.
- The downstream collection channel appeared to be consistently graded to the downstream collection sump. The channel was generally dry, with only a very small amount of water ponded in the channel from approximately Stn 1+250 to the pond (Photographs 21, Appendix A2).
- Minor cracking was observed in the crests of the downstream collection sump berms that was similar to what was observed in 2017 (e.g., Photograph 26, Appendix A2).
- Jetty 1 was in good condition, no signs of instability (Photographs 27 to 29, Appendix A2). Some erosion marks on the slope due to wave erosion from historic high water levels.

Dike D-CP5

At the time of the inspection of D-CP5, the following general observations were made:

- Overall, the dike appeared stable, with no significant geotechnical concerns identified.
- Minor cracking was observed in a few locations on the upstream and downstream sides of the dike crest in the area between Stn.1+170 and 1+185 (e.g., Photographs 34, 35, 40, and 41, Appendix A2). The cracking on the downstream crest near Stn. 1+180 was similar to 2017. The rest of the cracking was not observed in 2017.
- There are two small holes near ground temperature cable VGTC-2 (Stn. 1+180) where there were failed drilling attempts during instrumentation installation.
- There were no signs of seepage from the downstream toe.
- There was a small pond of water in a low area downstream of the dike near Stn 1+170 with a pump in place but there was no active pumping at the time of the inspection (Photographs 42, Appendix A2). This water is likely due to surface runoff collecting in naturally low topography as D-CP5 was constructed across the southern portion of Lake A54.
- Jetty 5 is the causeway for the pump back station for CP5. Jetty 5 appeared stable with no significant geotechnical concerns identified (Photographs 43 and 45, Appendix A2).

Construction of D-CP1 and D-CP5 was completed in July 2017, and the dikes were transitioned from AEM's construction team to its engineering team at the end of 2017. AEM's engineering team conducted visual geotechnical inspections of the dikes between 14 June and 1 September 2018. Twelve inspections were completed and documented for both D-CP1 and D-CP5. The initial four inspections were completed within one week in June (14 to 21 June 2018). The remainder of the inspections were conducted approximately weekly from 5 July to 1 September, except for one missed inspection in mid-August. The inspections included observations of cracking and settlement, pond elevation, pumping activities and generally included photographs. AEM prepared visual tracking sheets for each dike by adding sketches of the locations of their observations to plan drawings of the dikes. No seepage was observed at either dike. The observations made by AEM staff were consistent with the observations during the 2018 annual inspection. Cracks and locations of settlement were also marked with spray paint in the field to monitor changes.

AEM noted that a channel had been constructed to connect the low areas of H17 and H6 so that water within the H6 area close to the dike could be drawn down further.

4.1.2 Geotechnical Instrumentation and Monitoring

Horizontal and vertical thermistors were installed in D-CP1 and D-CP5 between March and July 2017, as shown in Figures C4 to C7 in Appendix C. Plots of the thermistor data are provided in Appendix C. Thermistor data was provided up to 1 September 2018. As discussed in Section 2.0, the salinity of the groundwater at the Project site can result in freezing point depression of up to 3.2°C at depth. The salinity of the groundwater increases with depth so the freezing point depression near surface is expected to be less, but frozen conditions may not occur at 0°C.

Dike DCP-1

There were five horizontal thermistors installed in D-CP1 above the liner parallel to the key trench and five vertical thermistors installed upstream and downstream of the key trench. The locations of these instruments are summarized in Table 2. Horizontal thermistor data was provided from 21 March 2017 to 1 September 2018 and vertical thermistor data was provided from initial readings (varies between May and July 2017) to 1 September 2018.

There were also six settlement survey monuments installed over the liner crest in the central area of the dike as shown in Figures C4 and C5 in Appendix C2.

Table 3: Summary of D-CP1 Thermistor Locations

Instrument	Horizontal or Vertical (H or V)	Location	Additional Details
HGTC-1	H	Stn. 1+513 to 1+562	
HGTC-2	H	Stn. 1+254 to 1+304	
HGTC-3	H	Stn. 1+343 to 1+394	
HGTC-4	H	Stn. 1+432 to 1+482	
HGTC-5	H	Stn. 1+117 to 1+158	
VGTC-1	V	1+278	upstream of the liner and key trench
VGTC-2	V	1+280	downstream of the liner and key trench
VGTC-3	V	1+461	upstream of the liner and key trench
VGTC-4	V	1+460	downstream of the liner and key trench
VGTC-5	V	1+300	along slope upstream of the Phase 2 liner

Stn = Station (distance) along centreline of each dike from the starting reference point.

The following observations were made regarding the instrumentation readings collected for D-CP1:

- The horizontal ground temperature cable plots (Appendix C2) were indicating a warming trend in the base of the key trench in 2017. They cooled over the winter with most of the nodes approaching temperatures near -10˚C in early June 2018. Temperatures measured from early June to late August 2018 showed a warming trend of about 2 to 3˚C, indicating influence of ambient temperatures and/or ponded water within CP1. Winter readings were not collected between January and June 2018 for three of the instruments, HGTC-1, HGTC-3, and HGTC-5. All horizontal ground temperature cable nodes at the base of the key trench have remained frozen based on the data provided. Some of the nodes that are located on the downstream slope of the key trench and along the foundation of the dike below the downstream slope had temperatures that rose above 0˚C, particularly HGTC-5 which has beads that extend below and possibly downstream of the rockfill shell. These nodes have less cover and are therefore more influenced by ambient temperatures. Maximum temperatures may not have been reached as of the last readings provided for 1 September 2018.
- Vertical ground temperature cable plots (Appendix C2) indicate that the dike and foundation remained below 0˚C after November 2017 throughout the winter until about April/June of 2018. The maximum depth of 0˚C temperature readings ranged from approximately 1.2 m to 2.7 m in the summer and early fall of 2018. The final readings received (1 September 2018) identified the greatest depth of 0˚C temperature readings at 2.7 m observed in VGTC-01, located upstream of the liner and key trench. The maximum depth of 0˚C temperature readings may not have been reached as of the last readings on 1 September 2018. The maximum depth of 0˚C temperature readings in 2017 was equal to the depths measured in 2018 or 0.5 m lower, with the exception of VGTC-05 which had a maximum depth of 0˚C 1.2 m lower than what was measured in 2018. All the vertical thermistors indicate that the foundation and the lower 1 to 2 m of the dike (both upstream and downstream of the liner) remained below 0˚C during the reporting period.

- D-CP1 survey monitoring points M-1 to M-6 indicate a range of total vertical displacement between 29 and 40 mm between the baseline survey using the total station on 19 September 2017 to the last reading received for the reporting period on 13 August 2018. The range of total vertical displacement from the last reading in 2017 on 25 October to the last reading received for 2018 on 13 August was 18 to 25 mm. The maximum vertical displacement was observed at survey marker M-6 (station 1+510) and the minimum vertical displacement was observed at survey marker M-2 (station 1+230). The OMS manual indicates that total vertical settlement less than 120 mm is an acceptable (green) condition.

Dike D-CP5

Two horizontal thermistors are installed in the key trench approximately 250 mm above the liner along most of the length of the trench. Three vertical thermistors were installed upstream and downstream of the key trench and liner. The locations of these instruments are summarized in Table 4. There were also three settlement survey monuments installed over the liner crest in the central area of the dike as shown in Figures C6 and C7 in Appendix C2. Data provided for the horizontal thermistors is from April 2017 to September 2018. Data for the Vertical thermistors is from June 2017 to September 2018.

Table 4: Summary of D-CP5 Thermistor Locations

Instrument	Horizontal or Vertical (H or V)	Location	Additional Details
HGTC-1	H	Stn. 0+052 to 0+202	
HGTC-2	H	Stn. 0+164 to 0+304	
VGTC-1	V	Stn. 0+181	upstream of the liner and key trench
VGTC-2	V	Stn. 0+185	upstream of the liner and key trench
VGTC-3	V	Stn. 0+185	downstream of the liner and key trench

Stn = Station (distance) along centreline of each dike from the starting reference point.

The following observations were made regarding the instrumentation readings collected for D-CP5:

- The horizontal ground temperature cable plots initially indicated a warming trend after installation in the spring 2017. Beginning in January 2018, the data began showing a cooling trend. The cooling trend continued until about April 2018 and then started to warm as ambient temperatures increased. All thermistor nodes within the key trench remained at or below 0˚C throughout the reporting period (April 2017 to September 2018) and ranged from -3 to -10˚C. Maximum temperatures may not have been reached by the last readings on 1 September 2018.

- Vertical ground temperature cables VGTC-01 and VGTC-02 are located upstream of the liner and key trench in D-CP5. The data from these instruments indicates that the upstream dike fills were below 0˚C from October 2017 until April 2018. The maximum depth of temperatures above 0˚C extended approximately 3.5 m to near the interface between the base of the dike fills and original ground at VGTC-01 and 3.0 m at VGTC-02. The depth of 0˚C temperatures appeared to be stabilizing in September but may not have reached the maximum depth. In 2017, the maximum depth of 0˚C temperature readings was 4 m at VGTC-01 and 3.5 m at VGTC-02. Up to the last reading on 1 September 2018, the foundation below the dike remained below -1˚C and -2˚C at the location of VGTC-01 and VGTC-02, respectively.
- D-CP5 survey monitoring points M-1 and M-2 indicate total vertical displacement of approximately 20 mm between the baseline survey using the total station on 19 September 2017 to the last reading received for the reporting period on 21 July 2018. The range of total vertical displacement from the last reading in 2017 on 25 October to the last reading received for 2018 on 21 July was 9 to 12 mm. M-3 indicated a total vertical displacement of about 40 mm as of 25 October 2017. No additional readings were recorded for M-3 as it was reported as being destroyed. The OMS manual indicates that total settlement of less than 100 mm is an acceptable (green) condition.

AEM provided Golder with plots that are used to document the pond levels in CP1 and CP5. Pond elevations were taken from twice a day to once every one to three days from 25 May to 11 September 2018. The plots included the maximum allowable pond levels for pre-freshet, open water, pre-winter, and during a flood. The pond elevation in CP5 was above the maximum operating pond level from the start of monitoring on 5 June until 20 June 2018.

An operation, maintenance, and surveillance (OMS) manual, including an emergency response plan and emergency preparedness plan, was prepared for D-CP1 and D-CP5 (AEM 2018).

4.1.3 Recommendations

The following recommendations are provided regarding D-CP1 and D-CP5:

- Water volumes within containment ponds should be managed to the levels defined in the OMS, including maintaining the water level below the elevation defined for the end of October in the OMS Manual over the winter to promote freezing of the dikes.
- The D-CP1 sump and downstream collection channel should be emptied in the fall/early winter to refreeze the ground around these facilities. During the open water season, keeping the water level in the downstream channel and sump low will also reduce the potential for thaw of the ground and associated settlement.
- The open cracks and depressions observed in the dike crests should be filled with fine rockfill or sand to reduce the potential for infiltration into the dike that could lead to propagation of the cracks and cause additional thermal warming. These areas should be monitored following repair works to determine if these cracks and depressions reappear.

- The pipe ramp constructed out of sand upstream of D-CP1 near Stn. 1+140 is susceptible to erosion, and some erosion was observed since the 2017 inspection. It is recommended that the pipe ramp be covered with a coarser rockfill to protect it from erosion.
- Monitor the cracking observed in the D-CP1 downstream sump berms. Recontouring and/or compacting the areas of cracking to close the cracks will reduce the potential for water to infiltrate into the cracks that could lead to propagation of the cracks and warming of the permafrost and additional thaw settlement.
- Geotechnical inspections of the dikes should be conducted and documented following the schedule developed in the OMS Manual. Inspections were conducted in 2018 from June to September that generally met the requirements for weekly and monthly inspections laid out in the OMS Manual. Monthly routine inspections were conducted by Ms. Jennifer Pyliuk M.Eng., P.Eng., and weekly inspections were conducted by technicians from the engineering department. There were no inspections conducted from January to May 2018 due to snow cover. The OMS Manual indicates that daily inspections should be completed and documented using the same form as the weekly inspection, which were not completed in 2018. The OMS Manual does not indicate if there is seasonal variability to the frequency of documented inspections. It may be acceptable to seasonally vary the frequency of inspections, but this should be reviewed with the Engineer of Record (EoR) for the dikes and the OMS Manual should be updated, as required.
- It is a good practice to review the OMS Manual on an annual basis (e.g., the names and contact numbers for key personnel). The current OMS Manual is dated June 2018, so should be reviewed and updated as necessary around June 2019.
- The ground temperature cables and survey monitoring points should continue to be monitored following the schedule and procedures developed in the OMS Manual. The ground temperatures should be monitored to determine if the foundation remains frozen. Fluctuations of the temperature within the active layer in the dikes are expected; however, the foundation is designed to be maintained frozen.
- Where access is feasible, snow should be removed from the dike crests and slopes in the winter as this can help to reduce the insulating effects of the snow, thereby allowing the temperatures of the dike and foundation to drop as low as possible. Snow removal is more important if thermistor readings indicate warmer temperatures than expected.
- Survey marker M-3 on D-CP5 should be replaced, if possible, to continue monitoring liner settlement in this area of the dike.

4.2 Saline Pond

The saline pond is located east of DP3-A and was constructed during the third quarter of 2016. The saline pond was constructed to manage excess underground saline water before a long-term saline water disposal/treatment plan was finalized. During 2018, water was transferred from the saline pond to the P-Area for evaporation. At the time of the inspection, the permanent Saline Water Treatment Plant (SWTP) was under construction. AEM is planning to have the SWTP operational in 2019.

The saline pond was largely constructed by excavation within permafrost overburden and bedrock. A small berm approximately 1 to 2 m high was constructed around the excavation with a till core and rockfill cover to promote permafrost development in the original ground below the berm and keep surface water from the surrounding area from draining into the pond. The pond is designed to maintain the maximum pond elevation under the inflow design flood (1-in-100-year precipitation event) below original ground and below the level of CP5 to minimize the potential for seepage out of the saline pond.

4.2.1 Visual Observations

The inspection involved walking along the crest of the saline pond perimeter berm, examining the condition of the berm for visual signs of deformation and instability, cracking, uneven surfaces, and seepage. A selection of photos from the inspection are included in Appendix A2.

At the time of the inspection of the saline pond, the following general observations were made:

- Overall, the pond and perimeter berm appeared stable, with no significant geotechnical concerns identified.
- There was water in the pond at the time of the site visit that was well below the top of the bedrock excavation (Photograph 46, Appendix A2).
- Water was ponded between DP3-A and the northwest perimeter of the Saline Pond (Photograph 50, Appendix A2). There was more water ponded than in 2017.
- Cracking and settlement were observed in the perimeter berm in several locations on the upstream and downstream crest (Photograph 46, 47 and 48, Appendix A2). Cracking on the northwest perimeter berm had increased slightly from 2017. Cracking observed on the southwest and southeast sections of the perimeter berm were not observed in 2017.
- There is an area near the upstream toe of the northwest perimeter berm that appears to have settled. This area was observed in 2017 and did not appear to have changed substantially at the time of the 2018 inspection (Photograph 49, Appendix A2). Seepage water from DP3-A has been observed to pond against the north side of the Saline Pond berm and may seep into the berm. During the 2017 inspection, AEM also indicated that there is a fault in this area and surface water sometimes seeps into the pond through the northwest section of the perimeter berm (downstream of DP3-A). This seepage could be causing thawing of the permafrost in the foundation resulting in settlement and cracking within the berm.
- There was no seepage into the Saline Pond observed during the inspection.

4.2.2 Recommendations

The following recommendations are provided regarding the saline pond for the time it is in operation:

- Consideration for filling in the cracks with fine rockfill, recontouring, and re-compacting the slopes and crests may be warranted to reduce the potential for infiltration into the berms that may increase the cracking and settlement.
- Monitor the downstream side of the perimeter berm for ponding water and consider diverting it or pumping it so it does not seep into the saline pond and warm the foundation below the berm.

4.3 Diversion Channels and Berms

Diversion Channel 1, 2, 3, and 5 were inspected and Berm 3. The channels were constructed by excavating a trench, placing woven geotextile to line the excavation, and then placement of riprap (coarser rocks) over the fabric to line the channels.

Channel 1 is designed to move water from Pond H13 to CP1 and extends from Culvert 2 to Pond H9 along the north and east sides of Portal #2. Channel 1 had been completed from Lake H9 to just west of Culvert 16. Channel 1 will be approximately 493 m long when it is complete with a base width of 3 m.

Channel 2 is located along the northern end of the main mine site industrial pad and is approximately 270 m long with a base width of 1 m. During construction and operation, contact water from the plant site area will naturally flow or be diverted into Channel 2, which in turn will flow into ponds H15E, H15, H14, H13, H12, H9, H8, and eventually into CP1.

Channel 3 is designed to direct seepage and run-off water from the future tailings storage facility (TSF) into future collection pond CP3. Channel 3 is located northwest of the operational landfill and runs along the southwestern boundary of the TSF. Most of Channel 3 had been constructed at the time of the site visit, except for a small section at the outlet end near future CP3. Channel 3 will be approximately 619 m long when complete with a base width of 1 to 2 m.

Channel 5 and Berm 3 are located west of CP5 and are designed to divert water from the pond A12 catchment area into CP5 so that this water does not flow into Tiriganiaq Pit 1. A selection of photos from the inspection are included in Appendix A2 (Photographs 67 through 76). Channel 5 is the main water diversion structure; Berm 3 is only required to temporarily retain water under an extreme rainfall event when the water level in CP5 is temporarily high (Tetra Tech 2016d). Channel 5 is approximately 429 m long with a base width of approximately 3 m. Berm 3 is approximately 315 m long with a maximum height of about 2.8 m. Berm 3 consists of a till core, a foundation key trench backfilled with till, and a cover layer constructed out of 600 mm minus esker material. The design specified run-of-mine rockfill for the cover; however, this material was not available at the time of construction.

4.3.1 Visual Observations

Channel 1 and Culvert 16

The inspection of Channel 1 involved walking along the southern boundary of the channel from the western extent to the outlet at the east, with periodic crossing to the northern boundary where feasible. A selection of photographs from the inspection are included in Appendix A2 (Photographs 51 to 56). There was water ponded in several locations along the channel, likely coinciding with the ponds that it was constructed through (H9 to H12). There was water ponded upstream of the inlets to Culvert 16 as the inverts of the culverts were elevated. If the channel invert remains below the invert of the lowest culvert, water will have to pond in the area prior to flowing through the culverts. There was cracking and some settlement along the edges of the channel (e.g., Photograph 52). The movement may be slumping of the riprap over the fabric or may be due to thaw settlement in the permafrost within the edges of the channel.

Channel 2

Channel 2 was inspected by walking from the start of the channel at east end to the outlet at the west end. A selection of photos from the inspection are included in Appendix A2 (Photographs 57 through 62). The slope of the channel base is not consistent and some pooling of water and deposition of sediment in lower areas was observed which is consistent with previous observations. Ponded water may infiltrate into the channel base but is not expected to be substantial. No geotechnical concerns associated with Channel 2 were identified.

Channel 3

Channel 3 was inspected by walking from the start of the channel at the east end to the northwest end. Most of the construction of Channel 3 had been recently completed at the time of the inspection, except the northwest section (Photograph 66). A selection of photos from the inspection are included in Appendix A2 (Photographs 63 through 66). The access road to the future location of CP3 runs along the western boundary of Channel 3 (Photograph 64 and 65). Water was ponded in the northwestern section of the channel which is the lowest elevation and close to the outlet to CP3. No geotechnical concerns associated with Channel 3 were identified.

Channel 5

Channel 5 was inspected by walking the southern crest from near the northwestern end of the channel to the outlet near CP5. A selection of photos from the inspection are included in Appendix A2 (Photographs 67 to 71). Overall Channel 5 appeared stable, with no significant geotechnical concerns identified. There was some cracking observed adjacent to Channel 5 (Photographs 67 and 71, Appendix A2). The most substantial cracking was observed at the northwestern end of the channel where lakes H12 and H13 were located. Water was ponded within the channel in this area (Photograph 71). There was some shallow ponding of water in the channel near the outlet to CP5 and near station 0+220.

Berm 3

Berm 3 was inspected by walking along the crest and slopes examining the condition of the berm for visual signs of deformation and instability, cracking, or uneven surfaces. A selection of photos from the inspection are included in Appendix A2 (Photographs 72 to 78).

- Overall, Berm 3 appeared stable with no significant geotechnical concerns identified.
- Water was ponding near the upstream toe of Berm 3 near station 0+100 (Photograph 74, Appendix A2).
- Erosion and minor cracking observed on upstream and downstream slopes (e.g., Photographs 76 to 78).
- Water was ponded over the tundra in some areas downstream of the dam, but there was no seepage observed from the downstream slope.

4.3.2 Recommendations

The following recommendations are provided regarding the diversion channels and Berm 3:

- Monitor the cracking adjacent to Channel 1 and Channel 5. Re-contouring and/or compacting the areas of cracking to close the cracks will reduce the potential for water to infiltrate into the cracks, and reduce the potential for warming of the permafrost and additional thaw settlement and cracking. Check as-built slopes of Channel 1 in the areas of cracking to confirm constructed to design (3H:1V), or as otherwise approved by the design engineer; steeper slopes may be the cause of the movement. Reducing the amount and duration of water ponding in Channel 5 will help reduce thermal degradation of the surrounding permafrost and cracking.
- If the bottom of Channel 1 remains below the inlets for Culvert 16, consider lowering the invert of the lowest culvert or adjust the invert of the channel, if possible, so that water will not need to pond in the channel before flowing through the culverts.
- According to the design for Channel 5 and Berm 3 (Tetra Tech EBA 2016d), Channel 5 is supposed to be able to handle run-off flows except for an extreme rain event and Berm 3 is only intended to temporarily retain water when the water level in CP5 is high due to an extreme rain event. However, at the time of the 2017 site visit, water had overflowed Channel 5 and was ponded against Berm 3. There was water ponded against Berm 3 during the 2018 inspection as well, but a much smaller amount. Ponding upstream of Berm 3 should be monitored to determine how much and how often ponding occurs and if Berm 3 can perform as required with the ponding.
- The Berm 3 cover materials are susceptible to erosion and some minor erosion was observed during the 2018 inspection. Erosion of the slopes should be monitored and consideration should be given to placing coarser material on Berm 3 to reduce the potential for erosion if it becomes substantial.

5.0 SITE ROADS, CULVERTS, AND TIRIGANIAQ ESKER AND WESMEG BORROW AREA

This section summarizes the observations made during the 2018 geotechnical inspection regarding the main site roads and associated culverts, and the Tiriganiaq Esker and Wesmeg Borrow Area roads and facilities. Appendix A3 contains selected photographs taken during the inspection. The following is a list of the roads, water management structures, and facilities inspected:

- landfill access road and to future TSF area, including Culvert 1 (Photographs 1 to 3, Appendix A3)
- main site pad area roads, including Culverts 2, 3 and 4 (Photographs 4 to 12, Appendix A3)
- main site water intake access road (Photographs 13 to 16, Appendix A3)
- emulsion plant pad access road and Culvert 13 (Photographs 17 to 22, Appendix A3)
- Tiriganiaq Esker access road (Photographs 23 and 24, Appendix A3)
- magazine storage area and access road (Photograph 25, Appendix A3)
- Wesmeg access road, Wesmeg Borrow area and vent raise (Photographs 26 to 31, Appendix A3)
- CP4 access road (Photograph 32, Appendix A3)

5.1 Visual Observations

5.1.1 Site Roads and Culverts

At the time of the site visit, the site roads were generally in good condition. As the site is in active construction, roads were in various stages of construction/operation. The roads appeared to generally be of adequate width with pull outs where required to allow vehicles to safely pass. The heights of the road fills were such that berms were not required. Many of the roads appeared to have been constructed using a combination of sand and gravel obtained from esker borrow areas, rockfill, and crushed aggregate. Normal maintenance of the roads should be anticipated. No geotechnical concerns were identified during the inspection.

There were four permanent water management culverts in place through road fills at the time of the site visit: Culverts 1, 2, 3, and 4. A summary of the culverts inspected, general observations, and any recommendations is provided in Table 5.

Table 5: Summary of Site Culverts Inspected

Access Road	Culvert No.	Culvert Description	Visual Observations
Operation Landfill Access Road (and future TSF)	1	2 × 1000 mm CSP	Culverts were in good condition (Photographs 2 and 3, Appendix A3). There was a small pool of water below the upstream ends of the culverts, but no flow through the culverts. The inlets of the culverts were elevated above the ground upstream which will allow some water to pond against the road prior to flowing through the culverts. Culverts appeared to have a sufficient thickness and appropriately sized cover material.
Service Road on west side of Portal #2 and Crusher Ramp	2	4 × 1200 mm CSP	Culverts were in good condition (Photographs 6 and 7, Appendix A3). There was some water ponded in the area around the downstream ends of the culverts, but no water flowing through the culverts at the time of the site visit. Culverts appeared to have appropriately sized cover material.
Service road on west side of CP1	3	3 × 600 mm CSP	Culverts were in good condition (Photographs 8 and 9, Appendix A3). The downstream ends of the culverts were partially submerged in a small pool of water within CP1, but there was no flow through the culverts at the time of the site visit. Culverts appeared to have appropriately sized cover material.
	4	1 × 600 mm CSP	Small amount of damage to upstream end of the culvert (Photographs 10 to 12, Appendix A3), which isn't expected to substantially reduce flow capacity and had not changed from 2017. No flow through the culvert. Culvert appeared to have appropriately sized cover material.

Note: 1 × 600 mm = the number of culverts × the diameter of the culvert.

CSP = corrugated steel pipe.

5.1.2 New Emulsion Plant and Access Road

The emulsion access road was constructed in 2017. The following are some of the general observations:

- The road appeared to generally be of adequate width and had pull outs to allow vehicles to safely pass. The height of the road fill was such that berms were not required.
- The road appeared to have been constructed using esker sand and gravel material, which may be susceptible to erosion. The surface of the road was in variable condition. The northern section, past the laydown area, had a fairly rough surface. The road fills were thicker south of the laydown area and the road surface was smoother. There were straw logs in place in a few locations adjacent to the road, for sediment control. AEM representative indicated that water was flowing over the road during the freshet and straw logs were placed to capture suspended solids.
- A culvert was installed through the road near the laydown area, but there was no flow at the time of the site visit. Straw logs had been placed to control erosion and suspended solids in the flow.
- There was some minor cracking observed in the crest of the road in a couple of locations.
- During construction, some areas of the tundra adjacent to the road were stripped and water was ponded along the road in several of these areas during the 2018 inspection. Ponded water can cause degradation of permafrost leading to settlement and additional road maintenance.
- Culvert 13 was installed at the south end of the road near H15E. There was some minor damage to the outlet of the right culvert (looking downstream).

5.1.3 Wesmeg Borrow and Tiriganiaq Esker Area Facilities

The magazine storage, Wesmeg Borrow, and vent raise areas were inspected, as well as, the access roads to these facilities. A selection of photographs taken during the inspection are provided in Appendix 3 (Photographs 23 through 32).

The Wesmeg access road was constructed by borrowing material on either side of the road leaving disturbed trenches along the edges of the road. During the 2018 inspection, there was an area adjacent to the Wesmeg access road, northeast of the magazine storage area, that was disturbed, and water was ponded against the road (Photograph 27, Appendix A3). There was a large pond of water against the road where it crosses low topography north of Lake B33A (Photographs 28, Appendix A3). The design report for the Wesmeg Road (Tetra Tech EBA 2016e) indicates that a culvert was planned for this location.

The following are some of the general observations:

- The magazine storage area and blast guard berms were inspected and there were no signs of erosion or cracking (Photograph 25, Appendix A3). No geotechnical concerns associated with the magazine storage area were identified.

- Cracking and erosion were observed in the materials stockpiled at the Wesmeg Borrow area (Photograph 29, Appendix A3). Straw logs had been placed downstream to control the sediment. There are no geotechnical concerns with the erosion, but remediation of the area is required for longer term sediment control. Rehabilitation of the Wesmeg esker has been scheduled by AEM to be completed after construction of the vent raise.
- A small rockfill pad had been constructed at the Wesmeg vent raise with a low area and a berm on the west side (Photograph 30, Appendix A3). Two steel pipes were installed through the access road to the pad for water management (Photograph 31, Appendix A3). There was no flow at the time of the site visit.

5.2 Recommendations

The following are recommendations for the site roads and culverts and the Tiriganiaq and Wesmeg Borrow areas:

- Consider lowering the lower culvert at Culvert #1 so that water won't pond against the road prior to flowing through the culverts.
- The culvert planned for where the Wesmeg Borrow access road crosses low topography, north of Lake B33A, should be installed if the road is blocking natural drainage that is causing more water to pond that could lead to permafrost degradation and settlement or cracking in the road.
- The Wesmeg Borrow area should be recontoured and either capped with a coarser material or some other form of reclamation to protect against erosion.
- Culverts should be installed in areas of the emulsion plant road where water was flowing over the road in 2018.
- If erosion occurs in the esker sand material used to construct the emulsion plant road, rockfill should be placed to cap the road and reduce erosion. Placement of a gravel road capping may also be beneficial to improve the road surface, particularly over the northern section of the road.
- It is recommended that the disturbed areas adjacent to the Emulsion Plant and Wesmeg Borrow access roads be regraded so that water does not pond adjacent to the road and thaw the permafrost around and under the road which could lead to settlement.
- Regular monitoring and maintenance of the roads should be conducted.

6.0 TEMPORARY ORE AND WASTE STOCKPILES

The ore and waste rock storage area is located east of the P-Area. The rock and ore (high grade and low grade) piles are relatively small during the development stage of the mine. A selection of photographs from the inspection are provided in Appendix A4 (Photographs 1 through 9).

Ore and waste materials removed from the underground development are transported to surface and placed in stockpiles. The majority of waste rock is crushed into various sizes for use in construction. There were also stockpiles of crushed materials in this area. Berms were in place around the top benches of the piles and there was a small pond of water observed in the middle of the bench of the Waste Rock Pile (Photograph 5, Appendix A4). Some cracking was observed in one area of one of the high grade ore stockpiles that looked to be shallow slumping of material on the slope likely due the slope being locally over steepened. There was no active placement on this pile and material had been placed to block access on the ramp so there is no concern with the cracking (Photograph 4, Appendix A4). If placement was to restart on this pile, the slope in the area of cracking should be resloped to be consistent with the slopes around the remainder of the pile.

No geotechnical concerns related to the stability of the stockpiles were identified.

7.0 OTHER MELIADINE FACILITIES

This section contains the observations and recommendations from the 2018 geotechnical inspection of other Meliadine facilities including: the landfarm, underground Portal No. 1, underground Portal No. 2, exploration landfill, operations landfill, fuel storage areas, and industrial and mine site pads. A general description of each facility and the visual observations from the 2018 inspection are provided in Section 7.1 and recommendations for the facilities are provided in Section 7.2.

A selection of photos from the inspection are included in Appendix A5. Photograph 1 provides a Google Earth Image overview of the mine facilities.

7.1 Visual Observations

7.1.1 Landfarm

The new landfarm is located at the southeast corner of the industrial pad area and west of the water treatment plant (Photograph 1, Appendix A5) and replaces the exploration landfarm (Section 8.1.3) which will be decommissioned. The landfarm was constructed in 2017 and includes perimeter containment berms constructed mainly out of esker sand and gravel material, 30 mm minus liner bedding, geomembrane liner with geotextile placed above and below, 30 mm minus liner cover and 200 mm minus rockfill final cover. There is a sump located in the southeast corner of the facility. The slopes of the berms appeared to be approximately 2.5 horizontal to 1 vertical as per the design (Tetra Tech 2017b). There were no signs of erosion, cracking, or settlement. No geotechnical concerns were identified.

At the time of the 2018 site visit, AEM had set up a lined temporary screening area on the west side of the landfarm. Large cobbles and boulders were being screen out for use elsewhere on site and the fine material was being placed back in the landfarm.

A selection of photos from the inspection are included in Appendix A5 (Photographs 2 through 11).

7.1.2 Underground Portal No. 1

Underground Portal No. 1 is located southwest of P3 (Photograph 1, Appendix A5). At the time of the inspection, Portal No. 1 had been constructed and was in use. A selection of photos from the inspection are included in Appendix A5 (Photographs 12 through 15).

A small excavation and corrugated culvert are used to connect the underground ramp to surface. Portal No. 1 was observed from the surface only, with observation of the small bedrock cut face above the culvert. A rockfill berm was also in place around the perimeter of the portal excavation. The toe of the rockfill perimeter berm was close to the crest of the rock face in some locations and there was evidence of ravelling of rockfill into the cut; however, the corrugated culvert protects the access to the portal, so there is no safety concern. There was some minor erosion observed on the surface of the backfill material adjacent to the portal (Photograph 12, Appendix A5). The condition of the portal area was similar to 2017 and there were no other geotechnical concerns identified at the time of the inspection.

7.1.3 Underground Portal No. 2

Underground Portal No. 2 is located northwest of the P-Area, on the west side of the access road from Portal No. 1 to the main camp site (industrial pad) (Photograph 1, Appendix A5). Waste rock was being removed from the portal. At the time of the inspection, backfill was in progress around the sides of the corrugated steel culvert forming the entrance to Portal No. 2. A selection of photos from the inspection are included in Appendix A5 (Photographs 16 through 20).

A small excavation and corrugated culvert are used to connect the underground ramp to surface. Portal No. 2 was observed from the surface only, with observation of the small bedrock cut face and perimeter berm. Rock bolts and mesh were in place over most of the rockfill cut. There was some evidence of ravelling of rockfill into the excavation; however, the catch berms appeared to generally be sufficient to allow safe backfill placement round the culvert. The slopes above active backfill placement should be regularly monitored for potential rock fall hazards. The culvert protects access to the portal during operations. Water was observed ponding in some areas around the perimeter of the portal (outside the perimeter berm). AEM indicated that water management facilities will be constructed once the backfill is complete.

7.1.4 Exploration Landfill

The exploration landfill is located southwest of Portal No. 2 and northwest of the P-Area (Photograph 1, Appendix A5) and is within the future Waste Rock Storage Area 1 (WRSA1) footprint. The exploration landfill had been decommissioned and the new operation landfill was in use.

The exploration landfill is located on gently sloping ground and is contained on three sides by berms and by high ground on the fourth (south) side. The berms appeared to be constructed with esker materials that contained substantial amounts of sand and gravel. The slopes appeared to be approximately 2.5 horizontal to 1 vertical. It appeared that esker material had been used to cover the top of the landfill as part of decommissioning. Some wood debris was still evident protruding through the cover. A selection of photos from the inspection are included in Appendix A5 (Photographs 21 through 26).

Cracking was observed on the downstream slopes of the containment berms, similar to the 2017 inspection. The cracking appeared to be largely due to translational slumping of the berm materials on the slope (e.g., Photographs 22 and 24, Appendix A5). There was water ponded in a small depression adjacent to the access road and south side of the landfill, but there was no ponded water on the surface of the landfill and no seepage observed.

7.1.5 Operation Landfill

The operation landfill is located northwest of Portal No. 2 and within the northeast corner of the future Waste Rock Storage Facility 1 footprint (Photograph 1, Appendix A5). The operation landfill was constructed in 2017. At the time of the 2018 site visit, a substantial portion of the original operation landfill was full and an expansion had been constructed on the south side of the original landfill. A selection of photos from the inspection are included in Appendix A5 (Photographs 27 through 34).

The operation landfill is located on sloping ground and is contained by perimeter berms. The berms and floor were constructed with esker materials that contained substantial amounts of sand and gravel. The slopes appeared to match the design of approximately 2.5 horizontal to 1 vertical for the exterior slopes and 2 horizontal to 1 vertical for interior slopes. The slopes of the expansion portion of the operation landfill appeared to be steeper than the original berms. The berm crests and slopes were in good condition, except for the toe of the northeast corn of the facility where water was observed to be ponding on the tundra downstream and there was some erosion and potentially slumping on the slope (Photograph 30, Appendix A5). The sand and gravel material may be susceptible to erosion. If erosion is observed, a coarser rockfill layer should be placed over the exterior slopes and berm crests to protect against erosion. As WRSF1 is constructed, the landfill will become surrounded by rockfill.

7.1.6 Fuel Storage Containment Areas

There are two fuel storage areas at the main mine site, the mine site fuel area and the industrial fuel storage area. The mine site fuel storage is located south of the west end of D-CP1 and north of the saline pond and the Industrial fuel storage area is located northwest of the landfarm (Photograph 1, Appendix A5). The fuel storage areas are lined perimeter berm facilities to provide secondary containment for the fuel tanks. The floors of the facilities are graded to a drainage sump to collect surface runoff water.

The mine site fuel storage area was constructed in 2017. There are two tanks: 3 million litres and 250,000 litres contained in the facility. The industrial site fuel storage area was constructed in 2017 and 2018. There are two tanks: 6 million litres and 250,000 litres contained in the facility.

The interiors of the facilities are lined with HDPE liner with non-woven geotextile placed above and below. The dike slopes appeared to be approximately 2 horizontal to 1 vertical, as per the design (Tetra Tech and WSP Canada Inc. 2017). There were minor signs of sloughing in the liner cover materials, but no other geotechnical concerns identified. There was no ponded water or seepage observed. A selection of photos from the inspection are included in Appendix A5 (Photographs 35 through 40).

7.1.7 Main Site Pads

At the time of the 2018 inspection, the northern portion of the industrial pad was mainly complete, but the southern portion of the industrial pad was under construction. Various facilities were also under construction on the pads. In addition to the main industrial pad there are several other smaller pads that have been constructed for various mine site facilities that were inspected, such as, the effluent water treatment plant pad, incinerator pad, east air intake pad, temporary cyanide storage pad and emulsion plant and storage area pads.

Inspection of the pads involved walking along crests and toes, examining the condition of the slopes for visual signs of erosion and instability, cracking, or uneven surfaces. A selection of the photographs taken during the inspection are provided in Appendix A5 (Photographs 41 through 58).

The pads on site have been constructed using a combination of rockfill and esker sand and gravel obtained from borrow areas. A surface layer of crushed aggregate was observed in some areas (e.g., Photographs 43 and 47, Appendix A5). The height of the pad varies, based on topography. The slopes of the edges of the pad ranged from approximately 2.5 to 3 horizontal to 1 vertical, and appeared stable.

Normal maintenance of the surface of the pads, in particular areas with heavier traffic (e.g., roads), should be anticipated, as well as maintenance of slopes, particularly where pads have been constructed with esker materials that are more prone to erosion.

The following is a summary of the key observations from the pad inspections:

- Similar to the 2017 inspection, during the 2018 inspection, there was visual evidence of erosion of the north slopes of the industrial pad (Photographs 41 and 42, Appendix A5). The erosion had increased from 2017. There was also some erosion and cracking observed at the crests and on the slopes of some of the other pads that was not observed in 2017 (e.g., incinerator and emulsion plant pads Photographs 47 and 54, Appendix A5).
- There was a relatively large pond of water located west of the industrial fuel storage area (Photograph 46, Appendix A5). The slopes around the ponded water appeared to be approximately 3H:1V and there was no instability observed. AEM has scheduled this area to be filled and graded with fill materials as part of finalizing the Industrial Pad construction during 2019.
- A pipe berm on the south side of the effluent water treatment plant pad had been constructed out of sand that is susceptible to erosion (Photograph 50, Appendix A5).
- There was an area of the emulsion storage pad (located near the emulsion plant pad), that had large ruts from where a loader had gotten stuck (Photograph 58, Appendix A5). The surface of the pad appeared to be finer esker material, no rockfill surfacing material had been placed. This surface will likely continue to cause trafficking issues during periods of high precipitation. The emulsion plant pad surface was in better condition, likely due to recent grader work, but was also observed to have finer material at surface that may cause trafficking issues during high precipitation. There was some ditching in place around the south and eastern perimeters of the emulsion plant pad to help with water management.

7.2 Recommendations

The following are recommendations for the Meliadine Mine site facilities summarized in Section 7.1:

- The slopes of the operation landfill should be monitored, particularly the northeast corner where water was observed to be ponded and there appeared to be some slumping on the berm slope. Recontouring of the slope in this area will reduce the potential for future erosion.
- The north slopes of the industrial pad should be recontoured and a coarser surfacing layer should be placed on the slopes where erosion is substantial.
- A coarser rockfill cover should be placed over the pipe berm constructed out of sand on the south side of the effluent water treatment plant to protect against erosion.
- AEM indicated that ground control engineers routinely conducted and documented inspections of the rock slopes surrounding Portal No. 2 during backfill placement around the culvert at the entrance to the portal. Monitoring of the slopes, including loose rockfill material above the slopes should continue during backfill placement around the culvert.

- Snow management around and above Portal No. 1 and 2 may be advisable, especially prior to freshet, to reduce the potential for larger surface water inflows entering the underground.
- Where erosion occurs on the slopes of the various site pads, coarser rockfill should be placed over the slopes and crests to reduce the potential for further erosion.
- A gravel or rockfill surfacing layer may be required at the emulsion plant and storage pads if trafficking issues continue.
- The exploration landfill will eventually be covered by WRSA1, so the cracking and erosion on the slopes is not a substantial concern. Placement of a coarser rockfill layer over the decommissioned exploration landfill could be considered to reduce cracking and erosion in the short term.

8.0 EXPLORATION CAMP AND ACCESS ROAD

The exploration camp site was the first area of the project that was developed and at the time of the site visit it was still being used. The new camp and office facilities at the main mine site had been constructed and were in use; however, due to the number of people on site the exploration camp and office facilities were still being used.

The exploration site was inspected including the site pad, genset containment facility, fresh water intake, diffuser access, landfarm, fuel storage, and access road. The following sections provide a summary of the observations and recommendations relating to the exploration camp and access road.

A general description of each facility and the visual observations from the 2018 inspection are provided in Section 8.1. Recommendations for the facilities are provided in Section 8.2.

8.1 Visual Observations

8.1.1 Exploration Camp Pad, Water Intake, and Diffuser Access

The exploration camp site is located on a peninsula on the west shore of Meliadine Lake. The exploration pad has primarily been constructed with esker sand and gravel material; however, small localized portions of the slopes contain coarser grained particles. The thickness of the pad varies based on topography; however, it is generally relatively thin. The slopes appeared to be approximately 2 to 2.5 horizontal to 1 vertical. During the 2018 inspection, the slopes generally appeared stable and in a similar condition to 2017. There was some surface erosion on southeast side of the exploration camp pad that was in a similar condition to what was observed in 2017 (Photograph 3, Appendix A6). Sand had been used to cover some cables on the south side of the pad that is susceptible to erosion (Photographs 4, Appendix A6). At the time of the inspection, an excavator was removing contaminated material from a fuel spill on the south side of the camp (Photograph 5, Appendix A6). There was some disturbance to the tundra observed on the south side of the exploration camp that may have been due to boat access to the lake (Photograph 9, Appendix A6). Trafficking over the tundra directly should be avoided. A new genset containment facility was under construction at the time of the site visit at the northeast end of the site (Photographs 10 and 11, Appendix A6). The containment berms appeared to have been constructed out of esker materials that could be susceptible to erosion, but otherwise the berms were in good condition. The facility appeared to be lined and there was a drain in one corner of the facility. There were no other geotechnical issues identified for the exploration camp pad. A selection of photos from the inspection are included in Appendix A6 (Photographs 1 through 11).

A short access road extends to the north from the exploration camp pad to the edge of Meliadine Lake, to provide vehicle access to the fresh water intake pump house and pipeline. No geotechnical concerns were identified. A selection of photographs from the water intake access inspection are included in Appendix A6 (Photographs 12 through 15).

The diffuser access road starts at the water intake access road and runs east to Meliadine Lake. The road appeared to have been constructed with esker materials and there was cracking along the edges of the road along most of its length. Cracking was observed along more of the road than in 2017 and some of the cracks observed in 2017 were wider. The cracking is not a significant concern and no other geotechnical issues were identified. A selection of photographs from the diffuser access inspection are included in Appendix A6 (Photographs 16 through 21).

8.1.2 Exploration Camp Access Road

At the time of the site visit, the exploration road was generally in good condition and appeared to have been constructed with esker materials. There was some erosion observed on the slopes of the road (e.g., Photographs 28 and 29, Appendix A6) that had increased from 2017. There were four culverts installed through the road, and observations from the inspection are summarized in Table 6. A selection of photographs from the diffuser access inspection are included in Appendix A6 (Photographs 22 through 37).

Table 6: Exploration Camp Access Road Culvert Summary

Culvert Location	Culvert Description	Comments/Recommendations
North side of camp	1 × 450 mm HDPE corrugated	Upstream end of culvert appears to have been buried within the exploration camp pad (Photographs 22, Appendix A6). No flow.
North side of camp	1 × 450 mm HDPE corrugated	Upstream end of culvert appears to have been buried within the exploration camp pad (Photographs 23, Appendix A6). No flow.
North side of camp	1 × 600 mm CSP	Culvert in good condition, no obstructions, no flow, minor amount of water pooled in base of culvert and on ground downstream of outlet. Esker material surrounding culvert. Upstream and downstream slopes are not armoured. (Photographs 24 and 25, Appendix A6).
West of camp near Lake J1	1 × 600 mm HDPE corrugated	Some deformation of haunch of culvert under road. Minor flow. Upstream inlet to culvert armoured with rockfill and outlet partially armoured. (Photographs 30 and 31, Appendix A6).
West of camp near Lake J1	1 × 600 mm HDPE corrugated	Culvert in good condition. Upstream inlet to culvert armoured with rockfill that extends into culvert. Downstream end of culvert partially blocked with material that should be cleared out. (Photographs 32 and 33, Appendix A6).

Note: 1 ×__ mm = the number of culverts × the diameter of the culvert.

CSP = corrugated steel pipe.

8.1.3 Fuel Storage Area and Landfarm

The fuel storage area, landfarm, and core storage pad are located along the north side of the exploration camp access road, approximately 0.9 km west of the camp. A selection of photos from the inspection are included in Appendix A6 (Photographs 38 through 48).

The exploration bulk fuel storage tanks contain jet fuel and diesel. At the exploration camp, there is a small tank with gasoline. All tanks are double lined and self-contained. The tanks are located on raised pads, constructed with esker sand and gravel. There is no liner or berm surrounding the tanks. The exploration fuel storage pad was generally in good condition; however, some minor cracking was observed along the east crest due to settlement (e.g., Photograph 39, Appendix A6). The cracking is not a significant geotechnical concern.

The exploration landfarm consists of an above-ground bermed containment area, which appears to have been constructed of esker sand and gravel, with a 60 millimetre HDPE geomembrane liner and nonwoven geotextile beneath the liner. The liner surface has been covered with a layer of sand and gravel. Contaminated soils have been placed within the bermed area. There was no water ponding within the facility, but there was damp soil indicating that water sometimes ponds, as was observed during the 2017 inspection. It is understood that water samples are periodically collected and, if necessary, the water is treated prior to discharge. There was no seepage or ponded water downstream of the containment berms observed at the time of the inspection; however, there were some indications of minor erosion on the slopes that could be due to previous seepage. Vegetation had grown over most of the downstream slopes of the berms.

It is understood that AEM intends to decommission the exploration landfarm now that the new landfarm at the main site is operational (Section 7.1.1). When the exploration landfarm is decommissioned, it is anticipated that some cleanup of the foundation soil, and containment berms material will be necessary. Until such time that the exploration landfarm is decommissioned, AEM should try to minimize the amount of water contained within the exploration landfarm.

The core storage pad is located north of the landfarm. The pad slopes generally looked stable; however, there were some fairly large cracks along the east crest (e.g., Photograph 49, Appendix A6).

8.2 Recommendations

The following are recommendations for the exploration camp and access road:

- The south side of the exploration camp pad should be regraded to manage surface water to reduce channelization of the flow that leads to erosion. The slope should also be regraded where erosion has occurred and a coarser surfacing layer could also be placed to help reduce the potential for future erosion.
- The diffuser access road could be regraded to close up the cracks and reduce the potential for future cracking.
- The culverts through the exploration camp access road should be cleared of material.
- The exploration camp access road should be regraded and consideration given to placing some coarser rockfill on the slopes where there is erosion.
- The cracks in fuel storage pad should be monitored; however, they are not considered to be a geotechnical concern.

9.0 ALL-WEATHER ACCESS ROAD (AWAR) AND ASSOCIATED WATER MANAGEMENT STRUCTURES

The All Weather Access Road (AWAR) construction activities began during the winter of 2012, and construction was completed by the end of October 2013 to connect the hamlet of Rankin Inlet to the Project. Appendix B contains photographs taken during the inspection. The road is approximately 23.8 km long, with three bridge crossings and culverts installed at a total of 19 locations. The road has two-way traffic and is approximately 6.5 m wide with pull outs approximately every 400 m ±50 m to facilitate vehicles passing.

The AWAR is used by AEM and also provides unrestricted all-terrain vehicle (ATV) access for the public, if it is safe to do so. The AWAR is used to transport building materials, construction/mining equipment, fuel, reagents, supplies, workers, and contractors to the Project.

The road design is based on a general sub-base composed of rockfill or sand and gravel from esker sources and crushed granular surfacing with a combined minimum thickness of 500 mm. The road design varied based on the relative susceptibility to freeze and thaw induced settlement of the foundation soils. The thickness of the road fill material was generally increased, to a minimum of 1.3 m, in areas where potentially thaw-sensitive soils were identified. Along portions of the road where thaw-sensitive soils were identified, a geotextile material was incorporated into the road design to limit damage to the road should the foundation material thaw.

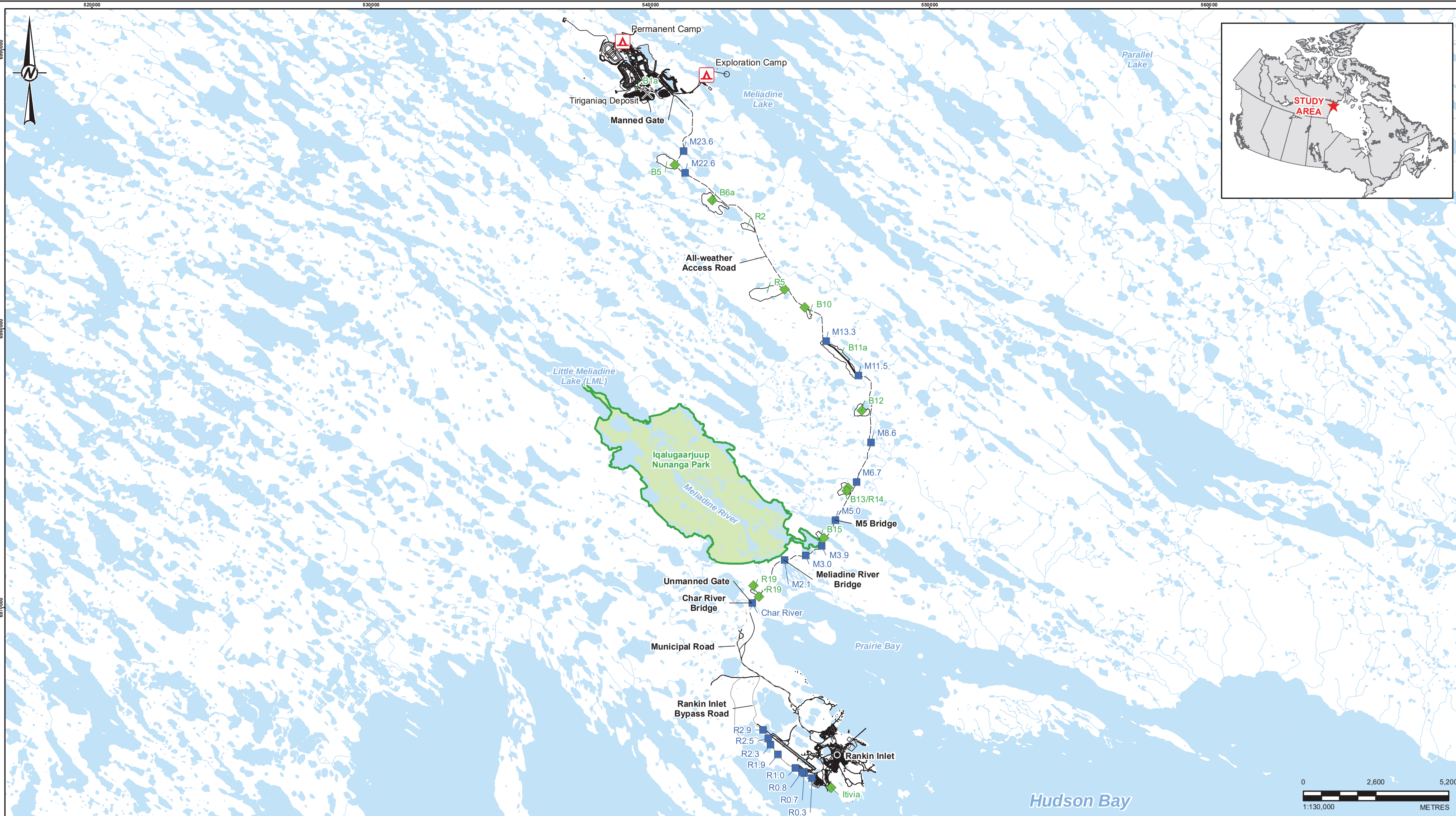
No evidence of thermal degradation of the permafrost was observed on the road during the inspection. It should be noted that visual evidence may not necessarily be observed due to the regular road maintenance performed by AEM. During the inspection, water levels were considered to be normal to low and flow velocities at the crossings were considered to be low.

9.1 Observations and Recommendations

The culverts were generally observed to be in good condition, at the time of the inspection. Most culverts were unobstructed with no signs of substantial damage to the culverts. All bridges and their embankments were in good geotechnical condition at the time of the inspection. A structural and/or mechanical assessment of the bridges was not conducted and is beyond the scope of this geotechnical inspection.

A photographic record of the inspected culverts and bridges is provided in Appendix B. Figure 5 shows the location of the primary water management structures along the road (e.g., M3.9). However, additional culverts have been added that are not shown in Figure 5.

Table 7 lists the locations of water management structures: culverts and bridges that have been installed along the AWAR. The location of the culverts and bridges are listed, based on distance from the Friendship Centre in Rankin Inlet, with the gate house at Meliadine being 29 km. Size and number of culverts is provided in Table 7, along with specific observations and photos at the time of the inspection, and any recommendations. It was observed during the 2017 inspection that flags with kilometre markings had been installed at the culvert locations; however, the distance markers on the culverts did not match with the location along the AWAR. During the 2018 inspection, AEM indicated that new distance markers had been ordered.



LEGEND

- CAMP
- PROPOSED MINE SITE
- QUARRY/BORROW PIT LOCATION
- WATERCOURSE CROSSING
- ALL-WEATHER ACCESS ROAD (AWAR)
- ROAD - NEW
- ROAD - EXISTING
- WATERCOURSE
- WATERBODY
- TERRITORIAL PARK

REFERENCE(S)
1. BASE DATA OBTAINED FROM AGNICO EAGLE MINES LIMITED.
2. DATUM: NAD83 PROJECTION UTM ZONE 15

CLIENT
AGNICO EAGLE MINES LTD.

CONSULTANT
GOLDER

YYYY-MM-DD	2019-02-14
DESIGNED	FE
PREPARED	CDB
REVIEWED	FE
APPROVED	ACI

PROJECT
MELIADINE GOLD PROJECT

TITLE
MELIADINE ALL WEATHER ACCESS ROAD WITH QUARRIES AND WATERCOURSE CROSSINGS

PROJECT NO.	CONTROL	REV.	FIGURE
18105719	3000/002	0	5

Table 7: 2018 Inspection Record of Water Management Structures along the All-Weather Access Road

Station (distance from Friendship Centre)	Water Management Structure Description	Conditions, Observations, and Recommendations (at time of inspection)
KM 6.0	Char River Bridge	Good condition, stable embankments and abutments. Left abutment downstream, sand and gravel, with potential for erosion. Recommendation: Monitor finer grained material on left abutment to determine if armouring should be added.
KM 6.2	3 CSP culverts: 2 × 1,300 mm 1 × 700 mm	The culverts are vertically offset with the 700 mm culvert elevated above the 1,300 mm culverts. Some minor erosion observed between the culverts on the downstream side. All clear and in good condition. Small flow in the lower 1,300 mm culvert. Recommendation: Monitor to determine if armouring should be added.
KM 7.0	3 CSP culverts: 2 × 1,000 mm 1 × 700 mm	The culverts are vertically offset with the 700 mm culvert elevated above the 1,000 mm culverts. The 700 mm culvert had a dent in side. Ponded water observed in the lower culvert. Small amount of water ponded upstream. Sandy soil around culverts, potential for erosion causing turbidity. Recommendation: Consider adding armouring around culverts to reduce potential for erosion.
KM 7.1	3 CSP culverts: 2 × 1,000 mm 1 × 700 mm	Vertically offset. 700 mm culvert is elevated. Water ponded in the lower culvert on the right side when looking downstream, minor deformation of culverts under the road, no substantial reduction of cross-sectional area. Minor flow in lower 1,000 mm culvert. The culverts and riprap appear in good condition.
KM 7.4	3 CSP culverts: 1 × 900 mm 1 × 700 mm 1 × 1,000 mm	Vertically offset. 700 mm culvert is elevated. Damaged, partially crushed inlet of the 900 mm culvert, but not expected to substantially reduce flow capacity. Erosion potential due to finer grained soils around 700 mm culvert at the inlet and outlet. 1,000 mm clear, low flow/ponding water. Recommendation: Consider extending 700 mm culvert and armour around it to reduce erosion.
KM 8.0	Meliadine River Bridge	Right abutment, downstream slope has exposed esker sand and gravel. Recommendation: Monitor right abutment to determine if armouring should be added.
KM 9.1	2 × 1,000 mm CSP culverts	Minor deformation of both culverts under the road. No flow, water ponded below the inlets. Design was for 5 culverts. No specific mention of capacity issues at this location in AEM inspections.
KM 9.5	1 × 1,300 mm CSP culvert.	Water ponded on upstream side of culvert/road with very low flow due to elevated inlet of CSP. CSP in good condition. Design was for 4 culverts. No specific mention of capacity issues at this location in AEM inspections.
KM 10.5	M-5 Bridge	Good condition, stable embankment and abutments of the bridge. Potential small erosion/settlement of rock embankment on the bridge's right abutment identified during previous annual inspections shows no signs of change. Exposed geotextile at base of downstream end of left abutment that could be due to erosion. Gabion damaged on downstream of Left (north) Abutment. Recommendation: Replace damaged gabion. Continue to monitor for erosion and/or settlement.
KM 12.1	4 CSP culverts: 2 × 1,300 mm 1 × 900 mm 1 × 700 mm	Vertically offset. 700 mm and 900 mm culverts are elevated. Some small dents and bending of haunches in 700 mm and one of the 1,300 mm culverts. Minor flow through the lowest of the 1,300 mm culverts. Embankment slope is generally in good condition.
KM 12.6	no culverts	Area of poor drainage. Flow along west side of road, suspect seepage under the road to east side. Some erosion along toe of road. Recommendation: Monitor this area and if erosion increases or ponding and seepage cause permafrost degradation and settlement of the road fills, a culvert should be installed in this location.
KM 13.5	5 CSP culverts: 3 × 1,300 mm 2 × 900 mm	Vertically offset, 900 mm culverts are elevated above 1,300 mm culverts. Good condition, no flow, minor dents and deflection in haunch.

Station (distance from Friendship Centre)	Water Management Structure Description	Conditions, Observations, and Recommendations (at time of inspection)
KM 14.7	Access road to B12 quarry, 500 mm HDPE corrugated culvert	No flow, small amount of water ponded against AWAR and quarry access road, below inlet of culvert. Minor dents observed in culvert. Small erosion at outlet. Culvert and embankments are generally in good condition.
KM 16.3	3 CSP culverts: 1 × 1,300 mm 1 × 700 mm 1 × 1,000 mm	Vertically offset, 1,300 mm culvert is the lowest, then the 1,000 mm culvert and the 700 mm culvert is the highest. No flow in the 700 mm and 1,000 mm culverts, good condition. Small flow in 1,300 mm culvert, good condition, small erosion visible at outlet. Outlets are all elevated increasing erosion potential. Drainage appears to be connected to M13.3 area (KM18.1 and 18.15), survey required to confirm. Recommendation: Monitor to assess if hydraulic capacity is adequate and if erosion is an issue. Consider installing culverts at lower elevations to improve water management.
KM 18.1	2 CSP culverts: 1 × 900 mm, 1 × 1,000 mm	Vertically offset culverts. The 900 mm culvert is elevated above 1,000 mm culvert. Lower culvert has some flow, minor dent on upstream end. Upper culvert is in good condition. Upper culvert is high on the embankment and has thin cover on the upstream side. Note for flow to occur in upper culvert, the road near KM18.15 would be nearly flooded. Culvert outlet is high, therefore potential for erosion of the embankment during high flow periods exists. Trench exists along upstream toe of road connecting the culverts at KM 18.1 to KM18.15. Recommendation: Monitor cover over upper culvert. If cover thickness is reduced, additional material should be placed to protect the culvert. Consider lowering upper culvert to allow flow with less ponding adjacent to road and less potential for erosion.
KM 18.15	1 × 600 mm CSP culvert.	Ponding on the upstream side. Additional ponding adjacent to road required before reaching the culvert inlet. Culvert outlet elevated, potential for erosion of toe of road embankment. Flow may initially occur through the road fill beneath the culvert. Trench exists along upstream toe of road connecting the culverts at KM 18.1 to KM18.15. Recommendation: Continue to monitor hydraulic capacity. If water management challenges observed, consider installing an additional culvert at this location, at a lower elevation.
KM 19.5	No culverts	Ponding on west side of road, reportedly the water ponds here year-round and can reach as high as half way up the embankment. Inspection reports by AEM note straw logs were placed at KM 19, so there may have been some flow over the road in this area. Recommendation: Consider installation of a culvert at this location.
KM 21.2 to 21.5	No culverts	Water ponded on west side of road near KM 21.2. Water reportedly flowed over the road near KM 21.5 during the 2017 freshet. Straw logs were placed on east side of road embankment to control suspended solids in flow. Recommendation: Install culverts in this area.
KM 21.7	2 × 160 mm steel pipes, used as culverts	Vertically offset steel pipes, clear, no flow. Water ponded upstream, erosion mark from higher water level evident in road embankment. Water reportedly flowed over the road at this location during freshet. AEM personnel report that the road was excavated to allow the water to drain. Capacity of pipes may be inadequate, or pipes could have been frozen (blocked) causing water to backup. Straw logs were observed on west side of road. Recommendation: Consider installation of larger diameter culvert(s). Make sure culverts are clear prior to freshet.
KM 22.3	2 × 160 mm steel pipes, used as culverts	Vertically offset, clear, no flow. Inlets are elevated above ponded water. Recommendation: Consider lowering culverts to reduce ponding upstream.
KM 22.7	No culverts	Water ponded on the east side of the road, signs of wet ground observed on west side of road indicating possible seepage under the road. Recommendation: Consider installing a culvert to manage water in this area.
KM 25.8	1 × 600 mm HDPE corrugated culvert	No flow, minor amount of gravel in base of culvert, some dents on upstream inlet to culvert. Inlet is partially blocked by road fill. Sandy soil around inlet and outlet. Some sediment erosion and deposition evident on downstream side of culvert. Some erosion of slope of road visible in this area. AEM inspection reports noted ponding of water at or over the road in this area during the freshet. Recommendation: Clear culvert inlet of road fill material. Consider adding armouring around culverts. Consider adding additional culverts if water management continues to be an issue during freshet.

Station (distance from Friendship Centre)	Water Management Structure Description	Conditions, Observations, and Recommendations (at time of inspection)
KM 26.2	2 × 160 mm steel pipes, used as culverts	Vertically offset, lower pipe bent upwards, unable to see through, upper pipe is clear. The inlets are elevated close to the road surface. Very thin road fill cover over inlets. Some sediment deposition downstream is evident. Water ponded along road below upstream inverts of pipes. AEM inspection reports noted ponding of water at or over the road in this area during the freshet. Recommendation: Lower pipe should be replaced. Consider adding additional culverts if water management continues to be an issue during freshet.
KM 26.5	3 × 700 mm CSP culverts	Equal elevation, some sediment buildup, no flow, small dents, no blockages.
KM 26.8	2 × 160 mm steel pipes, used as culverts	Vertically offset, no flow. Inlet of the lower culvert was completely covered by new road fill. Some erosion evident at downstream ends. Recommendation: Inlet of the lower culvert should be cleared and extended or culvert should be replaced.
KM 27.1	3 CSP culverts: 1 × 900 mm 1 × 700 mm 1 × 1,000 mm (southernmost)	Vertically offset, middle culvert (700 mm) elevated above adjacent culverts. Clear, minor flow in lowest culvert, some small dents in 900 mm and 1,000 mm culverts. Some sloughing of riprap near culvert inlets. Recommendation: Monitor riprap and add more protection if more erosion occurs.
KM 28.7	No culverts	Ponded water on east side of road. AEM notes that water ponds against road for most of open water season and road surface is often soft, indicating signs of seepage through road. This year water flowed over the road at this location during freshet. Recommendation: Install a culvert at this location.
KM 29.6	1 × 500 mm HDPE corrugated culvert	No flow, some small dents, small erosion evident upstream, water ponded upstream. Inlet is partially blocked by road fill and riprap. Recommendation: Clear the culvert inlet and consider lowering culvert to reduce ponding adjacent to road.

1 ×__ mm = the number of culverts × the diameter of the culvert.

CSP = corrugated steel pipe; AWAR = all-weather access road.

AEM has implemented a watercourse crossing inspection and maintenance program (AEM 2015b), which includes:

- a regular inspection program to identify issues relating to watercourse crossings, such as structural integrity and hydraulic function
- an event-based inspection program to track the impacts of larger storm events on watercourse crossings
- a culvert location inspection program to ensure that culverts have been installed in the correct location with respect to watercourses and that the culvert capacity is adequate, for hydraulic conditions

A total of 20 inspections were conducted and documented by AEM's environment and site services departments in 2018. Inspections were carried out more frequently during freshet (May and June). There was no record of inspections carried out in February, July, August, September or December. AEM indicated that the site services department conducts weekly inspections, but reporting is not always completed.

Prior to spring freshet, the culverts and bridges were inspected to assess their condition and ability to accommodate rapid spring thaws. The visual inspections are intended to identify any structural issues, blockages, ponding against or over the road, required maintenance, damage, bed erosion, or scour. The inspections include photos of key observations and are documented and filed for future reference.

Road maintenance and snow management are carried out, as deemed necessary. Steaming of culverts, is included as a maintenance activity. AEM indicated that they re-capped the AWAR and applied calcium spray for dust control through the spring and summer. Six new pull outs were also added along the AWAR in 2018.

Records of the inspections carried out by the environmental and site services teams were provided to Golder for review. The following are some of the key observations related to geotechnical stability that were documented in the inspection reports:

- Road was typically noted to be in good condition from January to March.
- Snow clearing was noted to have been pushed properly so as not to disturb the tundra.
- 4 May 2018 – Started clearing Char River crossing. Meliadine River and M5 water crossing along with culverts to be cleared.
- 9, 17, and 27 May 2018 – Culverts North of KM 8.6 need to be cleared. All bridges along the AWAR are clear. Culverts south of KM 8.6 are cleared.
- 1 June 2018 – Most of the culverts along the AWAR are snow covered and should be cleared by 6 June 2018. High temperatures are expected following 6 June 2018 and culverts should be clear to prevent erosion of road.
- 6 June 2018 – Flow across the AWAR at KM 24 is beginning to wash out the road. Straw logs are being installed at downstream side of road to control sediments. KM 28 has developed a pond adjacent to the road that has begun to flow and poses wash-out hazards. Straw logs are being placed.
- 9 June 2018 – Straw log set-ups were installed along the AWAR at KM 22 and KM 19. The AWAR will continue to be inspected, and problematic water crossings reported/addressed.
- 10 to 13 June 2018 – Culverts currently being cleared to prevent flow across road. Straw logs have been installed where flow across road is ongoing at locations not containing culverts where no culverts exist.
- 14 June, 13 and 20 October, 12 November 2018 – No issues.

10.0 ITIVIA FUEL STORAGE SITE AND BYPASS ROAD

The Itivia site is located south of Rankin Inlet on the north shore of Melvin Bay (Figure 6). It is used for bulk fuel storage and provides a laydown area for transfer of materials to the Meliadine Mine. To minimize impacts on Rankin Inlet, AEM constructed a bypass road to divert traffic travelling to and from the Itivia site and the Project site around Rankin Inlet. The following sections provide a summary of the observations and recommendations relating to the fuel storage site bypass road. The Itivia site and bypass road were constructed in 2017 and 2018.

10.1 Visual Observations

10.1.1 Fuel Storage and Laydown Area

The inspection involved walking along the crests and toes of the containment berms and examining the condition of the pad slopes for visual signs of deformation and instability, cracking, uneven surfaces or seepage. A selection of the photos taken during the site visit are provided in Appendix D (Photographs 1 through 11).

The laydown pad areas had been constructed with rockfill and crushed aggregate materials and the slopes appeared to range from about 2 to 3 horizontal to 1 vertical (Photographs 3 through 6, Appendix D). There is a rock cut face between the fuel storage facility and the upper laydown area above at the northwest corner of the fuel storage facility (Photograph 7 and 8, Appendix D). There were no geotechnical concerns identified.

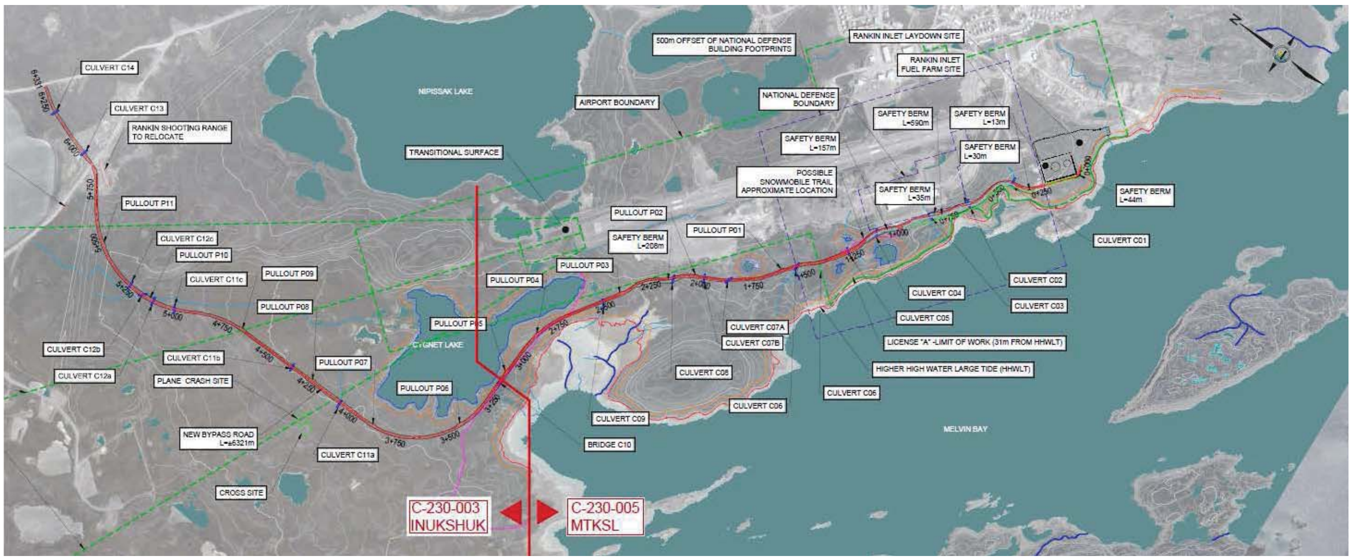
The fuel storage area has two tanks (20 million and 13.5 million litres) within a bermed secondary containment facility. The raised base and perimeter berms of the secondary containment were constructed out of rockfill with liner bedding and transition layers and an HDPE liner.

The perimeter berms for the secondary fuel containment were generally in good condition. The liner was exposed due to minor sloughing of the liner cover material in a few locations on the south containment berm (Photographs 9 and 10, Appendix D). There was a shallow pond of water over the base of the containment facility south of the tanks (Photograph 11, Appendix D). A pumper truck was working on removing this water, taking it back to the Project site for treatment, at the time of the site visit. The pad areas for the laydown were constructed with rockfill and crushed materials and the slopes were in good condition, no signs of erosion, cracking or instability.

Two 900 mm corrugated steel culverts are installed across the access road into the Itivia site (Photographs 1 and 2, Appendix D). Some damage was observed on the outlet ends of the culverts. There was some water ponding on the upstream side of the culverts and a small flow through the lower culvert. Crush material had been placed at the outlets of the culverts with straw logs and rip rap placed in a semi-circle around the outlets for water management. There were no geotechnical concerns identified.

10.1.2 Bypass Road

The Itivia bypass road is a 6.3 km gravel road that was constructed to divert traffic from the Itivia fuel storage and laydown area to the Project site around Rankin Inlet (Figure 6). The road is designed to be 6.5 m wide for most of its length with pull outs to allow two-way traffic. Two sections are designed to be 8 m to allow two-way traffic without pullouts. A total of 19 culvert crossings were constructed along the length of the road. The road was constructed in 2017 and 2018 and was completed during the week of the 2018 inspection. The eastern portion of the road was constructed using blast rock from the Itivia Quarry, but the majority of the road was constructed using esker materials.



Source: Tetra Tech 2017e.
Figure 6: Itivia Bypass Road Alignment

The inspection of the Itivia Bypass Road was completed 14 September 2018 beginning at the Rankin Inlet Fuel Farm and advancing up station along the road alignment to the intersection with the AWAR. The inspection involved driving along the road and examining the condition of each of the culverts as well as examining the road surface and slopes for visual signs of erosion, deformation, instability, or cracking. Observations of ponded water were also noted. At the time of the inspection construction was generally complete. Construction activities observed during the inspection were limited to compaction of the road surfacing materials with a smooth drum vibratory roller.

The southeast corner of the Itivia fuel storage facility was marked as kilometre 0 and approximate culvert locations along the road were measured using the truck odometer. Some culvert locations measured during the inspection do not correlate with the design stationing in the construction drawings. At the time of compiling this inspection report, an as-built report was being prepared by AEM and had not yet been issued for the Itivia Bypass Road. Some of the culvert locations may have been adjusted during construction and AEM indicated that Culvert 08 was not installed based on topography in the area where it was planned. All culverts were inspected and generally appear to have been installed per the configurations detailed in the design report documents (Tetra Tech 2017a, d and e). Time was limited to complete the inspection, so dimensions of the culverts could not be confirmed in the field and are reported based on the design report documentation.

The as-built report should confirm culvert sizes and locations, confirm that safety berms have been constructed where required based on road fill height, and confirm that road slopes have been constructed to the design.

In general, the road was in very good condition as construction had just been completed. There were no signs of cracking or settlement. The majority of the road was constructed using esker materials which may be susceptible to erosion and some sections of the road appeared to have relatively steep embankment slopes in consideration of the materials used for construction. Some sections of the road were high enough that they required safety berms, which were constructed using large boulders along the eastern section and with esker materials along the remainder of the road. As per the design layout, the lower culverts were installed below grade. Riprap was placed at the inlet and outlets of culverts, per the design, with the exception of C7b, which is missing riprap at the outlet. AEM indicated that placement of this riprap is planned for 2019. The culverts should be monitored for potential erosion of rip rap materials placed upstream into the culverts.

Table 8 presents a summary of the culvert inspections completed.

Table 8: Itivia Bypass Road Culvert Inspection Summary

Approximate Distance from SE corner of Fuel Farm [a]	Culvert Design Identification	Water Management Structure Description	Observations	Photographs (Appendix D2)
0.35 km	C01	2 x 1,000 CSP culverts	Design configuration A. No water flowing through culverts. Potential for erosion of riprap placed upstream into the lower culvert. Road constructed out of blast rock. Large boulders placed on south crest of road as safety berm. Recommendation: Monitor for erosion of riprap into lower culvert.	12
0.6 km	C02	2 x 700 mm CSP culverts	Design configuration A. No water flowing through culverts. Some large boulders partially blocking the outlet of the lower culvert. Some larger rocks above the culverts that may be locally over steepened and have the potential to fall and damage or block the culverts. Road constructed out of blast rock. Large boulders placed on south crest of road as safety berm. Recommendation: Remove riprap that is partially blocking lower culvert.	13
0.8 km	C03	2 x 1,000 mm 1 x 700 mm	Design configuration B. No water flowing through culverts. Channel erosion in tundra observed upstream of culverts. Road constructed out of blast rock. Large boulders placed on south crest of road as safety berm. Recommendation: Monitor erosion channel upstream of culverts. Not expected to be an issue, but if erosion continues, consider armouring the channel.	14 to 16
1.0 km	C04	2 x 1,000 mm	Design configuration A. Some cobbles observed in front of the lower culvert inlet that may erode into the culvert. Road constructed out of blast rock. Large boulders placed on south crest of road as safety berm. Recommendation: Remove riprap that is in front of the lower culvert.	17 and 18
1.2 km	C05	2 x 1,000 mm	Design configuration D. No water flowing through culverts, inlets and outlets armoured with smaller material than culverts C01 to C04. Some rockfill in front of inlets could erode into the culverts. Road and safety berm on south crest of road constructed out of esker materials. Recommendation: Remove riprap from in front of culvert inverts. Monitor erosion of safety berm.	19 and 20
1.5 km	C06	2 x 800 mm	Design configuration D. Culvert inlets installed above surrounding natural ground. Ponded water against toe of road north of the culvert inlets, a small berm has been constructed between the ponded water and the culvert inlet location. No water flowing through the culverts. Some rockfill in front of inlets could erode into the culverts. Road constructed out of esker materials. Recommendations: Remove riprap from in front of culvert invert. Monitor ponding of water, consider ditching to drain water to culvert inlets or add additional culvert where water is ponding.	21 to 23
1.6 km	C06-1	1 x 800 mm	AEM indicated this was an additional culvert installed based on the conditions observed in the field. Road constructed out of esker materials.	24 and 25
1.8 km	C07a	2 x 800 mm	Design configuration D. Ponded water observed at the inlets around the culverts and against the toe of the road embankment. Small flow through the east culvert. Culvert inlets installed over rockfill base raised above surrounding natural ground. Road constructed out of esker materials. Recommendation: Monitor ponding of water upstream of inlets and consider lowering culverts to reduce ponding.	26 and 27
1.9 km	C07b	2 x 1,000 mm	Design configuration D. No water flowing through the culverts, inlets and outlets are clear. Road constructed out of esker materials. Safety berm constructed on south crest of road. No armouring placed at outlet. Recommendation: Monitor potential erosion of safety berm. Place riprap to armour outlet.	28 and 29
2.4 km	C09	2 x 1,000 mm	Construction drawings identify C09 to be design configuration A. Culverts observed at this location are in design configuration D. No water flowing through culverts. Ponded water observed around the inlets and against the toe of the road embankment to the south. Road constructed out of esker material. Recommendation: Monitor ponding upstream of inlets and consider adding or relocating culvert(s) to reduce ponding.	30 and 31
3.1 km	C10	5 x 1,200 mm 1 x 1,000	Design configuration per Tetra Tech 2017d. Some damage to culvert inlets and deformation under road observed. Some water flow observed flowing into embedded culvert. Ponded water observed along the toe of the road embankment to the north of the culvert inlets. Road constructed out of esker material. Recommendation: Repair damaged culvert inlets and remove riprap that is partially blocking inlets.	32 to 34

Approximate Distance from SE corner of Fuel Farm [(a)]	Culvert Design Identification	Water Management Structure Description	Observations	Photographs (Appendix D2)
4.0 km	C11a	2 x 1,200 mm	Design configuration D. Culverts are constructed over riprap and inverts are raised above surrounding tundra. Some flow observed through both culverts. Shallow ponding of water over tundra upstream of the inlets and against the toe of the road embankment. Water mark visible along toe of road embankment. Road constructed out of esker material. Recommendation: Monitor ponding upstream of inlets and adjacent to road to determine if water should be ditched to inlets of culverts or if additional culverts required.	35 and 36
4.3 km	C11b	2 x 1,000 mm	Design configuration D. Culverts are constructed over riprap and inverts are raised above surrounding tundra. Some flow through the north culvert. Water ponded over tundra on both sides of culverts. Shallow ponded water at about KM 4.6 with channel running along toe of road embankment back to culvert C11b. Road constructed out of esker material. Recommendation: Monitor water ponding near KM 4.6 and flow along toe of road to determine if additional culvert required.	37 and 38
4.8 km	C11b-1	1 x 1,000 mm	AEM indicated this was an additional culvert installed based on the conditions observed in the field. Culvert is constructed over riprap and invert is raised above surrounding tundra. Small natural drainage path observed upstream and downstream of culvert. Water observed within drainage downstream of outlets. Small amount of water ponded in culvert, but no flow. Shallow ponded water at the toe of the road embankment to the south of the culvert. Road constructed out of esker material.	39 and 40
4.9 km	C11c	2 x 1,200 mm	Design configuration D. Culverts are constructed over riprap and inverts are raised above surrounding tundra. No flow through culverts. Shallow ponded water observed upstream and downstream of the culverts. Road constructed out of esker materials.	41 and 42
5.0 km	C12a	2 x 1,200 mm	Design configuration D. Culverts are constructed over riprap and inverts are raised above surrounding tundra. Ponded water observed over tundra upstream and downstream of the culverts. No flow through culverts. Road embankment looks steeper on east side compared to west side. Road constructed out of esker materials. Recommendation: Confirm road embankment slopes from as-built survey.	43 and 44
5.1 km	C12b	2 x 1,000 mm	Design configuration D. Culverts are constructed over riprap and inverts are raised above surrounding tundra. Water ponded upstream and downstream of the culverts and along the toe of the embankment. Road constructed out of esker materials. Recommendation: Monitor ponding upstream of culverts and adjacent to road and the condition of the road to determine if mitigation is required. Ditching or placement of fill material along the toe of the road to promote flow to the inlets of culverts, culverts could be lowered, or additional culverts could be added.	45 and 46
6.2 km	C13	2 x 800 mm	Design configuration D. Culverts are constructed over riprap and inverts are raised above surrounding tundra. Relatively large pond of water upstream and downstream of the culverts; road constructed through natural pond. Road constructed out of esker materials. Recommendation: Monitor ponding upstream and downstream of culverts and road condition to determine if mitigation required. Culverts could be lowered and/or material could be placed along toe of road to keep water away from road foundation.	47 and 48
6.3 km	C14	3 x 800 mm	Design configuration D. Culverts are constructed over riprap and inverts are raised above surrounding tundra. Water ponded upstream and downstream of the culverts. Road constructed out of esker materials. Recommendation: Monitor ponding upstream and downstream of culverts and road condition to determine if mitigation required. Culverts could be lowered and/or material could be placed along toe of road to keep water away from road foundation.	49 and 50

Notes: Dimensions, names, and alignment stations presented in the table are taken from the Tetra Tech design report and associated construction drawings, including amendments (Tetra Tech 2017a, d, and e).

1 ×__ mm = the number of culverts × the diameter of the culvert.

(a) Distances measured with truck odometer.

CSP = corrugated steel pipe; AWAR = all-weather access road.

10.2 Recommendations

The following are recommendations for the Itivia fuel storage area and by-pass road:

- The damaged outlets of the culverts through the entrance to the Itivia fuel storage area should be fixed.
- Cover material should be re-established over the liner that has been exposed on the south containment berm of the Itivia fuel storage facility to protect the liner.
- The locations and layouts of some of the culverts through the Itivia by-pass road do not correlate with the design drawings (Tetra Tech 2017e) and Figure 6. The discrepancy is due to modifications to the locations and layouts during construction based on site observations and conditions. The culvert locations should be referenced to the as-built report and drawings during the 2019 annual geotechnical inspection.
- The as-built report should confirm culvert sizes, locations, and invert elevations have been constructed to the design. The as-built report should also confirm that safety berms have been constructed where required based on road fill height and confirm that road slopes have been constructed to the design.
- The section of the road that is constructed with esker material may be susceptible to erosion. This should be monitored and maintenance completed as required. Coarser material can be placed for erosion protection if erosion occurs in some areas.

11.0 SUMMARY AND RECOMMENDATIONS

The results of the 2018 annual geotechnical inspection carried out at the Project site, along the AWAR, at the Itivia site, and along the Itivia by-pass road indicate that the infrastructure was generally in good condition and performing as designed.

The following presents a summary of the recommendations from the 2018 geotechnical inspection for the infrastructure in each of the areas inspected. The recommendations have been grouped based on the type of recommendation and have also been given a rating of High (L), Medium (M), or Low (L) priority.

The following recommendations are related to surveillance and monitoring:

The recommendations for surveillance and monitoring don't currently require a maintenance action but may warrant future maintenance if conditions worsen.

Main Site

- Geotechnical inspections should be carried out and documented for D-CP1 and D-CP5 following the schedule developed in the OMS manual. In addition, instrumentation should be monitored, and the data should be plotted and reviewed, following the schedule developed in the OMS manual. These activities were completed by AEM in 2018; however, not quite to the schedule in the OMS. The OMS manual indicates that daily inspections should be completed and documented using the same form as the weekly inspection, which were not completed in 2018. The OMS manual does not indicate if there is seasonal variability to the frequency of documented inspections. It may be acceptable to seasonally vary the frequency of inspections, but this should be reviewed with the Engineer of Record (EoR) for the dikes and the OMS manual should be updated, as required. The OMS manual should be reviewed and updated annually and is next due for review in June 2019. (H)
- If the P-Area dikes will continue to be used, they should be added to the OMS manual that was developed for D-CP1 and D-CP5. Geotechnical inspections and instrumentation monitoring should be carried out and documented following the schedule developed in the OMS manual. (H)
- Implement a road and culvert monitoring program for site roads, as is done for the AWAR, which is tied to a maintenance program. (M)
- Conduct inspections along Itivia by-pass road, as per the Road Management Plan (AEM 2015b), now that the road is complete. (M)
- Monitor the cracking adjacent to Channel 5. If cracking gets worse, recontouring and/or compacting the areas of cracking to close the cracks will reduce the potential for water to infiltrate into the cracks leading to warming of the permafrost and additional thaw settlement and cracking. (M)
- Monitor the cracking observed in the D-CP1 downstream sump berms and adjacent to the downstream collection channel. Recontouring and/or compacting the areas of cracking to close the cracks will reduce the potential for water to infiltrate into the cracks leading to warming of the permafrost and additional thaw settlement and cracking. (M)

- Ponding upstream of Berm 3 should be monitored to determine how much and how often ponding occurs and if Berm 3 can perform as required with the ponding. (M)
- The Berm 3 cover materials may be susceptible to erosion. This should be monitored, and if there is erosion, consideration should be given to placing coarser material on Berm 3 to reduce the potential for erosion. (M)

Exploration Site

- The cracks in fuel storage pad should be monitored; however, they are not considered to be a geotechnical concern. (L)

All-weather Access Road

- Continue to monitor culverts and hydraulic effectiveness to assess if current culverts provide adequate capacity and if any changes are required. Evaluate if any culverts need to be installed at a lower elevation to reduce ponding, and downstream erosion. (M)
- Monitor areas that have ponding, but no culverts and consider installing culverts to manage water. (M)
- Conduct inspections and document observations and recommendations as laid out in the Road Management Plan (AEM 2015b). Road inspections were completed and documented in 2018, but documentation indicates that the frequency of the inspections did not quite meet what is laid out in the Road Management Plan. (H)

Itivia Site and By-pass Road

- The locations of some of the culverts through the Itivia by-pass road do not correlate with the design drawings (Tetra Tech 2017e) due to changes made during construction. The culvert locations should be referenced to the as-built report and drawings during the 2019 annual geotechnical inspection. (M)
- The as-built report should confirm culvert sizes, locations, and invert elevations have been constructed to the design. The as-built report should also confirm that safety berms have been constructed where required based on road fill height and confirm that road slopes have been constructed to the design. (M)
- The section of the road and safety berm that is constructed with esker material may be susceptible to erosion. This should be monitored and maintenance completed as required. (L)
- Ponding of water along the road should be monitored and if it is impacting the condition of the road, mitigation measures should be implemented, such as, lowering the culverts or ditching or placing fill to direct water to the culvert inlets. (M)

The following recommendations are related to operational procedures:

Main Site

- Water volumes within containment ponds should be managed to the levels defined in the OMS manual, including maintaining the water level below the elevation defined for the end of October in the OMS manual over the winter to promote freezing of the dikes. (H)
- The D-CP1 sump and downstream collection channel should be emptied in the fall/early winter to refreeze the ground around these facilities. During the open water season, keeping the water level in the downstream channel and sump low will reduce the potential for thaw of the ground around the channel and sump and associated settlement. (M)
- Consider adding data loggers to thermistors for easier collection of data, especially in the winter when access may be more limited. (L)
- Where possible, try not to allow seepage water from DP3-A to pond against the Saline Pond berm to avoid permafrost degradation. (M)
- Monitor slopes above Portal No. 2 for rockfill instability during backfill placement. (H)
- Snow management around Portal No. 1 and 2 may be advisable prior to freshet to reduce inflows to the underground. (L)

Exploration Site

- Minimize the amount of water contained within the exploration landfarm until it is decommissioned and remediated. (M)

The following recommendations relate to maintenance or repairs that are required:

Main Site

- Cracks and areas of settlement in the containment pond dikes should be filled and/or recontoured to close the cracks and reduce the potential for infiltration and erosion. (M)
- Ponding of water adjacent to roads should be avoided. Disturbed areas from road construction should be recontoured to promote drainage away from the road and consideration should be given to installing culverts if ponding occurs in naturally low areas. This was most notable along the Emulsion Plant and Wesmeg Borrow access roads. (M)
- If the Wesmeg Borrow access road is blocking drainage near Lake B33A that is leading to ponding adjacent to the road, a culvert should be installed to allow drainage so that there isn't permafrost degradation and settlement. (M)
- Consider adding a crushed surface material to the Emulsion Plant and storage area pads if trafficability continues to be an issue. (M)
- Survey monitoring plate M-3 on D-CP5 should be replaced. (M)

- Where erosion is occurring on slopes of pads, the existing materials should be regraded and compacted, and a coarser material should be placed to further reduce erosion potential. Higher priority should be given to areas where erosion is encroaching on sea containers or other facilities placed close to the slope. The most significant pad erosion was observed at the north side of the main camp/industrial pad and the Emulsion Plant pad. (M)
- The cracking and sloughing along Channel 1 should be assessed to determine if the channel is too steep and riprap is sloughing over geotextile or if it is caused by thermal degradation of permafrost adjacent to the channel. If possible, the channel should be kept empty through the winter to promote freezing of the permafrost around the channel. (M)
- Where access is feasible, removal of snow from the water collection pond dikes (temporary and permanent) is recommended to reduce the insulating effects of the snow, thereby allowing the temperature of the core material in the dikes and the foundations to drop as low as possible. Snow removal is more important if thermistor data is indicating that the dike and/or foundation temperatures are warmer than expected. (M)
- Make sure thermistors in the water management dikes are well marked so they can be located and maintained during the winter and are not damaged during snow removal operations. (H)
- The slopes of the Operation Landfill should be monitored, particularly the northeast corner where water was observed to be ponding downstream and there was some possible sloughing on the slope. Regrading and compacting the slope in this area will reduce the potential for erosion. (M)
- Consider adding rockfill material to cover the till berm in P1, to protect the till and maintain its integrity if this berm is required for water management. (L)
- The Wesmeg Borrow Area should be recontoured and either capped with a coarser material or revegetated to reduce erosion. (M)
- A coarser rockfill layer should be placed over the decommissioned exploration landfill to reduce erosion and cracking. (M)
- Snow management around and above Portal No. 1 and 2 may be advisable, especially prior to freshet, to reduce the potential for larger surface water inflows entering the underground. (L)

Exploration Camp Site

- Repair surface erosion along south slope of exploration camp pad. Grade surface to reduce channelization of surface water flows and therefore reduce the potential for the erosion to reoccur. In this area, a coarser surfacing layer could be placed to help reduce the potential for future erosion. (L)
- The exploration camp access road should be regraded and consideration given to placing some coarser rockfill on the slopes where there is erosion. (M)
- The culverts through the exploration camp access road should be cleared of material. Large boulders should be removed from above culverts to prevent potential damage to the culverts and appropriately sized riprap should be added to the road fills around he culverts for erosion protection where there isn’t any. (M)

- The diffuser access road could be regraded to close up the cracks and reduce the potential for future cracking. (L)

All-weather Access Road

- The kilometre markings on the AWAR culverts should be checked and replaced with accurate numbers. At the time of the 2018 site visit, AEM indicated that new markers had been ordered, but had not arrived. (M)
- Specific recommendations for the AWAR culverts and bridges are summarized in Table 9.

Itivia Site and By-pass Road

- Cover material should be re-established over the liner that has been exposed on the south containment berm of the Itivia fuel storage facility to protect the liner. (M)
- The culverts should be cleared of all materials prior to freshet. (H)

The following recommendations relate to future construction:

- Road and pad materials should be compacted to reduce the potential of the material being eroded, and if necessary a coarser, well graded, cover material should be placed to further reduce erosion potential.
- When culverts are installed, ensure bedding material surrounding culverts is of a suitable gradation (e.g., sandy) and compacted. Large boulders should not be placed in direct contact with the culverts within the road fills; however, the slopes of the road around the outlets of the culverts should be armoured with appropriately sized material (e.g., cobbles) to reduce erosion.

Table 9: Recommendations for All-Weather Access Road

Station (distance from Friendship Centre in Rankin Inlet)	Water Management Structure Description	Recommendations
KM 6.0	Char River Bridge	Monitor for potential erosion of sand and gravel on left abutment downstream to determine if armouring should be added. No substantial erosion noted to date.
KM 6.2	3 CSP cuverts: 2 × 1,300 mm 1 × 700 mm	Monitor erosion between culverts to determine if armouring should be added.
KM 7.0	3 CSP culverts: 2 × 1000 mm 1 × 700 mm	Potential for erosion of sandy soil around culverts. Monitor to determine if armouring should be added.
KM 7.4	3 CSP culverts: 1 × 900 mm 1 × 700 mm 1 × 1000 mm	Erosion potential due to sandy soils around 700 mm culvert. Consider extending and adding armouring.
KM 8.0	Meliadine River Bridge	Right abutment, downstream slope has exposed esker sand and gravel. Monitor to determine if armouring should be added.
KM 10.5	M-5 Bridge	Potential small erosion/settlement of rock embankment on the bridge's right abutment identified during 2016 inspection shows no signs of change. Continue to monitor. Exposed geotextile at base of downstream end of left abutment that could be due to erosion, so should be monitored.
KM 12.6	no culverts	Area of poor drainage. Flow along road edge, suspect seepage under the road. Some erosion along toe of road. Monitor and consider installing a culvert to manage water and/or rockfill to protect road.
KM 16.3	3 CSP culverts: 1 × 1,300 mm 1 × 700 mm 1 × 1,000 mm	Outlets are all elevated increasing erosion potential. Monitor to assess if hydraulic capacity is adequate and if erosion is an issue. Consider installing culverts at lower elevations to improve water management.
KM 18.1	2 CSP culverts: 1 × 900 mm, 1 × 1,000 mm	Consider adding cover over upper culvert on upstream side. Upper culvert outlet is high, therefore water has to pond close to road surface for culvert to pass flows. Elevation of culvert leads to potential for erosion during high flow periods. Assess if hydraulic capacity is adequate.
KM 18.15	1 × 600 mm CSP culvert	Invert and outlet are both elevated, increasing erosion potential. Some erosion of road slope and toe visible. Assess if hydraulic capacity is adequate. If water management challenges observed, consider installing an additional culvert at this location, at a lower elevation.
KM 19.5 (approx.)	No culverts	Ponding on west side of road and AEM reports water flowing over the road at KM 19. Consider installation of a culvert at this area.
KM 21.5	No culverts	AEM reported that water flowed over road at this location during freshet. Consider adding a culvert to manage water.
KM 21.7	2 × 160 mm steel pipes, used as culverts	High water level evident near road surface. AEM indicate road was excavated to release flow. Consider marking pipe location and cleaning out, prior to freshet. Monitor for signs of erosion and adequacy of hydraulic capacity. Add additional culvert in this area if required.
KM 22.7	No culverts	Water ponded on the east side of the road, signs of wet ground observed on west side of road indicating possible seepage under the road. Consider installing a culvert.
KM 25.8	1 × 600 mm HDPE corrugated culvert	Culvert is partially blocked by road fill. Sandy soil around inlet and outlet and some sediment erosion. AEM inspection reports noted ponding of water at or over the road in this area during the freshet. Clean out culvert. Consider adding additional culverts if water management continues to be an issue during freshet. Also consider adding armour around culvert and on road slopes.
KM 26.2	2 × 160 mm steel pipes, used as culverts	Lower pipe bent upwards and should be replaced. Some sediment deposition downstream is evident. Water ponded along road below upstream inverts of pipes. AEM inspection reports noted ponding of water at or over the road in this area during the freshet. Lower pipe should be replaced. Consider adding additional or larger culverts if water management continues to be an issue during freshet.
KM 26.8	3 × 700 mm CSP culverts	Clear inlet of lower culvert of road fill material and extend.
KM 28.7	Seepage	Ponded water on east side of road. AEM notes that water ponds against road for most of open water season and road surface often is moist, indicating signs of seepage through road. Consider installation of a culvert.
KM 29.6	1 × 500 mm HDPE corrugated culvert	Clear culvert of road fil material.

1 ×__ mm = the number of culverts × the diameter of the culvert.

CSP = corrugated steel pipe.

12.0 CLOSURE

The reader is referred to the Study Limitations section, which precedes the text and forms an integral part of this report.

This report was prepared to summarize the findings of the 2018 geotechnical inspection conducted between 10 and 14 September 2018, to comply with the requirements of AEM's Type A Water Licence No. 2AM-MEL1631, Part I, Item 14 (page 21) and Schedule I, Item 1 (page 39).

We trust the information provided within is sufficient for your current needs. Should you require additional information or further clarification, please contact us.

Signature Page

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PERMIT TO PRACTICE
GOLDER ASSOCIATES LTD.
Signature
Date 20 feb 2019
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

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APPENDIX A

Mine Site Inspection Photographs

APPENDIX A-1

P-Area Ponds

Photograph 1: Overview of P-Area, Google Earth Image (August 2017)

Photograph 2: DP1-A, Looking Northeast from the Road (12 September 2018)

Photograph 3: DP1-A, North Slope Looking Southwest, Minor Slumping that was not observed during 2017 inspection (12 September 2018)

Photograph 4: DP1-A, Cracking Observed on Crest, Similar Condition to 2017 (12 September 2018)

Photograph 5: DP1-A, South Slope, Looking Southwest (12 September 2018)

Photograph 6: Pond 1 from DP1-B, Looking Southeast (12 September 2018)

Photograph 7: Snow Melt Management Pond, Looking South (12 September 2018)

Photograph 8: Snow Melt Management Pond, East Berm Downstream Slope, Looking North (12 September 2018)

Photograph 9: Snow Melt Management Pond, South Berm, Looking West (12 September 2018)

Photograph 10: DP1-B, Upstream Slope from Jetty 2 Looking East toward Snow Melt Management Pond, Minor Erosion on Slope (12 September 2018)

Photograph 11: DP1-B, Downstream Slope, Looking East. Orange Delineator on Crest Marks Thermistor Location (12 September 2018)

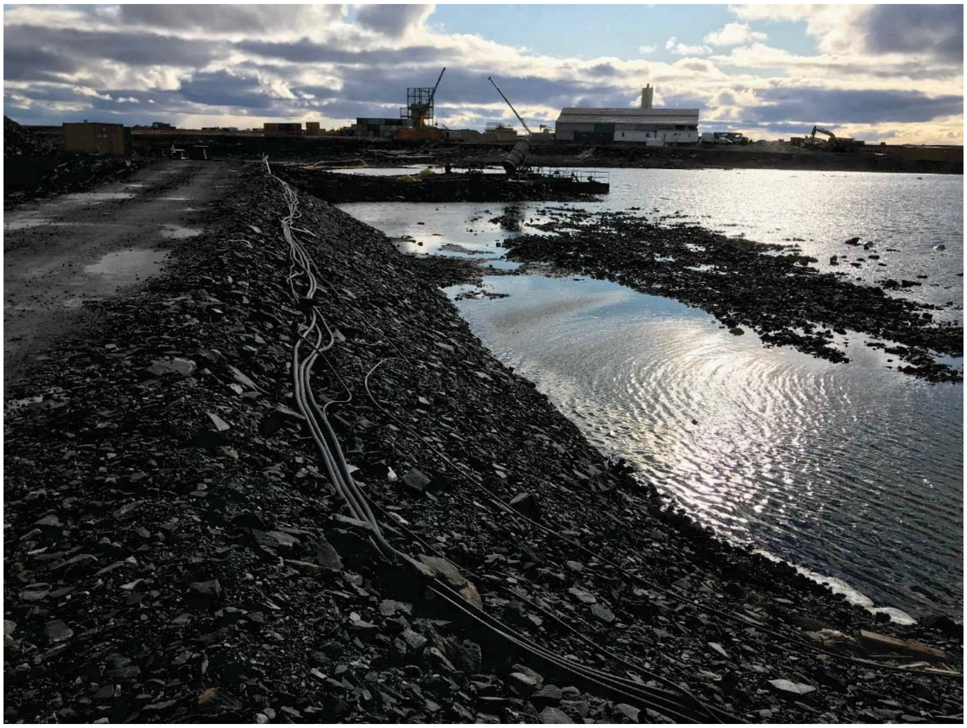
Photograph 12: DP1-B, Cracking on Crest of Jetty 2 has Increased Slightly from 2017. No cracking observed at Jetty 3 or Jetty 4 during inspection (12 September 2018)

Photograph 13: DP1-B, Downstream Slope near Station 0+300, Looking West. Minor Seepage from Downstream Toe, Similar to 2017, Entering Collection Channel to Right of Photograph (12 September 2018)

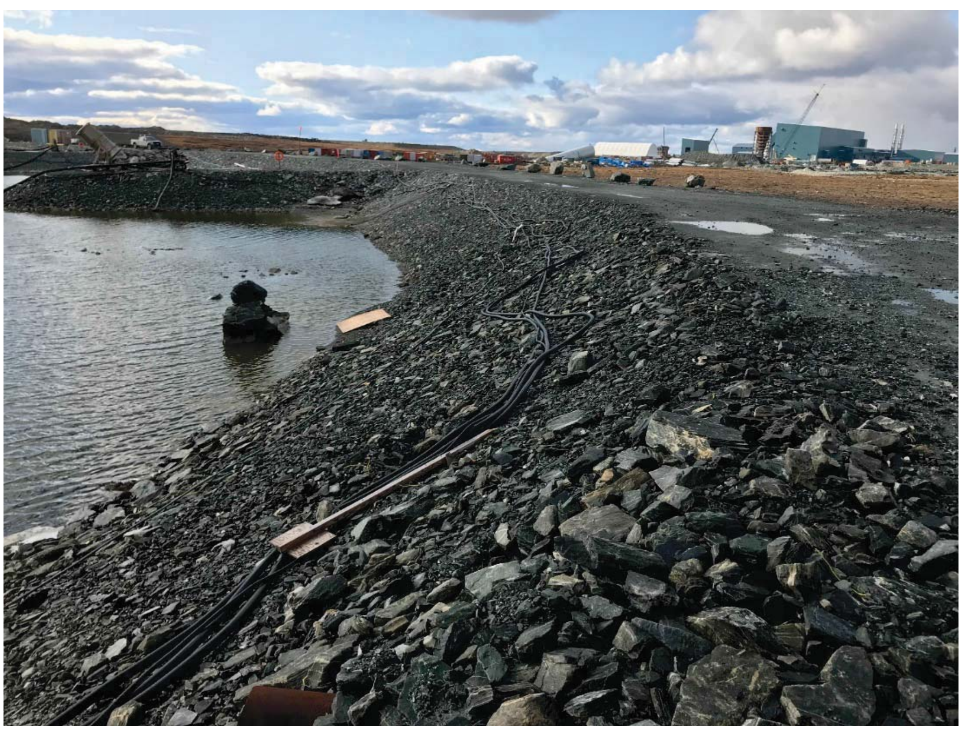
Photograph 14: DP1-B, Run-off and Seepage Collection Channel Downstream of Dike, Looking East. Seepage in Channel was Clear and at a Similar Level to 2017 (12 September 2018)

Photograph 15: DP1-B, Clear Seepage Visible from Dike Toe near Station 0+190. Less Seepage at This Location than in 2017 (12 September 2018)

Photograph 16: DP1-B, Downstream Channel and Sump near Station 0+120, Looking East. Slightly Lower Water Level at Sump Location than in 2017 (12 September 2018)



Photograph 17: DP1-B, Upstream Slope near Station 0+330, looking South. Evaporator #4 Jetty and Pump Barge in Background (12 September 2018)



Photograph 18: DP1-B, Upstream Slope looking West near Station 0+320. Evaporator #2 Jetty in Background (12 September 2018)

Photograph 19: DP1-B, Crest looking Northwest near Station 0+320 (12 September 2018)

Photograph 20: DP1-B, Evaporator #4 Jetty and Pump Barge Looking West (12 September 2018)

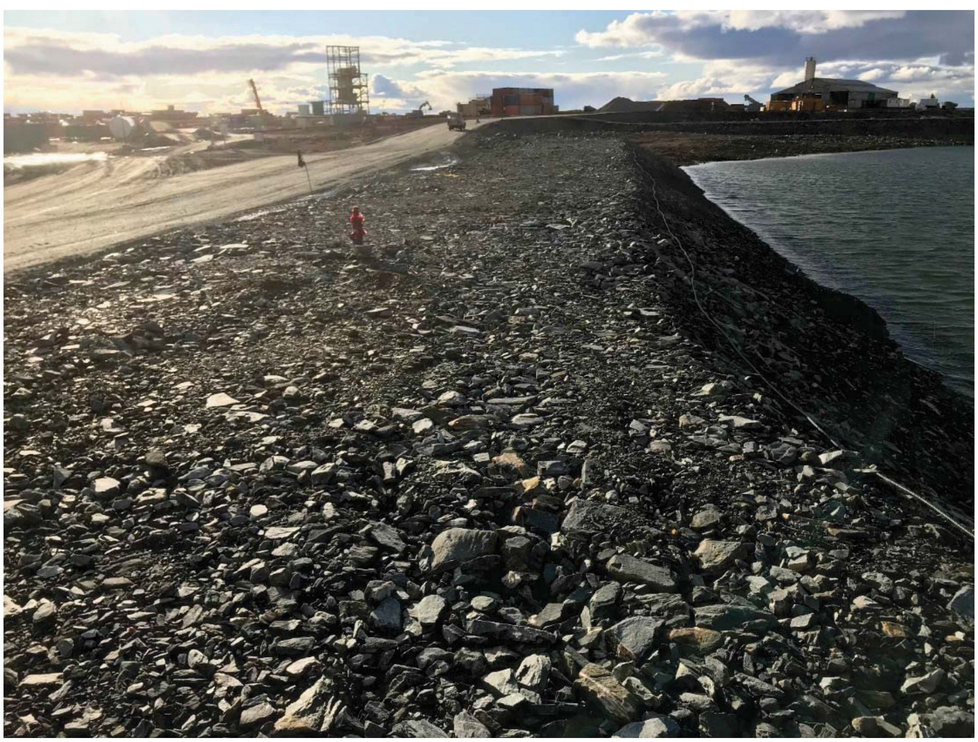
Photograph 21: Overview of P1 and Evaporator #4 Jetty and Pump Barge looking West from Near Station 0+400 of DP1-B. Evaporator #1 in Operation (12 September 2018)

Photograph 22: P1 Till Dividing Berm, Looking West (12 September 2018)

Photograph 23: DP2-A, West End of Dike, Looking East (12 September 2018)

Photograph 24: DP2-A, Upstream Slope near Station 0+025, Looking East (12 September 2018)

Photograph 25: DP2-A, Downstream Slope near Station 0+70, Looking East. Mine Access Road runs along Downstream Toe of Dike (12 September 2018)



Photograph 26: DP2-A, Upstream Slope near Station 0+65, Signs of Minor Slumping at Crest, Looking West. Signs of Slumping at Crest were not Observed in 2017 (12 September 2018)

Photograph 27: DP2-A, Cracking near Station 0+100, looking West. (12 September 2018)

Photograph 28: DP2-A, Cracking near Station 0+100, looking East. The Length of the Cracking in This Area of the Dike was Similar to 2017, but the Cracks were Wider and Deeper (12 September 2018)

Photograph 29: DP2-A, Upstream Side Looking West from Near Station 0+110 (12 September 2018)

Photograph 30: DP3-A, Downstream Slope and Seepage Collection Channel, Looking Southwest near Station 0+300. More Water Ponded Downstream than in 2017 (12 September 2018)

Photograph 31: DP3-A, Upstream Slope and Pond 3, Looking Southwest near Station 0+300 (12 September 2018)

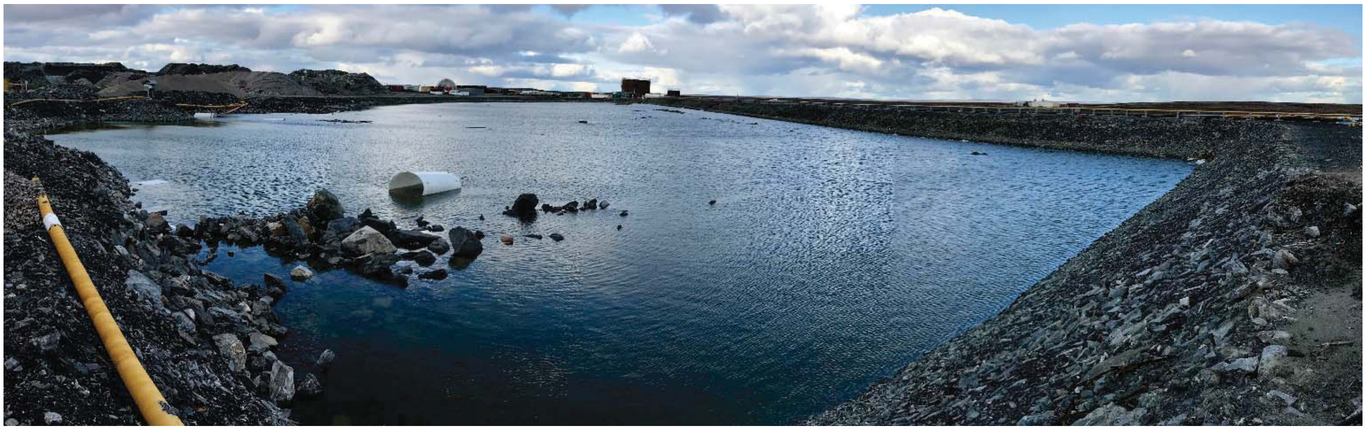
Photograph 32: DP3-A, Cracking on the Crest near Station 0+150, Looking Southwest. Cracking was Slightly Wider and Deeper than in 2017 (12 September 2018)

Photograph 33: DP3-A, Cracking on the Upstream Slope near Station 0+150 that was not Observed in 2017 (12 September 2018)

Photograph 34: DP3-A, Upstream Slope and Crest Looking Northeast near Station 0+150 (12 September 2018)

Photograph 35: View Northeast of the Saline Pond from near Station 0+150 of DP3-A. Clear Seepage Water Ponded in Downstream Collection Channel and Along Dike Toe. More Ponded Water than in 2017 (12 September 2018)

Photograph 36: DP3-A Downstream Slope and Seepage Collection Channel, looking Northeast near Station 0+40. More Ponded Water Downstream than in 2017 (12 September 2018)



Photograph 37: DP3-A, Looking Northeast at Pond 3 from near Station 0+000 (12 September 2018)

APPENDIX A-2

Permanent Water Management Facilities

Photograph 1: D-CP1, Overview of D-CP1, Google Earth Image (20 August 2017)

Photograph 2: D-CP1, Water Pipeline Ramp Upstream of Dike Near Station 1+140, Looking South. Some Minor Erosion Observed that was not Observed in 2017 (12 September 2018)

Photograph 3: D-CP1, Upstream Slope Near Station 1+140, Looking Northeast (12 September 2018)

Photograph 4: D-CP1, Cracking on Upstream Bench Crest Near Station 1+150, Looking Northeast. Length of Cracking had Increased Slightly from 2017 Observations and Minor Increase in the Widths of the Cracks (12 September 2018)

Photograph 5: D-CP1, Upstream Slope near Station 1+230, Looking North (12 September 2018)

Photograph 6: D-CP1, Upstream Slope near Station 1+290, Looking South (12 September 2018)

Photograph 7: D-CP1, Upstream Slope and Crest Near Station 1+350, Looking North (12 September 2018)

Photograph 8: D-CP1, Upstream Bench Crest Near Station 1+400, Looking North (12 September 2018)

Photograph 9: D-CP1, Cracking on Upstream Bench Crest Near Station 1+450, Looking North. Similar Condition to 2017 (12 September 2018)

Photograph 10: D-CP1, Upstream Slope Near Station 1+450, Looking South (12 September 2018)

Photograph 11: D-CP1, VGTC-03 on Upstream Bench, Station 1+460, Looking North (12 September 2018)

Photograph 12: D-CP1, Upstream Slope and Crest Near Station 1+540, Looking South (12 September 2018)

Photograph 13: D-CP1, Upstream Bench Crest Near Station 1+575, Looking South (12 September 2018)

Photograph 14: D-CP1, Crest Looking South Near Station 1+575, Looking South (12 September 2018)

Photograph 15: D-CP1, Crest Looking North Near Station 1+510 (12 September 2018)

Photograph 16: D-CP1, Crest Looking South Near Station 1+420 (12 September 2018)

Photograph 17: D-CP1, Downstream Slope and Crest Looking South Near Station 1+250 (12 September 2018)

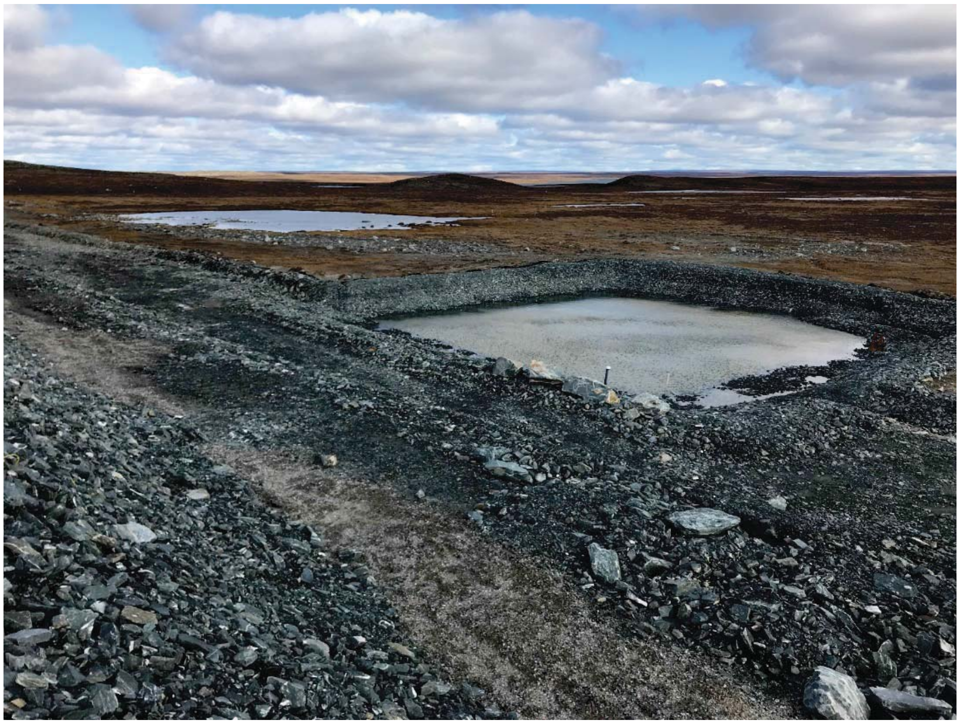
Photograph 18: D-CP1, Crest Overview Looking Northeast Near Station 1+160 (12 September 2018)

Photograph 19: D-CP1, Cracking on Downstream Bench Near Station 1+145, Looking Northeast. Cracks are Wider and Deeper Than in 2017 (12 September 2018)

Photograph 20: D-CP1, Downstream Slope and Seepage Collection Channel Looking South, Near Station 1+550 (12 September 2018)

Photograph 21: D-CP1, Downstream Slope Looking Northwest, Near Station 1+250 (12 September 2018)

Photograph 22: D-CP1, Downstream Slope Looking Southwest, Near Station 1+210 (12 September 2018)



Photograph 23: D-CP1, Downstream Sump Looking Northeast Near Station 1+220 (12 September 2018)

Photograph 24: D-CP1, Downstream Sump Looking Southeast Near Station 1+240 (12 September 2018)

Photograph 25: D-CP1, Downstream Sump and Downstream Slope Looking South Near Station 1+240 (12 September 2018)

Photograph 26: D-CP1, Cracking/Slumping in North Side of Downstream Sump, Looking East. Similar Condition to 2017 (12 September 2018)

Photograph 27: CP1 Jetty 1, Southeast Slope Overview, Looking North (13 September 2018)

Photograph 28: CP1 Jetty 1, Northwest Slope, Looking Northeast (13 September 2018)

Photograph 29: Jetty 1, Southeast Slope, Looking Southwest (13 September 2018)

Photograph 30: General overview of D-CP5, Berm 3, Channel 5, and the Saline Pond, Google Earth Image (August 2017

Photograph 31: D-CP5, Upstream Bench at Southwest Abutment Looking Northeast Near Station 1+025 (12 September 2018)

Photograph 32: D-CP5, Upstream Slope, Looking South Near Station 1+170 (12 September 2018)

Photograph 33: D-CP5, Upstream Crest Looking Southwest Near Station 1+170 (12 September 2018)

Photograph 34: D-CP5, Cracking on Upstream Bench Looking Northeast Near Station 1+180. This Cracking was not Observed in 2017 (12 September 2018)

Photograph 35: D-CP5, Cracking on Upstream Bench Looking Northeast Near Station 1+185. This Cracking was not Observed in 2017 (12 September 2018)

Photograph 36: D-CP5, Upstream Crest Looking Southwest Near Station 1+250 (12 September 2018)

Photograph 37: D-CP5, Upstream Crest Looking Southwest Near Station 1+300 (12 September 2018)

Photograph 38: D-CP5, Downstream Slope and Crest Overview Looking Southwest Near Station 1+275 (12 September 2018)

Photograph 39: D-CP5, Crest Overview Looking Southwest Near Station 1+250 (12 September 2018)

Photograph 40: D-CP5, Downstream Bench Cracking looking Northeast Near Station 1+180. Similar Condition to 2017 (12 September 2018)

Photograph 41: D-CP5, Cracking in Downstream Slope Looking Southwest Near Station 1+175. This Cracking was not Observed in 2017 (12 September 2018)

Photograph 42: D-CP5, Downstream Slope and Pump Location Looking Northeast Near Station 1+170 (12 September 2018)

Photograph 43: CP5, Jetty 5 and Pumping Station. South Slope of Jetty, Looking West (12 September 2018)

Photograph 44: CP5, Jetty 5 Pipeline and Pumping Station. North Slope of Jetty, Looking West (12 September 2018)

Photograph 45: CP5, Jetty 5 Intake and Southwest Toe Looking Southeast (12 September 2018)

Photograph 46: Saline Pond, Looking Southeast (12 September 2018)

Photograph 46: Saline Pond, Cracking in Northwest Perimeter Berm Looking Southeast. Cracking and Slumping have Increased Slightly from 2017 (12 September 2018)

Photograph 47: Saline Pond, Southwest Perimeter Berm Looking Northwest, Cracking Along Downstream Crest. This Cracking was not Observed in 2017 (12 September 2018)

Photograph 48: Saline Pond, Southeast Perimeter Berm Cracking in Upstream Crest, Looking Northwest. This Cracking was not Observed in 2017 (12 September 2018)

Photograph 49: Saline Pond, Area of Possible Settlement Identified During 2017 Inspection, Near Toe of Northwest Perimeter Berm, Looking Southwest. No Visible Change from 2017 (12 September 2018)

Photograph 50: Saline Pond, Downstream Slope of the Northwest Perimeter Berm and Water Ponded Between Saline Pond and DP3-A (12 September 2018)

Photograph 51: Channel 1, Outlet of Channel at East End, Looking Northeast towards CP1 (13 September 2018)

Photograph 52: Channel 1, Small Slump and Crack along the South Slope Crest About 30 m West from Outlet of Channel (13 September 2018)

Photograph 53: Channel 1, Looking Upstream Northwest Towards Culvert 16 (13 September 2018)

Photograph 54: Channel 1, Outlets of Culvert 16 Looking Southwest (13 September 2018)

Photograph 55: Channel 1, Inlets of Culvert 16 and Pond Area H12. Construction Was Not Complete in This Area at the Time of the Site Visit (13 September 2018)

Photograph 56: Channel 1, Inlets of Culvert 16, Looking Northeast (13 September 2018)

Photograph 57: Channel 2, Unlined Extension of East End of Channel 2, Looking Northwest (11 September 2018)

Photograph 58: Channel 2, Start of Lined Channel at East End, Looking Northwest (11 September 2018)

Photograph 59: Channel 2, Eastern End, Looking Northwest (11 September 2018)

Photograph 60: Channel 2, Western Section, Looking East (11 September 2018)

Photograph 61: Channel 2, West End Near Outlet, Looking West. Some Water Ponded in Base of Channel (11 September 2018)

Photograph 62: Channel 2, Outlet of Channel at West End, Looking West (11 September 2018)

Photograph 63: Channel 3, Beginning of Alignment at Station 0+000 Looking Southwest (13 September 2018)

Photograph 64: Channel 3, Near Station 0+140 Looking West (13 September 2018)

Photograph 65: Channel 3, Extent of Completed Channel Looking East (13 September 2018)

Photograph 66: Channel 3, Alignment of Remaining Construction Looking West from the West end of the Completed Channel (13 September 2018)

Photograph 67: Channel 5, Looking Northeast from Near Station 0+250 (12 September 2018)

Photograph 68: Channel 5, Looking West from Near Station 0+250

Photograph 69: Channel 5, Looking West Near Station 0+220 (12 September 2018)

Photograph 70: Channel 5, Looking West Near Station 0+145. Less Water Ponded in this Area Compared to 2017 (12 September 2018)

Photograph 71: Channel 5, Water Ponded in Channel and Cracking Along South Slope of Trench Near Station 0+050, Looking Southwest. This Cracking was Not Observed in 2017 but Access to This Area was Limited due to Water Levels and Saturated Conditions in the Tundra (12 September 2018)

Photograph 72: Berm 3, Upstream Slope and Crest Near Abutment with D-CP5, Looking Northwest (12 September 2018)

Photograph 73: Berm 3, Downstream Slope and Crest Near Abutment with D-CP5, Looking Northwest (12 September 2018)

Photograph 74: Berm 3, Upstream Slope and Crest Near Station 0+060, Looking Southeast (12 September 2018)

Photograph 75: Berm 3, Downstream Slope and Crest Near Station 0+060, Looking Southeast (12 September 2018)

Photograph 76: Berm 3, Upstream Slope, Some Cracking Near Station 0+280, Looking North. This Cracking was Not Observed in 2017 (12 September 2018)

Photograph 77: Berm 3, Downstream Slope, Some Cracking Near Station 0+280, Looking North. Cracking was not Observed in 2017 (12 September 2018)

Photograph 78: Berm 3, Upstream Slope, Erosion at Toe and Along Slope from Previous High Water Mark, Near Station 0+230, Looking Northwest (12 September 2018)