Waste Rock Storage Facility 3 (WRSF3) Design Report and Drawings
6515-686-163-REP-002

30-Day Notice to Nunavut Water Board
In Accordance with Water License 2AM-MEL1631 (Part D, item 1)

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1 INTRODUCTION

Agnico Eagle Mines Limited (Agnico Eagle) is operating the Meliadine gold mine, located approximately 25 km north of Rankin Inlet and 80 km southwest from Chesterfield Inlet in the Kivalliq Region of Nunavut. Situated on the western shore of Hudson Bay, the Meliadine site is located on a peninsula between the east, south, and west basins of Meliadine Lake (63°1'23.8'' N, 92°13'6.42"W).

The current mine plan focuses on the development of the Tiriganiaq gold deposit, which will be mined using both conventional open-pit and underground mining operations. Existing or proposed mining facilities to support this development include a plant site and accommodations, waste rock storage facilities (WRSFs) and a water management system comprised of collection ponds, diversion channels, dikes and retention berms. A Type "A" Water License (No. 2AM-MEL-1631) was awarded to Agnico Eagle for the development of this project in 2016.

Fragmented rock material with no economic value generated from underground and open pit developments, as well as overburden produced from open pit stripping activities, require storage in permanent, engineered facilities. A total of three WRSFs have been identified for the co-disposal of these mine waste products within the Meliadine mine footprint. Waste material created thus far during mine development has been used for numerous construction projects on the site, with excess waste being generated for the first time during Q4 of 2019.

In accordance with Part D of the Type "A" Water License this report summarizes the design basis and design criteria for WRSF3. Also provided are construction and operational procedures, thermal instrumentation and monitoring requirements and issued for construction (IFC) drawings. The design report and drawings for WRSF1 was submitted for approval in November 2019, while the detailed design for WRSF2 will be provided in a future submission.

2 GENERAL SITE CONDITIONS

2.1 CLIMATE

The Meliadine site lies within the Southern Arctic Climatic Region, where daylight reaches a minimum of four hours per day in winter and a maximum of 20 hours per day in summer. The nearest weather station is Rankin Inlet A (Station 2303401), located approximately 25 km south of the mine.

The climate is extreme, experiencing long cold winters and short cool summers. The monthly mean air temperature is typically above 0°C for the months of June to September, and is below 0°C between October and May. July is typically the warmest month with a mean temperature of 12°C and January the coldest with a mean temperature of -31°C. The mean annual temperature for the period of record from 1981 to 2009 was -10.4°C.

Mean annual precipitation at the Meliadine site is estimated to be 411.7 mm, after accounting for rainfall and snowfall undercatch (based on the hydrological year from October 1 to September 30). Approximately 51% of the precipitation occurs as rainfall, while 49% occurs as snow.

The region is known for high winds, blowing from the north and north-northwest direction more than 30% of the time. The mean values for wind speed show that the north-northwest, together with north and northwest winds, have the highest speeds and tend to be the strongest. Mean monthly wind speeds are typically between 19 km/hour and 27 km/hour. Calm winds occur at a frequency of only 2.8%.

The climate in the Meliadine region is projected to be warmer for the 2020s, 2050s, and 2080s time horizons when compared to the observed historic values (Agnico Eagle and Golder 2014).

Precipitation shows an increase compared to historical values, but the majority of projections are not significantly different from the annual recorded precipitation value

2.2 PERMAFROST

The Meliadine site is located within the Southern Arctic terrestrial eco-zone in an area of continuous permafrost. Continuous permafrost to depths of between 360 m to 495 m is expected based on ground temperature data from thermistors installed throughout the mine site and as measured in underground development. The measured ground temperature data indicates that the active layer is 1.0 m to 3.0 m in areas of shallow soils and areas away from the influence of lakes. The typical permafrost ground temperatures at the depths of zero annual amplitude (typically at a depth of below 15 m) are in the range of -5.0°C to -7.5°C in the areas away from lakes and streams. The geothermal gradient ranges from 0.012°C/m to 0.02°C/m (Golder 2012a).

2.3 GROUNDWATER

In areas of continuous permafrost, there are generally two groundwater flow regimes: a shallow groundwater flow regime located in the active layer near the ground surface, and a deep groundwater flow regime located beneath permafrost. From late spring to early autumn, when temperatures are above 0˚C, the active layer thaws. Within the active layer, the water table is expected to be a subdued replica of topography, and is expected to parallel the topographic surface. The Meliadine area groundwater in the active layer flows to local depressions and ponds that drain to larger lakes.

The permafrost in the rock in the mine site area would be virtually impermeable to groundwater flow. The shallow groundwater flow regime, therefore, has little to no hydraulic connection with the deep groundwater regime. A numerical hydrogeological model for the deep groundwater flow regime was developed (Golder 2013a). The results of the hydrogeological model have indicated that the rock at the Meliadine site below the base of the permafrost or in taliks is generally of low hydraulic conductivity, on the order of 3×10^{-9} m/s (Golder 2013b).

To a lesser degree, groundwater beneath the permafrost is influenced by density differences due to the upward diffusion of deep-seated brines (density-driven flow). In the Canadian Shield, concentrations of Total Dissolved Solids (TDS) in groundwater increase with depth, primarily in response to upward diffusion of deep-seated brines. Salinity can induce a freezing point depression, creating a cryopeg in permafrost where water can be unfrozen even though the temperature is below 0°C. At the mine site, the freezing point depression was calculated to be equivalent to -3.3°C (Golder 2012a). The portion of the permafrost, where groundwater may be partially or wholly unfrozen due to the freezing point depression, has been estimated to be at a depth of 350 m to 375 m (Golder 2012a).

2.4 SEISMIC ZONE

The Meliadine area is situated in an area of low seismic risk. The peak ground acceleration (PGA) for the area was estimated from the 2015 National Building Code of Canada seismic hazard website (http://earthquakesscanada.nrcan.gc.ca). The estimated PGA is 0.022 g for a 5% in 50-year probability of exceedance (0.001 per annum or 1 in 1,000 year return) and 0.037 g for a 2% in 50-year probability of exceedance (0.000404 per annum or 1 in 2,475 year return) for the area.

3 DESIGN BASIS

3.1 2019 MINE WASTE MANAGEMENT PLAN

As part of the documentation series produced for the Type "A" Water License, Agnico Eagle presented a *Mine Waste Management Plan* (MWMP) for the mine site in March of 2019 (Agnico Eagle, 2019a). This plan described the feasibility-level design basis and general operational procedures for the WRSFs.

Key points for the design and construction of the WRSFs from the 2019 MWMP included the following:

- A total of 29.5 Mt of waste rock will be produced through the remaining construction and over an operational mine life of eight (8) years. Approximately 2.8 Mt will be used for surface construction purposes, while an additional 2.1 Mt will be used for underground backfill. The vast majority of the waste rock produced (24.6 Mt) will require permanent storage on the surface;
- A total of 7.1 Mt of overburden will be produced during construction activities and development of the open pits. A small portion of this overburden (0.1 Mt) will be used for reclamation of the tailings storage facility, while the remainder will require permanent storage on the surface.

3.1.1 Refinements Since 2019 Mine Waste Management Plan

Refinements to the expected production schedule and predicted volumes have been made since the release of the March 2019 MWMP. Specifically, although overall quantities of waste rock (31.4 Mt vs 29.5 Mt) and overburden (7.0 Mt vs 7.1 Mt) have generally remained similar, the expected yearly distribution has shifted in order to support an advanced open pit schedule.

Table 1 summarizes the overall production schedule, quantities and distribution of the mine waste by year based on the latest life of mine (LOM) schedule (V11_2).

Table 1: Schedule and Bank Quantities of Mine Waste Production by Year (V11_2)

Year	Mine Year	Mine Waste from Underground (t)	Mine Waste from Open Pit Tiri_001 (t)		Mine Waste from Open Pit Tiri_002 (t)	
		Waste Rock	Waste Rock	Overburden	Waste Rock	Overburden
2019	Yr-1	482,736	--	334,383*	236,219	77,301
2020	Yr 1	871,289	853,138	238,208	2,772,255	554,928
2021	Yr 2	705,814	159,028	1,959,165	2,250,994	--
2022	Yr 3	734,254	2,583,128	1,644,159	230,031	--
2023	Yr 4	766,156	2,733,105	2,020,044	--	--
2024	Yr 5	805,326	6,171,994	130,110	--	--
2025	Yr 6	541,685	4,946,761	--	--	--
2026	Yr 7	332,451	3,220,643	--	--	--
2027	Yr 8	5,006	--	--	--	--
Total		**5,244,718**	**20,667,797**	**6,326,068**	**5,489,498**	**632,230**

** Includes approximately 142,446 t of excess overburden from various excavation works conducted 2016 – 2018 including CP3, CP4, SP2 and Channel 3*

As shown in Table 2, requirements for waste rock for surface construction (6.7 Mt vs 2.8 Mt) or underground backfill (3.6 Mt vs 2.1 Mt) purposes have increased since the 2019 MWMP, as the need for thermal protection and yearly aggregate production to support the open pits have been added and underground backfill quantities have risen. Therefore, as the overall total of waste rock generated has slightly increased since the 2019 MWMP, the total amount of waste rock requiring permanent surface storage has decreased (21.1 Mt vs 24.6 Mt).

Table 2: Bank Quantities and Distribution of Mine Waste Production by Year (V11_2)

Year	Mine Year	Total Waste Rock from Mine Operations (t)	Utilization of Waste Rock (t)		
			Construction/Thermal Protection	Underground Backfill	TSF Closure Cover
2019	Yr-1	718,955	355,753	90,024	141,154
2020	Yr 1	4,496,682	933,341	353,880	192,926
2021	Yr 2	3,115,835	977,039	457,130	188,949
2022	Yr 3	3,547,414	100,000	425,235	166,920
2023	Yr 4	3,499,261	922,281	361,568	229,319
2024	Yr 5	6,977,320	220,831	437,801	538,419
2025	Yr 6	5,488,446	262,505	433,045	277,896
2026	Yr 7	3,553,094	100,000	416,418	245,524
2027	Yr 8	5,006	100,000	316,672	99,050
2028	Yr 9	--	100,000	313,388	453,339
Total		**31,402,013**	**4,141,751**	**3,605,160**	**2,533,496**

The updated quantities, schedule and distribution of mine waste materials will be reflected in the 2020 version of the MWMP.

3.2 MINE WASTE PROPERTIES AND CHARACTERISTICS

3.2.1 Overburden Geotechnical Properties

Numerous site investigation programs have been conducted at Meliadine since 1998, with a total of twenty (20) geotechnical boreholes and test pits having been drilled/excavated around the proposed footprint of Tiri_002, which will be the source of the overburden placed in WRSF3.

In general, the overburden consists of a thin layer of organic material overlying sandy gravel or gravelly sand overlying silty sand or sandy silt till and boulders. Natural moisture contents of the material range from 2.9% to 11.7% and it is non-plastic in nature (Golder, 2010). The overburden materials are assumed to have a specific gravity of 2.70 and an in-place density of 1.62 t/m3 after being placed. The porewater salinity is assumed to be 7 ppt.

3.2.2 Waste Rock Geotechnical Characteristics

The majority of the waste rock is greywacke from the Sam formation and upper oxide formation, and mafic rock from the Wesmeg formation. The waste rock types were generally classified as medium to very strong with uniaxial compressive strength of 92 to 212 MPa (Golder, 2013c). Waste rock from underground sources is typically classified as a 600 mm minus material, with the rock from the open pits expected to be of a larger particle size (1000 mm minus).

The waste rock materials are assumed to have a specific gravity of 2.82 and an in-place density of 1.88 t/m3 after being placed in waste rock piles. These in-place density values are considered to be on the conservative (lower) side for waste rock and overburden management. The actual densities could be higher; therefore, less storage capacity may be required than planned.

3.2.3 Geochemical Characteristics

A series of waste geochemical characterization programs were carried out between 1998 and 2011, with the principle findings presented in Golder 2014. Testing the acid rock drainage and metal leaching potential included mineralogical and chemical composition testing, acid base accounting (ABA), shake flask extraction (SFE), humidity cell tests (HCTs), large column tests and field cell tests. Results of the geochemical characterization indicate that both the overburden and waste rock from the Tiriganiaq deposit is considered non-potentially acid generating (NPAG) and have low potential for metal leaching (ML).

3.3 LOCATION AND SURFACE CONDITIONS

WRSF3 will be located to the southeast of CP1 and to the northeast of future open pit Tiri_002. Figure 1 shown below provides the proposed footprint of WRSF3 in relation to other site infrastructure, including the water management facilities and haulage roads. Haulage distances from Tiri_002 to WRSF3 range from 208 m to 700 m, while the distance from Tiri_001 ranges from 950 m to about 1440 m.

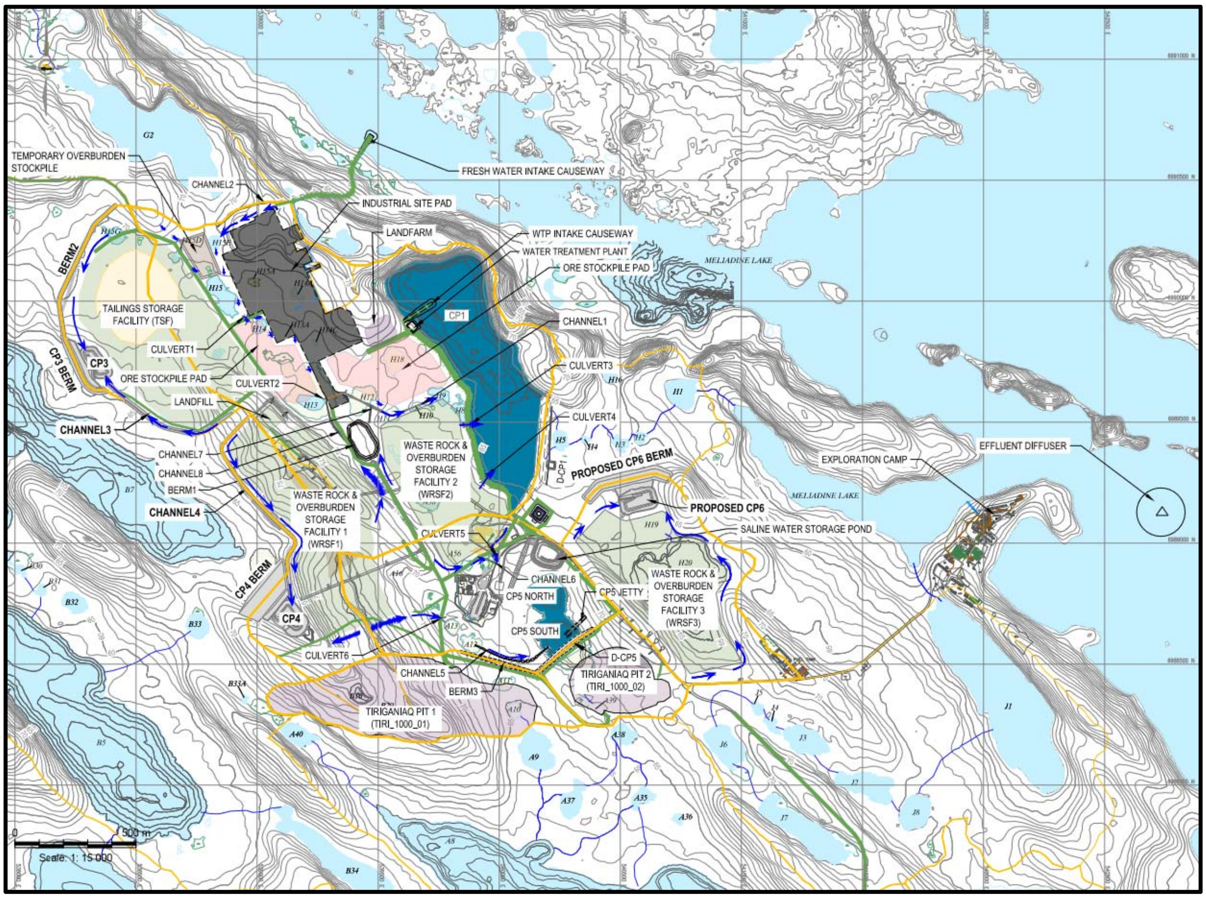

Figure 1: Meliadine General Arrangement (*Tetra Tech, 2020a*)

The footprint of WRSF3 will fall entirely within the southern end of Watershed H and will completely cover the former Lake H20 and partially envelop the former Lake H19. The two former lakes lie between a series of esker outcrops, with the natural drainage path flowing from H20 to H19 to H2 and into Meliadine Lake. Lake H20 had a surface area of 9.58 ha and a maximum depth of 1.6 m, while Lake H19 had a surface area of 2.91 ha and maximum depth of 1.4 m. Closed talik conditions were found below the lakebed sediments of both former lakes and partial dewatering of both lakes occurred prior to freezing in the fall of 2019. Outside of the lake beds, vegetation in the area consists of moss/peat cover. Steep slopes (approximately 8%) lie along the western boundary.

3.4 SUBSURFACE GEOTECHNICAL CONDITIONS

A total of twenty-six (26) boreholes have been drilled within (8 boreholes) or near (18 boreholes) the proposed WRSF3 footprint, with the location of these boreholes shown below on Figure 2.

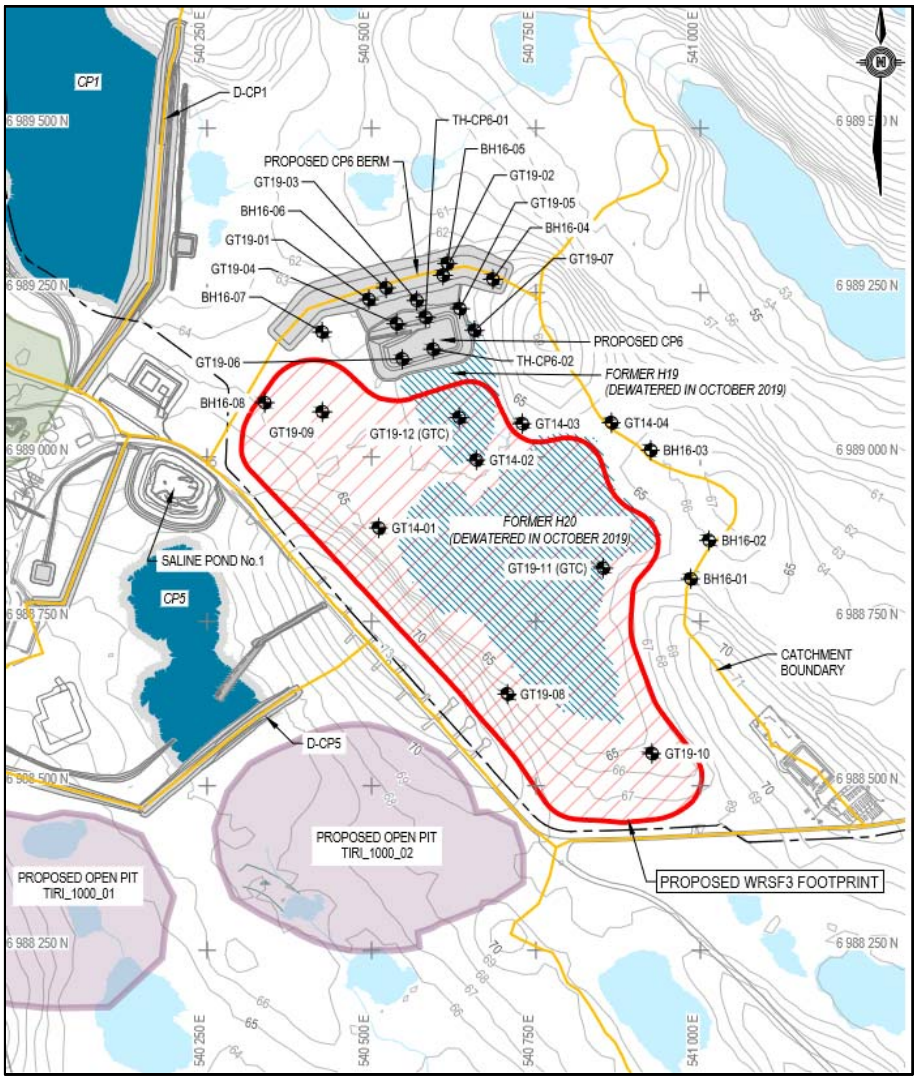

Figure 2: Proposed WRSF3 Footprint with Borehole Locations (*Tetra Tech, 2020a*)

In general, the subsurface of WRSF3 consists of a thin layer of organic material overlying sand or silty sand or sand and silt and gravel, ice-rich sandy silt or silty sand, gravelly sand and silt and greywacke bedrock. Excess ice was observed in most of the boreholes and ice lenses and sand/silt (ground ice) layers (0.1 m to 1.3 m thick) were encountered in more than half of the boreholes drilled on land away from the former lakes H19 and H20. Within the WRSF3 footprint, the depth to bedrock ranges from 2.3 m on the western side of the WRSF to 4.5 m near the northern boundary.

Table 3 summarizes the key geotechnical information of the overburden soils within the WRSF3 footprint, while the summary of all geotechnical borehole information can be located in Appendix B.

Table 3: Summary of Geotechnical Information from Overburden Soils in WRSF3 Footprint

Borehole No.	Organic Layer Thickness (m)	Overburden Soil Description	Ice Conditions	Bedrock Depth (m)
GT14-01	0.10	Sand; sand and silt; silty sand; ice and silt	0.2 m ice and silt	2.25
GT14-02	0.60	Silty sand, sandy silt	Up to 20% Vx, Vr	3.85
BH16-08	0.10	Sand; ice and sand; ice and silt; silty sand; gravel and sand	Up to 10% Vc, Vs; 0.15 m ice and sand; 0.75 m ice and silt	4.30
GT19-08	0.45	Sand; silty sand; sand and ice; silty sand	1.3 m sand and ice (up to 60% Vu, Vs; 40% Vx; 1 mm to 2 mm thick ice formations)	3.40
GT19-09	0.45	Silty sand; sand; ice; sand	0.2 m ice; Up to 35% Vx, Vc	3.10
GT19-10	0.50	Silty sand; cobbles; sand	Up to 10% Vr; Up to 5% Vs (1 mm thick); Nbn	3.35
GT19-11	0.35	Boulder; gravelly sand	Nbn in organic layer	3.35
GT19-12	0.00	Cobble; sand; sandy silt; boulders	Nbn in top 2 m soils; thawed/unfrozen in remaining overburden soils	4.5

3.5 ADDITIONAL KEY DESIGN CONSIDERATIONS

In addition to the expected waste rock production schedule, quantities and characteristics, a number of other factors were reflected in the detailed design of the WRSF. Additional key considerations include:

- **Site climate conditions**: The geographic location of the site was maximized to promote the mine waste freezing process, freeze-back of the underlying foundation soils and encourage permafrost development in the facility;
- **Environmental obligations**: Avoidance of impacts on fish-bearing habitat by maintaining a suitable buffer distance from protected natural lakes and minimizing the overall footprint;
- **Water management**: Facilitate the collection and management of contact water from the WRSF during operations to avoid potentially negative impacts on the outside environment;
- **Geotechnical issues**: Maintain the short and long term stability of the facility;
- **Constructability/Operational concerns**: Minimize haulage wherever feasible and reduce pre-production construction; maintain minimum safe distances from the toe of the WRSF and haul roads and the open pits.

4 DESIGN OF WRSF3

4.1 DESIGN CONCEPT AND PARAMETERS

To address the numerous considerations presented in the design basis for WRSF3, both overburden and waste rock materials will be co-disposed within the same facility. Geochemically, both the overburden and waste rock are similar in that neither material requires a means to prevent oxidation. The overburden will be encapsulated within the waste rock in order to increase the overall stability of the facility. Table 4 presents the key parameters adopted for the detailed WRSF3 design, while the issued for construction (IFC) drawings, including typical cross section, are provided in Appendix A.

Table 4: Key Design Parameters for WRSF3

Design Parameter	Value
Maximum height of each overburden and waste rock bench (m)	5.0
Minimum number of benches	7
Average overall overburden side slopes	Angle of repose (bench-scale only approximately 1.8H: 1V)
Average overall waste rock side slopes	3H: 1V
Maximum height (elevation) above original ground of facility (m) (masl)	35.0 (97.0)
Minimum internal overburden setback distance from toe of WRSF (m)	70.8
Typical width of horizontal offset between waste rock benches (m)	14.5
Assumed waste rock in place bulk density (t/m^3)	1.88
Assumed overburden in place bulk density (t/m^3)	1.62

Based on the above design criteria, WRSF3 provides for a total of 4.73 Mm^3 of capacity: 0.34 Mm^3 of overburden and 4.38 Mm^3 of waste rock.

4.1.1 Refinements Since 2019 Mine Waste Management Plan

The total available capacity of WRSF3 has slightly decreased since the 2019 MWMP (4.7 Mm^3 versus 5.0 Mm^3), due to geometric differences in the detailed waste pile design as a result of the updated thermal and stability analysis.

Due to the future expansion work planned at Meliadine (in which the full permitting process will be followed) beginning in early 2024, storage of any excess waste rock will be accounted for within the expansion infrastructure. In parallel, Agnico Eagle will utilize an adoptive, performance-based management system of the WRSFs and opportunities to increase the capacity of WRSF3 may present themselves dependent on both the mining sequence and the on-going analysis of the temperatures of the foundation soils. Section 6.0 of this report will discuss these opportunities in greater detail.

4.2 SLOPE STABILITY ANALYSIS

Limit equilibrium analyses were conducted to calculate the deterministic factor of safety (FoS) against slope failure under both static and pseudo-static (seismic) conditions. Two design cross sections of WRSF3 were evaluated under short and long term construction and closure situations assuming various conditions.

The stability acceptance criteria adopted for this analysis is from Hawley and Cunning (2017) and based on the failure consequence and confidence level in foundation conditions, waste material properties, piezometric pressures, overall fill slope angles, height of repose angle slopes and expected precipitation.

Based on the classifications and site conditions, the minimum FoS adopted for the WRSF3 stability design and the minimum calculated FoS for the various failure mechanisms are presented in Table 5.

Table 5: Summary of Slope Stability Analysis Results

Conditions	Required Minimum FoS	Calculated FoS	Comment
Short-term (construction), static, deep-seated slip surface	1.25	1.25	Unfrozen, unsaturated waste material; warm, ice-rich sand/silt in foundation soils; failure through overburden/rock below 92.0 m elev.
Long-term (closure), static, deep-seated slip surface	1.25	1.27	Unfrozen, unsaturated waste material; warm, ice-rich sand/silt in foundation soils; assumes Berm CP6 breached
Long-term (closure), seismic, deep-seated slip surface	1.05	1.21	Unfrozen, unsaturated waste material; warm, ice-rich sand/silt in foundation soils; assumes Berm CP6 breached; addition of appropriate horizontal peak ground acceleration
Shallow, static surficial slip surface	1.10	1.18	Shallow, surficial slips along waste rock side slopes

The results indicate that the calculated FoS for WRSF3 meet or exceed industry and AEM requirements for all loading scenarios given the assumed waste material and ground conditions. The stability analyses did not consider the freeze back that is expected to occur in the waste material and the related accompanying increase in strength parameters.

The stability and design of WRSF3 are strongly influenced by the assumed strength parameters of the ice-rich sand/silt in the foundation soils which are in turn, strongly dependent on the temperatures of these soils. Consideration of this layer of material is discussed further in the thermal analysis (Section 4.3), overall deposition plan (Section 6.0) and monitoring (Section 8.0) portions of this report.

4.3 THERMAL ANALYSIS

Thermal analysis was conducted to estimate the thermal conditions of the overburden, waste rock and the foundation soils during mine operations and closure. This analysis has been updated since the 2014 feasibility to account for the detailed WRSF design and expected volumes, as well as the latest climate change predictions, and was used to support the stability analysis discussed above.

Given the placement schedule provided in Section 6.0 and assumed initial waste and foundation soil temperatures, a summary of the thermal analysis is as follows:

- An active layer approximately 4 m in depth below the surface of the WRSF will form. Below this active layer, waste rock and overburden initially placed in an unfrozen state will freeze-back within several years after initial placement.
- The predicted temperatures of the placed waste materials below the active layer in WRSF3 range from -0.5°C to -2.5°C within 100 years of assumed climate change conditions after initial mine closure.
- The majority of the foundation of WRSF3 is occupied by the former lakebeds of H19 and H20. Although partial dewatering of these lakes occurred in October 2019, closed talik conditions and “warm” permafrost is anticipated to underlie the facility, with long-term (by 2126) ground

temperatures in the ice-rich sand/silt foundation soils predicted to range between -0.3°C and -0.9°C.

The initial thermal assumptions regarding temperatures underlying the lakebeds are expected to be conservative and will require on-going verification and refinement as temperature monitoring and as-built data becomes available, particularly prior to placement of waste materials at the 77.0 m bench. The opportunities to modify the current design and increase capacity of the WRSF are discussed further in Section 6.0.

4.4 CREEP AND LONG-TERM DEFORMATION

Frozen soils and ice act as visco-elastic materials under loading and exhibit time dependent deformation (creep). As noted in Section 3.4, the foundation soils underlying WRSF3 tend to be ice-rich, with excess or visible ice observed in most of the boreholes where recovery was possible. Similar foundation conditions are observed under the tailings storage facility (TSF), located just to the northwest of WRSF. Analysis was conducted to evaluate the potential long-term deformation behaviors of the TSF (Tetra Tech EBA, 2014), with this analysis adjusted for WRSF3 design parameters and anticipated ground temperatures in 2020. The results of this updated creep analysis are summarized as follows:

- Maximum horizontal displacements of 0.01 m to 0.06 m per year are expected to occur at the middle of the WRSF side slopes; and
- Maximum vertical displacements of 0.005 m to 0.03 m per year are expected on the crest of the WRSF side slopes.

The above expected deformations assume ductile deformation of a continuous ice-rich silt layer in a primary or secondary creep state. Although the underlying assumptions in this analysis are expected to be conservative, it is observed that the WRSF can tolerate the predicted maximum deformations.

5 CONSTRUCTION METHODS AND PROCEDURES

5.1 PRE-CONSTRUCTION

Pre-construction activities at WRSF3 prior to waste placement will consist of removal of residual ice from the former Lake H19 and H20 lake beds. No other surface preparation is required as the design assumes waste material will be placed directly over original ground.

A topographical survey of the original ground will be completed after ice removal and prior to waste placement.

5.2 OPERATIONAL CONSTRUCTION

The general construction sequence of WRSF3 during operations will be as follows:

- Excess snow/ice will be pushed out of the dumping area with the bulldozer during winter placement.
- Conduct a topographical survey of the original ground surface and place stakes marking the limits of overburden and waste rock.
- Overburden from Tiri_002 will be hauled and end-dumped to its designated location. The material will be spread after dumping into controlled lifts with a CAT D8 bulldozer. This material will be track-packed only. The side slopes of each lift will be to the natural angle of repose (approximately 1.8H:1V).

- Waste rock from Tiri_001 and Tiri_002 will be hauled and end-dumped to its designated location. The material will be placed and pushed around the perimeter of the overburden as cover material. This material will be track-packed only. The side slopes of each bench of waste rock will be to the natural angle of repose (approximately 1.2H:1V).

Further details regarding the overall deposition plan are provided in Section 6.0.

5.3 QUALITY CONTROL

A quality control plan will be developed and included as part of the Operation, Maintenance and Surveillance (OMS) plan for the WRSFs. This plan is expected to include on-going verification of design assumptions and parameters, including monitoring of ground/waste temperatures and on-going ARD/ML testing.

6 OVERALL WASTE DEPOSITION PLAN

The overall deposition plan considers the requirement to promote freeze-back of the waste material and the underlying original ground, as well as minimize haulage distances. The general schedule of deposition per lift (elevation), as well as the expected volumes of the placed material is summarized in Table 6. It should be noted however, that due to planned future expansion work at Meliadine beginning in early 2024, the overall waste rock management schedule is expected to change at this time as new infrastructures and construction activities to support the expansion will be required.

Table 6: Waste Placement Schedule for WRSF3

Waste Type	Top Bench Elevation (m)	Approx. Period of Waste Placement	Volume of Waste Placed (m3)
Overburden	67.0	April to May 2020	342,647
Waste Rock	67.0	May to July 2020	303,162
Waste Rock	72.0	July 2020 to December 2020	1,134,251
Overburden/Waste Rock	77.0	May to October 2023; January 2024	1,053,770
Waste Rock	82.0	June to August 2024	673,508
Waste Rock	87.0	September to December 2024	542,903
Waste Rock	92.0	June to August 2025	410,304
Waste Rock	97.0	September to December 2025	265,623

As indicated previously, the stability of the current design of WRSF3 is being driven by the assumption of “warm” permafrost underlying the facility in the lakebeds of the former lakes H19 and H20. Although dewatering of these lakes began in the fall of 2019 in order to aggrade the permafrost and enhance the freezing of the closed taliks beneath the lakes, the dewatering campaign was only partially successful and the beginning of waste deposition in the area has been advanced forward by several years, leaving little time for cooling to occur.

Therefore, to further promote freeze-back and permafrost development in the waste material and original ground surface, the following placement strategies will be adopted:

- Removal of residual ice/snow from the former H19 and H20 footprints prior to placement of waste.

- Reduced overburden lifts. Where possible, overburden bench 67.0 m will be placed in maximum lift heights of 2.5 m. The reduced lift thickness of this overburden bench is expected to provide better consolidation of the material at the base, increase stability and reduce thermal losses.

- Timing of overburden placement. As shown in Table 6, overburden placement will be optimized in order to ensure below freezing conditions are maintained in the original ground.

- Replacement of overburden in bench 77.0 m with waste rock, which is expected to have a cooling effect on the center of the facility. WRSF3-VGTC-01 (discussed in Section 8.0) will be installed as soon as placement of bench 77.0 m has been completed.

Thermal monitoring will occur in the natural ground and at the base of the facility to verify the assumptions made during the design process as described in Section 8.0. It is expected that prior to placement of bench 82.0 m, these assumptions will be revisited, with the intent of decreasing the bench width to the typical 14.5 m and thereby increasing the capacity of the facility.

7 WATER MANAGEMENT

The water management system of WRSF3 consists of a collection pond and thermal berm designed to collect any seepage and runoff from the waste rock facility. No additional water management structures (such as diversion channels) are anticipated to be required in the area due to the natural topography which directs flow towards the collection pond. Design and drawings of the water management infrastructures related to the WRSF have been submitted for approval to the Nunavut Water Board.

As indicated previously, one catchment system is impacted by WRSF3, with the management strategy for the watershed summarized as follows:

1. CP1 Catchment. Seepage and runoff from the waste rock facility will be collected in Collection Pond 6 (CP6) and pumped into CP1 for treatment prior to discharge into Meliadine Lake.

All water management infrastructure will remain in place until mine closure activities are complete and monitoring results demonstrate that the contact water quality from the WRSF meets the discharge criteria. Further details on water management for the WRSFs are provided in the *Water Management Plan* (Agnico Eagle, 2019b).

8 MONITORING AND INSPECTION

Performance monitoring is an integral part of the operation of any structure in an arctic environment. Geotechnical instrumentation is required to monitor the behavior of the placed waste materials and the underlying foundation during operation. The instrumentation is intended to provide the following information:

- Confirmation that the performance of the foundation soils and placed waste materials are consistent with the predictions made during the design studies, notably in terms of stability, deformation, seepage, and thermal analyses.

- Early warning of the development of potentially adverse trends such as seepage, deformation, and permafrost degradation.

The instrumentation plan for WRSF3 therefore includes a minimum of five (5) ground temperature cables (GTCs) as shown on Drawings 65-686-230-209-001 and -002. Two (2) of these cables will be both horizontal and vertical, installed approximately 10 m into original ground near the centre of the WRSF and then placed horizontally over original ground to the toes of the pile. The remaining three (3) GTCs will be installed vertically after completion of the corresponding benches to a minimum depth below the original ground. Additional vertical and horizontal ground temperature cables may be installed if required after review of monitoring data and operational performance. Thermistor readings will be measured once a month during the first year, and then on a quarterly basis during operation, with the measured readings analyzed and reported in the annual inspection report.

Visual inspection and monitoring can provide early warning of many conditions that can contribute to structure failures and incidents. Agnico Eagle will undertake daily visual inspections of WRSF3 during active development and monthly inspections when placement activity ceases on an interim/seasonal basis. Once construction of WRSF3 has been completed, visual inspection will continue on a semi-annual basis until closure. Records of all inspections will be maintained, and any potential hazards/risks will be identified, including deformations, seepage, slumping or any other signs of instability.

An annual inspection, in accordance with Part I, items 14 and 15 of Water Licence-2AM-MEL1631 will be conducted by a qualified Geotechnical Engineer to document the performance of the facility. The reports will be submitted to the Nunavut Water Board as per the water license requirements.

Further details regarding the monitoring and inspection plan for the WRSF can be located in the 2019 MWMP (Agnico Eagle, 2019a).

REFERENCES

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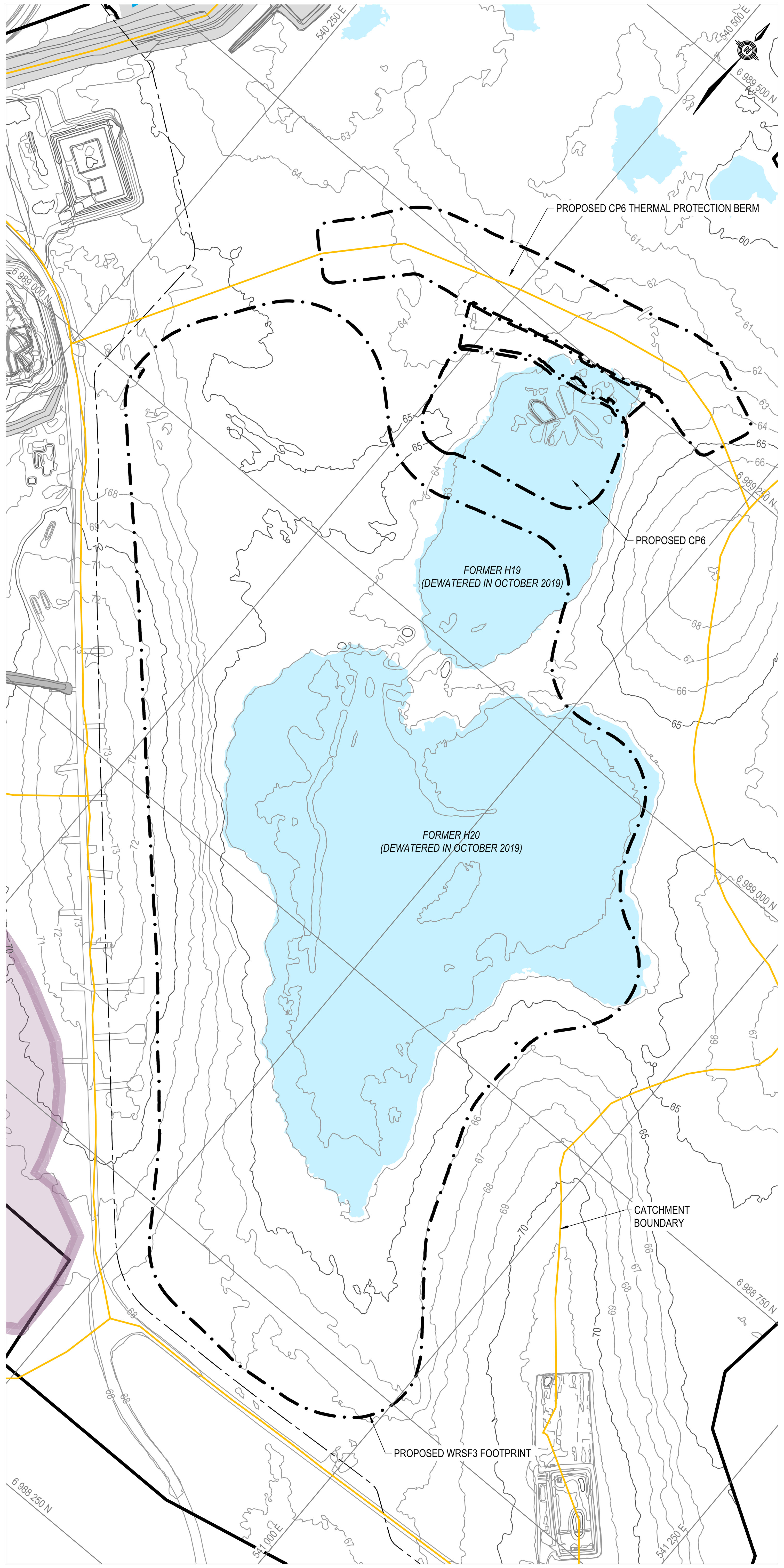
Tetra Tech, 2020a. Stability Analysis for Waste Rock Storage Facility No3 (WRSF3), Meliadine Gold Mine, Nunavut. A Technical Memorandum submitted to Agnico Eagle Mines Ltd. by Tetra Tech February 14, 2020.

Tetra Tech, 2020b. Thermal Analysis for Waste Rock Storage Facility No3, Meliadine Gold Mine, Nunavut. A Technical Memorandum submitted to Agnico Eagle Mines Ltd. By Tetra Tech, February 14, 2020.

Appendix A

NO. DESSIN DRAWING NO. 65–686–230–205

FORMAT ARCHD



PLAN VIEW SHOWING CURRENT CONDITION

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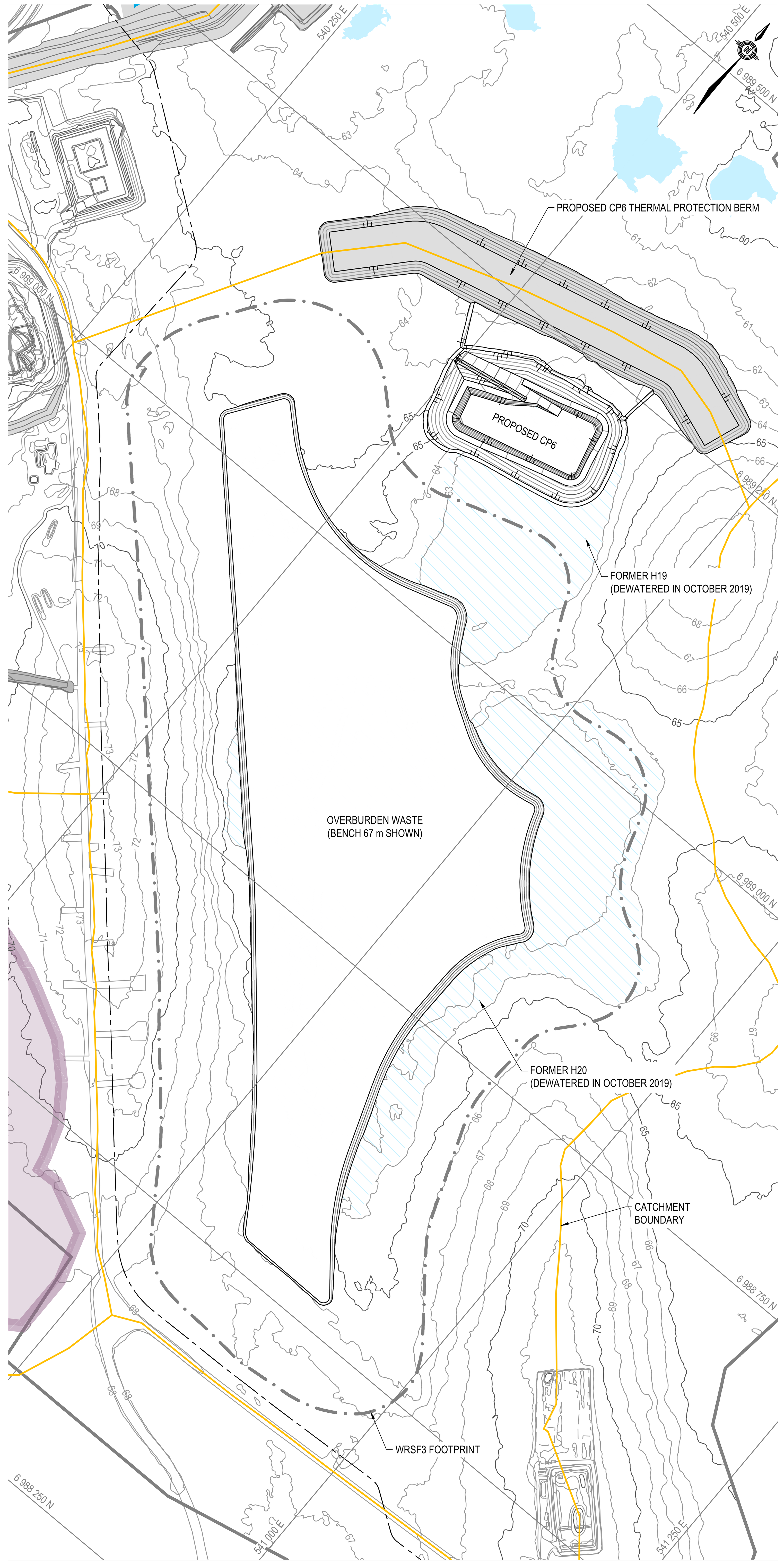

PLAN VIEW SHOWING INTERNAL DESIGN GEOMETRY OF OVERBURDEN WASTE IN WRSF3

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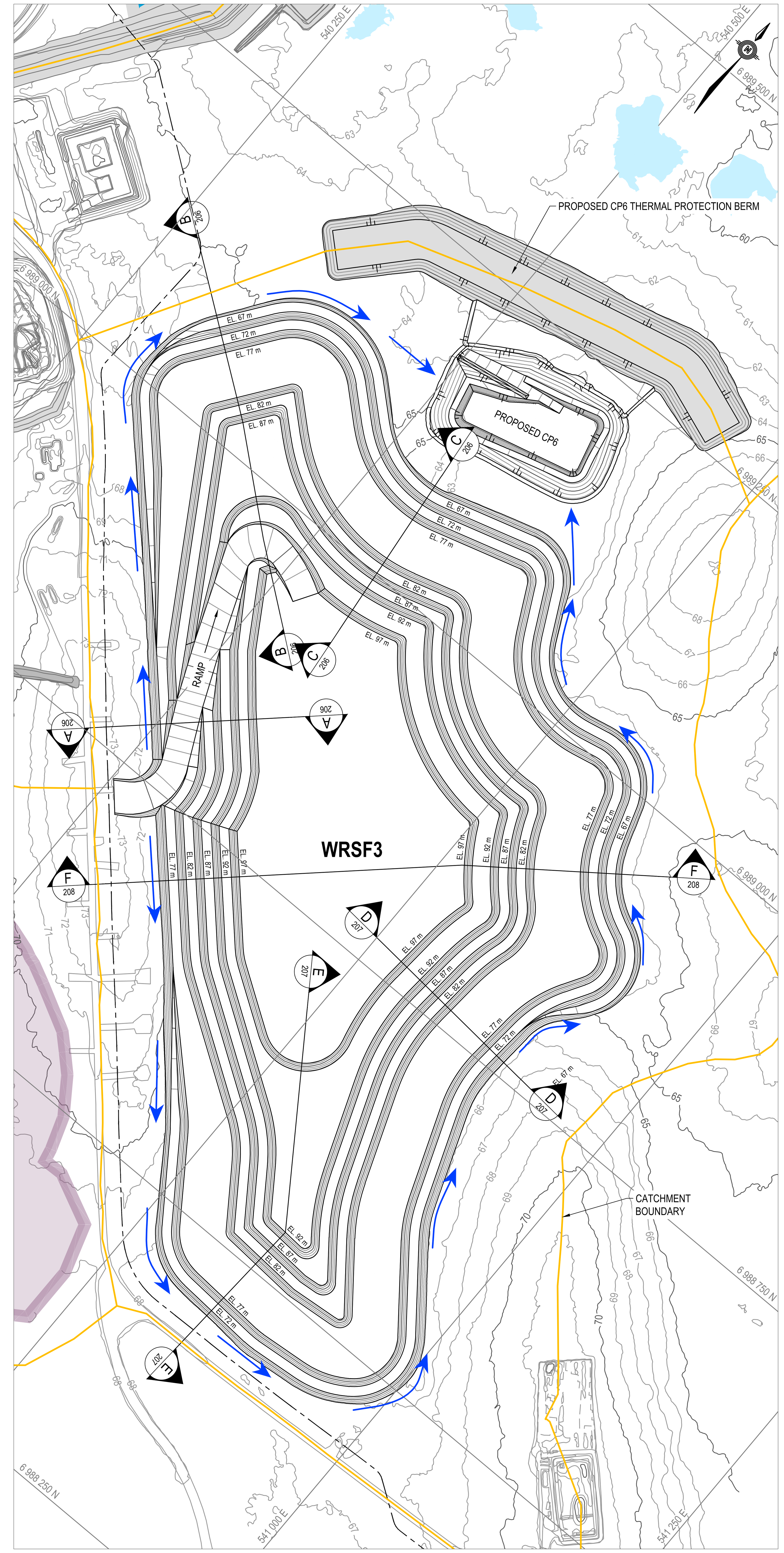

PLAN VIEW SHOWING DESIGN GEOMETRY OF WASTE ROCK OUTSIDE SHELL FOR WRSF3

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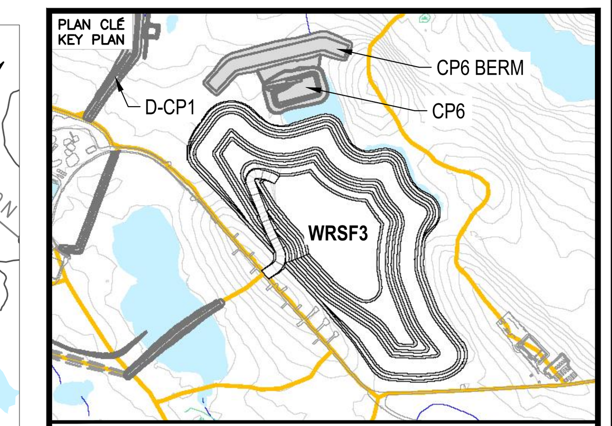
PLAN CLÉ KEY PLAN



TETRA TECH

NOTES GÉNÉRALES / GENERAL NOTES

1. THE WRSF3 DESIGN PRESENTED HEREIN HAS BEEN BASED ON THE WASTE ROCK AND OVERBURDEN PRODUCTION PLAN THAT WAS PROVIDED ON JANUARY 29 AND FEBRUARY 3, 2020 AND THE CORRESPONDING PRELIMINARY WASTE ROCK AND OVERBURDEN PLACEMENT PLAN THAT WAS DEVELOPED FOR THE DESIGN OF WRSF3. THIS WRSF3 DESIGN SHOULD BE REVIEWED OR UPDATED (IF REQUIRED) IF THE FINAL WASTE ROCK AND OVERBURDEN PLACEMENT PLAN FOR WRSF3, ESPECIALLY THE PLACEMENT PLAN FOR THE INITIAL BENCHES (67 M AND 72 M) OF THE WASTE ROCK AND OVERBURDEN, IS DIFFERENT FROM THAT USED IN THIS DESIGN.

DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

TITRE / TITLE	# DWG
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AGNICO EAGLE

REV.	DATE	DESCRIPTION	PAR/BY	APP.	CLIENT
0	2020–02–21	ISSUED FOR CONSTRUCTION	GZ	WTH	
A	2020–02–14	ISSUED FOR REVIEW	GZ	WTH	

REVISIONS

REGISTERED PROFESSIONAL ENGINEER G. ZHANG LICENSEE NWT/NU Feb. 21, 2020

PERMIT TO PRACTICE TETRA TECH CANADA INC.
Signature
Date Feb 21, 2020
PERMIT NUMBER: P 018
NT/NU Association of Professional Engineers and Geoscientists

TITRE / TITLE
AGNICO EAGLE MELIADINE GOLD PROJECT
WASTE ROCK STORAGE FACILITY No. 3

MELIADINE WRSF3 DETAILED DESIGN:
PLAN VIEW

DESSINÉ PAR DRAWN BY	EL	DATE	2020–02–21
VERIFIÉ PAR CHECKED BY	GZ		2020–02–21
APPROUVÉ PAR APPROVED BY	WTH		2020–02–21
ÉCHELLE SCALE	1:2000	DATE	2020–02–21
NO. DESSIN DRAWING NO.	65–686–230–205		
NO. PROJET PROJECT NO.	6515	REVISION 0	FEUILLE / SHT 1 / 6

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FILE NO. 65–686–230–205.dwg

NO. DESSIN / DRAWING NO. 65-686-230-206

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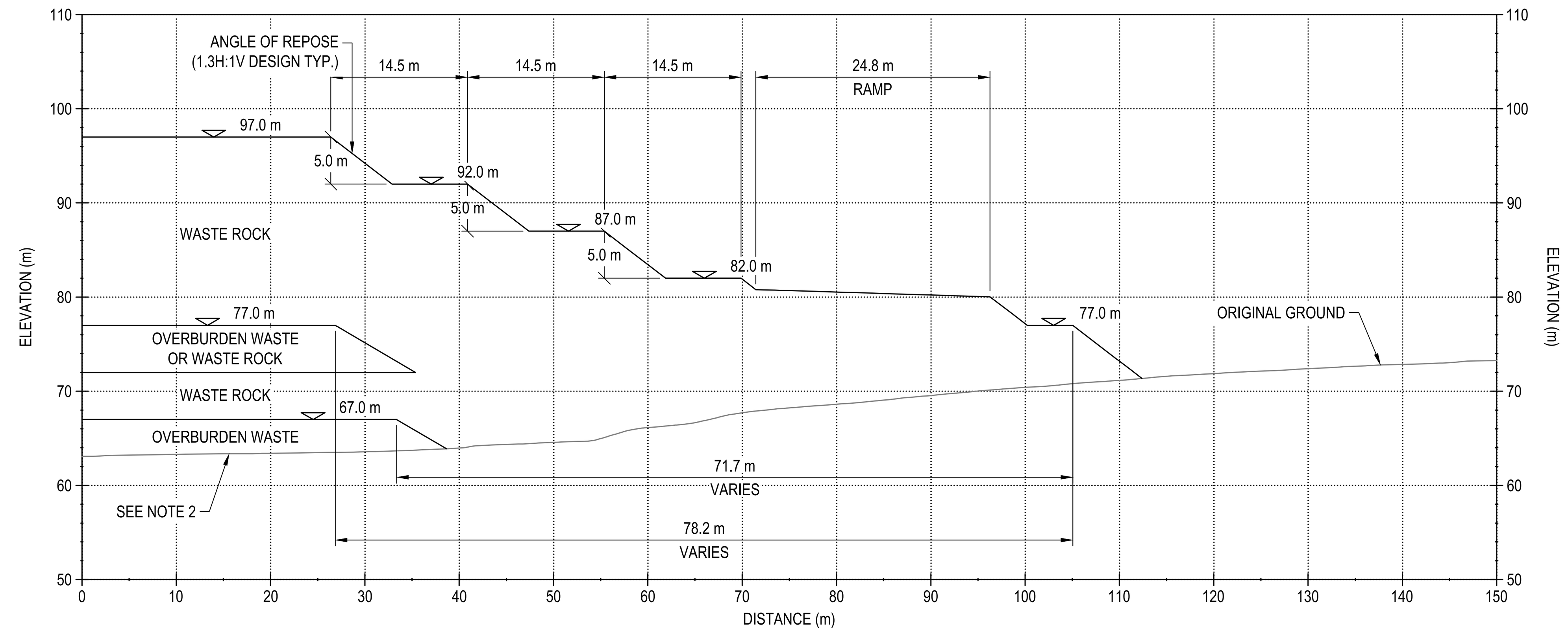

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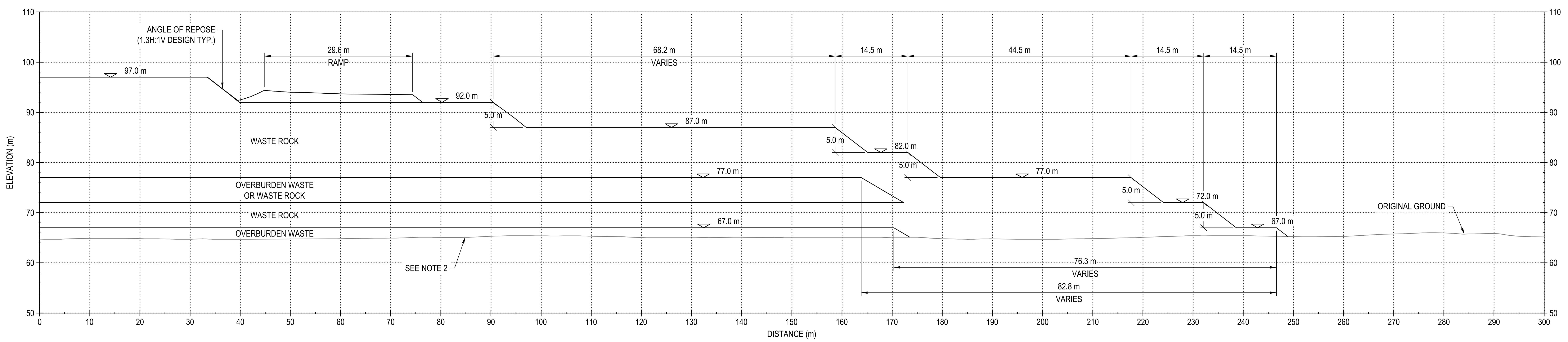

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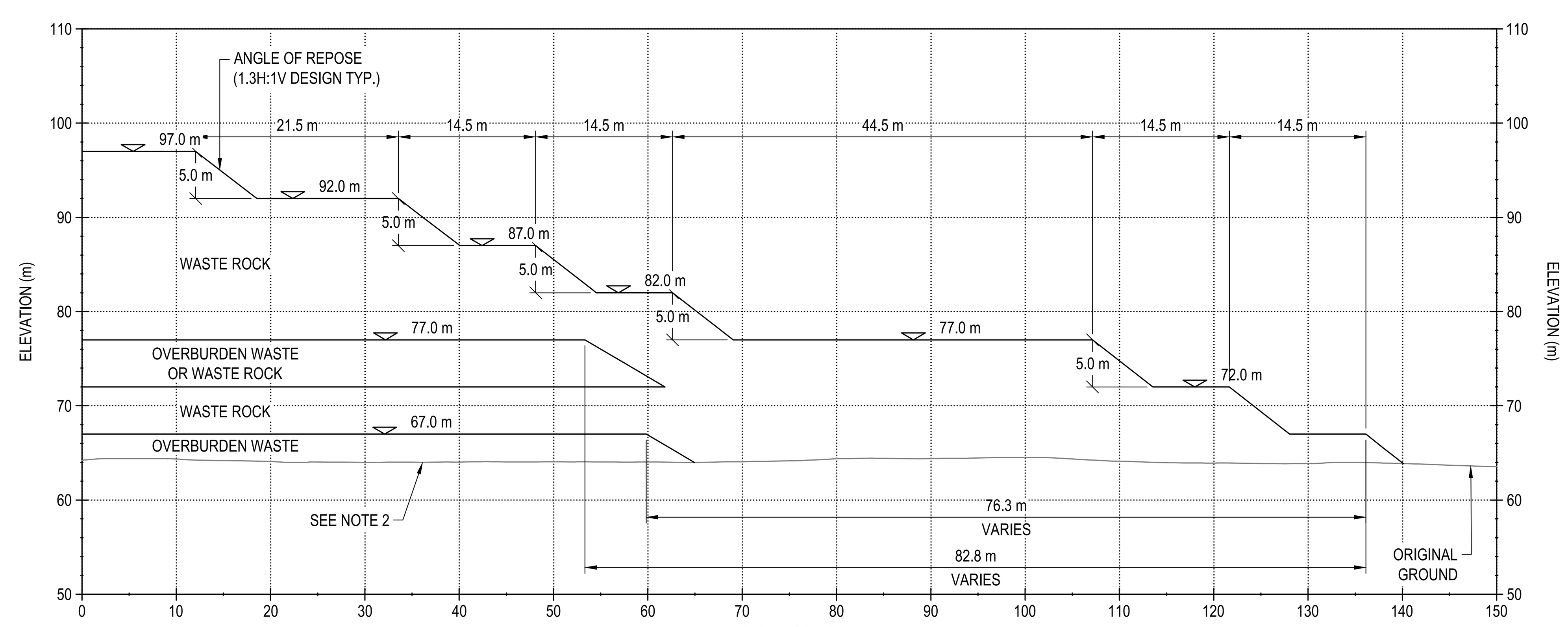

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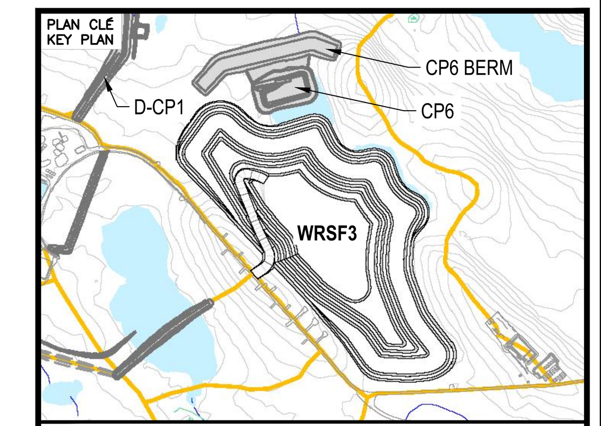

TETRA TECH

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2. THE FORMER LAKES H19 AND H20 WERE NOT COMPLETELY DEWATERED BEFORE THE REMAINING WATER FROZE LAST FALL. THEREFORE, THERE IS A LAYER OF SOLID/CLEAR ICE WITHIN THE FORMER H19 AND H20 AREAS. THIS LAKE ICE LAYER TOGETHER WITH ANY SNOW/ICE WITHIN THE WRSF3 FOOTPRINT SHOULD BE COMPLETELY REMOVED BEFORE PLACING THE WASTE ROCK AND OVERBURDEN IN WRSF3.
3. THE MAXIMUM LIFT THICKNESS DURING WASTE PLACEMENT SHOULD BE LIMITED TO 2.5 M FOR THE OVERBURDEN WASTE AND TO 5.0 M FOR THE WASTE ROCK.

DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

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AGNICO EAGLE

REV.	DATE	DESCRIPTION	PAR/BY	APP.	CLIENT
0	2020-02-21	ISSUED FOR CONSTRUCTION	GZ	WTH	
A	2020-02-14	ISSUED FOR REVIEW	GZ	WTH	

REVISIONS

REGISTERED PROFESSIONAL ENGINEER G. ZHANG LICENSEE NWT/NU Feb 21, 2020

PERMIT TO PRACTICE TETRA TECH CANADA INC.
Signature
Date Feb. 21, 2020
PERMIT NUMBER: P 018
NT/NU Association of Professional Engineers and Geoscientists

TITRE / TITLE
AGNICO EAGLE MELIADINE GOLD PROJECT
WASTE ROCK STORAGE FACILITY No. 3

MELIADINE WRSF3 DETAILED DESIGN:
SECTIONS A TO C

DESSINÉ PAR / DRAWN BY	EL	DATE	2020-02-21
VERIFIÉ PAR / CHECKED BY	GZ		2020-02-21
APPROUVÉ PAR / APPROVED BY	WTH		2020-02-21
ÉCHELLE / SCALE	1:2000	DATE	2020-02-21

NO. DESSIN / DRAWING NO. 65-686-230-206

NO. PROJET / PROJECT NO.	REVISION	FEUILLE / SHT
6515	0	2 / 6

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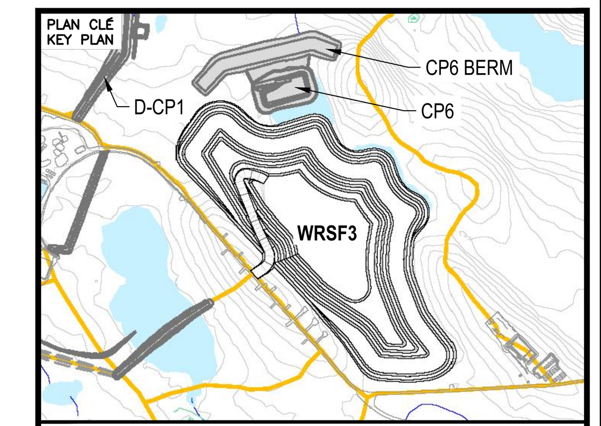

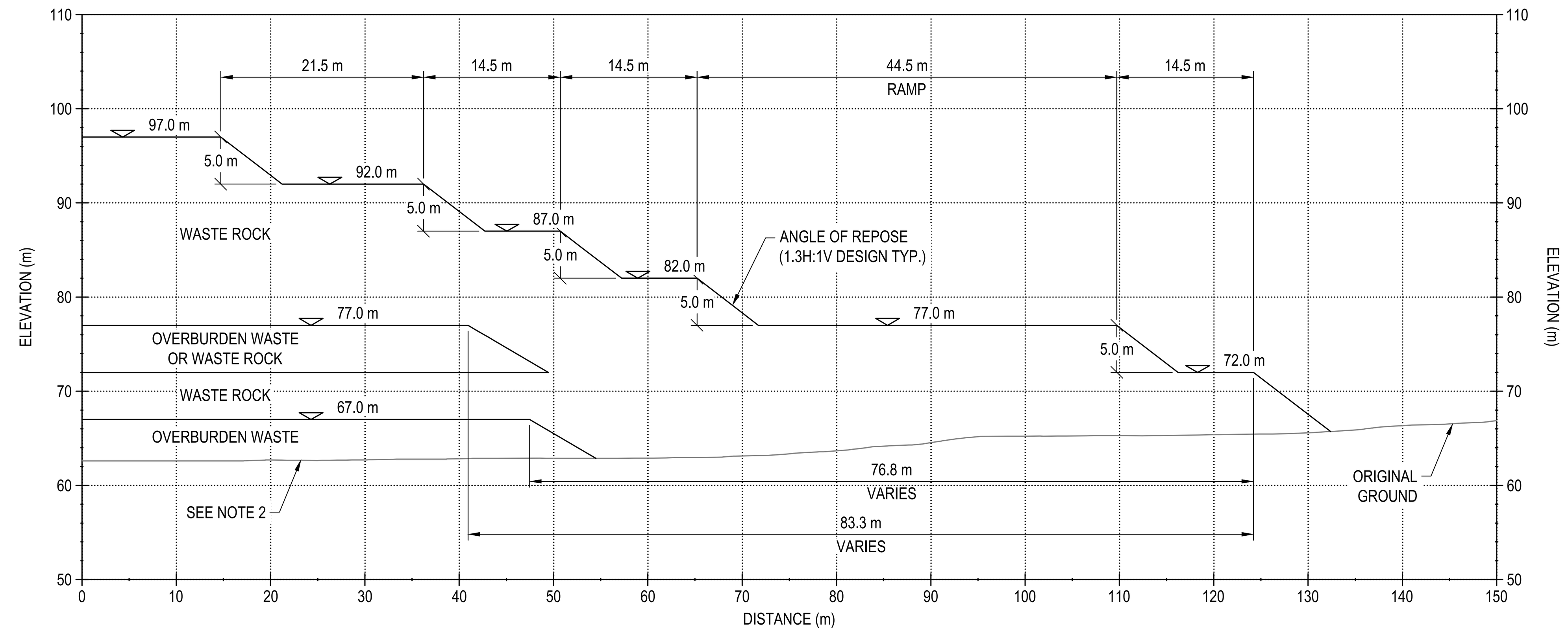

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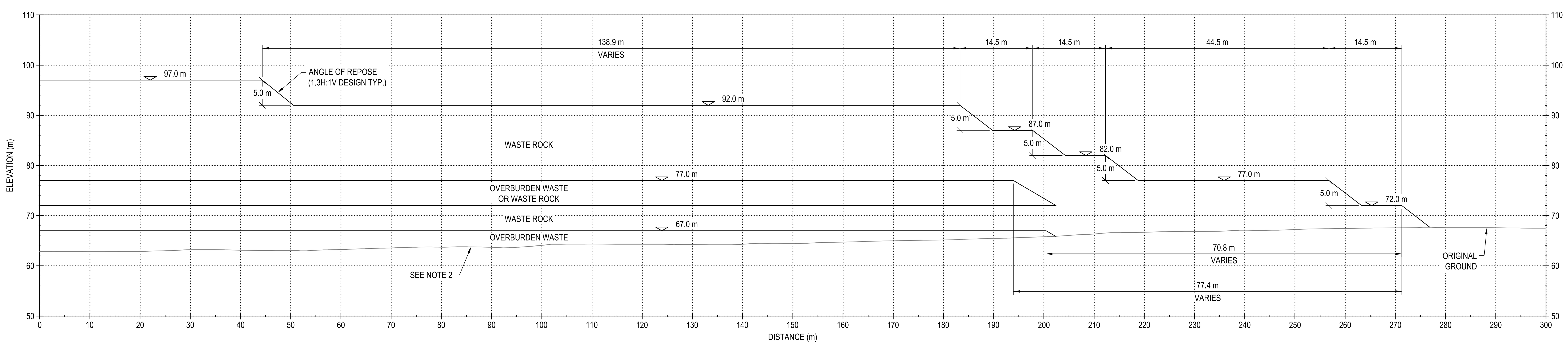

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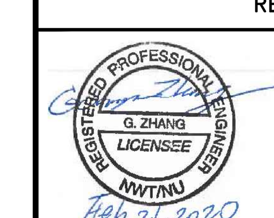

TETRA TECH

NOTES GÉNÉRALES / GENERAL NOTES

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3. THE MAXIMUM LIFT THICKNESS DURING WASTE PLACEMENT SHOULD BE LIMITED TO 2.5 M FOR THE OVERBURDEN WASTE AND TO 5.0 M FOR THE WASTE ROCK.

DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

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AGNICO EAGLE

REV.	DATE	DESCRIPTION	PAR/BY	APP.	CLIENT
0	2020-02-21	ISSUED FOR CONSTRUCTION	GZ	WTH	
A	2020-02-14	ISSUED FOR REVIEW	GZ	WTH	

REVISIONS

REGISTERED PROFESSIONAL ENGINEER G. ZHANG LICENSEE NWT/NU Feb 21, 2020

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Signature
Date Feb 21, 2020
PERMIT NUMBER: P 018
NT/NU Association of Professional Engineers and Geoscientists

TITRE / TITLE
AGNICO EAGLE MELIADINE GOLD PROJECT
WASTE ROCK STORAGE FACILITY No. 3

MELIADINE WRSF3 DETAILED DESIGN:
SECTIONS D AND E

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VÉRIFIÉ PAR CHECKED BY	GZ	2020-02-21
APPROUVÉ PAR APPROVED BY	WTH	2020-02-21
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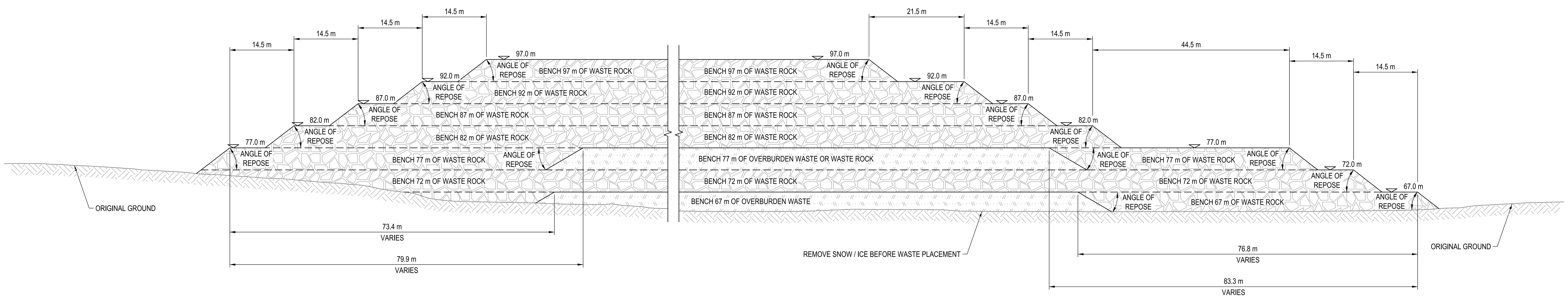

F / 205 TYPICAL SECTION WITHOUT ACCESS RAMP

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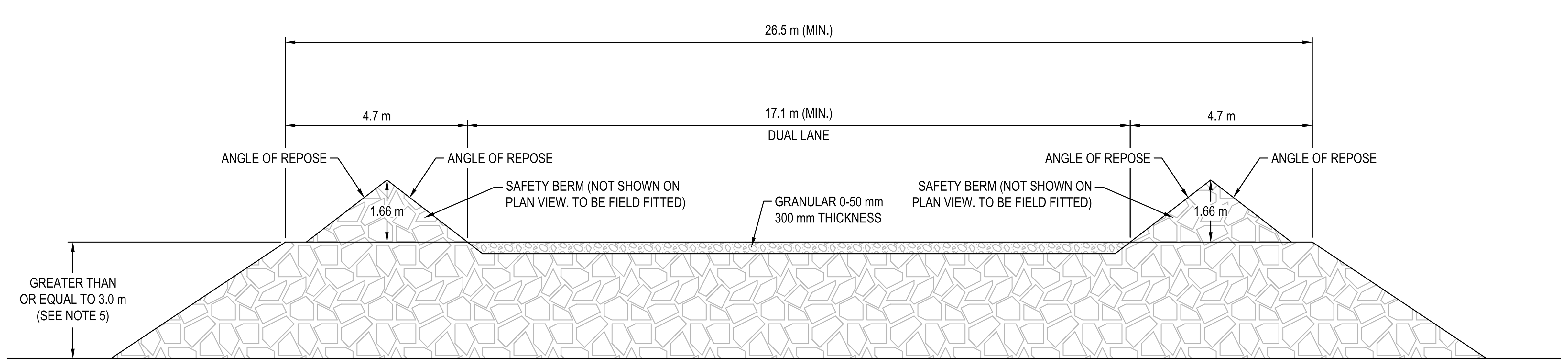
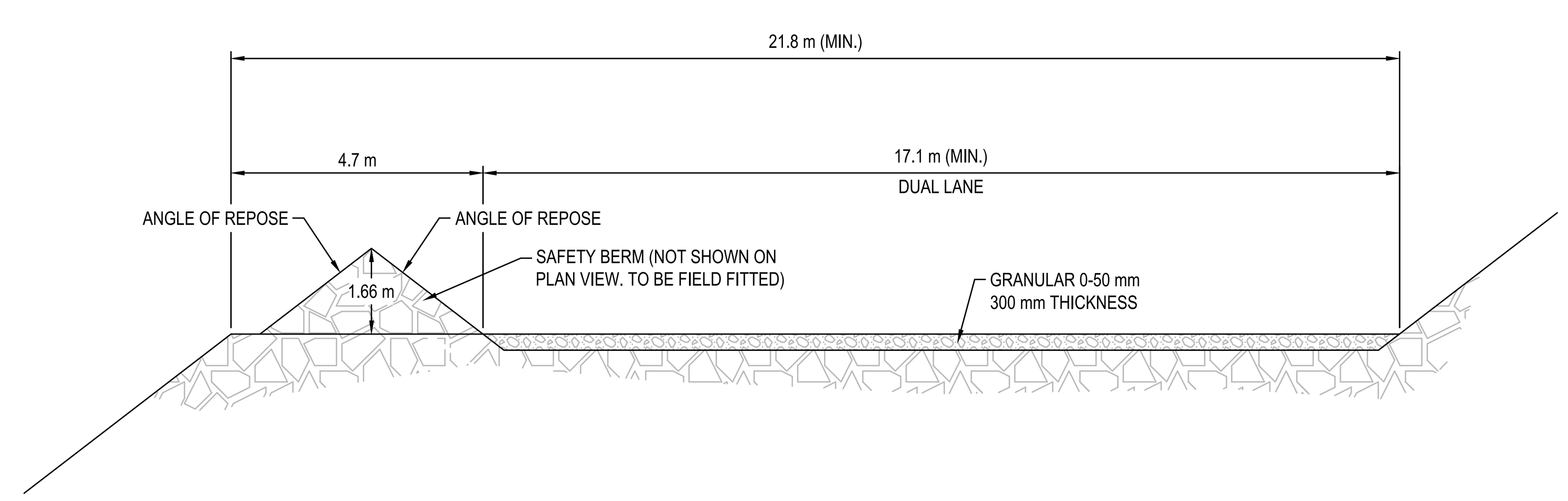


TYPICAL ACCESS RAMP FOR HAUL ROAD WITH TWO SIDE SAFETY BERMS

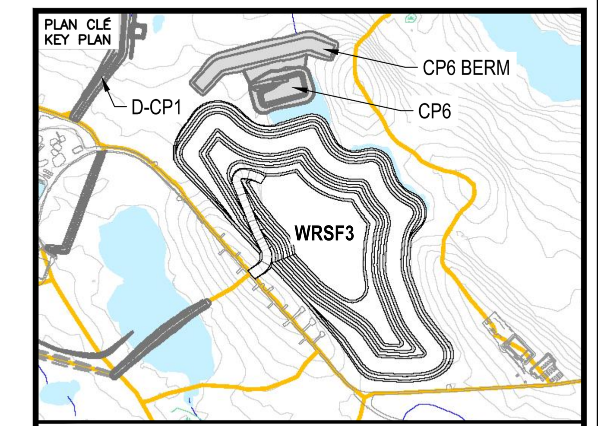
N.T.S.



TYPICAL ACCESS RAMP FOR HAUL ROAD WITH ONE SIDE SAFETY BERM

N.T.S.

PLAN CLÉ / KEY PLAN



TETRA TECH

NOTES GÉNÉRALES / GENERAL NOTES

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3. THE MAXIMUM LIFT THICKNESS DURING WASTE PLACEMENT SHOULD BE LIMITED TO 2.5 M FOR THE OVERBURDEN WASTE AND TO 5.0 M FOR THE WASTE ROCK.
4. ACCESS RAMP DESIGNED FOR HAUL TRUCK TYPE OF CAT 775G OR SMALL EQUIPMENT.
5. A SAFETY BERM ON THE SIDE OF A HAUL ROAD IS REQUIRED IF A DROP OFF GREATER THAN 3 M EXISTS.

DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

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AGNICO EAGLE

REV.	DATE	DESCRIPTION	PAR/BY	APP.	CLIENT
0	2020–02–21	ISSUED FOR CONSTRUCTION	GZ	WTH	
A	2020–02–14	ISSUED FOR REVIEW	GZ	WTH	

REVISIONS

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Signature
Date Feb 21, 2020
PERMIT NUMBER: P 018
NT/NU Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL ENGINEER — G. ZHANG — LICENSEE — NWT/NU — Feb 21, 2020

TITRE / TITLE
AGNICO EAGLE MELIADINE GOLD PROJECT
WASTE ROCK STORAGE FACILITY No. 3

MELIADINE WRSF3 DETAILED DESIGN:
TYPICAL SECTION AND ACCESS RAMP

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VÉRIFIÉ PAR / CHECKED BY	GZ		2020–02–21
APPROUVÉ PAR / APPROVED BY	WTH		2020–02–21
ÉCHELLE / SCALE	1:2000	DATE	2020–02–21

NO. DESSIN / DRAWING NO. 65–686–230–208

NO. PROJET / PROJECT NO.	REVISION	FEUILLE / SHT
6515	0	4 / 6

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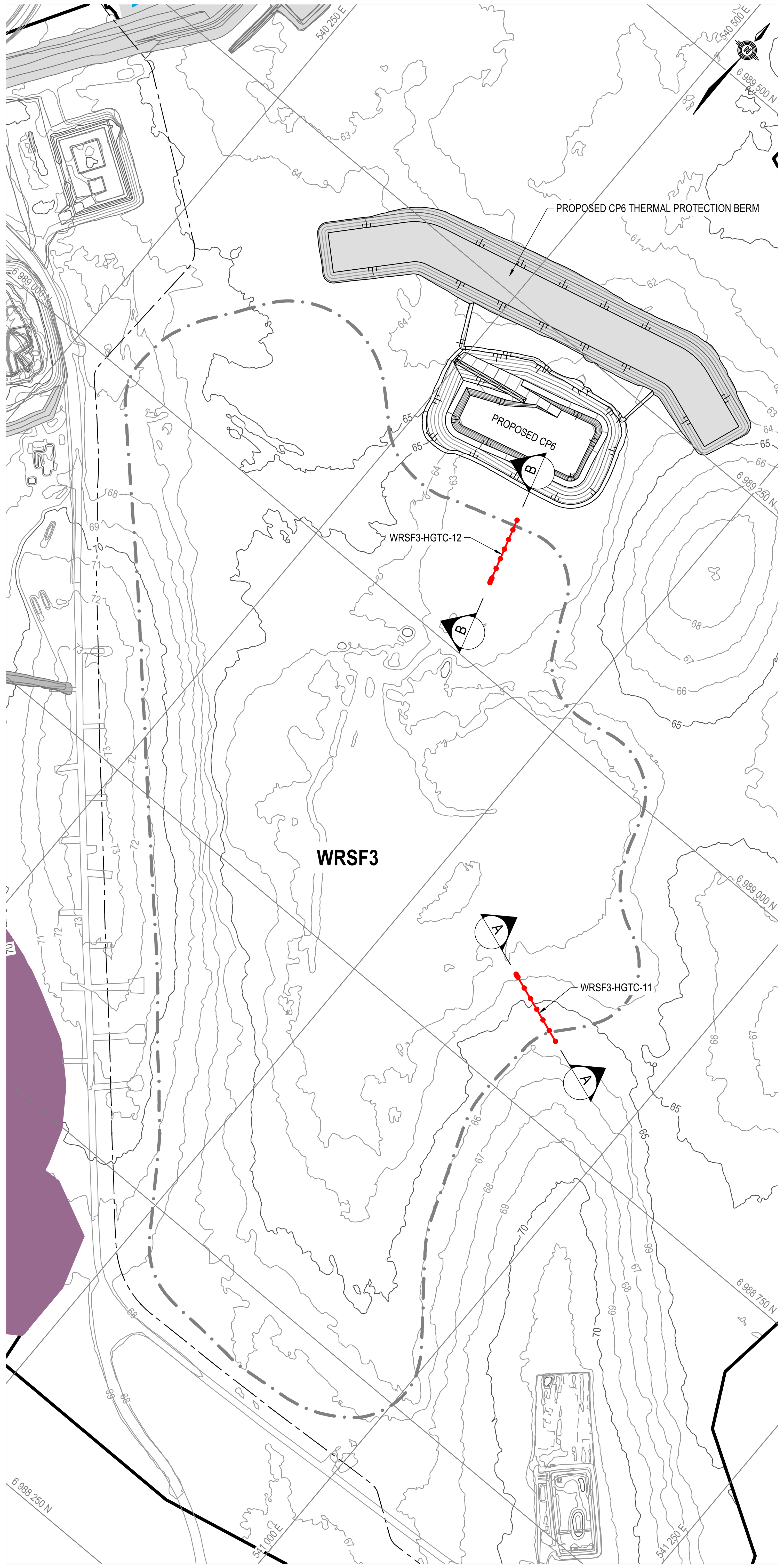

PLAN VIEW SHOWING LOCATIONS OF GROUND TEMPERATURE CABLES FOR WRSF3
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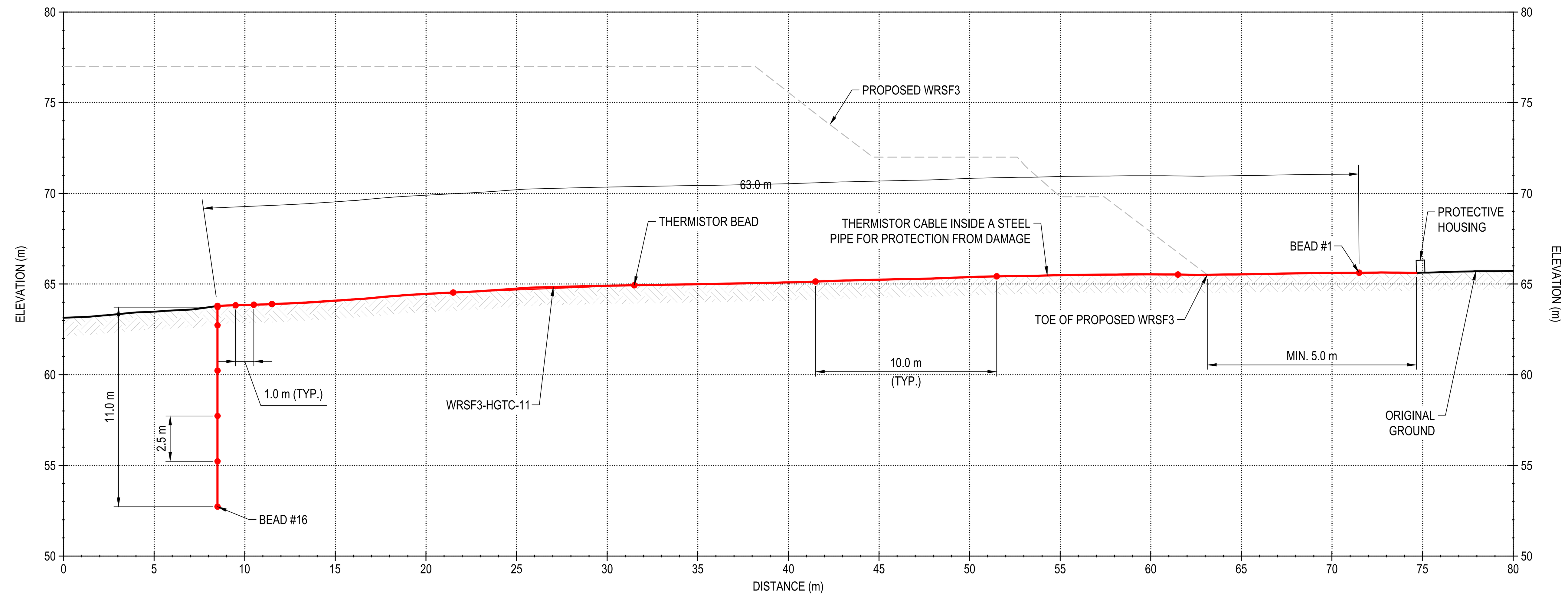

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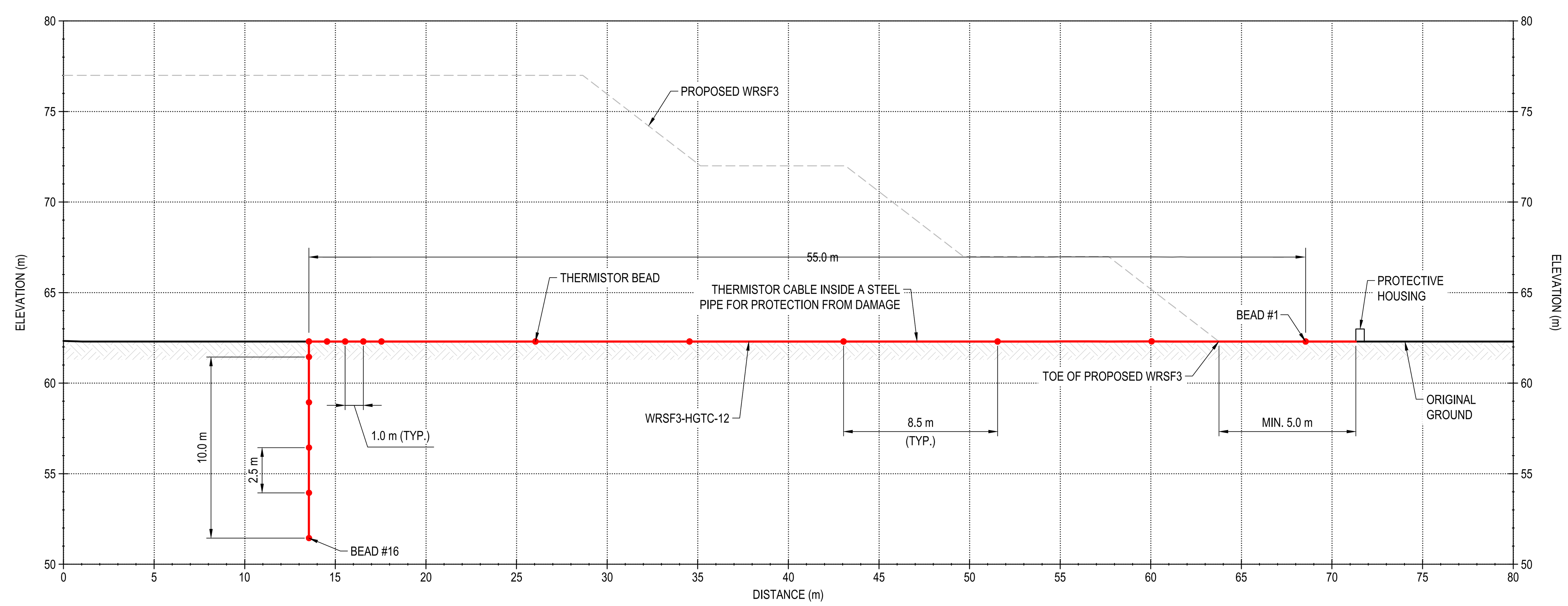

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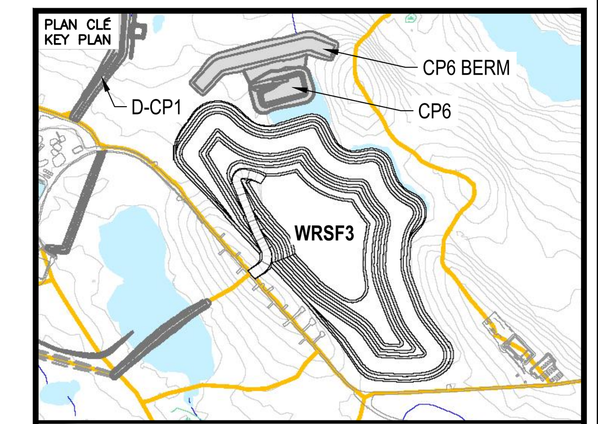
PLAN CLÉ KEY PLAN



TETRA TECH

NOTES GÉNÉRALES / GENERAL NOTES

1. A TOTAL OF 16 THERMISTOR BEADS FOR EACH GROUND TEMPERATURE CABLE.
2. THE THERMISTOR CABLES FOR WRSF3-HGTC-11 AND WRSF3-HGTC-12 WERE MANUFACTURED BEFORE THE DESIGN OF WRSF3. THESE CABLES WERE INSTALLED ON JANUARY 25 AND 26, 2020 DURING THE SITE INVESTIGATION. DUE TO HOLE SLOUGHING ISSUE, THE BOTTOMS OF BOTH CABLES WERE NOT INSTALLED TO THE DESIGN DEPTH. THE AS-INSTALLED BEAD LOCATIONS INSIDE THE HOLES ARE SHOWN ON THIS DRAWING. THE PLANNED BEAD LOCATIONS FOR THE HORIZONTAL PORTION OF THE CABLES ARE SHOWN SINCE THE ACTUAL INSTALLATION DETAILS ARE NOT AVAILABLE.

DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

TITRE / TITLE	# DWG
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AGNICO EAGLE

REV.	DATE	DESCRIPTION	PAR/BY	APP.	CLIENT
0	2020–02–21	ISSUED FOR CONSTRUCTION	GZ	WTH	
A	2020–02–14	ISSUED FOR REVIEW	GZ	WTH	

REVISIONS

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NT/NU Association of Professional Engineers and Geoscientists

TITRE / TITLE
AGNICO EAGLE MELIADINE GOLD PROJECT
WASTE ROCK STORAGE FACILITY No. 3

MELIADINE WRSF3 DETAILED DESIGN:
GROUND TEMPERATURE CABLE AND
THERMISTOR BEAD LOCATIONS

DESSINÉ PAR DRAWN BY	EL	DATE 2020–02–21
VERIFIÉ PAR CHECKED BY	GZ	2020–02–21
APPROUVÉ PAR APPROVED BY	WTH	2020–02–21
ÉCHELLE SCALE	1:2000	DATE 2020–02–21

NO. DESSIN DRAWING NO. 65–686–230–209–001

NO. PROJET PROJECT NO.	REVISION	FEUILLE / SHT
6515	0	5 / 6

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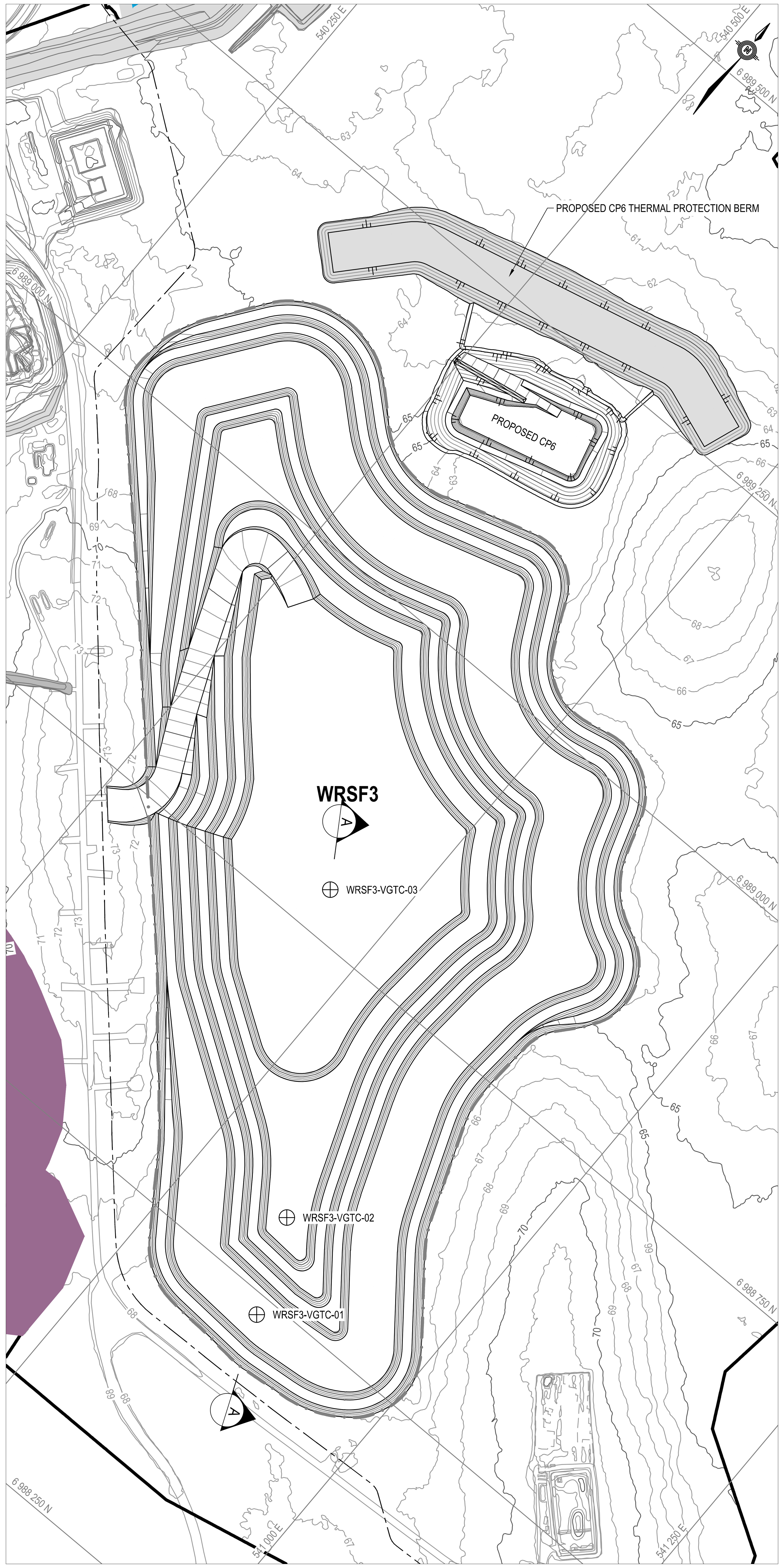
FILE NO. 65–686–230–209–001.dwg

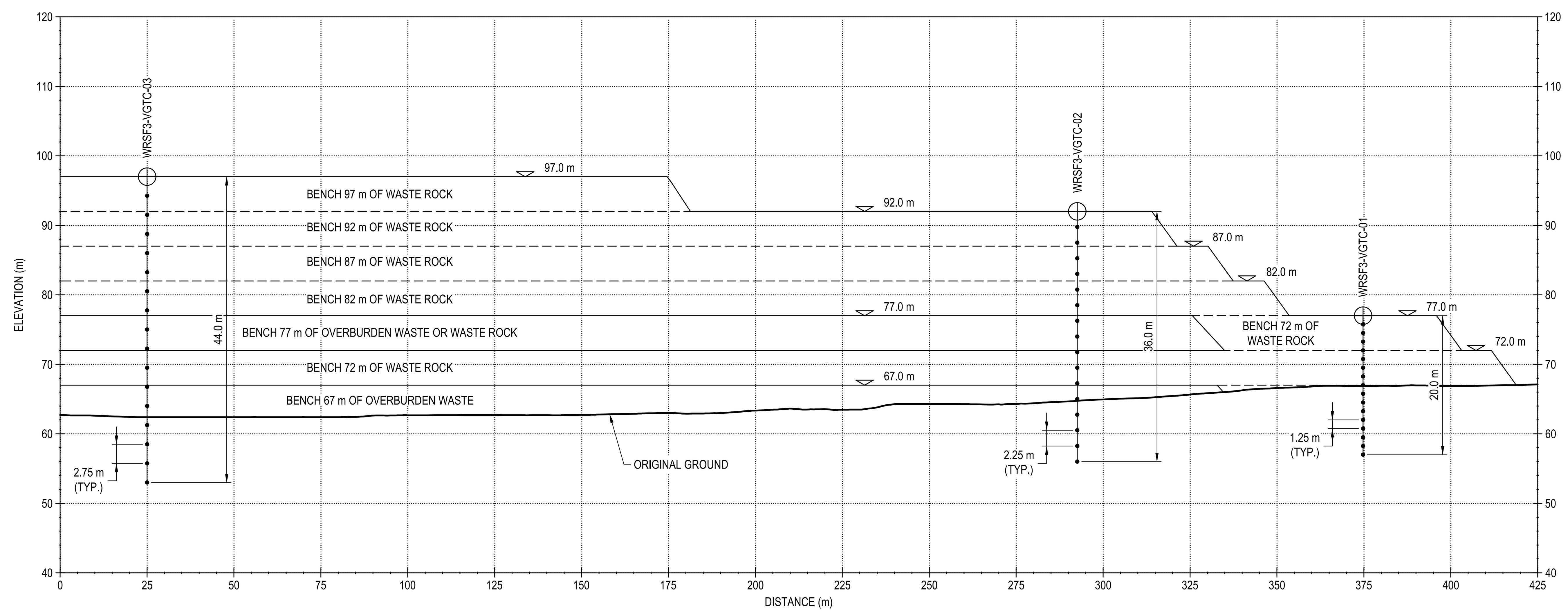
NO. DESSIN / DRAWING NO. 65-686-230-209-002

FORMAT ARCHD



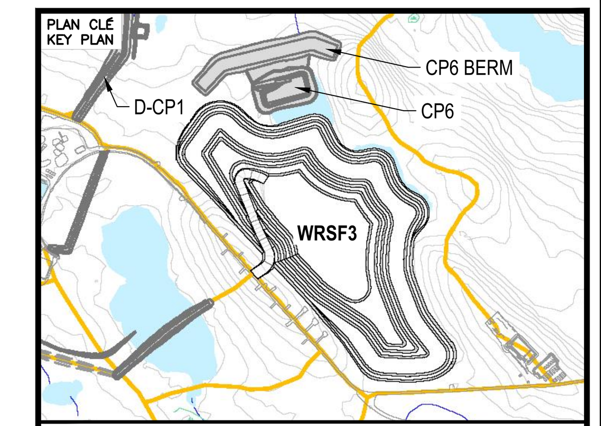
PLAN VIEW SHOWING LOCATIONS OF GROUND TEMPERATURE CABLES FOR WRSF3

SCALE = 1:5000



A INSTRUMENTATION

SCALE: 1:500



TETRA TECH

NOTES GÉNÉRALES / GENERAL NOTES

1. A TOTAL OF 16 THERMISTOR BEADS FOR EACH GROUND TEMPERATURE CABLE.

DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

TITRE / TITLE	# DWG
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AGNICO EAGLE

REV.	DATE	DESCRIPTION	PAR/BY	APP.	CLIENT
0	2020-02-21	ISSUED FOR CONSTRUCTION	GZ	WTH	
A	2020-02-14	ISSUED FOR REVIEW	GZ	WTH	

REVISIONS

G. ZHANG LICENSEE NWT/NU — Feb 21, 2020

PERMIT TO PRACTICE TETRA TECH CANADA INC.
Signature
Date Feb 21, 2020
PERMIT NUMBER: P 018
NT/NU Association of Professional Engineers and Geoscientists

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ÉCHELLE / SCALE	1:2000	2020-02-21

NO. DESSIN / DRAWING NO. 65-686-230-209-002

NO. PROJET / PROJECT NO. 6515 — REVISION 0 — FEUILLE / SHT 6 / 6

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FILE NO. 65-686-230-209-002.dwg

Appendix B

TETRA TECH

TECHNICAL MEMO

ISSUED FOR USE

To:	Jennifer Pyliuk, P.Eng., Agnico Eagle	**Date:**	February 21, 2020
c:	Bill Horne, P.Eng., Tetra Tech	**Memo No.:**	001
From:	Guangwen (Gordon) Zhang, P.Eng., Tetra Tech Jasmine Lalli, E.I.T., Tetra Tech	**File:**	ENG.EARC03140-10
Subject:	Thermal Analyses for Waste Rock Storage Facility No. 3 (WRSF3), Meliadine Gold Mine, Nunavut		

1.0 INTRODUCTION

Tetra Tech Canada Inc. (Tetra Tech) was retained by Agnico Eagle Mines Ltd. (Agnico Eagle) to design the Waste Rock Storage Facility No. 3 (WRSF3) for the Meliadine Gold Mine, Nunavut, Canada. The mine site is located on a peninsula between the east, south, and west basins of Meliadine Lake at latitude 63°01'N and longitude 92°13'W and is 25 km northwest of Rankin Inlet, Nunavut.

Thermal analyses were carried out to evaluate the thermal conditions of WRSF3 and its foundation during waste placement and under long-term climate change conditions. The main purpose of the thermal analyses is to provide supporting information for stability analyses of the WRSF3 design.

This technical memorandum summarizes the methodology, input parameters, assumptions, and findings of the thermal analyses. It is understood that this memorandum will be included as an appendix to the WRSF3 design report to be prepared by Agnico Eagle.

2.0 GENERAL SITE CONDITIONS

2.1 Climate

The Meliadine mine site lies within the Southern Arctic Climatic Region where daylight reaches a minimum of 4 hours per day in winter and a maximum of 20 hours per day in summer. The nearest weather station is Rankin Inlet A (Station 2303401), located approximately 25 km south of the Project site. The monthly mean air temperature is typically above 0°C for the months of June to September and is below 0°C between October and May. July is typically the warmest month and January the coldest. The mean annual air temperature for the 1981 - 2010 Climate Normal period was -10.5°C.

Mean annual precipitation at the mine site, based on the hydrological year from 1 October to 30 September, is estimated to be 412 mm after accounting for rainfall and snowfall undercatch. Approximately 51% of precipitation occurs as rain and 49% occurs as snow (Agnico Eagle 2015).

The region is known for high winds, which are due in part to the broad, flat, uninterrupted expanses offered to moving air masses. The wind blows from the north and north-northwest direction more than 30% of the time. The mean values for wind speed show that the north-northwest, together with north and northwest winds, have the highest speeds and tend to be the strongest. Mean monthly wind speeds are typically between 19 km/hour and 27 km/hour.

Tetra Tech Canada Inc.
14940 - 123 Avenue
Edmonton, AB T5V 1B4 CANADA
Tel 780.451.2121 Fax 780.454.5688

2.2 Subsurface Conditions

A total of 17 diamond drilling boreholes and 9 percussion drilling probe holes were drilled within and around the proposed WRSF3 footprint during several geotechnical site investigation programs (Tetra Tech EBA 2014a, Tetra Tech EBA 2016, Agnico Eagle 2019, Tetra Tech 2020a). The locations of the boreholes and probe holes are presented on Figure 1. In general, the subsurface of the WRSF3 area consists of a thin layer of organic material overlying sand or silty sand or sand and silt or sand and gravel, ice-rich sandy silt or silty sand, silty sand or gravelly sand and silt or silty sand, and bedrock (greywacke, highly weathered to fresh, strong, dark grey, fine grained). Excess ice was observed within the overburden soils in most of the boreholes. 0.1 m to 1.3 m thick ice and sand/silt (ground ice) layers (in the boreholes drilled on land away from the former lakes H19 and H20) were encountered in 8 of the 17 diamond drilling boreholes. The depth to bedrock ranges from 1.7 m to 8.5 m. Table 1 summarizes the key geotechnical information of the overburden soils in the WRSF3 area.

Table 1: Geotechnical Information of Overburden Soils in WRSF3 Area

Borehole No.	General Location	Organic Layer Thickness (m)	Major Overburden Soil Types	Ice Conditions	Depth to Bedrock (m)
GT14-01	Inside WRSF3 Footprint	0.10	Sand; Sand and Silt; Silty Sand; Ice and Silt	0.2 m Ice and Silt	2.25
GT14-02		0.60	Silty Sand; Sandy Silt	Up to 20% Vx, Vr	3.85
BH16-08		0.10	Sand; Ice and Sand; Ice and Silt; Silty Sand; Gravel and Sand	Up to 10% Vc, Vs; 0.15 m Ice and Sand; 0.75 m Ice and Silt	4.30
GT19-08		0.45	Sand; Silty Sand; Sand and Ice; Silty Sand	1.3 m Sand and Ice (up to 60% Vu, Vs; 40% Vx; 1 mm to 2 mm thick ice formations)	3.40
GT19-09		0.45	Silty Sand; Sand; Ice; Sand	0.2 m Ice; Up to 35% Vx, Vc	3.10
GT19-10		0.50	Silty Sand; Cobbles; Sand	Up to 10% Vr; Up to 5% Vs (1 mm thick); Nbn	3.35
GT19-11		0.35	Boulder; Gravelly Sand	Nbn in organic layer	3.35
GT19-12		0.00	Cobble; Sand; Sandy Silt; Boulders	Nbn in top 2 m soils; thawed/unfrozen in remaining overburden soils	4.5
GT14-03	Near WRSF3 Footprint	0.28	Sand and Silt; Sand; Silt	Vs 2%; 1 mm to 2 mm thick ice lens; partially thawed (1 m to 1.5 m)	2.80
GT14-04		0.10	Gravelly Sand; Sand; Silt and Sand	Up to 25% Vc, Vx, Vs (10%, 1 mm to 2 mm thick ice lenses), Vr	4.46
BH16-01		0.13	Sand and Gravel; Ice and Sand; Silty Sand; Ice and Silt; Gravel and Sand	Up to 20% Vx, Vs, Vc; 0.50 m Ice and Sand; 0.50 m Ice and Silt	3.50
BH16-02		0.13	Boulder, Sand and Gravel; Gravelly Sand; Ice and Sand; Silt and Sand	Vx 10%; 0.6 m Ice and Sand from 1.1 m to 1.6 m); 0.60 m Ice and Sand (from 2.1 m to 2.7 m)	6.40
BH16-03		0.00	Gravelly Sand; Sand and Gravel; Silt and Sand; Gravel and Sand	Up to 15% Vx, Vs (10% to 15%, 10 mm thick clear ice lens), Vc	6.50
BH16-04		0.24	Cobbles and Boulders; Gravelly Sand; Silty Sand and Gravel; Silty Sand	Up to 10% Vx, Vs (5% to 10%, 1 mm thick clear ice lenses), Vc	8.50
BH16-05		1.07	Sand and Gravel; Sand; Gravel and Sand; Boulders	Up to 50% Vx, Vs (20 mm thick ice lens); 0.10 m Ice and sand layer	4.90
BH16-06		0.06	Sand and Gravel; Sand; Sand and Silt	Up to 15% Vx, Vs (20 mm thick ice lens)	2.90
BH16-07		0.06	Sand and Silt; Ice and Sand; Silty Gravel and Sand	Up to 20% Vx, Vs; 0.10 m Ice and Sand	6.40
GT19-01		-	-	-	1.70
GT19-02		-	-	-	6.70
GT19-03		-	-	-	2.90
GT19-04		-	-	-	5.60
GT19-05		-	-	-	2.40
GT19-06		-	-	-	2.90
GT19-07		-	-	-	6.10
TH-CP6-01		-	-	-	4.90
TH-CP6-02		-	-	-	4.40

2.3 Ground Temperature and Permafrost Condition

The Project site is located within the Southern Arctic terrestrial eco-zone, one of the coldest and driest regions of Canada, in a zone of continuous permafrost. Data obtained from ground temperature cables (GTCs) installed in some boreholes confirm the presence of continuous permafrost to depths between 360 m and 495 m, with the depth of the active layer ranging from approximately 1 m to 3 m. It is anticipated that the active layer adjacent to lakes or below a body of water could be deeper. Frozen soils have been observed in most of the boreholes drilled on site. The typical permafrost ground temperatures at the depths of zero annual amplitude (typically at the depth of below 15 m) are in the range of -5.0°C to -7.5°C in the areas away from lakes and streams. Limited overburden soil porewater salinity tests (EBA 2013) indicated that the overburden soils may have a porewater salinity of 4 to 12 parts per thousand (ppt). The geothermal gradient ranges from 0.012°C/m to 0.02°C/m (Golder 2012).

Two GTCs were installed in Boreholes GT19-11 and GT19-12 during the late January 2020 site investigation (Tetra Tech 2020a). The measured ground temperatures were -2.3°C to -2.5°C at 6 m to 11 m below the ground surface on February 8, 2020 (13 days after installation) at GT19-11. The measured ground temperatures were 0.4°C to -0.6°C at 3 m to 8 m below the ground surface on February 2, 2020 (8 days after installation) at GT19-12.

3.0 WASTE ROCK AND OVERBURDEN PROPERTIES, PRODUCTION PLAN, AND PRELIMINARY PLACEMENT PLAN FOR WRSF3

3.1 Waste Rock and Overburden Properties

The mine site is within the Rankin Inlet Greenstone Belt. The ore deposits are low-sulphide, gold-quartz vein deposits. The principal lithological units include turbiditic sedimentary rocks, volcanic-hosted and sediment-hosted iron formation, sericite altered siltstones and graphitic argillite, and schistose and carbonate-altered mafic volcanic rocks (Agnico Eagle 2015).

A baseline geochemical characterization program for the mine was initiated in 2008 and consisted of static and kinetic testing methods to assess the chemical composition of the mine waste and overburden, its potential to generate acid rock drainage and its potential for metal leaching (ML) upon exposure to ambient conditions. Based on the waste rock geochemical testing findings, the waste rock from the Tiriganiaq deposit area is considered non-potentially acid generating (NPAG) and has a low potential for ML in view of proposed waste rock management for the Project. The results of geochemical characterization indicated that the overburden produced will be NPAG. Waste rock and overburden have compatible geochemical characteristics such that these materials can be managed together in the same disposal facilities (Agnico Eagle 2015).

3.2 Waste Rock and Overburden Production Plan

Agnico Eagle is developing the waste rock and overburden production plan for the mine. The yearly waste rock and overburden production plan was provided by Agnico Eagle in an email on January 29, 2020 (Agnico Eagle 2020a) for the design of WRSF3. It is understood that the waste rock and overburden from Open Pit Tiri_1000_02 in 2020 will be placed in WRSF3. The monthly waste rock and overburden placement plan in 2020 for WRSF3 was provided by Agnico Eagle in an email on February 3, 2020 (Agnico Eagle 2020b) for the design of WRSF3. Based on the current yearly waste rock and overburden production plan, the waste rock and overburden will not be placed in WRSF3 in 2021 and 2022. In 2023 to 2025, the waste rock (or overburden) will be placed in WRSF3 until its design capacity is reached.

3.3 Preliminary Waste Rock and Overburden Placement Plan for WRSF3

A preliminary waste rock and overburden placement plan was adopted for thermal and stability evaluations for WRSF3 based on Agnico Eagle (2020a, 2020b). Further details on the plan are presented in Tetra Tech (2020b). Table 2 summarizes the preliminary waste rock and overburden placement plan for the design of WRSF3.

Table 2: Preliminary Waste Rock and Overburden Placement Plan for Design of WRSF3

Location of Mine Waste Placement	Approximate Period of Mine Waste Placement	Period when the Majority of Mine Waste Materials are Placed
Bench 67 m of overburden waste	April and May 2020	April and May 2020
Bench 77 m of overburden waste or waste rock	May to July 2023 and January 2024	May to July 2023
Bench 67 m of waste rock	May to July 2020	May and June 2020
Bench 72 m of waste rock	July to December 2020	July to December 2020
Bench 77 m of waste rock	August to October 2023	August to October 2023
Bench 82 m of waste rock	June to August 2024	June to August 2024
Bench 87 m of waste rock	September to December 2024	November to December 2024
Bench 92 m of waste rock	June to August 2025	June to August 2025
Bench 97 m of waste rock	September to December 2025	November to December 2025

Bench 77 m may contain overburden waste in the center portion, and waste rock around the perimeter, or it may contain only waste rock. The thermal analyses in this memorandum assumed the Bench 77 m contained overburden waste and waste rock. This is the more critical case.

4.0 THERMAL ANALYSIS MODEL AND CLIMATIC DATA

4.1 General

Thermal analyses were carried out using Tetra Tech's proprietary finite element computer model, GEOTHERM. The model simulates transient heat conduction with change of phase for a variety of boundary conditions, including heat flux, convective heat flux, and temperature and ground-air boundaries. The heat exchange at the ground surface is modelled with an energy balance equation considering air temperatures, wind velocity, snow depth, and solar radiation. The model facilitates the inclusion of temperature phase change relationships for saline soils, such that any freezing depression and unfrozen water content variations can be explicitly modelled.

The model has been verified by comparing its results with closed-form analytical solutions and many different field observations since. The model has formed the basis for thermal evaluations and designs of a substantial number of projects in the Arctic and sub-Arctic regions since the 1980's, including mine waste storage facilities, dams, foundations, pipelines, utilidor systems, and landfills.

Thermal analyses using an axisymmetric model were carried out to simulate the presence of the former lakes H19 and H20 (up to 1.6 m deep) in the proposed WRSF3 footprint and the lake dewatering (partially) in early October 2019. The analysis results provided the estimated initial ground temperatures before waste rock and overburden placement in WRSF3. Additional axisymmetric thermal analyses of a typical section for the proposed WRSF3 were conducted to simulate the WRSF3 construction sequence and then to predict long-term thermal conditions after construction completion under adopted climatic and boundary conditions.

Several calibration thermal analyses were conducted for past projects at the Meliadine site to calibrate the thermal model with the site specific climatic and soil conditions and to compare with measured ground temperatures. The most recent calibration thermal analysis was carried out in November 2019 for the geotechnical design of the Waste Rock Storage Facility No. 1 (WRSF1), as summarized in Tetra Tech (2019). Therefore, a separate calibration thermal analysis was not performed in this study.

4.2 Mean Climatic Data

Climatic data required for the thermal analyses includes monthly air temperature, wind speed, solar radiation, and snow cover. The closest meteorological station from where the long-term climatic data is available is at Rankin Inlet. The mean monthly air temperatures, wind speed, and snow cover at Rankin Inlet Station are from Environment Canada's website (http://www.climate.weatheroffice.ec.gc.ca). Mean daily solar radiation data for the period of 1951 to 1980 at Baker Lake station (Environment Canada 1982) were adopted for the Project site. Table 3 summarizes the mean climatic data for the Project site.

Table 3: Mean Climatic Conditions at Meliadine Project Site

Month	Monthly Air Temperature (°C)[(a)]	Monthly Wind Speed (km/h)[(b)]	Monthly Average Snow Cover (m)[(c)]	Daily Solar Radiation (W/m^2)[(d)]
January	-30.1	24.2	0.26	9.1
February	-30.0	23.6	0.29	38.7
March	-24.9	23.5	0.33	119.5
April	-15.7	22.6	0.35	206.4
May	-5.4	22.2	0.19	259.7
June	4.7	20.3	0.01	252.0
July	11.0	19.4	0.00	226.4
August	10.0	20.9	0.00	160.8
September	4.0	23.8	0.00	124.9
October	-4.4	26.3	0.03	41.3
November	-16.6	25.1	0.13	14.4
December	-25.0	24.0	0.22	3.7

Notes:

[(a)] Measured monthly air temperatures at Rankin Inlet station (1989-2018).

[(b)] Measured wind speed data at Rankin Inlet station (1981-2010 Climate Normals).

[(c)] Measured snow cover data at Rankin Inlet station (1981-2010 Climate Normals).

[(d)] Measured solar radiation data at Baker Lake station (1951-1980).

4.3 Climate Change Projection

The historical air temperature data from Rankin Inlet indicates that the long-term climatic trend at Rankin Inlet is warming. Based on the observed warming trend in the historical air temperatures and state-of-practice, the thermal evaluations for this Project should consider the long-term effects of climate change (or global warming).

Government of Canada (GC) recently presented new climate change scenarios from the Coupled Model Intercomparison Project Phase 5 (CMIP5). The climate scenarios are presented in the Canadian Climate Data and Scenarios (CCDS) website (http://climate-scenarios.canada.ca/?page=main). The results of the climate scenarios from the CMIP5 climate models were used in the latest Intergovernmental Panel on Climate Change (IPCC)

Assessment Report (AR5). The website provides projected seasonal climate changes for each province in Canada. A series of tables with projections of climate change computed from the CMIP5 climate models are provided. Projections are based on the Representative Concentration Pathway (RCP) scenarios. Seasonal averages of projected changes in climate are available for RCP2.6, RCP4.5, and RCP8.5.

IPCC (2015) stated that "Anthropogenic GHG emissions are mainly driven by population size, economic activity, lifestyle, energy use, land use patterns, technology, and climate policy. The RCPs, which are used for making projections based on these factors, describe four different 21st century pathways of GHG emissions and atmospheric concentrations, air pollutant emissions, and land use. The RCPs include a stringent mitigation scenario (RCP2.6), two intermediate scenarios (RCP4.5 and RCP6.0), and one scenario with very high GHG emissions (RCP8.5)."

Canadian Standards Association (CSA) issued a report (CSA 2019) "Technical Guide; Infrastructure in permafrost: A guideline for climate change adaptation". This report is an updated version of CSA (2010). CSA (2019) presents two scenarios – RCP4.5 (a moderately reduced greenhouse gas emission scenario) and RCP8.5 ("high" greenhouse gas emission scenario). In comparison, the projected air temperature changes in the Project site area (Zone C1 in CSA (2019)) for the CSA 2019 RCP4.5 scenario are slightly less than those in Nunavut for the CMIP5 RCP4.5 scenario from GC.

The intermediate scenario, CMIP5 RCP4.5, was adopted for these thermal analyses which represents a reasonably conservative case. Table 4 summarizes the projected seasonal air temperature changes in Nunavut for the climate change scenario CMIP5 RCP4.5. The projected long-term air temperatures from the climate change scenario CMIP5 RCP4.5 are warmer than the A1B scenario in CSA (2010), which was applied in the feasibility level study.

Table 4: Projected Seasonal Air Temperature Changes Adopted for Thermal Analyses of WRSF3 (CMIP5 RCP4.5 Scenario for Nunavut (Government of Canada))

Period	Projected Seasonal Air Temperature Changes (50th (median) percentiles) from 1986-2005 Baseline under Representative Concentration Pathway (RCP) 4.5 Scenario for Nunavut (°C)			
	Winter	Spring	Summer	Autumn
2016–2035	2.0	1.3	0.9	2.1
2046–2065	4.4	2.7	1.8	4.0
2081-2100	5.9	3.5	2.4	5.2

Table 5 presents the predicted monthly air temperatures for several selected years used for the long-term thermal evaluation of WRSF3.

The climate change scenario CMIP5 RCP4.5 predicts that snow depth will slightly decrease with time in Nunavut. This snow depth reduction in the long term was not considered in the thermal analyses for WRSF3. Less snow cover depth in winter tends to result in colder ground temperatures.

Table 5: Measured and Projected Monthly Air Temperatures for Selected Years based on CMIP5 RCP4.5 Scenario

Month	Measured Monthly Air Temperature (1986-2005) [a] (°C)	Projected Monthly Air Temperature in 2026 [b] (°C)	Projected Monthly Air Temperature in 2056 [b] (°C)	Projected Monthly Air Temperature in 2096 [b] (°C)
January	-31.7	-29.7	-27.3	-25.6
February	-30.7	-28.7	-26.3	-24.5
March	-25.0	-23.7	-22.3	-21.4
April	-15.9	-14.6	-13.2	-12.3
May	-5.7	-4.3	-2.9	-2.0
June	4.1	5.0	5.9	6.6
July	10.6	11.5	12.4	13.1
August	9.7	10.6	11.5	12.2
September	3.8	6.0	7.9	9.2
October	-5.3	-3.2	-1.3	0.1
November	-17.4	-15.3	-13.4	-12.0
December	-25.7	-23.6	-21.2	-19.5
Mean	**-10.8**	**-9.2**	**-7.5**	**-6.3**

Notes:

[a] Based on measured data at Rankin Inlet weather station.

[b] Predicted based on measured air temperatures at Rankin Inlet (1986-2005) and the climate change scenario CMIP5 RCP4.5 for Nunavut, as summarized in Table 4.

5.0 THERMAL ANALYSES OF WRSF3

5.1 Material Properties for WRSF3 Thermal Analyses

The foundation geotechnical conditions underlying the proposed WRSF3 area are summarized in Section 2.2. Accordingly, this information was used to develop a generalized foundation soil profile for the thermal analyses of WRSF3. It was assumed that the original ground (before waste placement) consists of 1.5 m sand, 1.0 m ice-rich sand/silt, 1.5 m sandy silt over greywacke bedrock. The organic layer, typically 0.0 m to 0.6 m in the area, was not specifically modelled in the thermal analyses as it is expected that the layer will be compressed under the loads of waste rock and overburden. Since the ground generally tends to be colder with an organic cover, it is conservative to exclude the thin, compressed organic layer in the thermal analyses.

Thermal properties of the materials were determined indirectly from the well-established correlations with soil index properties (Farouki 1986; Johnston 1981) or assumed based on experience. Soil index properties were estimated from the available geotechnical information or assumed based on experience. The porewater salinity was assumed to be 7 ppt for the overburden waste and foundation overburden soils and 2 ppt for the waste rock and bedrock in the thermal analyses. Table 6 summarizes the material properties used in the thermal analyses.

Table 6: Material Properties Used in Thermal Analyses for WRSF3

Material	Water Content (%)	Bulk Density (Mg/m³)	Thermal Conductivity (W/m-K)		Specific Heat (kJ/kg-K)		Latent Heat (MJ/m³)
			Frozen	Unfrozen	Frozen	Unfrozen	
Sand	20	2.04	2.48	1.54	0.96	1.31	114
Ice-Rich Sand/Silt	60	1.60	2.36	1.03	1.24	2.03	200
Sandy Silt	15	2.13	2.44	1.71	0.91	1.18	93
Bedrock	1	2.63	2.90	2.90	0.75	0.77	9
Overburden Waste	17	1.76	1.59	1.18	0.93	1.24	85
Waste Rock	3	1.96	1.04	1.26	0.77	0.83	19

5.2 Thermal Analysis Approach and Assumptions

5.2.1 Effects of Former Lakes on Initial Ground Temperatures

Figure 1 shows that a large portion of the proposed WRSF3 footprint is covering the former lakes H19 and H20, which were partially dewatered early October 2019. A section through the northeast area of the proposed WRSF3, where the perimeter of the proposed WRSF3 is approximately overlapping the edge of the former lake H20, was used in an axisymmetric thermal analysis to simulate the thermal effects of the former H20 lake before the lake dewatering. A temperature boundary (see Table 7 for assumed lakebed temperatures) was applied to the former lakebed in the thermal analysis. A ground-air boundary was applied to the on-land ground surface, with the mean climatic conditions as presented in Table 3. The analysis was run until a nearly steady ground temperature profile was established.

A layer of solid/clear ice (up to 0.42 m thick) was found at the ground surface in the three boreholes (0.07 m ice in GT19-10 over the land away from the lakes; 0.29 m ice in GT19-11 at the edge of the former H20 lake; and 0.42 m ice in GT19-12 inside the former H19 lake) drilled in the WRSF3 area in late January 2020. This suggests that the lakes H19 and H20 were not completely dewatered before the remaining water froze last fall. This was confirmed by Agnico Eagle (2020c). The actual thickness of the remaining water in the lakes H19 and H20 after the October 2019 lake dewatering is unknown. Based on the ice thickness encountered in the boreholes, it is expected that the remaining water depth in the lakes H19 and H20 would be up to 0.5 m.

An axisymmetric thermal analysis was conducted to simulate the ground thermal conditions during the period from early October 2019 to the start date of the proposed waste rock and overburden placement in WRSF3. The lakebed temperatures (see Table 7), which were applied to the partially dewatered lakebed in the thermal analysis, were assumed based on experience and engineering judgement.

Table 7: Monthly Lakebed Temperatures Assumed for Initial Thermal Analyses

Month	Assumed Mean Monthly Lakebed Temperature in Former H20 before Lake Dewatering (°C)	Assumed Monthly Lakebed Temperature in Former H20 after Partially Lake Dewatering (October 2019 to May 2020) (°C)
January	1	-4
February	0	-7
March	-1	-7
April	-2	-5
May	0	-3
June	5	
July	15	
August	13	
September	10	
October	5	3
November	4	1
December	2	-1

As described in Section 2.3, two GTCs were installed in Boreholes GT19-11 and GT19-12 during the late January 2020 site investigation. One set of relatively stable GTC readings were taken on February 8, 2020 at GT19-11 and on February 2, 2020 at GT19-12, which were provided to Tetra Tech on February 8, 2020 (after the initial thermal analyses were completed). The measured ground temperatures were -2.3°C to -2.5°C at 6 m to 11 m below the ground surface on February 8, 2020 at GT19-11 (at the edge of the former H20 lake). The measured ground temperatures were 0.4°C to -0.6°C at 3 m to 8 m below the ground surface on February 2, 2020 at GT19-12 (50 m inside the former H19 lake). It is expected that the ground temperatures in the area inside the former H20 lake are warmer than the measured temperatures at GT19-12 because the former H20 lake was deeper and much bigger than the former H19 lake.

The estimated ground temperatures from the initial thermal analyses on early February 2020 are -1.0°C to -1.5°C at 6 m to 11 m below the lakebed surface at the edge of the former H20 lake and 2.5°C to 3.2°C at 3 m to 8 m below the lakebed surface at a location 50 m inside the former H20 lake. These temperatures are higher than those measured at GT19-11 and GT19-12, indicating that the initial ground temperatures estimated from the thermal analyses could be warmer than the actual ground temperatures, which are conservative for the WRSF3 design.

5.2.2 Simulation of Mine Waste Placement and Long-term Conditions

Additional axisymmetric thermal analyses of a typical section for the proposed WRSF3 were conducted to simulate the WRSF3 construction sequence and estimate long-term thermal conditions after construction completion under adopted climatic and boundary conditions. Figure 2 presents the typical section and waste placement benches adopted in the thermal analyses. Table 8 presents the mine waste placement schedules simulated in the thermal analyses of WRSF3. The schedules were adopted based on the preliminary waste rock and overburden placement plan, as described in Section 3.3.

Table 8: Waste Placement Schedules Simulated in Thermal Analyses of WRSF3

Waste Type	Bench Top Elevation (m)	Waste Placement Completion Time Simulated in Thermal Analyses	Bench Thickness (m)	Assumed Initial Waste Temperature at Placement (°C)
Overburden	67	June 1, 2020	Up to 5.0	-2.0
Waste Rock	67	July 1, 2020	Up to 5.0	2.0
Waste Rock	72	October 1, 2020	5.0	3.0
Overburden	77	July 1, 2023	5.0	1.0
Waste Rock	77	October 1, 2023	5.0	3.0
Waste Rock	82	August 1, 2024	5.0	5.0
Waste Rock	87	December 1, 2024	5.0	-1.0
Waste Rock	92	August 1, 2025	5.0	5.0
Waste Rock	97	December 1, 2025	5.0	-1.0

The projected monthly air temperatures from the climate change scenario CMIP5 RCP4.5 were used in the thermal analyses to simulate the waste rock and overburden placement during the period of 2020 to 2025 and estimate the ground temperatures after 2025. Snow cover thickness over the top of WRSF3 surfaces was assumed to be either 50% or 100% of mean monthly snow cover thickness during active placement of mine waste and 100% of mean monthly snow cover thickness after the completion of the mine waste placement.

5.3 Analysis Results for WRSF3

The results of the thermal analyses have been presented in the following figures:

- Figures 3 to 8 present the predicted isotherms on September 30 for years 2020 to 2025, respectively, during active placement of waste rock and overburden in WRSF3;
- Figures 9 to 14 present the predicted isotherms on September 30 for years 2026, 2046, 2066, 2086, 2106, and 2126, respectively, after the completion of waste rock and overburden placement in WRSF3;
- Figures 15 to 17 show the predicted temperature profiles (trumpet curves) on October 1 for years 2026, 2036, 2046, 2066, 2086, 2106, and 2126 at locations through the 97 m bench (140 m from the toe of the pile), 87 m bench (100 m from the toe of the pile), and 72 m bench (25 m from the toe of the pile), respectively; and
- Figures 18 and 19 present the predicted ground temperatures with time at three selected locations along the foundation soil at the depth of 1.5 m below the original ground surface in the WRSF3 foundation during the construction stage and after completion of the WRSF3 construction, respectively.

These figures indicate that the temperatures within the WRSF3 and its foundation change with time and location. The initially unfrozen waste rock and overburden below the active layer zone will gradually freeze back within five to ten years after the initial placement. The predicted long-term temperatures range from -0.5°C to -2.5°C in the waste rock and overburden zones that are at least 5 m below the top waste rock surface. The predicted temperatures of the waste rock and overburden are colder during the period of 2040 to 2060. Thereafter the predicted temperatures start to gradually warm up due to the assumed long-term climate change.

The predicted long-term ground temperatures in the ice-rich sand/silt layer in the foundation range from -0.3°C to -0.6°C in the areas below the benches 77 m to 97 m and from -0.6°C to -2.7°C in the area below the bench 72. By 2126, the predicted ground temperatures in the ice-rich sand/silt layer are between -0.3°C and -0.9°C.

6.0 DISCUSSIONS AND RECOMMENDATIONS

The predicted ground temperatures in WRSF3 and its foundation in this memorandum are based on the waste rock and overburden production plan that was provided on January 29 and February 3, 2020 and the corresponding preliminary waste rock and overburden placement plan that was developed for the design of WRSF3. It is recommended that the current design of WRSF3 and the associated thermal and stability analyses be reviewed or updated (if required) if the final waste rock and overburden placement plan in WRSF3, especially the placement plan for the initial benches (67 m and 72 m) of the waste rock and overburden, is different from that simulated in the thermal analysis in this memorandum.

The thermal analyses were based on many assumptions. Therefore, actual temperatures of WRSF3 and its foundation could be different from the predicted. It is recommended that GTCs be installed at selected locations to monitor the actual ground thermal conditions of WRSF3 and its foundation during construction and after completion of WRSF3. The monitored results can be used to confirm the assumptions in the thermal analyses and associated design for WRSF3, evaluate the WRSF3 actual thermal performance, and calibrate the thermal model for future prediction if required. The proposed locations and details for the GTCs will be separately presented in the design drawings for WRSF3.

It is recommended that the maximum lift thickness during waste placement be limited to 2.5 m for the overburden waste and to 5.0 m for the waste rock.

7.0 CLOSURE

Use of this memo is subject to Tetra Tech's Limitations on Use of this Document which are attached in Appendix A. We trust this technical memo meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech Canada Inc.

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NWT/NU
Feb. 21, 2020

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Feb 21, 2020

Reviewed by:
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/jf

PERMIT TO PRACTICE
TETRA TECH CANADA INC.

Signature ______
Date Feb 21, 2020

PERMIT NUMBER: P 018
NT/NU Association of Professional Engineers and Geoscientists

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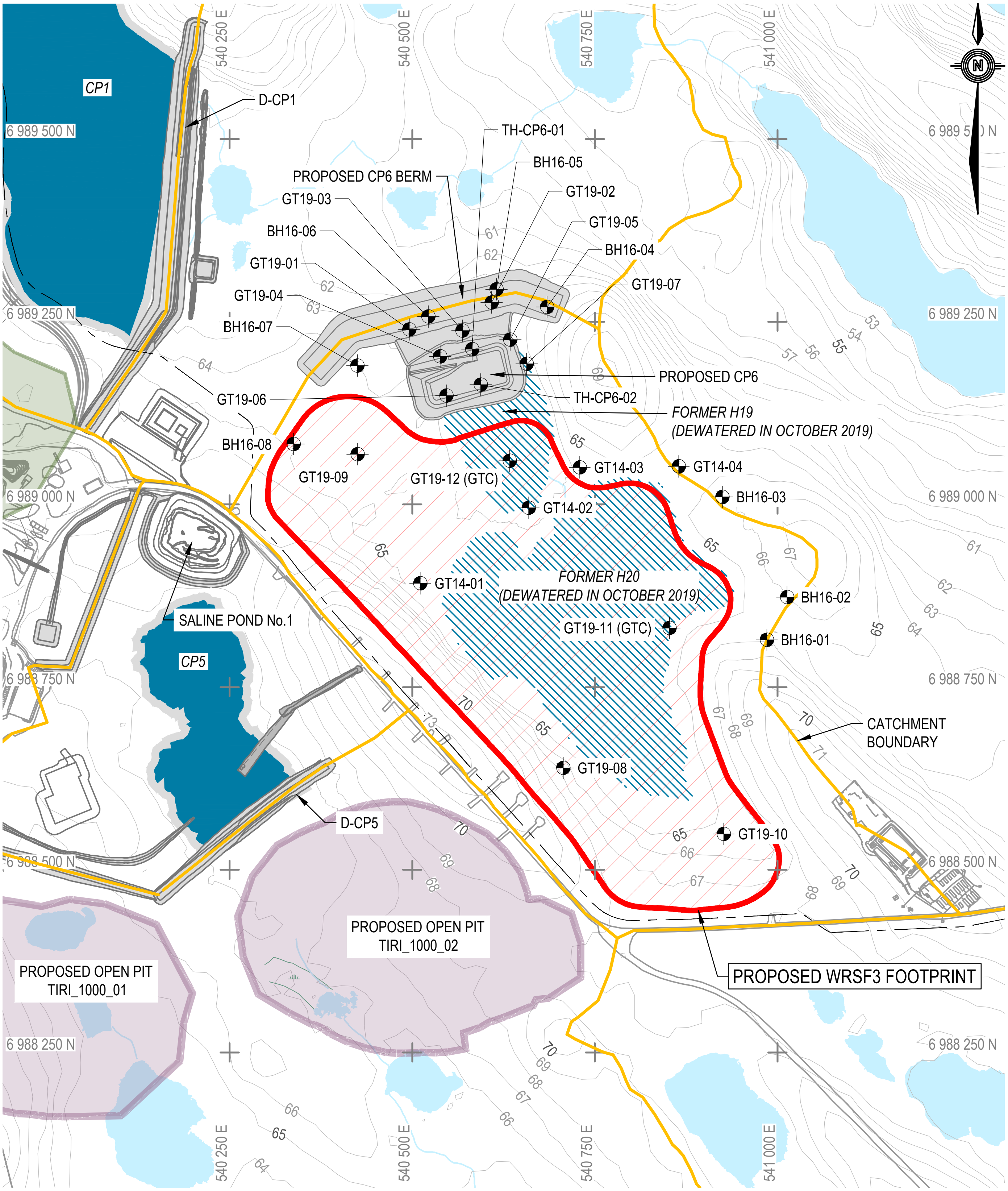
FIGURES



LEGEND:

BOREHOLE

0 250m

Scale: 1:7,500 @ 8.5"x11"

CLIENT

AGNICO EAGLE

TETRA TECH

THERMAL ANALYSIS OF WRSF3
MELIADINE GOLD PROJECT, NU

PROPOSED WRSF3 FOOTPRINT
WITH BOREHOLE LOCATIONS

PROJECT NO.	DWN	CKD	REV
ENG.EARC03140-10	EL	GZ	A

OFFICE	DATE
EDMONTON	FEBRUARY 14, 2020

FIGURE 1

Q:\Edmonton\Engineering\E141\Projects_MELIADINE\EARC03140-10_WRSF3\Production Drawings\Figure 1-For Thermal Analysis.dwg [FIGURE 1] February 12, 2020 - 2:41:06 pm (BY: LEE, ELVIN)

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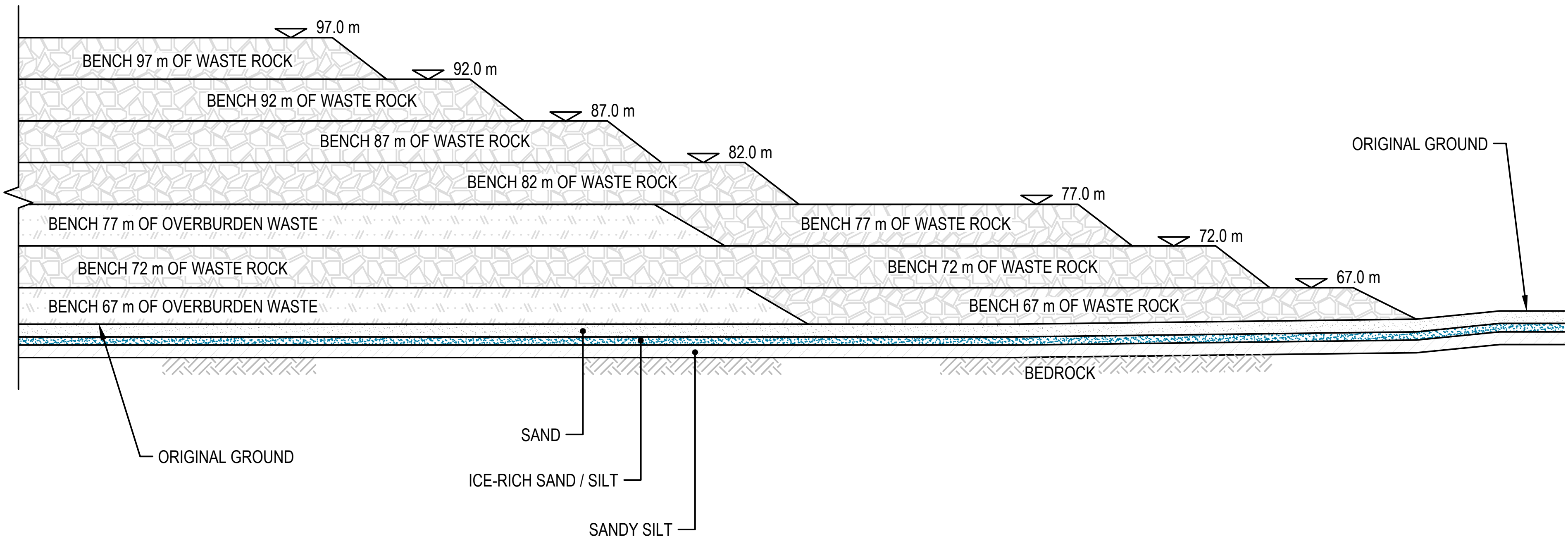


0 25m

Scale: 1:750 @ 8.5"x11"

CLIENT

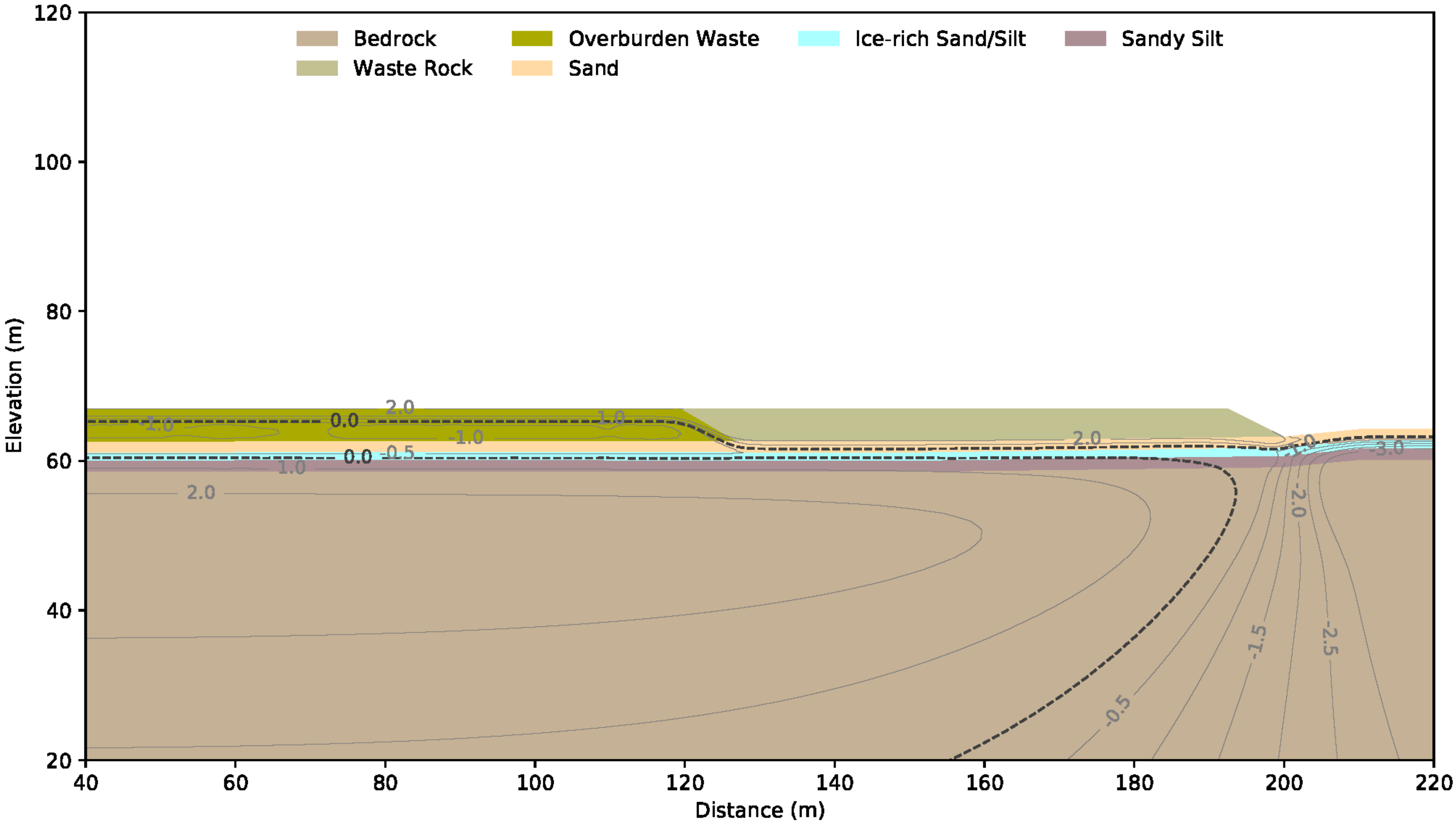
AGNICO EAGLE

TETRA TECH

THERMAL ANALYSIS OF WRSF3
MELIADINE GOLD PROJECT, NU

SECTION AND PLACEMENT BENCHES FOR THERMAL ANALYSIS OF WRSF3

PROJECT NO.	DWN	CKD	REV	
ENG.EARC03140-10	EL	GZ	A	**FIGURE 2**
OFFICE	DATE			
EDMONTON	FEBRUARY 14, 2020			



LEGEND

NOTES

1. Based on the preliminary waste rock and overburden placement plan developed for the design of WRSF3.

STATUS
ISSUED FOR USE

CLIENT

AGNICO EAGLE

TETRA TECH

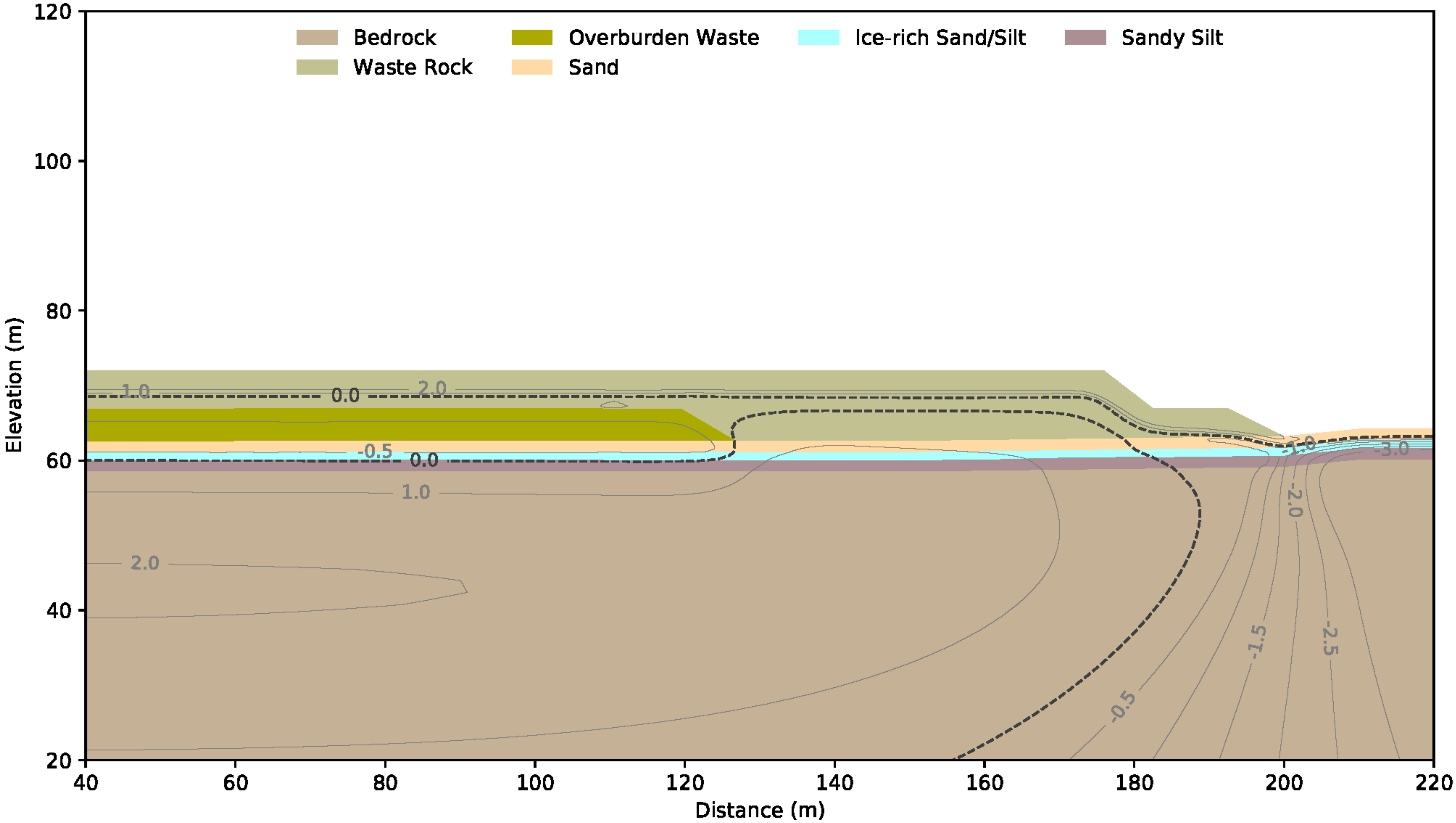
Thermal Analysis of WRSF3
Meliadine Gold Project, NU

Predicted Isotherms on September 30, 2020

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03140-10	JL	GZ	GZ	0

OFFICE	DATE
EBA-EDM	February 7, 2020

Figure 3



LEGEND

NOTES

1. Based on the preliminary waste rock and overburden placement plan developed for the design of WRSF3.

STATUS
ISSUED FOR USE

CLIENT
AGNICO EAGLE

TETRA TECH

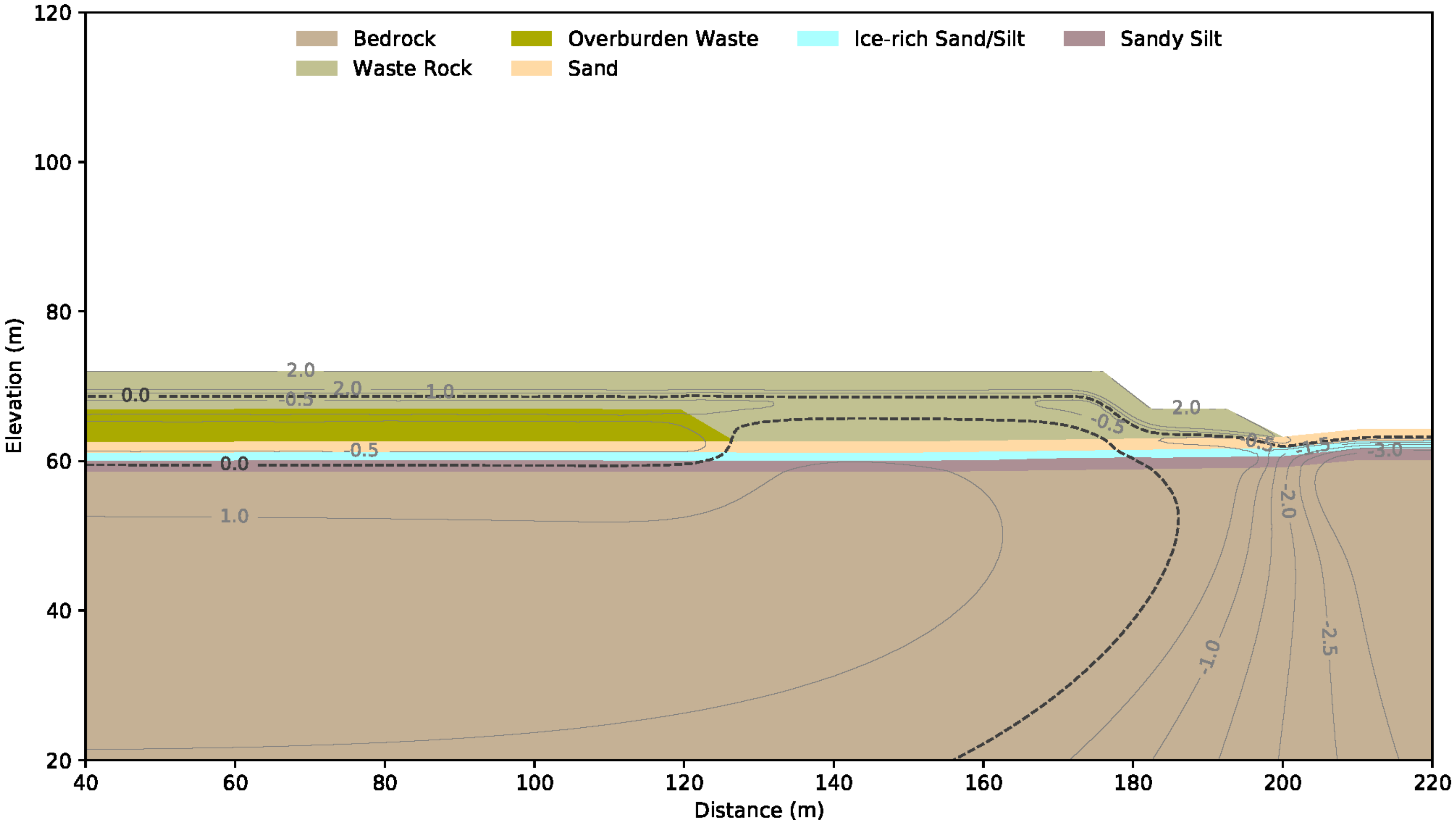
Thermal Analysis of WRSF3
Meliadine Gold Project, NU

Predicted Isotherms on September 30, 2021

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03140-10	JL	GZ	GZ	0

OFFICE	DATE
EBA-EDM	February 7, 2020

Figure 4



LEGEND

NOTES

1. Based on the preliminary waste rock and overburden placement plan developed for the design of WRSF3.

STATUS
ISSUED FOR USE

CLIENT
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TETRA TECH

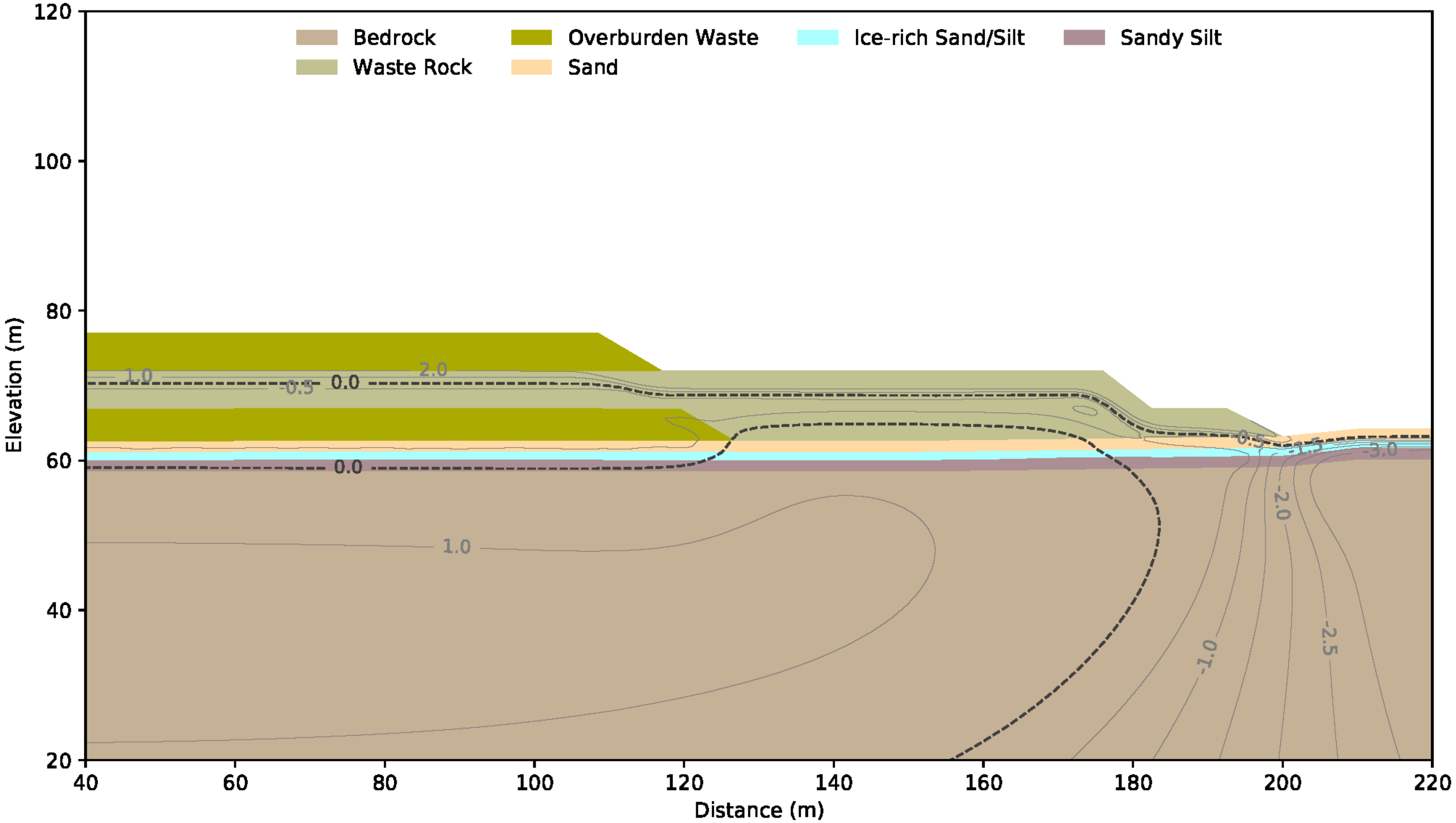
Thermal Analysis of WRSF3
Meliadine Gold Project, NU

Predicted Isotherms on September 30, 2022

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03140-10	JL	GZ	GZ	0

OFFICE	DATE
EBA-EDM	February 7, 2020

Figure 5



LEGEND

NOTES

1. Based on the preliminary waste rock and overburden placement plan developed for the design of WRSF3.

STATUS
ISSUED FOR USE

CLIENT
AGNICO EAGLE

TETRA TECH

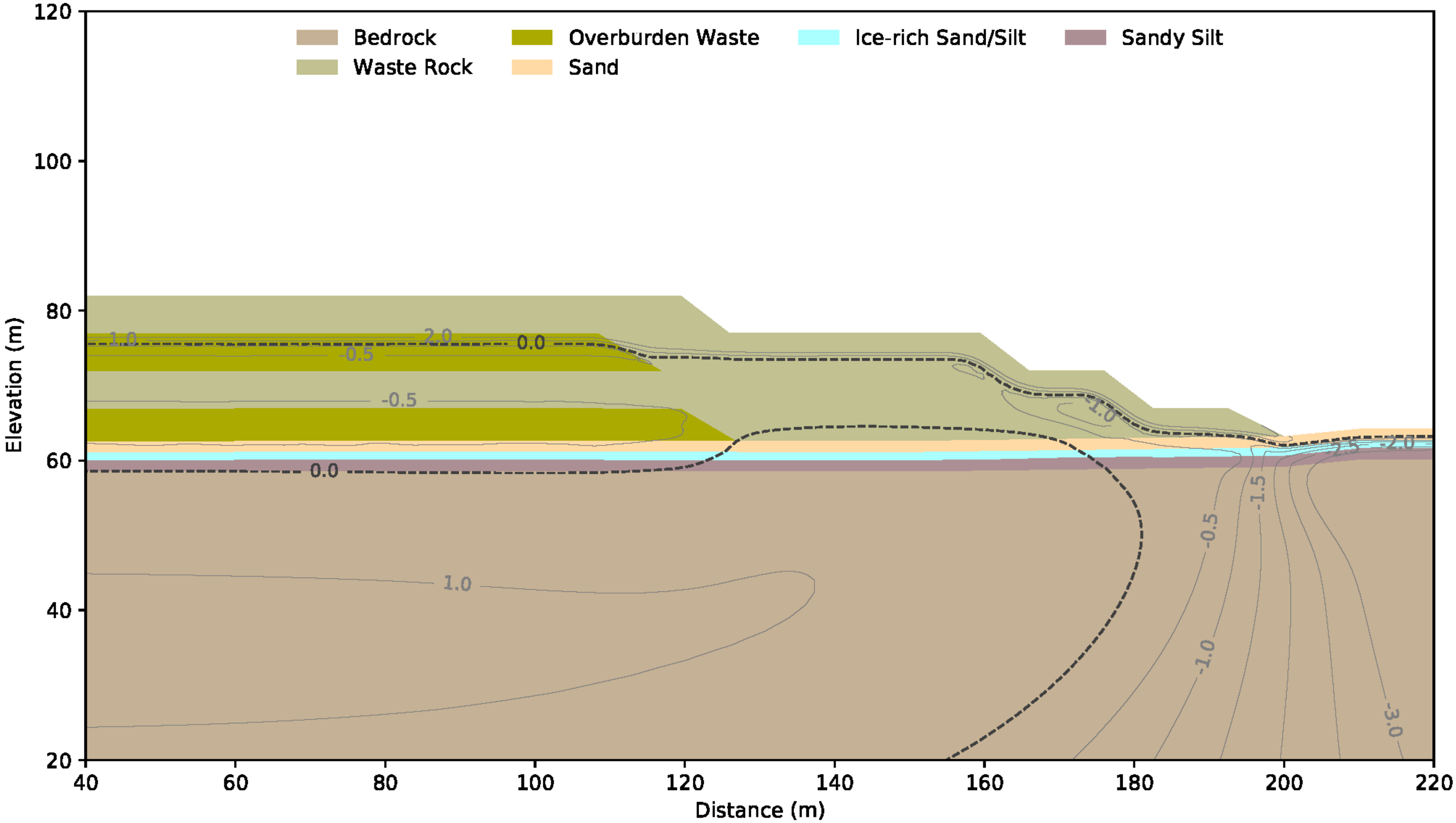
Thermal Analysis of WRSF3
Meliadine Gold Project, NU

Predicted Isotherms on September 30, 2023

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03140-10	JL	GZ	GZ	0

OFFICE	DATE
EBA-EDM	February 7, 2020

Figure 6



LEGEND

NOTES

1. Based on the preliminary waste rock and overburden placement plan developed for the design of WRSF3.

STATUS
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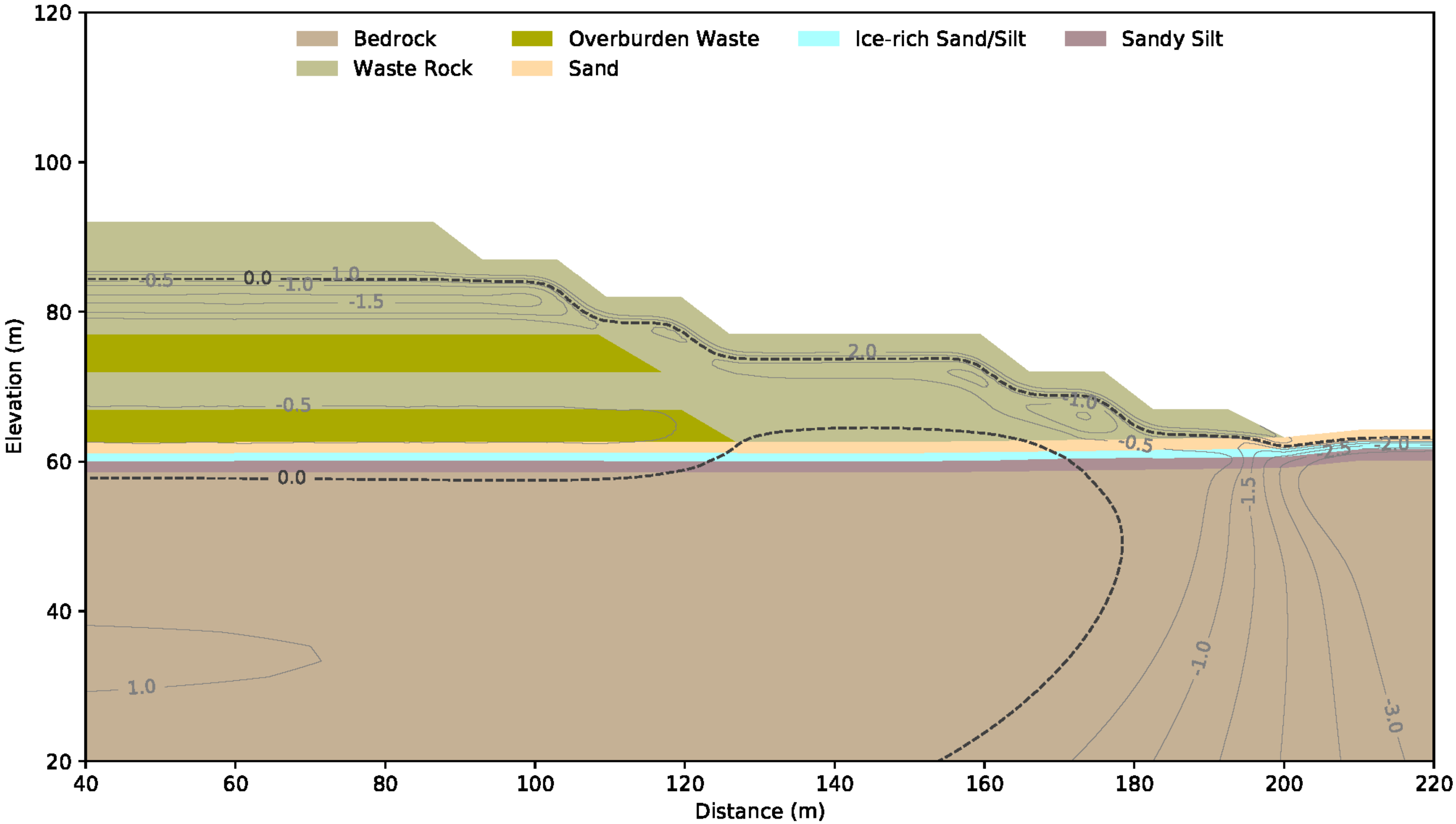
Thermal Analysis of WRSF3
Meliadine Gold Project, NU

Predicted Isotherms on September 30, 2024

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03140-10	JL	GZ	GZ	0

OFFICE	DATE
EBA-EDM	February 7, 2020

Figure 7



LEGEND

NOTES

1. Based on the preliminary waste rock and overburden placement plan developed for the design of WRSF3.

STATUS
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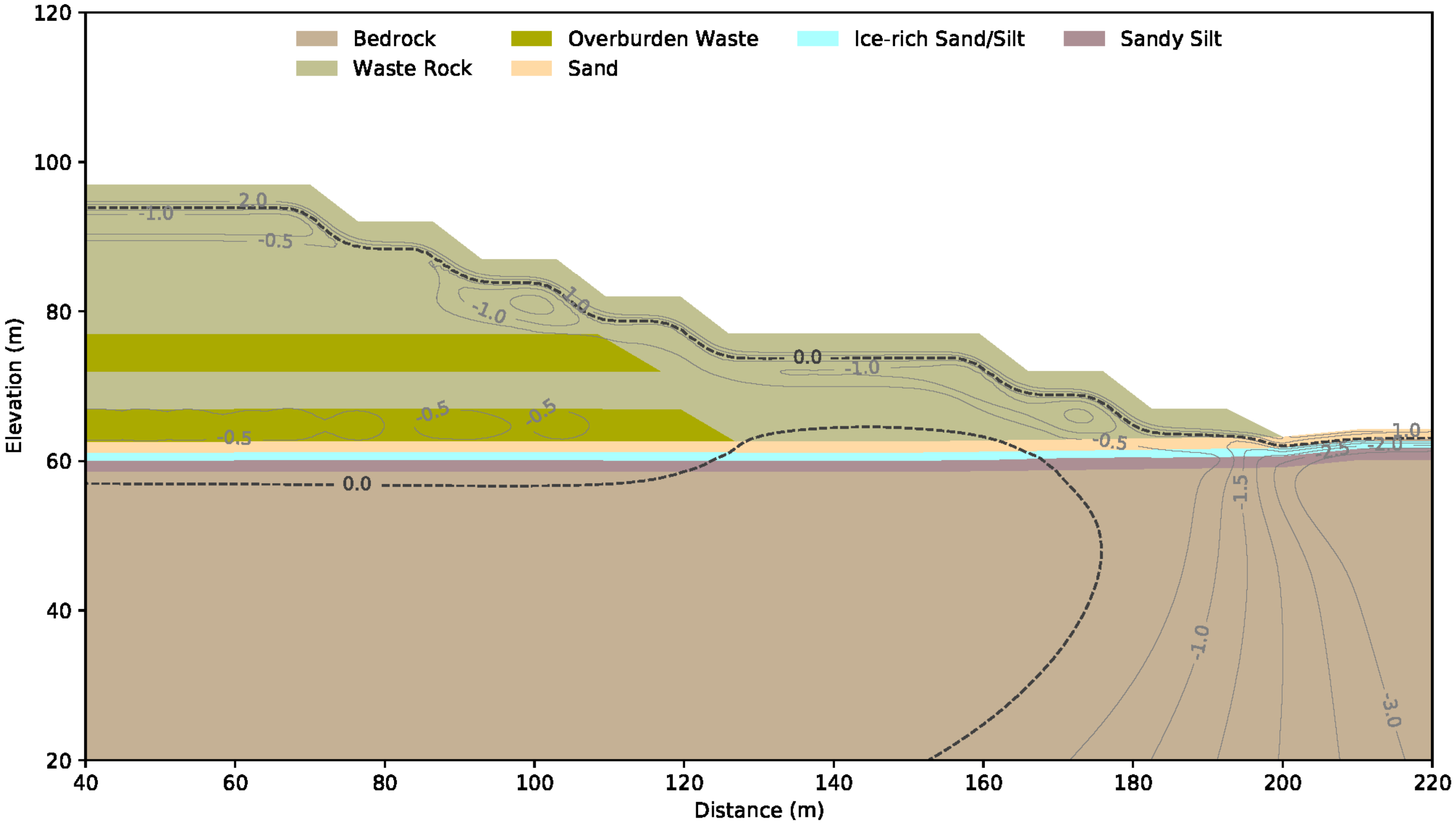
Thermal Analysis of WRSF3
Meliadine Gold Project, NU

Predicted Isotherms on September 30, 2025

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03140-10	JL	GZ	GZ	0

OFFICE	DATE
EBA-EDM	February 7, 2020

Figure 8



LEGEND

NOTES

1. Based on the preliminary waste rock and overburden placement plan developed for the design of WRSF3.
2. Based on the projected long-term air temperatures at Rankin Inlet for CMIP5-RCP4.5 climate change scenario.

STATUS
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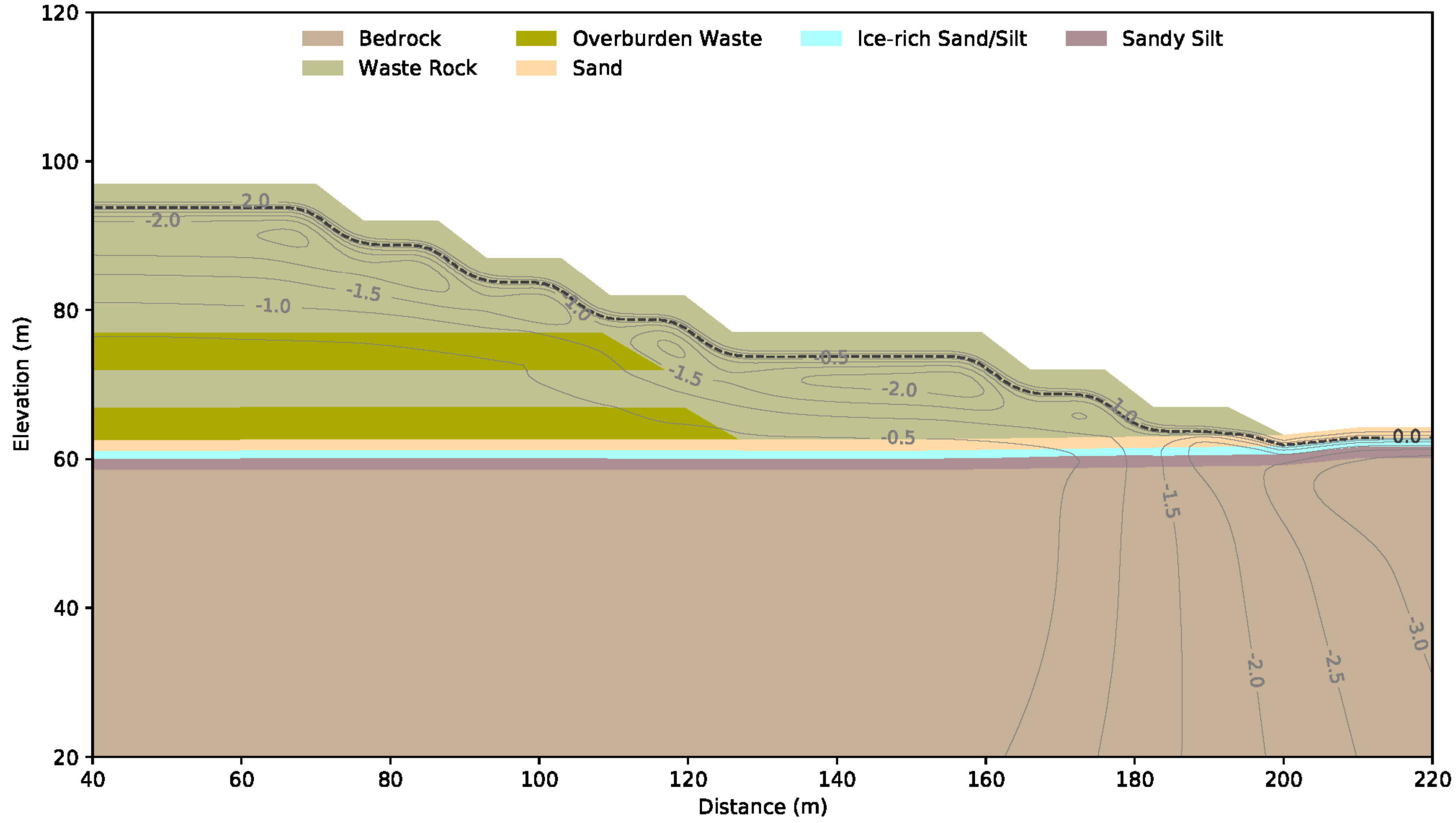
Thermal Analysis of WRSF3
Meliadine Gold Project, NU

Predicted Isotherms on September 30, 2026

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03140-10	JL	GZ	GZ	0

OFFICE	DATE
EBA-EDM	February 7, 2020

Figure 9



LEGEND

NOTES

1. Based on the preliminary waste rock and overburden placement plan developed for the design of WRSF3.
2. Based on the projected long-term air temperatures at Rankin Inlet for CMIP5-RCP4.5 climate change scenario.

STATUS
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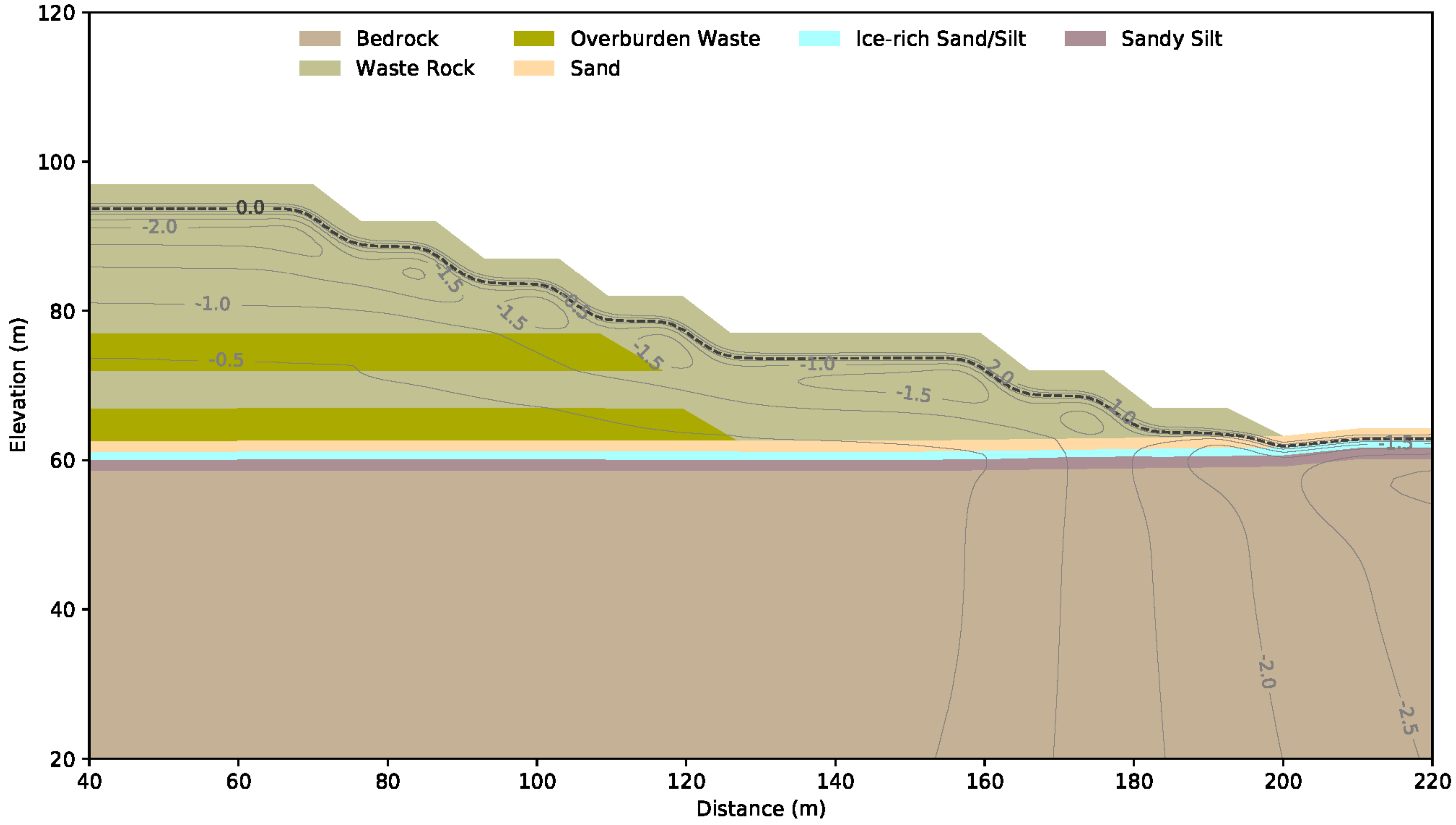
Thermal Analysis of WRSF3
Meliadine Gold Project, NU

Predicted Isotherms on September 30, 2046

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03140-10	JL	GZ	GZ	0

OFFICE	DATE
EBA-EDM	February 7, 2020

Figure 10



LEGEND

NOTES

1. Based on the preliminary waste rock and overburden placement plan developed for the design of WRSF3.
2. Based on the projected long-term air temperatures at Rankin Inlet for CMIP5-RCP4.5 climate change scenario.

STATUS
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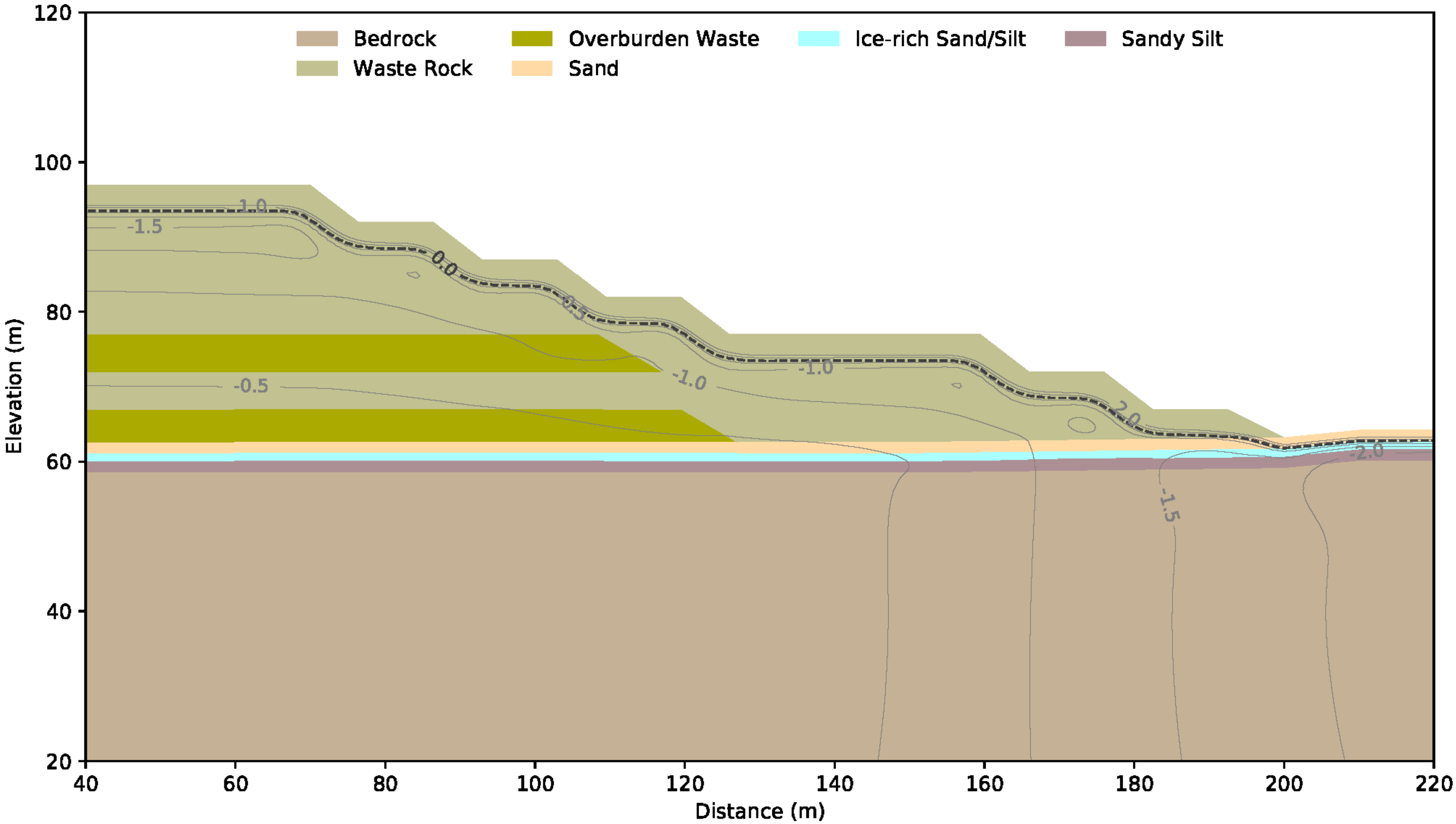
Thermal Analysis of WRSF3
Meliadine Gold Project, NU

Predicted Isotherms on September 30, 2066

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03140-10	JL	GZ	GZ	0

OFFICE	DATE
EBA-EDM	February 7, 2020

Figure 11



LEGEND

NOTES

1. Based on the preliminary waste rock and overburden placement plan developed for the design of WRSF3.
2. Based on the projected long-term air temperatures at Rankin Inlet for CMIP5-RCP4.5 climate change scenario.

STATUS
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CLIENT
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TETRA TECH

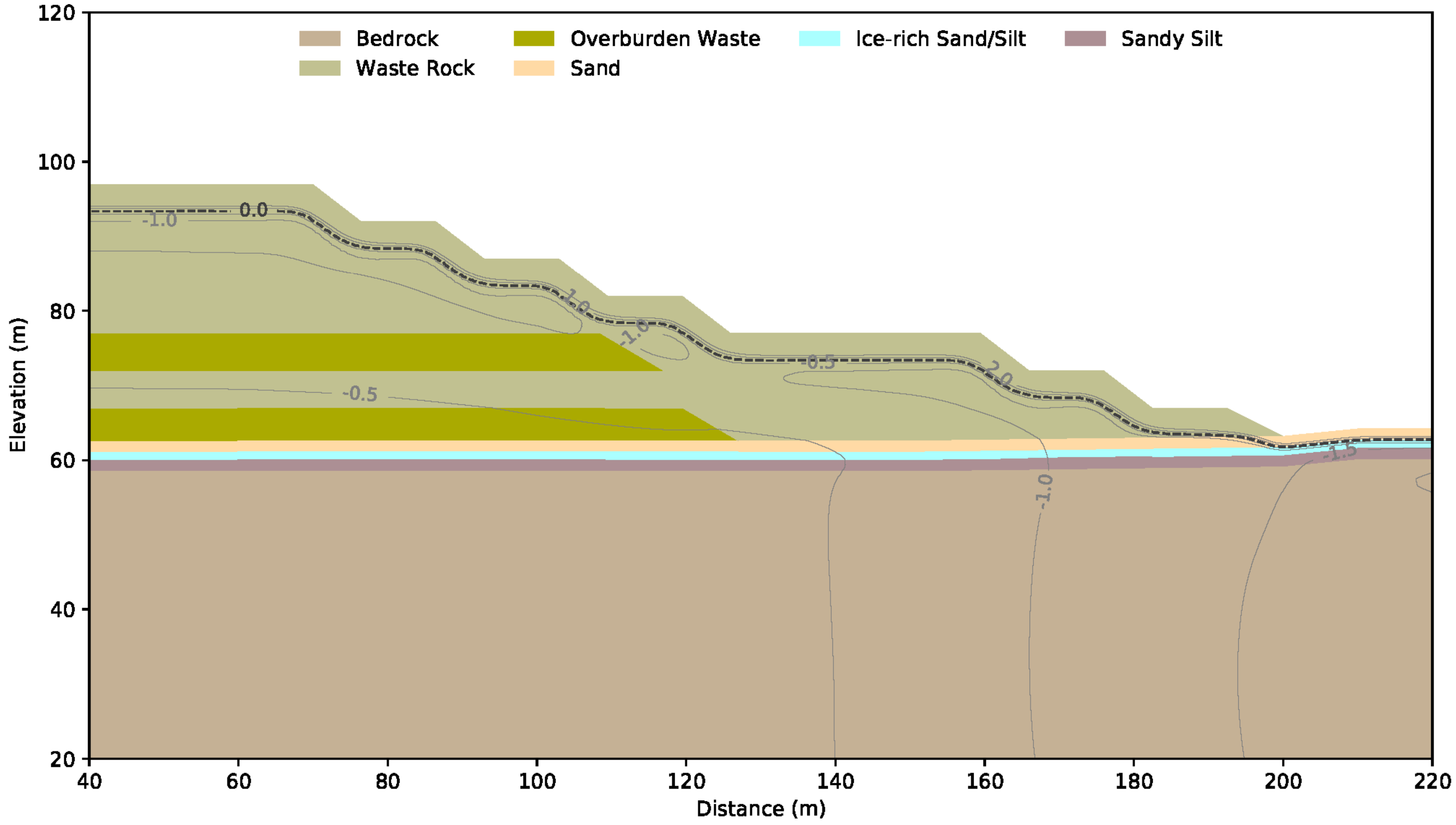
Thermal Analysis of WRSF3
Meliadine Gold Project, NU

Predicted Isotherms on September 30, 2086

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03140-10	JL	GZ	GZ	0

OFFICE	DATE
EBA-EDM	February 7, 2020

Figure 12



LEGEND

NOTES

1. Based on the preliminary waste rock and overburden placement plan developed for the design of WRSF3.
2. Based on the projected long-term air temperatures at Rankin Inlet for CMIP5-RCP4.5 climate change scenario.

STATUS
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TETRA TECH

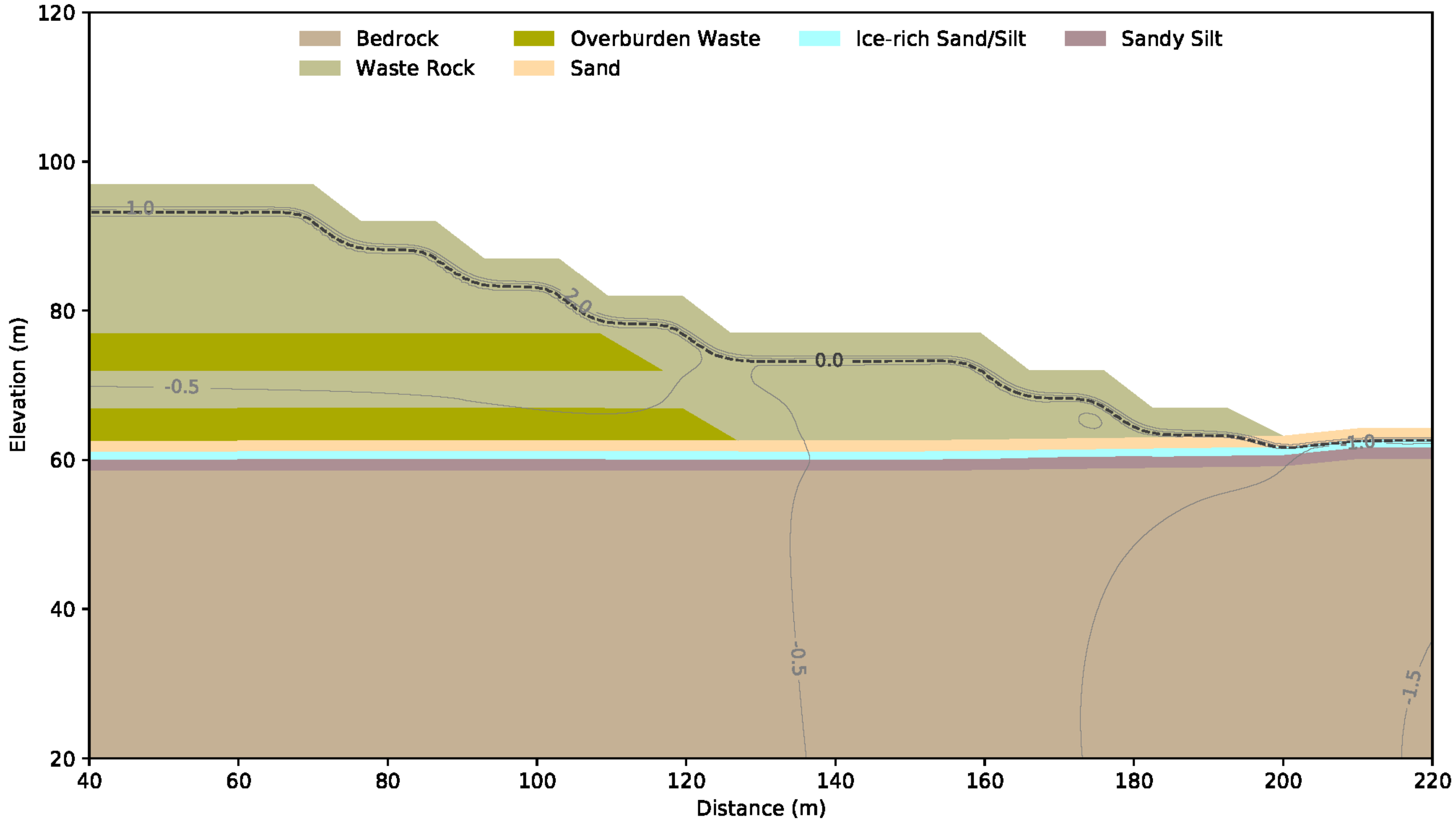
Thermal Analysis of WRSF3
Meliadine Gold Project, NU

Predicted Isotherms on September 30, 2106

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03140-10	JL	GZ	GZ	0

OFFICE	DATE
EBA-EDM	February 7, 2020

Figure 13



LEGEND

NOTES

1. Based on the preliminary waste rock and overburden placement plan developed for the design of WRSF3.
2. Based on the projected long-term air temperatures at Rankin Inlet for CMIP5-RCP4.5 climate change scenario.

STATUS
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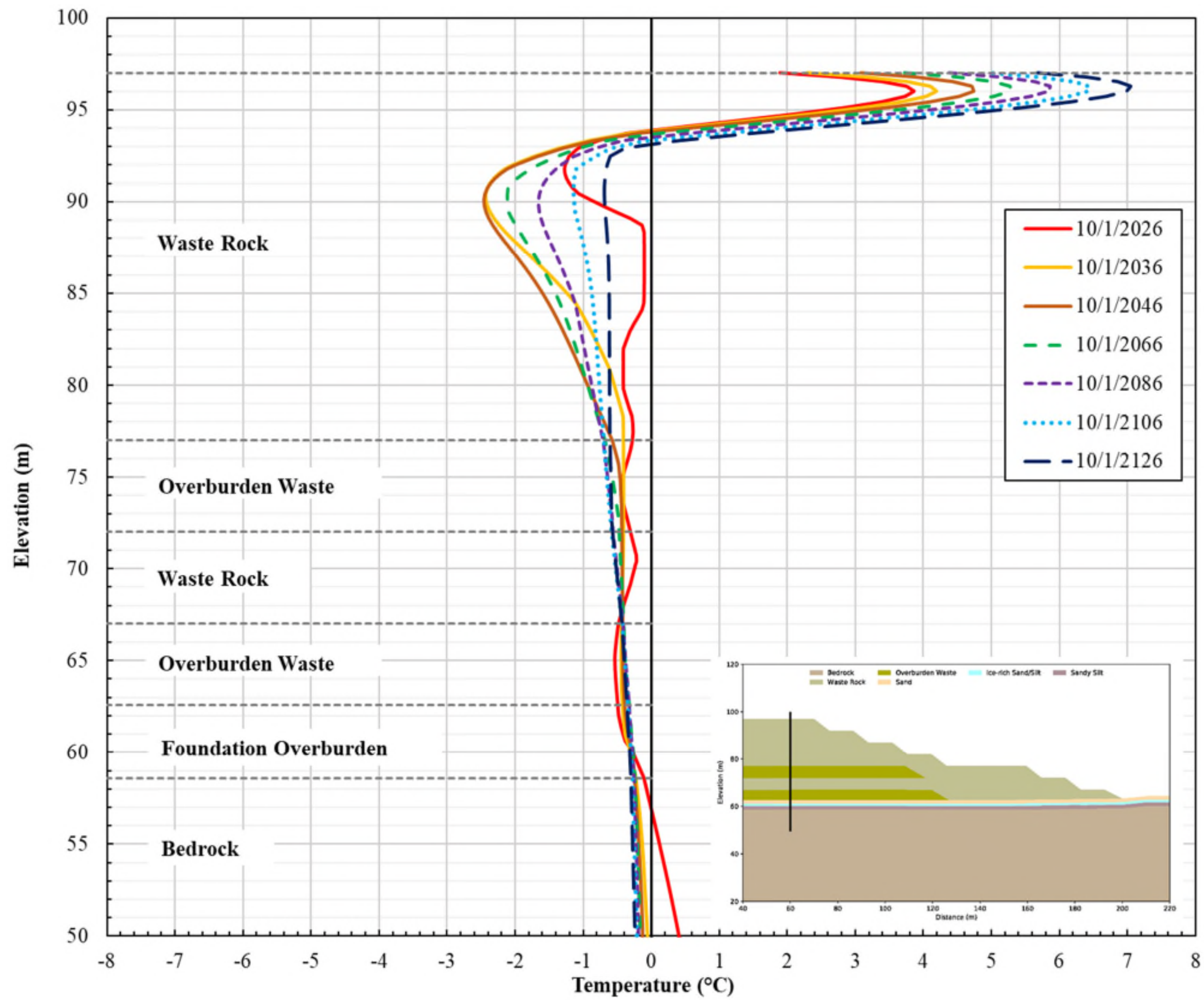
Thermal Analysis of WRSF3
Meliadine Gold Project, NU

Predicted Isotherms on September 30, 2126

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03140-10	JL	GZ	GZ	0

OFFICE	DATE
EBA-EDM	February 7, 2020

Figure 14



LEGEND

NOTES

1. Based on the preliminary waste rock and overburden placement plan developed for the design of WRSF3.
2. Based on the projected long-term air temperatures at Rankin Inlet for CMIP5-RCP4.5 climate change scenario.

STATUS
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TETRA TECH

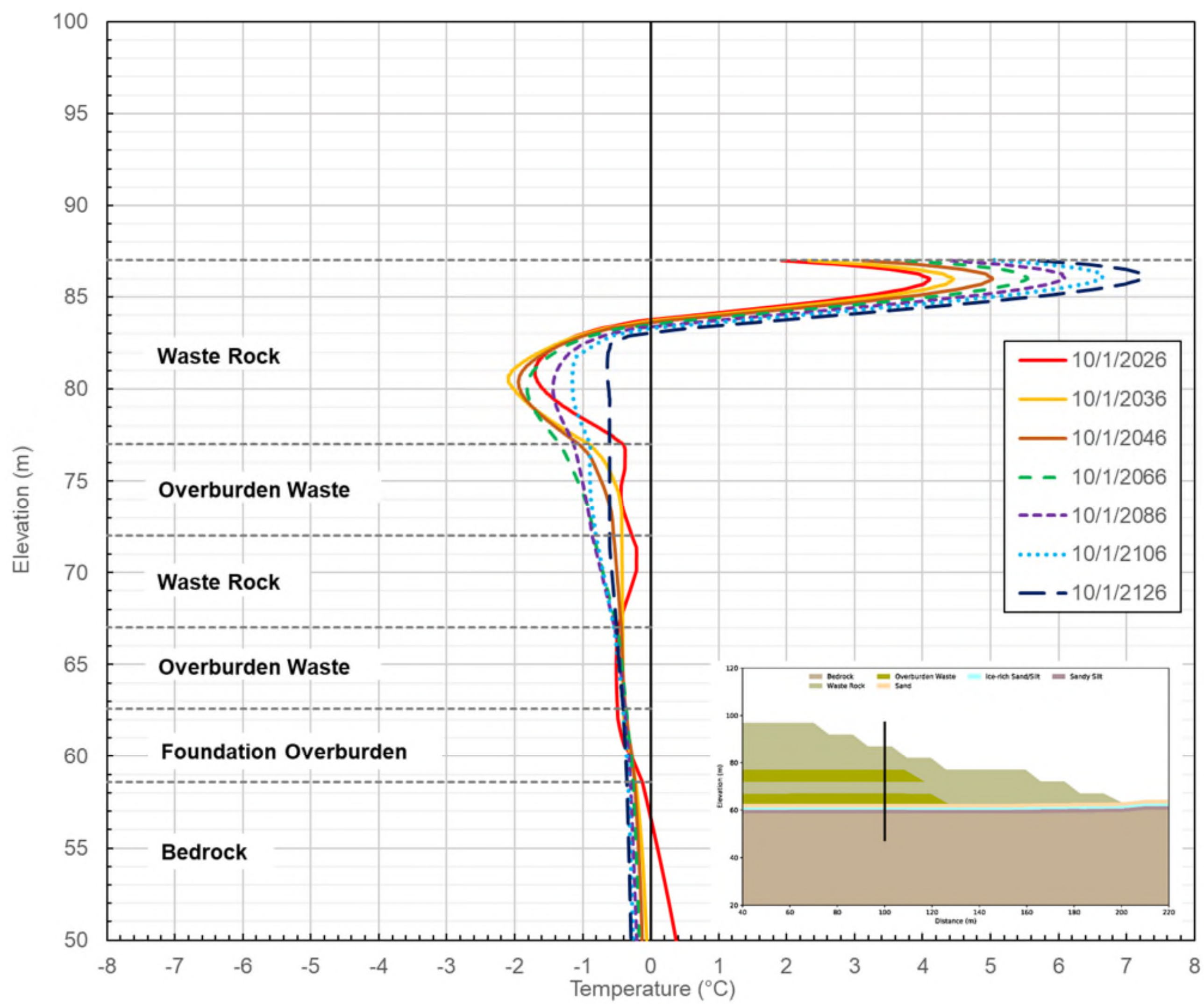
Thermal Analysis of WRSF3
Meliadine Gold Project, NU

Predicted Temperature Profiles on October 1 Below 97 m Bench (about 140 m from the lowest toe of the pile)

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03140-10	JL	GZ	GZ	0

OFFICE	DATE
EBA-EDM	February 6, 2020

Figure 15



LEGEND

NOTES

1. Based on the preliminary waste rock and overburden placement plan developed for the design of WRSF3.
2. Based on the projected long-term air temperatures at Rankin Inlet for CMIP5-RCP4.5 climate change scenario.

STATUS
ISSUED FOR USE

CLIENT
AGNICO EAGLE

TETRA TECH

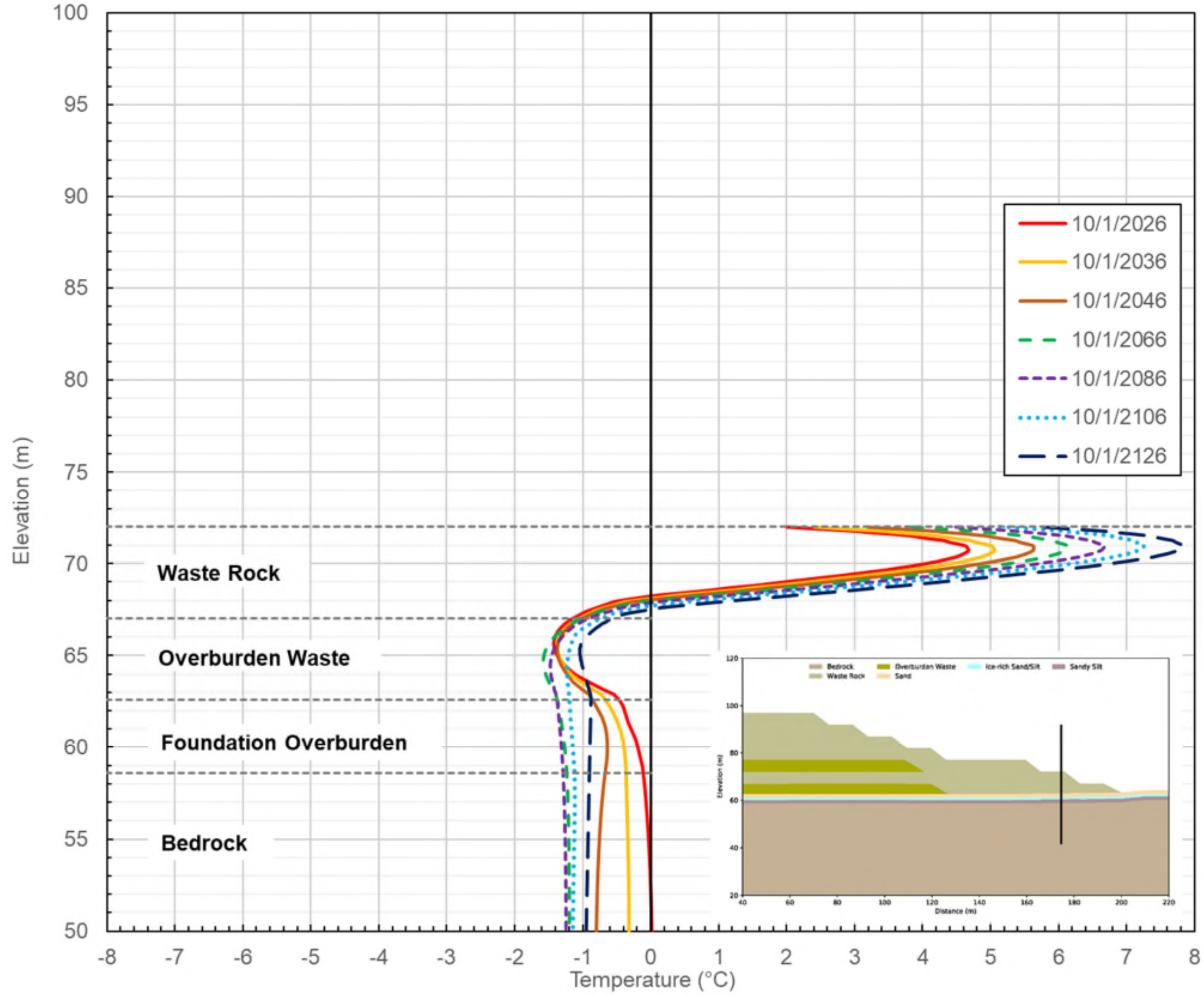
Thermal Analysis of WRSF3 Meliadine Gold Project, NU

Predicted Temperature Profiles on October 1 Below 87 m Bench (about 100 m from the lowest toe of the pile)

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03140-10	JL	GZ	GZ	0

OFFICE	DATE
EBA-EDM	February 7, 2020

Figure 16



LEGEND

NOTES

1. Based on the preliminary waste rock and overburden placement plan developed for the design of WRSF3.
2. Based on the projected long-term air temperatures at Rankin Inlet for CMIP5-RCP4.5 climate change scenario.

STATUS
ISSUED FOR USE

CLIENT
AGNICO EAGLE

TETRA TECH

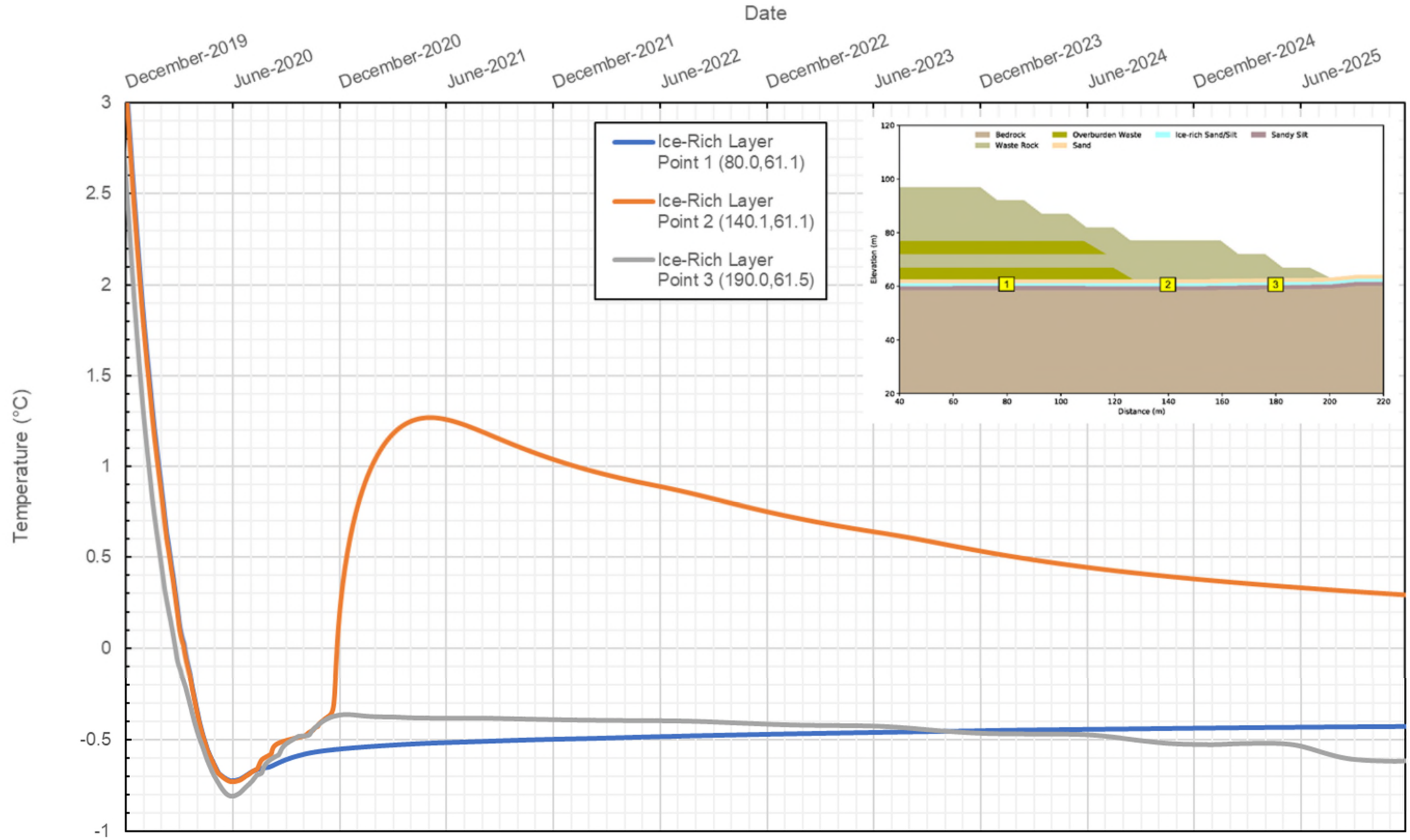
Thermal Analysis of WRSF3
Meliadine Gold Project, NU

Predicted Temperature Profiles on October 1 Below 72 m Bench (about 25 m from the lowest toe of the pile)

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03140-10	JL	GZ	GZ	0

OFFICE	DATE
EBA-EDM	February 7, 2020

Figure 17



LEGEND

NOTES

1. Based on the preliminary waste rock and overburden placement plan developed for the design of WRSF3.

STATUS
ISSUED FOR USE

CLIENT
AGNICO EAGLE

TETRA TECH

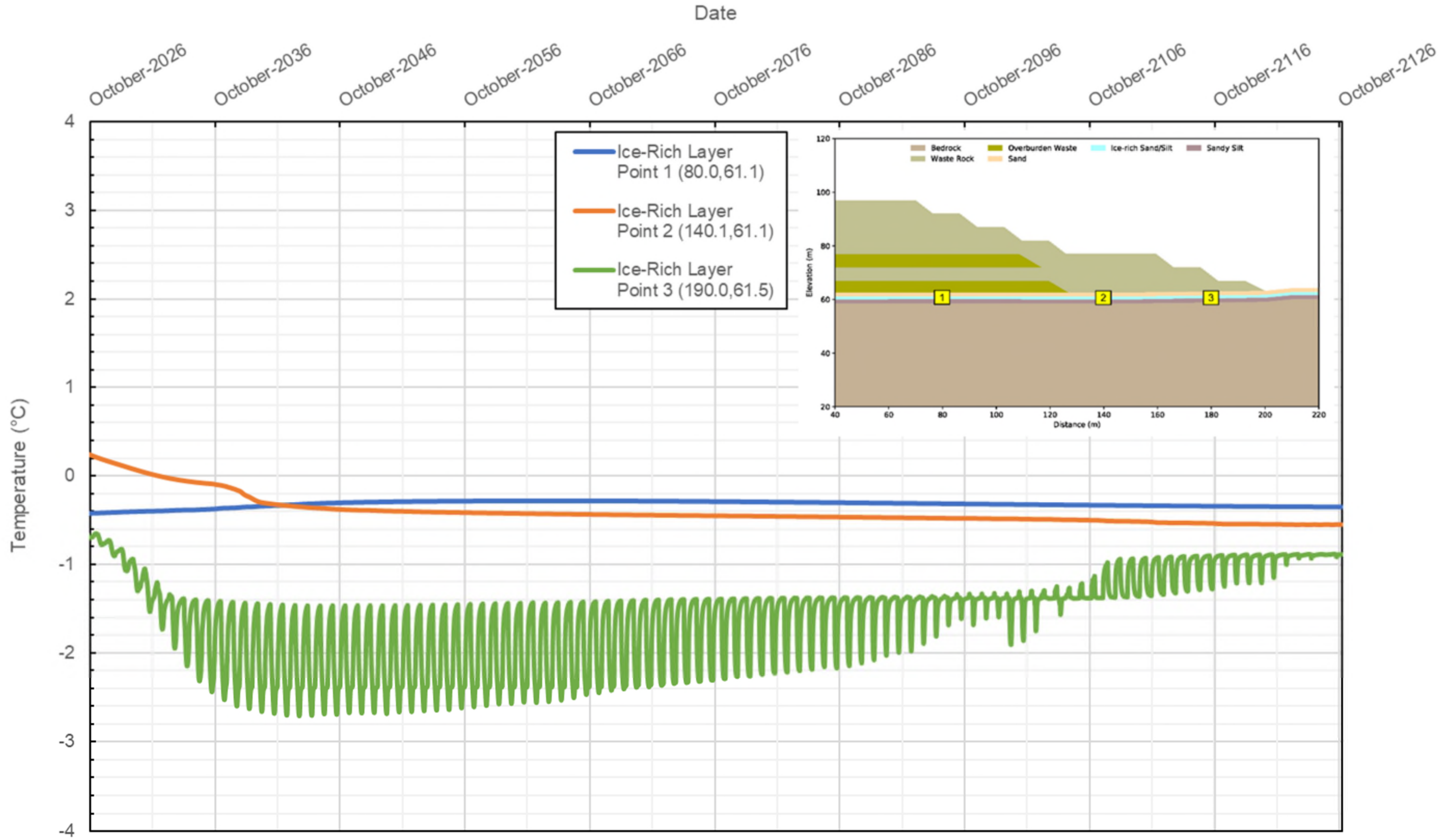
Thermal Analysis of WRSF3
Meliadine Gold Project, NU

Predicted Temperature History of Foundation Soil at 1.5 m below Original Ground Surface During Construction of WRSF3

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03140-10	JL	GZ	GZ	0

OFFICE	DATE
EBA-EDM	February 7, 2020

Figure 18



LEGEND

NOTES

1. Based on the preliminary waste rock and overburden placement plan developed for the design of WRSF3.
2. Based on the projected long-term air temperatures at Rankin Inlet for CMIP5-RCP4.5 climate change scenario.

STATUS
ISSUED FOR USE

CLIENT

AGNICO EAGLE

TETRA TECH

Thermal Analysis of WRSF3
Meliadine Gold Project, NU

Predicted Temperature History of Foundation Soil at 1.5 m below Original Ground Surface After Construction of WRSF3

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03140-10	JL	GZ	GZ	0

OFFICE	DATE
EBA-EDM	February 7, 2020

Figure 19

APPENDIX A

TETRA TECH'S LIMITATIONS ON USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

GEOTECHNICAL

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During the performance of the work and the preparation of this Professional Document, TETRA TECH may have relied on information provided by persons other than the Client.

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This Professional Document is based solely on the conditions presented and the data available to TETRA TECH at the time the data were collected in the field or gathered from available databases.

The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

The Professional Document is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site conditions present, or variation in assumed conditions which might form the basis of design or recommendations as outlined in this report, at or on the development proposed as of the date of the Professional Document requires a supplementary investigation and assessment.

TETRA TECH is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

1.7 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, TETRA TECH has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

1.8 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. TETRA TECH does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

1.9 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

1.10 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. TETRA TECH does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

1.11 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

1.12 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

1.13 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

1.14 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

1.15 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

1.16 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

1.17 SAMPLES

TETRA TECH will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

Appendix C

TETRA TECH

TECHNICAL MEMO

ISSUED FOR USE

To:	Jennifer Pyliuk, P.Eng., Agnico Eagle	**Date:**	February 21, 2020
c:	Bill Horne, P.Eng., Tetra Tech	**Memo No.:**	002
From:	Guangwen (Gordon) Zhang, P.Eng., Tetra Tech	**File:**	ENG.EARC03140-10
Subject:	Stability Analyses for Waste Rock Storage Facility No. 3 (WRSF3), Meliadine Gold Mine, Nunavut		

1.0 INTRODUCTION

Tetra Tech Canada Inc. (Tetra Tech) was retained by Agnico Eagle Mines Ltd. (Agnico Eagle) to conduct the geotechnical design of the Waste Rock Storage Facility No. 3 (WRSF3) for the Meliadine Gold Mine, Nunavut, Canada. The mine site is located on a peninsula between the east, south, and west basins of Meliadine Lake at latitude 63°01'N and longitude 92°13'W and is 25 km northwest of Rankin Inlet, Nunavut.

Slope stability analyses were carried out as a component of the WRSF3 design. The purpose of the slope stability analyses was to assist in developing the typical cross-section and design of WRSF3.

This technical memorandum summarizes the methodology, input parameters, assumptions, and findings of the stability analyses. It is understood that this memorandum will be included as an appendix to the WRSF3 design report to be prepared by Agnico Eagle.

2.0 GENERAL SITE CONDITIONS

2.1 Climate

The Meliadine mine site lies within the Southern Arctic Climatic Region where daylight reaches a minimum of 4 hours per day in winter and a maximum of 20 hours per day in summer. The nearest weather station is Rankin Inlet A (Station 2303401), located approximately 25 km south of the Project site. The monthly mean air temperature is typically above 0°C for the months of June to September and is below 0°C between October and May. July is typically the warmest month and January the coldest. The mean annual air temperature for the 1981 - 2010 Climate Normal period was -10.5°C.

Mean annual precipitation at the mine site, based on the hydrological year from 1 October to 30 September, is estimated to be 412 mm after accounting for rainfall and snowfall undercatch. Approximately 51% of precipitation occurs as rain and 49% occurs as snow (Agnico Eagle 2015).

The region is known for high winds, which are due in part to the broad, flat, uninterrupted expanses offered to moving air masses. The wind blows from the north and north-northwest direction more than 30% of the time. The mean values for wind speed show that the north-northwest, together with north and northwest winds, have the highest speeds and tend to be the strongest. Mean monthly wind speeds are typically between 19 km/hour and 27 km/hour.

Tetra Tech Canada Inc.
14940 - 123 Avenue
Edmonton, AB T5V 1B4 CANADA
Tel 780.451.2121 Fax 780.454.5688

2.2 Subsurface Conditions

A total of 17 diamond drilling boreholes and 9 percussion drilling probe holes were drilled within and around the proposed WRSF3 footprint during several geotechnical site investigation programs (Tetra Tech EBA 2014a, Tetra Tech EBA 2016, Agnico Eagle 2019, Tetra Tech 2020a). The locations of the boreholes and probe holes are presented on Figure 1. In general, the subsurface of the WRSF3 area consists of a thin layer of organic material overlying sand or silty sand or sand and silt or sand and gravel, ice-rich sandy silt or silty sand, silty sand or gravelly sand and silt or silty sand, and bedrock (greywacke, highly weathered to fresh, strong, dark grey, fine grained). Excess ice was observed within the overburden soils in most of the boreholes. 0.1 m to 1.3 m thick ice and sand/silt (ground ice) layers (in the boreholes drilled on land away from the former lakes H19 and H20) were encountered in 8 of the 17 diamond drilling boreholes. The depth to bedrock ranges from 1.7 m to 8.5 m. Table 1 summarizes the key geotechnical information of the overburden soils in the WRSF3 area.

Table 1: Geotechnical Information of Overburden Soils in WRSF3 Area

Borehole No.	General Location	Organic Layer Thickness (m)	Major Overburden Soil Types	Ice Conditions	Depth to Bedrock (m)
GT14-01	Inside WRSF3 Footprint	0.10	Sand; Sand and Silt; Silty Sand; Ice and Silt	0.2 m Ice and Silt	2.25
GT14-02		0.60	Silty Sand; Sandy Silt	Up to 20% Vx, Vr	3.85
BH16-08		0.10	Sand; Ice and Sand; Ice and Silt; Silty Sand; Gravel and Sand	Up to 10% Vc, Vs; 0.15 m Ice and Sand; 0.75 m Ice and Silt	4.30
GT19-08		0.45	Sand; Silty Sand; Sand and Ice; Silty Sand	1.3 m Sand and Ice (up to 60% Vu, Vs; 40% Vx; 1 mm to 2 mm thick ice formations)	3.40
GT19-09		0.45	Silty Sand; Sand; Ice; Sand	0.2 m Ice; Up to 35% Vx, Vc	3.10
GT19-10		0.50	Silty Sand; Cobbles; Sand	Up to 10% Vr; Up to 5% Vs (1 mm thick); Nbn	3.35
GT19-11		0.35	Boulder; Gravelly Sand	Nbn in organic layer	3.35
GT19-12		0.00	Cobble; Sand; Sandy Silt; Boulders	Nbn in top 2 m soils; thawed/unfrozen in remaining overburden soils	4.5
GT14-03	Near WRSF3 Footprint	0.28	Sand and Silt; Sand; Silt	Vs 2%; 1 mm to 2 mm thick ice lens; partially thawed (1 m to 1.5 m)	2.80
GT14-04		0.10	Gravelly Sand; Sand; Silt and Sand	Up to 25% Vc, Vx, Vs (10%, 1 mm to 2 mm thick ice lenses), Vr	4.46
BH16-01		0.13	Sand and Gravel; Ice and Sand; Silty Sand; Ice and Silt; Gravel and Sand	Up to 20% Vx, Vs, Vc; 0.50 m Ice and Sand; 0.50 m Ice and Silt	3.50
BH16-02		0.13	Boulder, Sand and Gravel; Gravelly Sand; Ice and Sand; Silt and Sand	Vx 10%; 0.6 m Ice and Sand from 1.1 m to 1.6 m); 0.60 m Ice and Sand (from 2.1 m to 2.7 m)	6.40
BH16-03		0.00	Gravelly Sand; Sand and Gravel; Silt and Sand; Gravel and Sand	Up to 15% Vx, Vs (10% to 15%, 10 mm thick clear ice lens), Vc	6.50
BH16-04		0.24	Cobbles and Boulders; Gravelly Sand; Silty Sand and Gravel; Silty Sand	Up to 10% Vx, Vs (5% to 10%, 1 mm thick clear ice lenses),Vc	8.50
BH16-05		1.07	Sand and Gravel; Sand; Gravel and Sand; Boulders	Up to 50% Vx, Vs (20 mm thick ice lens); 0.10 m Ice and sand layer	4.90
BH16-06		0.06	Sand and Gravel; Sand; Sand and Silt	Up to 15% Vx, Vs (20 mm thick ice lens)	2.90
BH16-07		0.06	Sand and Silt; Ice and Sand; Silty Gravel and Sand	Up to 20% Vx, Vs; 0.10 m Ice and Sand	6.40
GT19-01		-	-	-	1.70
GT19-02		-	-	-	6.70
GT19-03		-	-	-	2.90
GT19-04		-	-	-	5.60
GT19-05		-	-	-	2.40
GT19-06		-	-	-	2.90
GT19-07		-	-	-	6.10
TH-CP6-01		-	-	-	4.90
TH-CP6-02		-	-	-	4.40

2.3 Ground Temperature and Permafrost Condition

The Project site is located within the Southern Arctic terrestrial eco-zone, one of the coldest and driest regions of Canada, in a zone of continuous permafrost. Data obtained from ground temperature cables (GTCs) installed in some boreholes confirm the presence of continuous permafrost to depths between 360 m and 495 m, with the depth of the active layer ranging from approximately 1 m to 3 m. It is anticipated that the active layer adjacent to lakes or below a body of water could be deeper. Frozen soils have been observed in most of the boreholes drilled on site. The typical permafrost ground temperatures at the depths of zero annual amplitude (typically at the depth of below 15 m) are in the range of -5.0°C to -7.5°C in the areas away from lakes and streams. Limited overburden soil porewater salinity tests (EBA 2013) indicated that the overburden soils may have a porewater salinity of 4 to 12 parts per thousand (ppt). The geothermal gradient ranges from 0.012°C/m to 0.02°C/m (Golder 2012).

Two GTCs were installed in Boreholes GT19-11 and GT19-12 during the late January 2020 site investigation (Tetra Tech 2020a). The latest set of GTC readings were taken on February 8, 2020 (13 days after installation) at GT19-11 and on February 2, 2020 (8 days after installation) at GT19-12. The measured ground temperatures were -2.3°C to -2.5°C at 6 m to 11 m below the ground surface on at GT19-11. The measured ground temperatures were 0.4°C to -0.6°C at 3 m to 8 m below the ground surface at GT19-12.

3.0 WASTE ROCK AND OVERBURDEN PROPERTIES AND PRODUCTION PLAN, AND PRELIMINARY PLACEMENT PLAN FOR WRSF3

3.1 Waste Rock and Overburden Properties

The mine site is within the Rankin Inlet Greenstone Belt. The ore deposits are low-sulphide, gold-quartz vein deposits. The principal lithological units include turbiditic sedimentary rocks, volcanic-hosted and sediment-hosted iron formation, sericite altered siltstones and graphitic argillite, and schistose and carbonate-altered mafic volcanic rocks (Agnico Eagle 2015).

A baseline geochemical characterization program for the mine was initiated in 2008 and consisted of static and kinetic testing methods to assess the chemical composition of the mine waste and overburden, its potential to generate acid rock drainage and its potential for metal leaching (ML) upon exposure to ambient conditions. Based on the waste rock geochemical testing findings, the waste rock from the Tiriganiaq deposit area is considered non-potentially acid generating (NPAG) and has a low potential for ML in view of proposed waste rock management for the Project. The results of geochemical characterization indicated that the overburden produced will be NPAG. Waste rock and overburden have compatible geochemical characteristics such that these materials can be managed together in the same disposal facilities (Agnico Eagle 2015).

3.2 Waste Rock and Overburden Production Plan

Agnico Eagle is developing the waste rock and overburden production plan for the mine. The latest yearly waste rock and overburden production plan was provided by Agnico Eagle in an email on January 29, 2020 (Agnico Eagle 2020a) for the design of WRSF3. It is understood that the waste rock and overburden from Open Pit Tiri_1000_02 in 2020 will be placed in WRSF3. The monthly waste rock and overburden placement plan in 2020 for WRSF3 was provided by Agnico Eagle in an email on February 3, 2020 (Agnico Eagle 2020b) for the design of WRSF3. Based on the current yearly waste rock and overburden production plan, the waste rock and overburden will not be placed in WRSF3 in 2021 and 2022. In 2023 to 2025, the waste rock (or overburden) will be placed in WRSF3 until its design capacity is reached.

3.3 Preliminary Waste Rock and Overburden Placement Plan for WRSF3

Agnico Eagle is developing the waste rock and overburden placement plan for mine waste storage facilities including WRSF3. The plan also depends on the final design of WRSF3, which is currently being developed. A preliminary waste rock and overburden placement plan was adopted for thermal and stability evaluations for WRSF3 based on Agnico Eagle (2020a, 2020b). Further details on the plan are presented in Tetra Tech (2020b). Table 2 summarizes the preliminary waste rock and overburden placement plan for the design of WRSF3.

Table 2: Preliminary Waste Rock and Overburden Placement Plan for Design of WRSF3

Location of Mine Waste Placement	Approximate Period of Mine Waste Placement	Period when the Majority of Mine Waste Materials are Placed
Bench 67 m of overburden waste	April and May 2020	April and May 2020
Bench 77 m of overburden waste or waste rock	May to July 2023 and January 2024	May to July 2023
Bench 67 m of waste rock	May to July 2020	May and June 2020
Bench 72 m of waste rock	July to December 2020	July to December 2020
Bench 77 m of waste rock	August to October 2023	August to October 2023
Bench 82 m of waste rock	June to August 2024	June to August 2024
Bench 87 m of waste rock	September to December 2024	November to December 2024
Bench 92 m of waste rock	June to August 2025	June to August 2025
Bench 97 m of waste rock	September to December 2025	November to December 2025

Bench 77 m may contain overburden waste in the center portion, and waste rock around the perimeter, or it may contain only waste rock. The stability analyses in this memorandum assumed the Bench 77 m contained overburden waste and waste rock. This is the more critical case.

4.0 STABILITY ANALYSIS METHODOLOGY AND ACCEPTANCE CRITERIA

4.1 Methodology

Limit equilibrium analyses were conducted to determine the factor of safety against slope failure during construction and in the long term after the construction of WRSF3. All analyses were conducted using the two-dimensional, limit equilibrium software, Slope/W of GeoStudio 2016 (Geo-Slope International Ltd., Version 8.16.1.13452). The Morgenstern-Price method with a half-sine interslice force assumption was adopted in the analyses. The analyses were conducted to evaluate the slope stability of WRSF3 during several stages of construction and post-construction. Potential post-construction seismic loading was modelled as pseudo-static with a design horizontal peak acceleration.

The principles underlying the method of limit equilibrium analyses of slope stability are as follows:

- A slip mechanism is postulated;
- The shear resistance required to equilibrate the assumed slip mechanism is calculated by means of statics;
- The calculated shear resistance required for equilibrium is compared with the available shear strength in terms of factor of safety; and

- The slip surface with the lowest factor of safety is determined through iteration.

A design factor of safety is used to account for the uncertainty and variability in the strength and pore water pressure parameters, and to limit deformations.

4.2 Stability Acceptance Criteria for Factors of Safety

The *Guidelines for Mine Waste Dump and Stockpile Design* (Hawley and Cunning 2017) provides guidelines for assigning stability criteria and factors of safety for various waste rock pile configurations and site conditions. The suggested stability acceptance criteria from Hawley and Cunning (2017) are based on the failure consequence and confidence level in foundation conditions, waste material properties, piezometric pressures, overall fill slope angles, height of repose angle slopes, and precipitation. The guidelines in Hawley and Cunning (2017) are considered an update to the previous (PAE 1991) interim design acceptability criteria, which did not specifically distinguish between factors such as the size of facility, consequence of failure, or confidence in foundation conditions. Therefore, the design acceptance criteria for the analyses in this study are based on the guidelines in Hawley and Cunning (2017).

Hawley and Cunning (2017) provides detailed guidelines on how to classify the consequence of failure and the confidence level. The guidelines are quoted below:

> *"Consequence of Failure:*
>
> *Low – waste dumps and stockpiles with overall fill slopes less than 25° and less than 100 m high and repose angle slopes less than 50 m high. No critical infrastructure or unrestricted access within potential runout shadow. Limited potential for environmental impact. Long-term (more than 5 years) exposure for sites subject to very low to low (less than 350 mm) annual precipitation; medium-term (1 to 5 years) exposure for sites subject to moderate (350 mm to 1,000 mm) annual precipitation; short-term (less than 1 year) exposure for sites subject to high (1,000 mm to 2,000 mm) annual precipitation; dry season construction/operation only for sites subject to very high (more than 2,000 mm) annual precipitation or intensive rainy season(s).*
>
> *Moderate – waste dumps with overall fill slopes less than 30° and less than 250 m high or repose angle slopes less than 100 m high. No critical infrastructure or unrestricted access, or robust containment/mitigative measures to protect critical infrastructure and access within potential runout shadow. Potential for moderate environmental impact, but manageable. Long-term (more than 5 years) exposure for sites subject to moderate (350 mm to 1,000 mm) annual precipitation; medium-term (1 to 5 years) exposure for sites subject to high (1,000 mm to 2,000 mm) annual precipitation; short-term (less than 1 year) exposure for sites subject to very high (more than 2,000 mm) annual precipitation or intensive rainy season(s).*
>
> *High – waste dumps with overall fill slopes more than 30° and more than 250 m high, or with repose angle slopes more than 200 m high. Critical infrastructure or unrestricted access within potential runout shadow with limited runout mitigation/containment measures. Potential for high environmental impact that would be difficult to manage. Long-term exposure (more than 5 years) for sites subject to high (1,000 mm to 2,000 mm) annual precipitation; medium-term (1 to 5 years) exposure for sites subject to very high (more than 2,000 mm) annual precipitation or intensive rainy season(s).*

Confidence Level:

Low – limited confidence in foundation conditions, waste material properties, piezometric pressures, analysis technique, or potential instability mechanism(s). Poorly defined or optimistic input parameters; high data variability. For proposed structures, investigations at the conceptual level with limited supporting data. For existing structures, poorly documented or unknown construction and operational history; lack of monitoring records; unknown or poor historical performance.

Moderate – moderate confidence in foundation conditions, waste material properties, piezometric pressures, analysis technique, or potential failure mechanism(s). Input parameters adequately defined; moderate data variability. For proposed structures, investigations at the pre-feasibility study level with adequate supporting data. For existing structures, reasonably complete construction documentation and monitoring records; fair historical performance.

High – high confidence in foundation conditions, waste material properties, piezometric pressures, analysis technique, and instability mechanism(s). Well-defined, conservative input parameters; low data variability. For proposed structures, investigations at the feasibility study level with comprehensive supporting data. For existing structures, well-documented construction and monitoring records and good historical performance."

The stability acceptance criteria for the WRSF3 design have been adopted to capture different slope slip mechanisms, failure consequence, and confidence levels in stability analysis input parameters, key assumptions, and site conditions. Table 3 summarizes the stability criteria for the design of WRSF3.

Table 3: Adopted Stability Criteria for WRSF3 Design

Potential Failure Mechanism and Conditions	Consequence of Failure	Confidence Level	Minimum Factor of Safety for Static Loading	Minimum Factor of Safety for Pseudo-static Loading
Surficial, shallow slips	Low	High	1.10	1.00
Deep-seated slips for cases with assumed unfrozen foundation soils or thawing foundation soils	Low to Moderate	Low to Moderate	1.40	1.10
Deep-seated slips for cases with assumed warm ice-rich sand/silt (frozen) in foundation soils (conservative assumption)	Low to Moderate	Moderate to High	1.25	1.05

The consequence of failure and confidence level in Table 3 are based on the following considerations:

- The surficial, shallow slips are classified as low consequence (the small size of the potential slip material) and high confidence level due to reasonably conservative strength parameters assumed for surficial waste rock and overburden.
- The consequence of failure is classified as low to moderate for deep-seated slips. This is due to the following factors:
  - Relatively moderate size of slip material if failure occurs;
  - Potential for minimal or manageable environmental impact if failure occurs;

  - Overall design slope of 24.2° or flatter from crest to toe for WRSF3, which is less than 25° (for low consequence of failure);
  - Maximum height of 35 m for WRSF3 (less than 100 m for low consequence of failure);
  - Repose angle slopes of 5 m high (less than 50 m high for low consequence of failure);
  - Moderate (mean annual precipitation of 412 mm, which is between 350 mm and 1,000 mm) annual precipitation;
  - Limited infrastructure (CP6, CP6 Berm, and haul roads) close to WRSF3 during the operation period of the mine; and
  - No permanent infrastructures around WRSF3 after mine closure.
- For deep-seated slips, the confidence level in the analysis input parameters and assumptions is low to moderate for the cases with assumed unfrozen foundation soils or thawing foundation soils. The confidence level is moderate to high for the cases with assumed warm ice-rich layer in foundation soils, which is a conservative assumption.

5.0 STABILITY ANALYSIS INPUT DATA AND CASES

5.1 Foundation Soil Profile and Material Properties

The foundation geotechnical conditions underlying the WRSF3 area are summarized in Section 2.2. Accordingly, this information was used to develop a generalized foundation soil profile for the stability analyses of WRSF3. It was assumed that the original ground (before waste placement) consists of 1.5 m sand, 1.0 m ice-rich sand/silt, 1.5 m sandy silt over bedrock. The thin organic layer (0.0 m to 0.6 m thick) over the original ground was not specifically modelled in the stability analyses. It is expected that the organic layer will be compressed under loads from waste rock and overburden, and its shear strength parameters would be close to the underlying overburden soils. Therefore, any local presence of the compressed organic layer can be represented by the equivalent underlying overburden soils in the stability analyses.

Soil strength tests on samples from the mine site are limited. A laboratory consolidated-undrained triaxial test on a silty sand overburden sample was conducted in EBA (2013). The sample was taken from a borehole drilled in an area more than 1,500 m west of WRSF3. The test indicated the soil had an inferred peak internal angle of friction of 36°. This value is on the high side for a silty sand. In this study, the effective angles of internal friction for the foundation soils were assumed to be lower, which is on the conservative side.

Of importance to the slope stability assessment is the strength of the ice-rich sand/silt in the foundation. The long-term cohesion of the ice-rich sand/silt depends on its temperatures – the colder the soil, the higher its long-term cohesion. The long-term cohesion of the frozen ice-rich sand/silt was adopted based on Weaver and Morgenstern (1981) and then adjusted for the frozen fraction (change with soil temperature) of the soil porewater for an assumed porewater salinity of 7 ppt. Thermal analyses for WRSF3 in Tetra Tech (2020b) indicate that the predicted temperatures of the ice-rich sand/silt slightly vary with location and time, and are generally within the range of -0.3°C to -0.9°C for the majority of the soil within the WRSF3 footprint. This temperature range was used to estimate the long-term cohesion of the ice-rich foundation layer for stability analysis cases with an assumed warm ice-rich layer in foundation soils.

Table 4 summarizes the material properties used for the WRSF3 stability analyses.

Table 4: Material Properties Used in WRSF3 Stability Analyses

Material	Thickness (m)	Effective Angle of Internal Friction (º)	Cohesion (kPa)	Unit Weight (kN/m³)
Waste Rock Zone 1 (0 to 15 m depth)	Up to 15	42	0	19
Waste Rock Zone 2 (16 m to 30 m depth)	Up to 15	40	0	19
Overburden Waste	Up to 5	28	0	17
Sand (within the original active layer)	1.5	31	0	20
Unfrozen (ice-rich) Sand/Silt (after thaw)	1.0	28	0	17
Warm Ice-rich Sand/Silt (predicted temperatures of -0.3°C to -0.9°C)	1.0	0	40 (static loading); 60 (seismic loading)	16
Sandy Silt (ice-poor)	1.5	32	0	21

5.2 Other Input Parameters

An assumed piezometric line, together with a pore pressure coefficient, $\bar{B}$ was used in each of the analyses to simulate pore water conditions. $\bar{B}$ is defined as a ratio of the excess pore-pressure generated in a given soil to the change in vertical stress in the soil due to fill placement above the original ground surface. The following values of $\bar{B}$ were applied in the stability analyses:

- 0.1 in the unfrozen sand layer in the overburden soils in modeling the excess pore-pressure that can be potentially generated in the top sand layer during mine waste placement;
- 0.2 in the unfrozen sand/silt to model the excess pore-pressure that can be potentially generated in the soil during mine waste placement;
- 0.1 in the thawing sand layer to model the excess pore-pressure that can be potentially generated in the thawing soil for several analysis cases;
- 0.2 in the thawing ice-rich sand/silt to model the excess pore-pressure that can be potentially generated in the thawing soil for several analysis cases;
- 0.0 in the bottom sandy silt foundation soil; and
- 0.0 for the remaining soils and cases.

The Project site is situated in an area of low seismic risk. The peak ground acceleration (PGA) under a potential earthquake for the Project area was estimated from the 2015 National Building Code of Canada seismic hazard website (http://www.earthquakescanada.nrcan.gc.ca/hazard-alea/interpolat/calc-en.php). The estimated PGA is 0.022 g for a 5% in 50-year probability of exceedance (0.001 per annum or 1 in 1,000 year return) and 0.037 g for a 2% in 50-year probability of exceedance (0.000404 per annum or 1 in 2,475 year return) for the area. In this study, the horizontal PGA of 0.037 g was used for the analyses under seismic (pseudo-static) loading conditions.

Liquefaction (under both static and cyclic loading) potential of the overburden waste and foundation overburden soils for WRSF3 is very low due to the following factors:

- The foundation overburden soils are predicted to be in partially or frozen conditions in the long term, except for a small zone of seasonal unfrozen soils in the active layer close to the lowermost toe of WRSF3;
- The overburden waste is expected to be in unsaturated conditions during waste placement and is predicted to be in partially or frozen conditions in the long term (after freeze back if initially placed in unfrozen conditions); and
- The mine site is in an area of low seismic risk.

As a result, soil properties for liquefied overburden soils were not used in the stability analyses for WRSF3.

5.3 Cases Evaluated

Various preliminary stability analyses were undertaken to develop the typical design section for WRSF3. The typical design section and final design geometry of WRSF3 will be presented in the design drawings to be attached to the WRSF3 design report.

Two design sections (Sections A and B) were evaluated in the final stability analyses. Figure 2 shows the locations of the two sections in the WRSF3 plan. Figure 3 presents the section details for Sections A and B. These sections were selected based on the following:

- Section A was selected to represent the typical section for the area where the WRSF3 waste rock and overburden will be placed within the footprints of the former lakes H19 and H20, which were partially dewatered in early October 2019; and
- Section B was selected to represent the typical section for the area where the original ground close to the nearest WRSF3 footprint has higher elevations and upward slopes, which are favorable for slope stability, such that a different design section (with an overall steeper slope than that for Section A) is proposed.

Various conditions were evaluated for WRSF3:

- Slope stability under static loading during short-term stage-construction;
- Slope stability under static loading under long-term post-construction conditions;
- Slope stability under seismic (pseudo-static) loading during long-term after construction; and
- Other parametric sensitivity analysis cases.

6.0 FINAL STABILITY ANALYSIS RESULTS FOR DESIGN OF WRSF3

The factors of safety calculated in the stability analyses for WRSF3 are summarized below in Table 5 together with the required minimum factors of safety. Figures 4 to 21 present selected slope stability analysis cases and results.

Table 5: Summary of Slope Stability Analysis Results for WRSF3

Section	Conditions		Required Minimum Factor of Safety	Calculated Minimum Factor of Safety	Figure No.	Comments
A	Placement of waste rock and overburden during construction, static loading	Bench 67.0 m of waste rock and overburden	1.40	1.59	4	Assumed unfrozen sand/silt beneath Bench 67 m waste rock; assumed excess pore-pressure in unfrozen sand and sand/silt layers due to mine waste placement
			1.25	1.49	5	Assumed warm ice-rich sand/silt (with a long-term cohesion of 40 kPa) in the foundation
		Bench 77 m of waste rock and overburden	1.40	1.72	6	Same assumptions as for the case in Figure 4 (for Bench 67 m with unfrozen sand and unfrozen sand/silt beneath Bench 67 m waste rock)
			1.25	1.43	7	Assumed warm ice-rich sand/silt in the foundation
		Bench 87 m of waste rock	1.40	1.72	8	Same assumptions as for the case in Figure 4
			1.25	1.35	9	Assumed warm ice-rich sand/silt in the foundation
		Bench 97 m of waste rock	1.40	1.72	10	Same assumptions as for the case in Figure 4
			1.25	1.25	11	Assumed warm ice-rich sand/silt in the foundation
	Long term after construction (during mine operation with the maximum water elevation in CP6 of 60.0 m)	Static loading	1.25	1.25	12	Assumed warm ice-rich sand/silt in the foundation
		Seismic loading	1.05	1.20	13	Assumed warm ice-rich sand/silt (a cohesion of 60 kPa under seismic loading) in the foundation; seismic loading with a horizontal peak acceleration of 0.037 g
		Static loading	1.40	1.71	14	Assumed thawing ice-rich sand/silt in the foundation
		Seismic loading	1.10	1.54	15	Assumed thawing ice-rich sand/silt in the foundation; seismic loading with a horizontal peak acceleration of 0.037 g

Table 5: Summary of Slope Stability Analysis Results for WRSF3

Section	Conditions		Required Minimum Factor of Safety	Calculated Minimum Factor of Safety	Figure No.	Comments
	Long term after mine closure with the maximum water elevation in the CP6 area of approximately 64.0 m (the original H19 outlet elevation after CP6 Berm is breached)	Static loading	1.25	1.27		Assumed warm ice-rich sand/silt in the foundation
		Seismic loading	1.05	1.21		Assumed warm ice-rich sand/silt (a cohesion of 60 kPa under seismic loading) in the foundation; seismic loading with a horizontal peak acceleration of 0.037 g
		Static loading	1.40	1.72		Assumed thawing ice-rich sand/silt in the foundation
		Seismic loading	1.10	1.54		Assumed thawing ice-rich sand/silt in the foundation; seismic loading with a horizontal peak acceleration of 0.037 g
	Shallow surficial slip along waste rock side slopes	Static loading	1.10	1.18		Shallow surficial slip along waste rock side slopes
		Seismic loading	1.00	1.09		Shallow surficial slip along waste rock side slopes; seismic loading with a horizontal peak acceleration of 0.037 g
B	Placement of waste rock and overburden during construction, static loading	Bench 82 m of waste rock	1.25	1.61	16	Assumed warm ice-rich sand/silt (with a long-term cohesion of 40 kPa) in the foundation
		Bench 92 m of waste rock	1.25	1.56	17	Same assumptions as for the case in Figure 16
	Long term after construction	Static loading	1.25	1.44	18	Assumed warm ice-rich sand/silt in the foundation
		Seismic loading	1.05	1.37	19	Assumed warm ice-rich sand/silt (a cohesion of 60 kPa under seismic loading) in the foundation; seismic loading with a horizontal peak acceleration of 0.037 g
		Static loading	1.40	1.57	20	Assumed thawing ice-rich sand/silt in the foundation
		Seismic loading	1.10	1.44	21	Assumed thawing ice-rich sand/silt in the foundation; seismic loading with a horizontal peak acceleration of 0.037 g

The results in Table 5 suggests that the calculated minimum factor of safety for each stability analysis is equal to or greater than the required minimum factor of safety.

7.0 DEFORMATIONS OF WRSF3 AND ITS FOUNDATION

It is expected that some of the waste materials (especially the overburden waste), which are to be placed in frozen conditions and within the active layer (annual freeze-thaw) zones, will settle when they are initially thawed during the thawing seasons after placement. Most of the thaw settlement will occur during the construction period or several years after the waste placement. The settlement is acceptable and not expected to be detrimental to the overall stability of WRSF3.

Ice-rich soils tend to creep under shear loading. The ice-rich sand/silt layer in the foundation of WRSF3 may creep under loading of the waste rock and overburden. The magnitude of the creep-induced deformations will mainly depend on the stress state, temperature, and porewater salinity of the ice-rich layer.

A soil deformation analysis to consider the long-term creep of the ice-rich sand/silt layer in the foundation was conducted to evaluate the potential long-term deformation behaviours of the TSF in Tetra Tech EBA (2014b). The analysis was carried out using FLAC 7.0, a commercial two-dimensional explicit finite-difference program for engineering applications. The modelled section of the TSF in the analysis had a maximum height of 33 m and side slopes of 3H:1V to 4H:1V. The analysis results were documented in Tetra Tech EBA (2014b).

The potential horizontal and vertical deformations of WRSF3 due to the creep of the ice-rich sand/silt layer in the foundation were assessed based on the analysis results for the TSF and then adjusted for the maximum height of WRSF3 and the predicted temperatures in the ice-rich sand/silt layer for WRSF3 in Tetra Tech (2020b). The estimated maximum horizontal deformation in WRSF3 is 10 mm to 60 mm per year. The estimated maximum vertical deformation is 5 mm to 30 mm per year. It is expected that the ice-rich sand/silt layer will deform in a primary or secondary creep state and undergo ductile deformation. WRSF3 can tolerate the deformations. The estimated deformations assumed a continuous layer of the ice-rich sand/silt layer in the foundation of WRSF3. This is likely conservative; therefore, the actual deformations of WRSF3 could be smaller.

8.0 SUMMARY AND RECOMMENDATIONS

A series of slope stability analyses were carried out to assist in developing the typical design section and final design of WRSF3. The results of the analyses for the final design sections indicate that the calculated minimum factors of safety for WRSF3 meet or exceed the adopted minimum factors of safety for design under various conditions.

The current design sections and geometry of WRSF3 are based on the waste rock and overburden production plan that was provided by Agnico Eagle (2020a, 2020b) and the corresponding preliminary waste rock and overburden placement plan that was developed for the design of WRSF3. It is recommended that the current design of WRSF3 and the associated thermal and stability analyses be reviewed or updated (if required) if the final waste rock and overburden placement plan for WRSF3, especially the placement plan for the initial benches (67 m and 72 m), is different from that simulated in the thermal analysis in Tetra Tech (2020b).

It is recommended that the maximum lift thickness during waste placement be limited to 2.5 m for the overburden waste and to 5.0 m for the waste rock.

A large portion of the proposed WRSF3 footprint is over the former lakes H19 and H20, which were dewatered in early October 2019. A layer of solid/clear ice (up to 0.42 m thick) was found at the ground surface in the three boreholes (0.07 m ice in GT19-10 over the land away from the lakes; 0.29 m ice in GT19-11 at the edge of H20; and 0.42 m ice in GT19-12 in H19) drilled in the WRSF3 area in late January 2020. This suggests that the lakes H19 and H20 were not completely dewatered before the remaining water froze last fall. This was confirmed by Agnico Eagle (2020c). This former lake ice layer together with any snow/ice within the WRSF3 footprint would be detrimental to the stability and performance of WRSF3 and therefore should be completely removed before placing the waste rock and overburden in WRSF3. The current design of WRSF3 assumes that the ice/snow layer will be completely removed. Without removing the ice/snow layer, the stability and performance of WRSF3 will be compromised and the current design of WRSF3 needs to be updated.

It is recommended that regular visual inspection of WRSF3 be taken during and after the construction of WRSF3 to identify any signs of excess deformations, instability, or distress. If any of those signs are identified, the information should be provided to Tetra Tech to evaluate the root cause and develop a mitigation plan if required.

9.0 CLOSURE

Use of this memo is subject to Tetra Tech's Limitations on Use of this Document which are attached in Appendix B. We trust this technical memo meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech Canada Inc.

REGISTERED PROFESSIONAL ENGINEER
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LICENSEE
NWT/NU
Feb 21, 2020

FILE: ENG.EARC03140-10
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PERMIT TO PRACTICE
TETRA TECH CANADA INC.

Signature ______________

Date Feb 20, 2020

PERMIT NUMBER: P 018

NT/NU Association of Professional Engineers and Geoscientists

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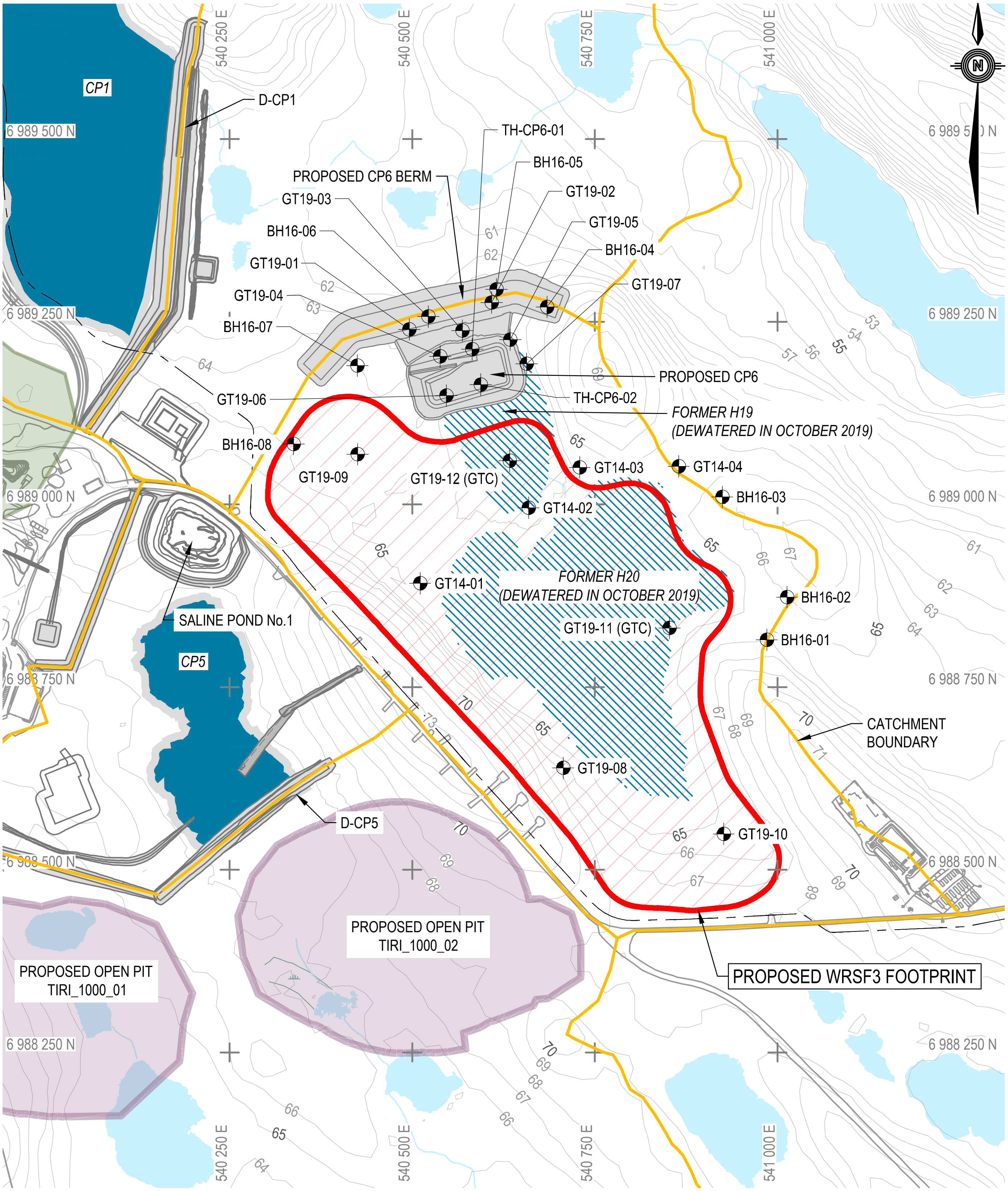
APPENDIX A

FIGURES



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LEGEND:

BOREHOLE

0 250m

Scale: 1:7,500 @ 8.5"x11"

CLIENT

AGNICO EAGLE

TETRA TECH

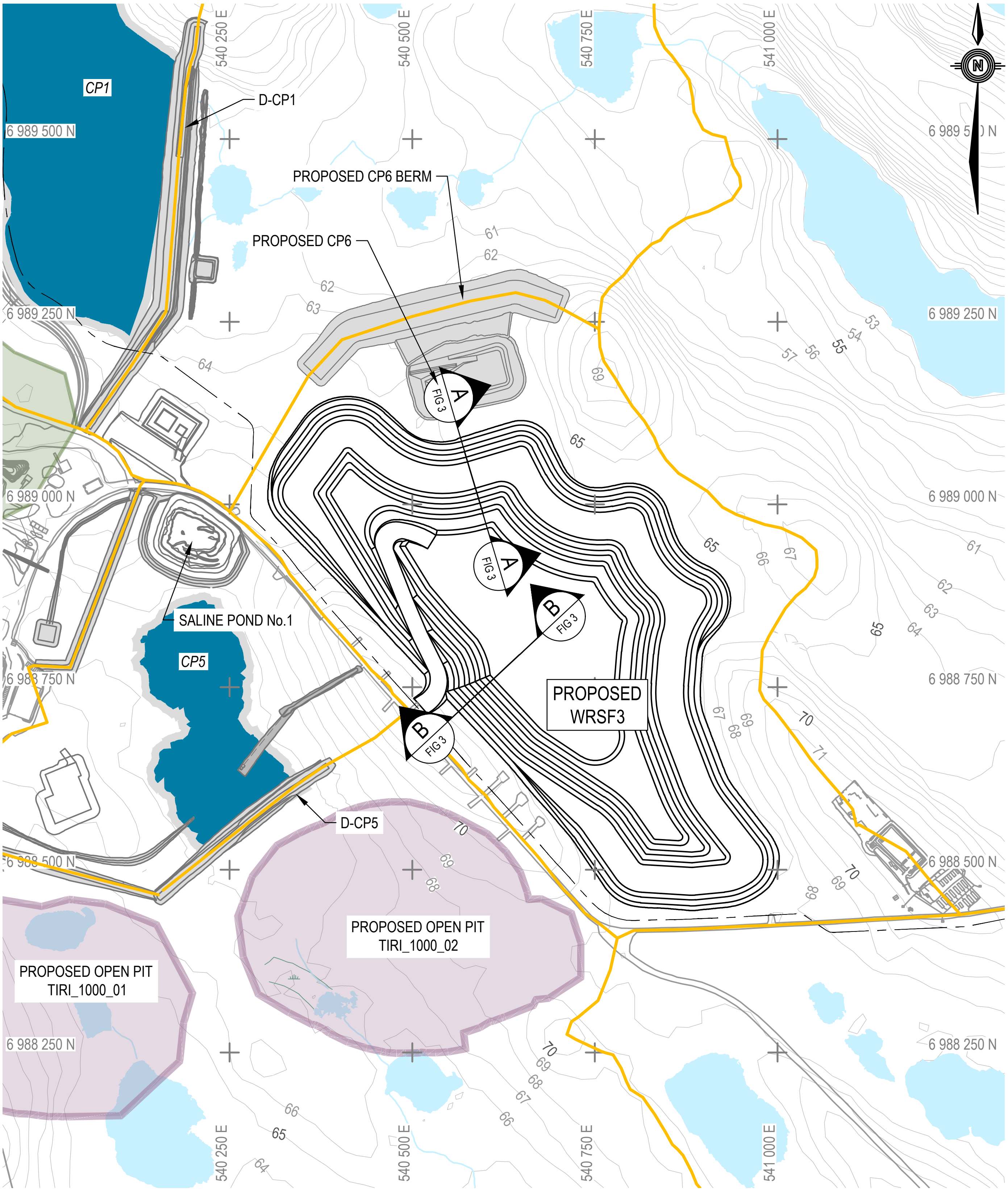
STABILITY ANALYSIS OF WRSF3
MELIADINE GOLD PROJECT, NU

PROPOSED WRSF3 FOOTPRINT
WITH BOREHOLE LOCATIONS

PROJECT NO.	DWN	CKD	REV
ENG.EARC03140-10	EL	GZ	A

OFFICE	DATE
EDMONTON	FEBRUARY 14, 2020

FIGURE 1



CLIENT

AGNICO EAGLE

TETRA TECH

STABILITY ANALYSIS OF WRSF3
MELIADINE GOLD PROJECT, NU

LOCATION OF SECTIONS A AND B
FOR STABILITY ANALYSIS

PROJECT NO.	DWN	CKD	REV	
ENG.EARC03140-10	EL	GZ	A	**FIGURE 2**
OFFICE	DATE			
EDMONTON	FEBRUARY 14, 2020			

0 250m
Scale: 1:7,500 @ 8.5"x11"

Q:\Edmonton\Engineering\E141\Projects_MELIADINE\EARC03140-10_WRSF3\Production Drawings\Figure 2-For Stability Analysis.dwg [FIGURE 2] February 14, 2020 - 11:13:07 am (BY: LEE, ELVIN)

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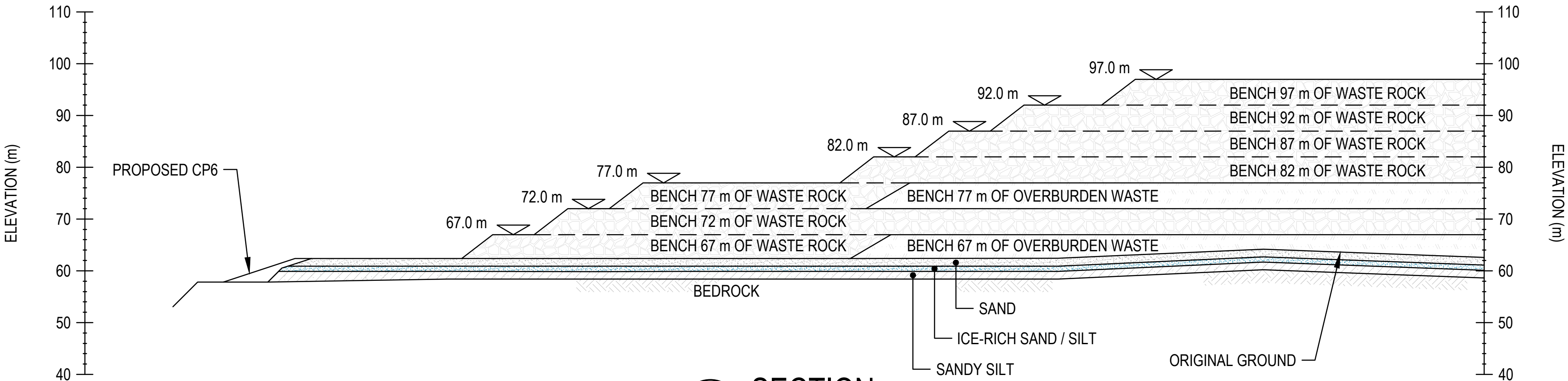
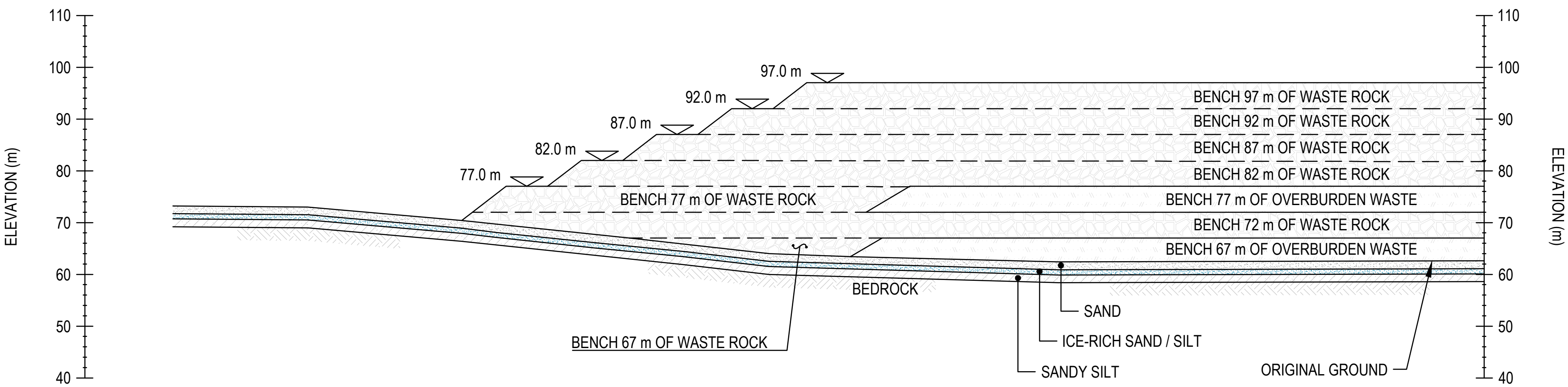


A
FIG 2
SECTION
SCALE: 1:1250



B
FIG 2
SECTION
SCALE: 1:1250

0 50m

Scale: 1:1,250 @ 8.5"x11"

CLIENT

AGNICO EAGLE

TETRA TECH

STABILITY ANALYSIS OF WRSF3
MELIADINE GOLD PROJECT, NU

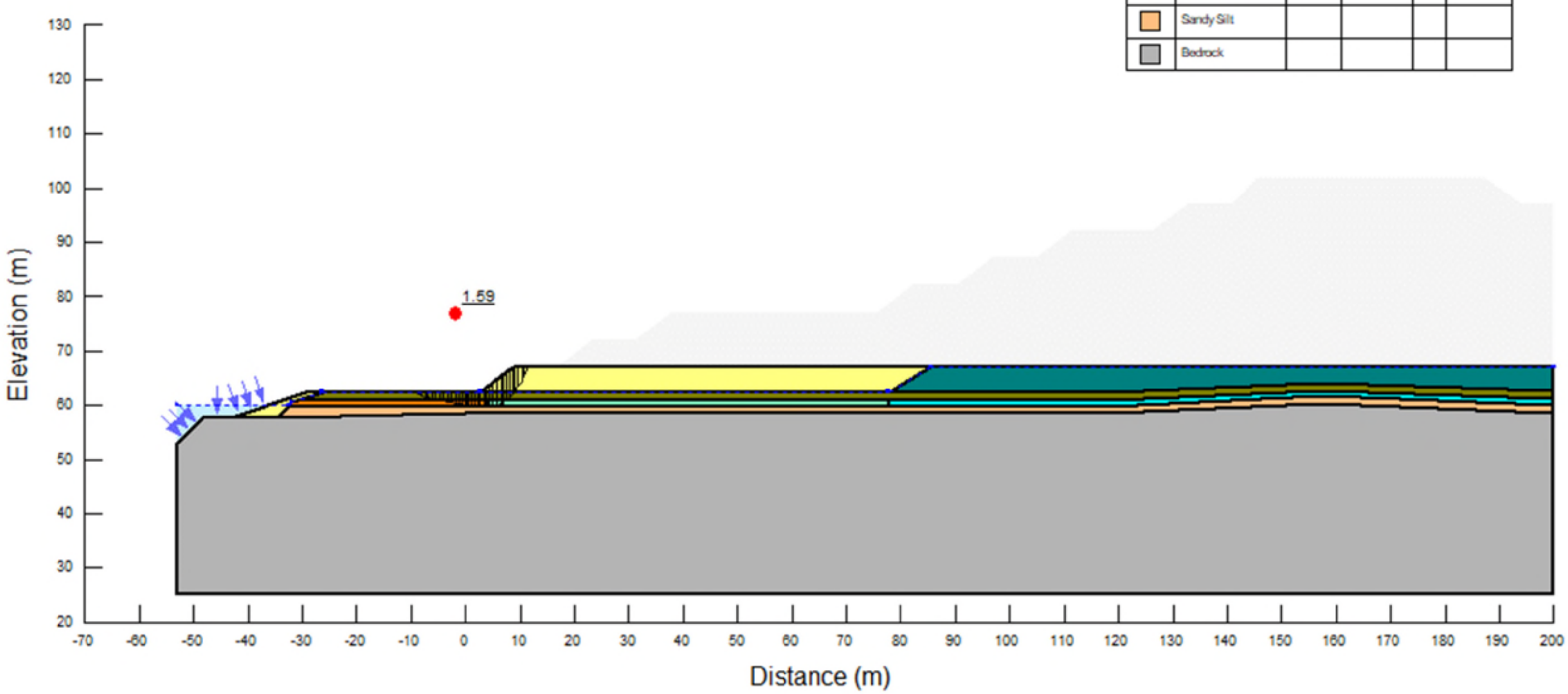
TYPICAL SECTIONS FOR
STABILITY ANALYSIS OF WRSF3

PROJECT NO.	DWN	CKD	REV
ENG.EARC03140-10	EL	GZ	A

OFFICE	DATE
EDMONTON	FEBRUARY 14, 2020

FIGURE 3

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Cohesion (kPa)
	Waste Rock Zone 1 (<= 15 m depth)	19	0	42	
	Overburden Waste	17	0	28	
	Sand	20	0	31	
	Unfrozen Sand/Silt	17	0	28	
	Warm Ice-Rich Sand/Silt	16			40
	Thawing Ice-Rich Sand/Silt	16	0	28	
	Sandy Silt				
	Bedrock				



LEGEND

NOTES

Note: During Construction, Static Loading

STATUS
ISSUED FOR USE

CLIENT

AGNICO EAGLE

TETRA TECH

Stability Analysis of WRSF3
Meliadine Gold Project, NU

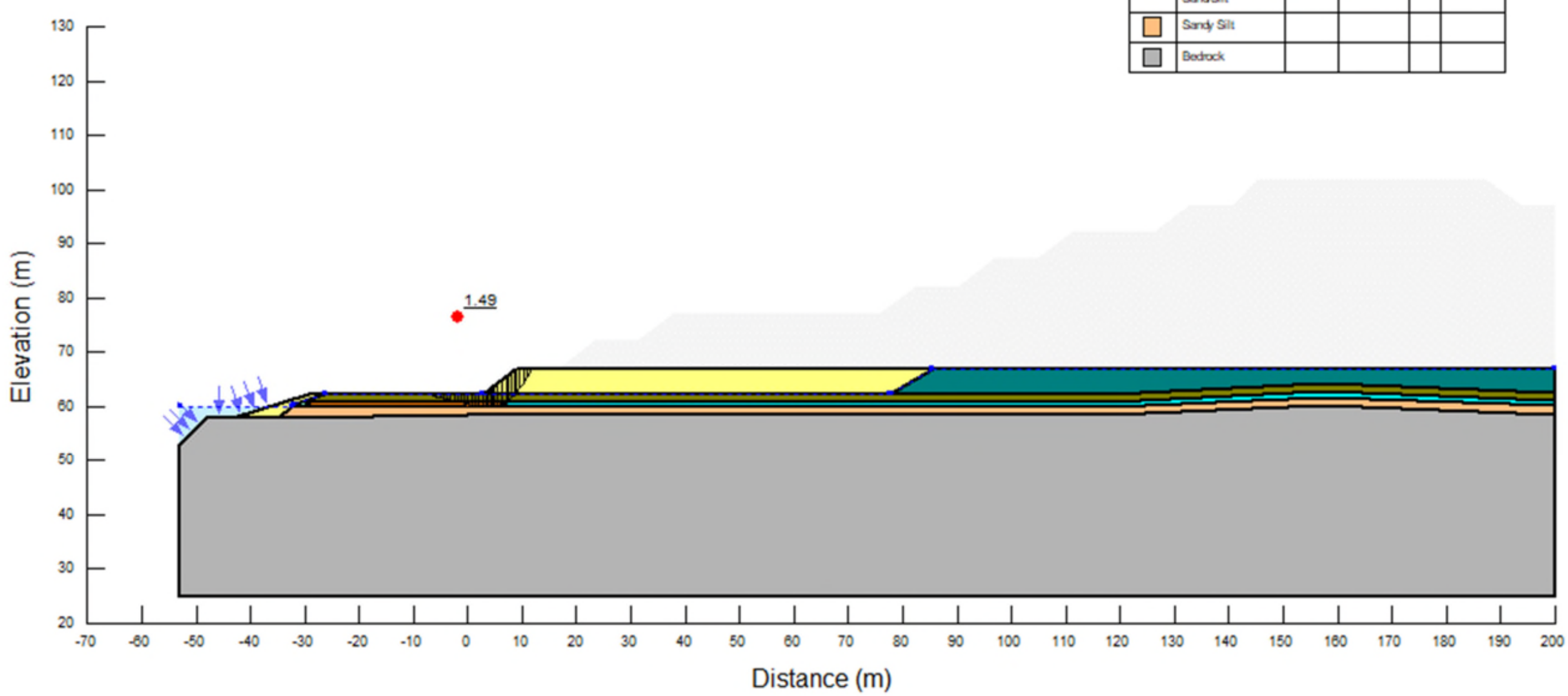
Section A
Bench 67.0 m of Waste Rock and Overburden during Construction (assumed unfrozen sand/silt beneath Bench 67 m waste rock)

PROJECT NO.	DWN	CKD	APVD	REV
ENG.EARC03140-10	GZ	WTH	WTH	A

OFFICE	DATE
EBA-EDM	February 2020

Figure 4

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Cohesion (kPa)
	Waste Rock Zone 1 (<= 15m depth)	19	0	42	
	Overburden Waste	17	0	28	
	Sand	20	0	31	
	Unfrozen Sand/Silt	17	0	28	
	Warm Ice-Rich Sand/Silt	16			40
	Thawing Ice-Rich Sand/Silt	16	0	28	
	Sandy Silt				
	Bedrock				



LEGEND

NOTES

Note: During Construction, Static Loading

STATUS
ISSUED FOR USE

CLIENT
AGNICO EAGLE

TETRA TECH

Stability Analysis of WRSF3
Meliadine Gold Project, NU

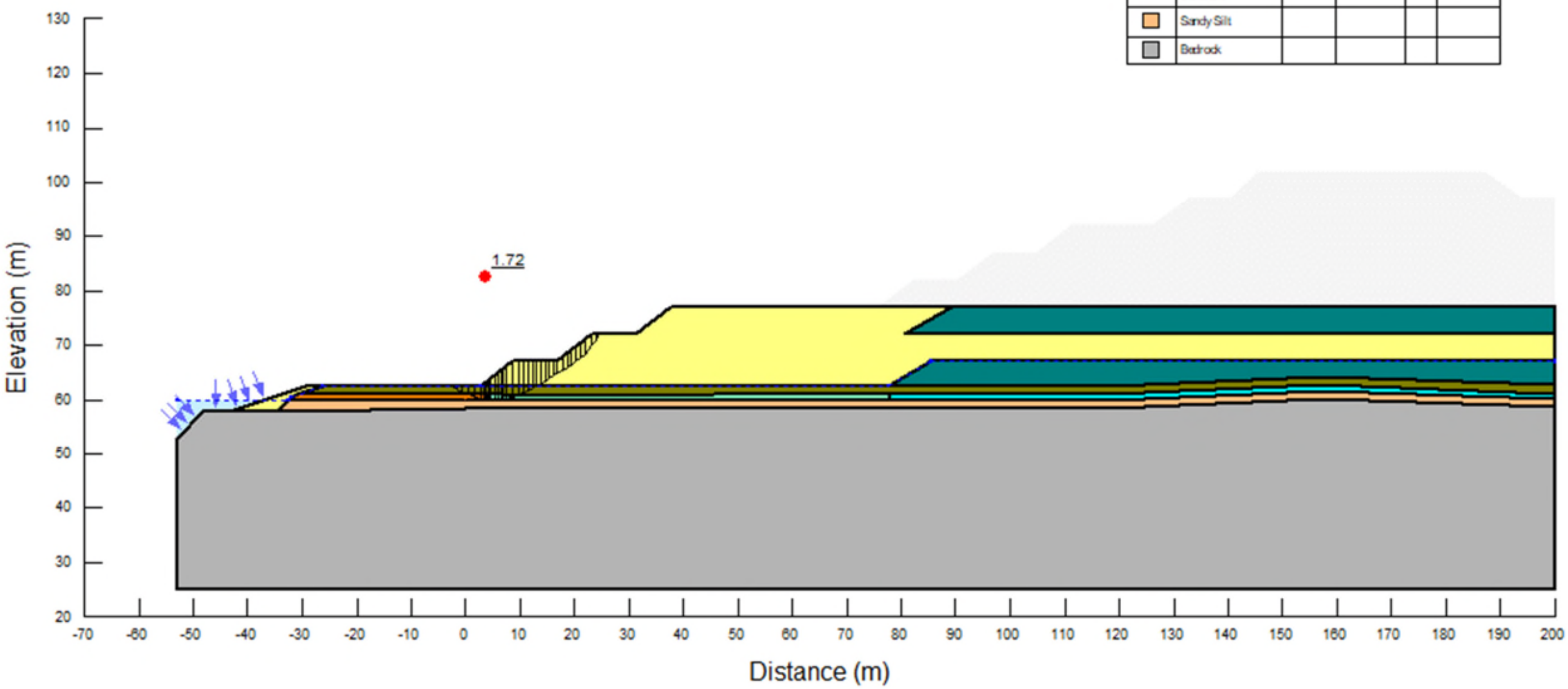
Section A
Bench 67.0 m of Waste Rock and Overburden during Construction (assumed warm ice-rich sand/silt in the foundation overburden)

PROJECT NO.	DWN	CKD	APVD	REV
ENG.EARC03140-10	GZ	WTH	WTH	A

OFFICE	DATE
EBA-EDM	February 2020

Figure 5

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Cohesion (kPa)
	Waste Rock Zone 1 (<= 15m depth)	19	0	42	
	Overburden Waste	17	0	28	
	Sand	20	0	31	
	Unfrozen Sand/Silt	17	0	28	
	Warm Ice-Rich Sand/Silt	16			40
	Thawing Ice-Rich Sand/Silt	16	0	28	
	Sandy Silt				
	Bedrock				



LEGEND

NOTES

Note: During Construction, Static Loading

STATUS
ISSUED FOR USE

CLIENT

AGNICO EAGLE

TETRA TECH

Stability Analysis of WRSF3
Meliadine Gold Project, NU

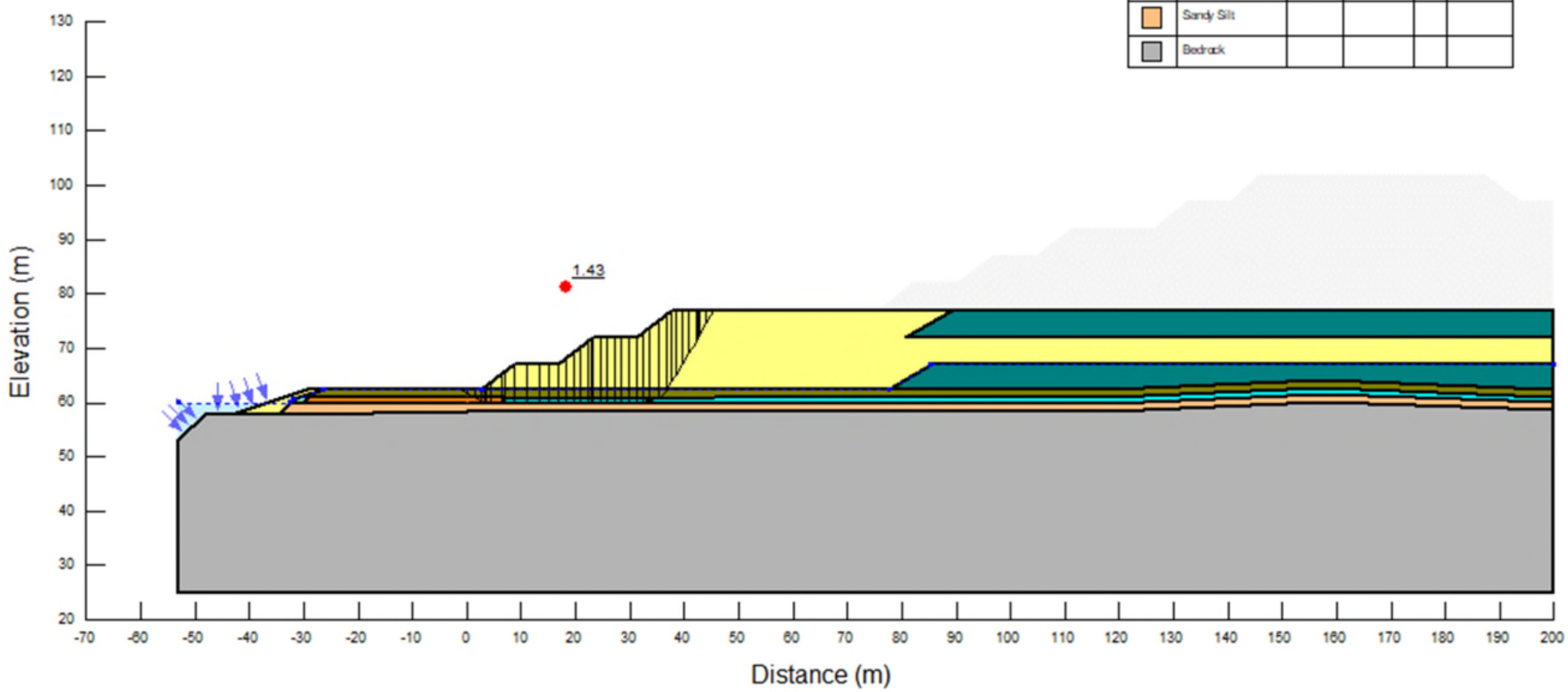
Section A
Bench 77.0 m of Waste Rock and Overburden during Construction (assumed unfrozen sand/silt beneath Bench 67 m waste rock)

PROJECT NO.	DWN	CKD	APVD	REV
ENG.EARC03140-10	GZ	WTH	WTH	A

OFFICE	DATE
EBA-EDM	February 2020

Figure 6

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Cohesion (kPa)
	Waste Rock Zone 1 (<= 15 m depth)	19	0	42	
	Overburden Waste	17	0	28	
	Sand	20	0	31	
	Unfrozen Sand/Silt	17	0	28	
	Warm Ice-Rich Sand/Silt	16			40
	Thawing Ice-Rich Sand/Silt	16	0	28	
	Sandy Silt				
	Bedrock				



LEGEND

NOTES

Note: During Construction, Static Loading

STATUS
ISSUED FOR USE

CLIENT

AGNICO EAGLE

TETRA TECH

Stability Analysis of WRSF3
Meliadine Gold Project, NU

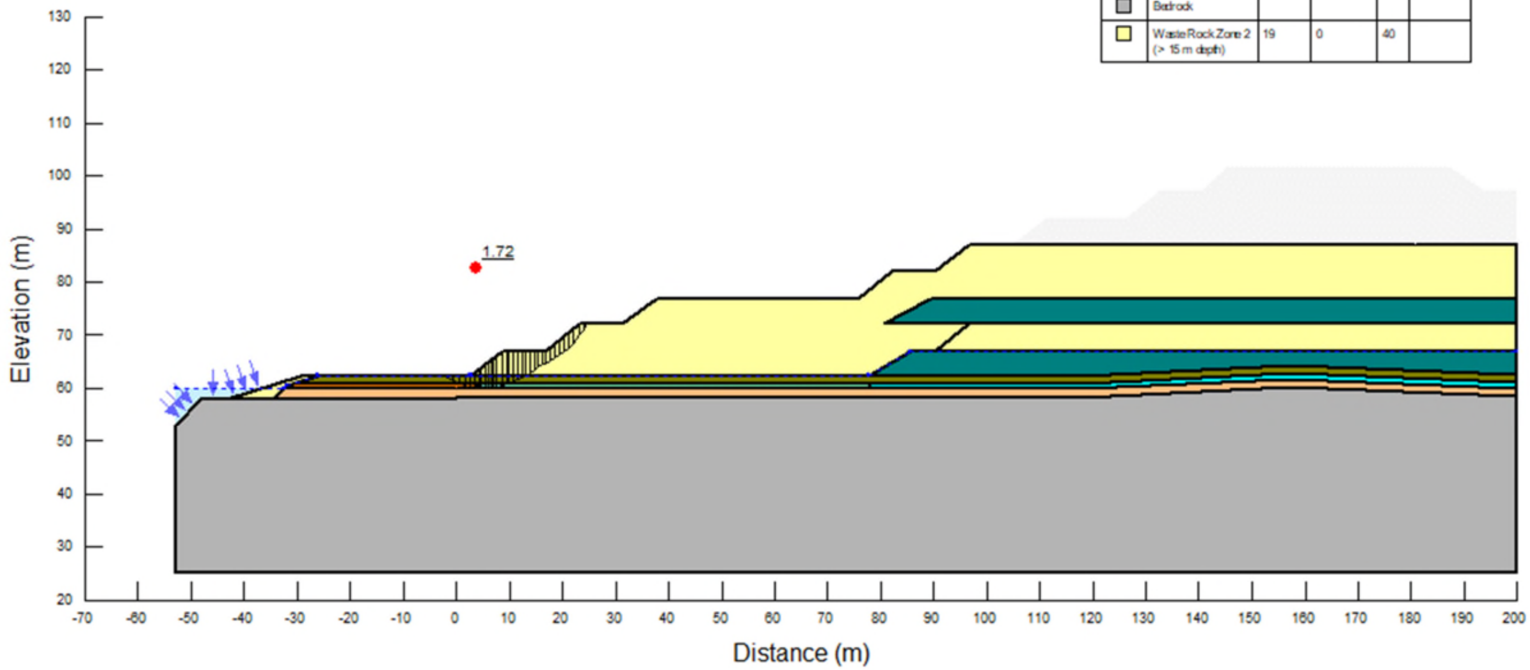
Section A
Bench 77.0 m of Waste Rock and Overburden during Construction (assumed warm ice-rich sand/silt in the foundation overburden)

PROJECT NO.	DWN	CKD	APVD	REV
ENG.EARC03140-10	GZ	WTH	WTH	A

OFFICE	DATE
EBA-EDM	February 2020

Figure 7

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Cohesion (kPa)
	Waste Rock Zone 1 (<= 15 m depth)	19	0	42	
	Overburden Waste	17	0	28	
	Sand	20	0	31	
	Unfrozen Sand/Silt	17	0	28	
	Warm Ice-Rich Sand/Silt	16			40
	Thawing Ice-Rich Sand/Silt	16	0	28	
	Sandy Silt				
	Bedrock				
	Waste Rock Zone 2 (> 15 m depth)	19	0	40	



LEGEND

NOTES

Note: During Construction, Static Loading

STATUS
ISSUED FOR USE

CLIENT

AGNICO EAGLE

TETRA TECH

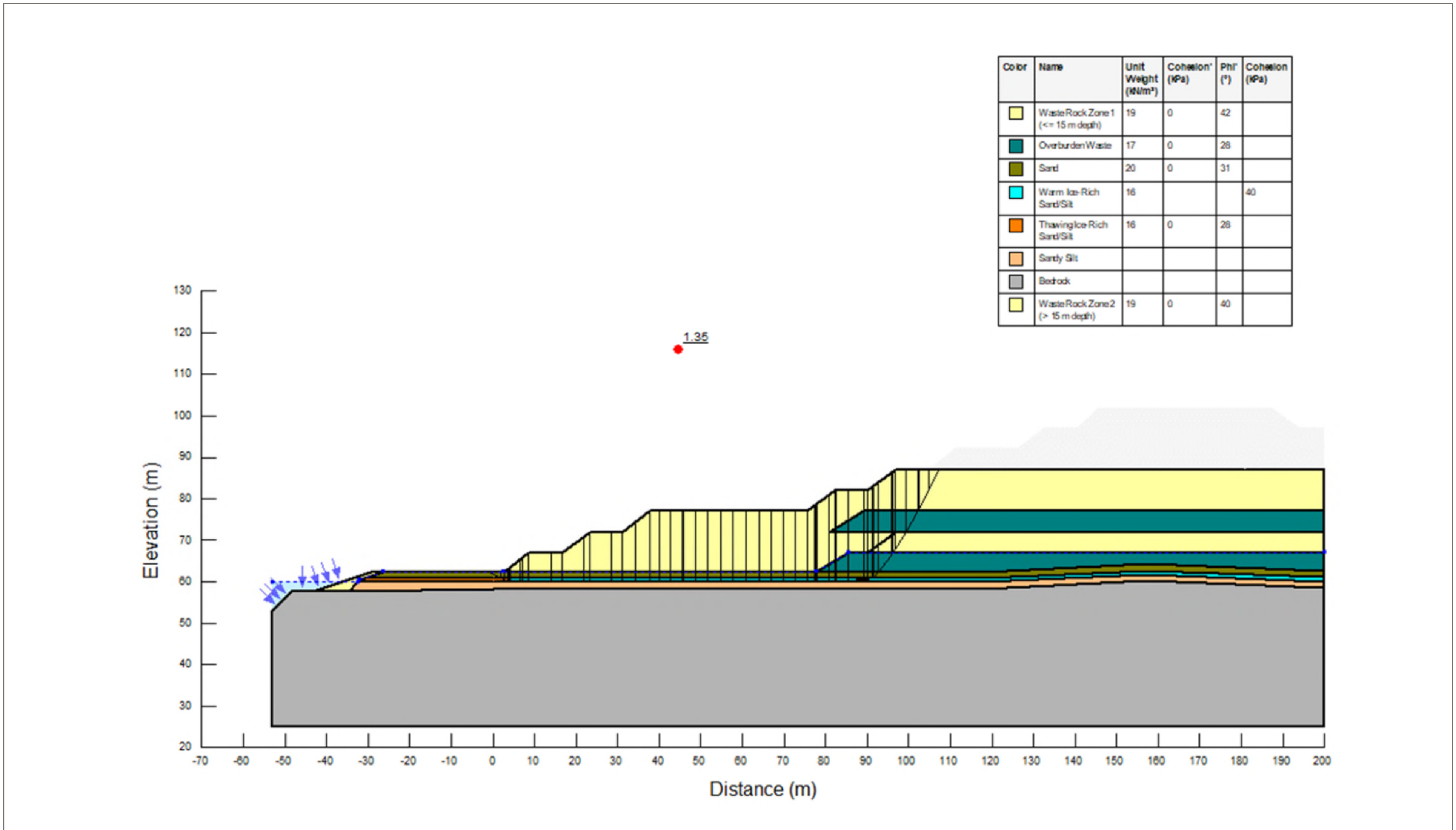
Stability Analysis of WRSF3
Meliadine Gold Project, NU

Section A
Bench 87.0 m of Waste Rock during Construction
(assumed unfrozen sand/silt beneath Bench 67 m waste rock)

PROJECT NO.	DWN	CKD	APVD	REV
ENG.EARC03140-10	GZ	WTH	WTH	A

OFFICE	DATE
EBA-EDM	February 2020

Figure 8



Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Cohesion (kPa)
	Waste Rock Zone 1 (<= 15 m depth)	19	0	42	
	Overburden Waste	17	0	28	
	Sand	20	0	31	
	Warm Ice-Rich Sand/Silt	16			40
	Thawing Ice-Rich Sand/Silt	16	0	28	
	Sandy Silt				
	Bedrock				
	Waste Rock Zone 2 (> 15 m depth)	19	0	40	

LEGEND

NOTES

Note: During Construction, Static Loading

STATUS
ISSUED FOR USE

CLIENT

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TETRA TECH

Stability Analysis of WRSF3
Meliadine Gold Project, NU

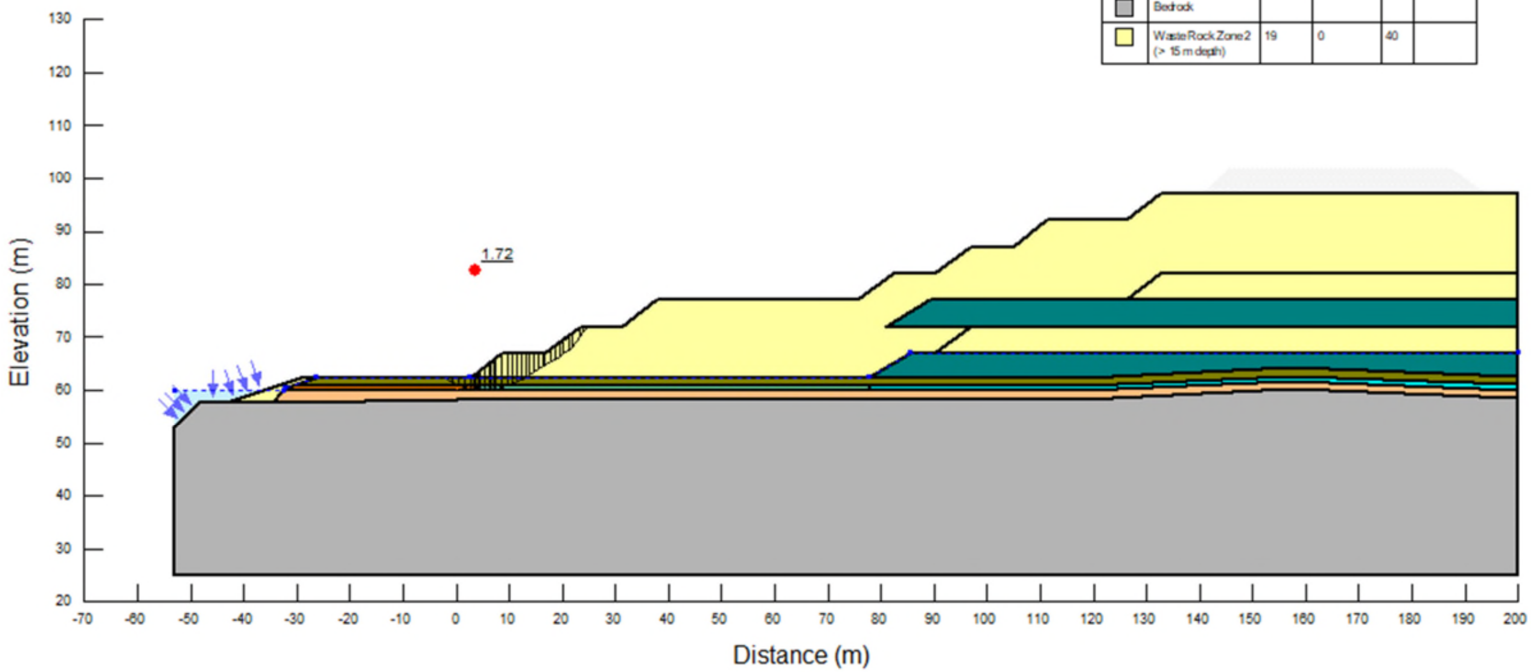
Section A
Bench 87.0 m of Waste Rock and Overburden during Construction (assumed warm ice-rich sand/silt in the foundation overburden)

PROJECT NO.	DWN	CKD	APVD	REV
ENG.EARC03140-10	GZ	WTH	WTH	A

OFFICE	DATE
EBA-EDM	February 2020

Figure 9

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Cohesion (kPa)
	Waste Rock Zone 1 (<= 15 m depth)	19	0	42	
	Overburden Waste	17	0	28	
	Sand	20	0	31	
	Unfrozen Sand/Silt	17	0	28	
	Warm Ice-Rich Sand/Silt	16			40
	Thawing Ice-Rich Sand/Silt	16	0	28	
	Sandy Silt				
	Bedrock				
	Waste Rock Zone 2 (> 15 m depth)	19	0	40	



LEGEND

NOTES

Note: During Construction, Static Loading

STATUS
ISSUED FOR USE

CLIENT

AGNICO EAGLE

TETRA TECH

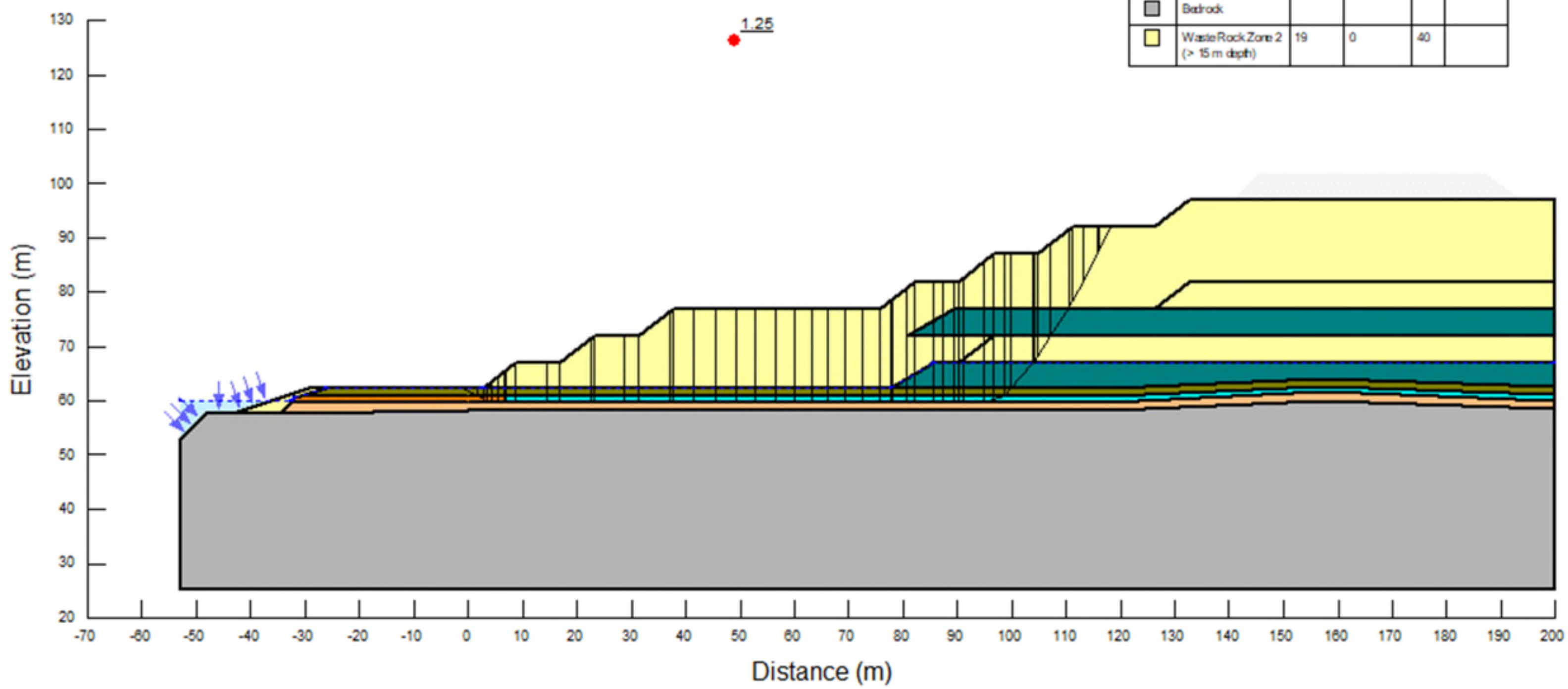
Stability Analysis of WRSF3
Meliadine Gold Project, NU

Section A
Bench 97.0 m of Waste Rock during Construction (assumed unfrozen sand/silt beneath Bench 67 m waste rock)

PROJECT NO.	DWN	CKD	APVD	REV
ENG.EARC03140-10	GZ	WTH	WTH	A

OFFICE	DATE
EBA-EDM	February 2020

Figure 10



Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Cohesion (kPa)
	Waste Rock Zone 1 (<= 15 m depth)	19	0	42	
	Overburden Waste	17	0	28	
	Sand	20	0	31	
	Warm Ice-Rich Sand/Silt	16			40
	Thawing Ice-Rich Sand/Silt	16	0	28	
	Sandy Silt				
	Bedrock				
	Waste Rock Zone 2 (> 15 m depth)	19	0	40	

LEGEND

NOTES

Note: During Construction, Static Loading

STATUS
ISSUED FOR USE

CLIENT

AGNICO EAGLE

TETRA TECH

Stability Analysis of WRSF3
Meliadine Gold Project, NU

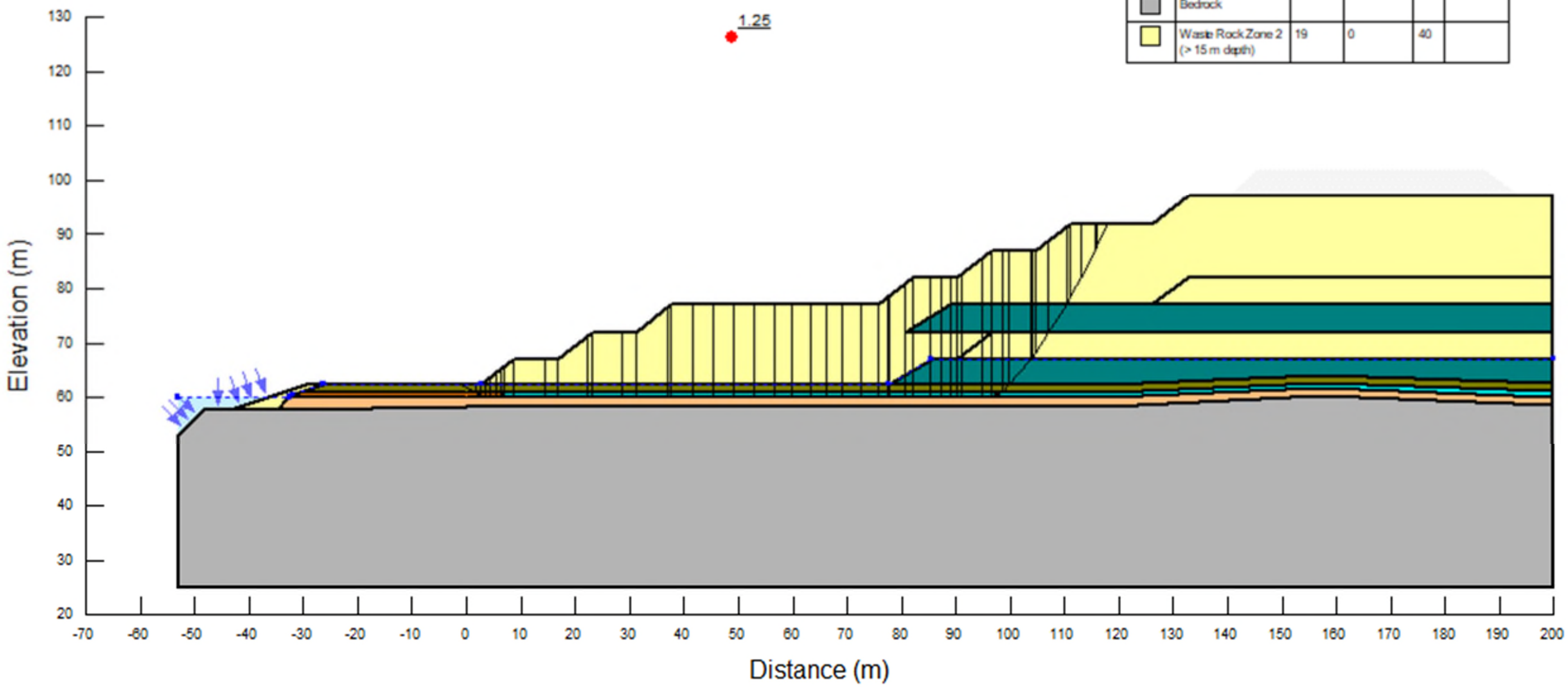
Section A
Bench 97.0 m of Waste Rock during Construction (assumed warm ice-rich sand/silt in the foundation overburden)

PROJECT NO.	DWN	CKD	APVD	REV
ENG.EARC03140-10	GZ	WTH	WTH	A

OFFICE	DATE
EBA-EDM	February 2020

Figure 11

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Cohesion (kPa)
	Waste Rock Zone 1 (<= 15 m depth)	19	0	42	
	Overburden Waste	17	0	28	
	Sand	20	0	31	
	Warm Ice-Rich Sand/Silt	16			40
	Thawing Ice-Rich Sand/Silt	16	0	28	
	Sandy Silt				
	Bedrock				
	Waste Rock Zone 2 (> 15 m depth)	19	0	40	



LEGEND

NOTES

Note: Long-term Post-construction, Static Loading

STATUS
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Stability Analysis of WRSF3
Meliadine Gold Project, NU

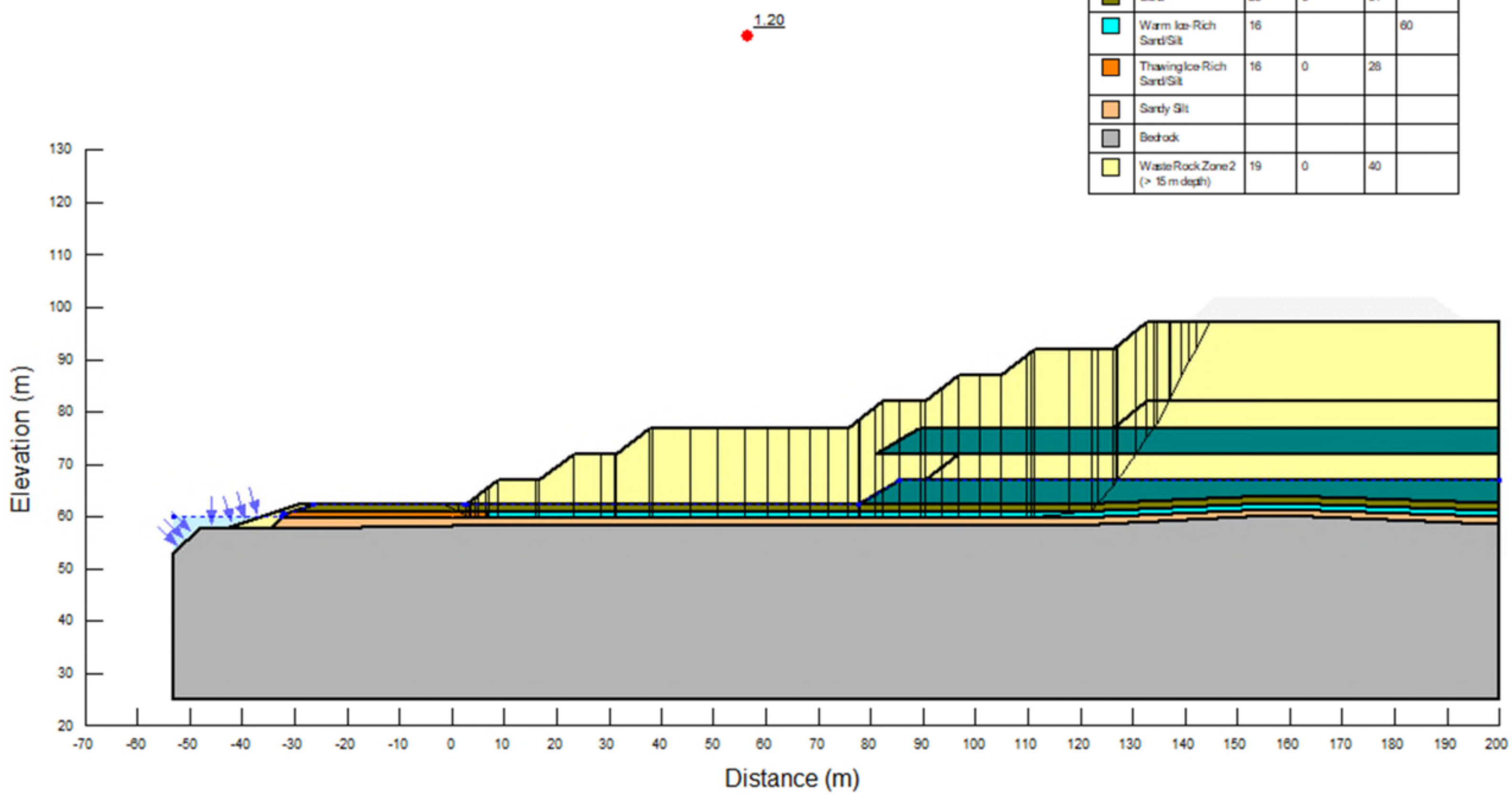
Section A
Long-term static loading after construction (assumed warm ice-rich sand/silt in the foundation overburden)

PROJECT NO.	DWN	CKD	APVD	REV
ENG.EARC03140-10	GZ	WTH	WTH	A

OFFICE	DATE
EBA-EDM	February 2020

Figure 12

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Cohesion (kPa)
	Waste Rock Zone 1 (<= 15 m depth)	19	0	42	
	Overburden Waste	17	0	28	
	Sand	20	0	31	
	Warm Ice-Rich Sand/Silt	16			60
	Thawing Ice-Rich Sand/Silt	16	0	28	
	Sandy Silt				
	Bedrock				
	Waste Rock Zone 2 (> 15 m depth)	19	0	40	



LEGEND

NOTES

Note: Long-term post-construction, seismic loading with a horizontal peak acceleration of 0.037 g.

STATUS
ISSUED FOR USE

CLIENT

AGNICO EAGLE

TETRA TECH

Stability Analysis of WRSF3 Meliadine Gold Project, NU

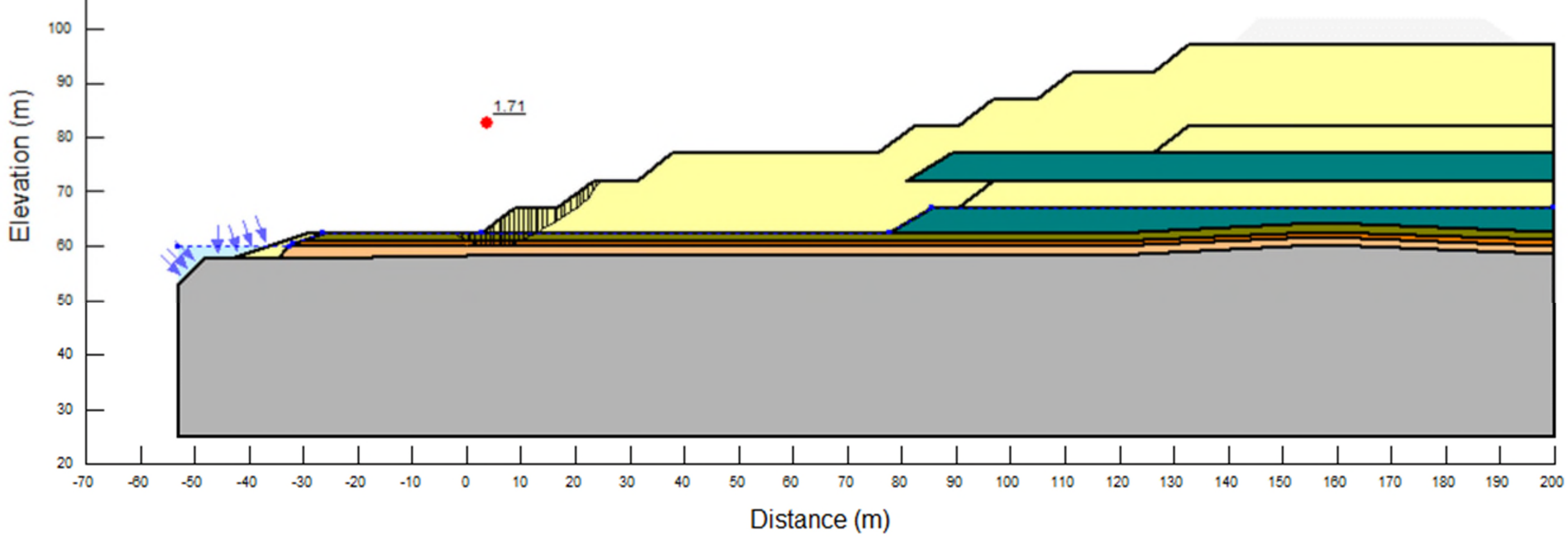
Section A
Long-term seismic loading after construction (assumed warm ice-rich sand/silt in the foundation overburden)

PROJECT NO.	DWN	CKD	APVD	REV
ENG.EARC03140-10	GZ	WTH	WTH	A

OFFICE	DATE
EBA-EDM	February 2020

Figure 13

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	Waste Rock Zone 1 (<= 15 m depth)	19	0	42
	Overburden Waste	17	0	28
	Sand	20	0	31
	Thawing Ice-Rich Sand/Silt	16	0	28
	Sandy Silt			
	Bedrock			
	Waste Rock Zone 2 (> 15m depth)	19	0	40



LEGEND

NOTES

Note: Long-term Post-construction, Static Loading

STATUS
ISSUED FOR USE

CLIENT

AGNICO EAGLE

TETRA TECH

Stability Analysis of WRSF3
Meliadine Gold Project, NU

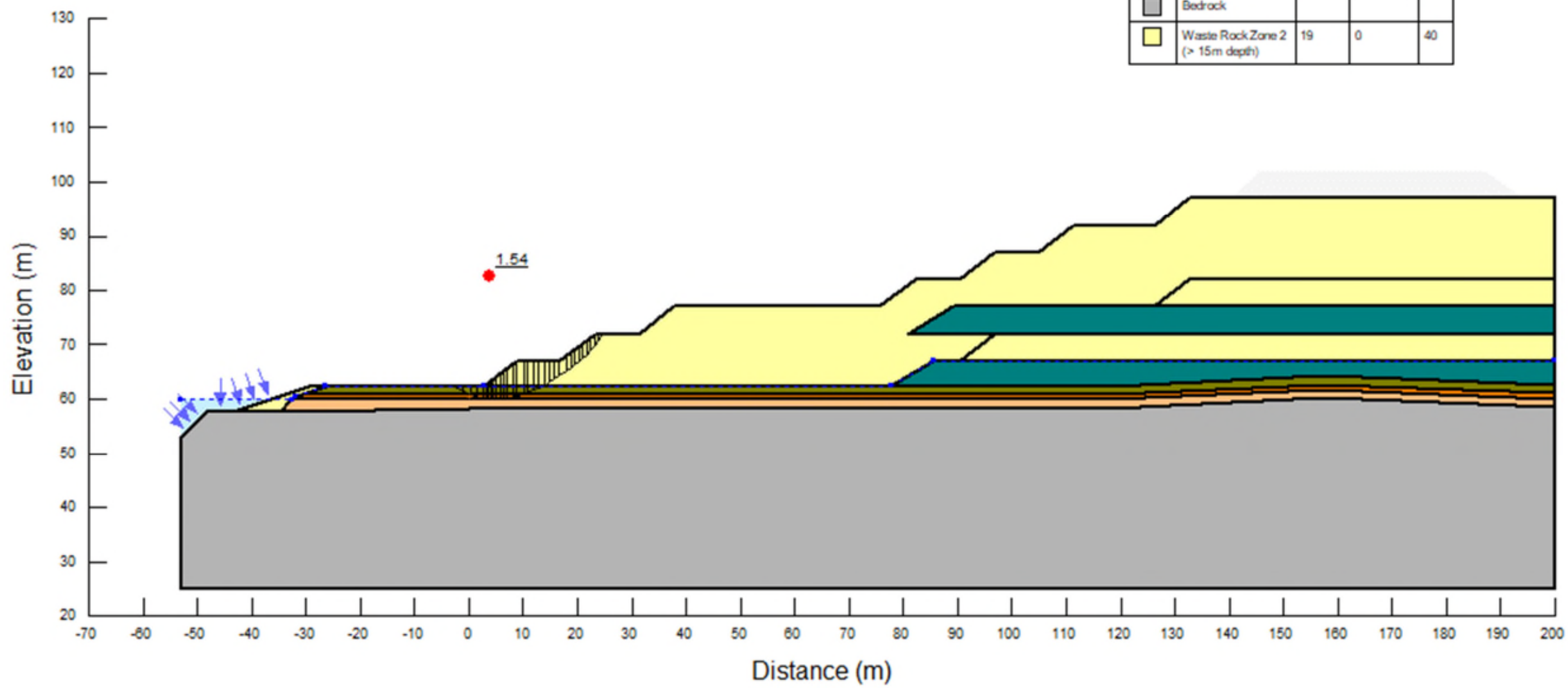
Section A
Long-term static loading after construction (assumed thawing ice-rich sand/silt in the foundation overburden)

PROJECT NO.	DWN	CKD	APVD	REV
ENG.EARC03140-10	GZ	WTH	WTH	A

OFFICE	DATE
EBA-EDM	February 2020

Figure 14

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	Waste Rock Zone 1 (<= 15 m depth)	19	0	42
	Overburden Waste	17	0	28
	Sand	20	0	31
	Thawing Ice-Rich Sand/Silt	16	0	28
	Sandy Silt			
	Bedrock			
	Waste Rock Zone 2 (> 15m depth)	19	0	40



LEGEND

NOTES

Note: Long-term post-construction, seismic loading with a horizontal peak acceleration of 0.037 g.

STATUS
ISSUED FOR USE

CLIENT

AGNICO EAGLE

TETRA TECH

Stability Analysis of WRSF3 Meliadine Gold Project, NU

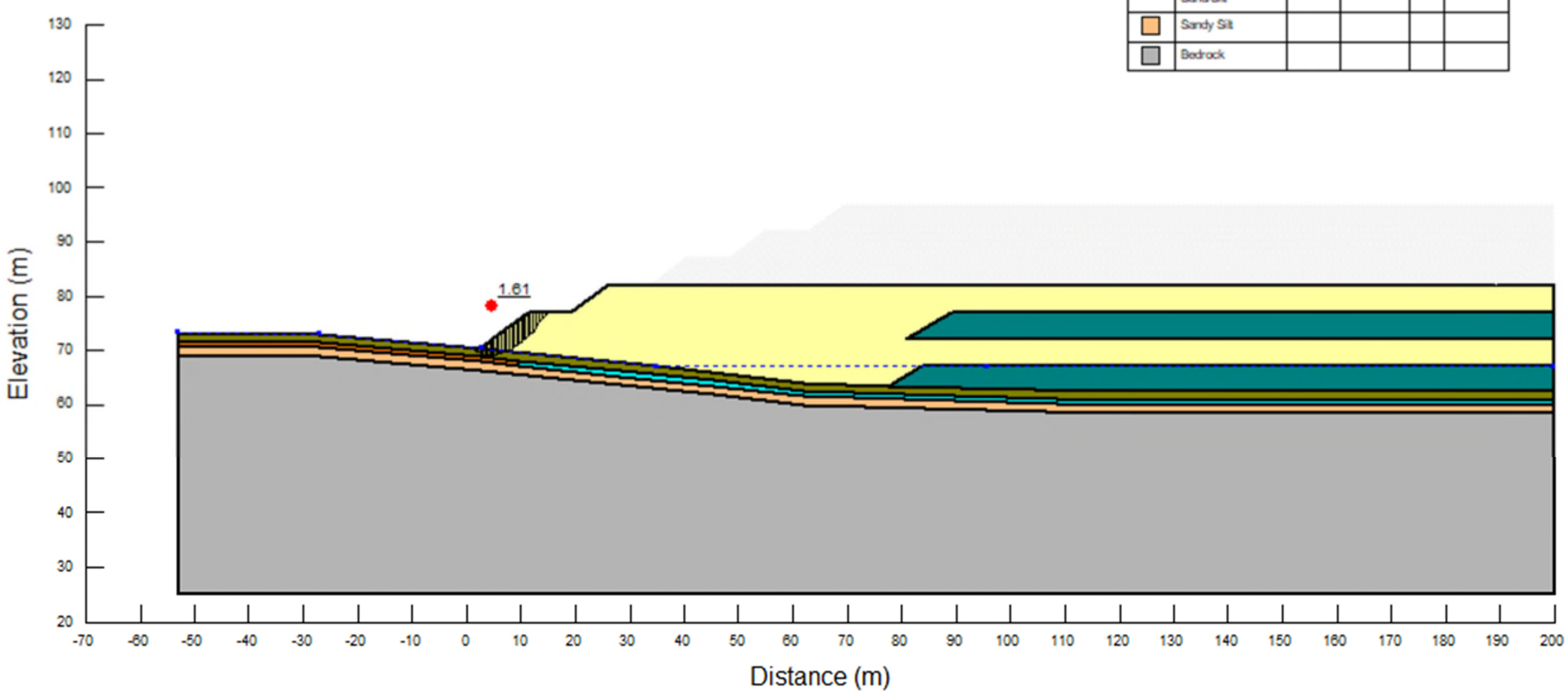
Section A
Long-term seismic loading after construction (assumed thawing ice-rich sand/silt in the foundation overburden)

PROJECT NO.	DWN	CKD	APVD	REV
ENG.EARC03140-10	GZ	WTH	WTH	A

OFFICE	DATE
EBA-EDM	February 2020

Figure 15

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Cohesion (kPa)
	Waste Rock Zone 1 (<=15 m depth)	19	0	42	
	Overburden Waste	17	0	28	
	Sand	20	0	31	
	Warm Ice-Rich Sand/Silt	16			40
	Thawing Ice-Rich Sand/Silt	16	0	28	
	Sandy Silt				
	Bedrock				



LEGEND

NOTES

Note: During Construction, Static Loading

STATUS
ISSUED FOR USE

CLIENT

AGNICO EAGLE

TETRA TECH

Stability Analysis of WRSF3 Meliadine Gold Project, NU

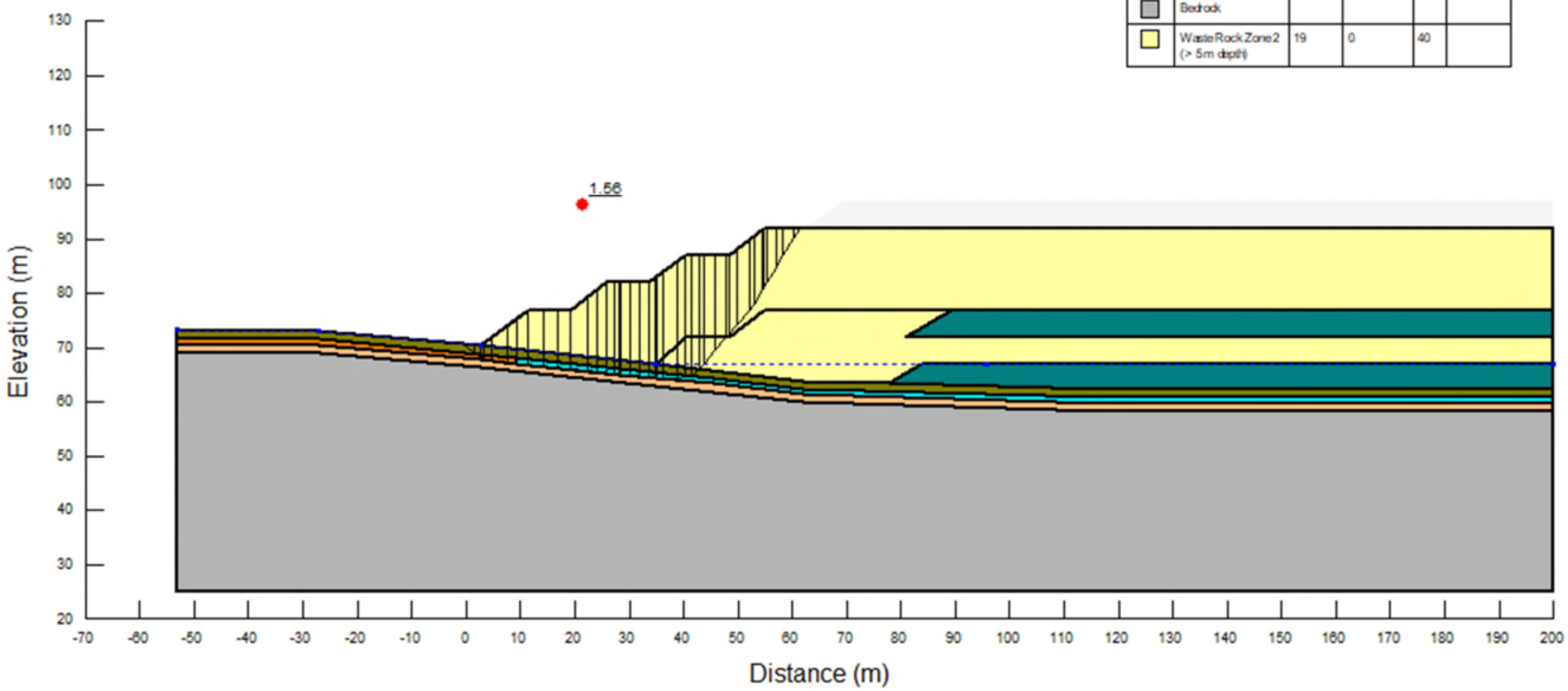
Section B
Bench 82.0 m of Waste Rock during Construction (assumed warm ice-rich sand/silt in the foundation overburden)

PROJECT NO.	DWN	CKD	APVD	REV
ENG.EARC03140-10	GZ	WTH	WTH	A

OFFICE	DATE
EBA-EDM	February 2020

Figure 16

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Cohesion (kPa)
	Waste Rock Zone 1 (<=15 m depth)	19	0	42	
	Overburden Waste	17	0	28	
	Sand	20	0	31	
	Warm Ice-Rich Sand/Silt	16			40
	Thawing Ice-Rich Sand/Silt	16	0	28	
	Sandy Silt				
	Bedrock				
	Waste Rock Zone 2 (> 5m depth)	19	0	40	



LEGEND

NOTES

Note: During Construction, Static Loading

STATUS
ISSUED FOR USE

CLIENT

AGNICO EAGLE

TETRA TECH

Stability Analysis of WRSF3
Meliadine Gold Project, NU

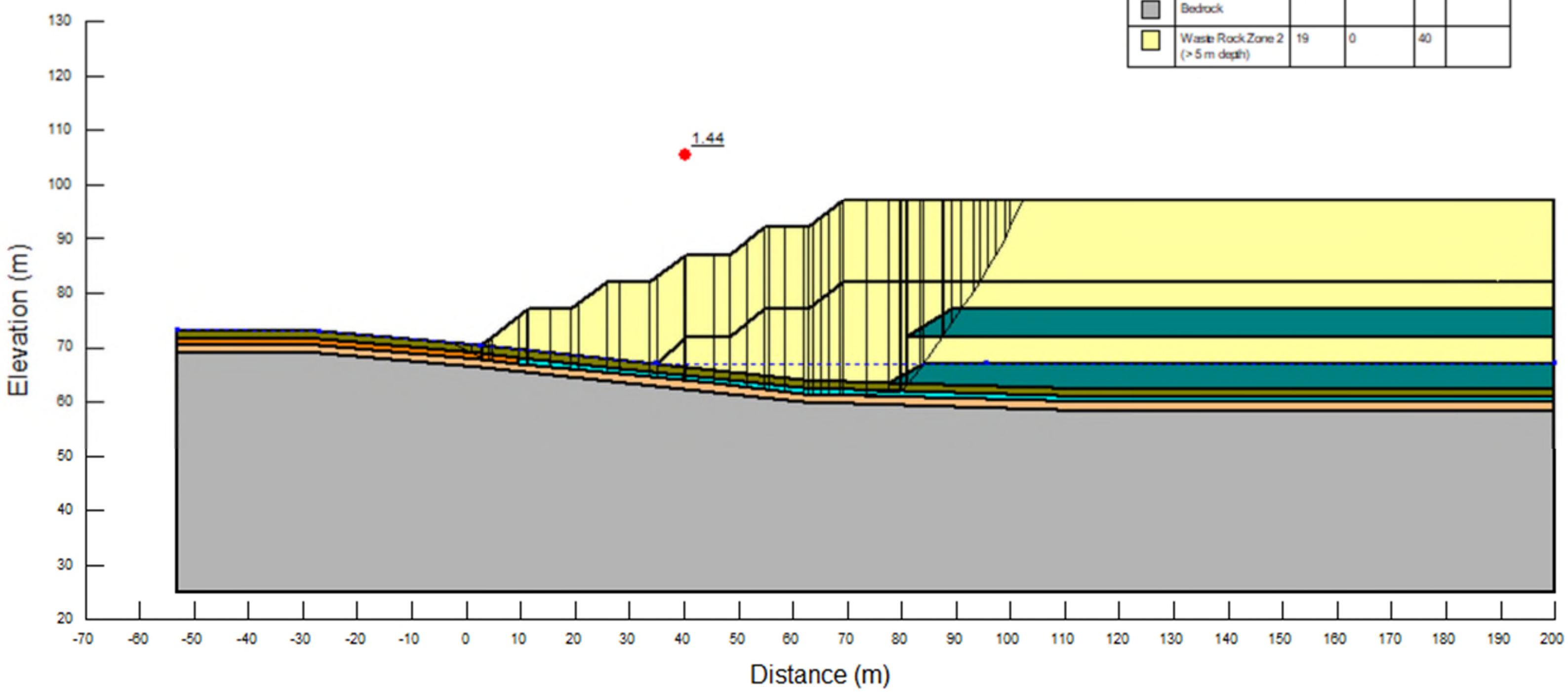
Section B
Bench 92.0 m of Waste Rock during Construction (assumed warm ice-rich sand/silt in the foundation overburden)

PROJECT NO.	DWN	CKD	APVD	REV
ENG.EARC03140-10	GZ	WTH	WTH	A

OFFICE	DATE
EBA-EDM	February 2020

Figure 17

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Cohesion (kPa)
	Waste Rock Zone 1 (<= 15 m depth)	19	0	42	
	Overburden Waste	17	0	28	
	Sand	20	0	31	
	Warm Ice-Rich Sand/Silt	16			40
	Thawing Ice-Rich Sand/Silt	16	0	28	
	Sandy Silt				
	Bedrock				
	Waste Rock Zone 2 (> 5 m depth)	19	0	40	



LEGEND

NOTES

Note: Long-term after construction, static loading

STATUS
ISSUED FOR USE

CLIENT
AGNICO EAGLE

TETRA TECH

Stability Analysis of WRSF3
Meliadine Gold Project, NU

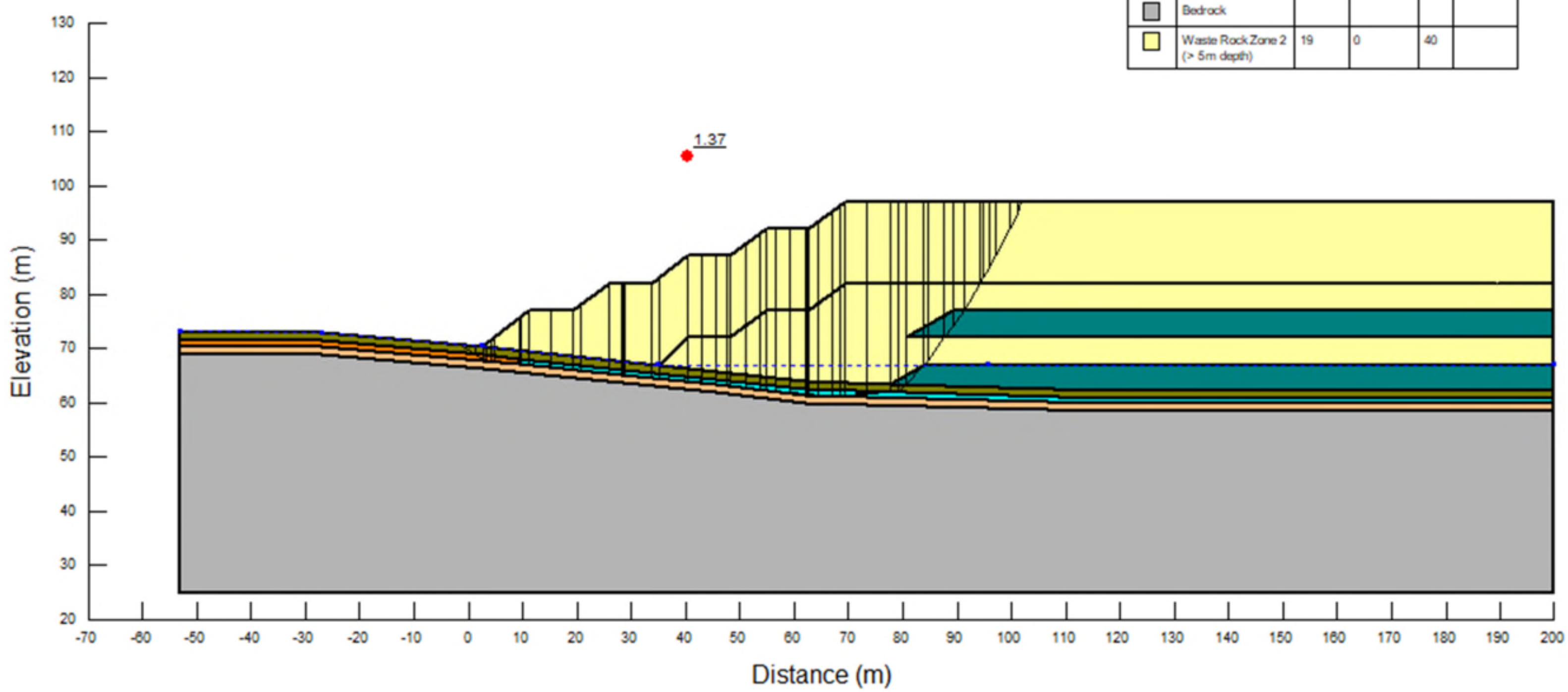
Section B
Long-term static loading after construction (assumed warm ice-rich sand/silt in the foundation overburden)

PROJECT NO.	DWN	CKD	APVD	REV
ENG.EARC03140-10	GZ	WTH	WTH	A

OFFICE	DATE
EBA-EDM	February 2020

Figure 18

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Cohesion (kPa)
	Waste Rock Zone 1 (<=15m depth)	19	0	42	
	Overburden Waste	17	0	28	
	Sand	20	0	31	
	Warm Ice-Rich Sand/Silt	16			60
	Thawing Ice-Rich Sand/Silt	16	0	28	
	Sandy Silt				
	Bedrock				
	Waste Rock Zone 2 (> 5m depth)	19	0	40	



LEGEND

NOTES

Note: Long-term post-construction, seismic loading with a horizontal peak acceleration of 0.037 g.

STATUS
ISSUED FOR USE

CLIENT

AGNICO EAGLE

TETRA TECH

Stability Analysis of WRSF3 Meliadine Gold Project, NU

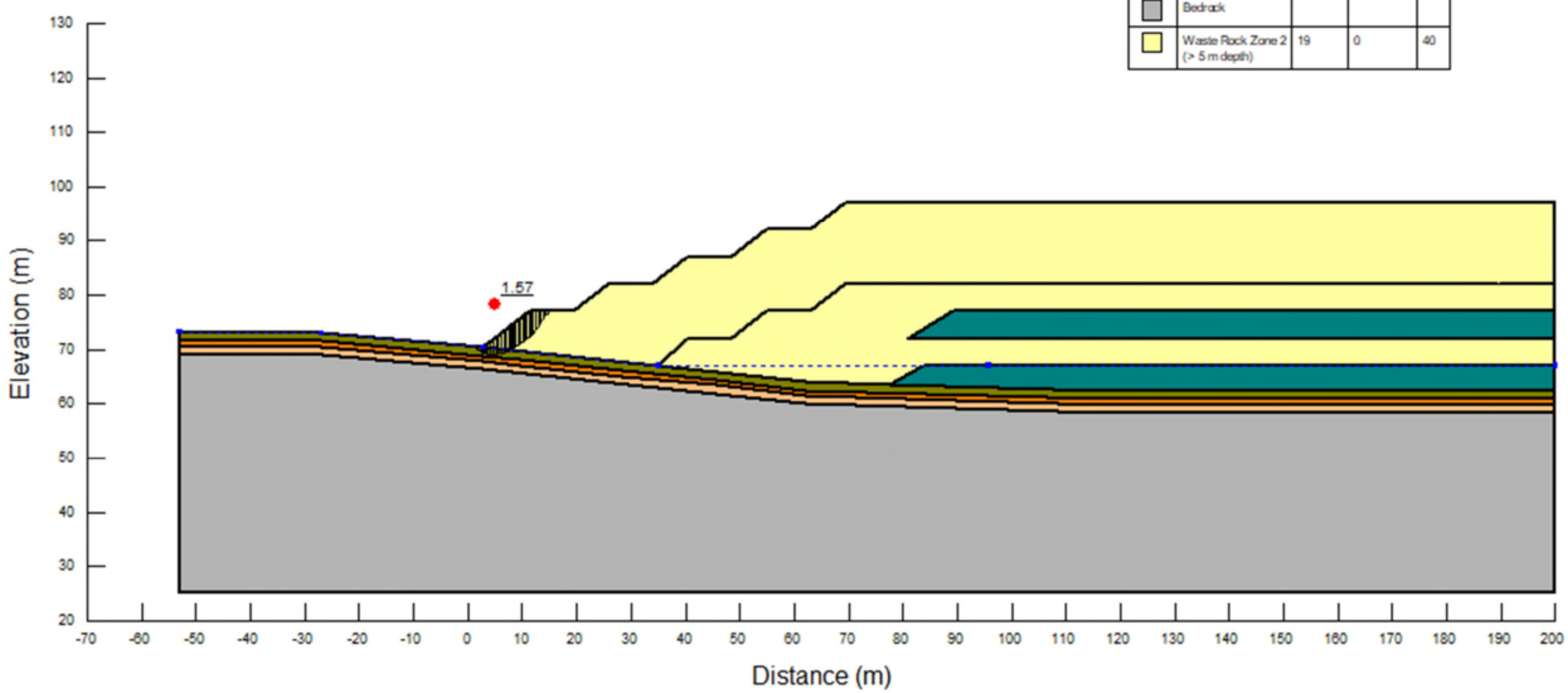
Section B
Long-term seismic loading after construction (assumed warm ice-rich sand/silt in the foundation overburden)

PROJECT NO.	DWN	CKD	APVD	REV
ENG.EARC03140-10	GZ	WTH	WTH	A

OFFICE	DATE
EBA-EDM	February 2020

Figure 19

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	Waste Rock Zone 1 (<=15 m depth)	19	0	42
	Overburden Waste	17	0	28
	Sand	20	0	31
	Thawing Ice-Rich Sand/Silt	16	0	28
	Sandy Silt			
	Bedrock			
	Waste Rock Zone 2 (> 5 m depth)	19	0	40



LEGEND

NOTES

Note: Long-term after construction, static loading

STATUS
ISSUED FOR USE

CLIENT

AGNICO EAGLE

TETRA TECH

Stability Analysis of WRSF3 Meliadine Gold Project, NU

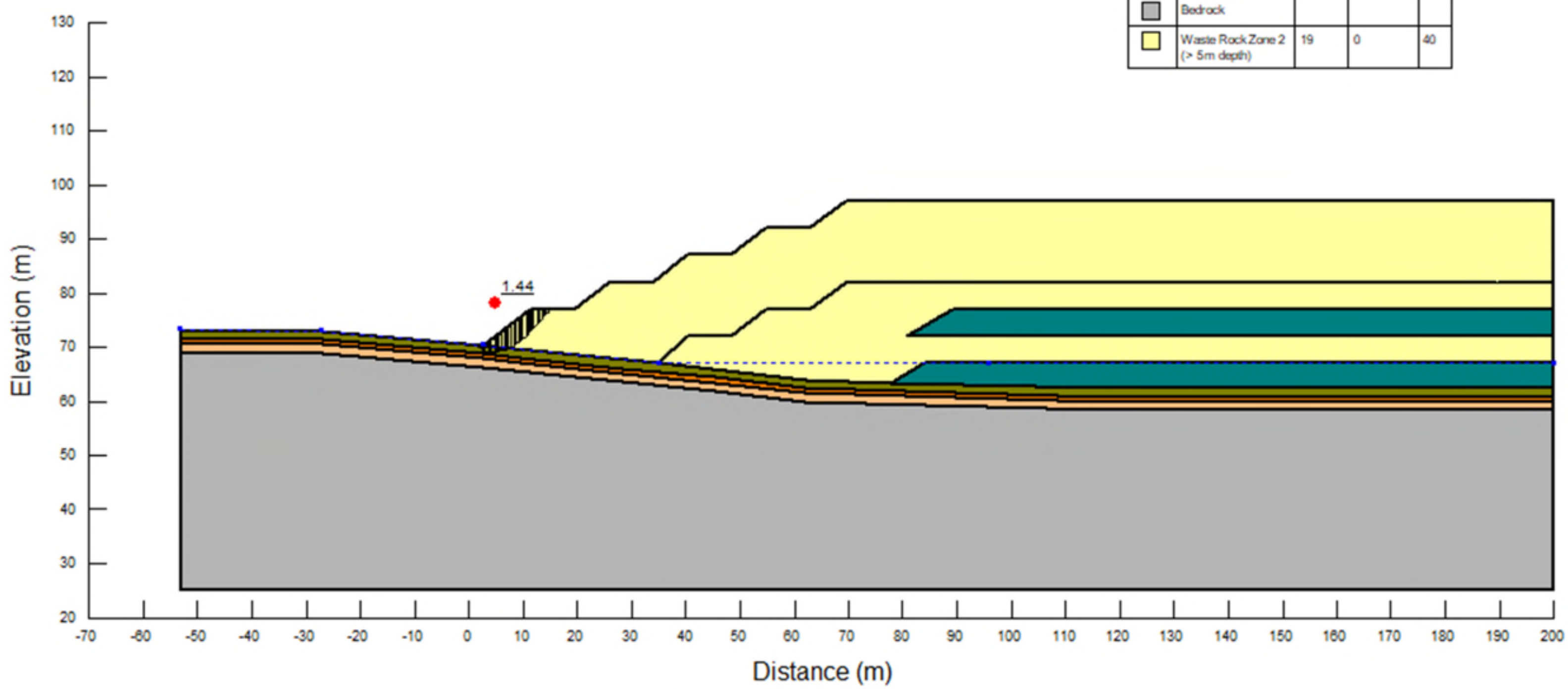
Section B
Long-term static loading after construction (assumed thawing ice-rich sand/silt in the foundation overburden)

PROJECT NO.	DWN	CKD	APVD	REV
ENG.EARC03140-10	GZ	WTH	WTH	A

OFFICE	DATE
EBA-EDM	February 2020

Figure 20

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	Waste Rock Zone 1 (<=15m depth)	19	0	42
	Overburden Waste	17	0	28
	Sand	20	0	31
	Thawing Ice-Rich Sand/Silt	16	0	28
	Sandy Silt			
	Bedrock			
	Waste Rock Zone 2 (> 5m depth)	19	0	40



LEGEND

NOTES

Note: Long-term post-construction, seismic loading with a horizontal peak acceleration of 0.037 g.

STATUS
ISSUED FOR USE

CLIENT

AGNICO EAGLE

TETRA TECH

Stability Analysis of WRSF3 Meliadine Gold Project, NU

Section B
Long-term seismic loading after construction (assumed thawing ice-rich sand/silt in the foundation overburden)

PROJECT NO.	DWN	CKD	APVD	REV
ENG.EARC03140-10	GZ	WTH	WTH	A

OFFICE	DATE
EBA-EDM	February 2020

Figure 21

APPENDIX B

TETRA TECH'S LIMITATIONS ON USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

GEOTECHNICAL

1.1 USE OF DOCUMENT AND OWNERSHIP

This document pertains to a specific site, a specific development, and a specific scope of work. The document may include plans, drawings, profiles and other supporting documents that collectively constitute the document (the "Professional Document").

The Professional Document is intended for the sole use of TETRA TECH's Client (the "Client") as specifically identified in the TETRA TECH Services Agreement or other Contractual Agreement entered into with the Client (either of which is termed the "Contract" herein). TETRA TECH does not accept any responsibility for the accuracy of any of the data, analyses, recommendations or other contents of the Professional Document when it is used or relied upon by any party other than the Client, unless authorized in writing by TETRA TECH.

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The Professional Document and any other form or type of data or documents generated by TETRA TECH during the performance of the work are TETRA TECH's professional work product and shall remain the copyright property of TETRA TECH.

The Professional Document is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of TETRA TECH. Additional copies of the Document, if required, may be obtained upon request.

1.2 ALTERNATIVE DOCUMENT FORMAT

Where TETRA TECH submits electronic file and/or hard copy versions of the Professional Document or any drawings or other project-related documents and deliverables (collectively termed TETRA TECH's "Instruments of Professional Service"), only the signed and/or sealed versions shall be considered final. The original signed and/or sealed electronic file and/or hard copy version archived by TETRA TECH shall be deemed to be the original. TETRA TECH will archive a protected digital copy of the original signed and/or sealed version for a period of 10 years.

Both electronic file and/or hard copy versions of TETRA TECH's Instruments of Professional Service shall not, under any circumstances, be altered by any party except TETRA TECH. TETRA TECH's Instruments of Professional Service will be used only and exactly as submitted by TETRA TECH.

Electronic files submitted by TETRA TECH have been prepared and submitted using specific software and hardware systems. TETRA TECH makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

1.3 STANDARD OF CARE

Services performed by TETRA TECH for the Professional Document have been conducted in accordance with the Contract, in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Professional judgment has been applied in developing the conclusions and/or recommendations provided in this Professional Document. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of the Professional Document.

If any error or omission is detected by the Client or an Authorized Party, the error or omission must be immediately brought to the attention of TETRA TECH.

1.4 DISCLOSURE OF INFORMATION BY CLIENT

The Client acknowledges that it has fully cooperated with TETRA TECH with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The Client further acknowledges that in order for TETRA TECH to properly provide the services contracted for in the Contract, TETRA TECH has relied upon the Client with respect to both the full disclosure and accuracy of any such information.

1.5 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of this Professional Document, TETRA TECH may have relied on information provided by persons other than the Client.

While TETRA TECH endeavours to verify the accuracy of such information, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information even where inaccurate or unreliable information impacts any recommendations, design or other deliverables and causes the Client or an Authorized Party loss or damage.

1.6 GENERAL LIMITATIONS OF DOCUMENT

This Professional Document is based solely on the conditions presented and the data available to TETRA TECH at the time the data were collected in the field or gathered from available databases.

The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

The Professional Document is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site conditions present, or variation in assumed conditions which might form the basis of design or recommendations as outlined in this report, at or on the development proposed as of the date of the Professional Document requires a supplementary investigation and assessment.

TETRA TECH is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

1.7 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, TETRA TECH has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

1.8 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. TETRA TECH does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

1.9 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

1.10 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. TETRA TECH does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

1.11 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

1.12 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

1.13 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

1.14 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

1.15 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

1.16 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

1.17 SAMPLES

TETRA TECH will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.