TETRA TECH

TECHNICAL MEMO

ISSUED FOR REVIEW-REVISION 1

To:	Angie Arbaiza, Agnico Eagle	**Date:**	January 13, 2023
c:	Jenyfer Mosquera, Agnico Eagle Nigel Goldup, Tetra Tech	**Memo No.:**	001
From:	Fai Ndofor, Tetra Tech Hongwei Xia, Tetra Tech	**File:**	704-ENG.EARC03193-04
Subject:	Stability Evaluation of the Waste Rock Storage Facilities, Meliadine Extension Project, Nunavut		

1.0 INTRODUCTION

Agnico Eagle Mines Limited (Agnico Eagle) is currently operating the approved Meliadine Gold Mine (the Meliadine Mine), located approximately 25 km north of Rankin Inlet, Nunavut, by mining the Tiriganiaq (TIR) deposit with two open pits and an underground (UG) operation. Agnico Eagle has continued to extend its knowledge and validation of the gold deposits around the Meliadine Mine and currently proposed an improved project, referred to as the Meliadine Extension. The Meliadine Extension will incorporate six additional gold deposits, namely, Wesmeg, Wesmeg North, Pump, F Zone, Discovery, and Tiriganiaq-Wolf to the approved operation and extend the life of mine from 2032 to 2043. Based on the proposed mine waste management plan, the mine waste (i.e., waste rock and overburden) from the Meliadine Extension will be stored at designated Waste Rock Storage Facilities (i.e., WRSF1, WRSF3, WRSF5, WRSF6, WRSF7, WRSF8, and WRSF9).

Tetra Tech Canada Inc. (Tetra Tech) was retained by Agnico Eagle to conduct a prefeasibility level study of the proposed WRSFs to facilitate the application of the Type A Water Licence Amendment (WLA) for the Meliadine Extension. As part of the prefeasibility level study, slope stability analyses for each WRSF were carried out to assist in developing typical cross sections for the WRSFs.

This technical memorandum summarizes the methodology, input parameters, and findings of the slope stability analyses for the proposed WRSFs.

2.0 GENERAL SITE CONDITIONS

2.1 Climate and Meteorology

The Meliadine Mine 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 mine site. The closest long-term regional evaporation station operated by Environment Canada is in Churchill, Manitoba.

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

The monthly mean air temperature is typically above 0°C for the months of June to September, and below 0°C between October and May. July is typically the warmest month and January the coldest. Winters are typically long and cold, while summers are short and cool. Spring and fall are short. The mean annual temperature for the period of record from 1981 to 2020 was -10.4°C (Agnico Eagle 2022).

The annual average total precipitation at the mine site is 430 mm/year and falls almost equally as snow and rainfall (Agnico Eagle 2022). Average annual evaporation for small waterbodies in the Project area is estimated to be 323 mm between June and September. The average annual loss of snowpack to sublimation and snow redistribution is estimated to vary between 46% and 52% of the total precipitation for the winter period and occurs between October and May (Golder 2013).

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 generally from the northwest and north-northwest direction. The mean values for wind speed show that the north-northwest, together with northwest winds, have the highest speeds and tend to be the strongest. Mean monthly wind speeds are typically between 19 km/hour and 29 km/hour, with an average of 22.3 km/hour.

The representative concentration pathway scenario 4.5 (RCP4.5) under the Intergovernmental Panel on Climate Change was adopted for the projection of climate at the Meliadine Mine (Agnico Eagle 2022). It is anticipated that the mean temperature in the Project region will increase approximately 0.06 °C/year relative to historical means over the period from 2020 to 2120. Precipitation at the Project region is also predicted to increase by 0.7 mm/year on average.

2.2 Environmental Setting

The dominant terrain in the Meliadine Mine area comprises glacial landforms such as drumlins (glacial till), eskers (gravel and sand), and lakes. A series of low relief ridges are composed of glacial deposits, oriented in a northwest-southeast direction, which control the regional surface drainage patterns. The property is about 60 metres above sea level (masl) in low-lying topography with numerous lakes. Surface waters are usually frozen by early October and remain frozen until early June.

The surveyed lake surface elevations in the Meliadine Mine area range from about 51 masl at Meliadine Lake to about 74 masl for local small, perched lakes. Lakes formed by glaciofluvial processes or glacial processes, are common throughout the Project area. Most of the perched lakes at the Project site are relatively shallow (less than 2 m water depths). Late-winter ice thicknesses on freshwater lakes in the Project area range between 1.0 m and 2.3 m with an average thickness of 1.7 m. Ice covers usually appear by the end of October and are completely formed in early November. The spring freshet typically begins in mid-June and is complete by early July (Golder 2012a).

2.3 Permafrost

The Meliadine Mine site is located within the Southern Arctic terrestrial eco-zone which is one of the coldest and driest regions of Canada, in a zone of continuous permafrost. Continuous permafrost to depths of between 285 m to 430 m is expected based on ground temperature data from thermistors installed near Tiriganiaq, FZone, and Discovery deposits (Agnico Eagle 2022). The measured ground temperature data indicates that the active layer ranges from 1.0 m to 3.0 m in areas of shallow soils and areas away from the influence of lakes. It is anticipated that the active layer adjacent to lakes or below a body of moving water such as a stream could be deeper. The typical permafrost ground temperatures at the depths of zero annual amplitude (typically at the depth of below 18 m) are in the range of -5.9°C to -7.0°C in the areas away from lakes and streams. The geothermal gradient ranges from 0.016°C/m to 0.02°C/m (Agnico Eagle 2022).

The formation of an open-talik, which penetrates through the permafrost, would be expected for lakes that exceed a critical depth and size. Thermal modelling was conducted by Golder to assess the extend of lake taliks. It is anticipated that open-taliks exist below portions of Lake B4, Lake B5, Lake B7, Lake A6, Lake A8, Lake CH6, and Lake D4 (Agnico Eagle 2022). The salinity of groundwater also influences the temperature at which the groundwater will freeze.

2.4 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. Groundwater in the active layer flows to local depressions and ponds that drain to larger lakes in the Meliadine Extension area.

The permafrost in the rock in the Meliadine Extension 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 in 2012 and updated several times in 2016, 2019, and 2021 (Agnico Eagle 2022). It was reported that the elevations of the larger lakes with taliks extending down to the deep groundwater regime (referred to as open taliks) provide the principal driving force for deep groundwater flow. Through thermal modelling, open-taliks were suggested to exist beneath Lake B4, Lake B5, Lake B7, Lake A6, Lake A8, Lake CH6, and Lake D4 (Agnico Eagle 2022). Hydrogeological testing conducted at the Project site indicated that the bulk bedrock is generally of low hydraulic conductivity, ranged from 1×10^{-10} m/s to 6×10^{-9} m/s (Agnico Eagle 2022). Groundwater velocities in the deep groundwater regime are very low and on the order of 0.2 m/year to 0.3 m/year.

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. A “West Bay”-type well was installed in 2011 at the site near the proposed Tiriganiaq UG infrastructure to establish a baseline for deep groundwater quality. A second “West Bay”-type well was installed in 2020 near the Discovery deposit to support the Meliadine Extension. Mean salinity of groundwater below the permafrost has been estimated at approximately 61,000 mg/L (Agnico Eagle 2022). 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. The freezing point depression was calculated to be equivalent to -3.3°C in the Meliadine Extension area (Golder 2012b). 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 280 m to 290 m (Agnico Eagle 2022).

2.5 Seismic Zone

The Meliadine Mine site is in an area of low seismic risk. The site classification for seismic response is “Class C” based on the determined ground conditions. The Peak Ground Acceleration (PGA) for a reference “Class C” site under various Annual Exceedance Probability (AEP) was estimated using the 2020 National Building Code of Canada Seismic Hazard Tool. The estimated PGA is 0.0285 g for a 5% in 50-year probability of exceedance (0.001 per annum or 1 in 1,000 year return) and 0.0498 g for a 2% in 50-year probability of exceedance (0.000404 per annum or 1 in 2,475 year return) for the Meliadine Mine site.

3.0 SUBSURFACE CONDITIONS

3.1 General

Geotechnical site investigation programs were carried out at various locations of the Meliadine Extension site in 1998, 1999, 2007, 2009, 2011, 2012, 2013, 2014, 2016, and 2021. Figure 1 shows the locations of the geotechnical boreholes drilled around the proposed site facilities for the Meliadine Extension. The sub-sections below summarize subsurface conditions obtained from previous geotechnical site investigations performed in some within or close to the footprint of the various WRSFs. This information includes overburden soils and bedrock depths underneath the footprint of the proposed WRSFs for the Meliadine Extension.

3.2 Subsurface Conditions in the WRSF1 Area

WRSF1 is located on the high ground to the west of Portal 2 and east of Lake SP6. A total of 17 boreholes were drilled within the proposed WRSF1 footprint, and 4 boreholes drilled within approximately 100 m outside of the boundary of the proposed WRSF1 footprint. The detailed geotechnical information and borehole logs can be found in the associated site investigation reports (Golder 2009, 2011, 2012b, and 2012c; EBA 2013; Tetra Tech EBA 2014). In general, the subsurface of the WRSF1 area consists of a thin layer of organic material overlying silty sand or sand and silt, ice-rich sandy silt or silty sand, silty sand or gravelly sand and silt, with traces of clay and shells with cobbles. Excess ice was observed within the overburden soils in most of the boreholes. The depth to bedrock ranges from 2.2 m to 13.6 m. Table 1 summarizes the key geotechnical information of the overburden soils and bedrock depths in the WRSF1 area.

Table 1: Geotechnical Information of Overburden Soils within and close to the WRSF1 Footprint

Borehole No.	Organic Layer Thickness (m)	Major Overburden Soil Types	Ice Conditions	Depth to Bedrock (m)
GT09-13	0.08	Peat; Sandy Silt; Dense Gravel; Gravel and Cobbles; Frozen Gravel and Silty sand	Frozen from depth of 4.9 m, Nbn	6.0
GT09-20	0.02	Silty sand; silt and sand	Vr >50% from 0.9 m to 1.4 m	2.2
GT11-06	-	Low recovery; sand; sand and silt	Vs from 2.5 m to 2.75 m	13.6
GT11-07	0.60	Low recovery; silty sand and gravel	Vx from 1.5 m to 6.1 m	6.1
GT11-11	0.06	Gravelly sand; ice and silty sand; silty sandy gravel	1.5 m ice and silty sand from 2.25 m to 3.75 m	8.4
GT12-12	0.04	Peat; Gravel; Silty sand and Silty Gravel	Up to 20% Nbn, Up to 60 % Vx from 0.6 m to 2.3 m	2.3
GT12-13	-	Ice; Frozen Silt and Sand; Frozen Sandy Silt	Ice from GS to depth of 1.10; Nbn., Vr and Vs	4.3
GT12-14	0.02	Sandy silty gravel	Not logged	8.5
GT12-15	0.08	Silty sand; sandy silt; gravelly sand and silt	Vr from 1.6 m to 3.5 m	12.7
GT12-16	-	Low recovery; sand and gravel; gravelly silty sand; sandy silty gravel	Thawed during drilling	10.4

Table 1: Geotechnical Information of Overburden Soils within and close to the WRSF1 Footprint

Borehole No.	Organic Layer Thickness (m)	Major Overburden Soil Types	Ice Conditions	Depth to Bedrock (m)
GT12-17	0.05	Low recovery; silty sand; boulders and cobbles; gravelly sandy silt	Thawed during drilling	8.5
GT13-01	0.20	Sand and silt; gravelly sand	Up to 30% Vx, Vr from 0.6 m to 1.2 m; 0.2 m ice and sand from 1.6 m to 1.8 m	5.8
GT13-02	0.18	Peat; Sand; Ice and sand; Boulders; Sand and Gravel	Excess ice (Vs, Vx, and Vc), Excess visible ice 1% to 2%, thawed material at depth of 7 m	8.6
GT13-03	-	Boulders and Gravel; Sand; Sand and Silt	Excess ice (Vs, Vx, and Vc), Excess visible ice 1% to 2%, Nbn' possibly thermally disturbed from depth 2.5 m to 6 m	6.6
GT13-08	0.15	Low recovery; boulders and cobbles	Thawed during drilling	10.4
GT13-09	0.08	Low recovery; gravel; boulders	Thawed during drilling	9.5
GT14-09	0.52	Peat; sand; sandy silt; ice and silt	0.6 m ice and silt from 2.9 m to 3.5 m	4.0
GT14-34	0.30	Sandy silt; sand; ice and silt; silty sand	Vs 30%; Vc/Vx 10; 0.8 m ice and silt from 1.4 m to 2.2 m	8.3
GT17-21	0.12	Sand, gravel, ice, silt, boulder	Vs from 1 m to 1.5 m 98% ice from 1.3 m to 1.38 m	6.2
GT17-22	0.3	Silt, and ice	Nbn, Nbe, Vr, ice from 1.65 m to 1.8 m	6.3
GT17-23	0.24	Silt, sand, gravel, cobble	Vr, 71% Ice from 2.5 m to 2.65 m Nbn	4.77

3.3 Subsurface Conditions in the WRSF3 Area

A total of 46 boreholes were drilled within (14 boreholes) and around (32 boreholes) the proposed WRSF3 footprint in the past geotechnical site investigation programs (Tetra Tech EBA 2014; Tetra Tech EBA 2016; Tetra Tech 2020; Tetra Tech 2021a). In general, the subsurface of the WRSF3 area consists of a very thin layer (0 to 0.28 m) of organic peat overlying silty sand or sand and silt, ice-rich gravelly sand with some silt, silty sand or gravelly sand and silt, with traces of clay and shells with cobbles, and bedrock (greywacke, highly weathered to fresh, strong, dark grey, fine grained). Excess ice (Vx, Vs, or Vr) was observed within the overburden soils in most of the boreholes. 0.6 m thick ice and sand/silt (ground ice) layers with excess ice content up to 70% was observed in Borehole GT21-66. The depth of bedrock ranges from 2.2 m to 8.5 m. Table 2 summarizes the key geotechnical information of the overburden soils in the WRSF3 area together with bedrock elevations.

Table 2: Geotechnical Information of Overburden Soils within and close to the WRSF3 Footprint

Borehole No.	Organic Thick (m)	Major Overburden Soil Types	Ice Conditions	Depth to Bedrock (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; Sand and Ice; Silty Sand	Up to 60% Vu, Vs; 40% Vx; 1 mm to 2 mm thick ice formations	3.40
GT19-09	0.45	Silty Sand; Sand	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	4.5
GT14-03	0.28	Sand and Silt; Sand; Silt	Vs 2%	2.80
GT14-04	0.10	Gravelly Sand; Sand; Silt and Sand	Up to 25% Vc, Vx, Vs, 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%; 0.35 m Ice and Sand; 0.60 m Ice and Sand	6.40
BH16-03	0.00	Gravelly Sand; Sand and Gravel; Silt and Sand; Gravel and Sand	Up to 15% Vx, Vs, Vc	6.50
GT21-66	0.1	Peat; Sand; Ice and Sand and Gravel	Up to 70% Vr, Vs, Nbe; 0.6 m of ICE + Sand and Gravel	2.3
GT21-64	0.45	Peat; Gravel	Up to 15% Vx; ice crystals	2.7
GT21-65	0.29	Peat; Silt; Gravel and Cobbles	Up to 20% Vs, Vr; lenticular ice and ice crystals	4.5
BH16-04	0.24	Cobbles and Boulders; Gravelly Sand; Sand and Gravel; Silty Sand	Up to 10% Vx, Vs, Vc	8.50
BH16-05	1.07	Sand and Gravel; Sand; Gravel and Sand; Boulders	Up to 50% Vx, Vs; 0.10 m Ice	4.90
BH16-06	0.06	Sand and Gravel; Sand; Sand and Silt	Up to 15% Vx, Vs	2.90
BH16-07	0.06	Sand and Silt; Ice and Sand; 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

Table 2: Geotechnical Information of Overburden Soils within and close to the WRSF3 Footprint

Borehole No.	Organic Thick (m)	Major Overburden Soil Types	Ice Conditions	Depth to Bedrock (m)
TH-CP6-02*	-	-	-	4.40
GT21-01*	-	-	-	5.0
GT21-02*		-	-	8.2
GT21-03*	-	-	-	4.2
GT21-04*	-	-	-	3.8
GT21-05*	-	-	-	5.3
GT21-06*	-	-	-	6.7
GT21-07*	-	-	-	7.6
GT21-08*	-	-	-	5.0
GT21-09*	-	-	-	3.5
GT21-10*				12.8
GT21-11*	-	-	-	7.0
GT21-12*	-	-	-	6.5
GT21-14*	-	-		4.3
GT21-15*	-	-	-	6.1
GT21-67*	-	-	-	2.5
GT21-68*	-	-	-	4.8
GT21-69*	-	-	-	1.5
GT21-70*	-	-	-	0.9

*Destructive boreholes

3.4 Subsurface Conditions in the WRSF5 Area

WRSF5 is located east of water pond CP8. As illustrated in Figure 1, no borehole has been drilled within the footprint of WRSF5. The closest boreholes to the footprint of WRSF5 are GT21-16 to GT21-19 that are located within approximately 100 m to 400 m outside of the WRSF5 footprint. It is assumed that subsurface conditions at these boreholes represent the general subsurface conditions beneath the WRSF5 area. In general, the subsurface conditions are expected to be a thin layer of organic material overlying ice-rich silt and sand or gravel. Excess ice was observed within the overburden soil in most of the boreholes. The depth of bedrock ranges from 2.8 m to 4.4 m. Table 3 summarizes the key geotechnical information of the overburden soils and the bedrock depth close to the WRSF5 area. The detailed geotechnical information and borehole logs can be found in the Spring 2021 Geotechnical Drilling Report (Tetra Tech 2021a).

Table 3: Geotechnical Information of Overburden Soils near the WRSF5 Footprint

Borehole No.	Organic layer Thickness (m)	Overburden Soil Description	Ice Conditions	Bedrock Depth (m)
GT21-16	0.27	Peat; Gravel (Rubbles)	Nbn in organic layer	2.8
GT21-17	0.45	Peat; Gravel and Sand; Silt; Ice and Silt	Vs 58% from 2.0 m to 3.7 m, wavy ice to 3 mm thick	3.7
GT21-18	0.26	Peat; Rubble; Sand; Ice and Silt and Sand	Clear ice through in 1 mm to 20 mm lenses, Vs, Vx 73% from 2.0 m to 3.5 m	4.4
GT21-19	0.06	Peat; Silt; Gravel: Ice and Sand and Silt; Cobbles	Visible ice, lenses range from 2 mm to 5 mm and spaced 2 mm to 5 mm, Vs 55% (1.4 m to 1.7 m); Vs, Vx 45% to 55% from 1.7 m to 2.6 m	3.8

3.5 Subsurface Conditions in the WRSF6 Area

WRSF6 is located southeast of water pond CP8. As illustrated in Figure 1, one borehole (GT11-16) was drilled within the proposed footprint and ten destructive boreholes were drilled around the west and south perimeters of the WRSF6 footprint to determine the bedrock depth. The borehole log for GT11-16 indicates that the subsurface consists of a layer of sandy silt overlying sandy gravel, some silt, and silt and boulder. Ice-rich layers were not encountered at GT11-16. No detailed borehole logs were recorded for the destructive holes. Moisture content of the selected overburden soils from the destructive holes tested by Agnico Eagle on site ranges from 8.3% to 25.6% depending on the depth and location of the selected samples. The bedrock depth ranges from 7.8 m to 13.1 m.

Table 4 summarizes the key geotechnical information of the overburden soils at GT11-16 along with the bedrock depths. The detailed geotechnical information and borehole log at GT11-16 can be found in Golder (2011).

Table 4: Geotechnical Information of Overburden Soils within and near the WRSF6 Footprint

Borehole No.	Organic layer Thickness (m)	Overburden Soil Description	Ice Conditions	Bedrock Depth (m)
GT11-16	0.07	Sandy silt; sandy gravel, some silt, boulder; gravelly silt and sand, cobbles, and boulders	Ice content 5.7%, from 1.6 m to 3.08 m; Frozen (Nbn), gravelly silt and sand from 3.08 m to 9.83 m	13.1
GT21-22 to GT21-34	N/A	N/A	Water content ranging from 8.3% to 25.6%	7.8 to 12.4

3.6 Subsurface Conditions in the WRSF7 Area

WRSF7 is located east of Lake A6. As illustrated in Figure 1, no borehole was drilled within the proposed footprint and eight destructive holes (GT21-36 to GT21-43) were drilled around the south perimeter of the WRSF7 to determine the bedrock depth. One borehole (GT12-41) was drilled approximately 450 m from the west side of the proposed footprint for the WRSF7 footprint during the 2012 geotechnical drilling program. The borehole log for GT12-41 indicates that the subsurface at GT12-41 consists of a layer of sandy silty and gravel overlying gravelly silty sand. The moisture contents of selected overburden samples from the destructive drilling ranges from 7.6% to 16.0% depending on the depth and location of the selected samples. The bedrock depth ranges from 7.3 m to

11.4 m. Table 5 summarizes the key geotechnical information of the overburden soils and bedrock depth at GT12-41. The detailed geotechnical information and borehole log at GT12-41 can be found in Golder (2012c).

Table 5: Geotechnical Information of Overburden Soils near the WRSF7 Footprint

Borehole No.	Organic layer Thickness (m)	Overburden soil Description	Ice Conditions	Bedrock Depth (m)
GT12-41	0.05	Sandy silty and gravel; Gravelly silty sand; Ice silty sand, trace gravel; gravelly silty sand	Ice silty sand, trace gravel from 1.1 m to 1.42 m; frozen from 1.42 m to 8.06 m	8.06
GT21-36 to GT21-43	N/A	N/A	Water content ranging from 7.6% to 16.0%	7.3 to 11.4

3.7 Subsurface Conditions in the WRSF8 Area

WRSF8 is located north of Dis01 open pit. As illustrated in Figure 1, Boreholes GT21-82, GT21-83, GT21-93, and GT21-94 are destructive boreholes that were drilled within the proposed footprint of WRSF8. Five other destructive boreholes (GT21-81, GT21-84, GT21-90, GT21-90, and GT21-92) were drilled around the south and northwest perimeter of the WRSF8 footprint to determine the bedrock depth. Table 6 summarizes the key geotechnical information of the overburden soils and the bedrock depth within and close to the WRSF8 area.

Table 6: Geotechnical Information of Overburden Soils within and near the WRSF8 Footprint

Borehole No.	Moisture Content (%)	Bedrock Depth (m)
GT21-81	2.0, 4.0, 6.0, 8.0	8.7
GT21-82	1.0, 3.0, 5.0, 7.0	9.4
GT21-83	1.0, 2.0	3.0
GT21-84	2.0,4.0	4.4
GT21-90	1.0, 2.0	2.2
GT21-91	1.5, 2.5	3.0
GT21-92	1.0, 2.0, 3.0, 4.0	9.3
GT21-93	1.0, 2.0, 3.0, 4.0	8.8
GT21-94	1.0, 2.0, 3.0, 4.0	7.5

3.8 Subsurface Conditions in the WRSF9 Area

WRSF9 is located east of Dis01 open pit. Two boreholes (DS09GT 10 within the footprint and DS09GT 05 around the footprint) were drilled in 2009. The borehole logs indicate that the subsurface consists of a thin layer of organic material overlying silty sand material. Well bonded frozen samples with no excess ice were recovered from 1.26 m to 1.30 m. Table 7 summarizes the key geotechnical information of the overburden soils and the bedrock depth in the WRSF9 area. The detailed geotechnical information and borehole logs can be found in Golder (2009).

Table 7: Geotechnical Information of Overburden Soils near the WRSF9 Footprint

Borehole No.	Organic layer Thickness (m)	Overburden Soil Description	Ice Conditions	Bedrock Depth (m)
DS09GT-05	0.45	Peat; Silty Sand; Gravel and Cobbles	-	4.0
DS09GT-10	0.08	Peat; Sand and Silt; Gravel and Cobbles	Frozen from 1.26 m, Nbn	3.4

4.0 ANALYSIS METHODLOGY AND DESIGN CRITERIA

4.1 Methodology

Limit equilibrium analyses were conducted to evaluate the overall stability of the proposed WRSFs under long-term loading conditions after construction. All analyses were conducted and the factor of safety (FoS) against slope failure was calculated using the two-dimensional, limit equilibrium software, Slope/W of GeoStudio 2021 (Geo-Slope International Ltd. 2021). The Morgenstern-Price method with a half-sine interslice force assumption was adopted in the analyses. 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 FoS.
- The slip surface with the lowest FoS is determined through iteration.

4.2 Stability Acceptance Criteria for Factor of Safety

The *Guidelines for Mine Waste Dump and Stockpile Design* (Hawley and Cunning 2017) provides guidelines for assigning stability criteria and FoS 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 as an update and improvement to the previous (PAE 1991) interim design acceptability criteria, which did not specifically distinguish between factors such as the size of a 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 presented in Hawley and Cunning (2017).

The stability acceptance criteria suggested by Hawley and Cunning (2017) is presented in Table 8.

Table 8: Suggested Stability Acceptance Criteria

Consequence[1]	Confidence[2]	Minimum FoS for Static Analysis	Minimum FoS for Pseudo-Static Analysis
Low	Low	1.3-1.4	1.05-1.1
	Moderate	1.2-1.3	1.0-1.05
	High	1.1-1.2	1.0
Moderate	Low	1.4-1.5	1.1-1.15
	Moderate	1.3-1.4	1.05-1.1
	High	1.2-1.3	1.0-1.05
High	Low	>1.5	1.15
	Moderate	1.4-1.5	1.1-1.15
	High	1.3-1.4	1.05-1.1

1. 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).

2. 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 each WRSF design will be adopted to capture different slope slip mechanisms, failure consequence, and confidence levels in stability analysis input parameters, key assumptions, proximity to mining open pit, and site conditions. Table 9 summarizes the stability criteria adopted for the design of each WRSF.

Table 9: Adopted Stability Criteria for the WRSFs Design

WRSF	Consequence of Failure	Confidence Level	Minimum Factor of Safety for Static Loading	Minimum Factor of Safety for Pseudo-static Loading
WRSF1	Moderate	Moderate	1.3-1.4	1.05-1.1
WRSF3	High	Moderate	1.4-1.5	1.1-1.15
WRSF5	High	Low	>1.5	1.15
WRSF6	High	Low	>1.5	1.15
WRSF7	High	Low	>1.5	1.15
WRSF8	High	Low	>1.5	1.15
WRSF9	High	Low	>1.5	1.15

The key considerations to choose the stability design criteria for each WRSF are presented in Table 10.

Table 10: Key Considerations for WRSF Design

WRSF	Key Considerations
WRSF1	Deep seated failure may slide into SP6. Overall design of 20.5°, less than 25°. Twenty geotechnical boreholes drilled within the footprint of the WRSF. Localized ice-rich layer. Slightly conservative assumption on shear strength of the ice-rich layer.
WRSF3	Deep seated failure may slide into CP2 and Meliadine Lake. Overall design of 20.5°, less than 25°. Twenty geotechnical boreholes drilled within the footprint of the WRSF. Localized ice-rich layer. Slightly conservative assumption on shear strength of the ice-rich layer.
WRSF5	Deep seated failure may slide into adjacent mining open pit. Overall design of 20.5°, less than 25°. No geotechnical boreholes drilled within the footprint of the WRSF. Potential ice-rich layer in the foundation.
WRSF6	
WRSF7	
WRSF8	
WRSF9	

The PGA of 0.0498 g for a 2% in 50-year probability of exceedance (0.000404 per annum or 1 in 2,475 year return) for the Meliadine Mine site was adopted in the slope stability analyses.

5.0 STABILITY ANALYSIS INPUT DATA AND CASES

5.1 Foundation Soil Profile

The foundation soil profiles to be used for the stability for each WRSF was generated based on the available drilling borehole information. The details on the subsurface conditions of each WRSF are summarized in the Section 4 of the prefeasibility level design report. Tetra Tech conducted the detailed design of WRSF1 and WRSF3 for the approved Meliadine project to meet the conditions specified in Part D, Item 2 of the Type A Water Licence (2AM-MEL-1631). The same foundation soil profiles used for the detailed design of WRSF1 and WRSF3 were adopted for the slope stability analyses of WRSF1 and WRSF3 for the Meliadine Extension. In general, the foundation soils within the footprint of the WRSF1 consists of 1.5 m sand and silt, 1.0 m ice-rich silt, 2.0 m to 10 m silty sand over bedrock. The foundation soils within the footprint of the WRSF3 consists of 1.5 m sand, 1.0 m ice-rich sand/silt, 1.5 m sandy silt over bedrock.

Limited knowledge of the geotechnical conditions underlying WRSF5, WRSF6, WRSF7, WRSF8, and WRSF9 is available at this stage of study. Accordingly, the foundation of these WRSFs is assumed to be similar to WRSF1 at this stage. Till material was identified within the footprint of the proposed WRSF5. Tetra Tech assumes that the overburden material within the designated area of the proposed WRSF5 will be excavated for infrastructure construction.

5.2 Material Properties

Soil strength tests on samples from the Meliadine Gold Mine are limited. A laboratory consolidated-undrained triaxial test on a silty sand overburden sample was conducted in 2013 (EBA 2013). The sample was taken from a borehole drilled in an area more than 300 m west of WRSF1. The test results indicated that 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 angle of internal friction for the silty sand in the foundation was assumed to be 34°, which is the same as what were used in the WRSF1 detailed design (Tetra Tech 2019b). However, since there are weaker layers above the silty sand layer in the foundation, the strength parameter for the silty sand does not govern the stability analysis results.

Of importance to the slope stability assessment is the strength of the ice-rich silt in the foundation. The long-term cohesion of the ice-rich silt depends on its temperatures – the colder the soil, the higher its long-term cohesion. The long-term cohesion of the frozen ice-rich silt was adopted based on Weaver and Morgenstern (1981).

Detailed thermal analyses were performed by Tetra Tech for the detailed design of WRSF1 and WRSF3 (Tetra Tech 2019a, 2019b, 2021b). Thermal analyses for the WRSFs at Discovery under climate change scenario RCP 4.5 were performed to establish the basis for closure design of the WRSFs at Discovery (Okane 2022). No thermal analyses were conducted for WRSF5 to WRSF7 for the Meliadine Extension at this stage. Tetra Tech reviewed the past thermal analyses results for WRSF1 and WRSF3 and assumed that the thermal conditions of WRSF5, WRSF6, WRSF7, WRSF8, and WRSF9 and the foundation underneath them will be similar as predicted in the detailed design of WRSF1 under long-term conditions. The representative temperatures in various zones along the ice-rich silt layer under long-term conditions after construction that were obtained from the thermal analysis performed for the detailed design of WRSF1 will be adopted for this study.

Table 11 summarizes typical material properties used for the stability analysis of the WRSFs. Foundation material properties to be used for each WRSF may be slightly different depending on the actual foundation conditions for each WRSF.

Table 11: Material Properties for the WRSFs Stability Analyses

Material		Effective Angle of Internal Friction, Ø (º)	Cohesion, *c* (kPa)	Unit Weight, γ (kN/m^3)
Waste Rock		42	0	19
Overburden Waste		28	0	17
Sand/gravel and Silt		31	0	20
Gravelly Sand and Silt		36	0	21
Sandy Gravel		29	0	19
Unfrozen Silt		28	0	17
Unfrozen Sand and Gravel		30	0	20
Ice-rich Silt	Ice-rich Silt C40 (for zones with predicted temperatures of -0.7°C to -1.0°C)	0	40	16
	Ice-rich Silt C60 (for zones with predicted temperatures of -1.0°C to -1.5°C)	0	60	16
	Ice-rich Silt C100 (for zones with predicted temperatures of -1.5°C to -2.0°C)	0	100	16
	Ice-rich Silt C130 (for zones with predicted temperatures of -2.0°C to -2.5°C)	0	130	16
Thawing Ice-rich Silt		28	0	16
Ice-Poor Silty Sand		34	0	21

5.3 Cases Evaluated

Slope stability analyses at selected cross section locations for each WRSF were conducted to evaluate the long-term slope stability under the following loading conditions:

- Slope stability under long-term static loading conditions post-construction; and
- Slope stability under long-term seismic (pseudo-static) loading conditions post-construction.

The slope stability analyses in this study were focused on the long-term post-construction conditions. Slope stability analyses under short-term static loading during stage construction was not included in this study. The plan view and the location of the section selected for the slope stability are presented in Figure 2.

6.0 STABILITY ANALYSIS RESULTS

The calculated FoS for each WRSF under the long-term static and pseudo-static loading conditions are summarized in Table 12 along with the required minimum FoS as defined in Table 9. Figures 3 to 14 present the results of the slope stability analysis for the WRSFs evaluated.

Table 12: Summary of Calculated Factor of Safety for each WRSF

WRSF	Descriptions	Calculated FoS	Required Minimum FoS	Figure No.
WRSF1	Long-term static loading conditions post-construction	1.5	1.3-1.4	3
	Seismic loading condition post-construction	1.3	1.05-1.1	4
WRSF3	Long-term static loading conditions post-construction	1.5	1.4-1.5	5
	Seismic loading condition post-construction	1.2	1.1-1.15	6
WRSF5	Long-term static loading conditions post-construction	1.5	1.5	7
	Seismic loading condition post-construction	1.3	1.1	8
WRSF6	Long-term static loading conditions post-construction	1.8	1.5	9
	Seismic loading condition post-construction	1.5	1.15	10
WRSF7	Long-term static loading conditions post-construction	1.6	1.5	11
	Seismic loading condition post-construction	1.3	1.15	12
WRSFs 8 and 9	Long-term static loading conditions post-construction	1.9	1.5	13
	Seismic loading condition post-construction	1.6	1.15	14

7.0 DISCUSSION AND CONCLUSION

A series of slope stability analyses were conducted under various assumptions to assist in developing typical sections of the WRSFs for the Meliadine Extension. The results of the analyses for the final design section indicate that the calculated minimum FoS for each WRSF meet or exceed the adopted minimum FoS under long-term static loading and seismic loading post construction. The analyses were conducted under various assumptions including the subsurface condition and thermal condition under the long-term climate change scenario (RCP 4.5).

8.0 LIMITATIONS OF REPORT

This technical memo and its contents are intended for the sole use of Agnico Eagle Mines Limited (Agnico Eagle) and their agents. Tetra Tech Canada Inc. does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Agnico Eagle, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on Use of this Document attached in the Appendix A or Contractual Terms and Conditions executed by both parties.

9.0 CLOSURE

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.

704-ENG.EARC03193-04 704-ENG.EARC03193-04 704-ENG.EARC03193-04 704-ENG.EARC03193-04 704-ENG.EARC03193-04 704-ENG.EARC03193-04 704-ENG.EARC03193-04	704-ENG.EARC03193-04 704-ENG.EARC03193-04 704-ENG.EARC03193-04 704-ENG.EARC03193-04 704-ENG.EARC03193-04 704-ENG.EARC03193-04 704-ENG.EARC03193-04
Prepared by: Hongwei Xia, Ph.D., P.Eng. Senior Geotechnical Engineer, Arctic Group Direct Line: 587.460.3646 Hongwei.Xia@tetratech.com	Reviewed by: Fai Ndofor Akongnui, M.Sc., P.Geo Manager, Edmonton, Arctic Group Direct Line: 587.460.3486 Fai.Ndofor@tetratech.com

/jf

REFERENCES

Agnico Eagle Mines Limited (Agnico Eagle), 2022, Meliadine Mine – Meliadine Extension FEIS Addendum, July 2022.

EBA, 2013. Meliadine Gold Project 2013 March Geotechnical Site Investigation Data Report. A Technical Report Submitted to Agnico Eagle Mines Ltd. by EBA, A Tetra Tech Company, May 2013.

GEO-SLOPE International Ltd. Tutorial, Slope/W of GeoStudio 2021.

Golder, 2009. Tiriganiaq Deposit and F-Zone Deposit Summer 2009 Geotechnical Field Investigations - Meliadine Gold Project, Nunavut. Final Report submitted to Agnico Eagle Mines Limited. by Golder, March 10, 2010.

Golder, 2011. SD 2-4A Factual Report on 2011 Geotechnical Drilling Program- Meliadine Gold Project, Nunavut. Final Report submitted to Agnico Eagle Mines Limited. by Golder, June 7, 2012.

Golder, 2012a. Factual Report on 2011 Geotechnical Drilling Program. A Technical Report Submitted to Agnico Eagle Mines Ltd. by Golder Associates, June 7, 2012.

Golder, 2012b. Factual Report on 2012 Geotechnical Drilling Program. A Technical Report Submitted to Agnico Eagle Mines Ltd. by Golder Associates, November 2012.

Golder, 2012c. Tailings Storage Facility Preliminary Design – Meliadine Gold Project, Nunavut. A Draft Report Submitted to Agnico Eagle Mines Ltd. by Golder, August 16, 2012.

Golder, 2013. Volume 7.0 Freshwater Environment and Impact Assessment, Draft Environment Impact Statement (DEIS) - Meliadine Gold Project, Nunavut. Report Number: Doc 288-1013730076. Golder Associates, January 2013.

Hawley, M. and Cunning, J. (editors), 2017. Guidelines for Mine Waste Dump and Stockpile Design, CSIRO Publishing, 2017, p370.

Okane, 2022. Thermal Modelling of Discovery WRSF 948-021-010 Rev 3. February 2022. A Technical Report issued to Agnico Eagle Mines Limited by Okane Consultants Inc.

PAE, 1991. Guidelines for Investigation and Design of Mine Dumps Submitted to British Columbia Mine Dump Committee by Piteau Associates Engineering Ltd., May 1991.

Tetra Tech EBA, 2014. Meliadine Gold Project 2014 Geotechnical Site Investigation Data Report. Submitted to Agnico Eagle Mines Limited by EBA, A Tetra Tech Company, EBA File: E14103181-01, May 2014.

Tetra Tech EBA, 2016. Meliadine Gold Project 2016 Geotechnical Site Investigation Data Report. Submitted to Agnico Eagle Mines Limited by Tetra Tech EBA Inc. EBA File: EARC03020-01, July 2016.

Tetra Tech, 2019a. Thermal Analyses for Waste Rock Storage Facility No1 (WRSF1), Meliadine Project, Nunavut. A Technical Memorandum submitted to Agnico Eagle Mines Ltd. by Tetra Tech Canada Inc., August 15, 2019.

Tetra Tech, 2019b. Waste Rock Storage Facility No1 (WRSF1) Design Report and Drawings, Meliadine Project, Nunavut. A Technical Memorandum submitted to Agnico Eagle Mines Ltd. by Tetra Tech Canada Inc., November 2019.

Tetra Tech, 2020. Geotechnical Site Investigation for Waste Rock and Overburden Storage Facility No. 3, Meliadine Gold Project, NU. Technical Report (IFU) issued to Agnico Eagle Mines Limited. March 2, 2020.

Tetra Tech, 2021a. Spring 2021 Geotechnical Site Investigation, Meliadine Gold Project, NU. Technical Report (IFU) issued to Agnico Eagle Mines Limited. September 22, 2021.

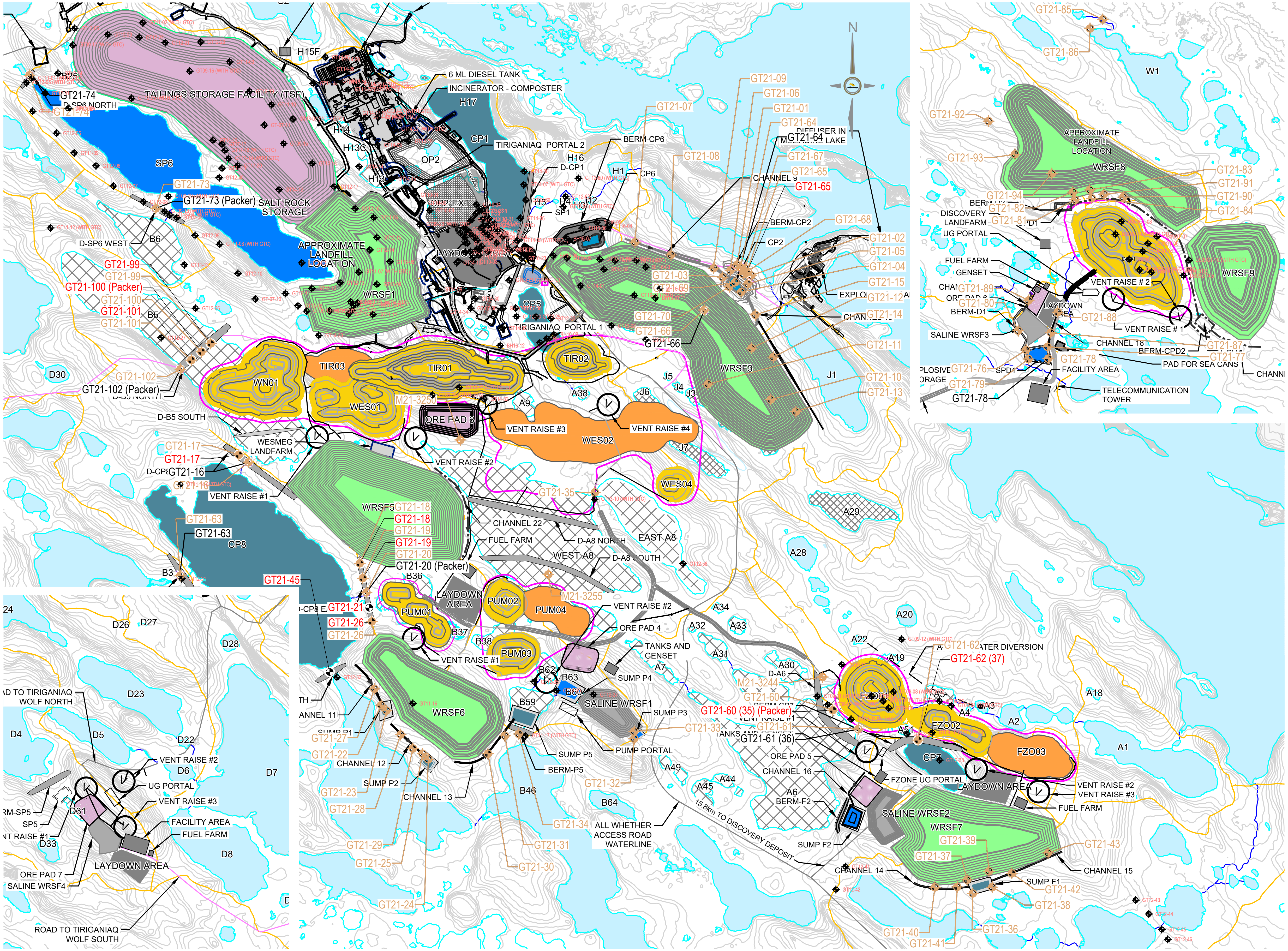
Tetra Tech, 2021b. Waste Rock Storage Facility 3 (WRSF3) Version 2, Meliadine Project, Nunavut. A Technical Memorandum submitted to Agnico Eagle Mines Ltd. by Tetra Tech Canada Inc, November 2021.

Weaver, J.S., and Morgenstern, N.R., 1981. Pile Design in Permafrost. Can. Geotech., J., 18, 357-371 (1981).

FIGURES

NO. DESSIN
DRAWING NO.

FORMAT ANSI B-11x17



LEGEND

- CATCHMENT BOUNDARY
- ROADS IN WATER LICENSE AMENDEMENT
- SERVICE ROAD AS BUILD
- HAUL ROAD AS BUILD
- WASTE ROCK STORAGE FACILITY
- PLOM 2020 PIT DESIGN LIMIT
- MINING AREA BOUNDARY
- HAUL ROAD TO BUILD
- SERVICE ROAD TO BUILD
- DIVERSION CHANNEL
- PROPOSED BOREHOLE LOCATION (NON-DESTRUCTIVE)
- PROPOSE BOREHOLE LOCATION WITH MULTI-BEAD GROUND TEMPERATURE CABLE
- 2021 DDH PROBEHOLES
- 2021 BOREHOLES (AGNICO EAGLE)
- EXISTING BOREHOLE FROM PREVIOUS DRILLING PROGRAMS

AGNICO EAGLE

TETRA TECH

TITRE / TITLE	# DWG
–	–
–	–
–	–
–	–
–	–

DESSINS EN RÉFÉRENCE/REFERENCE DRAWINGS

REV	DESCRIPTION	DATE	PAR BY

REVISIONS

DESSINÉ PAR / DRAWN BY — DATE
VÉRIFIÉ PAR / CHECKED BY
APPROUVÉ PAR / APPROVED BY
No. PROJET / PROJECT NO.
DATE

TITRE / TITLE
AGNICO EAGLE – MELIADINE DIVISION
MELIADINE EXTENSION PROJECT
BOREHOLE LOCATIONS

ÉCHELLE/SCALE 1:15000 — FICHIER/FILE .DWG

No. DESSIN/DRAWING NO. FIGURE 1 — RÉVISION A — FEUILLE/SHT 1 / 2

AE-CART-ANSI B

Q:\Edmonton\Engineering\E141\Projects_MELIADINE\ENG.EARC03193-04 MEL WLA\MEL Extension WLA Site Layout\Yearly Layout Update R1 - 2022\Figure 3-DBM.dwg

LEGEND

EXISTING GROUND		WATER	
ROAD		DEWATERED	
CATCHMENT BOUNDARY LINE		OPEN PITS	
MINING AREA		TAILINGS STORAGE FACILITY	
DIVERSION CHANNEL		WASTE ROCK STORAGE FACILITY	
CONTACT WATER POND		OPEN PIT START OF MINING	
SALINE POND			

NOTE

1. ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED.

REFERENCE

1. REFERENCE BASE DRAWING FROM AGNICO EAGLE "14-2043 YEAR OVER SITE LAYOUT.DXF".

NOT FOR CONSTRUCTION

0 500 1,000
1:15,000 METRES

CLIENT
AGNICO EAGLE MINES LIMITED

PROJECT
MELIADINE MINE EXTENSION

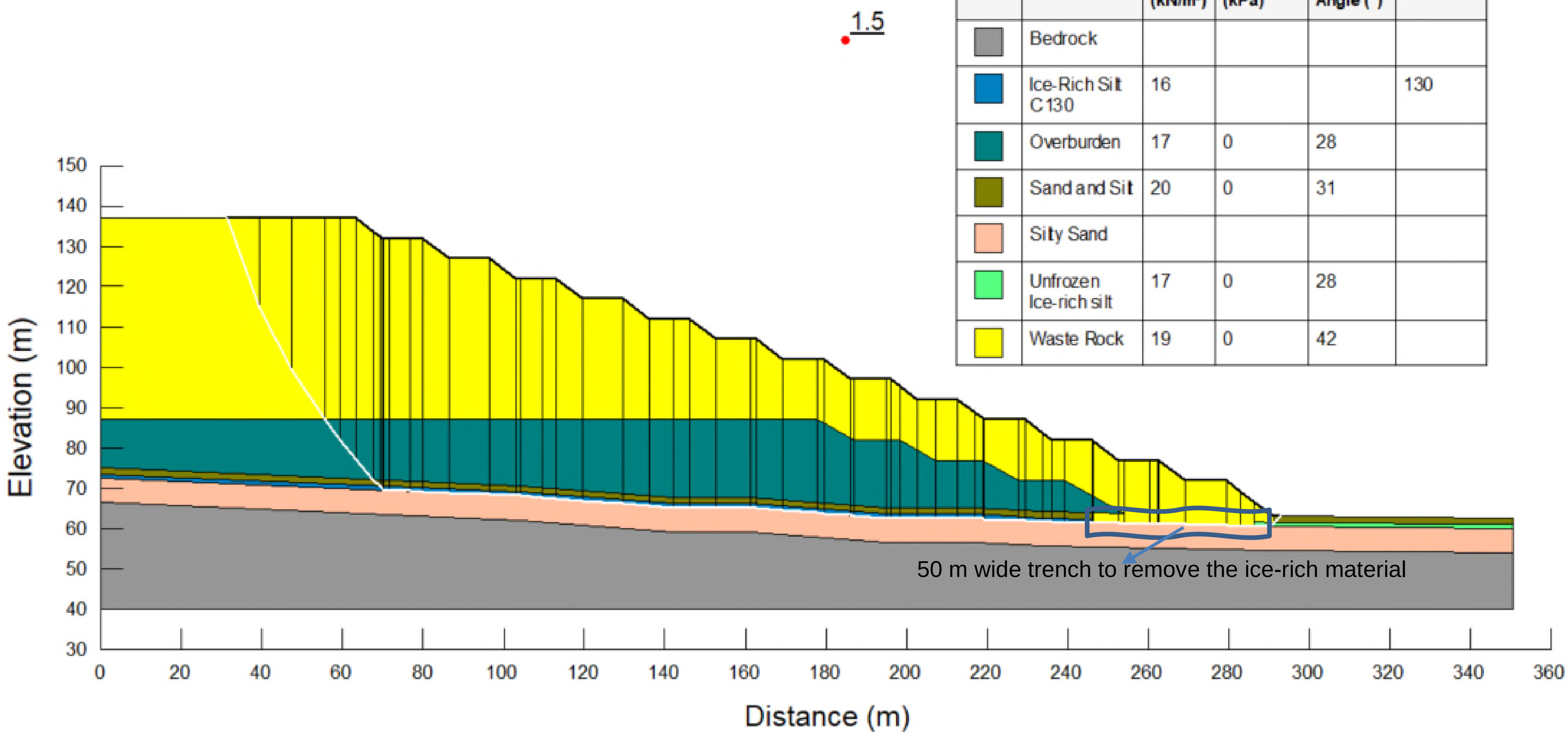
CONSULTANT
TETRA TECH

YYYY-MM-DD	2022-05-24
DESIGNED	HX
PREPARED	HX
REVIEWED	HX
APPROVED	

TITLE
FIGURE 2 - PLAN VIEW AND LOCATION OF CROSS SECTION FOR SLOPE STABILITY ANALYSIS

PROJECT NO.	PHASE/TASK/DOC.	REV.	FIGURE
EARC03193	04	A	2

Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Cohesion (kPa)
	Bedrock				
	Ice-Rich Silt C130	16			130
	Overburden	17	0	28	
	Sand and Silt	20	0	31	
	Silty Sand				
	Unfrozen Ice-rich silt	17	0	28	
	Waste Rock	19	0	42	



LEGEND

NOTES

STATUS
ISSUED FOR REVIEW

CLIENT

AGNICO EAGLE

TETRA TECH

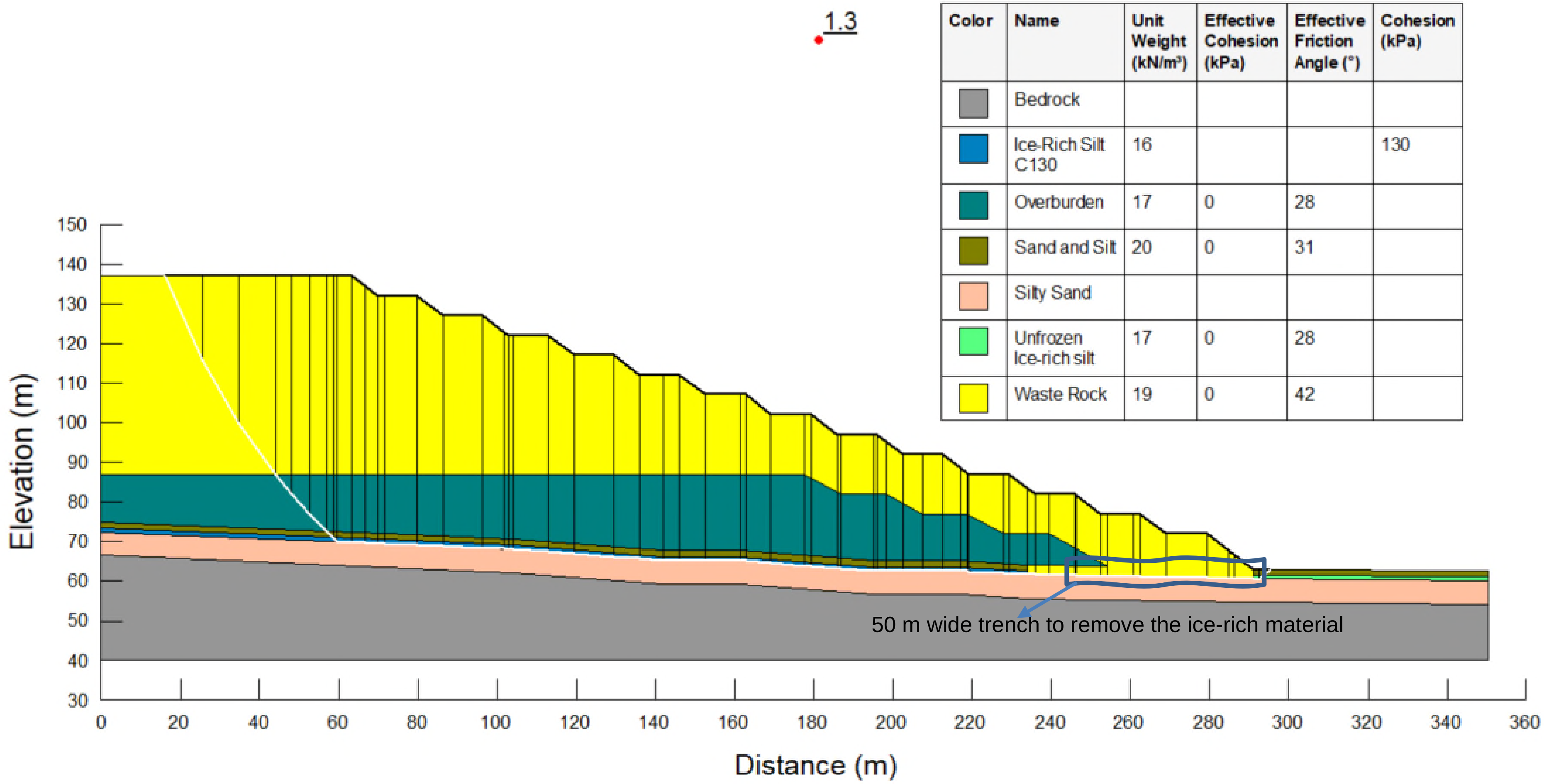
STABILITY ANALYSES FOR WASTE ROCK STORAGE FACILITY, MELIADINE EXTENSION PROJECT, NU

WRSF1 Long-term Stability, Static Loading Deep Seated Slip Failure

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03193-04	HX	FN		A

OFFICE	DATE
Edmonton	November 2022

Figure 3



Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Cohesion (kPa)
	Bedrock				
	Ice-Rich Silt C130	16			130
	Overburden	17	0	28	
	Sand and Silt	20	0	31	
	Silty Sand				
	Unfrozen Ice-rich silt	17	0	28	
	Waste Rock	19	0	42	

LEGEND

NOTES

PGA of 0.0498 g

STATUS
ISSUED FOR REVIEW

CLIENT

AGNICO EAGLE

TETRA TECH

STABILITY ANALYSES FOR WASTE ROCK STORAGE FACILITY, MELIADINE EXTENSION PROJECT, NU

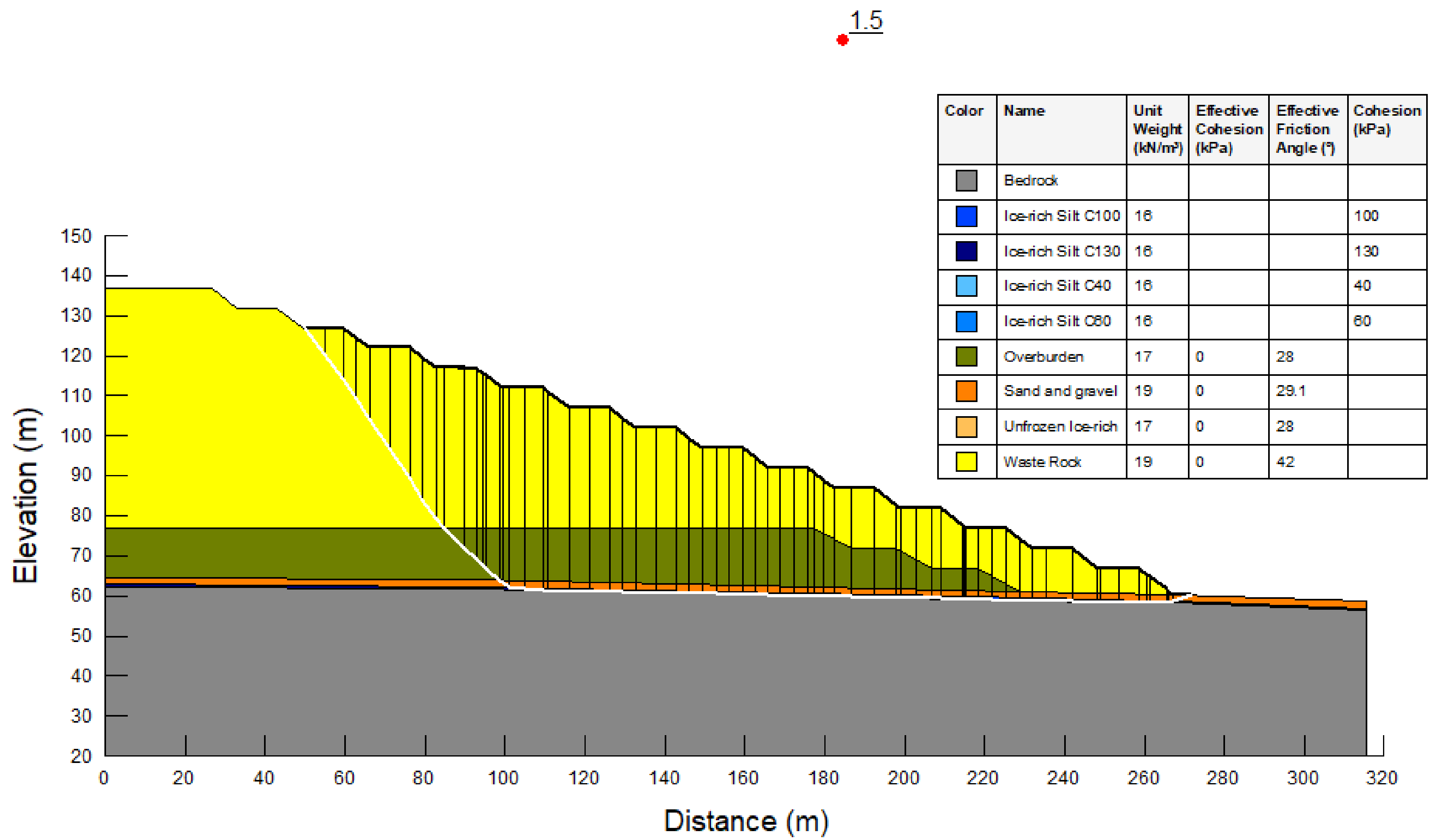
WRSF1 Long-term Stability, Pseudo-Static Loading, Deep Seated Slip Failure

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03193-04	HX	FN		A

OFFICE: Edmonton

DATE: November 2022

Figure 4



Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Cohesion (kPa)
	Bedrock				
	Ice-rich Silt C100	16			100
	Ice-rich Silt C130	16			130
	Ice-rich Silt C40	16			40
	Ice-rich Silt C80	16			80
	Overburden	17	0	28	
	Sand and gravel	19	0	29.1	
	Unfrozen Ice-rich	17	0	28	
	Waste Rock	19	0	42	

LEGEND

NOTES

STATUS
ISSUED FOR REVIEW

CLIENT

AGNICO EAGLE

TETRA TECH

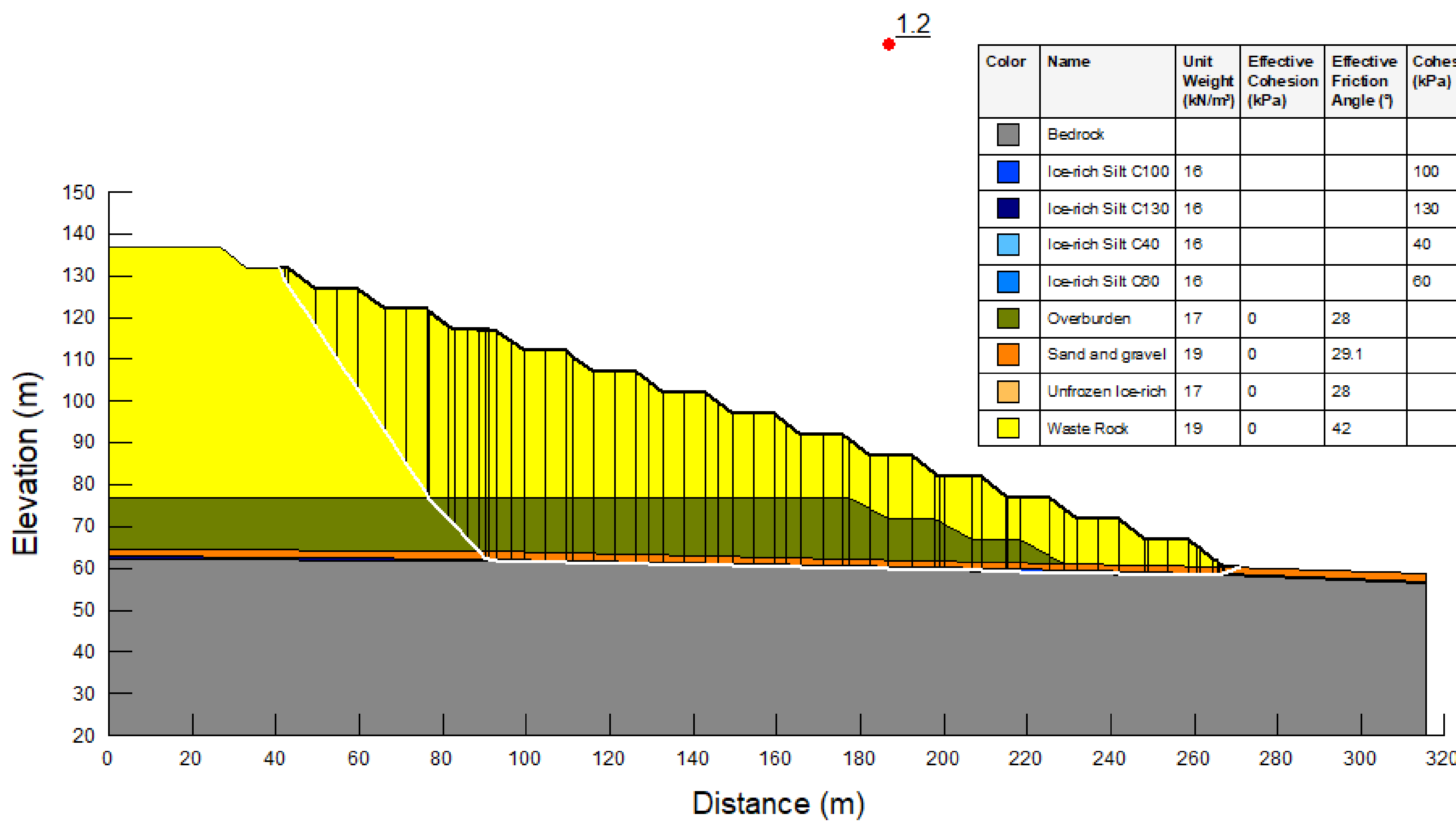
STABILITY ANALYSES FOR WASTE ROCK STORAGE FACILITY, MELIADINE EXTENSION PROJECT, NU

WRSF3 Long-term Stability, Static Loading Deep Seated Slip Failure

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03193-04	HX	FN		A

OFFICE	DATE
Edmonton	November 2022

Figure 5



Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Cohesion (kPa)
	Bedrock				
	Ice-rich Silt C100	16			100
	Ice-rich Silt C130	16			130
	Ice-rich Silt C40	16			40
	Ice-rich Silt C60	16			60
	Overburden	17	0	28	
	Sand and gravel	19	0	29.1	
	Unfrozen Ice-rich	17	0	28	
	Waste Rock	19	0	42	

LEGEND

NOTES

PGA of 0.0498 g

STATUS
ISSUED FOR REVIEW

CLIENT

AGNICO EAGLE

TETRA TECH

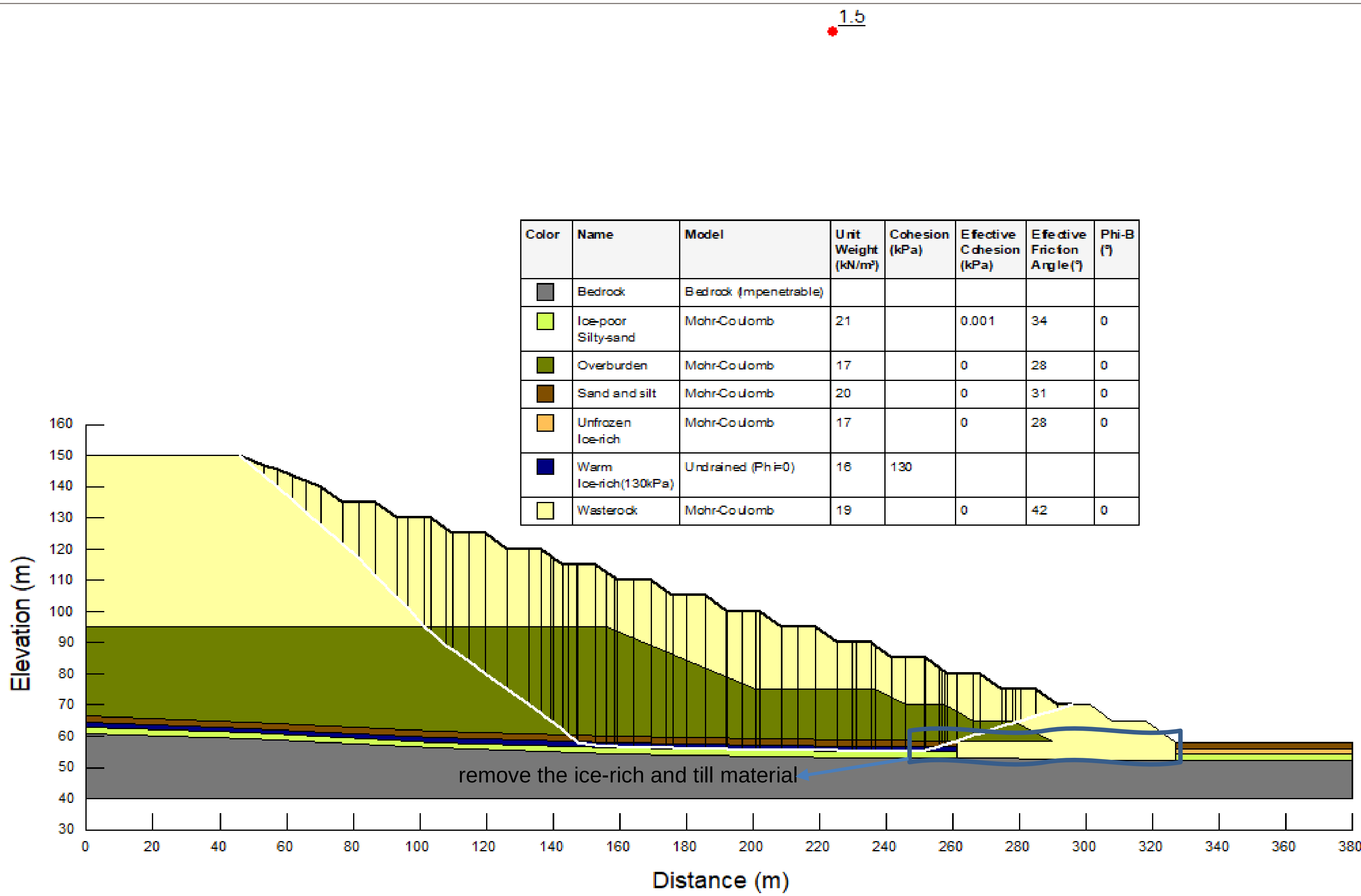
STABILITY ANALYSES FOR WASTE ROCK STORAGE FACILITY, MELIADINE EXTENSION PROJECT, NU

WRSF3 Long-term Stability, Pseudo-Static Loading, Deep Seated Slip Failure

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03193-04	HX	FN		A

OFFICE	DATE
Edmonton	November 2022

Figure 6



Color	Name	Model	Unit Weight (kN/m³)	Cohesion (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)					
	Ice-poor Silty-sand	Mohr-Coulomb	21		0.001	34	0
	Overburden	Mohr-Coulomb	17		0	28	0
	Sand and silt	Mohr-Coulomb	20		0	31	0
	Unfrozen Ice-rich	Mohr-Coulomb	17		0	28	0
	Warm Ice-rich(130kPa)	Undrained (Phi=0)	16	130			
	Wasterock	Mohr-Coulomb	19		0	42	0

LEGEND

NOTES

STATUS
ISSUED FOR REVIEW

CLIENT

AGNICO EAGLE

TETRA TECH

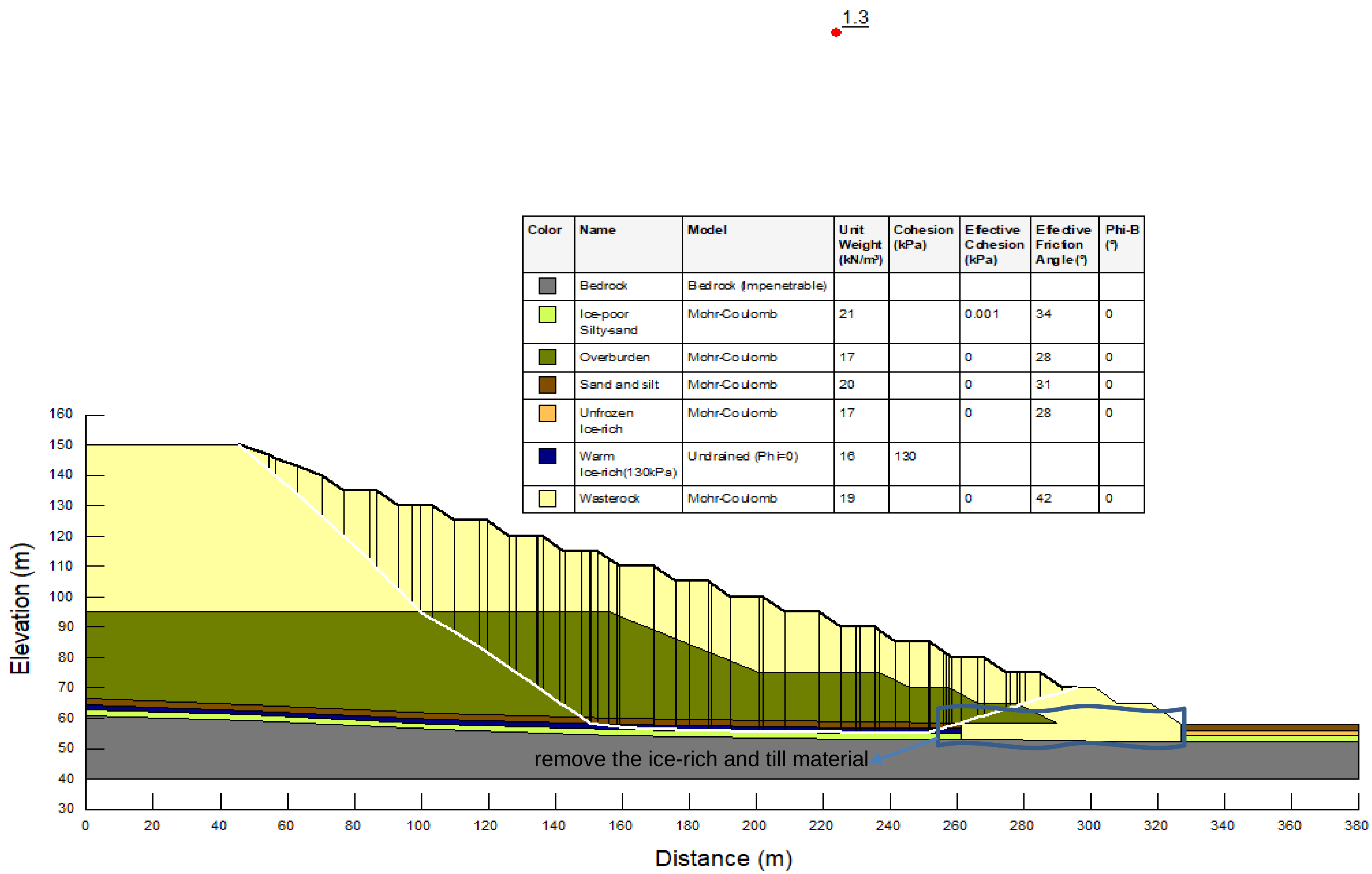
STABILITY ANALYSES FOR WASTE ROCK STORAGE FACILITY, MELIADINE EXTENSION PROJECT, NU

WRSF5 Long-term Stability, Static Loading Deep Seated Slip Failure

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03193-04	HX	FN		A

OFFICE	DATE
Edmonton	November 2022

Figure 7



Color	Name	Model	Unit Weight (kN/m³)	Cohesion (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)					
	Ice-poor Silty-sand	Mohr-Coulomb	21		0.001	34	0
	Overburden	Mohr-Coulomb	17		0	28	0
	Sand and silt	Mohr-Coulomb	20		0	31	0
	Unfrozen Ice-rich	Mohr-Coulomb	17		0	28	0
	Warm Ice-rich(130kPa)	Undrained (Phi=0)	16	130			
	Wasterock	Mohr-Coulomb	19		0	42	0

LEGEND

NOTES

PGA of 0.0498 g

STATUS
ISSUED FOR REVIEW

CLIENT

AGNICO EAGLE

TETRA TECH

STABILITY ANALYSES FOR WASTE ROCK STORAGE FACILITY, MELIADINE EXTENSION PROJECT, NU

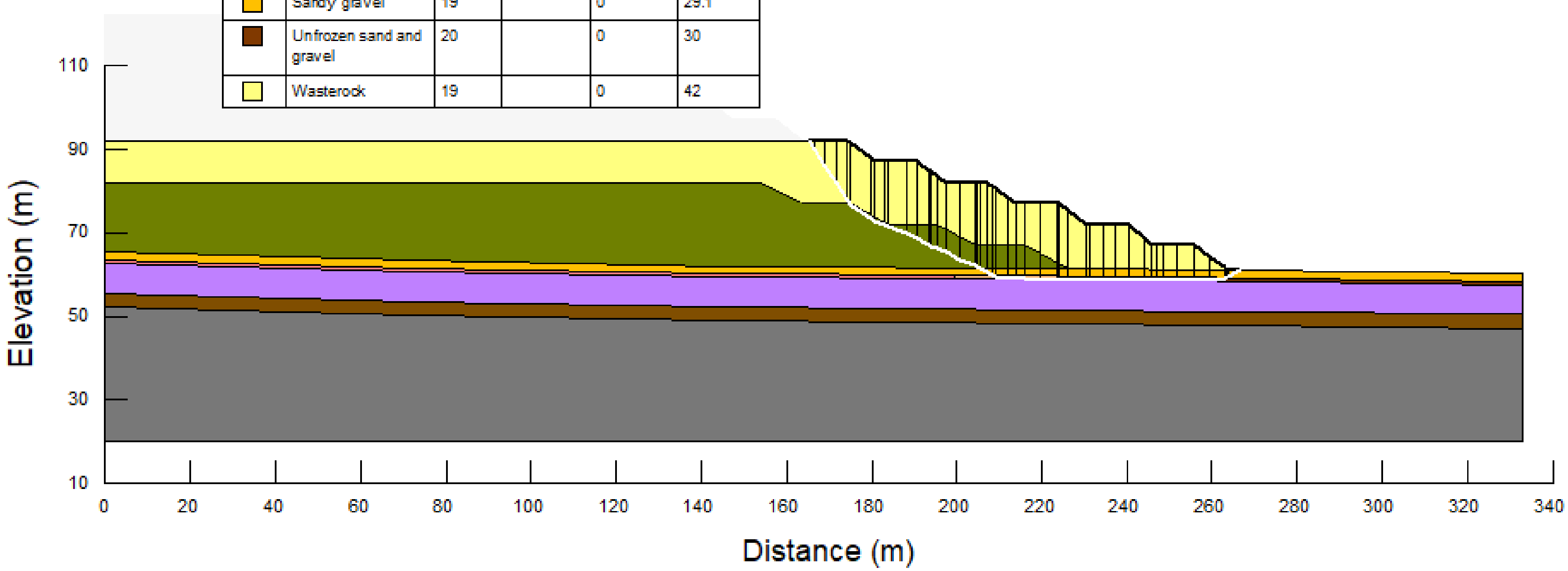
WRSF5 Long-term Stability, Pseudo-Static Loading, Deep Seated Slip Failure

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03193-04	HX	FN		A

OFFICE	DATE
Edmonton	November 2022

Figure 8

Color	Name	Unit Weight (kN/m³)	Cohesion (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Bedrock				
	Frozen silty clay	21		50	30
	gravelly sand and silt	21		0	36
	Icy poor sand and gravel - 130 kPa	19	130		
	Icy poor sand and gravel -100 kPa	19	100		
	Overburden	17		0	28
	Sandy gravel	19		0	29.1
	Unfrozen sand and gravel	20		0	30
	Wasterock	19		0	42



LEGEND

NOTES

STATUS
ISSUED FOR REVIEW

CLIENT

AGNICO EAGLE

TETRA TECH

STABILITY ANALYSES FOR WASTE ROCK STORAGE FACILITY, MELIADINE EXTENSION PROJECT, NU

WRSF6 Long-term Stability, Static Loading Deep Seated Slip Failure

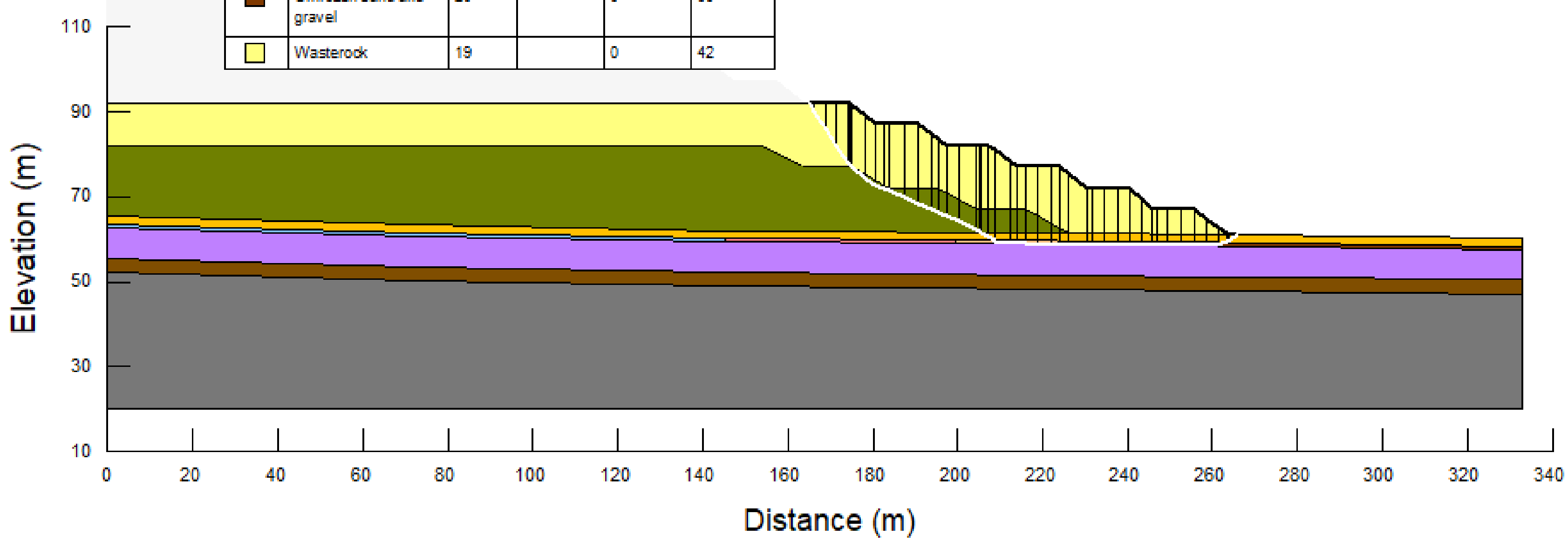
PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03193-04	HX	FN		A

OFFICE: Edmonton

DATE: November 2022

Figure 9

Color	Name	Unit Weight (kN/m³)	Cohesion (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Bedrock				
	Frozen silty clay	21		50	30
	gravelly sand and silt	21		0	38
	Icy poor sand and gravel - 130 kPa	19	130		
	Icy poor sand and gravel - 60 kPa	19	60		
	Icy poor sand and gravel -100 kPa	19	100		
	Overburden	17		0	28
	Sandy gravel	19		0	29.1
	Unfrozen sand and gravel	20		0	30
	Wasterock	19		0	42



LEGEND

NOTES

PGA of 0.0498 g

STATUS
ISSUED FOR REVIEW

CLIENT

AGNICO EAGLE

TETRA TECH

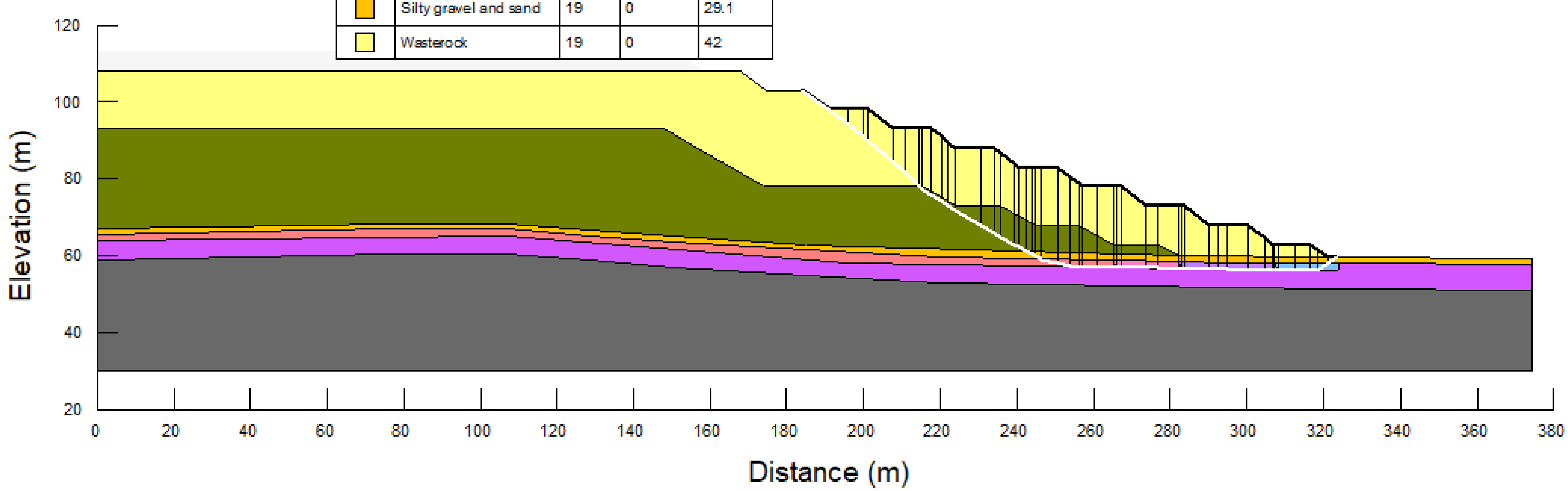
STABILITY ANALYSES FOR WASTE ROCK STORAGE FACILITY, MELIADINE EXTENSION PROJECT, NU

WRSF6 Long-term Stability, Pseudo-Static Loading, Deep Seated Slip Failure

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03193-04	HX	FN		A

OFFICE	DATE
Edmonton	November 2022

Figure 10



Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Bedrock			
	Gravelly silty sand	21	0	36
	Ice-Rich Silt - 100 kPa	17	100	0.001
	Ice-Rich Silt - 130 kPa	17	130	0.001
	Ice-Rich Silt - 40 kPa	17	40	0.001
	Ice-Rich Silt - 60 kPa	17	60	0.001
	Overburden	17	0	28
	Silty gravel and sand	19	0	29.1
	Wasterock	19	0	42

LEGEND

NOTES

STATUS
ISSUED FOR REVIEW

CLIENT

AGNICO EAGLE

TETRA TECH

STABILITY ANALYSES FOR WASTE ROCK STORAGE FACILITY, MELIADINE EXTENSION PROJECT, NU

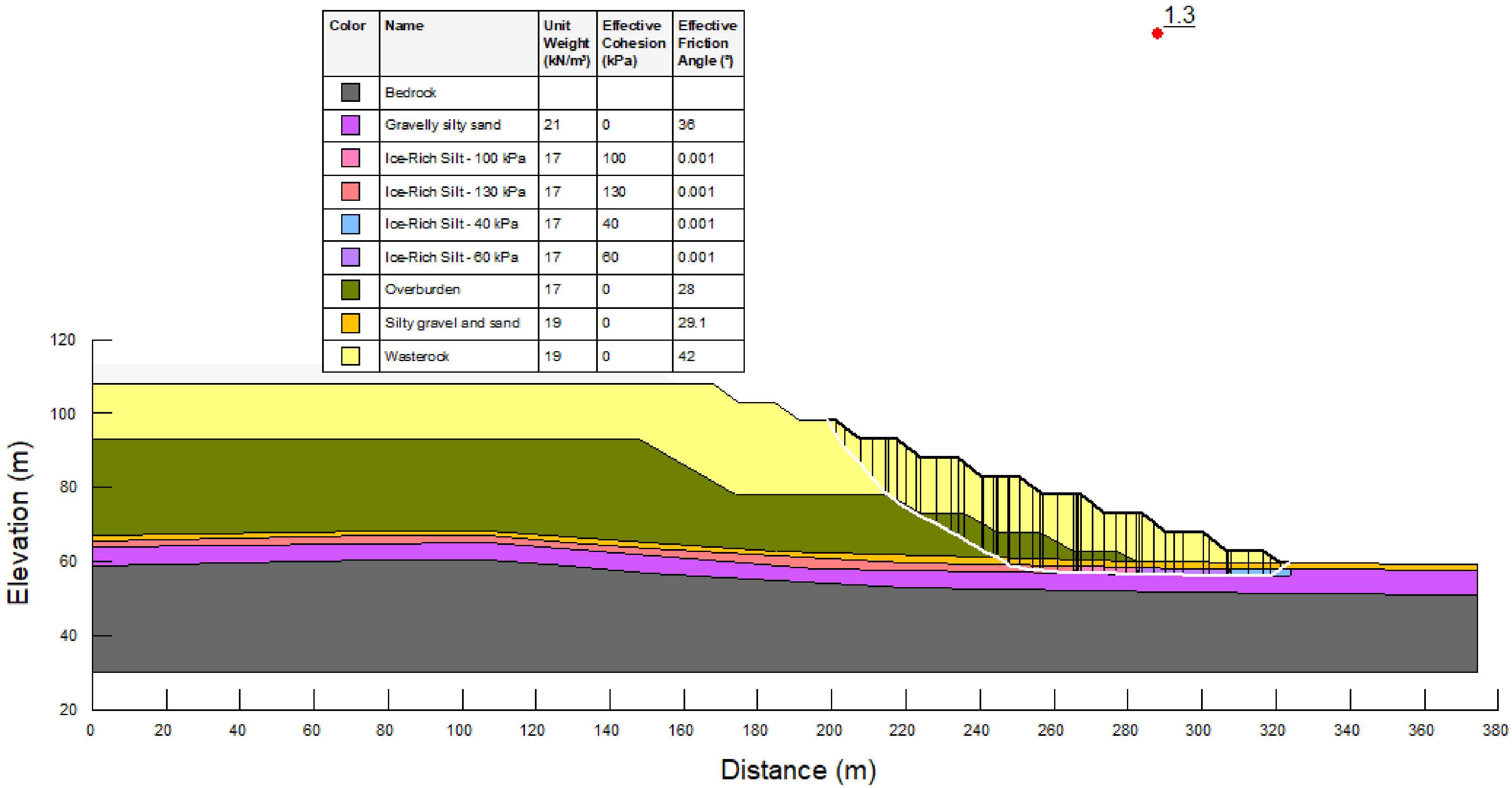
WRSF7 Long-term Stability, Static Loading Deep Seated Slip Failure

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03193-04	HX	FN		A

OFFICE	DATE
Edmonton	November 2022

Figure 11

Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Bedrock			
	Gravelly silty sand	21	0	36
	Ice-Rich Silt - 100 kPa	17	100	0.001
	Ice-Rich Silt - 130 kPa	17	130	0.001
	Ice-Rich Silt - 40 kPa	17	40	0.001
	Ice-Rich Silt - 60 kPa	17	60	0.001
	Overburden	17	0	28
	Silty gravel and sand	19	0	29.1
	Wasterock	19	0	42



LEGEND

NOTES

PGA of 0.0498 g

STATUS
ISSUED FOR REVIEW

CLIENT

AGNICO EAGLE

TETRA TECH

STABILITY ANALYSES FOR WASTE ROCK STORAGE FACILITY, MELIADINE EXTENSION PROJECT, NU

WRSF7 Long-term Stability, Pseudo-Static Loading, Deep Seated Slip Failure

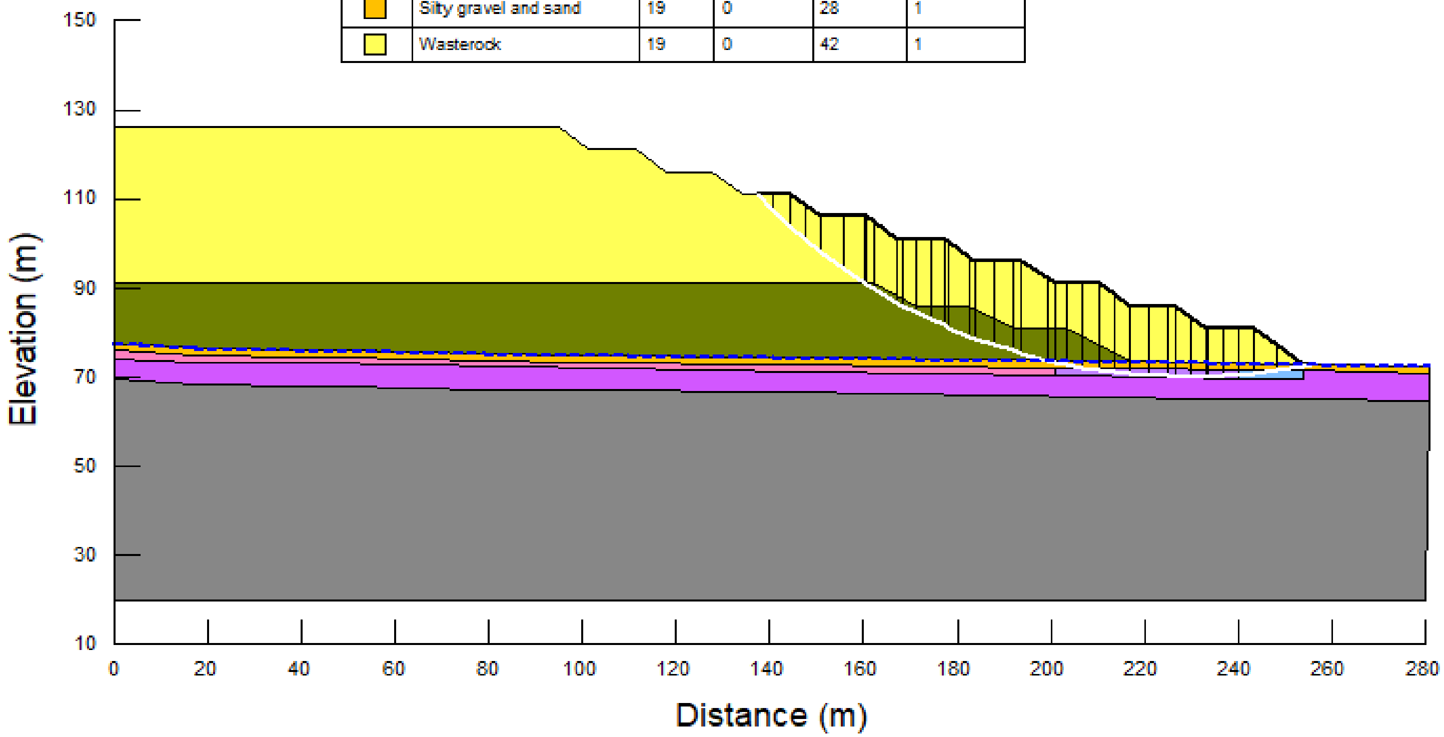
PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03193-04	HX	FN		A

OFFICE	DATE
Edmonton	November 2022

Figure 12

Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Piezometric Line
	BedRock				1
	Gravelly silty sand	21	0	36	1
	Ice-poor Silt Sand - 120 kPa	18	120	0.001	1
	Ice-poor Silt Sand - 160 kPa	18	160	0.001	1
	Ice-poor Silt Sand - 80 kPa	18	80	0.001	1
	Overburden	17	0	28	1
	Silty gravel and sand	19	0	28	1
	Wasterock	19	0	42	1

1.9



LEGEND

NOTES

STATUS
ISSUED FOR REVIEW

CLIENT

AGNICO EAGLE

TETRA TECH

STABILITY ANALYSES FOR WASTE ROCK STORAGE FACILITY, MELIADINE EXTENSION PROJECT, NU

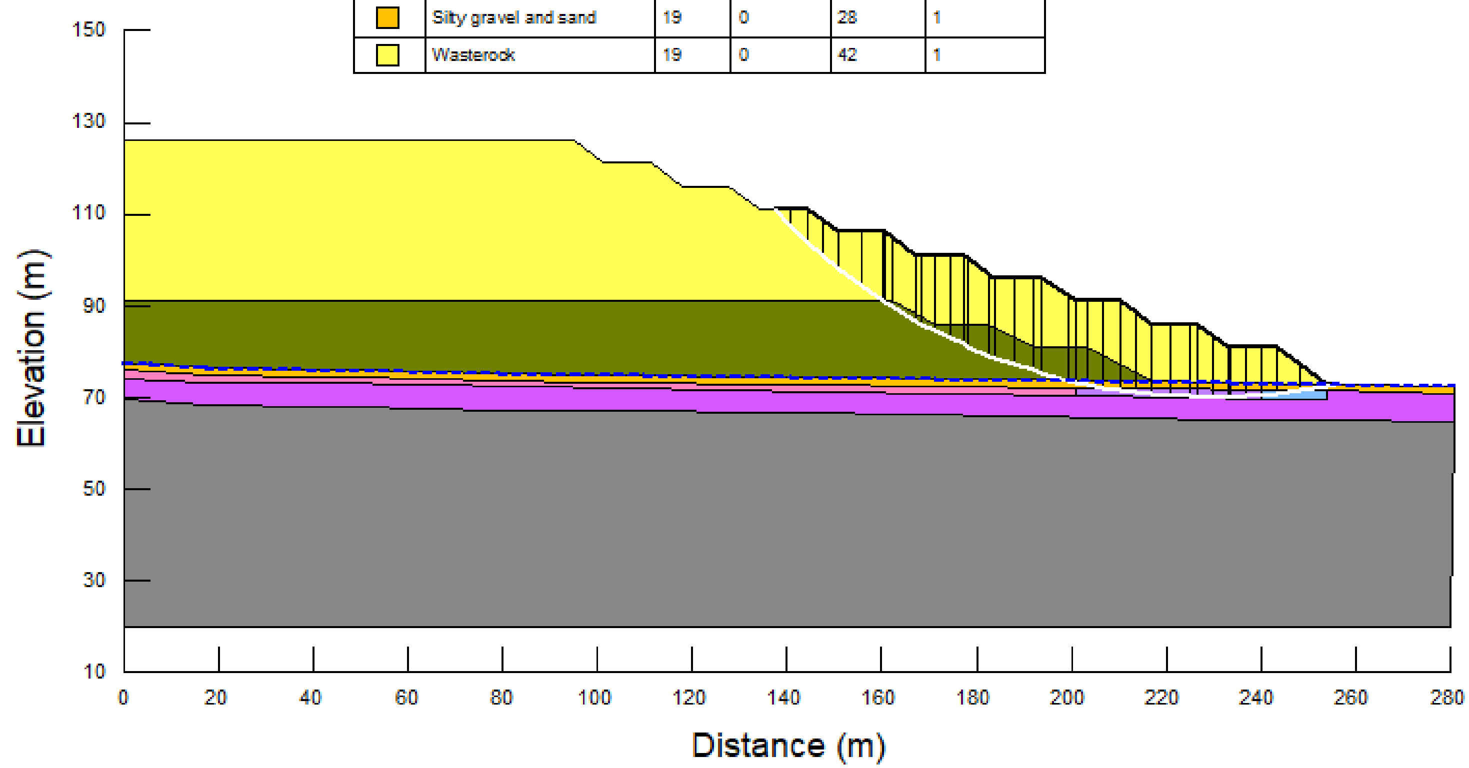
WRSF8 Long-term Stability, Static Loading Deep Seated Slip Failure

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03193-04	HX	FN		A

OFFICE	DATE
Edmonton	November 2022

Figure 13

Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Piezometric Line
	BedRock				1
	Gravelly silty sand	21	0	36	1
	Ice-poor Silt Sand - 120 kPa	18	120	0.001	1
	Ice-poor Silt Sand - 160 kPa	18	160	0.001	1
	Ice-poor Silt Sand - 80 kPa	18	80	0.001	1
	Overburden	17	0	28	1
	Silty gravel and sand	19	0	28	1
	Wasterock	19	0	42	1



LEGEND

NOTES

PGA of 0.0498 g

STATUS
ISSUED FOR REVIEW

CLIENT

AGNICO EAGLE

TETRA TECH

STABILITY ANALYSES FOR WASTE ROCK STORAGE FACILITY, MELIADINE EXTENSION PROJECT, NU

WRSF8 Long-term Stability, Pseudo-Static Loading, Deep Seated Slip Failure

PROJECT NO.	DWN	CKD	APVD	REV
704-ENG.EARC03193-04	HX	FN		A

OFFICE	DATE
Edmonton	November 2022

Figure 14

APPENDIX A

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.

Any unauthorized use of the Professional Document is at the sole risk of the user. TETRA TECH accepts no responsibility whatsoever for any loss or damage where such loss or damage is alleged to be or, is in fact, caused by the unauthorized use of the Professional Document.

Where TETRA TECH has expressly authorized the use of the Professional Document by a third party (an "Authorized Party"), consideration for such authorization is the Authorized Party's acceptance of these Limitations on Use of this Document as well as any limitations on liability contained in the Contract with the Client (all of which is collectively termed the "Limitations on Liability"). The Authorized Party should carefully review both these Limitations on Use of this Document and the Contract prior to making any use of the Professional Document. Any use made of the Professional Document by an Authorized Party constitutes the Authorized Party's express acceptance of, and agreement to, the Limitations on Liability.

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.