

CH2M HILL CANADA LIMITED

**NORTH FORK ROSE CREEK REMEDIATION,
FARO MINE COMPLEX, YUKON**

PHASE 1A SITE INVESTIGATION

FINAL

PROJECT NO.: 1085-007-02
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June 19, 2015
Project No.: 1085-007-02

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Dear Jenna,

**Re: North Fork Rose Creek Remediation, Faro Mine Complex, Yukon, Phase 1A Site
Investigation – FINAL**

As requested, please find attached a copy of the aforementioned report.

Yours sincerely,

BGC ENGINEERING INC.

per:

A handwritten signature in blue ink, appearing to read 'Jack' followed by a stylized monogram or set of initials.

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EXECUTIVE SUMMARY

The Government of Yukon (YG) manages the site care and maintenance and closure planning activities for the closed Faro Mine Complex, located in south-central Yukon. Contaminated waste dump seepage water is currently affecting the water quality in the North Fork Rose Creek (NFRC), a non-contact water channel, and interim measures to date have been only partially effective in capturing impacted seepage. YG has directed CH2M HILL Canada, Limited (CH2M HILL) to initiate final design on select closure measures for remediation, including possible relocation of the NFRC. The objective of the NFRC remediation program is to protect Rose Creek by achieving stable, long-term separation of clean and contaminated water systems.

In 2015, CH2M HILL subcontracted BGC Engineering Inc. (BGC) to provide geotechnical and permafrost engineering input for the project, including providing technical direction for a site investigation program (termed “Phase 1A”) along the hill slope east and south of the NFRC. The geotechnical investigation program included the drilling of eight boreholes, in which soil and ground ice conditions were logged and samples were retained and later sent for geotechnical laboratory index testing. Standpipe piezometers and solid polyvinyl chloride casing were installed in the boreholes for measurement of groundwater levels and, after insertion of a thermistor string, ground temperatures. Geotechnical drilling was carried out with a variety of tools (solid and hollow stem auger, CRREL core barrels, ODEX, and standard penetration test [SPT] split spoons). The drilling and instrumentation installations were completed between April 16 and 24, 2015.

Based on the findings of the Phase 1A site investigation, ground conditions along the hill slope to the south and east of the NFRC show a complex erosional and depositional history, with terrain units ranging from colluvium, alluvium, till, glaciofluvial, and glaciolacustrine deposits. Subsurface conditions consist of a mixture of sand, silt, clay, and gravel of varying proportion, with occasional buried layers of peat and organics, and occasional cobbles and boulders in the till deposits. The fines were typically low-plastic, except in occasional organic layers, which were found to be high-plastic. In unfrozen soils, SPT “N” blow counts typically ranged between 10 and 50, indicative of compact to dense conditions for coarse-grained soils. Lower SPT “N” blow counts of 5 to 8, indicative of loose density, were observed on two occasions. Bedrock was encountered in two of the eight boreholes, at depths ranging from 5.6 to 19.8 m.

Mean ground temperatures in the area are close to 0 degrees Celsius (°C) (+/- 2°C). Permafrost is discontinuous and was encountered in three or four of the eight boreholes (subject to confirmation with ground temperature measurements in September 2015), with thicknesses ranging from approximately 4 metres (m) to greater than 15 m. Permafrost was more prevalent in the area of the NFRC located within approximately 500 m east of the haul road. High ice content (greater than 15 percent [%]) frozen soil layers were observed in three boreholes, at depths ranging from approximately 2 to 4.5 m. Otherwise, visible ice contents were generally less than 5%. In addition, some soil layers were frozen but showed non-visible

excess ground ice that would become wet when thawed. In 2015, the maximum depth of seasonal frost, where no permafrost was encountered, ranged from approximately 1.5 to 3 m.

Groundwater level observations from May 6 to 9, 2015, indicated groundwater depths varying greatly, ranging from 2.2 (borehole CH15-107-MW016) to greater than 15 m below ground surface (bgs) (boreholes CH15-107-MW012 and -MW015). These levels are expected to fluctuate.

The findings of the 2015 Program 1A site investigation did not correlate well with the desktop surficial geology mapping carried out for the area by the Yukon Geological Survey (Bond, 1999). Furthermore, the one borehole that was drilled along one of the former geophysical survey lines conducted in the area by Aurora Geosciences (Aurora, 2013), did not correlate strongly with the geophysical interpretation for this section. The lack of strong correlation between the borehole data and the previous surficial geology mapping and interpretation of geophysical data is attributed to the fact that the other studies had few to no borehole data with which to correlate.

For the proposed channel relocation concept, the findings indicated the following:

- Foundation conditions are generally suitable for supporting fill embankments, although occasional layers of buried organics and ice-rich frozen soils were encountered and require specific assessments about their potential presence on channel stability (cuts or embankments). In addition, further geotechnical investigations of the valley floor along the creek are required.
- The proposed cut slope angle of 2H:1V is generally feasible, provided that exposed layers of ice-rich frozen soil and/or organics are excavated and backfilled with compacted granular fill, and provided that the base of the cut slope is above the groundwater table; flatter side slopes will be required for cuts that penetrate the existing water table or leave exposed layers of ice-rich frozen soils (i.e., soils that would become wet when thawed).
- The excavation of seasonal or perennially frozen ground may be hampered by frost, particularly in those areas where the soils are near-saturated and ice-bonded.
- Excavations may also require water control during construction if they penetrate the existing water table.
- The excavated materials consist of sand, silt, clay, and gravel of varying proportions, including occasional peat and organics, and cobbles and boulders. Apart from the organic layers, the material is generally suitable for re-use as embankment fills; frozen soils should be broken into small lumps [less than 100 millimetre (mm) diameter] and/or allowed to mostly thaw prior to being re-used. Ice-rich frozen layers will require additional drying to be suitable as embankment fills; ice-rich frozen layers should be stockpiled separately. Ice-rich materials that do not drain quickly and all organic soils should be wasted.

BGC recommends the following:

- Measure as-built borehole coordinates and collar elevations with differential global positioning system (GPS) and update the borehole summary table (3-1).
- Continue standpipe piezometer and ground temperature measurements, particularly in September 2015, when near-surface ground temperatures will be warmest, and update tables and plots.
- Excavate test pits adjacent to boreholes CH15-107-MW011, -MW012, -MW014, and -MW017, to further examine permafrost conditions at these locations and assess the rippability of the frozen soils; these test pits may be left open for a year to assess the stability of exposed frozen soils when thawed, including placement of fill materials (thermal protection cover) to minimize the impacts of permafrost degradation.
- Install standpipe piezometers in areas with proposed deep cuts (7 m bgs or greater) to determine groundwater levels for cut slope stability design input.
- Perform site reconnaissance of Phase 1A borehole locations during summer 2015, to observe surface conditions free of snow cover.
- Install geotechnical boreholes (with standpipe piezometer and thermistor installations) along the valley floor of NFRC, particularly in those areas where high channel embankments are proposed, to provide input for embankment stability assessments.
- Provide geotechnical data from this report to Aurora Geosciences so that they can reassess their interpretation of the geophysical surveys conducted in the area in 2013 and 2014.
- Map cuts and stockpiles created in October 2014 during construction of the upstream access road to examine the soil and permafrost conditions in this area.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	i
TABLE OF CONTENTS.....	iv
LIST OF TABLES	v
LIST OF FIGURES.....	v
LIST OF APPENDICES	v
LIST OF DRAWINGS.....	v
LIMITATIONS	vi
1.0 INTRODUCTION	1
1.1. Background.....	1
1.2. Remediation Options	1
1.3. Scope of Work	2
1.4. Objectives	2
2.0 SITE CONDITIONS	4
2.1. Location, Physiography, and Vegetation	4
2.2. Climate.....	4
2.3. Geology	5
2.3.1. Bedrock Geology.....	5
2.3.2. Surficial Geology	5
2.4. Permafrost.....	5
2.5. Previous Field Investigations of NFRC Area	6
3.0 SITE INVESTIGATION	7
3.1. General	7
3.2. Borehole Locations	8
3.3. Drilling, Sampling and Logging Procedures.....	8
3.4. Standard Penetration Testing	9
3.5. Instrumentation Installations	9
3.5.1. Piezometers	10
3.5.2. Thermistor Casings	10
3.6. Sampling	11
3.7. Laboratory Testing.....	11
4.0 GEOTECHNICAL CONDITIONS.....	14
4.1. Borehole Logs	14
4.2. Subsurface Conditions	14
4.3. Seasonal Frost and Permafrost	15
4.4. Groundwater Observations	17
4.5. Correlation to Geophysical Surveys.....	17
4.6. Implications for Channel Design and Construction.....	18
4.6.1. Summary of Findings	18
4.6.2. Implications for Relocated Channel Design and Construction	19
5.0 RECOMMENDATIONS FOR FURTHER WORK	21

6.0 CLOSURE	22
REFERENCES	23

LIST OF TABLES

Table 3-1.	Completed Borehole Summary.....	8
Table 3-2.	Thermistor Casing and Standpipe Piezometer Installation Summary.	10
Table 3-3.	Completed Lab Tests.....	11
Table 4-1.	Summary of Observed Geological Deposits and Bedrock Conditions.	14
Table 4-2.	Frost Depth and Ground Ice Observations (late-April/early-May, 2015).....	15
Table 4-3.	Observed Groundwater Levels (May 6 to 9, 2015).	17

LIST OF FIGURES

Figure 3-1.	Atterberg limit test results on plasticity chart.	12
Figure 3-2.	Summary of grain size distribution curves.	13

LIST OF APPENDICES

APPENDIX A	BOREHOLE LOGS
APPENDIX B	SELECT PHOTOGRAPHS
APPENDIX C	MEASURED GROUND TEMPERATURE PROFILES
APPENDIX D	LABORATORY TEST RESULTS

LIST OF DRAWINGS

DRAWING 1	Surficial Geology, Proposed Channel Alignments, and Subsurface Investigations
DRAWING 2	Stratigraphic Cross Section
DRAWING 3	Line RCD-1
DRAWING 4	Line RCD-2
DRAWING 5	Line RCD-5

LIMITATIONS

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1.0 INTRODUCTION

1.1. Background

The Government of Yukon (YG) manages the site care and maintenance and closure planning activities for the closed Faro Mine Complex (FMC), located in south-central Yukon. Recently, YG has directed CH2M HILL Canada, Limited (CH2M HILL) to initiate final design on select closure measures for remediation (including possible relocation) of the North Fork Rose Creek (NFRC), located along the east side of the Faro Mine Area. Contaminated waste dump seepage water is now affecting the water quality in this non-contact water channel, and interim measures to date have been only partially effective in capturing impacted seepage. The objective of the NFRC remediation program is to protect Rose Creek by achieving stable, long-term separation of clean and contaminated water systems.

In 2015, CH2M HILL retained BGC Engineering Inc. (BGC) to provide geotechnical and permafrost engineering input for the project, which included attendance at a remediation options scoping meeting on February 26 and 27, 2015 (CH2M HILL, 2015b). Following from that meeting and on-going discussions in early-March, BGC prepared two memorandums (BGC, 2015a and 2015b) that outlined the site investigation objectives, drilling methods, borehole locations, and instrumentation for the proposed April 2015 site investigation program. In terms of nomenclature for these proposed site investigation programs required to support the design, the following numbering scheme was used:

- Phase 1A focused on the east valley slope above the NFRC (upstream of the North Fork Rock Drain [NFRD]) – April 2015.
- Phase 1B focused on valley bottom conditions proximal to the NFRC (upstream of NFRD) – April 2015. This phase was not completed.
- Phase 2 would be comprehensive program focused on all required aspects for design – summer 2015.
- Phase 3 may be select investigation program for final design details – winter 2016.

This current report focuses on the site investigation results and related conclusions and recommendations emerging from the Phase 1A work only. The report provides the applicable background information, including a review of potential remediation options, site description, details on the site investigation program methods and testing, a summary of interpreted ground conditions, and associated recommendations relative to NFRC relocation and additional field investigations.

1.2. Remediation Options

The general design objective for the remediation of NFRC is to separate mine-waste-impacted water (from waste dumps to the west) from clean, non-contact water entering NFRC from upstream. This would require the construction of an engineered channel, aligned approximately parallel to the existing creek and conveying non-contact water, while the existing

creek would convey mine-waste-impacted waters. Channel vertical separation or physical barriers may be required between the two water flows but a final design concept has not yet been chosen.

Drawing 1 shows three proposed channel layouts, P1 to P3, currently being considered by CH2M HILL (based on working designs provided to BGC on May 7, 2015). Alignment P2 generally follows Alignment P1 but crosses the haul road at a location further south, to provide further separation and potential influence from a proposed impacted-seepage collection pond to be sited immediately west of the haul road. Alignment P3 is approximately parallel to Alignment P1, but is centred closer to the existing creek to minimize cuts into the east valley hill slope.

The preliminary channel design carried out by CH2M HILL assumed fill embankment slopes, channel slopes, and cut excavation slopes of 2H:1V; the design configuration is to be confirmed. Based on the preliminary design work, fill embankment heights of up to approximately 15 m and cut excavations as deep as 15 m are planned.

There is currently inadequate site-specific geotechnical and permafrost data along the proposed channel footprints, particularly on the hill slope to the east and south of the creek, to determine whether or not the proposed channel cuts and embankments are technically feasible for the given subsurface conditions. As noted earlier, this report provides initial geotechnical design input for these preliminary designs.

1.3. Scope of Work

For this project, the following parties are responsible for the following roles:

- YG – Owner
- CH2M HILL - Project Manager and Design Engineer
- BGC – Geotechnical/Permafrost Input

On April 9, 2015, BGC submitted to CH2M HILL a proposal outlining the proposed work scope, budget estimate and associated assumptions to undertake Program 1A, which included the following four tasks:

1. Site investigation planning and fieldwork related to eight boreholes
2. Geotechnical laboratory testing
3. Reporting
4. Project Management.

Authorization to proceed with this work was granted via CH2M HILL Award/Agreement Number 10201-7-100357, dated April 13, 2015.

1.4. Objectives

The objectives of the Phase 1A site investigation program were to characterize subsurface conditions (overburden type, density, and thickness, groundwater levels, permafrost state and

characteristics) to identify potential fatal flaws associated with deep excavations or high fill embankments, as required for the relocated NFRC channel alignment. The findings from the investigation program would also be used for planning future investigation work for geotechnical design of the relocated channel, including investigation methods, depths, and locations. Given that only preliminary design concepts have been formulated, additional design and detailed investigation work will be required by CH2M HILL.

2.0 SITE CONDITIONS

2.1. Location, Physiography, and Vegetation

The FMC is located in south-central Yukon, within the Yukon Plateau physiographic subdivision, and is bound by the Pelly Mountains and Tintina Fault to the southwest, and the Tay River to the north (CH2M HILL, 2015). The local physiography is dominated by the northwest-trending Tintina Fault. The terrain is made up of rolling uplands, broad U-shaped valleys, rounded hills, rough mountain peaks, and glacial deposits.

The surficial geology of the region is controlled by three physiographic features: the Anvil Range, the Vangorda Plateau (and Swim Basin), and the trench formed by the Tintina Fault Zone (Tintina Trench) (Bond, 2001). The FMC is located on the Vangorda Plateau, a northwest-to-southeast-oriented rolling upland located between 1,000 and 1,400 m above sea level (asl). The FMC is surrounded by the Anvil Range to the north and east and the Rose Mountains to the south. The Vangorda Plateau parallels the Tintina Trench.

Vegetation in the FMC area is typical of boreal and subalpine zones. The dominant forest type in the boreal zone is black spruce, with moss dominating in moist understories that are often associated with permafrost soils, and lichens dominating in drier areas. Drier slopes and warmer aspects are frequently dominated by white spruce with occasional stands of trembling aspen. Vegetation in the subalpine zone is largely dominated by tall shrub vegetation (dwarf birch).

2.2. Climate

The climate around the FMC was summarized by CH2M HILL (2014). Below is a brief description of CH2M HILL's assessment.

The climate at FMC is characterized as subarctic continental, with long cold winters and short, cool to mild summers. The local topography influences the microclimate, as winter temperatures can be 10 degrees Celsius (°C) colder in valley bottoms compared to higher elevations, because of temperature inversions. At the FMC, the daily average temperature ranges from approximately -16°C in January to 12°C in July. The mean annual air temperature is approximately -2°C.

The mean total annual precipitation for the area is approximately 320 mm, of which nearly 70% is in the form of rainfall and approximately 30% is in the form of snowfall. The ground is generally snow-covered from the months of October to April.

Total wind speeds average just over 2 metres per second, with minor seasonal variations. The predominant wind is from the west and northwest during the summer and from the southeast during the winter.

2.3. Geology

The regional and local bedrock and surficial geology for the FMC were described in CH2M HILL (2015), from which the following summary was prepared.

2.3.1. Bedrock Geology

The FMC is located within Anvil District, between the Rose Mountains and the Anvil Range. The Cambrian-aged Mount Mye formation is the oldest unit exposed in Anvil District, and consists of phyllites and schists around the FMC. These rocks have been intruded by felsic magmas during Cretaceous and Eocene. The intrusive suites, occurring as dikes and sills, include granodiorite and gabbro. The area of the NFRC east of the NFRD is predominantly schist with granodiorite intrusions.

2.3.2. Surficial Geology

The glacial history of the Anvil District is dominated by deposits of the late Wisconsinan McConnell glaciation, approximately 25,000 to 15,000 years ago. During the McConnell glaciation, the Anvil District was covered by ice that flowed west and northwest from the Selwyn Mountains, by ice that flowed east and northwest from the Pelly Mountains, and by local glaciers that developed in the Anvil Range itself. Ice flow through the District was controlled by topography, except in areas of low relief. Upon retreat of the ice sheet southeast, a glacial lake (informally termed glacial Lake Pelly) formed in the Tintina Trench. Thick deposits of glaciolacustrine silts, glaciofluvial sediments, and till were deposited in the Trench during the melting and retreat of the ice sheet. Glacial overburden in the District varies greatly from less than 1 m to more than 100 m.

In addition to the above glacial deposits, fluvial materials (alluvium) are common at valley bottoms along creeks and rivers (including Rose Creek) while slope-derived colluvium is commonly found near the base of hill slopes.

The surficial geology of the FMC was mapped by the Yukon Geological Survey (Bond, 1999). According to their terrain mapping, conducted mainly by desktop analysis and surficial mapping, the surficial geology around the Faro Mine Area varies between Quaternary (glaciofluvial, till, and glaciolacustrine) and more recent (alluvial and colluvial) deposits.

2.4. Permafrost

Permafrost is defined as ground that remains below 0°C for at least 2 years. The FMC is located in an area of extensive and sporadic discontinuous permafrost (Heginbottom et al., 1995), meaning that permafrost is present in the area, but not widespread, and ground temperatures in the area are close to 0°C. Permafrost temperatures and distribution are influenced by soil type, soil moisture, vegetation cover, slope aspect, and snow cover. A local empirical-statistical permafrost probability model developed for the area around the FMC (Bonnaventure and Lewkowicz, 2012) indicates that the probability of permafrost occurrence in the area is generally higher at the bottom of valleys and along ridge tops.

In addition, CH2M HILL (2015) identified permafrost-related features along the NFRC, including interpreted active layer detachments, based on visual site reconnaissance.

2.5. Previous Field Investigations of NFRC Area

Numerous boreholes have been drilled and test pits excavated in the NFRC area, the locations of some of which are presented in Drawing 1. Most existing boreholes and test pits in the NFRC area are located north of the creek, at the toe of the waste dump. The boreholes were typically drilled to install monitoring wells or standpipe piezometers. As such, they provide some description of soil texture and type, but provided little geotechnical information about soil density, consistency, or moisture content. Furthermore, no ground ice descriptions were provided, because the drilling method did not provide intact samples of frozen soil and rock samples for proper ground ice characterization or because permafrost characterization was not an objective of the investigation program. Finally, no thermistor strings have been installed in the NFRC area to measure *in situ* ground temperatures.

In 2004, BGC conducted a review of the hydraulic performance of the NFRD (BGC, 2004). As part of the review, logs prepared by EBA Engineering Ltd. for five test pits that were excavated within the footprint of the current NFRD in 1987, prior to its construction of the NFRD, were reviewed. In general, a thin layer of peat (up to 0.5 m thick) was found to overlie sand and silt till. Permafrost was observed in one of the test pits to the maximum excavation depth of 5.9 m. Frozen ground (perhaps seasonal) to depths of 2.0 to 2.5 m was observed in two test pits. The remaining two test pits terminated at shallow depths (0.7 and 1.4 m), due to the presence of cobbles and boulders.

In the summer of 2013, Aurora Geosciences Ltd., under subcontract to CH2M HILL, conducted short dipole resistivity, ground penetrating radar (GPR), seismic reflection, and seismic refraction surveys across five alignments around the NFRC (Aurora, 2013). The geophysical data were only verified and interpreted with a limited number of available borehole data. Aurora found that the seismic refraction inversions provided the most useful tool in interpreting depths to the water table, as well as weathered and fresh bedrock contacts. The resistivity data imaged shallow zones of permeability. The GPR survey data showed distinct zones of signal character changes which correlated well with permeability, but only shallow, discontinuous reflectors were observed.

In the summer of 2014, Aurora carried out seismic refraction surveys at the NFRC (Aurora, 2014a; 2014b; 2014c). The purpose of the 2014 surveys was to identify the bedrock contact depth, the thickness of weathered bedrock above the competent bedrock, the approximate boundaries of high and low permeability materials, and to estimate the presence and extent of permafrost. Again, the geophysical data were only verified and interpreted with a limited number of available borehole data. The results of the geophysical surveys of 2013 and 2014 were interpreted to show sporadic and discontinuous distribution of permafrost around the NFRC, again based on limited borehole or test pit data.

3.0 SITE INVESTIGATION

3.1. General

The locations of the proposed boreholes were initially determined by BGC, based on desktop review of the surficial geology mapping, the available borehole and test pit logs from the NFRC provided by CH2M HILL, the geophysical surveys previously conducted by Aurora (2013; 2014a; 2014b; 2014c), and the proposed channel alignment being considered by CH2M HILL. The proposed locations were discussed with CH2M HILL. The locations were later confirmed in the field after discussions with the drilling contractor for site accessibility and with the project heritage resources consultant, Ecofor.

The Phase 1A site investigation program was initiated on April 13, 2015 when both the BGC Field Engineer and the CH2M HILL Field Manager mobilized to the town of Faro. Midnight Sun Drilling Ltd. (MSD) of Whitehorse, Yukon, was retained by CH2M HILL as the drilling contractor. They mobilized to site on April 14, 2015. Drilling and instrumentation installations were carried out between April 16 and 24, 2015. MSD demobilized back to Whitehorse on April 25, 2015. A total of eight boreholes were drilled using MSD's Prospector P1 track-mounted drill rig. This rig was capable of drilling and sampling with a variety of tools and methods, as follows:

- Solid-stem augers
- Hollow-stem augers
- Cold Regions Research and Engineering Laboratory (CRREL) barrel (for permafrost coring)
- Standard penetration testing (SPT)
- ODEX drilling (with compressed air).

The various tools were considered necessary because a variety of subsurface conditions were expected, based on previous field investigations in the area, including frozen and unfrozen soils and cobbles and boulders. The above techniques are suitable for logging soils but do not provide cores of rock samples suitable for coring necessary to characterize *in situ* rock mass and discontinuities. All drilling and sampling were completed with dry drilling techniques. MSD also supplied a Caterpillar D4 dozer to clear access trails and to create a snow drilling pad at each borehole location.

Mr. Robert Di Panfilo was Field Manager for CH2M HILL and was present throughout the field investigation program. He was responsible for site safety, tool box meetings, borehole layout and coordinate measurement, along with project progress tracking.

Mr. Scott Garrison, EIT (Alberta [AB]), was the Field Engineer for BGC. He was onsite from April 13 to 26, 2015. He provided full time monitoring of the drilling activities, including: soil and permafrost logging, sample collection, supervision of standard penetration testing, instrumentation installations, and coordination of the geotechnical laboratory testing program.

Mr. Jim Cassie, P.Eng., Principal Geotechnical Engineer with BGC, was onsite on April 16 and 17, 2015, to monitor the initial portion of the drilling program.

During the investigation program, the ground was typically covered by approximately 20 to 30 centimetres (cm) of snow. Air temperatures ranged from approximately -5° to 10°C. By the end of the investigation program, the snow was rapidly melting and provided poor trafficability, even for the tracked rig.

3.2. Borehole Locations

Planned borehole coordinates were initially staked by BGC on April 15, 2015 using a handheld GPS. The borehole locations were then reviewed with CH2M HILL and MSD and adjusted, as necessary, based on observed site conditions and rig accessibility. As-built coordinates, also measured with a handheld GPS, were recorded by CH2M HILL. Table 3-1 lists the completed borehole details.

Table 3-1. Completed Borehole Summary.

Borehole I.D.	Northing (m) ¹	Easting (m) ¹	Collar Elevation (m asl) ²	Completion Depth (m bgs) ³	Completion Date (dd-mmm-yy)
CH15-107-MW011	6,913,071	584,983	1113	19.8	24-Apr-15
CH15-107-MW012	6,913,167	585,085	1109	15.7	23-Apr-15
CH15-107-MW013	6,913,301	585,175	1105	15.2	17-Apr-15
CH15-107-MW014	6,913,427	585,170	1104	13.1	18-Apr-15
CH15-107-MW015	6,913,560	585,254	1115	15.3	22-Apr-15
CH15-107-MW016	6,913,615	585,448	1111	15.7	20-Apr-15
CH15-107-MW017	6,913,707	585,646	1109	7.6	21-Apr-15
CH15-107-MW018	6,913,796	585,975	1112	9.6	21-Apr-15

Notes:

1. Coordinates were recorded by CH2M HILL using a handheld GPS. NAD83 CSRS Epoch 2002 Datum.
2. Collar elevations were estimated from LiDAR topography for approximate borehole coordinates.
3. Metres below ground surface.

Drawing 1 shows a general plan view of the borehole (monitoring well) locations completed. Completed borehole logs are provided in Appendix A. Select photos of the NFRC, borehole locations, and recovered samples are provided in Appendix B.

3.3. Drilling, Sampling and Logging Procedures

Typically, at each borehole location, drilling commenced using a solid-stem auger. If frozen soils containing few gravel and coarser fragments were encountered, a Cold Regions

Research and Engineering Laboratory (CRREL) core barrel was then used to drill and sample frozen soils until unfrozen soils, poorly-bonded frozen soils, or coarse-grained soils were encountered. After CRREL barrel use, the drilling method was switched to solid- or hollow-stem augering, or to the ODEX system if cobbles and boulders or wet, sloughing ground were encountered.

Soil samples were obtained from the CRREL core barrel (if frozen), SPT split spoon, or disturbed auger cuttings. All soil samples were visually examined, photographed, and logged. Once visually logged, all soil samples were double-wrapped in plastic bags, labelled, and packed in sample buckets for temporary storage. After completing the investigation program, all soil samples were sent to ALS Environmental in Whitehorse for geotechnical laboratory testing.

Water levels and ground temperatures were measured upon completion of drilling and installation of the instrumentation casings, and again approximately two weeks following completion of drilling by Mr. Di Panfilo of CH2M HILL, on behalf of BGC.

3.4. Standard Penetration Testing

SPT using split spoons was completed at selected intervals in surficial soils to estimate the *in situ* density/consistency of the subsurface materials. SPT was completed using standard SPT equipment: 34.9-mm-diameter split spoon, 63.5-kilogram automatic trip hammer, and 762-mm drop height. SPT was carried out in accordance with ASTM International (ASTM) test method D1586-11, at depth intervals ranging from 0.75 to 3.0 m.

In addition to providing data used to characterize the *in situ* soil density, SPTs were carried out to provide disturbed “cores” that were visually examined to characterize ground ice (if frozen) and soil conditions (when drilling with the ODEX system). It is noted that *in situ* density inferred from SPT “N” blow counts are appropriate only for unfrozen ground only; SPT values in frozen ground are nominally meaningless. This caveat should be noted as SPT values are reviewed on the borehole logs.

3.5. Instrumentation Installations

A standpipe piezometer (50 mm diameter) and an open polyvinyl chloride (PVC) casing (25 mm diameter) were installed in each borehole. The purpose of the open PVC casing was to allow for thermistor strings to be lowered into and removed from each borehole location, so that thermistor strings could be re-used for a variety of boreholes. Thermistor cables were provided by CH2M HILL to BGC. All boreholes were completed with steel surface casings.

Measurements were recorded by BGC immediately after installation, as well as up to 5 days following installation. To ensure that the instrumentation measurements are representative of *in situ* conditions (i.e., not influenced by drilling disturbance), BGC requested that CH2M HILL record measurements 2 weeks following completion of the drilling. The latest thermistor and piezometer readings were recorded between May 6 and 9, 2015, by Mr. Di Panfilo of CH2M HILL. Measurements were made using one of three thermistor strings designed and

fabricated for CH2M HILL, as noted below. Two of the thermistor strings were fabricated by RST Instruments: cable part # EL380013P, serial numbers (S/N) TS3834 (9-m total length, with temperature measuring beads at 1.0-m spacing) and TS3957 (22-m total length, with temperature measuring beads at 1.5-m spacing). The thermistor strings were fabricated with 3 kilo-Ohm thermistors, which had a manufacturer's accuracy of $\pm 0.1^{\circ}\text{C}$; the strings were not calibrated to an ice bath. Specifications for the third thermistor string, read with a multimeter, were not provided to BGC. The thermistor strings were left in the open PVC casing for a period of at least 1 hour to ensure that the temperature around each temperature measuring point equilibrated to the *in situ* borehole temperature at that depth. Temperatures were measured using an RST TH2016B thermistor readout box supplied by CH2M HILL.

Table 3-2 summarizes the installation depths of the thermistor casings and standpipe piezometers.

Table 3-2. Thermistor Casing and Standpipe Piezometer Installation Summary.

Borehole I.D.	Thermistor Casing Depth (m bgs)	Standpipe Screened Depth Interval (m bgs)	
		From	To
CH15-107-MW011	19.7	15.6	18.6
CH15-107-MW012	15.2	10.7	15.2
CH15-107-MW013	9.4	12.2	15.2
CH15-107-MW014	13.2	8.5	13.1
CH15-107-MW015	13.1	12.1	15.1
CH15-107-MW016	4.2	2.7	8.8
CH15-107-MW017	7.5	3.7	6.7
CH15-107-MW018	7.6	4.1	8.6

3.5.1. Piezometers

The standpipes were constructed of 50-mm-diameter Schedule 40 threaded PVC pipe, with the lower portion screened and the upper portion solid. Solid sand-point tips capped the bottoms and rubber J-plugs were placed at the top of the casing. The depth of the standpipe screens targeted the water table, with a sand pack extending at least 30 cm above and below every screened section. A minimum 1-m-thick bentonite seal was placed at the surface to minimize surface water infiltration around the standpipe. Groundwater level measurements are described in Section 4.4.

3.5.2. Thermistor Casings

Solid 25-mm-diameter Schedule 40 threaded PVC was used as thermistor casing. PVC thread sealant was applied to every joint and taped with electrical tape to minimize groundwater

leakage into the open PVC casing. The bottoms of the casings were fitted with solid sand-point tips, and PVC end caps were placed on top of the casing. Ground temperature measurements are described in Section 4.3 and presented in Appendix C.

3.6. Sampling

Three types of samples were collected during drilling: CRREL core, SPT, and grab (from auger cuttings). The sampling frequency was approximately one sample every 0.75- to 1.5-m depth interval. In total, 126 samples were collected. All samples were double-bagged, with the exception of wet or high ice content samples, which were triple-bagged, to minimize sample moisture loss due to leakage when thawed.

3.7. Laboratory Testing

Recovered soil samples were dropped off at ALS Environmental in Whitehorse, Yukon, who then forwarded all samples to a number of their southern Canadian laboratories. Table 3-3 lists the number of tests completed and the relevant testing standard followed by the laboratory. Laboratory test data are compiled and tabulated in Appendix D.

Table 3-3. Completed Lab Tests.

Laboratory Test	Testing Standard	Number of Tests Completed	Test Name
Moisture Content Testing	ASTM D2974 Method A	126	Standard Test Method For Moisture, Ash, and Organic Matter of Peat and Other Organic Soils
Grain Size Distribution Testing ¹	ASTM D422	21	Standard Test Method for Particle-Size Analysis of Soils
Hydrometer	ASTM D422	21	Standard Test Method for Particle-Size Analysis of Soils
Atterberg Limits	ASTM D4318	6	Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
Specific Gravity	ASTM D5057	1	Standard Test Method for Screening Apparent Specific Gravity and Bulk Density of Waste
Total Organic Carbon	CSSS (1993) Method 21.2	9	Total Organic Carbon Using the Walkley-Black Method and Van Bemmelen Factor

¹ The grain size boundaries are based on the Unified Soil Classification System (USCS). Due to the small diameter of the sampling equipment, and the limited volume of sample recovered, coarser grain sizes such as coarse gravel, cobbles and boulders are not accurately represented in the grain size distributions provided.

Moisture content tests were performed on all samples. The highest moisture contents corresponded to the samples containing excess ground ice and/or high organic content.

Six Atterberg limit tests were performed – two each on samples interpreted to be till, glaciolacustrine, and colluvium. The test results are plotted on the plasticity chart shown in Figure 3-1. Five samples plotted as low plasticity, and one colluvium with organics sample plotted as high plasticity.

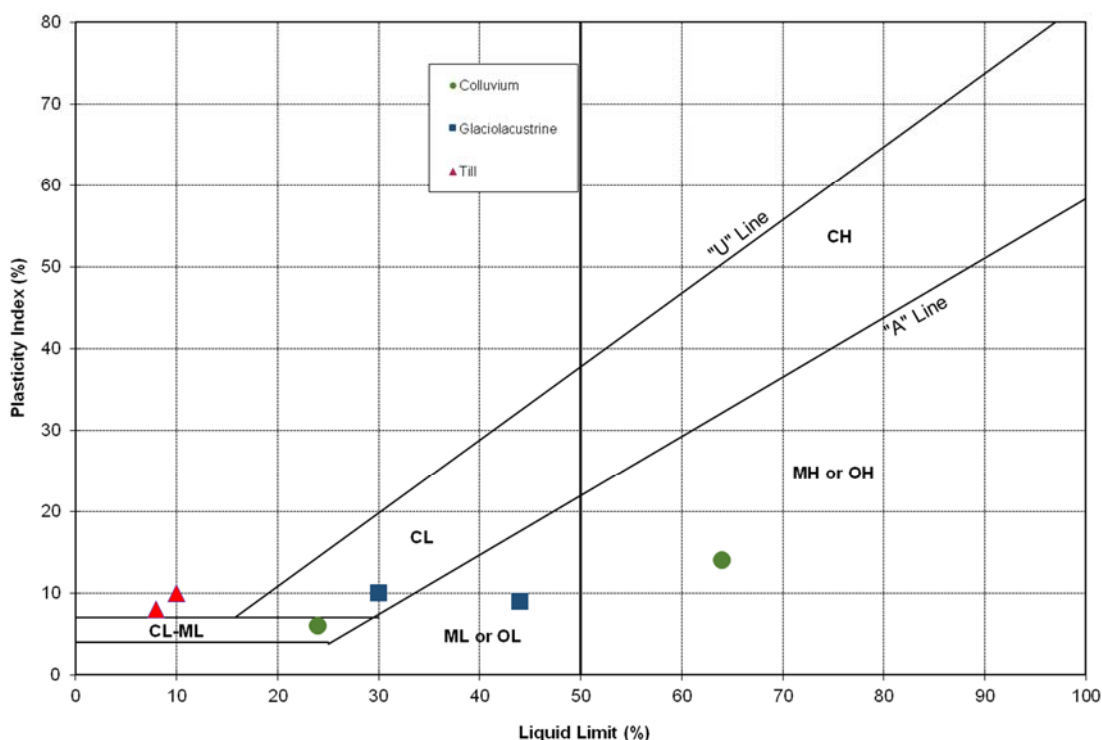


Figure 3-1. Atterberg limit test results on plasticity chart.

Of the nine samples sent for total organic carbon testing, eight returned detectible organic matter, ranging in content from 1 to 13%.

Twenty-one sieve-hydrometer tests were completed: six for till, six for glaciofluvial, five for alluvium, three for colluvium, and one for glaciolacustrine. The grain size distribution curves are presented in Appendix D and summarized in Figure 3-2.

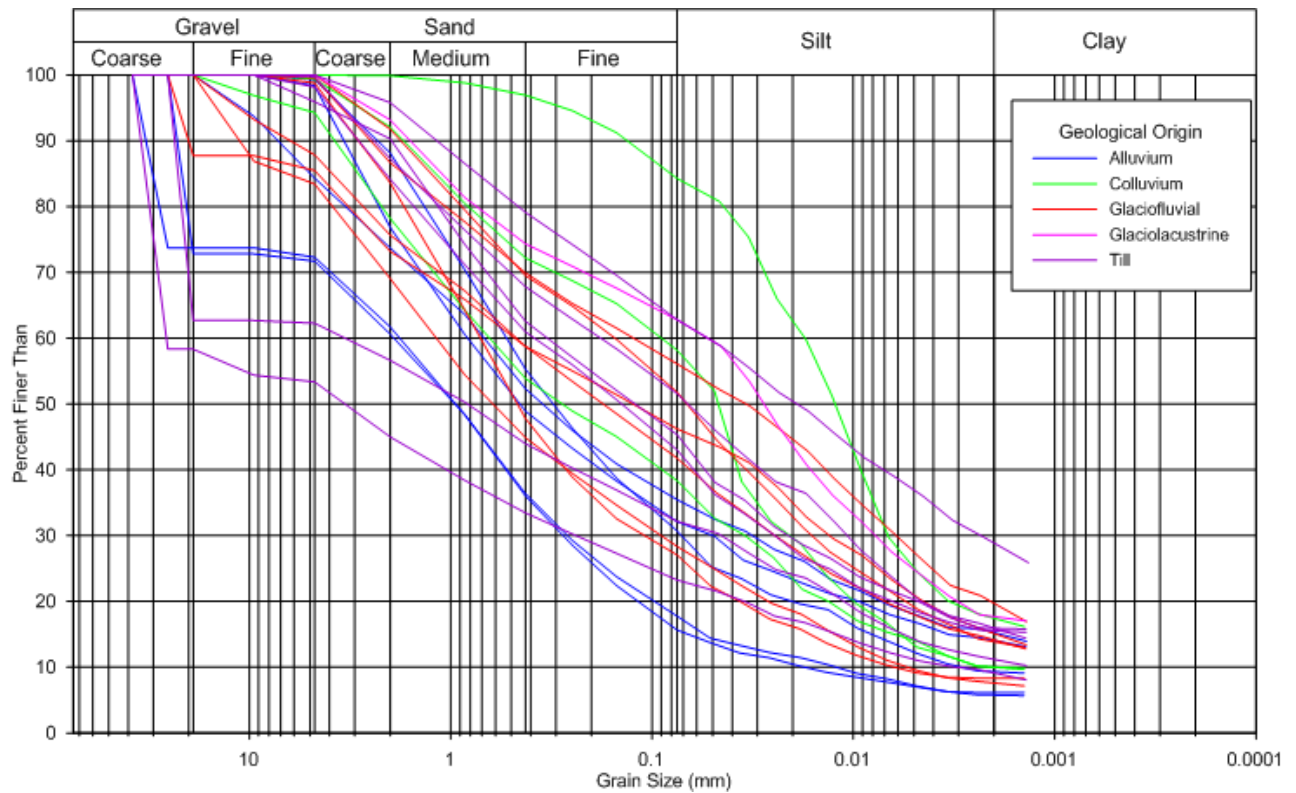


Figure 3-2. Summary of grain size distribution curves.

One specific gravity test was performed on a sample of sand till from borehole CH15-107-MW016, sample SPT-5 (approximate depth interval, 7.6 to 8.0 m). The measured specific gravity was 1.95, which is a value much lower than the expected range (2.6 to 2.7); it is considered erroneous or may be influenced by high organic content (not observed).

4.0 GEOTECHNICAL CONDITIONS

4.1. Borehole Logs

The borehole logs (Appendix A) present the observed subsurface conditions, the samples gathered, laboratory test data, the SPT “N” blow counts, and the standpipe piezometer and thermistor casing installation and hole backfill details. Select sample photographs are provided in Appendix B.

4.2. Subsurface Conditions

Table 4-1 summarizes the geological deposits and bedrock types observed during the Phase 1A investigation program. Drawing 2 presents cross sections of Section A, a longitudinal line that connects seven of the eight boreholes (Drawing 1), showing the different terrain unit layers.

Table 4-1. Summary of Observed Geological Deposits and Bedrock Conditions.

Geological Deposit/Bedrock	Observed in Boreholes (CH15-107-###)	General Description
Topsoil	All	Coarse woody debris and moss, 0.2 m thick
Colluvium	MW011, MW014, MW015, MW016, MW017 (with organics), MW018	Sand, some gravel to gravelly, some fines, to Silty Clay, some sand, low plastic, trace cobbles and boulders.
Peat/Organics	MW012, MW017	Medium fibrous peat to organic silt and sand, high plastic
Alluvium	MW012, MW018	Sand, some clay, some silt, to Silt and Sand, trace to some gravel, low plastic
Glaciofluvial	MW011, MW012, MW014, MW015, MW016	Sand, some silt to silty, to Clay and Sand, low-plastic, trace to some gravel
Till	MW011, MW012, MW013, MW014, MW015, MW016	Silty Clay (low-plastic) to Silty Sand to Sandy Gravel
Glaciolacustrine	MW011, MW014, MW015, MW017 (with organics)	Clay or Silt, some sand, to Clay and Sand, trace gravel, laminated, low-plastic
Schist	MW011	19.0 m bgs, penetrated with ODEX
Granodiorite	MW017	5.6 m bgs, moderately to highly weathered

As shown in Drawing 2 and Table 4-1, subsurface conditions are variable and complex. Till was found to be the most prominent geological deposit, followed by colluvium. Bedrock was only encountered at two borehole locations, CH15-107-MW011 and -MW017.

The complex soil erosional and depositional history of the area is such that the observed terrain units did not correlate well with the surficial geology mapping done for the area by the Yukon Geological Survey (Bond, 1999). Even within the same terrain unit (e.g., till), soil texture varied from coarse-grained to fine-grained, and with a range of geotechnical properties such as

permeability and plasticity. Consequently, in the vicinity of the NFRC, subsurface conditions should be confirmed through additional geotechnical boreholes and test pit excavations.

Where frozen, SPT “N” blow counts were high (greater than 50), as expected for ice-bonded frozen materials. Where unfrozen, SPT “N” blow counts were typically between 10 and 50, indicative of compact to dense conditions for coarse-grained soils. Lower SPT “N” blow counts of 5 to 8, indicative of loose soil density, were encountered in isolated layers in boreholes CH-107-MW016 and -MW018. SPT “N” blow counts exceeding 60 or not penetrating the full 0.45 m penetration were associated with cobbles and boulders.

Deeper than 4-m depth, the average gravimetric moisture content was 12.5% (standard deviation 3.9%), which is expected for a moist silty sand or near the plastic limit for cohesive soils. Up to approximately 4-m depth, higher moisture contents (up to 80%) were observed in layers associated with high organic or ground ice content.

4.3. Seasonal Frost and Permafrost

Ground ice in frozen soil has been visually described and classified according to the ASTM D-4083 Standard Practice for Description of Frozen Soils (Visual-Manual Procedure). Frozen soil descriptive nomenclature and symbols are presented in the Symbols and Terms flysheets presented with the borehole logs in Appendix A. Ground ice content is generally an indicator of moisture content, and ice may be visible, or non-visible. A soil that contains trace amounts of visible ground ice, also referred to as “ice-poor”, is typically representative of partially-saturated and poorly-bonded frozen soils that may be in a damp to moist state when thawed. The strength properties of such materials may not vary significantly between the frozen and unfrozen states. High or excess ice content refers to soils, typically with segregated ice (layers and lenses of ice) that are in a wet state when thawed. Such materials may become very soft and weak or settle when thawed. Hence, understanding the nature of the ground ice is critical for engineering assessments, particularly in permafrost areas.

Frost depth and ground ice observations are summarized in Table 4-2. The reported frost depths were inferred from measured ground temperature profiles (recorded by CH2M HILL during the period of May 6 to 9, 2015) and visual soil logging during the April 2015 site investigation.

Table 4-2. Frost Depth and Ground Ice Observations (late-April/early-May, 2015).

Borehole	Frost Depth (m bgs)	Ground Ice Observations
CH15-107-MW011	16	Trace visible ice
CH15-107-MW012	greater than 15	Visible ice throughout, high ice content between ~ 2.5 m bgs and 4.4 m bgs
CH15-107-MW013	2	Non-visible, poorly-bonded
CH15-107-MW014	12	Visible ice to 7 m bgs, high ice content between ~ 2.9 m bgs and 4.0 m bgs. 10

Borehole	Frost Depth (m bgs)	Ground Ice Observations
		to 15% visible ice from 5.2 m bgs to 6.1 m bgs
CH15-107-MW015	1.5	Non-visible, poorly-bonded
CH15-107-MW016	1.5	Visible and non-visible ice
CH15-107-MW017	3-4	Visible and non-visible ice, high ice content between ~ 2.0 m bgs and 2.4 m bgs
CH15-107-MW018	3	Non-visible, poorly-bonded

At the FMC site, frost depths of approximately 3 m or less are considered seasonally frozen ground, while frost depths greater than 3 m are considered permafrost. Ground temperature measurements during the fall will confirm whether the shallow frost conditions observed at borehole CH15-107-MW017 is indeed permafrost.

Permafrost thickness of 12 m to greater than 15 m was observed in three boreholes: CH15-107-MW011, -MW012, and -MW014. This suggests that permafrost is more prevalent in the area along NFRC within approximately 500 m northeast of the haul road. Permafrost may be absent in the gully where borehole CH14-107-MW013 is located because of the thermal influence of the denser forest canopy. Permafrost is absent or shallow in boreholes CH15-107-MW015 to -MW018. These boreholes are located on north-facing hill slopes along the NFRC. North-facing slopes are generally conducive to permafrost formation, and so its absence suggests that permafrost likely does not occur beneath the south-facing slopes on the other (north) side of the creek valley opposite these boreholes.

High ice content layers (i.e., soil layers with visible ice contents of nominally 15% or greater) were observed at depths of between approximately 2 to 4.5 m in three boreholes: CH15-107-MW012, -MW014, and -MW017. They were observed in well-graded sands with high fines content (alluvium or glaciofluvial) or in peat/organic silt and sand. When these soil layers thaw, they will become wet, very soft, and will crack, deform and/or settle under load. Such materials are not suitable for re-use as embankment fills unless thawed and dried.

Generally, at other depth intervals and boreholes, frozen soils were found to exhibit low ice content (nominally 5% or less visible ice) or were not well-bonded, indicating the material was only partially-saturated. This indicates that the shear strength of these “ice-poor” materials will be similar in both frozen and thawed states, and will not settle appreciably when thawed.

The implications for geotechnical design of frozen soil layers with intermediate visible ice contents (between 5 and 15%) should be examined on a case-by-case basis, as their influence on foundation or slope stability depends on a number of factors, including their distribution and temperature.

Measured ground temperatures, presented in Appendix C, are generally close to 0 degrees Celsius ($^{\circ}\text{C}$) ($\pm 2^{\circ}\text{C}$), indicating that permafrost, where present, is marginal, i.e., close to melting. Such permafrost could degrade within years or decades due to disturbance of thermal equilibrium through changes at the ground surface (e.g., cuts, fills, removal of vegetation cover, long-term climate warming). Ground temperatures were observed to be warmest ($+1.5^{\circ}\text{C}$ at 6 m depth) in borehole CH15-107-MW018.

4.4. Groundwater Observations

Groundwater observations are valid only at the time of reading and are subject to seasonal and annual fluctuations. Table 4-3 summarizes the groundwater levels measured by CH2M HILL between May 6 and 9, 2015.

Table 4-3. Observed Groundwater Levels (May 6 to 9, 2015).

Borehole	Collar Elevation (m asl) ¹	Depth to Water (m bgs)	Approximate Water Table Elevation (m asl) ¹	April 2015 Frost Depth (m bgs)
CH15-107-MW011	1113	6.0 (frozen)	1107	16
CH15-107-MW012	1109	Dry (to 15.2)	below 1094	greater than 15
CH15-107-MW013	1105	9.7	1095	2
CH15-107-MW014	1104	12.2	1092	12
CH15-107-MW015	1115	Dry (to 15.1)	Below 1100	1.5
CH15-107-MW016	1111	2.2	1109	1.5
CH15-107-MW017	1109	5.4	1104	3-4
CH15-107-MW018	1112	6.0	1106	3

Notes:

1. Elevations estimated from LiDAR data and borehole coordinates recorded with handheld GPS.

Groundwater was observed in six of the eight boreholes, with the two remaining boreholes, CH15-107-MW012 and -MW015, dry to the maximum piezometer depth of approximately 15 m bgs. Groundwater levels were shallowest (2.2 m bgs) at borehole CH15-107-MW016 and between 5 and 6 m bgs at boreholes CH15-107-MW011, -MW017, and -MW018.

As shown in Table 4-3, groundwater levels vary between the eight borehole locations, and may be impacted by surface drainage and frost (seasonal or permafrost) at the time of measurement; the observed frost depths described for each borehole location in Table 4-2 are repeated in this table for reference.

4.5. Correlation to Geophysical Surveys

Drawings 3, 4 and 5 present interpreted geophysical sections from Aurora (2013)'s lines RCD-1, RCD-2, and RCD-5, respectively, with mapped surficial geology (from Bond, 1999)

and recent borehole data added. Borehole CH15-107-MW011 is offset approximately 40 m northeast of Line RCD-1. At the borehole location, frozen soil was observed to a depth of approximately 16 m, with schist bedrock observed at a depth of approximately 19 m. Overburden consisted of colluvium, glaciofluvial, till, and glaciolacustrine deposits that predominantly had a high fines content. The resistive layer observed near this borehole location was previously interpreted by Aurora (2013) as shallow bedrock, although the borehole information suggests that it is more likely represents frozen overburden.

Borehole CH15-107-MW013 penetrated 15.1 m of overburden (unfrozen, except for 1.5 m of seasonal frost) without encountering bedrock. Geophysical line RCD-2 (Drawing 4) crossed this borehole, and Aurora (2013) interpreted shallow bedrock to be expected in this area.

Borehole CH15-107-MW015, was drilled along geophysical line RCD-5 (Drawing 5). This borehole was drilled to a depth of 15.1 m without encountering bedrock. No permafrost was observed in this borehole. The standpipe piezometer was dry to a depth of 15.1 m. The interpreted geophysical section also indicated that there was no permafrost at this area, in agreement with borehole observations, but the water table was estimated to be at approximately 5 m bgs, far shallower than the borehole observations.

Aurora should be given an opportunity to review the interpretation of the geophysical sections, based on the findings of the Phase 1A investigation.

4.6. Implications for Channel Design and Construction

4.6.1. Summary of Findings

In summary, ground conditions along the hill slope to the south and east of the NFRC show a complex depositional and erosional history, with terrain units ranging from colluvium, alluvium, till, glaciofluvial, and glaciolacustrine deposits. Soil types are generally sand, silt, clay and gravel of varying proportion, with occasional buried layers of peat and organics, and occasional cobbles and boulders encountered in the till deposits. Mean ground temperatures in the area are close to 0°C (+/- 2°C). Permafrost is discontinuous and was encountered in three or four boreholes, with thicknesses ranging from approximately 4 m to greater than 15 m. Permafrost was more prevalent in the area of the NFRC located within approximately 500 m east of the haul road. Frozen soil layers with more than 15% visible ice content were observed in three boreholes, at depths ranging from approximately 2 to 4 m. Otherwise, visible ice contents were generally less than 5%, and other layers exhibiting transitional ice contents of between 5 and 15%. In addition, some soil layers were frozen but showed non-visible excess ground ice. In 2015, the maximum depth of seasonal frost, where there is no permafrost, ranged from approximately 1.5 to 3 m.

Groundwater level observations from May 6 to 9, 2015, indicated groundwater depths varying greatly, from 2.2 m bgs (borehole CH15-107-MW016) to greater than 15 m bgs (boreholes CH15-107-MW012 and -MW015). These levels are expected to fluctuate throughout the year.

4.6.2. Implications for Relocated Channel Design and Construction

As described in Section 1.3, the relocated channel could require a combination of relatively high embankments and deep excavations. A balanced cut and fill design considers that the excavated materials could be re-used as fill materials. The following summary comments are based solely on the findings to date of the Phase 1A site investigation. Additional investigations, as further discussed in Section 5, are recommended to provide further data to address channel design and construction issues. As additional details become available relevant to specific design elements, it is possible that the following comments may change or evolve.

a. Channel Embankment Stability

None of the findings of the Phase 1A investigation would suggest that fill embankments constructed up to 15 m high with 2H:1V side slopes would not be technically feasible. Thin, buried layers of peat, organic soils, and ice-rich permafrost soils were observed in some boreholes, and their distribution and extent could influence embankment stability or deformations (from foundation settlement) in localized areas; their removal may be required at select locations. In addition, a large portion of the new channel embankment would also be constructed over the valley floor, where there are currently no geotechnical data. Additional geotechnical investigations are recommended in this area, followed by site-specific stability analyses, to confirm foundation stability.

b. Construction Excavations

The presence of seasonal or perennially-frozen ground could hamper the ability of an excavator to effectively excavate the required cuts. Shallow test pits (up to 6 m depth) should be excavated in areas adjacent to the boreholes, particularly those where permafrost was encountered (boreholes CH15-107-MW011, -MW012, -MW014, and – MW017) to test whether mechanical excavation is feasible or needs to be staged.

Cuts in permafrost may create thawing conditions in the native subgrade that lead to localized seepage generation and the need for water control. Fill covers, or thermal protection blankets, may be required to provide thermal insulation and increase the stability of the exposed slope.

Cuts that penetrate the groundwater table could require water control during construction, particularly where geosynthetic liners and their associated soil bedding and cover materials are placed at levels below the existing water table.

Detailed knowledge of frost depths and groundwater levels will be required for planning construction execution and staging.

c. Cut Slope Stability

The proposed 2H:1V cut slope angles are considered feasible, except in areas where the cut penetrates the groundwater table, or in layers with ice-rich frozen ground and/or organics. Based on the available information, the stability of the cut slopes will likely

be controlled by groundwater conditions. Groundwater levels on the hill slope east and south of the NFRC do not necessarily follow surface topography, and so groundwater levels should be confirmed in areas requiring excavations, whether through monitoring wells (for deep cuts) or test pits (for shallow cuts). Flatter side-slopes will likely be required for those portions of the cuts below the water table.

Exposed layers of ice-rich frozen soil or organics should be over-excavated and replaced with compacted, free-draining granular fill. Cuts may expose soils with high fines content that may erodible or add sediments to the constructed channel. Erosion protection measures such as granular covers, matting, or vegetation should be added to minimize these effects. Some areas, such as the gullies where boreholes CH15-107-MW013 and -MW016 are located, may have concentrated surface water flows that may need more robust protection of the exposed cut slopes.

d. Suitability of Excavated Materials for Re-Use

Excavated materials are expected to consist of gravel, sand, silt, and clay to varying proportions, and with occasional cobbles, boulders, and peat/organics. Consequently, the compaction density, characteristics, and sensitivity to changes in moisture levels could vary depending on the proportion of silts and clays in the mixture. The excavated materials could also potentially be frozen and contain excess ground ice. In general, these materials are considered acceptable as embankment fills with the following exceptions:

- o Frozen soil layers containing over 5% visible ice or non-visible excess ground ice should be set aside in a specific stockpile and allowed to melt, drain, and dry before being re-used as embankment fills. If the stockpiled frozen soils do not adequately thaw or drain within the time frame required for re-use, these materials may need to be wasted.
- o Peat and organics are deleterious materials that are not considered suitable as fill materials, and should be set aside in a topsoil stockpile.
- o Frozen soil layers containing less than 5% visible ice (ice-poor soils) should be allowed to thaw before being re-used as embankment fills. Occasional frozen lumps of ice-poor soils less than 100-mm diameter may be used during construction, provided they constitute, together, less than 10% of the fill lift by volume and the potential embankment settlements and reduction in fill strength when thawed are assessed.
- o Oversize materials such as cobbles and boulders may need to be screened or removed.

More stringent fill specifications and compaction control may be prepared for final design when the geotechnical design objectives and requirements for fill shear strength and tolerances for settlement are defined.

5.0 RECOMMENDATIONS FOR FURTHER WORK

In consideration of the findings of the 2015 Phase 1A site investigation program, BGC recommends the following to advance the project design:

- Measure as-built borehole coordinates and collar elevations with a differential GPS system and update borehole logs, groundwater elevations and associated sections.
- Continue measuring standpipe piezometer and ground temperature measurements, particularly in September 2015 and update of associated groundwater elevation tables and thermistor plots.
- Excavate test pits adjacent to boreholes CH15-107-MW011, -MW012, -MW014, and -MW017, to further examine permafrost conditions at these locations and assess the rippability of the frozen soils. These test pits may be left open over one year to examine the stability of the slopes when exposed and thawed, including the use of fill covers (thermal protection blankets)..
- Install standpipe piezometers in areas with proposed deep cuts (7 m bgs or greater) to determine groundwater levels for cut slope stability design input.
- Perform visual examination of surface/vegetation/forest cover of the 2015 Program 1A borehole locations and determine correlations, if any, with observed permafrost distribution.
- Drill geotechnical boreholes (and install thermistor and standpipe piezometers) and excavate test pits along the valley floor of NFRC, particularly in those areas where high channel embankments (greater than 5 m thickness) are proposed, for embankment stability evaluations.
- Provide geotechnical data from this report to Aurora Geosciences so that they can re-assess their interpretation of the geophysical surveys of 2013 and 2014.
- Log and sample slope cuts and material stockpiles created during the October 2014 upstream access road, to provide additional information on subsurface conditions in the vicinity of the NFRD, in addition to the stability and erodibility of exposed cuts in the area.

6.0 CLOSURE

We trust the above satisfies your requirements at this time. Should you have any questions or comments, please do not hesitate to contact us.

Yours sincerely,

BGC ENGINEERING INC.
per:

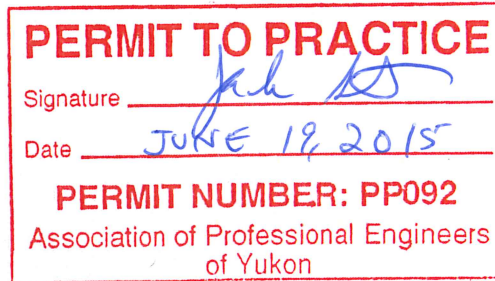


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Heginbottom, J.A., Dubreuil, M.A., and Haker, P.T., 1995. Canada Permafrost. (1:7,500,000 scale). In The National Atlas of Canada, 5th Edition, sheet MCR 4177. Ottawa: Natural Resources Canada.

APPENDIX A BOREHOLE LOGS

SYMBOLS AND TERMS

FOR SOIL DESCRIPTIONS ON BOREHOLE LOGS

Project Name: North Fork Rose Creek Relocation Project, Faro Mine, YT

Project Number: 1085-007

SAMPLE SYMBOLS



CRREL



GRAB



NO RECOVERY



SPT

CLASSIFICATION BY PARTICLE SIZE⁽¹⁾

NAME	(mm) ⁽²⁾	SIZE RANGE	
		US STANDARD SIEVE SIZE	
		Retained	Passing
Boulders	>300	12 inch	-
Cobbles	75 - 300	3 inch	12 inch
Gravel:			
Coarse	19 - 75	0.75 inch	3 inch
Fine	5 - 19	No. 4	0.75 inch
Sand:			
Coarse	2 - 5	No. 10	No. 4
Medium	0.4 - 2	No. 40	No. 10
Fine	0.074 - 0.4	No. 200	No. 40
Fines (Silt or Clay) ⁽³⁾	<0.074	-	No. 200

PROPORTION OF MINOR COMPONENTS BY WEIGHT

"and"	35% to 50%.
"y/ey"	20% to 35%
"Some"	10% to 20%
"Trace"	0% to 10%

PARTICLE SHAPE

Flat	Particles with width/thickness >3
Elongated	Particles with length/width >3
Flat and Elongated	Particles that meet both criteria

ANGULARITY

"Angular"	Particles have sharp edges and relatively planar sides with unpolished surfaces.
"Sub-angular"	Particles are similar to angular description but have some rounded edges.
"Sub-rounded"	Particles have nearly planar sides but have well rounded corners and edges.
"Rounded"	Particles have smoothly curved sides and no edges.

DENSITY OF GRANULAR SOILS

DESCRIPTION	SPT - "N" ⁽⁴⁾	FIELD IDENTIFICATION
"Very Loose"	0-4	None
"Loose"	4-10	Easily penetrated by 13 mm rod by hand
"Compact"	10-30	Easily penetrated by 13 mm rod by hammer
"Dense"	30-50	Penetrated 0.3 m by 13 mm rod by hammer
"Very dense"	>50	Penetrated a ~cm by 13 mm rod by hammer

CONSISTENCY OF COHESIVE SOILS

DESCRIPTION	SPT- "N" ^(6,7)	UNDRAINED SHEAR STRENGTH - "S _u " kPa ⁽⁵⁾	FIELD IDENTIFICATION
"Very soft"	<2	<12	Easily penetrated several cm by the fist.
"Soft"	2-4	12-25	Easily penetrated several cm by the thumb.
"Firm"	4-8	25-50	Can be penetrated several cm by the thumb with moderate ef-
"Stiff"	8-15	50-100	Readily indented by the thumb but penetrated only with great
"Very Stiff"	15-30	100-200	Readily indented by the thumb nail.
"Hard"	>30	>200	Indented with difficulty by the thumbnail.

(1) ASTM D2487-11, Unified Soil Classification System (USCS).

(2) Approximate metric conversion.

(3) Fines are classified as silt or clay on the basis of Atterberg limits (refer to Plasticity Chart).

(4) Standard Penetration Test (SPT) blow count uncorrected, after Terzaghi and Peck, 1948.

(5) Undrained shear strength can be estimated by vane (gives S_u), pocket penetrometer (gives unconfined compressive strength, i.e., 2 S_u), or unconfined compression test (gives 2 S_u).

(6) Approximate correlation with Standard Penetration Test blow counts, after Terzaghi and Peck, 1948.

(7) "R" represents sampler refusal during Standard Penetration Test.

SYMBOLS AND TERMS

FOR SOIL DESCRIPTIONS ON BOREHOLE LOGS

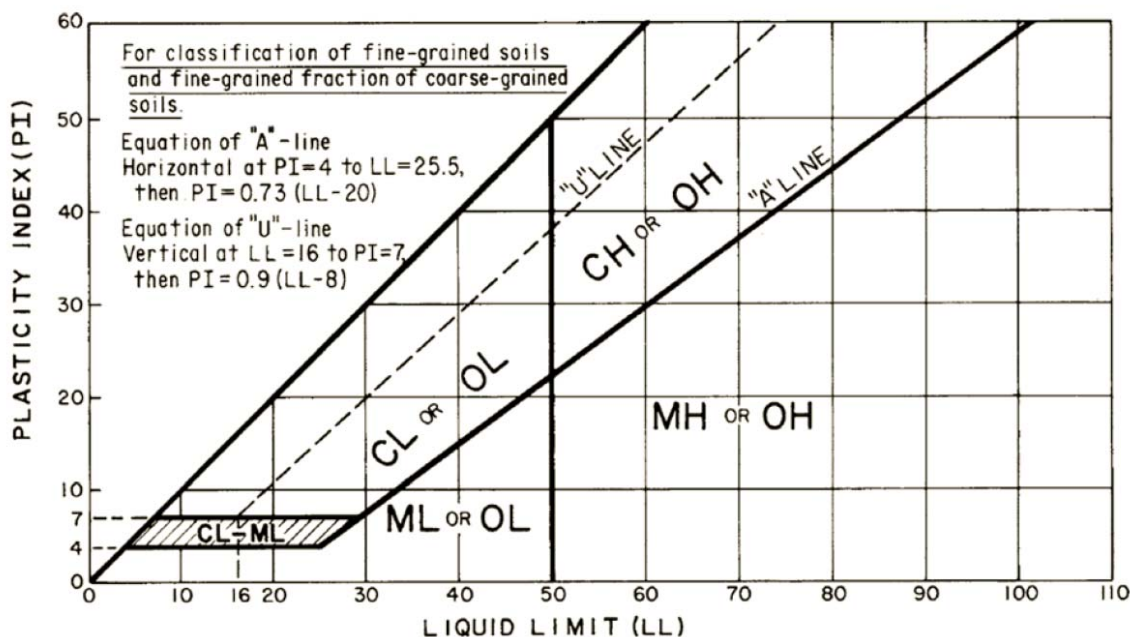
Project Name: North Fork Rose Creek Relocation Project, Faro Mine, YT

Project Number: 1085-007

PLASTICITY OF COHESIVE SOILS ⁽⁹⁾

DESCRIPTION	SILT	CLAY	CRITERIA
High	$W_L^{(10)} > 50\%$	$W_L > 50\%$	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.
Low	$W_L < 50\%$	$W_L < 50\%$	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Non-Plastic	NP	-	A 1/8 inch (3 mm) thread cannot be rolled at any water content.

PLASTICITY OF COHESIVE SOILS ⁽¹⁰⁾



MOISTURE CONDITION ⁽⁸⁾		CEMENTATION ⁽⁸⁾		DILATANCY ⁽¹¹⁾	
Description	Criteria	Description	Criteria	Description	Criteria
Dry	Absence of moisture	Weak	Crumbles or breaks with handling or little pressure	None	No visible change in the specimen during shaking or squeezing
Moist	Damp but no visible water	Moderate	Crumbles or breaks with considerable finger pressure	Slow	Water appears slowly on the surface of the specimen during shaking and disappears slowly upon squeezing
Wet	Visible free water, usually soil is below water table	Strong	Will not crumble or break with finger pressure	Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing

Notes:

(8) ASTM D2488-09a.

(9) This plasticity classification conforms to the Unified Soil Classification System (USCS) and to ASTM D-2487. Under ASTM and USCS, all clays with a liquid limit less than 50% are classified as low plasticity (CL).

(10) W_L = Liquid Limit (%)

(11) Test for dilatancy conducted by shaking and squeezing a moulded ball of soil that is 12 mm in diameter.

(12) Test for dry strength conducted on natural soil pieces or moulded balls about 25 mm in diameter that have been dried at less than 60°C.

SYMBOLS AND TERMS

FOR SOIL DESCRIPTIONS ON BOREHOLE LOGS

Project Name: North Fork Rose Creek Relocation Project, Faro Mine, YT

Project Number: 1085-007

STRUCTURE

Description	Criteria
Stratified	Alternating layers of varying material or colour with layers at least 6 mm thick; note thickness
Laminated	Alternating layers of varying material or colour with the layers less than 6 mm thick; note thickness
Fissured	Breaks along definite planes or fracture with little resistance to fracturing
Slickensided	Fracture planes appear polished or glossy, sometimes striated
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness
Homogeneous	Same colour and appearance throughout
Heterogeneous	Colour and appearance vary throughout

IDENTIFICATION OF INORGANIC FINE-GRAINED SOILS FROM MANUAL TESTS

Soil Symbol	Dry Strength	Dilatancy
ML	None to Low	Slow to Rapid
CL/CI	Medium to High	None to Slow
MH	Low to Medium	None to Slow
CH	High to Very High	None

DRY STRENGTH

Description	Criteria ⁽¹²⁾
None	The dry specimen crumbles into powder upon applying pressure or handling
Low	The dry specimen breaks into pieces or crumbles with considerable finger pressure
High	The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb and a hard surface
Very High	The dry specimen cannot be broken between the thumb and a hard surface

Lithological Graphic Log Legend

	High Plastic Clay
	Low Plastic Clay
	Silt/Clay
	Low Plastic Silt
	Clay/Sand
	Poorly Graded Sand
	Well Graded Sand
	Sand/Gravel
	Low Plastic Organic Soil
	High Plastic Organic Soil
	Clay/Gravel
	Silt/Sand
	Peat/Topsoil

Bedrock

	Schist
	Granodiorite

SYMBOLS AND TERMS

FOR SOIL DESCRIPTIONS ON BOREHOLE LOGS

Project Name: North Fork Rose Creek Relocation Project, Faro Mine, YT

Project Number: 1085-007

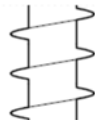
DRILLING METHOD



Solid-Stem Auger



Hollow-Stem Auger



CRREL Barrel



ODEX

GROUND ICE DESCRIPTION

ICE NOT VISIBLE

GROUP SYMBOL	SUBGROUP		
	SYMBOLS	DESCRIPTION	
N	Nf	Poorly bonded or friable	
	Nbn	No excess ice, well bonded	
	Nbe	Excess ice, well bonded	

VISIBLE ICE LESS THAN 2.5cm THICK

V	Vx	Individual ice crystals or inclusions	
	Vc	Ice coatings on particles	
	Vr	Random or irregularly oriented ice formations	
	Vs	Stratified or distinctly oriented ice formations	

VISIBLE ICE GREATER THAN 2.5cm THICK

ICE	ICE + soil type	Ice with soil inclusions	
	ICE	Ice without soil inclusions	

(Modified from Guide to Field Description of Permafrost for Engineering Purposes, NRC. Technical Memorandum 79)

NOTE 1) Dual symbols are used to indicate borderline or mixed ice classifications
2) Visual estimates of ice content as indicated on borehole logs are $\pm 5\%$

LEGEND or
Soil Ice

SYMBOLS AND TERMS

FOR ROCK DESCRIPTIONS ON BOREHOLE LOGS

Project Name: North Fork Rose Creek Relocation Project, Faro Mine, YT

Project Number: 1085-007

WEATHERING/ALTERATION ⁽¹³⁾

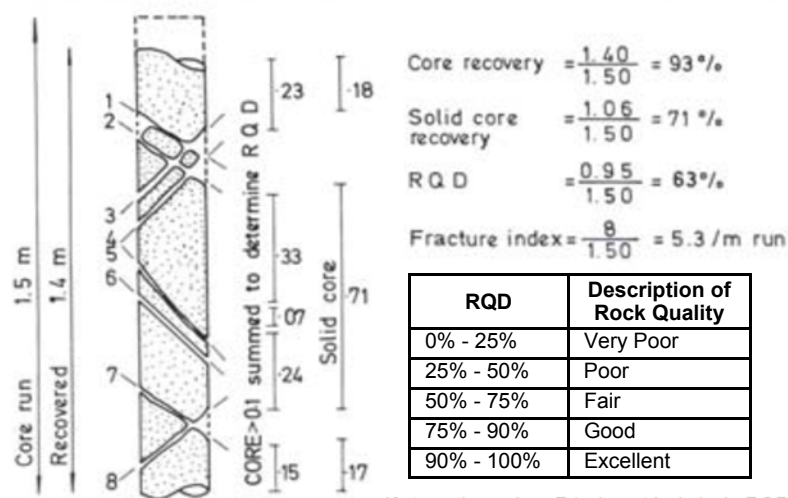
GRADE	Description	Field Identification
A/W 1	Fresh and Unweathered	No visible sign of rock material weathering
A/W 2	Slightly Weathered or Altered	Discolouration indicated weathering of rock material and discontinuity surfaces. All rock material may be discoloured by weathering and may be weaker than in its fresh condition.
A/W 3	Moderately Weathered or Altered	Less than 50% of rock material decomposed and/or disintegrated to soil. Fresh/ discoloured rock present as a continuous framework or corestones.
A/W 4	Highly Weathered or Altered	More than 50% rock material is decomposed or disintegrated to soil. Fresh/ Discoloured rock present as discontinuous framework or corestones.
A/W 5	Completely Weathered or Altered	All rock material decomposed and/or disintegrated to soil. Original mass structure still largely intact
A/W 6	Residual Soil	All rock material converted to soil; mass structure and material fabric destroyed.

HARDNESS CLASSIFICATION FOR ROCK ⁽¹⁴⁾

GRADE	Description	Field Identification
R6	Extremely Strong	Specimen can only be chipped with flat end of geological hammer
R5	Very Strong	Specimen requires many blows of flat end of geological hammer to fracture
R4	Strong	Specimen requires more than one blow of flat end of geological hammer to fracture
R3	Medium Strong	Cannot be scraped or peeled with pocket knife; can be fractured with single firm blow of flat end of the geologic hammer
R2	Weak	Can be peeled with pocket knife with difficulty; shallow indentation made by firm blow with point of geological hammer
R1	Very Weak	Crumbles under firm blow with point of geological hammer; can be peeled by a pocket knife
R0	Extremely Weak	Indented by thumbnail

JOINT CONDITION ⁽¹⁵⁾

Condition of Joints	Rating
Very rough surfaces. Not continuous. No separation. Hard joint wall rock.	25
Slightly rough surfaces. Separation <1mm. Hard joint wall rock.	20
Slightly rough surfaces. Separation <1mm. Soft joint wall rock.	12
Slickensided surfaces or gouge <5mm thick or joints open 1-5mm. Continuous joints.	6
Soft gouge >5mm thick or joints open >5mm. Continuous joints.	0



(13) After ISRM, 1981.

(14) ISRM, 1977

(15) Joint condition is a numerical index that summarizes the typical surface properties and infilling of discontinuities within an interval (Bieniawski, 1976).

If strength grade $\leq$ R1, do not include in RQD.

SYMBOLS AND TERMS

FOR ROCK DESCRIPTIONS ON BOREHOLE LOGS

Project Name: North Fork Rose Creek Relocation Project, Faro Mine, YT

Project Number: 1085-007

REFERENCES

American Society for Testing and Materials. Standard D2487-11: Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System). West Conshohocken, PA.

American Society for Testing and Materials. Standard D2488-09a: Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). West Conshohocken, PA.

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Methods for the Quantitative Description of Discontinuities in Rock Masses. Committee on Field Tests, Document No. 4, pp. 319-368.

International Society of Rock Mechanics (ISRM). 1981. International Society for Rock Mechanics: Commission of Classification of Rocks and Rock Masses, Basic Geotechnical Description of Rock Masses. International Journal of Rock Mechanics, Mineral Science, and Geomechanics. Vol. 18, pp. 85-110.

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Revision: May, 2015

BOREHOLE # CH15-107-MW011

Page 1 of 3

Project: Faro NFRC Remediation

Location: Faro North Fork Rose Creek

Project No.: 1085-007

Survey Method: Handheld GPS

Facility: Faro Mine Site

Start Date: 23 Apr 15

Co-ordinates (m): 584,983E, 6,913,071N

Drill Designation: Prospector P1

Finish Date: 24 Apr 15

Ground Elevation (m): 1113

Drilling Contractor: Midnight Sun Drilling

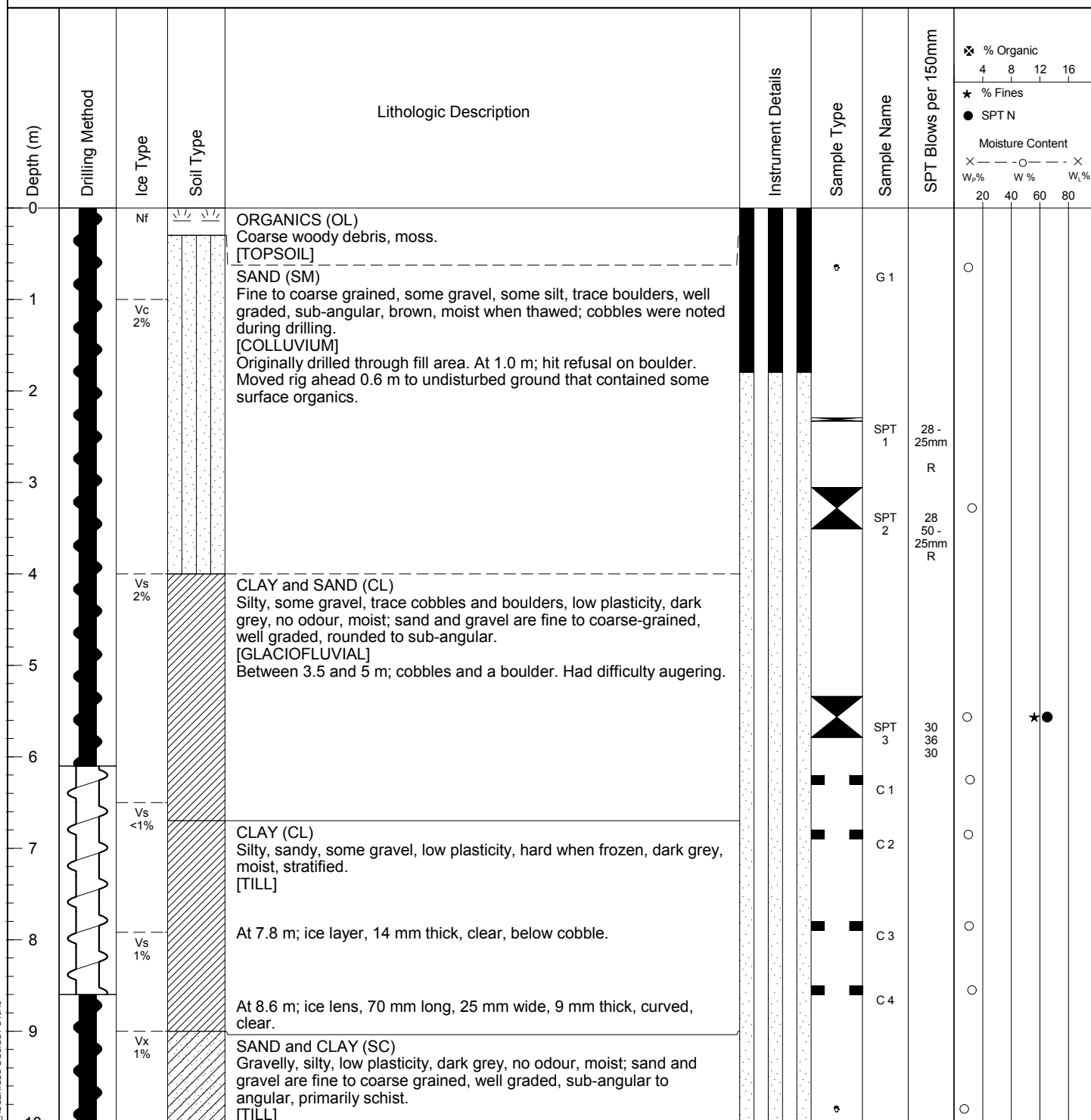
Final Depth of Hole (m): 19.80

Datum: NAD83 CSRS Epoch 2002

Drill Method: SSA/CRREL/ODEX

Logged by: SG

Reviewed by: JTCS



(Continued on next page)

BOREHOLE # CH15-107-MW011

Page 2 of 3

Project: Faro NFRC Remediation

Location: Faro North Fork Rose Creek

Project No.: 1085-007

Survey Method: Handheld GPS

Co-ordinates (m): 584,983E, 6,913,071N

Ground Elevation (m): 1113

Datum: NAD83 CSRS Epoch 2002

Facility: Faro Mine Site

Drill Designation: Prospector P1

Drilling Contractor: Midnight Sun Drilling

Drill Method: SSA/CRREL/ODEX

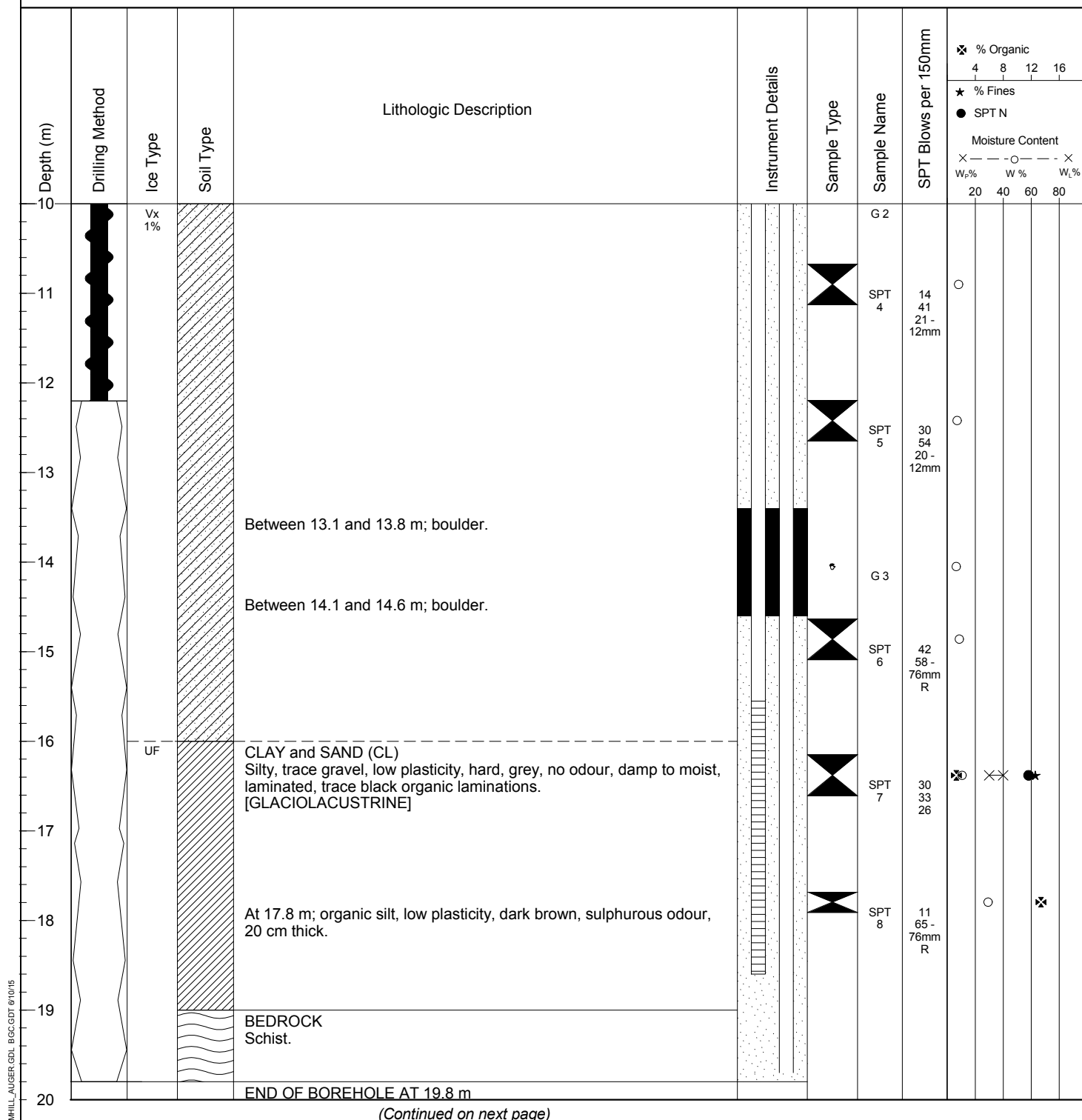
Start Date: 23 Apr 15

Finish Date: 24 Apr 15

Final Depth of Hole (m): 19.80

Logged by: SG

Reviewed by: JTCS



(Continued on next page)

BOREHOLE # CH15-107-MW011

Page 3 of 3

Project: Faro NFRC Remediation

Location : Faro North Fork Rose Creek

Project No.: 1085-007

Survey Method : Handheld GPS

Facility : Faro Mine Site

Start Date : 23 Apr 15

Co-ordinates (m) : 584,983E, 6,913,071N

Drill Designation Prospector P1

Finish Date : 24 Apr 15

Ground Elevation (m): 1113

Drilling Contractor : Midnight Sun Drilling

Final Depth of Hole (m) : 19.80

Datum : NAD83 CSRS Epoch 2002

Drill Method : SSA/CRREL/ODEX

Logged by : SG

Reviewed by : JTCS

Depth (m)	Drilling Method	Ice Type	Soil Type	Lithologic Description	Instrument Details	Sample Type	Sample Name	SPT Blows per 150mm	✕ % Organic 4 8 12 16 ★ % Fines ● SPT N Moisture Content ✕ — — — — ✕ W_p% W % W_L%
20				NOTES: - Hole was dry prior to standpipe installation. - Water level at 6.0 m two days after installation (April 24, 2015). - Water frozen at 6.0 m two weeks after installation (May 6, 2015). - Approximately 10 cm of sandy slough in bottom of hole before standpipe installation. Installed standpipe and thermistor inside ODEX rods by adding backfill material and lifting rods by approximately 1 m at a time.					
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									

BOREHOLE # CH15-107-MW012

Page 1 of 2

Project: Faro NFRC Remediation

Location : Faro North Fork Rose Creek

Project No.: 1085-007

Survey Method : Handheld GPS

Facility : Faro Mine Site

Start Date : 23 Apr 15

Co-ordinates (m) : 585,085E, 6,913,167N

Drill Designation Prospector P1

Finish Date : 23 Apr 15

Ground Elevation (m): 1101

Drilling Contractor : Midnight Sun Drilling

Final Depth of Hole (m) : 15.70

Datum : NAD83 CSRS Epoch 2002

Drill Method : SSA/CRREL

Logged by : SG

Reviewed by : JTCS

Depth (m)	Drilling Method	Ice Type	Soil Type	Lithologic Description	Instrument Details	Sample Type	Sample Name	SPT Blows per 150mm	% Organic 4 8 12 16	% Fines ★	SPT N ●	Moisture Content X --- - O --- - X W _p % W % W _L %
0		Vx <1%		ORGANICS (OL) Coarse woody debris, rootlets. [TOPSOIL]								
1		Vs 3%		ORGANIC SILT (OL) Some sand to sandy, trace gravel, low plasticity, dark brown, angular to sub-angular gravel, no odour, some organics including coarse woody debris; sand is fine to coarse grained. [COLLUVIUM with ORGANICS]			G 1 C 1					
2		Vx 5-10%		ORGANICS (PT) Fine fibrous, dark brown and black, no visible structure. [PEAT]			C 2 C 3					
3		Vs 40%		SAND (SC) Fine to coarse grained, some clay, some silt, trace to some gravel, low plasticity, dark brownish grey; sand is fine to coarse, well graded; gravel is rounded to sub-rounded, flat and elongated, oriented horizontally with paleoflow direction. [ALLUVIUM]			C 4 C 5					
4		Vs 30%		At 2.4 m; ice crystals up to 20 mm. Between 2.5 and 3.5 m; ice laminations, 3 to 5 mm thick, curved, parallel.			C 6 C 7					
5		Vs 10-20%		Between 3.5 and 4.0 m; ice laminations, lenticular, irregular, with muddy ice clasts up to 15 mm thick.			C 8 C 9					
6		Vx 3-5%		CLAY and SAND (CL) Silty, some gravel, trace cobbles, low plasticity, dark brown, maximum particle size of 100 mm; sand and gravel are fine to coarse grained, well graded, sub-angular. [TILL]			C 10 C 11					
7		Vx/Vs 5%		At 6.8 m; hit boulder, broke CRREL carbides, went down with concrete bit. At 6.9 m; ice lens, 21 mm thick, clear, granular, oriented 45 degrees to core axis.			C 12 C 13					
8		Vs 5-10%		SAND (SM) Fine to coarse grained, silty, some clay to clayey, some gravel, low plasticity, brown to dark greyish brown, wetter than plastic limit when thawed, gravel is rounded to sub-angular, maximum particle size of 50 mm, some stratified medium grained sand layers. [GLACIOFLUVIAL]			C 14 C 15					
9		Vx 1-2%		Between 7.6 and 8.5 m; ice chunks 1 to 5 mm diameter, clear.			C 16					
10		Vs 1-2%										
		Vx 2-3%										

(Continued on next page)

BOREHOLE # CH15-107-MW012

Page 2 of 2

Project: Faro NFRC Remediation

Location: Faro North Fork Rose Creek

Project No.: 1085-007

Survey Method: Handheld GPS

Facility: Faro Mine Site

Start Date: 23 Apr 15

Co-ordinates (m): 585,085E, 6,913,167N

Drill Designation: Prospector P1

Finish Date: 23 Apr 15

Ground Elevation (m): 1101

Drilling Contractor: Midnight Sun Drilling

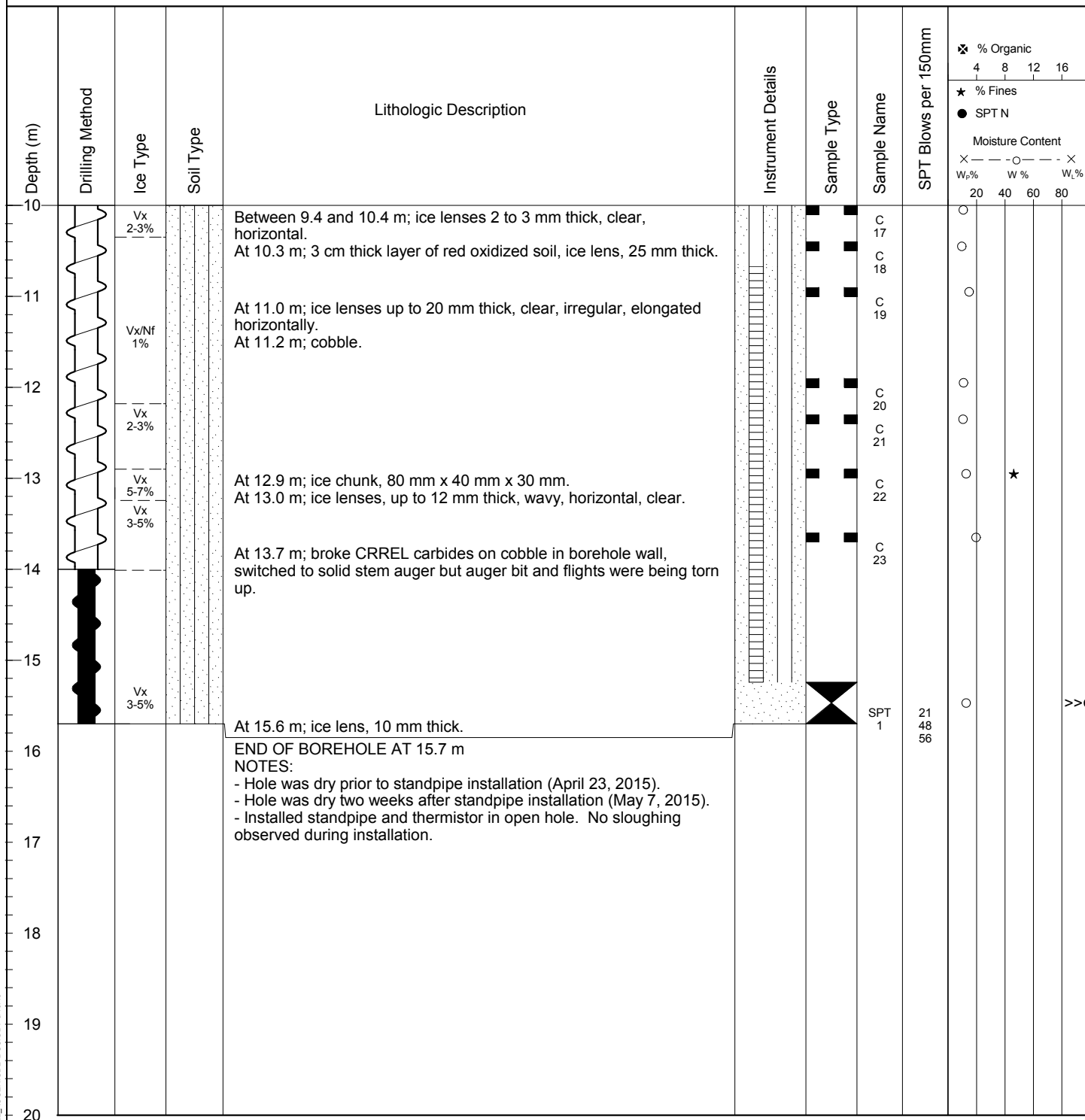
Final Depth of Hole (m): 15.70

Datum: NAD83 CSRS Epoch 2002

Drill Method: SSA/CRREL

Logged by: SG

Reviewed by: JTCS



BOREHOLE # CH15-107-MW013

Page 1 of 2

Project: Faro NFRC Remediation

Location: Faro North Fork Rose Creek

Project No.: 1085-007

Survey Method: Handheld GPS

Facility: Faro Mine Site

Start Date: 16 Apr 15

Co-ordinates (m): 585,175E, 6,913,301N

Drill Designation: Prospector P1

Finish Date: 17 Apr 15

Ground Elevation (m): 1105

Drilling Contractor: Midnight Sun Drilling

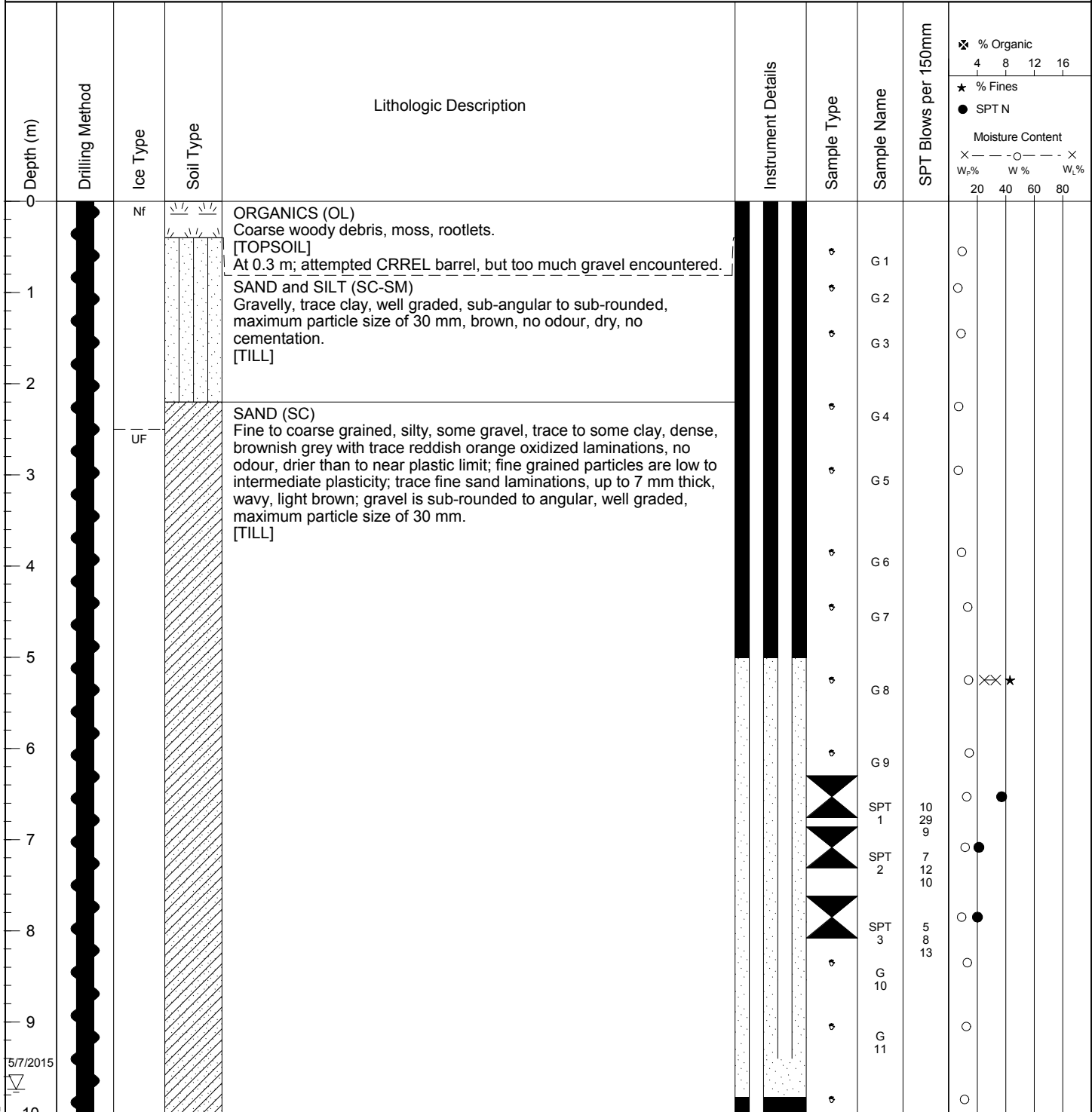
Final Depth of Hole (m): 15.20

Datum: NAD83 CSRS Epoch 2002

Drill Method: Solid-Stem Auger

Logged by: SG

Reviewed by: JTCS



(Continued on next page)

BOREHOLE # CH15-107-MW013

Page 2 of 2

Project: Faro NFRC Remediation

Location: Faro North Fork Rose Creek

Project No.: 1085-007

Survey Method: Handheld GPS

Co-ordinates (m): 585,175E, 6,913,301N

Ground Elevation (m): 1105

Datum: NAD83 CSRS Epoch 2002

Facility: Faro Mine Site

Drill Designation: Prospector P1

Drilling Contractor: Midnight Sun Drilling

Drill Method: Solid-Stem Auger

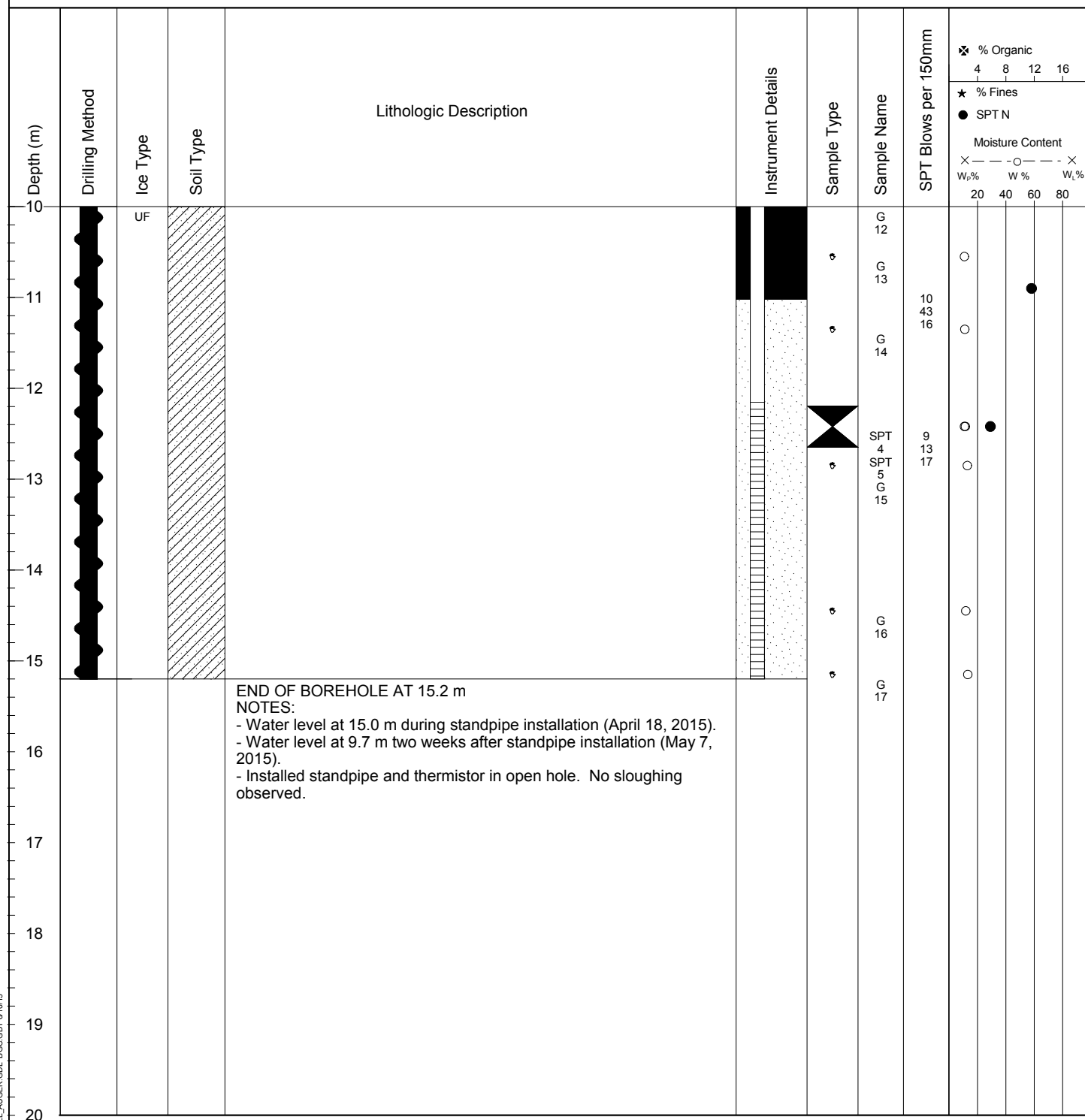
Start Date: 16 Apr 15

Finish Date: 17 Apr 15

Final Depth of Hole (m): 15.20

Logged by: SG

Reviewed by: JTCS



BOREHOLE # CH15-107-MW014

Page 1 of 2

Project: Faro NFRC Remediation

Location : Faro North Fork Rose Creek

Project No.: 1085-007

Survey Method : Handheld GPS

Facility : Faro Mine Site

Start Date : 18 Apr 15

Co-ordinates (m) : 585,170E, 6,913,427N

Drill Designation Prospector P1

Finish Date : 18 Apr 15

Ground Elevation (m): 1103

Drilling Contractor : Midnight Sun Drilling

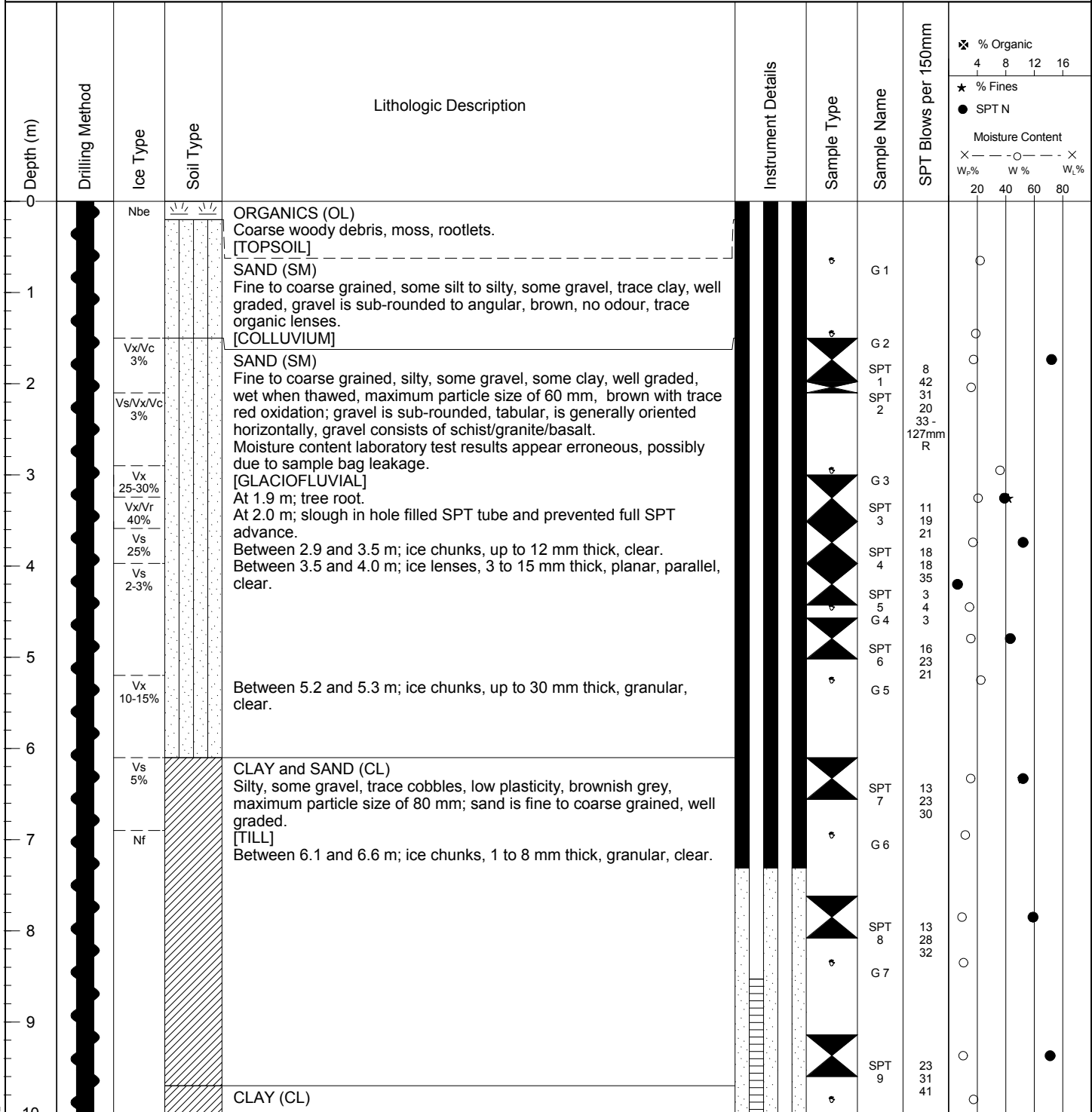
Final Depth of Hole (m) : 13.10

Datum : NAD83 CSRS Epoch 2002

Drill Method : Solid-Stem Auger

Logged by : SG

Reviewed by : JTCS



(Continued on next page)

BOREHOLE # CH15-107-MW014

Page 2 of 2

Project: Faro NFRC Remediation

Location: Faro North Fork Rose Creek

Project No.: 1085-007

Survey Method: Handheld GPS

Facility: Faro Mine Site

Start Date: 18 Apr 15

Co-ordinates (m): 585,170E, 6,913,427N

Drill Designation: Prospector P1

Finish Date: 18 Apr 15

Ground Elevation (m): 1103

Drilling Contractor: Midnight Sun Drilling

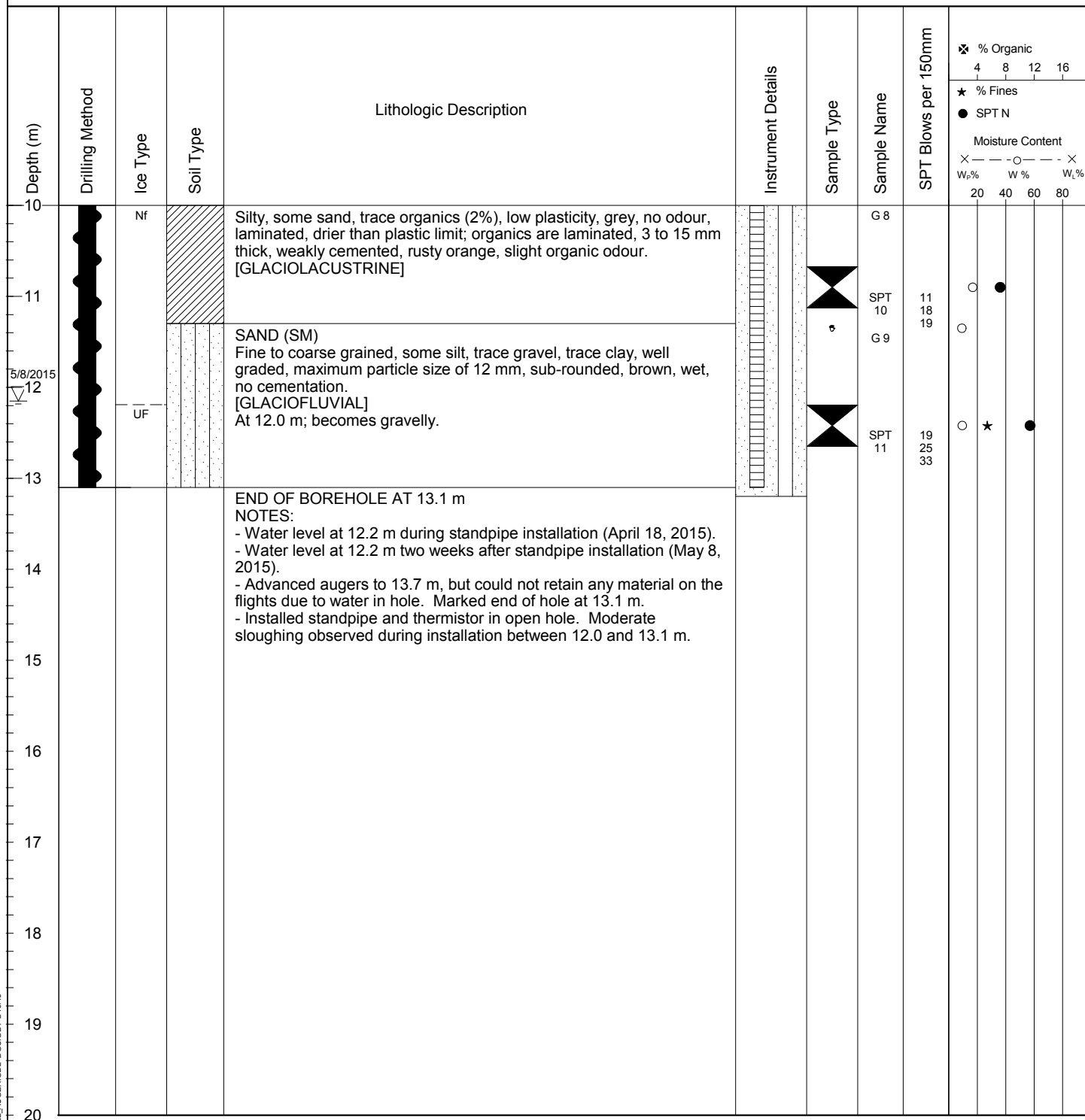
Final Depth of Hole (m): 13.10

Datum: NAD83 CSRS Epoch 2002

Drill Method: Solid-Stem Auger

Logged by: SG

Reviewed by: JTCS



BOREHOLE # CH15-107-MW015

Page 1 of 2

Project: Faro NFRC Remediation

Location: Faro North Fork Rose Creek

Project No.: 1085-007

Survey Method: Handheld GPS

Co-ordinates (m): 585,254E, 6,913,560N

Ground Elevation (m): 1115

Datum: NAD83 CSRS Epoch 2002

Facility: Faro Mine Site

Drill Designation: Prospector P1

Drilling Contractor: Midnight Sun Drilling

Drill Method: SSA/CRREL/HSA

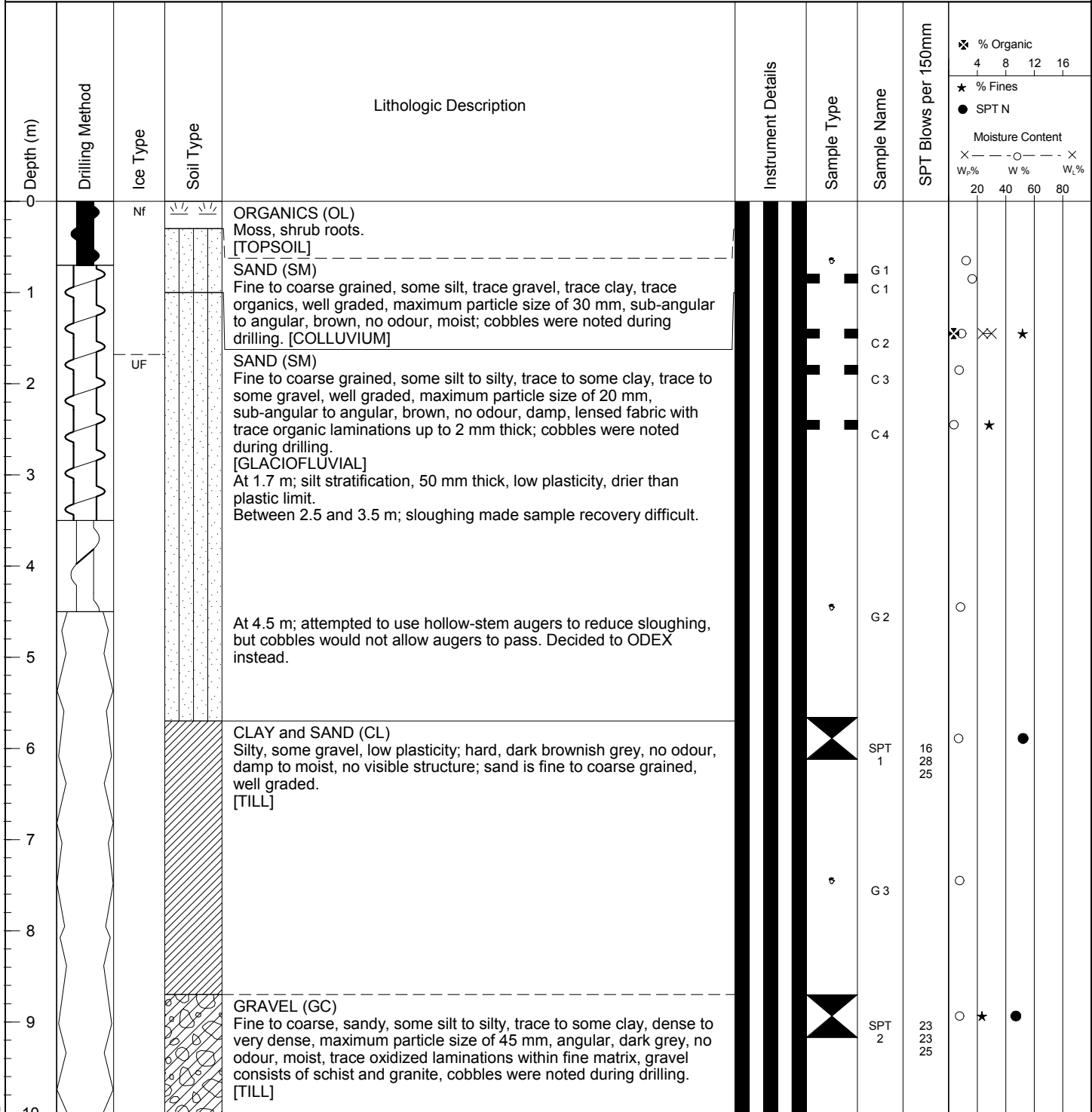
Start Date: 22 Apr 15

Finish Date: 22 Apr 15

Final Depth of Hole (m): 15.30

Logged by: SG

Reviewed by: JTCS



(Continued on next page)

BOREHOLE # CH15-107-MW015

Page 2 of 2

Project: Faro NFRC Remediation

Location : Faro North Fork Rose Creek

Project No.: 1085-007

Survey Method : Handheld GPS

Facility : Faro Mine Site

Start Date : 22 Apr 15

Co-ordinates (m) : 585,254E, 6,913,560N

Drill Designation : Prospector P1

Finish Date : 22 Apr 15

Ground Elevation (m): 1115

Drilling Contractor : Midnight Sun Drilling

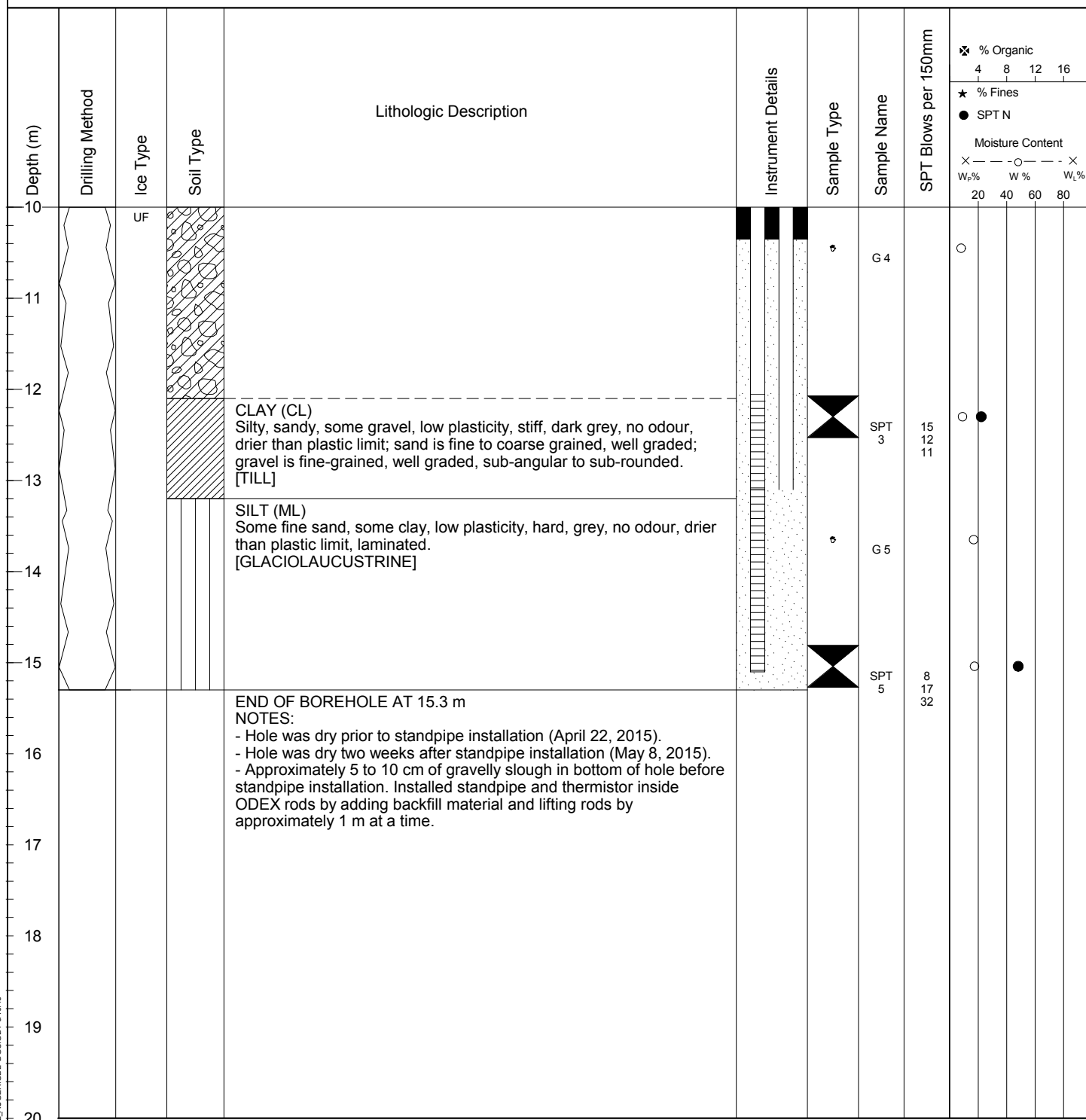
Final Depth of Hole (m) : 15.30

Datum : NAD83 CSRS Epoch 2002

Drill Method : SSA/CRREL/HSA

Logged by : SG

Reviewed by : JTCS



BOREHOLE # CH15-107-MW016

Page 1 of 2

Project: Faro NFRC Remediation

Location: Faro North Fork Rose Creek

Project No.: 1085-007

Survey Method: Handheld GPS

Facility: Faro Mine Site

Start Date: 20 Apr 15

Co-ordinates (m): 585,448E, 6,913,615N

Drill Designation: Prospector P1

Finish Date: 20 Apr 15

Ground Elevation (m): 1110

Drilling Contractor: Midnight Sun Drilling

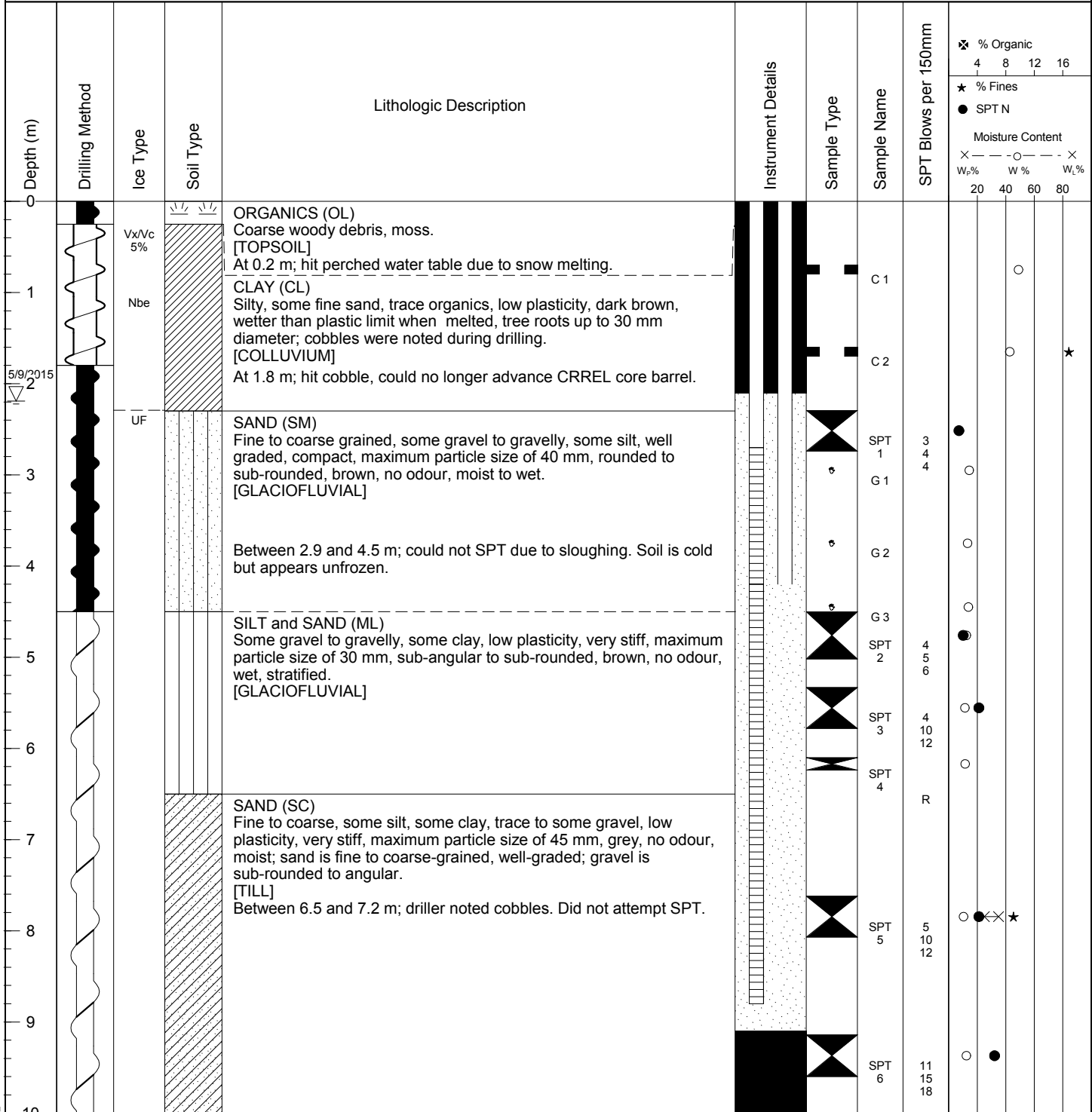
Final Depth of Hole (m): 15.70

Datum: NAD83 CSRS Epoch 2002

Drill Method: SSA/CRREL/HSA

Logged by: SG

Reviewed by: JTCS



(Continued on next page)

BOREHOLE # CH15-107-MW016

Page 2 of 2

Project: Faro NFRC Remediation

Location: Faro North Fork Rose Creek

Project No.: 1085-007

Survey Method: Handheld GPS

Facility: Faro Mine Site

Start Date: 20 Apr 15

Co-ordinates (m): 585,448E, 6,913,615N

Drill Designation: Prospector P1

Finish Date: 20 Apr 15

Ground Elevation (m): 1110

Drilling Contractor: Midnight Sun Drilling

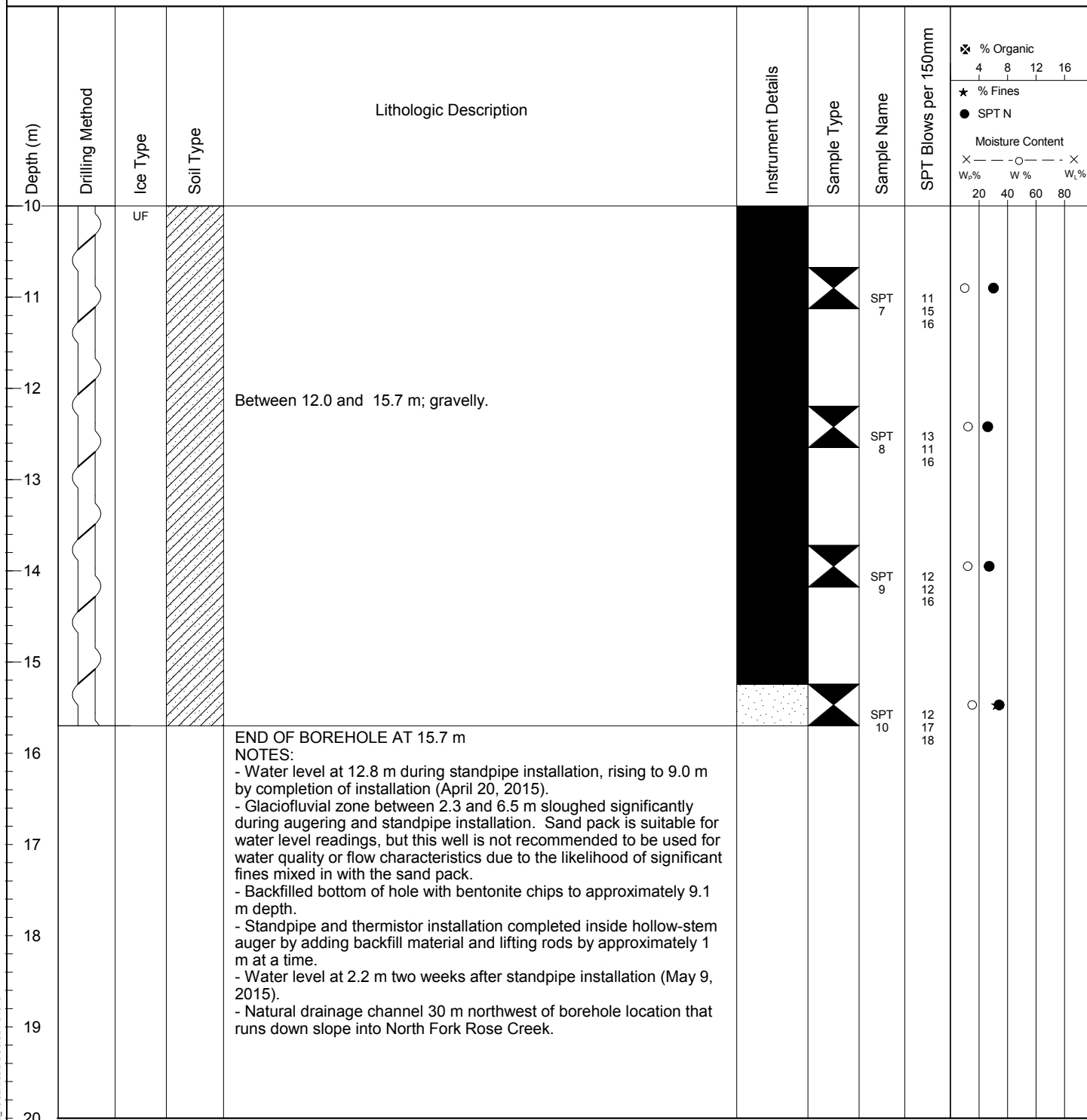
Final Depth of Hole (m): 15.70

Datum: NAD83 CSRS Epoch 2002

Drill Method: SSA/CRREL/HSA

Logged by: SG

Reviewed by: JTCS



BOREHOLE # CH15-107-MW017

Page 1 of 2

Project: Faro NFRC Remediation

Location: Faro North Fork Rose Creek

Project No.: 1085-007

Survey Method: Handheld GPS

Facility: Faro Mine Site

Start Date: 21 Apr 15

Co-ordinates (m): 585,646E, 6,913,707N

Drill Designation: Prospector P1

Finish Date: 21 Apr 15

Ground Elevation (m): 1110

Drilling Contractor: Midnight Sun Drilling

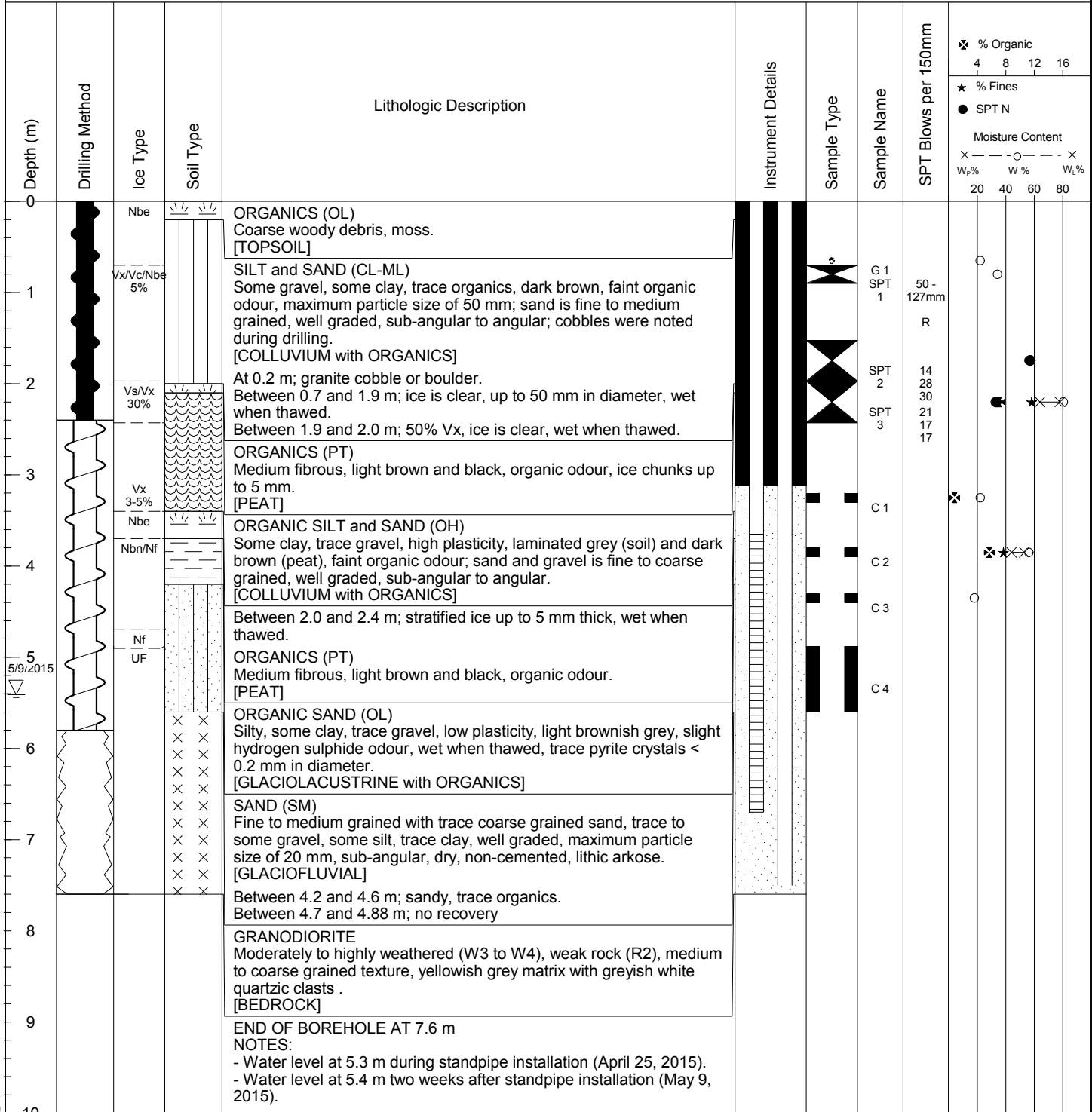
Final Depth of Hole (m): 7.60

Datum: NAD83 CSRS Epoch 2002

Drill Method: SSA/CRREL/ODEX

Logged by: SG

Reviewed by: JTCS



(Continued on next page)

BOREHOLE # CH15-107-MW017

Page 2 of 2

Project: Faro NFRC Remediation**Location :** Faro North Fork Rose Creek**Project No.:** 1085-007**Survey Method :** Handheld GPS**Facility :** Faro Mine Site**Start Date :** 21 Apr 15**Co-ordinates (m) :** 585,646E, 6,913,707N**Drill Designation** Prospector P1**Finish Date :** 21 Apr 15**Ground Elevation (m):** 1110**Drilling Contractor :** Midnight Sun Drilling**Final Depth of Hole (m) :** 7.60**Datum :** NAD83 CSRS Epoch 2002**Drill Method :** SSA/CRREL/ODEX**Logged by :** SG**Reviewed by :** JTCS

Depth (m)	Drilling Method	Ice Type	Soil Type	Lithologic Description	Instrument Details	Sample Type	Sample Name	SPT Blows per 150mm	✕ % Organic 4 8 12 16 ★ % Fines ● SPT N Moisture Content ✕ — — — — ✕ W _p % W % W _L % 20 40 60 80
10				- Approximately 30 cm of sandy slough in bottom of hole before standpipe installation. Installed standpipe and thermistor inside ODEX rods by adding backfill material and lifting rods by approximately 1 m at a time.					
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

BOREHOLE # CH15-107-MW018

Page 1 of 2

Project: Faro NFRC Remediation

Location: Faro North Fork Rose Creek

Project No.: 1085-007

Survey Method: Handheld GPS

Co-ordinates (m): 585,975E, 6,913,796N

Ground Elevation (m): 1107

Datum: NAD83 CSRS Epoch 2002

Facility: Faro Mine Site

Drill Designation: Prospector P1

Drilling Contractor: Midnight Sun Drilling

Drill Method: SSA/HSA

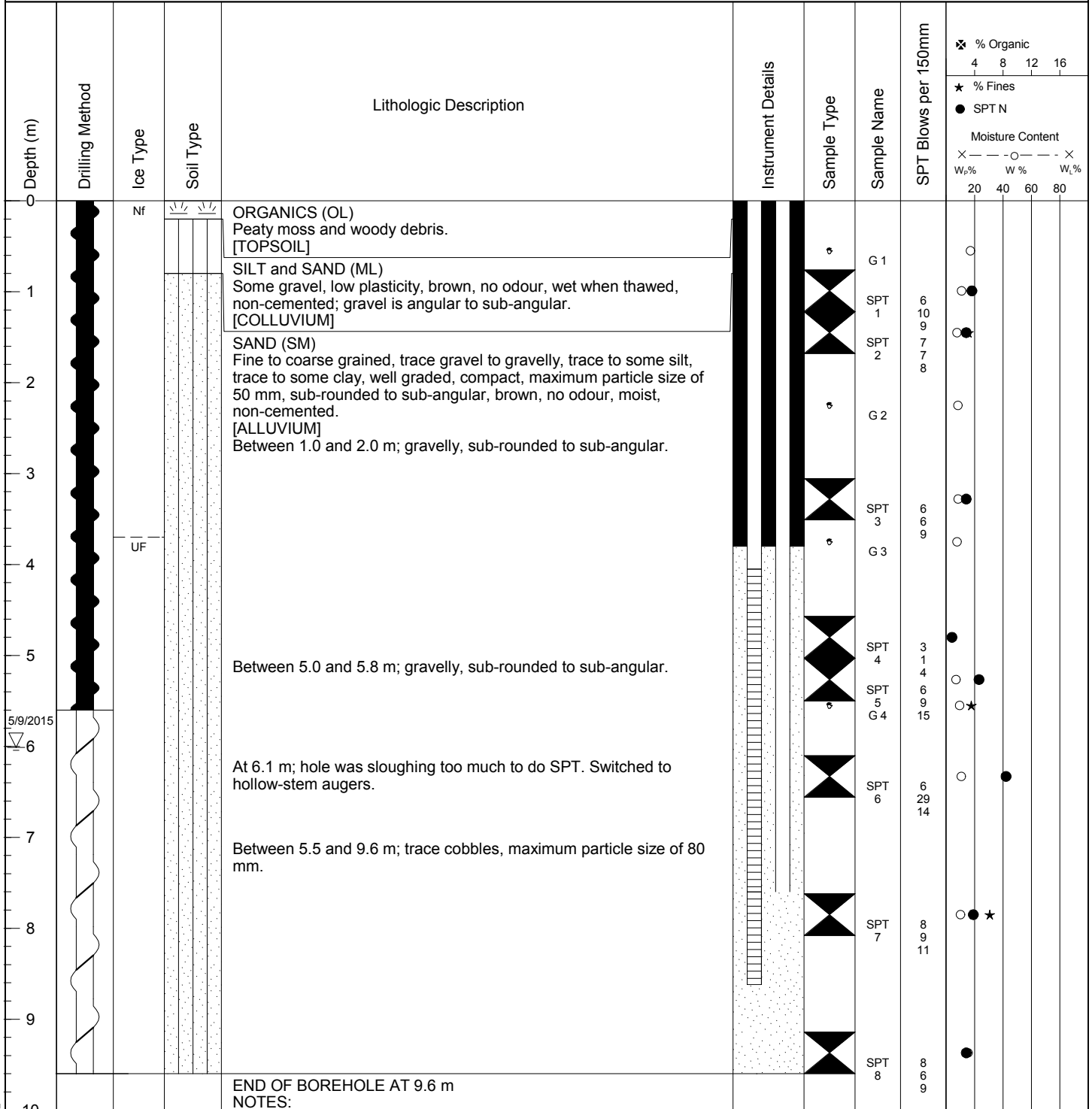
Start Date: 20 Apr 15

Finish Date: 21 Apr 15

Final Depth of Hole (m): 9.60

Logged by: SG

Reviewed by: JTCS



(Continued on next page)

BOREHOLE # CH15-107-MW018

Page 2 of 2

Project: Faro NFRC Remediation

Location : Faro North Fork Rose Creek

Project No.: 1085-007

Survey Method : Handheld GPS

Facility : Faro Mine Site

Start Date : 20 Apr 15

Co-ordinates (m) : 585,975E, 6,913,796N

Drill Designation Prospector P1

Finish Date : 21 Apr 15

Ground Elevation (m): 1107

Drilling Contractor : Midnight Sun Drilling

Final Depth of Hole (m) : 9.60

Datum : NAD83 CSRS Epoch 2002

Drill Method : SSA/HSA

Logged by : SG

Reviewed by : JTCS

Depth (m)	Drilling Method	Ice Type	Soil Type	Lithologic Description	Instrument Details	Sample Type	Sample Name	SPT Blows per 150mm	✕ % Organic 4 8 12 16 ★ % Fines ● SPT N Moisture Content ✕ — — — — ✕ W_p% W % W_L% 20 40 60 80
10				- Water level at 5.9 m during standpipe installation (April 21, 2015). - Water level at 6.0 m two weeks after standpipe installation (May 9, 2015). - Approximately 60 cm of sandy slough in bottom of hole before standpipe installation. Installed standpipe and thermistor inside hollow-stem auger by adding backfill material and lifting rods by approximately 1 m at a time.					
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

APPENDIX B

SELECT PHOTOGRAPHS



Photo 1.

**North Fork Rose Creek overview
taken from main access trail**

- Looking northeast
- April 15, 2015



Photo 2.

**North Fork Rose Creek overview
taken from haul road**

- Looking northeast
- May 6, 2015
- Photo provided by CH2M Hill



Photo 3.

View of borehole CH15-107-MW011

- Looking northeast
- May 6, 2015
- Photo provided by CH2M Hill



Photo 4.

View of borehole CH15-107-MW012

- Looking northeast
- April 21, 2015



Photo 5.

View of borehole CH15-107-MW013

- Looking north
- April 17, 2015



Photo 6.

View of borehole CH15-107-MW014

- Looking north
- May 8, 2015
- Photo provided by CH2M Hill



Photo 7.

View of borehole CH15-107-MW015

- Looking east
- May 8, 2015
- Photo provided by CH2M Hill



Photo 8.

View of borehole CH15-107-MW016

- Looking northwest
- April 16, 2015

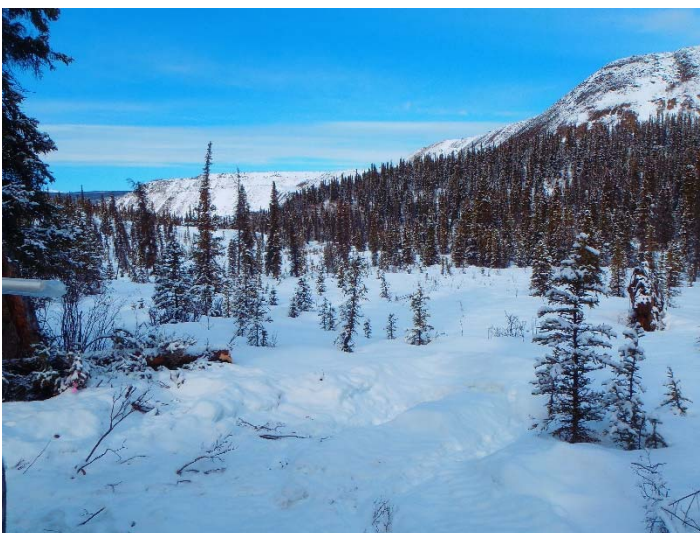


Photo 9.

View of borehole CH15-107-MW017

- Looking northwest
- April 21, 2015



Photo 10.

View of borehole CH15-107-MW018

- Looking northeast
- April 15, 2015



Photo 11.

Typical drilling activity

- Photo is from CH15-107-MW014
- April 18, 2015
- Photo provided by CH2M Hill



Photo 12.

Typical till material

- Photo is from 6.0 m depth in CH15-107-MW012
- Sample from CRREL barrel
- April 23, 2015



Photo 13.

Typical glaciofluvial material

- Photo is from 6.2 m depth in CH15-107-MW014
- Sample from SPT barrel
- April 18, 2015



Photo 14.

Typical ice-rich glaciofluvial sample, estimated 25-30% visible ice content

- Left side shows soil immediately after drilling
- Right side shows same material after being exposed to 3°C ambient temperature for 3 hours with no mechanical disturbance between photos
- Photo is from 2.9 m depth in CH15-107-MW014
- Sample from CRREL barrel
- April 18, 2015



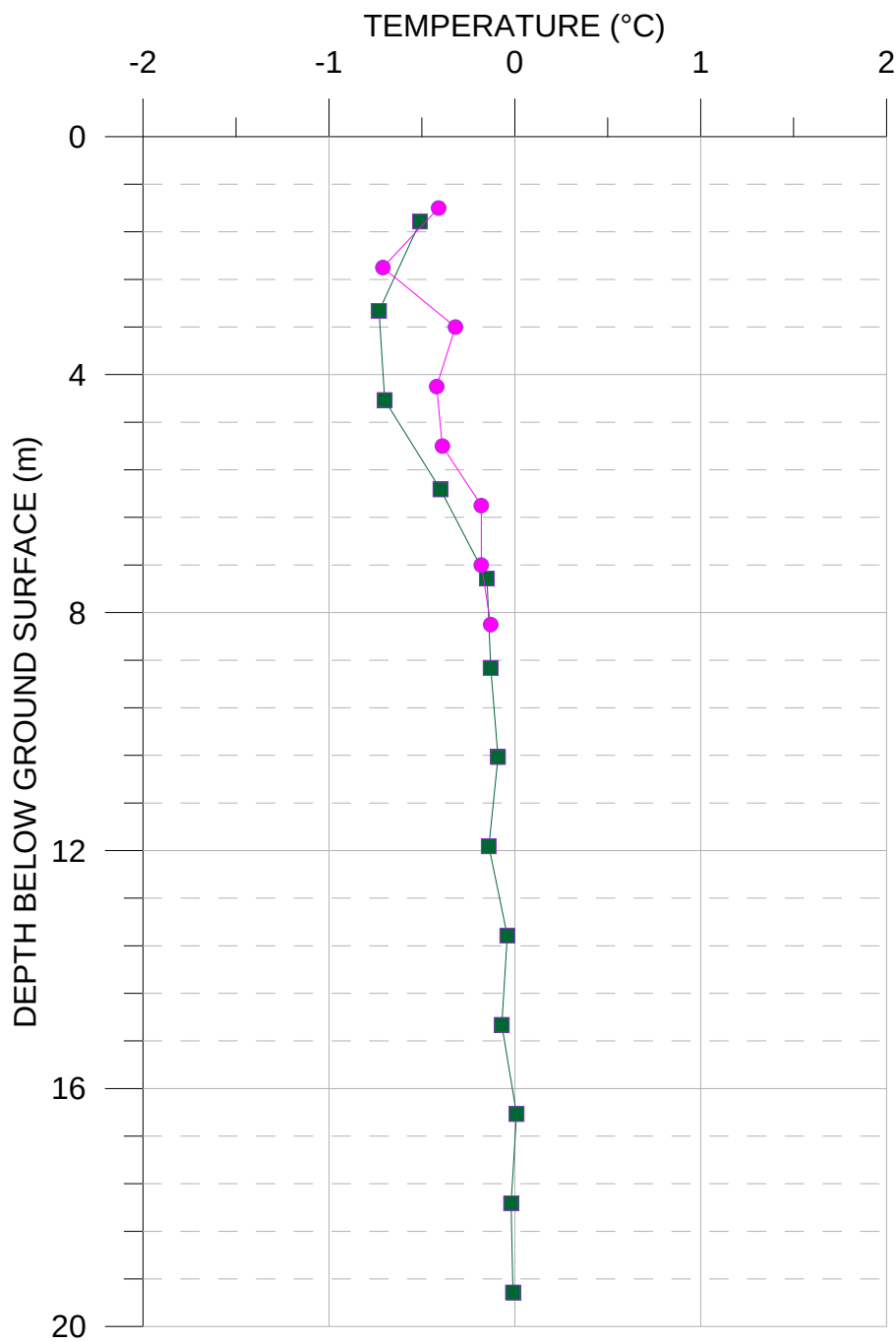
Photo 15.

Example of typical standpipe and thermistor casing installation before monument placement.

- Photo is from CH15-107-MW014
- April 18, 2015

APPENDIX C

MEASURED GROUND TEMPERATURE PROFILES



NOTE:
1) Drillhole completed on April 24th, 2015.

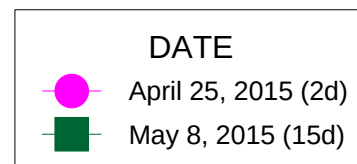
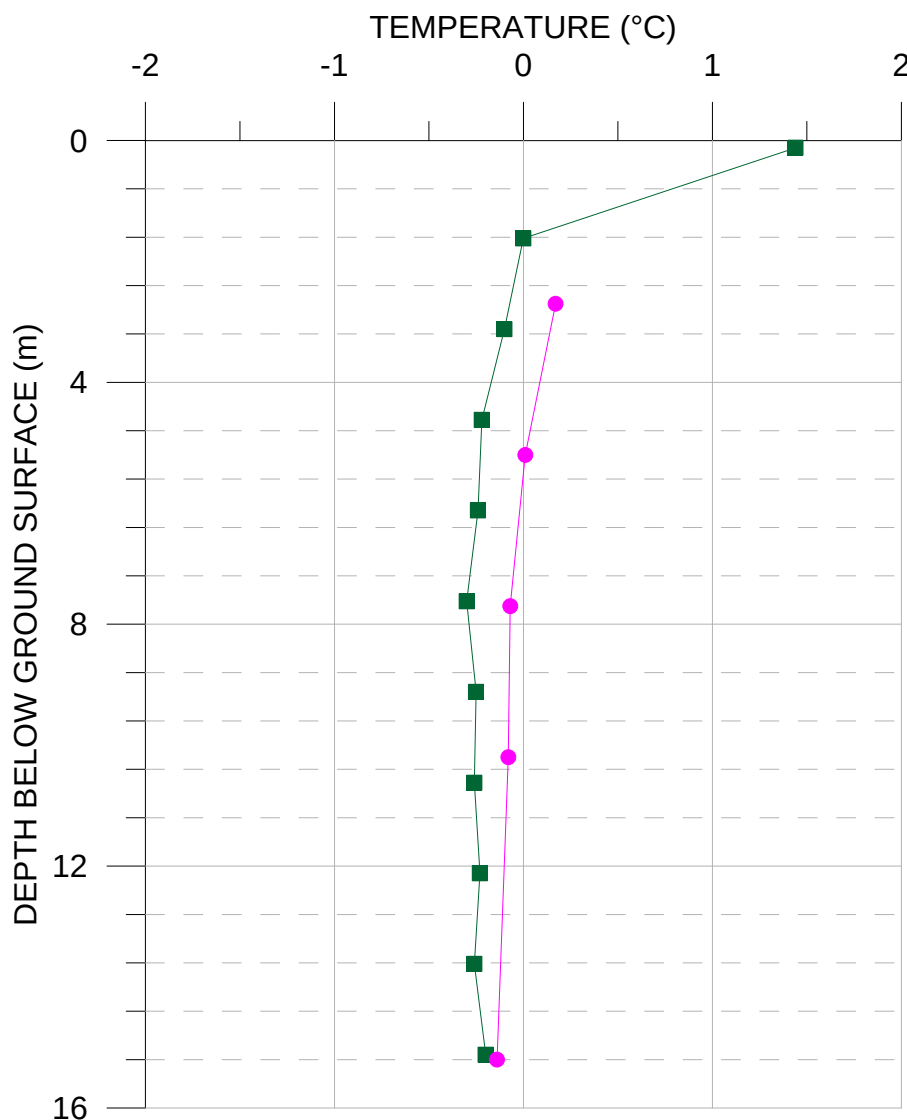
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SCALE:	NTS	DESIGNED:	SG
DATE:	JUN 2015	CHECKED:	JTCS
DRAWN:	SG	APPROVED:	JWC



CLIENT: CH2M HILL CANADA LIMITED

PROJECT:	FARO NORTH FORK ROSE CREEK REMEDIATION PHASE 1A SITE INVESTIGATION		
TITLE:	MEASURED GROUND TEMPERATURE PROFILES CH15-107-MW011		
PROJECT No.:	1085-007	FIG No.:	C-1
REV.:	-		



NOTE:

- 1) Drillhole completed on April 23rd, 2015.

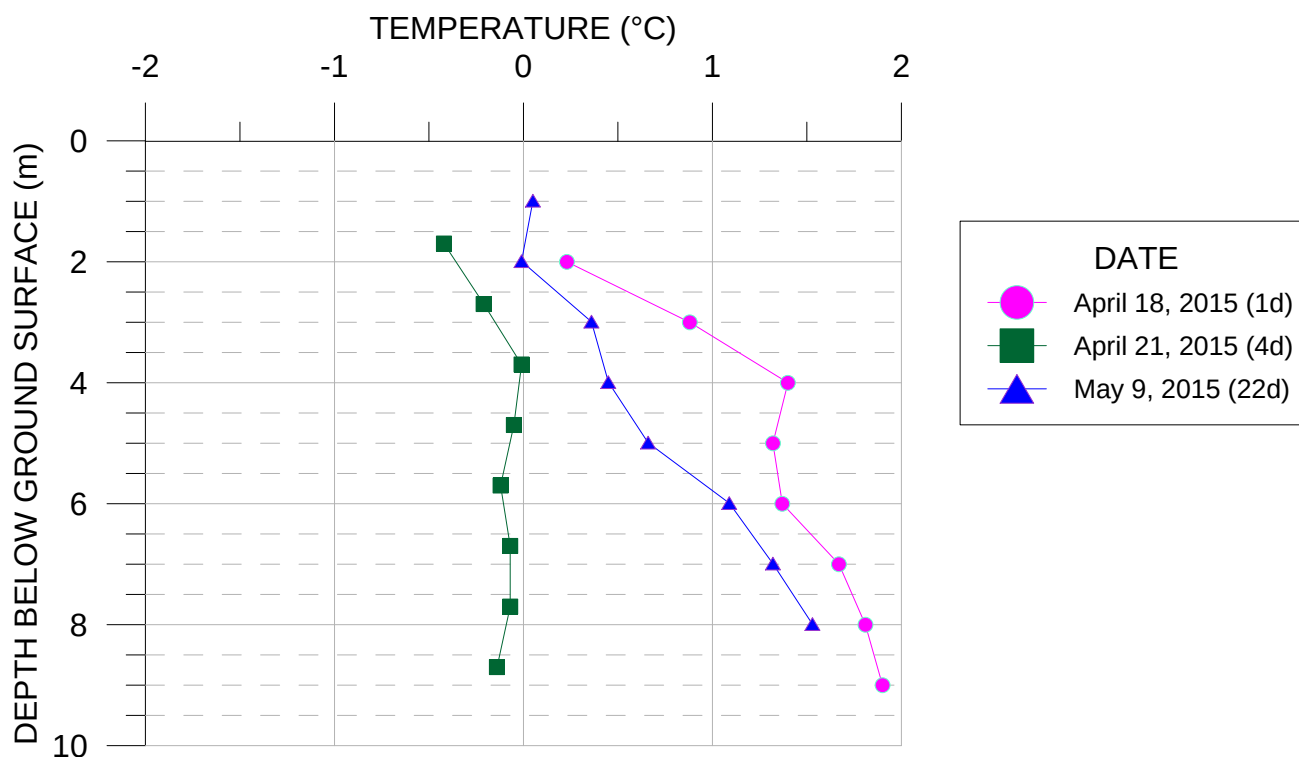
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SCALE:	NTS	DESIGNED:	SG
DATE:	JUN 2015	CHECKED:	JTCS
DRAWN:	SG	APPROVED:	JWC



CLIENT:	CH2M HILL CANADA LIMITED	PROJECT No.:	1085-007	FIG No.:	C-2	REV.:	-
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FIG. TO BE READ WITH BGC REPORT TITLED "NORTH FORK ROSE CREEK REMEDIATION, PHASE 1A SITE INVESTIGATION, FARO MINE COMPLEX, YUKON" DATED JUNE 2015.



NOTE:
1) Drillhole completed on April 17th, 2015.

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SCALE:	NTS	DESIGNED:	SG
DATE:	MAY 2015	CHECKED:	JTCS
DRAWN:	SG	APPROVED:	JWC

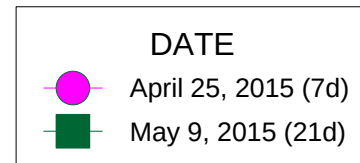
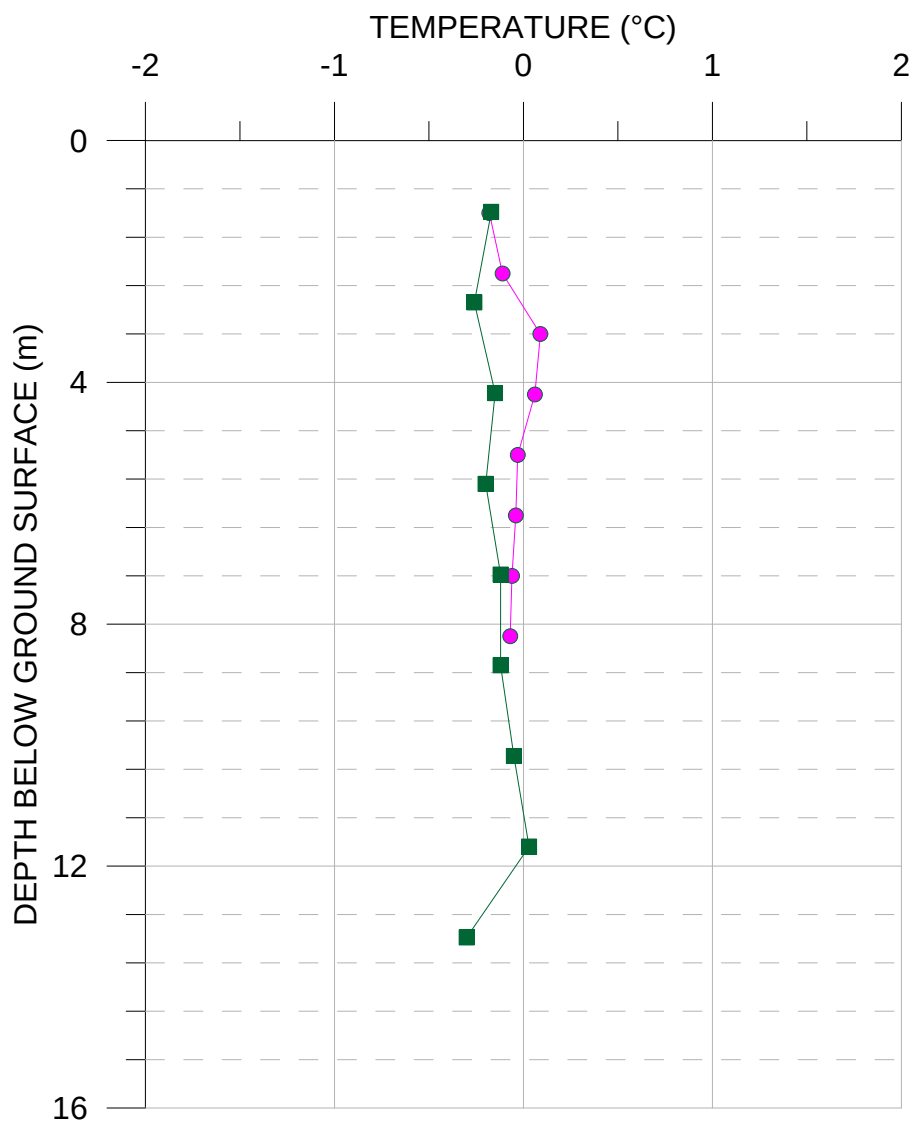


PROJECT:
FARO NORTH FORK ROSE CREEK REMEDIATION
PHASE 1A SITE INVESTIGATION

TITLE:
MEASURED GROUND TEMPERATURE PROFILES
CH15-107-MW013

CLIENT: CH2M HILL CANADA LIMITED	PROJECT No.: 1085-007	FIG No.: C-3	REV.: -
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FIG. TO BE READ WITH BGC REPORT TITLED "NORTH FORK ROSE CREEK REMEDIATION, PHASE 1A SITE INVESTIGATION, FARO MINE COMPLEX, YUKON" DATED JUNE 2015.



NOTE:
1) Drillhole completed on April 18th, 2015.

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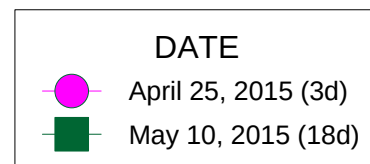
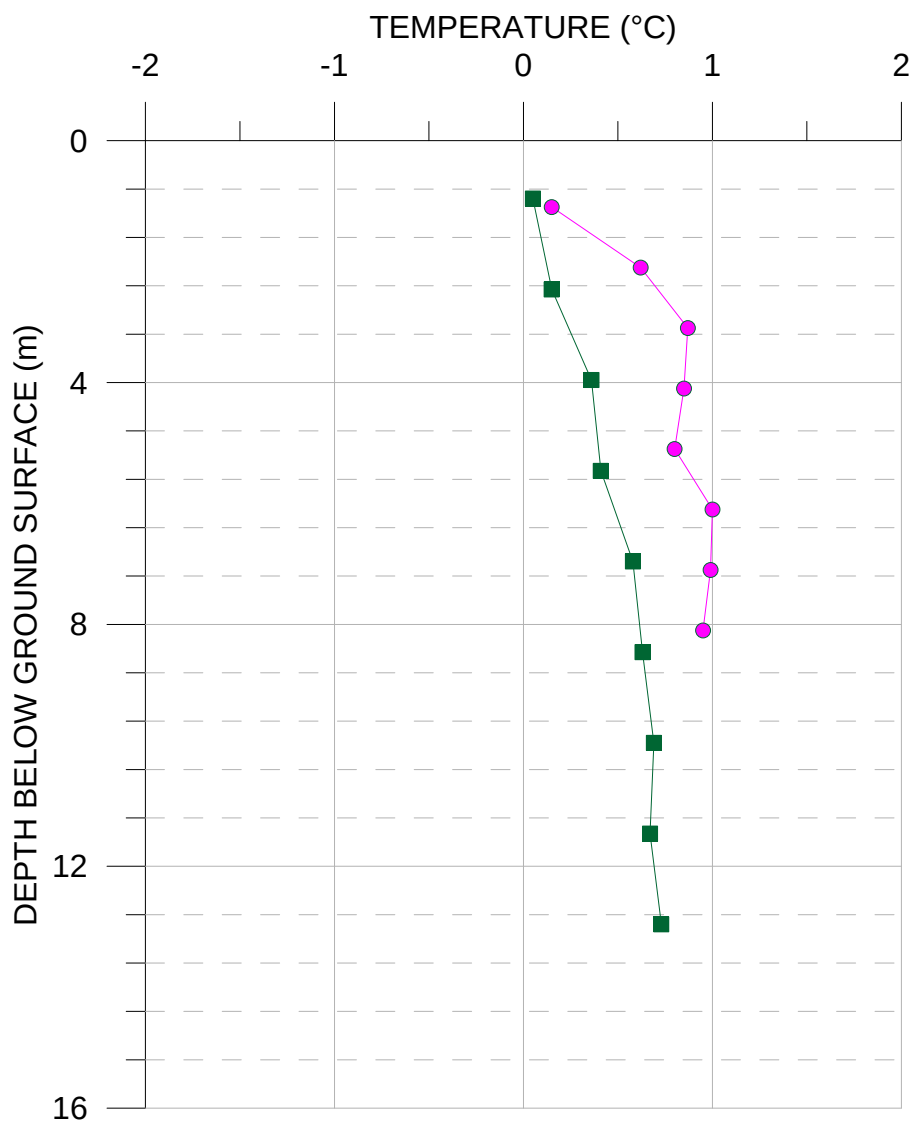
SCALE:	NTS	DESIGNED:	SG
DATE:	JUN 2015	CHECKED:	JTCS
DRAWN:	SG	APPROVED:	JWC



CLIENT:	CH2M HILL CANADA LIMITED
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PROJECT:	FARO NORTH FORK ROSE CREEK REMEDIATION PHASE 1A SITE INVESTIGATION
TITLE:	MEASURED GROUND TEMPERATURE PROFILES CH15-107-MW014

PROJECT No.:	1085-007	FIG No.:	C-4	REV.:	-
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NOTE:
1) Drillhole completed on April 22nd, 2015.

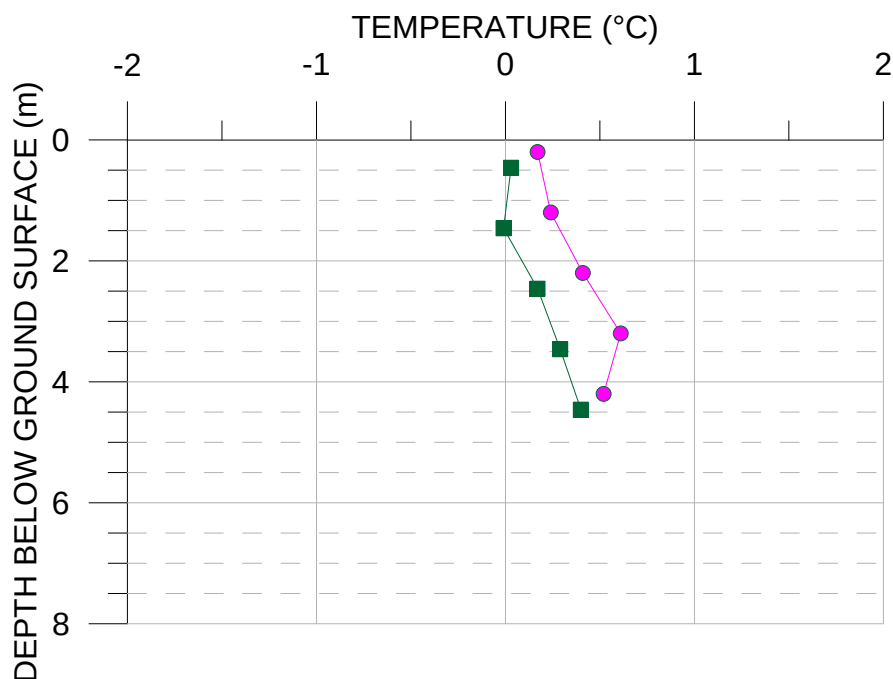
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SCALE:	NTS	DESIGNED:	SG
DATE:	JUN 2015	CHECKED:	JTCS
DRAWN:	SG	APPROVED:	JWC



PROJECT:	FARO NORTH FORK ROSE CREEK REMEDIATION PHASE 1A SITE INVESTIGATION		
TITLE:	MEASURED GROUND TEMPERATURE PROFILES CH15-107-MW015		

CLIENT:	CH2M HILL CANADA LIMITED	PROJECT No.:	1085-007	FIG No.:	C-5	REV.:	-
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DATE	
●	April 25, 2015 (5d)
■	May 10, 2015 (20d)

NOTE:
1) Drillhole completed on April 20th, 2015.

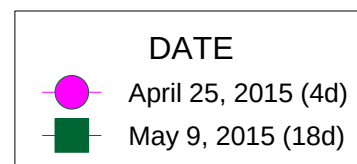
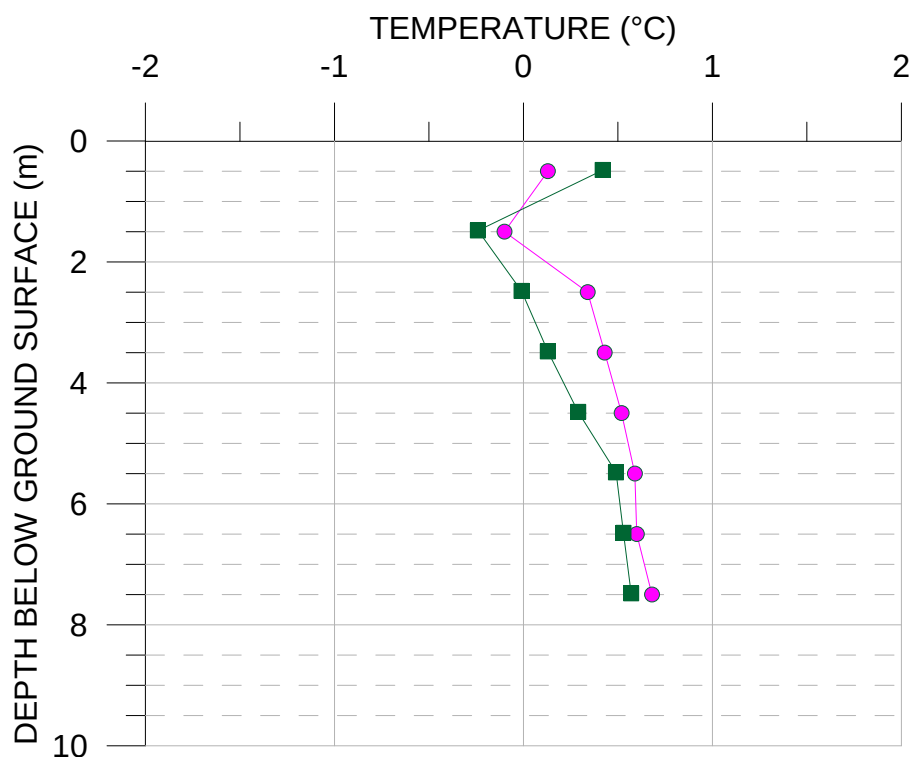
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SCALE:	NTS	DESIGNED:	SG
DATE:	JUN 2015	CHECKED:	JTCS
DRAWN:	SG	APPROVED:	JWC



PROJECT: FARO NORTH FORK ROSE CREEK REMEDIATION PHASE 1A SITE INVESTIGATION			
TITLE: MEASURED GROUND TEMPERATURE PROFILES CH15-107-MW016			
CLIENT:	PROJECT No.:	FIG No.:	REV.:
CH2M HILL CANADA LIMITED	1085-007	C-6	-

FIG. TO BE READ WITH BGC REPORT TITLED "NORTH FORK ROSE CREEK REMEDIATION, PHASE 1A SITE INVESTIGATION, FARO MINE COMPLEX, YUKON" DATED JUNE 2015.



NOTE:

1) Drillhole completed on April 21th, 2015.

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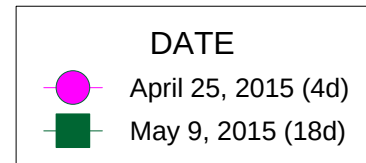
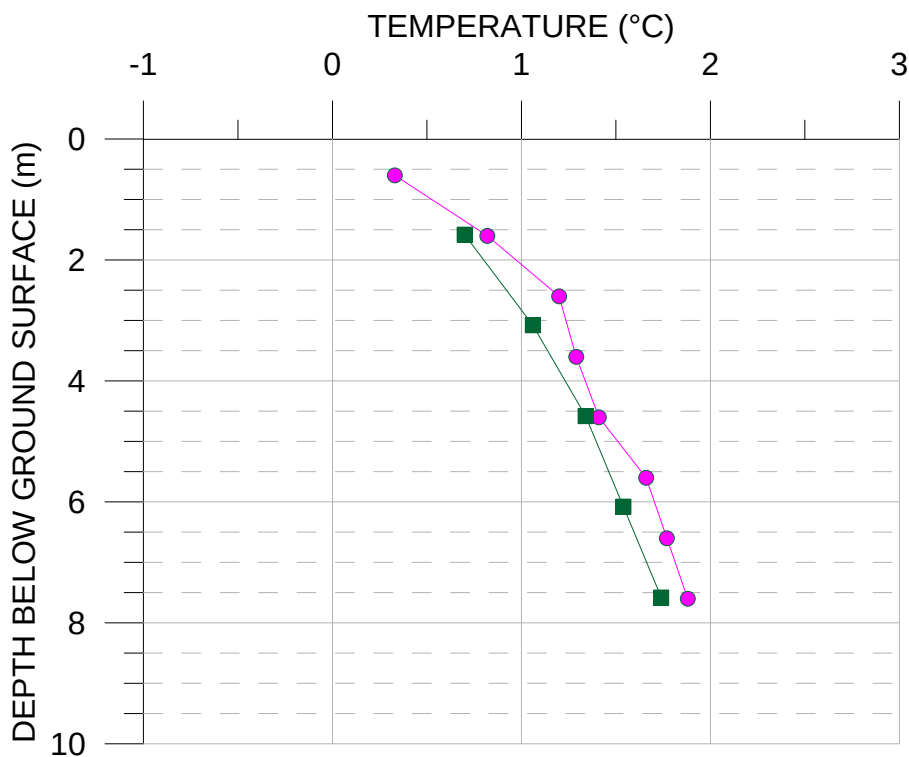
SCALE:	NTS	DESIGNED:	SG
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DRAWN:	SG	APPROVED:	JC



PROJECT:	FARO NORTH FORK ROSE CREEK REMEDIATION PHASE 1A SITE INVESTIGATION		
TITLE:	MEASURED GROUND TEMPERATURE PROFILES CH15-107-MW017		

CLIENT:	CH2M HILL CANADA LIMITED	PROJECT No.:	1085-007	FIG No.:	C-7	REV.:	-
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FIG. TO BE READ WITH BGC REPORT TITLED "NORTH FORK ROSE CREEK REMEDIATION, PHASE 1A SITE INVESTIGATION, FARO MINE COMPLEX, YUKON" DATED JUNE 2015.



NOTE:

1) Drillhole completed on April 21th, 2015.

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SCALE:	NTS	DESIGNED:	SG
DATE:	JUN 2015	CHECKED:	JTCS
DRAWN:	SG	APPROVED:	JWC



PROJECT:	FARO NORTH FORK ROSE CREEK REMEDIATION PHASE 1A SITE INVESTIGATION		
TITLE:	MEASURED GROUND TEMPERATURE PROFILES CH15-107-MW018		

CLIENT:	CH2M HILL CANADA LIMITED	PROJECT No.:	1085-007	FIG No.:	C-8	REV.:	-
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FIG. TO BE READ WITH BGC REPORT TITLED "NORTH FORK ROSE CREEK REMEDIATION, PHASE 1A SITE INVESTIGATION, FARO MINE COMPLEX, YUKON" DATED JUNE 2015.

APPENDIX D

LABORATORY TEST RESULTS

Borehole	Sample Type	Sample #	Midpoint Depth (m bgs)	Moisture Content (% dry weight)	Atterberg Limits (%)			Total Organic Carbon (% by weight)	Specific Gravity	Particle Size Distribution (% by weight)					
					Plastic Limit	Liquid Limit	Plasticity Index			Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay
										4.75 - 76 mm	2.0 - 4.75 mm	0.425 - 2.0 mm	0.075 - 0.425 mm	0.002 - 0.075 mm	<0.002 mm
CH15-107-MW011	CRREL	C 1	6.3	11.2	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW011	CRREL	C 2	6.9	10.0	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW011	CRREL	C 3	7.9	10.5	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW011	CRREL	C 4	8.6	12.5	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW011	GRAB	G 1	0.7	10.0	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW011	GRAB	G 2	9.9	7.2	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW011	GRAB	G 3	14	6.4	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW011	SPT	SPT 1	2.3	-	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW011	SPT	SPT 2	3.3	12.6	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW011	SPT	SPT 3	5.6	9.2	-	-	-	-	-	<1.0	13	17	14	36	20
CH15-107-MW011	SPT	SPT 4	10.9	8.1	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW011	SPT	SPT 5	12.4	7.1	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW011	SPT	SPT 6	14.9	8.6	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW011	SPT	SPT 7	16.4	10.6	20	30	10	1.3	-	<1.0	7	19	12	45	17
CH15-107-MW011	SPT	SPT 8	17.9	29.2	-	-	-	13.4	-	-	-	-	-	-	-
CH15-107-MW012	CRREL	C 1	1	23.1	-	-	-	10.7	-	-	-	-	-	-	-
CH15-107-MW012	CRREL	C 2	1.6	14.3	-	-	-	1.6	-	-	-	-	-	-	-
CH15-107-MW012	CRREL	C 3	1.8	17.3	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW012	CRREL	C 4	2.5	13.1	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW012	CRREL	C 5	2.9	16.4	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW012	CRREL	C 6	3.5	15.4	-	-	-	-	-	2	22	28	17	17	15
CH15-107-MW012	CRREL	C 7	3.9	13.2	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW012	CRREL	C 8	4.3	10.5	-	-	-	-	-	16	11	21	17	21	15
CH15-107-MW012	CRREL	C 9	4.5	10.7	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW012	CRREL	C 10	5.3	9.7	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW012	CRREL	C 11	5.5	14.8	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW012	CRREL	C 12	6.1	12.3	-	-	-	-	-	<1.0	4	17	16	35	28
CH15-107-MW012	CRREL	C 13	6.9	10.9	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW012	CRREL	C 14	7.9	10.5	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW012	CRREL	C 15	8.5	12.7	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW012	CRREL	C 16	9.1	19.7	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW012	CRREL	C 17	10.1	69.5	-	-	-	-	-	-	-	-	-	-	-

Borehole	Sample Type	Sample #	Midpoint Depth (m bgs)	Moisture Content (% dry weight)	Atterberg Limits (%)			Total Organic Carbon (% by weight)	Specific Gravity	Particle Size Distribution (% by weight)					
					Plastic Limit	Liquid Limit	Plasticity Index			Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay
										4.75 - 76 mm	2.0 - 4.75 mm	0.425 - 2.0 mm	0.075 - 0.425 mm	0.002 - 0.075 mm	<0.002 mm
CH15-107-MW012	CRREL	C 18	10.5	21.1	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW012	CRREL	C 19	11	21.0	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW012	CRREL	C 20	12	15.6	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW012	CRREL	C 21	12.4	25.4	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW012	CRREL	C 22	13	15.8	-	-	-	-	-	15	12	15	13	30	16
CH15-107-MW012	CRREL	C 23	13.7	15.3	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW012	GRAB	G 1	0.7	20.3	-	-	-	5.4	-	-	-	-	-	-	-
CH15-107-MW012	SPT	SPT 1	15.5	12.7	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW013	GRAB	G 1	0.5	9.4	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW013	GRAB	G 2	1	13.0	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW013	GRAB	G 3	1.5	12.3	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW013	GRAB	G 4	2.3	11.1	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW013	GRAB	G 5	3	10.8	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW013	GRAB	G 6	3.9	11.1	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW013	GRAB	G 7	4.5	12.9	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW013	GRAB	G 8	5.3	11.8	17	25	8	-	-	2	14	23	18	27	16
CH15-107-MW013	GRAB	G 9	6.1	13.2	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW013	GRAB	G 10	8.4	6.4	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW013	GRAB	G 11	9.1	8.6	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW013	GRAB	G 12	9.9	7.0	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW013	GRAB	G 13	10.6	6.7	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW013	GRAB	G 14	11.4	9.0	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW013	GRAB	G 15	12.9	13.3	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW013	GRAB	G 16	14.5	13.9	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW013	GRAB	G 17	15.2	14.4	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW013	SPT	SPT 1	6.5	12.6	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW013	SPT	SPT 2	7.1	11.5	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW013	SPT	SPT 3	7.9	9.1	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW013	SPT	SPT 4	10.9	11.5	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW013	SPT	SPT 5	12.4	10.8	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW014	GRAB	G 1	0.7	22.0	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW014	GRAB	G 2	1.5	19.0	-	-	-	-	-	-	-	-	-	-	-

Borehole	Sample Type	Sample #	Midpoint Depth (m bgs)	Moisture Content (% dry weight)	Atterberg Limits (%)			Total Organic Carbon (% by weight)	Specific Gravity	Particle Size Distribution (% by weight)					
					Plastic Limit	Liquid Limit	Plasticity Index			Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay
										4.75 - 76 mm	2.0 - 4.75 mm	0.425 - 2.0 mm	0.075 - 0.425 mm	0.002 - 0.075 mm	<0.002 mm
CH15-107-MW014	GRAB	G 3	3	36.0	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW014	GRAB	G 4	4.5	14.6	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW014	GRAB	G 5	5.3	22.5	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW014	GRAB	G 6	7	11.6	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW014	GRAB	G 7	8.4	10.4	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW014	GRAB	G 8	9.9	17.4	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW014	GRAB	G 9	11.4	9.2	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW014	SPT	SPT 1	1.8	17.4	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW014	SPT	SPT 2	2.1	16.8	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW014	SPT	SPT 3	3.3	9.4	-	-	-	-	-	12	12	17	17	28	14
CH15-107-MW014	SPT	SPT 4	3.7	15.7	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW014	SPT	SPT 5	4.2	20.6	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW014	SPT	SPT 6	4.8	17	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW014	SPT	SPT 7	6.3	-	-	-	-	-	-	<1.0	13	20	16	36	16
CH15-107-MW014	SPT	SPT 8	7.9	15.5	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW014	SPT	SPT 9	9.4	15.4	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW014	SPT	SPT 10	10.9	9.29	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW014	SPT	SPT 11	12.4	10.1	-	-	-	-	-	1	15	36	21	18	9
CH15-107-MW015	CRREL	C 1	0.9	16.5	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW015	CRREL	C 2	1.5	9.09	18	24	6	<0.70	-	<1.0	8	22	18	38	14
CH15-107-MW015	CRREL	C 3	1.9	7.31	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW015	CRREL	C 4	2.5	3.63	-	-	-	-	-	17	14	24	17	20	8
CH15-107-MW015	GRAB	G 1	0.7	12.2	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW015	GRAB	G 2	4.5	8.24	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW015	GRAB	G 3	7.6	7.68	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW015	GRAB	G 4	10.6	8.03	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW015	GRAB	G 5	13.8	16.8	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW015	SPT	SPT 1	5.9	6.88	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW015	SPT	SPT 2	8.9	7.65	-	-	-	-	-	47	8	12	10	15	9
CH15-107-MW015	SPT	SPT 3	12.3	9	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW015	SPT	SPT 5	15	-	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW015	SPT	SPT 4	0.2	17.4	-	-	-	-	-	-	-	-	-	-	-

Borehole	Sample Type	Sample #	Midpoint Depth (m bgs)	Moisture Content (% dry weight)	Atterberg Limits (%)			Total Organic Carbon (% by weight)	Specific Gravity	Particle Size Distribution (% by weight)					
					Plastic Limit	Liquid Limit	Plasticity Index			Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay
										4.75 - 76 mm	2.0 - 4.75 mm	0.425 - 2.0 mm	0.075 - 0.425 mm	0.002 - 0.075 mm	<0.002 mm
CH15-107-MW016	CRREL	C 1	0.8	49	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW016	CRREL	C 2	1.7	42.8	-	-	-	-	-	<1.0	<1.0	3	13	67	17
CH15-107-MW016	GRAB	G 1	3	14.4	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW016	GRAB	G 2	3.8	13.2	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW016	GRAB	G 3	4.5	13.8	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW016	SPT	SPT 1	2.5	-	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW016	SPT	SPT 2	4.8	15.2	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW016	SPT	SPT 3	5.6	12.4	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW016	SPT	SPT 4	6.2	11.4	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW016	SPT	SPT 5	7.9	11.5	15	25	10	-	1.95	4	6	28	17	29	16
CH15-107-MW016	SPT	SPT 6	9.4	10.4	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW016	SPT	SPT 7	10.9	12.4	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW016	SPT	SPT 8	12.4	10	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW016	SPT	SPT 9	14	12.3	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW016	SPT	SPT 10	15.5	12.1	-	-	-	-	-	38	6	13	12	21	11
CH15-107-MW017	CRREL	C 1	3.3	22.1	-	-	-	0.9	-	-	-	-	-	-	-
CH15-107-MW017	CRREL	C 2	3.9	56.2	35	44	9	5.8	-	6	16	24	16	28	10
CH15-107-MW017	CRREL	C 3	4.4	18	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW017	CRREL	C 4	5	8.31	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW017	GRAB	G 1	0.7	22	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW017	SPT	SPT 1	0.8	34.2	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW017	SPT	SPT 2	1.8	56.3	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW017	SPT	SPT 3	2.2	80.4	50	64	14	7.2	-	<1.0	7	20	14	48	10
CH15-107-MW018	GRAB	G 1	0.5	17.1	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW018	GRAB	G 2	2.3	8.32	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW018	GRAB	G 3	3.8	7.7	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW018	GRAB	G 4	5.6	9.52	-	-	-	-	-	28	11	24	19	12	6
CH15-107-MW018	SPT	SPT 1	1	10.9	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW018	SPT	SPT 2	1.5	7.66	-	-	-	-	-	28	11	26	20	10	6
CH15-107-MW018	SPT	SPT 3	3.3	8.45	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW018	SPT	SPT 4	4.8	-	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW018	SPT	SPT 5	5.3	6.97	-	-	-	-	-	-	-	-	-	-	-

Borehole	Sample Type	Sample #	Midpoint Depth (m bgs)	Moisture Content (% dry weight)	Atterberg Limits (%)			Total Organic Carbon (% by weight)	Specific Gravity	Particle Size Distribution (% by weight)					
					Plastic Limit	Liquid Limit	Plasticity Index			Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay
										4.75 - 76 mm	2.0 - 4.75 mm	0.425 - 2.0 mm	0.075 - 0.425 mm	0.002 - 0.075 mm	<0.002 mm
CH15-107-MW018	SPT	SPT 6	6.3	10.7	-	-	-	-	-	-	-	-	-	-	-
CH15-107-MW018	SPT	SPT 7	7.9	10.1	-	-	-	-	-	<1.0	11	33	25	22	8
CH15-107-MW018	SPT	SPT 8	9.4	15.4	-	-	-	-	-	-	-	-	-	-	-



BGC ENGINEERING INC.
ATTN: Scott Garrison
Suite 200 - 1121 Centre St NW
Calgary AB T2E 7K6

Date Received: 27-APR-15
Report Date: 08-MAY-15 17:54 (MT)
Version: FINAL

Client Phone: 403-250-5185

Certificate of Analysis

Lab Work Order #: L1603922
Project P.O. #: NOT SUBMITTED
Job Reference: 1085-007
C of C Numbers: 1, 2, 3, 4
Legal Site Desc:

Amber Springer
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1603922-1 CRREL GRAB CH15-107-MW011- C1	L1603922-2 CRREL GRAB CH15-107-MW011- C2	L1603922-3 CRREL GRAB CH15-107-MW011- C3	L1603922-4 CRREL GRAB CH15-107-MW011- C4	L1603922-5 GRAB CH15-107-MW011- G1
Grouping	Analyte					
SOIL						
Physical Tests	Grain Size Curve					
	Moisture (%)	11.2	9.97	10.5	12.5	10.0
	Liquid Limit (LL) (%)					
	Plasticity Index (PI) (%)					
	Specific Gravity (kg/L)					
Particle Size	Gravel (4.75mm - 3in.) (%)					
	Medium Sand (0.425mm - 2.0mm) (%)					
	Coarse Sand (2.0mm - 4.75mm) (%)					
	Fine Sand (0.075mm - 0.425mm) (%)					
	Silt (0.005mm - 0.075mm) (%)					
	Clay (<0.005mm) (%)					
Organic / Inorganic Carbon	Organic Carbon (%)					
	Organic Matter (%)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1603922-6 GRAB CH15-107-MW011- G2	L1603922-7 GRAB CH15-107-MW011- G3	L1603922-9 SPT CH15-107-MW011- SPT2	L1603922-10 SPT CH15-107-MW011- SPT3	L1603922-11 SPT CH15-107-MW011- SPT4
Grouping	Analyte					
SOIL						
Physical Tests	Grain Size Curve				SEE ATTACHED	
	Moisture (%)	7.17	6.41	12.6	9.21	8.08
	Liquid Limit (LL) (%)					
	Plasticity Index (PI) (%)					
	Specific Gravity (kg/L)					
Particle Size	Gravel (4.75mm - 3in.) (%)				<1.0	
	Medium Sand (0.425mm - 2.0mm) (%)				16.8	
	Coarse Sand (2.0mm - 4.75mm) (%)				12.9	
	Fine Sand (0.075mm - 0.425mm) (%)				13.8	
	Silt (0.005mm - 0.075mm) (%)				28.6	
	Clay (<0.005mm) (%)				27.5	
Organic / Inorganic Carbon	Organic Carbon (%)					
	Organic Matter (%)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1603922-12 SPT CH15-107-MW011-SPT5	L1603922-13 SPT CH15-107-MW011-SPT6	L1603922-14 SPT CH15-107-MW011-SPT7	L1603922-15 SPT CH15-107-MW011-SPT8	L1603922-16 CRREL GRAB CH15-107-MW012-C1
Grouping	Analyte					
SOIL						
Physical Tests	Grain Size Curve			SEE ATTACHED		
	Moisture (%)	7.06	8.63	10.6	29.2	23.1
	Liquid Limit (LL) (%)			30		
	Plasticity Index (PI) (%)			10		
	Specific Gravity (kg/L)					
Particle Size	Gravel (4.75mm - 3in.) (%)			<1.0		
	Medium Sand (0.425mm - 2.0mm) (%)			18.8		
	Coarse Sand (2.0mm - 4.75mm) (%)			6.8		
	Fine Sand (0.075mm - 0.425mm) (%)			11.5		
	Silt (0.005mm - 0.075mm) (%)			38.0		
	Clay (<0.005mm) (%)			24.9		
Organic / Inorganic Carbon	Organic Carbon (%)			0.80	7.80	6.20
	Organic Matter (%)			1.33	13.4	10.7

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1603922-17 CRREL GRAB CH15-107-MW012-C2	L1603922-18 CRREL GRAB CH15-107-MW012-C3	L1603922-19 CRREL GRAB CH15-107-MW012-C4	L1603922-20 CRREL GRAB CH15-107-MW012-C5	L1603922-21 CRREL GRAB CH15-107-MW012-C6
Grouping	Analyte					
SOIL						
Physical Tests	Grain Size Curve					SEE ATTACHED
	Moisture (%)	12.3	69.5	21.1	21.0	15.6
	Liquid Limit (LL) (%)					
	Plasticity Index (PI) (%)					
	Specific Gravity (kg/L)					
Particle Size	Gravel (4.75mm - 3in.) (%)					1.6
	Medium Sand (0.425mm - 2.0mm) (%)					27.9
	Coarse Sand (2.0mm - 4.75mm) (%)					21.5
	Fine Sand (0.075mm - 0.425mm) (%)					16.8
	Silt (0.005mm - 0.075mm) (%)					15.3
	Clay (<0.005mm) (%)					16.9
Organic / Inorganic Carbon	Organic Carbon (%)	0.90				
	Organic Matter (%)	1.57				

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1603922-22 CRREL GRAB CH15-107-MW012- C7	L1603922-23 CRREL GRAB CH15-107-MW012- C8	L1603922-24 CRREL GRAB CH15-107-MW012- C9	L1603922-25 CRREL GRAB CH15-107-MW012- C10	L1603922-26 CRREL GRAB CH15-107-MW012- C11
Grouping	Analyte					
SOIL						
Physical Tests	Grain Size Curve		SEE ATTACHED			
	Moisture (%)	25.4	15.8	15.3	14.3	17.3
	Liquid Limit (LL) (%)					
	Plasticity Index (PI) (%)					
	Specific Gravity (kg/L)					
Particle Size	Gravel (4.75mm - 3in.) (%)		15.7			
	Medium Sand (0.425mm - 2.0mm) (%)		21.4			
	Coarse Sand (2.0mm - 4.75mm) (%)		10.6			
	Fine Sand (0.075mm - 0.425mm) (%)		16.9			
	Silt (0.005mm - 0.075mm) (%)		17.4			
	Clay (<0.005mm) (%)		18.1			
Organic / Inorganic Carbon	Organic Carbon (%)					
	Organic Matter (%)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1603922-27 CRREL GRAB CH15-107-MW012-C12	L1603922-28 CRREL GRAB CH15-107-MW012-C13	L1603922-29 CRREL GRAB CH15-107-MW012-C14	L1603922-30 CRREL GRAB CH15-107-MW012-C15	L1603922-31 CRREL GRAB CH15-107-MW012-C16
Grouping	Analyte					
SOIL						
Physical Tests	Grain Size Curve	SEE ATTACHED 13.1	16.4	15.4	13.2	10.5
	Moisture (%)					
	Liquid Limit (LL) (%)					
	Plasticity Index (PI) (%)					
	Specific Gravity (kg/L)					
Particle Size	Gravel (4.75mm - 3in.) (%)	<1.0				
	Medium Sand (0.425mm - 2.0mm) (%)	16.7				
	Coarse Sand (2.0mm - 4.75mm) (%)	4.2				
	Fine Sand (0.075mm - 0.425mm) (%)	16.3				
	Silt (0.005mm - 0.075mm) (%)	25.9				
	Clay (<0.005mm) (%)	36.9				
Organic / Inorganic Carbon	Organic Carbon (%)					
	Organic Matter (%)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1603922-32 CRREL GRAB CH15-107-MW012- C17	L1603922-33 CRREL GRAB CH15-107-MW012- C18	L1603922-34 CRREL GRAB CH15-107-MW012- C19	L1603922-35 CRREL GRAB CH15-107-MW012- C20	L1603922-36 CRREL GRAB CH15-107-MW012- C21
Grouping	Analyte					
SOIL						
Physical Tests	Grain Size Curve					
	Moisture (%)	10.7	9.65	14.8	10.9	10.5
	Liquid Limit (LL) (%)					
	Plasticity Index (PI) (%)					
	Specific Gravity (kg/L)					
Particle Size	Gravel (4.75mm - 3in.) (%)					
	Medium Sand (0.425mm - 2.0mm) (%)					
	Coarse Sand (2.0mm - 4.75mm) (%)					
	Fine Sand (0.075mm - 0.425mm) (%)					
	Silt (0.005mm - 0.075mm) (%)					
	Clay (<0.005mm) (%)					
Organic / Inorganic Carbon	Organic Carbon (%)					
	Organic Matter (%)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1603922-37 CRREL GRAB CH15-107-MW012-C22	L1603922-38 CRREL GRAB CH15-107-MW012-C23	L1603922-39 GRAB CH15-107-MW012-G1	L1603922-40 SPT CH15-107-MW012-SPT1	L1603922-41 GRAB CH15-107-MW013-G1
Grouping	Analyte					
SOIL						
Physical Tests	Grain Size Curve	SEE ATTACHED 12.7	19.7	20.3	12.7	9.40
	Moisture (%)					
	Liquid Limit (LL) (%)					
	Plasticity Index (PI) (%)					
	Specific Gravity (kg/L)					
Particle Size	Gravel (4.75mm - 3in.) (%)	14.5				
	Medium Sand (0.425mm - 2.0mm) (%)	14.5				
	Coarse Sand (2.0mm - 4.75mm) (%)	12.3				
	Fine Sand (0.075mm - 0.425mm) (%)	12.5				
	Silt (0.005mm - 0.075mm) (%)	25.2				
	Clay (<0.005mm) (%)	21.0				
Organic / Inorganic Carbon	Organic Carbon (%)			3.10		
	Organic Matter (%)			5.42		

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1603922-42 GRAB CH15-107-MW013-G2	L1603922-43 GRAB CH15-107-MW013-G3	L1603922-44 GRAB CH15-107-MW013-G4	L1603922-45 GRAB CH15-107-MW013-G5	L1603922-46 GRAB CH15-107-MW013-G6
Grouping	Analyte					
SOIL						
Physical Tests	Grain Size Curve					
	Moisture (%)	6.38	8.62	6.96	6.71	9.02
	Liquid Limit (LL) (%)					
	Plasticity Index (PI) (%)					
	Specific Gravity (kg/L)					
Particle Size	Gravel (4.75mm - 3in.) (%)					
	Medium Sand (0.425mm - 2.0mm) (%)					
	Coarse Sand (2.0mm - 4.75mm) (%)					
	Fine Sand (0.075mm - 0.425mm) (%)					
	Silt (0.005mm - 0.075mm) (%)					
	Clay (<0.005mm) (%)					
Organic / Inorganic Carbon	Organic Carbon (%)					
	Organic Matter (%)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1603922-47 GRAB CH15-107-MW013-G7	L1603922-48 GRAB CH15-107-MW013-G8	L1603922-49 GRAB CH15-107-MW013-G9	L1603922-50 GRAB CH15-107-MW013-G10	L1603922-51 GRAB CH15-107-MW013-G11
Grouping	Analyte					
SOIL						
Physical Tests	Grain Size Curve		SEE ATTACHED			
	Moisture (%)	13.3	13.9	14.4	13.0	12.3
	Liquid Limit (LL) (%)		25			
	Plasticity Index (PI) (%)		8			
	Specific Gravity (kg/L)					
Particle Size	Gravel (4.75mm - 3in.) (%)		1.8			
	Medium Sand (0.425mm - 2.0mm) (%)		23.2			
	Coarse Sand (2.0mm - 4.75mm) (%)		14.0			
	Fine Sand (0.075mm - 0.425mm) (%)		18.0			
	Silt (0.005mm - 0.075mm) (%)		24.3			
	Clay (<0.005mm) (%)		18.7			
Organic / Inorganic Carbon	Organic Carbon (%)					
	Organic Matter (%)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1603922-52 GRAB CH15-107-MW013-G12	L1603922-53 GRAB CH15-107-MW013-G13	L1603922-54 GRAB CH15-107-MW013-G14	L1603922-55 GRAB CH15-107-MW013-G15	L1603922-56 GRAB CH15-107-MW013-G16
Grouping	Analyte					
SOIL						
Physical Tests	Grain Size Curve					
	Moisture (%)	11.1	10.8	11.1	12.9	11.8
	Liquid Limit (LL) (%)					
	Plasticity Index (PI) (%)					
	Specific Gravity (kg/L)					
Particle Size	Gravel (4.75mm - 3in.) (%)					
	Medium Sand (0.425mm - 2.0mm) (%)					
	Coarse Sand (2.0mm - 4.75mm) (%)					
	Fine Sand (0.075mm - 0.425mm) (%)					
	Silt (0.005mm - 0.075mm) (%)					
	Clay (<0.005mm) (%)					
Organic / Inorganic Carbon	Organic Carbon (%)					
	Organic Matter (%)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1603922-57 GRAB CH15-107-MW013- G17	L1603922-58 SPT CH15-107-MW013- SPT1	L1603922-59 SPT CH15-107-MW013- SPT2	L1603922-60 SPT CH15-107-MW013- SPT3	L1603922-61 SPT CH15-107-MW013- SPT4
Grouping	Analyte					
SOIL						
Physical Tests	Grain Size Curve					
	Moisture (%)	13.2	12.6	11.5	9.06	11.5
	Liquid Limit (LL) (%)					
	Plasticity Index (PI) (%)					
	Specific Gravity (kg/L)					
Particle Size	Gravel (4.75mm - 3in.) (%)					
	Medium Sand (0.425mm - 2.0mm) (%)					
	Coarse Sand (2.0mm - 4.75mm) (%)					
	Fine Sand (0.075mm - 0.425mm) (%)					
	Silt (0.005mm - 0.075mm) (%)					
	Clay (<0.005mm) (%)					
Organic / Inorganic Carbon	Organic Carbon (%)					
	Organic Matter (%)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1603922-62 SPT CH15-107-MW013-SPT5	L1603922-63 GRAB CH15-107-MW014-G1	L1603922-64 GRAB CH15-107-MW014-G2	L1603922-65 GRAB CH15-107-MW014-G3	L1603922-66 GRAB CH15-107-MW014-G4
Grouping	Analyte					
SOIL						
Physical Tests	Grain Size Curve					
	Moisture (%)	10.8	22.0	19.0	21.5	14.6
	Liquid Limit (LL) (%)					
	Plasticity Index (PI) (%)					
	Specific Gravity (kg/L)					
Particle Size	Gravel (4.75mm - 3in.) (%)					
	Medium Sand (0.425mm - 2.0mm) (%)					
	Coarse Sand (2.0mm - 4.75mm) (%)					
	Fine Sand (0.075mm - 0.425mm) (%)					
	Silt (0.005mm - 0.075mm) (%)					
	Clay (<0.005mm) (%)					
Organic / Inorganic Carbon	Organic Carbon (%)					
	Organic Matter (%)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1603922-67 GRAB CH15-107-MW014-G5	L1603922-68 GRAB CH15-107-MW014-G6	L1603922-69 GRAB CH15-107-MW014-G7	L1603922-70 GRAB CH15-107-MW014-G8	L1603922-71 GRAB CH15-107-MW014-G9
Grouping	Analyte					
SOIL						
Physical Tests	Grain Size Curve					
	Moisture (%)	22.5	11.6	10.4	17.4	9.20
	Liquid Limit (LL) (%)					
	Plasticity Index (PI) (%)					
	Specific Gravity (kg/L)					
Particle Size	Gravel (4.75mm - 3in.) (%)					
	Medium Sand (0.425mm - 2.0mm) (%)					
	Coarse Sand (2.0mm - 4.75mm) (%)					
	Fine Sand (0.075mm - 0.425mm) (%)					
	Silt (0.005mm - 0.075mm) (%)					
	Clay (<0.005mm) (%)					
Organic / Inorganic Carbon	Organic Carbon (%)					
	Organic Matter (%)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1603922-72 SPT CH15-107-MW014-SPT1	L1603922-73 SPT CH15-107-MW014-SPT2	L1603922-74 SPT CH15-107-MW014-SPT3	L1603922-75 SPT CH15-107-MW014-SPT4	L1603922-77 SPT CH15-107-MW014-SPT6
Grouping	Analyte					
SOIL						
Physical Tests	Grain Size Curve			SEE ATTACHED		
	Moisture (%)	17.4	15.7	20.6	17.0	15.5
	Liquid Limit (LL) (%)					
	Plasticity Index (PI) (%)					
	Specific Gravity (kg/L)					
Particle Size	Gravel (4.75mm - 3in.) (%)			12.2		
	Medium Sand (0.425mm - 2.0mm) (%)			16.9		
	Coarse Sand (2.0mm - 4.75mm) (%)			12.2		
	Fine Sand (0.075mm - 0.425mm) (%)			17.0		
	Silt (0.005mm - 0.075mm) (%)			23.7		
	Clay (<0.005mm) (%)			18.0		
Organic / Inorganic Carbon	Organic Carbon (%)					
	Organic Matter (%)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1603922-78 SPT CH15-107-MW014-SPT7	L1603922-79 SPT CH15-107-MW014-SPT8	L1603922-80 SPT CH15-107-MW014-SPT9	L1603922-81 SPT CH15-107-MW014-SPT10	L1603922-82 SPT CH15-107-MW014-SPT11
Grouping	Analyte					
SOIL						
Physical Tests	Grain Size Curve	SEE ATTACHED				SEE ATTACHED
	Moisture (%)	15.4	9.29	10.1	16.8	9.43
	Liquid Limit (LL) (%)					
	Plasticity Index (PI) (%)					
	Specific Gravity (kg/L)					
Particle Size	Gravel (4.75mm - 3in.) (%)	<1.0				1.2
	Medium Sand (0.425mm - 2.0mm) (%)	19.5				35.8
	Coarse Sand (2.0mm - 4.75mm) (%)	12.5				15.2
	Fine Sand (0.075mm - 0.425mm) (%)	16.3				20.8
	Silt (0.005mm - 0.075mm) (%)	30.7				17.8
	Clay (<0.005mm) (%)	20.9				9.3
Organic / Inorganic Carbon	Organic Carbon (%)					
	Organic Matter (%)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1603922-83 CRREL GRAB CH15-107-MW015- C1	L1603922-84 CRREL GRAB CH15-107-MW015- C2	L1603922-85 CRREL GRAB CH15-107-MW015- C3	L1603922-86 CRREL GRAB CH15-107-MW015- C4	L1603922-87 GRAB CH15-107-MW015- G1
Grouping	Analyte					
SOIL						
Physical Tests	Grain Size Curve		SEE ATTACHED		SEE ATTACHED	
	Moisture (%)	16.5	9.09	7.31	3.63	12.2
	Liquid Limit (LL) (%)		24			
	Plasticity Index (PI) (%)		6			
	Specific Gravity (kg/L)					
Particle Size	Gravel (4.75mm - 3in.) (%)		<1.0		16.6	
	Medium Sand (0.425mm - 2.0mm) (%)		22.3		24.2	
	Coarse Sand (2.0mm - 4.75mm) (%)		8.2		14.4	
	Fine Sand (0.075mm - 0.425mm) (%)		17.7		16.5	
	Silt (0.005mm - 0.075mm) (%)		32.6		18.7	
	Clay (<0.005mm) (%)		19.2		9.7	
Organic / Inorganic Carbon	Organic Carbon (%)		0.40			
	Organic Matter (%)		<0.70			

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1603922-88 GRAB CH15-107-MW015-G2	L1603922-89 GRAB CH15-107-MW015-G3	L1603922-90 GRAB CH15-107-MW015-G4	L1603922-91 GRAB CH15-107-MW015-G5	L1603922-92 SPT CH15-107-MW015-SPT1
Grouping	Analyte					
SOIL						
Physical Tests	Grain Size Curve					
	Moisture (%)	8.24	7.68	8.03	16.8	6.88
	Liquid Limit (LL) (%)					
	Plasticity Index (PI) (%)					
	Specific Gravity (kg/L)					
Particle Size	Gravel (4.75mm - 3in.) (%)					
	Medium Sand (0.425mm - 2.0mm) (%)					
	Coarse Sand (2.0mm - 4.75mm) (%)					
	Fine Sand (0.075mm - 0.425mm) (%)					
	Silt (0.005mm - 0.075mm) (%)					
	Clay (<0.005mm) (%)					
Organic / Inorganic Carbon	Organic Carbon (%)					
	Organic Matter (%)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1603922-93 SPT CH15-107-MW015-SPT2	L1603922-94 SPT CH15-107-MW015-SPT3	L1603922-95 SPT CH15-107-MW015-SPT5	L1603922-97 CRREL GRAB CH15-107-MW016-C1	L1603922-98 CRREL GRAB CH15-107-MW016-C2
Grouping	Analyte					
SOIL						
Physical Tests	Grain Size Curve	SEE ATTACHED				SEE ATTACHED
	Moisture (%)	7.65	9.00	17.4	49.0	42.8
	Liquid Limit (LL) (%)					
	Plasticity Index (PI) (%)					
	Specific Gravity (kg/L)					
Particle Size	Gravel (4.75mm - 3in.) (%)	46.6				<1.0
	Medium Sand (0.425mm - 2.0mm) (%)	11.6				3.0
	Coarse Sand (2.0mm - 4.75mm) (%)	8.3				<1.0
	Fine Sand (0.075mm - 0.425mm) (%)	10.2				12.7
	Silt (0.005mm - 0.075mm) (%)	12.1				59.2
	Clay (<0.005mm) (%)	11.2				25.1
Organic / Inorganic Carbon	Organic Carbon (%)					
	Organic Matter (%)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1603922-99 GRAB CH15-107-MW016-G1	L1603922-100 GRAB CH15-107-MW016-G2	L1603922-101 GRAB CH15-107-MW016-G3	L1603922-103 SPT CH15-107-MW016-SPT2	L1603922-104 SPT CH15-107-MW016-SPT3
Grouping	Analyte					
SOIL						
Physical Tests	Grain Size Curve					
	Moisture (%)	14.4	13.2	13.8	12.4	11.4
	Liquid Limit (LL) (%)					
	Plasticity Index (PI) (%)					
	Specific Gravity (kg/L)					
Particle Size	Gravel (4.75mm - 3in.) (%)					
	Medium Sand (0.425mm - 2.0mm) (%)					
	Coarse Sand (2.0mm - 4.75mm) (%)					
	Fine Sand (0.075mm - 0.425mm) (%)					
	Silt (0.005mm - 0.075mm) (%)					
	Clay (<0.005mm) (%)					
Organic / Inorganic Carbon	Organic Carbon (%)					
	Organic Matter (%)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1603922-105 SPT CH15-107-MW016-SPT4	L1603922-106 SPT CH15-107-MW016-SPT5	L1603922-107 SPT CH15-107-MW016-SPT6	L1603922-108 SPT CH15-107-MW016-SPT7	L1603922-109 SPT CH15-107-MW016-SPT8
Grouping	Analyte					
SOIL						
Physical Tests	Grain Size Curve		SEE ATTACHED			
	Moisture (%)	11.5	10.4	12.4	10.0	12.3
	Liquid Limit (LL) (%)		25			
	Plasticity Index (PI) (%)		10			
	Specific Gravity (kg/L)		1.95			
Particle Size	Gravel (4.75mm - 3in.) (%)		4.1			
	Medium Sand (0.425mm - 2.0mm) (%)		27.7			
	Coarse Sand (2.0mm - 4.75mm) (%)		5.7			
	Fine Sand (0.075mm - 0.425mm) (%)		17.2			
	Silt (0.005mm - 0.075mm) (%)		25.1			
	Clay (<0.005mm) (%)		20.3			
Organic / Inorganic Carbon	Organic Carbon (%)					
	Organic Matter (%)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1603922-110 SPT CH15-107-MW016-SPT9	L1603922-111 SPT CH15-107-MW016-SPT10	L1603922-112 CRREL GRAB CH15-107-MW017-C1	L1603922-113 CRREL GRAB CH15-107-MW017-C2	L1603922-114 CRREL GRAB CH15-107-MW017-C3
Grouping	Analyte					
SOIL						
Physical Tests	Grain Size Curve		SEE ATTACHED		SEE ATTACHED	
	Moisture (%)	12.1	15.2	22.1	56.2	18.0
	Liquid Limit (LL) (%)				44	
	Plasticity Index (PI) (%)				9	
	Specific Gravity (kg/L)					
Particle Size	Gravel (4.75mm - 3in.) (%)		37.7		5.7	
	Medium Sand (0.425mm - 2.0mm) (%)		12.7		24.3	
	Coarse Sand (2.0mm - 4.75mm) (%)		5.6		16.1	
	Fine Sand (0.075mm - 0.425mm) (%)		11.8		15.5	
	Silt (0.005mm - 0.075mm) (%)		17.9		24.3	
	Clay (<0.005mm) (%)		14.3		14.1	
Organic / Inorganic Carbon	Organic Carbon (%)			0.50	3.40	
	Organic Matter (%)			0.88	5.78	

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1603922-115 CRREL GRAB CH15-107-MW017- C4	L1603922-116 GRAB CH15-107-MW017- G1	L1603922-117 SPT CH15-107-MW017- SPT1	L1603922-118 SPT CH15-107-MW017- SPT2	L1603922-119 SPT CH15-107-MW017- SPT3
Grouping	Analyte					
SOIL						
Physical Tests	Grain Size Curve					SEE ATTACHED
	Moisture (%)	8.31	22.0	34.2	56.3	80.4
	Liquid Limit (LL) (%)					64
	Plasticity Index (PI) (%)					14
	Specific Gravity (kg/L)					
Particle Size	Gravel (4.75mm - 3in.) (%)					<1.0
	Medium Sand (0.425mm - 2.0mm) (%)					19.9
	Coarse Sand (2.0mm - 4.75mm) (%)					7.3
	Fine Sand (0.075mm - 0.425mm) (%)					14.0
	Silt (0.005mm - 0.075mm) (%)					44.8
	Clay (<0.005mm) (%)					13.4
Organic / Inorganic Carbon	Organic Carbon (%)					4.20
	Organic Matter (%)					7.19

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1603922-120 GRAB CH15-107-MW018-G1	L1603922-121 GRAB CH15-107-MW018-G2	L1603922-122 GRAB CH15-107-MW018-G3	L1603922-123 GRAB CH15-107-MW018-G4	L1603922-124 SPT CH15-107-MW018-SPT1
Grouping	Analyte					
SOIL						
Physical Tests	Grain Size Curve				SEE ATTACHED	
	Moisture (%)	17.1	8.32	7.70	9.52	10.9
	Liquid Limit (LL) (%)					
	Plasticity Index (PI) (%)					
	Specific Gravity (kg/L)					
Particle Size	Gravel (4.75mm - 3in.) (%)				28.3	
	Medium Sand (0.425mm - 2.0mm) (%)				24.3	
	Coarse Sand (2.0mm - 4.75mm) (%)				11.1	
	Fine Sand (0.075mm - 0.425mm) (%)				18.6	
	Silt (0.005mm - 0.075mm) (%)				10.5	
	Clay (<0.005mm) (%)				7.2	
Organic / Inorganic Carbon	Organic Carbon (%)					
	Organic Matter (%)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1603922-125 SPT CH15-107-MW018-SPT2	L1603922-126 SPT CH15-107-MW018-SPT3	L1603922-128 SPT CH15-107-MW018-SPT5	L1603922-129 SPT CH15-107-MW018-SPT6	L1603922-130 SPT CH15-107-MW018-SPT7
Grouping	Analyte					
SOIL						
Physical Tests	Grain Size Curve	SEE ATTACHED				SEE ATTACHED
	Moisture (%)	7.66	8.45	6.97	10.7	10.1
	Liquid Limit (LL) (%)					
	Plasticity Index (PI) (%)					
	Specific Gravity (kg/L)					
Particle Size	Gravel (4.75mm - 3in.) (%)	27.7				<1.0
	Medium Sand (0.425mm - 2.0mm) (%)	25.7				32.9
	Coarse Sand (2.0mm - 4.75mm) (%)	10.6				11.1
	Fine Sand (0.075mm - 0.425mm) (%)	20.4				24.6
	Silt (0.005mm - 0.075mm) (%)	8.6				18.4
	Clay (<0.005mm) (%)	7.1				12.3
Organic / Inorganic Carbon	Organic Carbon (%)					
	Organic Matter (%)					

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1603922-131 SPT CH15-107-MW018-SPT8				
Grouping	Analyte					
SOIL						
Physical Tests	Grain Size Curve	15.4				
	Moisture (%)					
	Liquid Limit (LL) (%)					
	Plasticity Index (PI) (%)					
	Specific Gravity (kg/L)					
Particle Size	Gravel (4.75mm - 3in.) (%)					
	Medium Sand (0.425mm - 2.0mm) (%)					
	Coarse Sand (2.0mm - 4.75mm) (%)					
	Fine Sand (0.075mm - 0.425mm) (%)					
	Silt (0.005mm - 0.075mm) (%)					
	Clay (<0.005mm) (%)					
Organic / Inorganic Carbon	Organic Carbon (%)					
	Organic Matter (%)					

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ATTERBERG-SK	Soil	Atterberg limits	CARTER CSSS 58
The liquid limit (or upper plastic limit) is the point at which the soil becomes semifluid, like softened butter. In operational terms, the liquid limit is defined as the water content at which a trapezoidal groove cut in moist soil is closed after 25 taps on a hard rubber plate (ASTM D-18, 1958). The plastic limit (or lower plastic limit) is defined as the water content at which soil begins to crumble on being rolled into a thread 1/8 inch (or 3 mm) in diameter. It represents the lowest water content at which soil can be deformed readily without cracking. The plastic index (which is the difference between the liquid and plastic limits) gives an indication of the "clayeyiness" or plasticity of a clay and is employed in engineering classification systems for soils. References: McKeague, J.A. 1978. Atterberg Limits pp 50 - 55 In: Soil Sampling and Methods of Analysis. Can. Soc. Soil Sci. p. 50 - 55			
C-TOT-ORG-WB-SK	Soil	Total Organic Carbon - Walkley Black	CSSS (1993) method 21.2
The soil sample is treated with excess potassium dichromate and sulfuric acid to oxidize organic carbon. Oxidized organic carbon is determined by back-titration with ferrous ammonium sulfate. Organic matter is estimated from the organic carbon result using the Van Bemmelen factor.			
GRAIN SIZE-HYD-SK	Soil	Grain Size by Hydrometer	ASTM D422-63
Particle size curve is generated from dry sieving (particles > 2 mm), wet sieving (particles 2 mm-75 um and hydrometer readings (particles < 75 um)			
MOISTURE-VA	Soil	Moisture content	ASTM D2974-00 Method A
This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.			
SPECGRAV-CL	Soil	Specific Gravity	ASTM D 5057 - 90
A portion of air-dried sample is weighed in a container that is calibrated for volume. Specific Gravity is reported as the mass of sample per mass of an equal volume of pure water, where the density of pure water is taken to be 1.00 g/mL.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

1	2	3	4
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GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L1603922

Report Date: 08-MAY-15

Page 2 of 3

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MOISTURE-VA		Soil						
Batch	R3184074							
WG2080955-1	MB							
Moisture			<0.25		%		0.25	01-MAY-15
Batch	R3184090							
WG2080860-3	DUP	L1603922-35						
Moisture		10.9	9.86		%	9.6	20	01-MAY-15
WG2080860-2	LCS							
Moisture			99.9		%		90-110	01-MAY-15
WG2080860-1	MB							
Moisture			<0.25		%		0.25	01-MAY-15
Batch	R3184408							
WG2081978-3	DUP	L1603922-70						
Moisture		17.4	17.5		%	0.3	20	04-MAY-15
WG2081978-2	LCS							
Moisture			97.1		%		90-110	04-MAY-15
WG2081978-1	MB							
Moisture			<0.25		%		0.25	04-MAY-15
Batch	R3184448							
WG2082016-2	LCS							
Moisture			100.4		%		90-110	04-MAY-15
WG2082016-1	MB							
Moisture			<0.25		%		0.25	04-MAY-15
Batch	R3184455							
WG2082061-3	DUP	L1603922-89						
Moisture		7.68	7.71		%	0.5	20	04-MAY-15
WG2082061-2	LCS							
Moisture			99.8		%		90-110	04-MAY-15
WG2082061-1	MB							
Moisture			<0.25		%		0.25	04-MAY-15
SPECGRAV-CL		Soil						
Batch	R3186946							
WG2084963-2	DUP	L1603922-106						
Specific Gravity		1.95	1.95		kg/L	0.0	20	08-MAY-15
WG2084963-1	IRM	DI_H2O						
Specific Gravity			100.0		%		90-110	08-MAY-15

Quality Control Report

Workorder: L1603922

Report Date: 08-MAY-15

Page 3 of 3

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS Laboratory Group

819-58th Street, Saskatoon,SK

PARTICLE SIZE DISTRIBUTION CURVE

Client Name: BGC ENGINEERING INC.

Project Number:

Client Sample ID CH15-107-MW011-SPT3

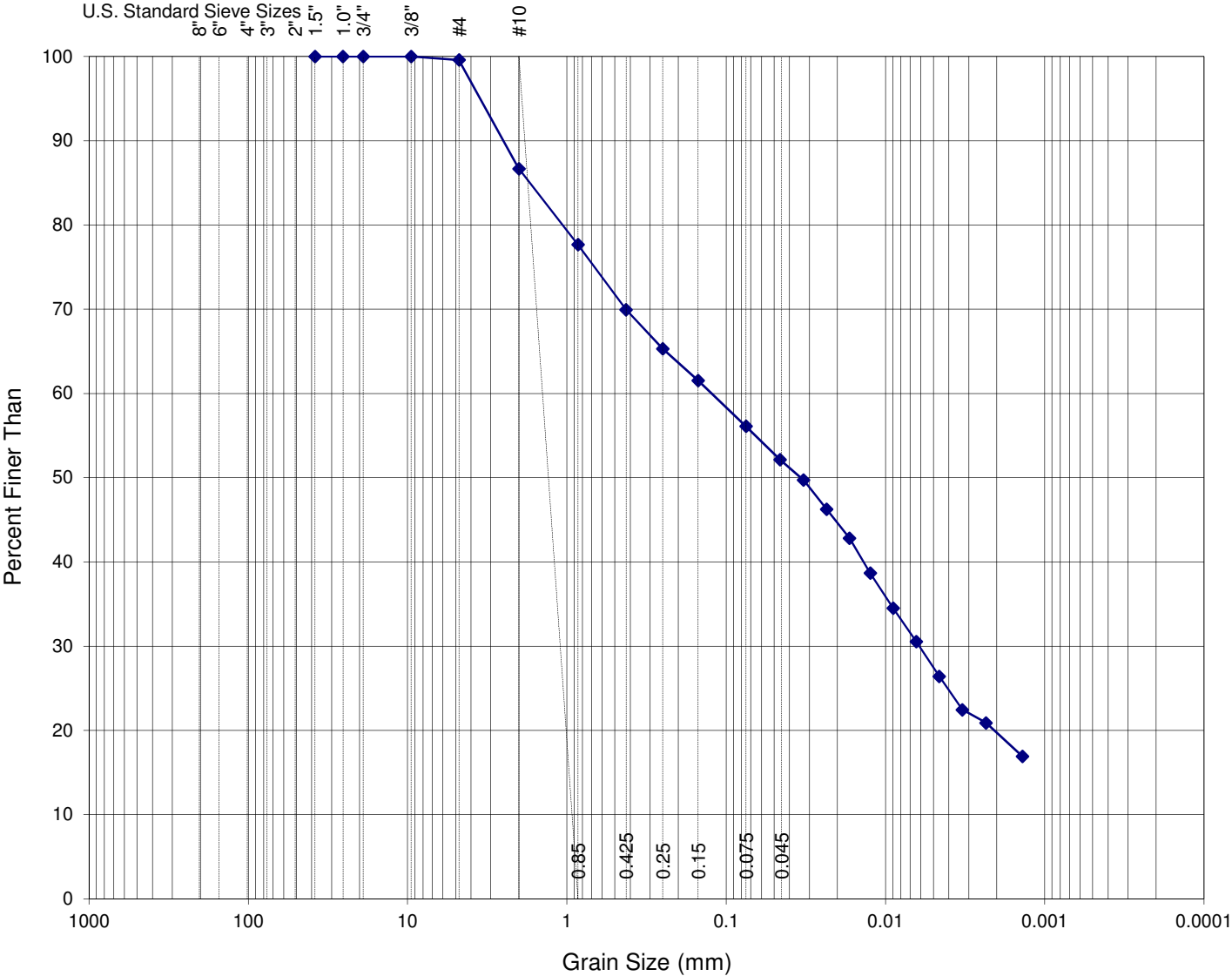
Lab Sample ID L1603922-10

Date Sample Received 27-Apr-15

Test Completion Date: 07-May-15

Analyst: SHC

BOULDERS	COBBLES	GRAVEL		SAND SIZES			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		



METHOD DESCRIPTION		SUMMARY OF RESULTS		
Method Reference: ASTM D 422 - 63 (2002)		GRAIN SIZE	WT %	DIA. RANGE (mm)
Dispersion method: Mechanical		% GRAVEL :	<1	> 4.75
Dispersion period: 1 minute		% COARSE SAND :	12.90	2.0 - 4.75
Soil classification system used: ASTM D422-63 Classification		% MEDIUM SAND :	16.75	0.425 - 2.0
DESCRIPTION OF SAND AND GRAVEL PARTICLES		% FINE SAND :	13.83	0.075 - 0.425
Shape: Angular		% SILT :	28.63	0.075 - 0.005
Hardness: Hard		% CLAY :	27.47	< 0.005

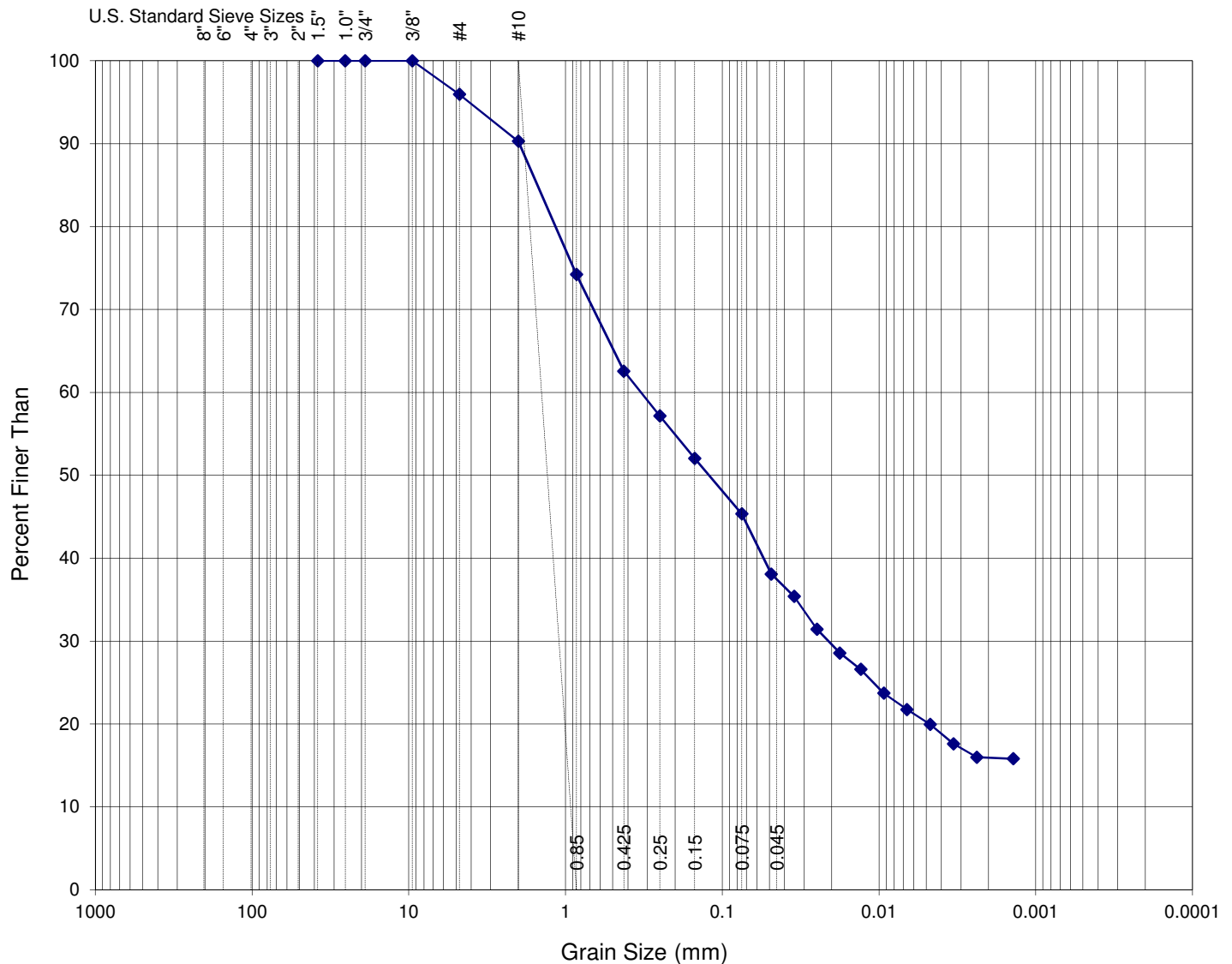
ALS Laboratory Group

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PARTICLE SIZE DISTRIBUTION CURVE

Client Name: BGC ENGINEERING INC.
Project Number:
Client Sample ID CH15-107-MW016-SPT5
Lab Sample ID L1603922-106
Date Sample Received 27-Apr-15
Test Completion Date: 07-May-15
Analyst: SHC

BOULDERS	COBBLES	GRAVEL		SAND SIZES			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		



METHOD DESCRIPTION

Method Reference: ASTM D 422 - 63 (2002)

Dispersion method: Mechanical

Dispersion period: 1 minute cm/s

Soil classification system used: ASTM D422-63 Classification

DESCRIPTION OF SAND AND GRAVEL PARTICLES

Shape: Angular

Hardness: Hard

SUMMARY OF RESULTS

GRAIN SIZE	WT %	DIA. RANGE (mm)
% GRAVEL :	4.06	> 4.75
% COARSE SAND :	5.65	2.0 - 4.75
% MEDIUM SAND :	27.74	0.425 - 2.0
% FINE SAND :	17.20	0.075 - 0.425
% SILT :	25.09	0.075 - 0.005
% CLAY :	20.26	< 0.005

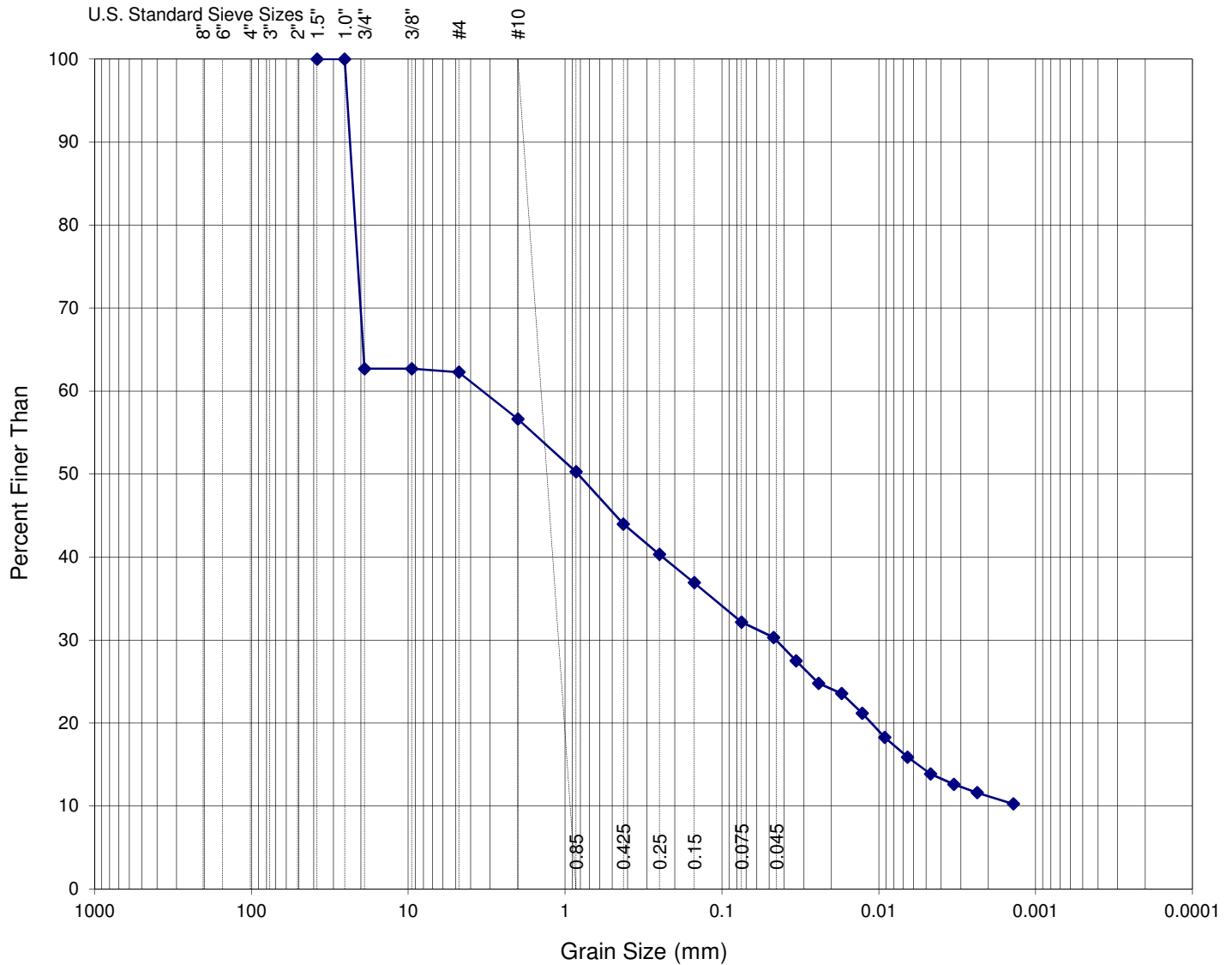
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PARTICLE SIZE DISTRIBUTION CURVE

Client Name: BGC ENGINEERING INC.
Project Number:
Client Sample ID CH15-107-MW016-SPT10
Lab Sample ID L1603922-111
Date Sample Received 27-Apr-15
Test Completion Date: 07-May-15
Analyst: SHC

BOULDERS	COBBLES	GRAVEL		SAND SIZES			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		



METHOD DESCRIPTION

Method Reference: ASTM D 422 - 63 (2002)

Dispersion method: Mechanical

Dispersion period: 1 minute cm/s

Soil classification system used: ASTM D422-63 Classification

DESCRIPTION OF SAND AND GRAVEL PARTICLES

Shape: Angular

Hardness: Hard

SUMMARY OF RESULTS

GRAIN SIZE	WT %	DIA. RANGE (mm)
% GRAVEL :	37.73	> 4.75
% COARSE SAND :	5.63	2.0 - 4.75
% MEDIUM SAND :	12.67	0.425 - 2.0
% FINE SAND :	11.80	0.075 - 0.425
% SILT :	17.90	0.075 - 0.005
% CLAY :	14.27	< 0.005

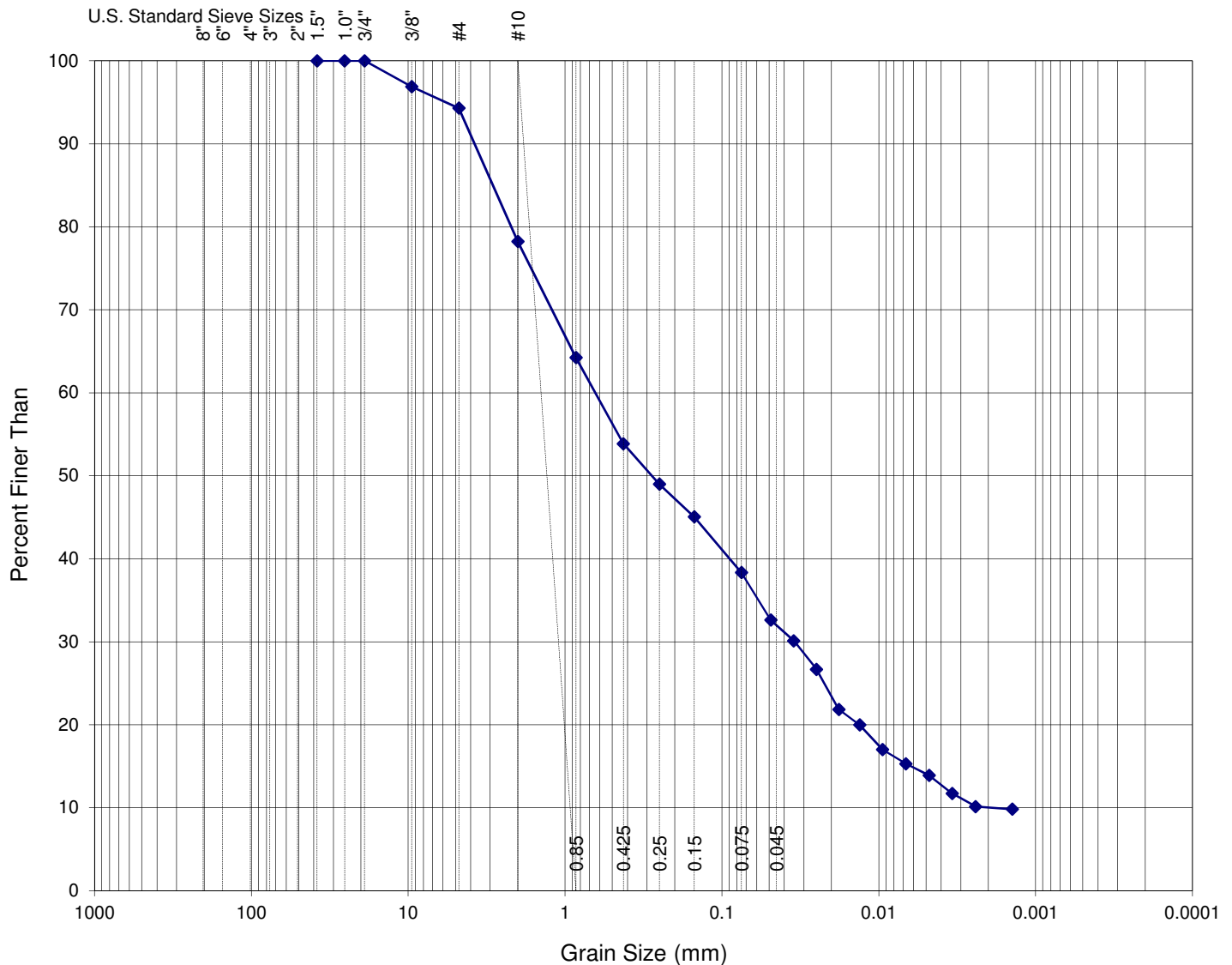
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PARTICLE SIZE DISTRIBUTION CURVE

Client Name: BGC ENGINEERING INC.
Project Number:
Client Sample ID CH15-107-MW017-C2
Lab Sample ID L1603922-113
Date Sample Received 27-Apr-15
Test Completion Date: 07-May-15
Analyst: SHC

BOULDERS	COBBLES	GRAVEL		SAND SIZES			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		



METHOD DESCRIPTION

Method Reference: ASTM D 422 - 63 (2002)

Dispersion method: Mechanical

Dispersion period: 1 minute cm/s

Soil classification system used: ASTM D422-63 Classification

DESCRIPTION OF SAND AND GRAVEL PARTICLES

Shape: Angular

Hardness: Hard

SUMMARY OF RESULTS

GRAIN SIZE	WT %	DIA. RANGE (mm)
% GRAVEL :	5.71	> 4.75
% COARSE SAND :	16.09	2.0 - 4.75
% MEDIUM SAND :	24.34	0.425 - 2.0
% FINE SAND :	15.53	0.075 - 0.425
% SILT :	24.25	0.075 - 0.005
% CLAY :	14.09	< 0.005

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Client Name:	BGC ENGINEERING INC.
Project Number:	
Client Sample ID	CH15-107-MW017-SPT3
Lab Sample ID	L1603922-119
Date Sample Received	27-Apr-15
Test Completion Date:	07-May-15
Analyst:	SHC

% GRAVEL :	<1	> 4.75
% COARSE SAND :	7.33	2.0 - 4.75
% MEDIUM SAND :	19.89	0.425 - 2.0
% FINE SAND :	14.01	0.075 - 0.425
% SILT :	44.80	0.075 - 0.005
% CLAY :	13.37	< 0.005

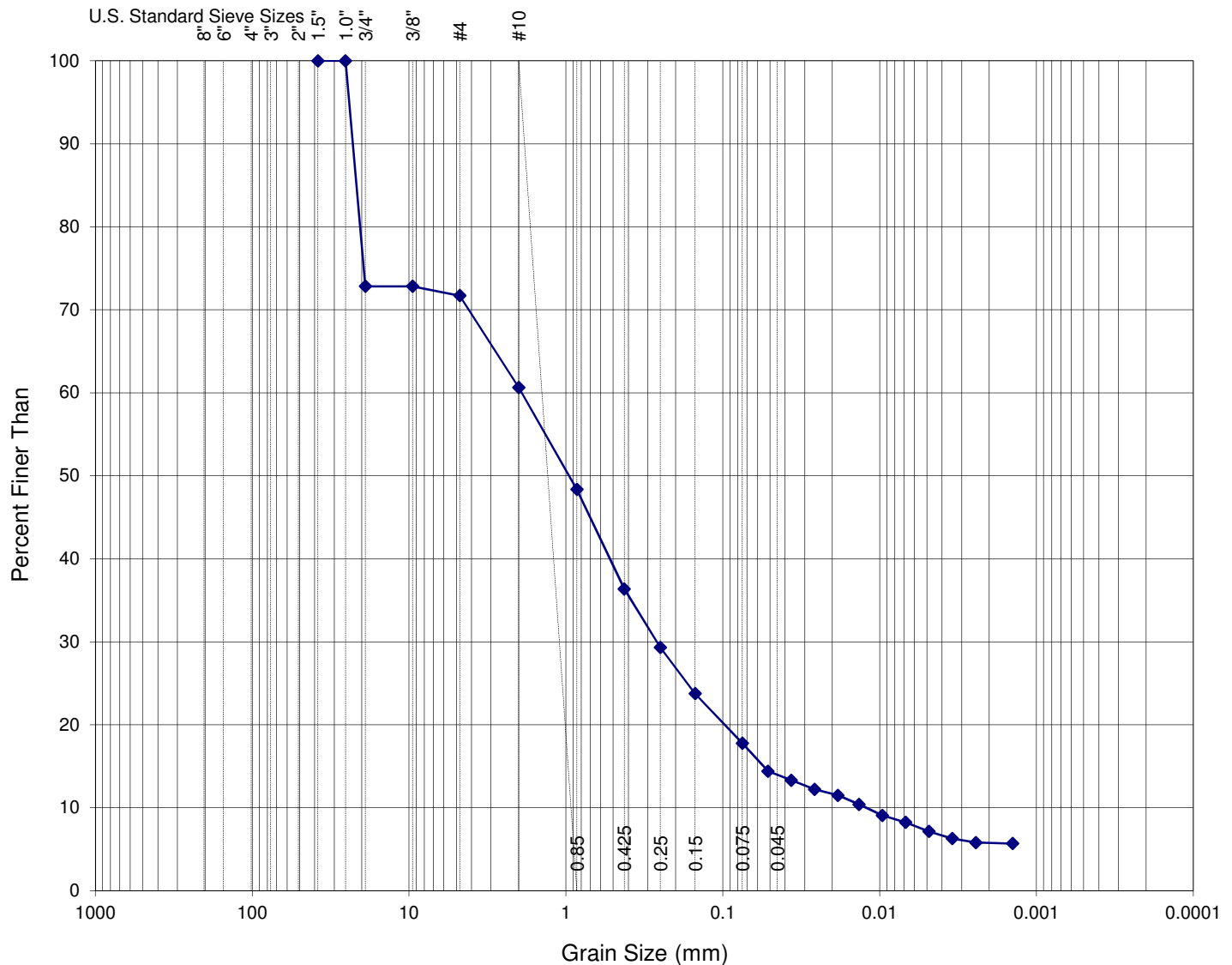
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PARTICLE SIZE DISTRIBUTION CURVE

Client Name: BGC ENGINEERING INC.
Project Number:
Client Sample ID CH15-107-MW018-G4
Lab Sample ID L1603922-123
Date Sample Received 27-Apr-15
Test Completion Date: 07-May-15
Analyst: SHC

BOULDERS	COBBLES	GRAVEL		SAND SIZES			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		



METHOD DESCRIPTION

Method Reference: ASTM D 422 - 63 (2002)

Dispersion method: Mechanical

Dispersion period: 1 minute cm/s

Soil classification system used: ASTM D422-63 Classification

DESCRIPTION OF SAND AND GRAVEL PARTICLES

Shape: Angular

Hardness: Hard

SUMMARY OF RESULTS

GRAIN SIZE	WT %	DIA. RANGE (mm)
% GRAVEL :	28.29	> 4.75
% COARSE SAND :	11.07	2.0 - 4.75
% MEDIUM SAND :	24.27	0.425 - 2.0
% FINE SAND :	18.60	0.075 - 0.425
% SILT :	10.53	0.075 - 0.005
% CLAY :	7.24	< 0.005

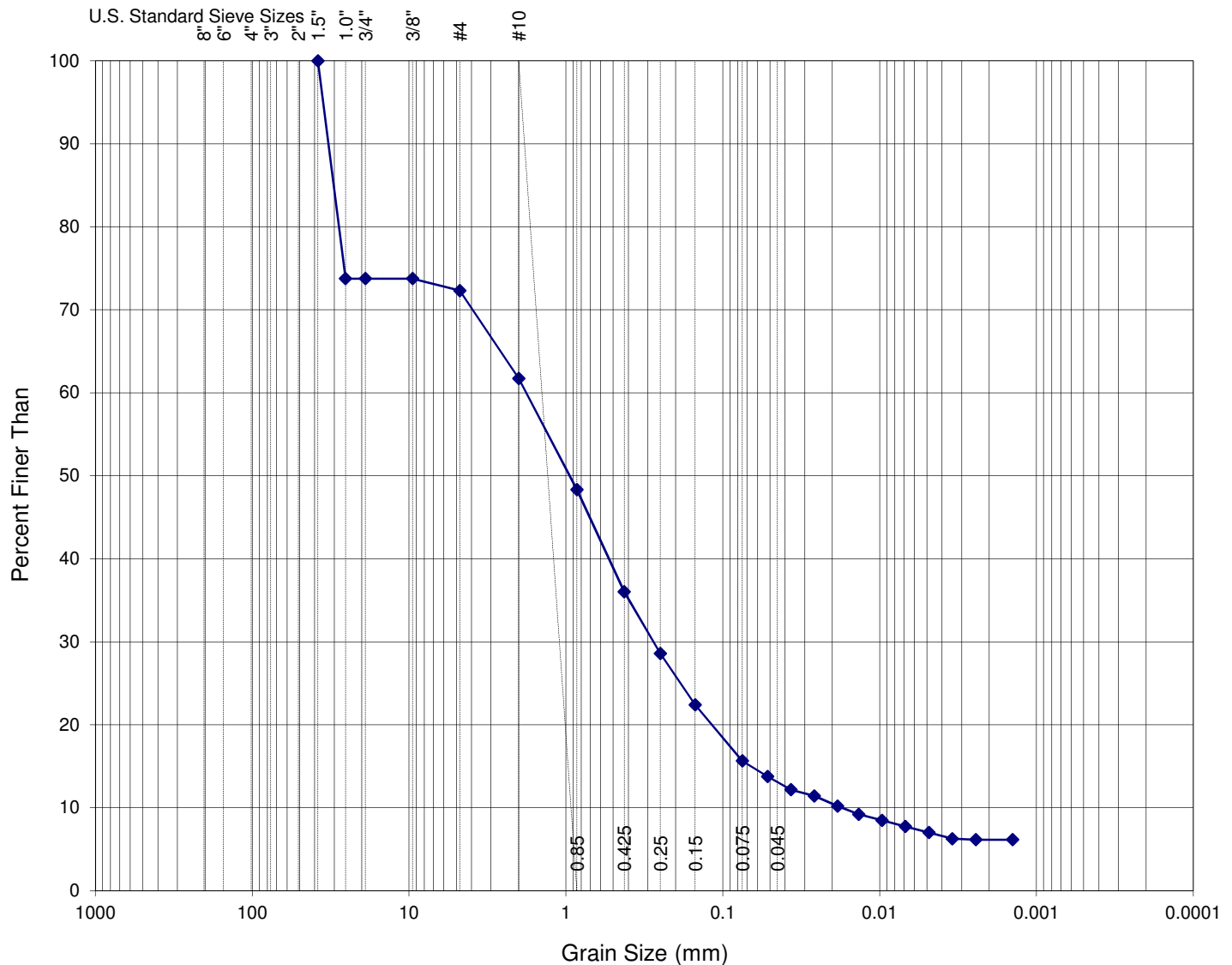
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PARTICLE SIZE DISTRIBUTION CURVE

Client Name: BGC ENGINEERING INC.
Project Number:
Client Sample ID CH15-107-MW018-SPT2
Lab Sample ID L1603922-125
Date Sample Received 27-Apr-15
Test Completion Date: 07-May-15
Analyst: SHC

BOULDERS	COBBLES	GRAVEL		SAND SIZES			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		



METHOD DESCRIPTION

Method Reference: ASTM D 422 - 63 (2002)

Dispersion method: Mechanical

Dispersion period: 1 minute cm/s

Soil classification system used: ASTM D422-63 Classification

DESCRIPTION OF SAND AND GRAVEL PARTICLES

Shape: Angular

Hardness: Hard

SUMMARY OF RESULTS

GRAIN SIZE	WT %	DIA. RANGE (mm)
% GRAVEL :	27.68	> 4.75
% COARSE SAND :	10.60	2.0 - 4.75
% MEDIUM SAND :	25.71	0.425 - 2.0
% FINE SAND :	20.37	0.075 - 0.425
% SILT :	8.58	0.075 - 0.005
% CLAY :	7.07	< 0.005

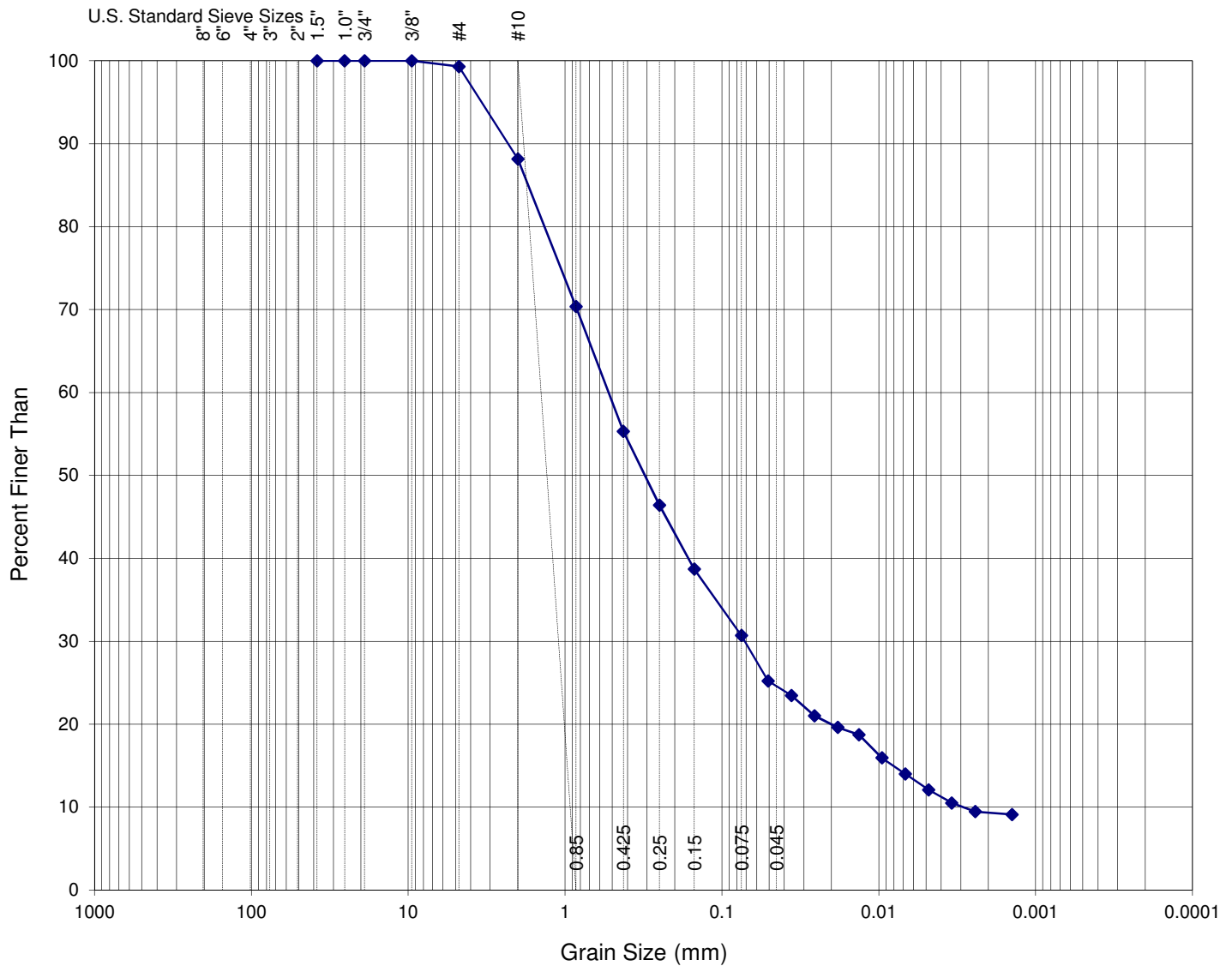
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PARTICLE SIZE DISTRIBUTION CURVE

Client Name: BGC ENGINEERING INC.
Project Number:
Client Sample ID CH15-107-MW018-SPT7
Lab Sample ID L1603922-130
Date Sample Received 27-Apr-15
Test Completion Date: 07-May-15
Analyst: SHC

BOULDERS	COBBLES	GRAVEL		SAND SIZES			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		



METHOD DESCRIPTION

Method Reference: ASTM D 422 - 63 (2002)

Dispersion method: Mechanical

Dispersion period: 1 minute cm/s

Soil classification system used: ASTM D422-63 Classification

DESCRIPTION OF SAND AND GRAVEL PARTICLES

Shape: Angular

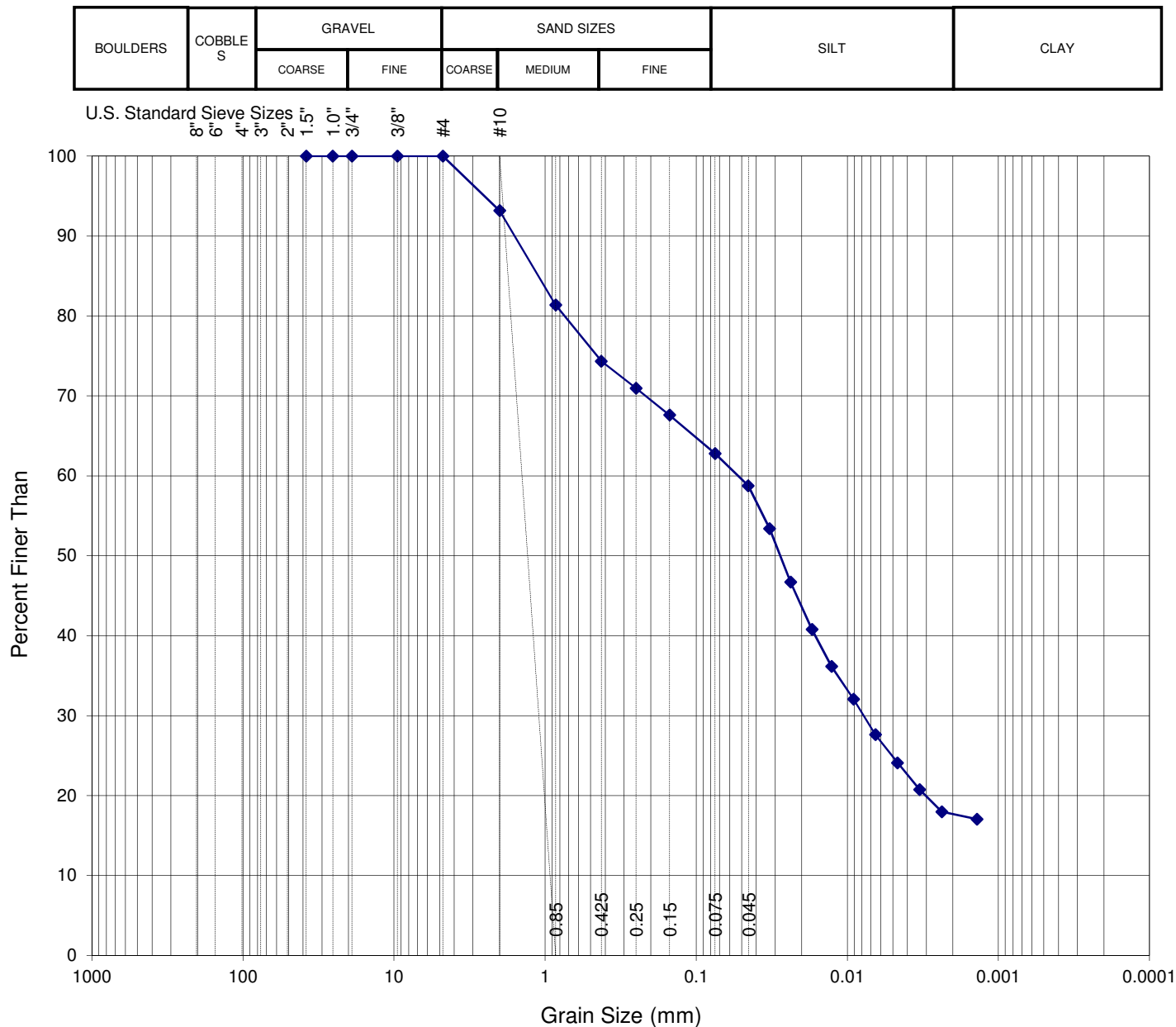
Hardness: Hard

SUMMARY OF RESULTS

GRAIN SIZE	WT %	DIA. RANGE (mm)
% GRAVEL :	<1	> 4.75
% COARSE SAND :	11.14	2.0 - 4.75
% MEDIUM SAND :	32.85	0.425 - 2.0
% FINE SAND :	24.60	0.075 - 0.425
% SILT :	18.40	0.075 - 0.005
% CLAY :	12.30	< 0.005

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Client Name:	BGC ENGINEERING INC.
Project Number:	
Client Sample ID	CH15-107-MW011-SPT7
Lab Sample ID	L1603922-14
Date Sample Received	27-Apr-15
Test Completion Date:	07-May-15
Analyst:	SHC



METHOD DESCRIPTION

Method Reference: ASTM D 422 - 63 (2002)

Dispersion method: Mechanical

Dispersion period: 1 minute cm/s

Soil classification system used: ASTM D422-63 Classification

DESCRIPTION OF SAND AND GRAVEL PARTICLES

Shape: Angular

Hardness: Hard

SUMMARY OF RESULTS

GRAIN SIZE	WT %	DIA. RANGE (mm)
% GRAVEL :	<1	> 4.75
% COARSE SAND :	6.83	2.0 - 4.75
% MEDIUM SAND :	18.84	0.425 - 2.0
% FINE SAND :	11.54	0.075 - 0.425
% SILT :	37.95	0.075 - 0.005
% CLAY :	24.85	< 0.005

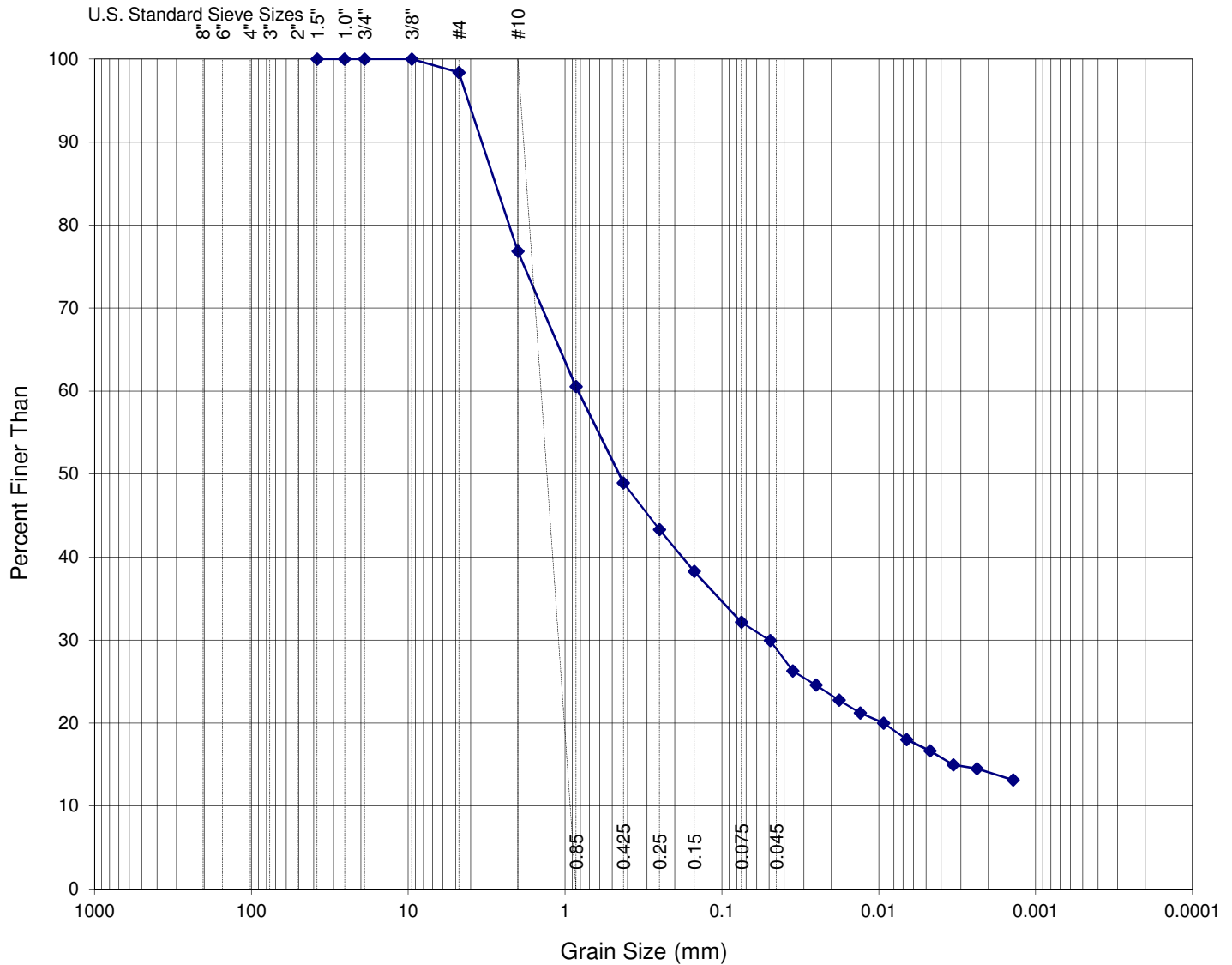
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PARTICLE SIZE DISTRIBUTION CURVE

Client Name: BGC ENGINEERING INC.
Project Number:
Client Sample ID CH15-107-MW012-C6
Lab Sample ID L1603922-21
Date Sample Received 27-Apr-15
Test Completion Date: 07-May-15
Analyst: SHC

BOULDERS	COBBLES	GRAVEL		SAND SIZES			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		



METHOD DESCRIPTION

Method Reference: ASTM D 422 - 63 (2002)

Dispersion method: Mechanical

Dispersion period: 1 minute cm/s

Soil classification system used: ASTM D422-63 Classification

DESCRIPTION OF SAND AND GRAVEL PARTICLES

Shape: Angular

Hardness: Hard

SUMMARY OF RESULTS

GRAIN SIZE	WT %	DIA. RANGE (mm)
% GRAVEL :	1.63	> 4.75
% COARSE SAND :	21.54	2.0 - 4.75
% MEDIUM SAND :	27.90	0.425 - 2.0
% FINE SAND :	16.78	0.075 - 0.425
% SILT :	15.26	0.075 - 0.005
% CLAY :	16.88	< 0.005

ALS Laboratory Group

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PARTICLE SIZE DISTRIBUTION CURVE

Client Name: BGC ENGINEERING INC.

Project Number:

Client Sample ID CH15-107-MW012-C8

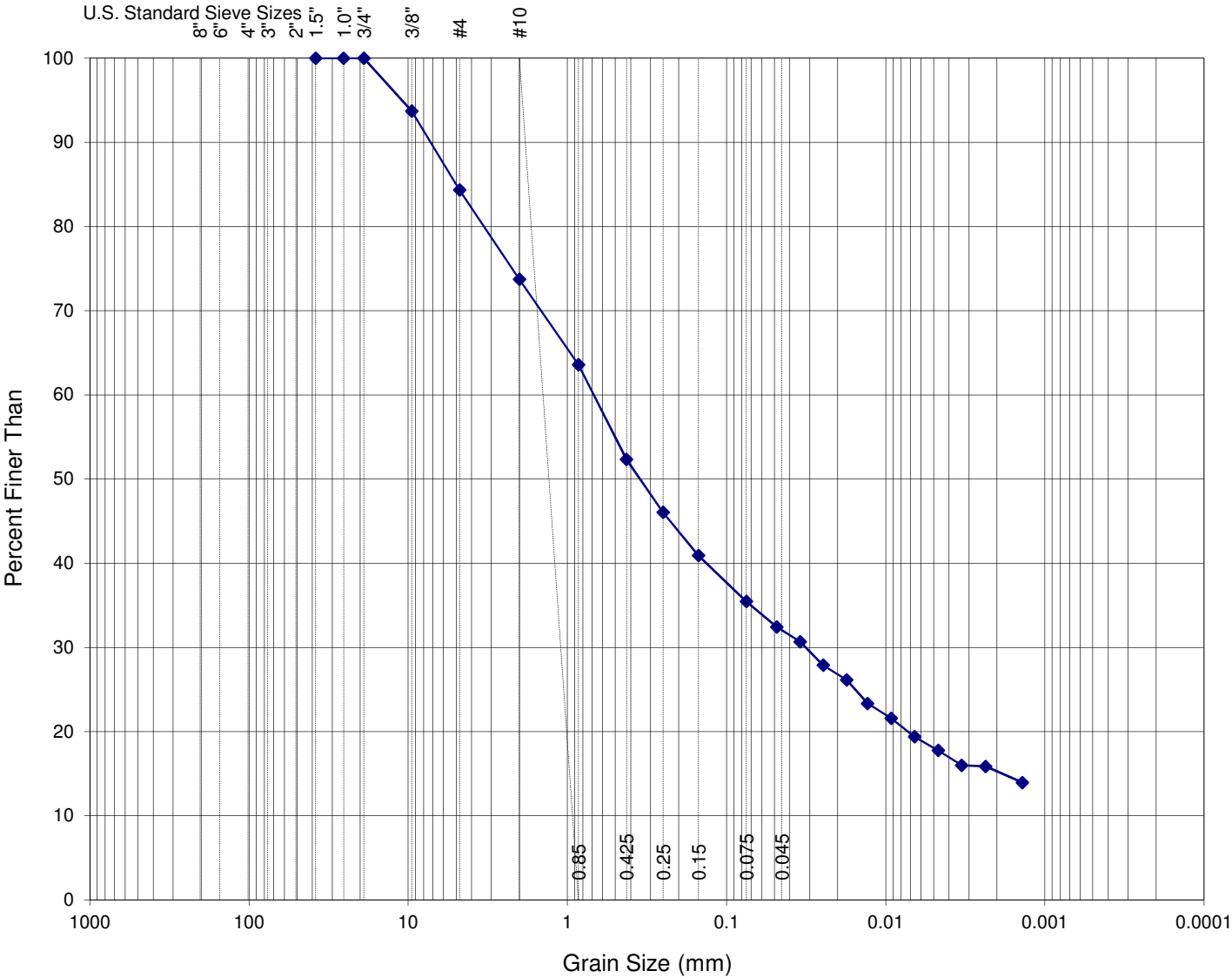
Lab Sample ID L1603922-23

Date Sample Received 27-Apr-15

Test Completion Date: 07-May-15

Analyst: SHC

BOULDERS	COBBLES	GRAVEL		SAND SIZES			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		



METHOD DESCRIPTION		SUMMARY OF RESULTS		
Method Reference: ASTM D 422 - 63 (2002)		GRAIN SIZE	WT %	DIA. RANGE (mm)
Dispersion method: Mechanical		% GRAVEL :	15.67	> 4.75
Dispersion period: 1 minute		% COARSE SAND :	10.61	2.0 - 4.75
Soil classification system used: ASTM D422-63 Classification		% MEDIUM SAND :	21.39	0.425 - 2.0
		% FINE SAND :	16.87	0.075 - 0.425
DESCRIPTION OF SAND AND GRAVEL PARTICLES		% SILT :	17.37	0.075 - 0.005
Shape: Angular		% CLAY :	18.07	< 0.005
Hardness: Hard				

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819-58th Street, Saskatoon,SK

PARTICLE SIZE DISTRIBUTION CURVE

Client Name: BGC ENGINEERING INC.

Project Number:

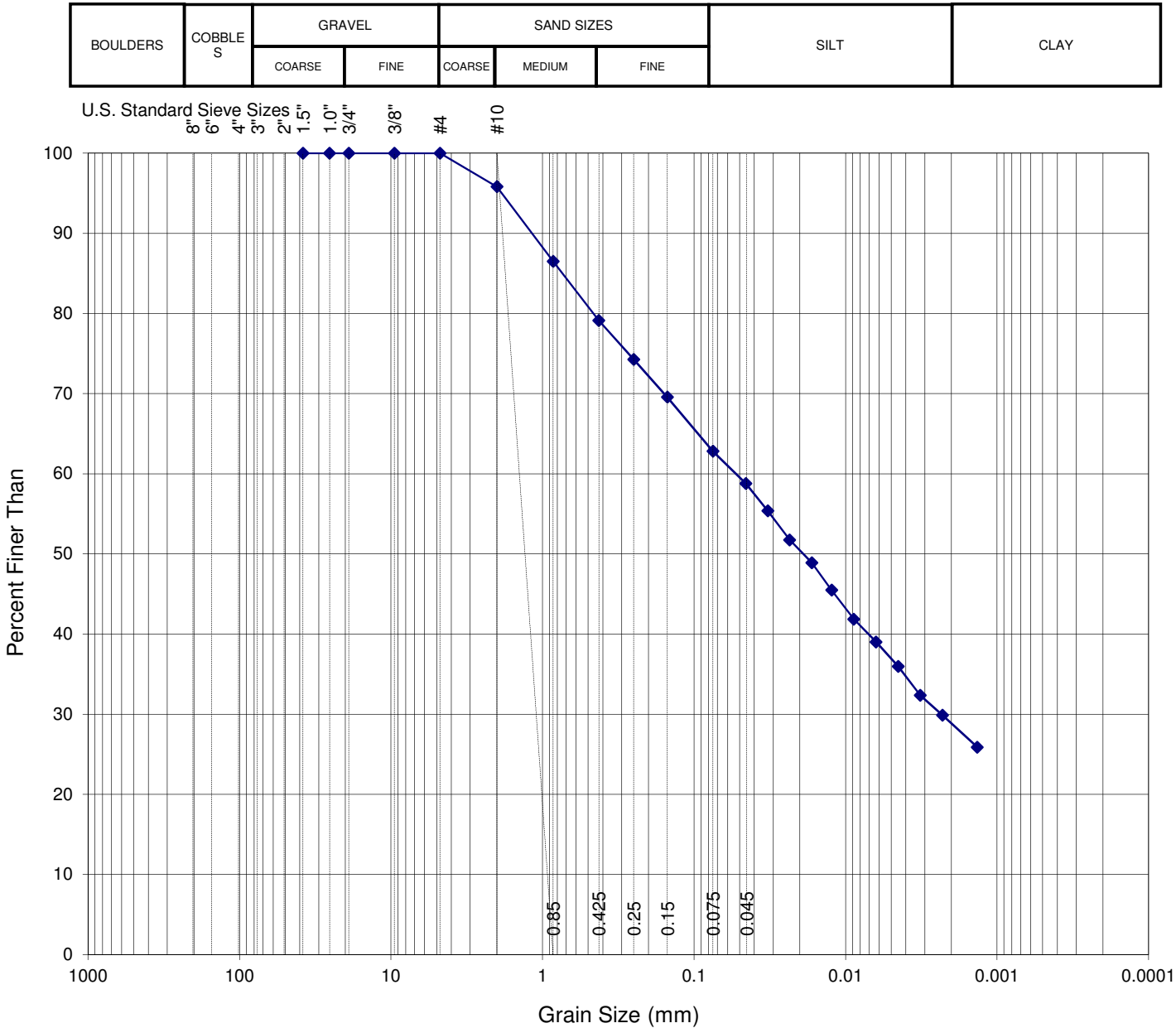
Client Sample ID CH15-107-MW012-C12

Lab Sample ID L1603922-27

Date Sample Received 27-Apr-15

Test Completion Date: 07-May-15

Analyst: SHC

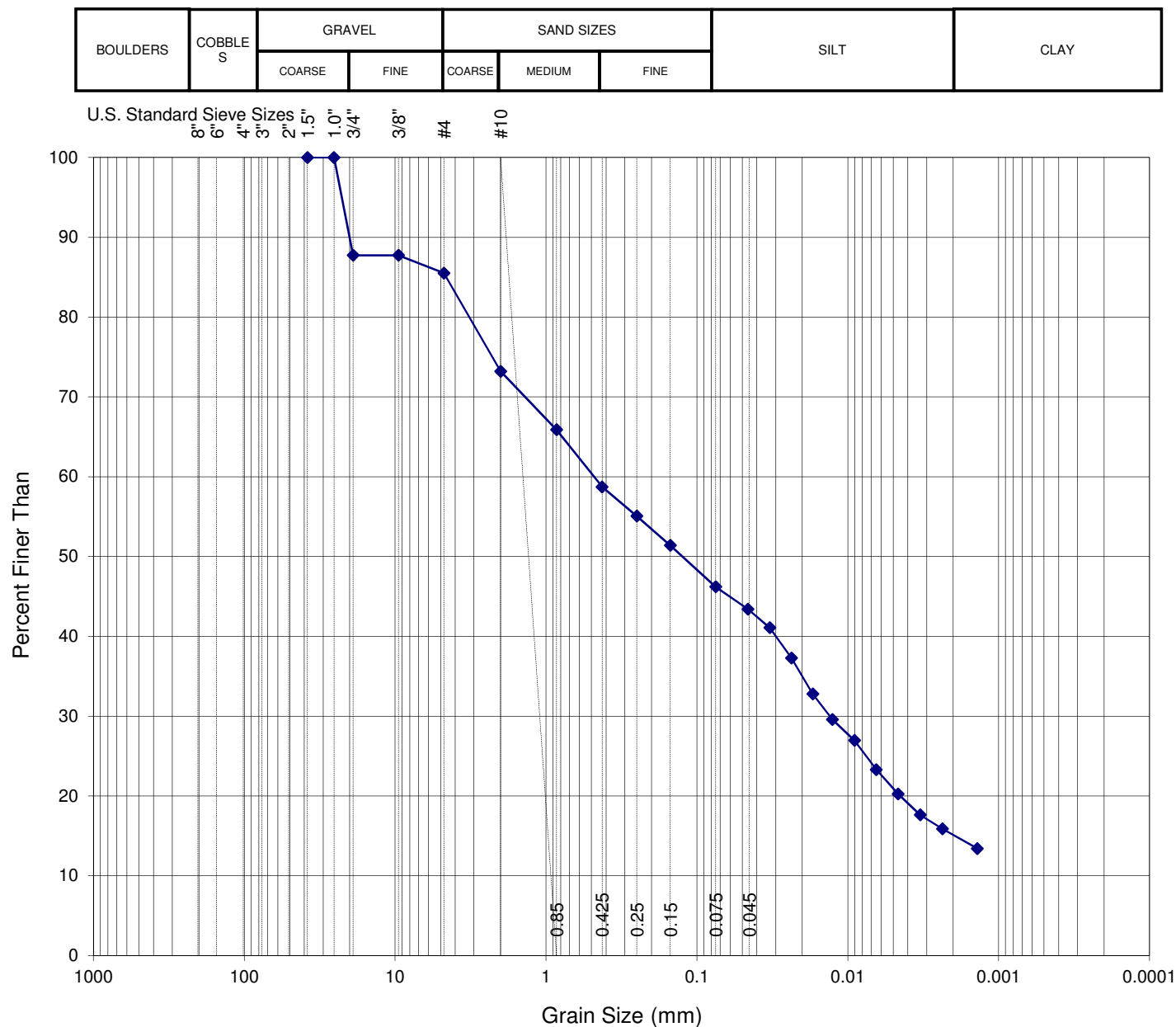


METHOD DESCRIPTION		SUMMARY OF RESULTS		
Method Reference: ASTM D 422 - 63 (2002)		GRAIN SIZE	WT %	DIA. RANGE (mm)
Dispersion method: Mechanical		% GRAVEL :	<1	> 4.75
Dispersion period: 1 minute		% COARSE SAND :	4.18	2.0 - 4.75
Soil classification system used: ASTM D422-63 Classification		% MEDIUM SAND :	16.70	0.425 - 2.0
DESCRIPTION OF SAND AND GRAVEL PARTICLES		% FINE SAND :	16.30	0.075 - 0.425
Shape: Angular		% SILT :	25.88	0.075 - 0.005
Hardness: Hard		% CLAY :	36.93	< 0.005

819-58th Street, Saskatoon,SK

PARTICLE SIZE DISTRIBUTION CURVE

Client Name:	BGC ENGINEERING INC.
Project Number:	
Client Sample ID	CH15-107-MW012-C22
Lab Sample ID	L1603922-37
Date Sample Received	27-Apr-15
Test Completion Date:	07-May-15
Analyst:	SHC



METHOD DESCRIPTION

Method Reference: ASTM D 422 - 63 (2002)

Dispersion method: Mechanical

Dispersion period: 1 minute cm/s

Soil classification system used: ASTM D422-63 Classification

DESCRIPTION OF SAND AND GRAVEL PARTICLES

Shape: Angular

Hardness: Hard

SUMMARY OF RESULTS

GRAIN SIZE	WT %	DIA. RANGE (mm)
% GRAVEL :	14.49	> 4.75
% COARSE SAND :	12.30	2.0 - 4.75
% MEDIUM SAND :	14.49	0.425 - 2.0
% FINE SAND :	12.52	0.075 - 0.425
% SILT :	25.24	0.075 - 0.005
% CLAY :	20.95	< 0.005

ALS Laboratory Group

819-58th Street, Saskatoon,SK

Client Name: BGC ENGINEERING INC.

Project Number:

Client Sample ID CH15-107-MW013-G8

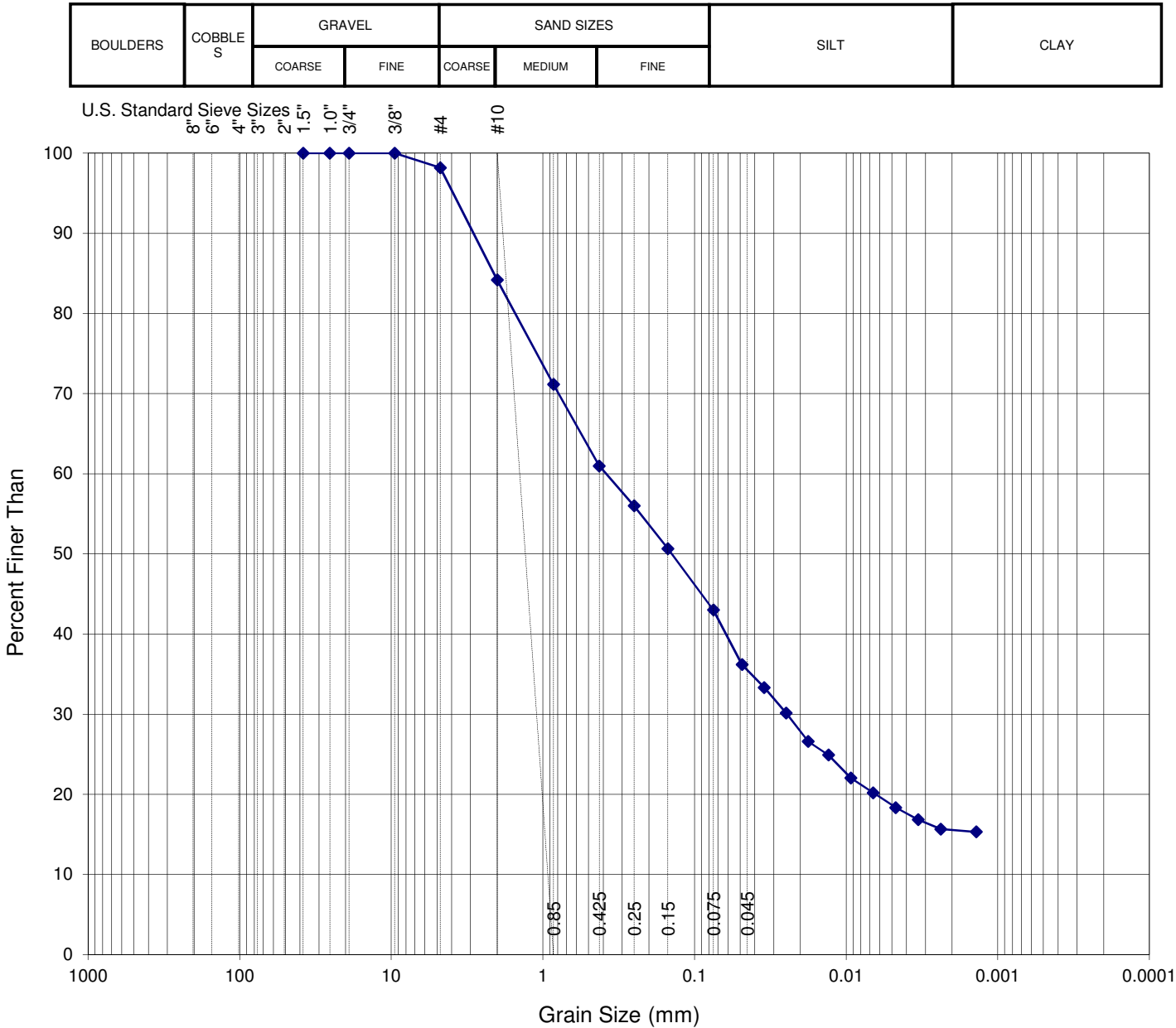
Lab Sample ID L1603922-48

Date Sample Received 27-Apr-15

Test Completion Date: 07-May-15

Analyst: SHC

PARTICLE SIZE DISTRIBUTION CURVE



METHOD DESCRIPTION		SUMMARY OF RESULTS		
Method Reference: ASTM D 422 - 63 (2002)		GRAIN SIZE	WT %	DIA. RANGE (mm)
Dispersion method: Mechanical		% GRAVEL :	1.82	> 4.75
Dispersion period: 1 minute		% COARSE SAND :	14.01	2.0 - 4.75
Soil classification system used: ASTM D422-63 Classification		% MEDIUM SAND :	23.21	0.425 - 2.0
DESCRIPTION OF SAND AND GRAVEL PARTICLES		% FINE SAND :	17.98	0.075 - 0.425
Shape: Angular		% SILT :	24.32	0.075 - 0.005
Hardness: Hard		% CLAY :	18.67	< 0.005

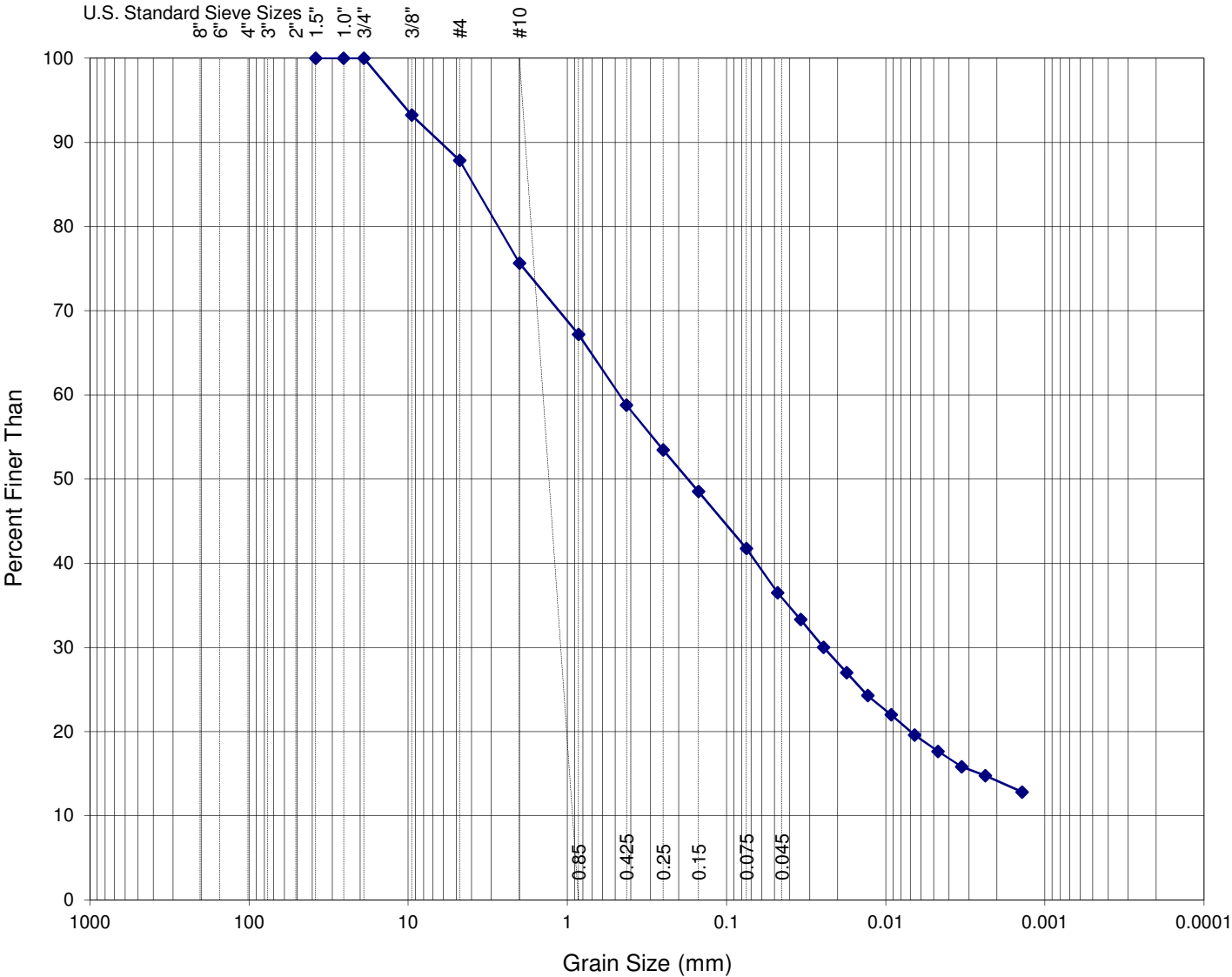
ALS Laboratory Group

819-58th Street, Saskatoon,SK

PARTICLE SIZE DISTRIBUTION CURVE

Client Name: BGC ENGINEERING INC.
Project Number:
Client Sample ID CH15-107-MW014-SPT3
Lab Sample ID L1603922-74
Date Sample Received 27-Apr-15
Test Completion Date: 07-May-15
Analyst: SHC

BOULDERS	COBBLES	GRAVEL		SAND SIZES			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		



METHOD DESCRIPTION		SUMMARY OF RESULTS		
Method Reference: ASTM D 422 - 63 (2002)		GRAIN SIZE	WT %	DIA. RANGE (mm)
Dispersion method: Mechanical		% GRAVEL :	12.15	> 4.75
Dispersion period: 1 minute cm/s		% COARSE SAND :	12.19	2.0 - 4.75
Soil classification system used: ASTM D422-63 Classification		% MEDIUM SAND :	16.90	0.425 - 2.0
DESCRIPTION OF SAND AND GRAVEL PARTICLES		% FINE SAND :	17.01	0.075 - 0.425
Shape: Angular		% SILT :	23.74	0.075 - 0.005
Hardness: Hard		% CLAY :	18.01	< 0.005

ALS Laboratory Group

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PARTICLE SIZE DISTRIBUTION CURVE

Client Name: BGC ENGINEERING INC.

Project Number:

Client Sample ID CH15-107-MW014-SPT7

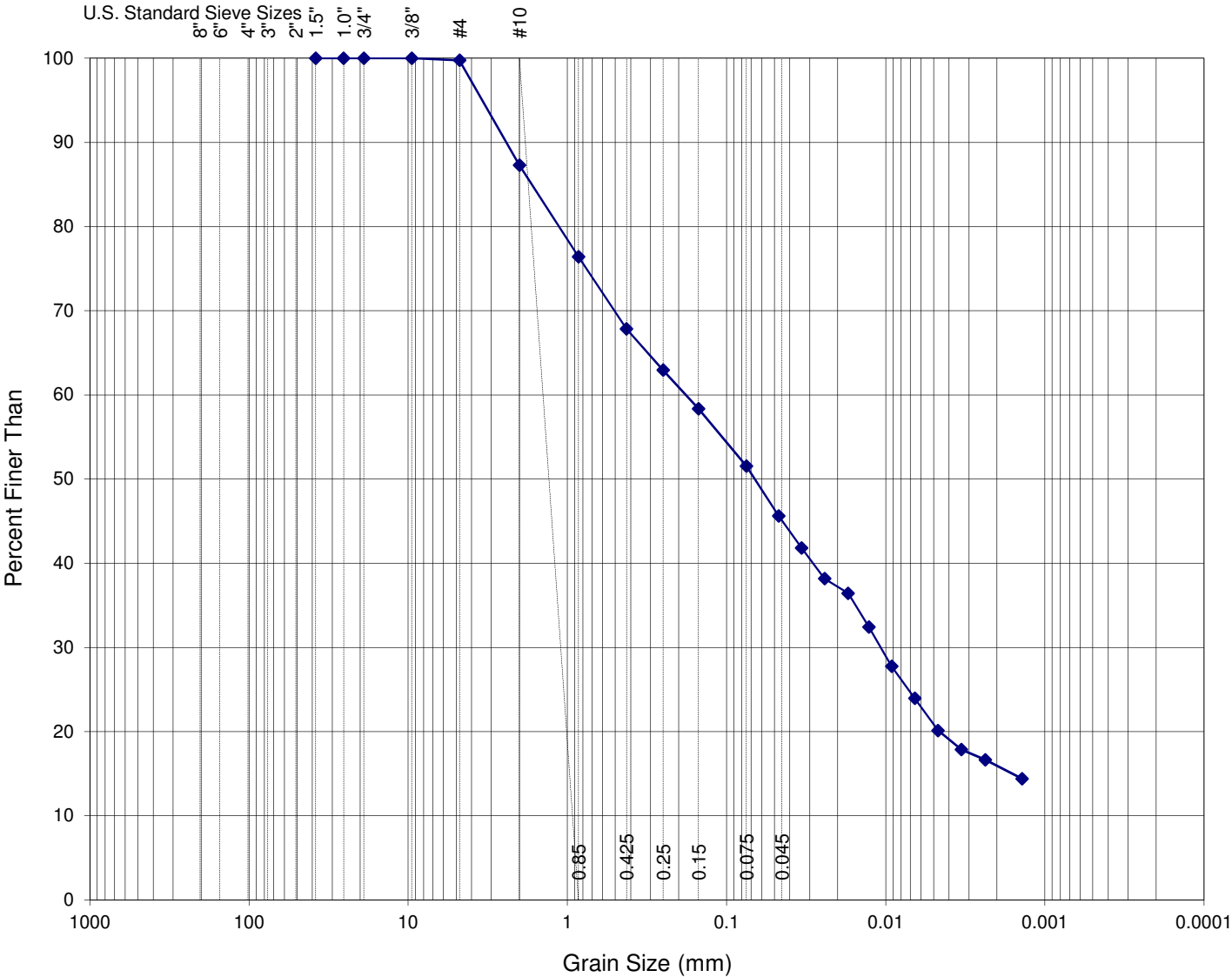
Lab Sample ID L1603922-78

Date Sample Received 27-Apr-15

Test Completion Date: 07-May-15

Analyst: SHC

BOULDERS	COBBLES	GRAVEL		SAND SIZES			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		



METHOD DESCRIPTION		SUMMARY OF RESULTS		
Method Reference: ASTM D 422 - 63 (2002)		GRAIN SIZE	WT %	DIA. RANGE (mm)
Dispersion method: Mechanical		% GRAVEL :	<1	> 4.75
Dispersion period: 1 minute		% COARSE SAND :	12.45	2.0 - 4.75
Soil classification system used: ASTM D422-63 Classification		% MEDIUM SAND :	19.48	0.425 - 2.0
DESCRIPTION OF SAND AND GRAVEL PARTICLES		% FINE SAND :	16.27	0.075 - 0.425
Shape: Angular		% SILT :	30.70	0.075 - 0.005
Hardness: Hard		% CLAY :	20.85	< 0.005

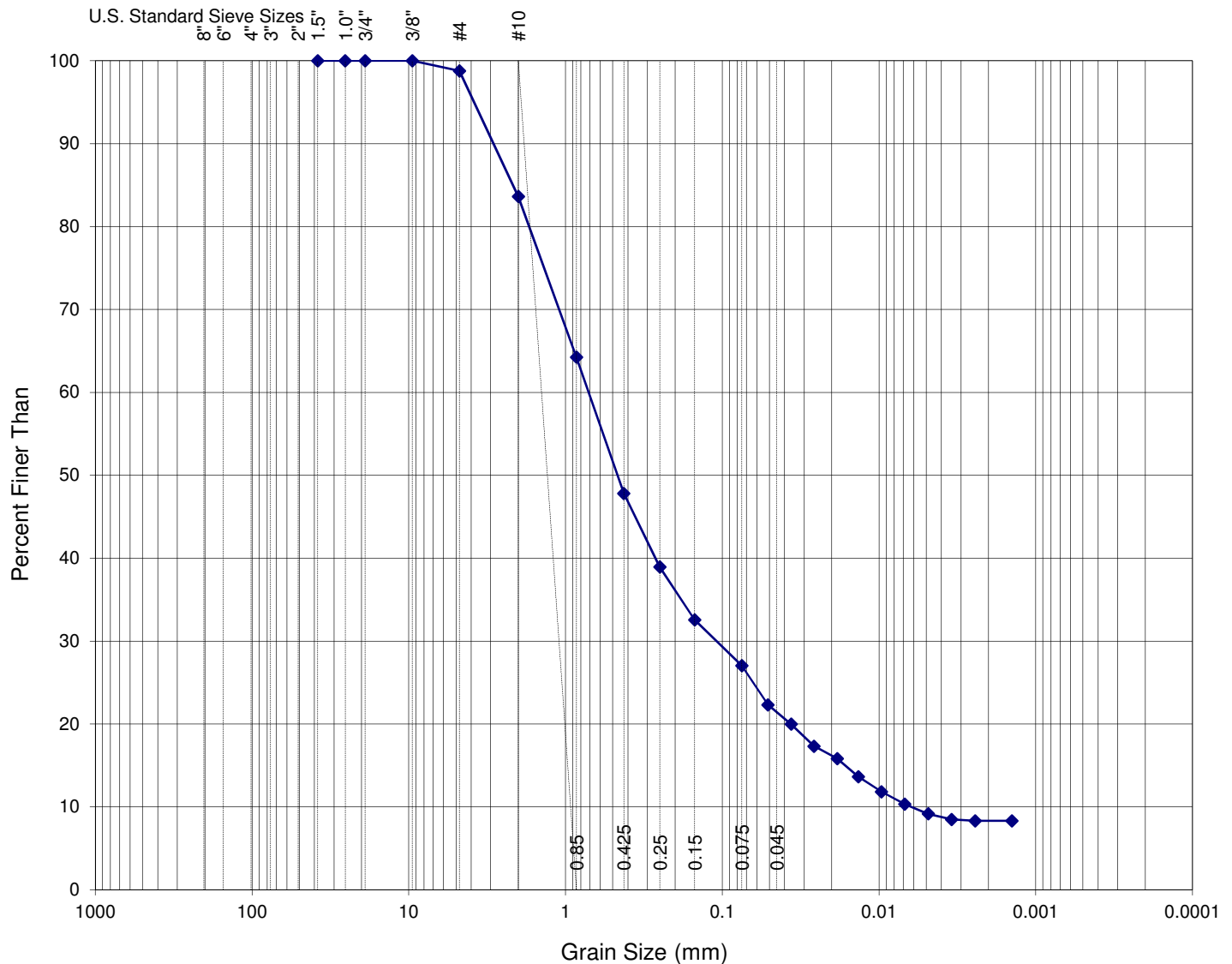
ALS Laboratory Group

819-58th Street, Saskatoon, SK

PARTICLE SIZE DISTRIBUTION CURVE

Client Name: BGC ENGINEERING INC.
Project Number:
Client Sample ID CH15-107-MW014-SPT11
Lab Sample ID L1603922-82
Date Sample Received 27-Apr-15
Test Completion Date: 07-May-15
Analyst: SHC

BOULDERS	COBBLES	GRAVEL		SAND SIZES			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		



METHOD DESCRIPTION

Method Reference: ASTM D 422 - 63 (2002)

Dispersion method: Mechanical

Dispersion period: 1 minute cm/s

Soil classification system used: ASTM D422-63 Classification

DESCRIPTION OF SAND AND GRAVEL PARTICLES

Shape: Angular

Hardness: Hard

SUMMARY OF RESULTS

GRAIN SIZE	WT %	DIA. RANGE (mm)
% GRAVEL :	1.22	> 4.75
% COARSE SAND :	15.17	2.0 - 4.75
% MEDIUM SAND :	35.81	0.425 - 2.0
% FINE SAND :	20.76	0.075 - 0.425
% SILT :	17.78	0.075 - 0.005
% CLAY :	9.26	< 0.005

ALS Laboratory Group

819-58th Street, Saskatoon,SK

PARTICLE SIZE DISTRIBUTION CURVE

Client Name: BGC ENGINEERING INC.

Project Number:

Client Sample ID CH15-107-MW015-C2

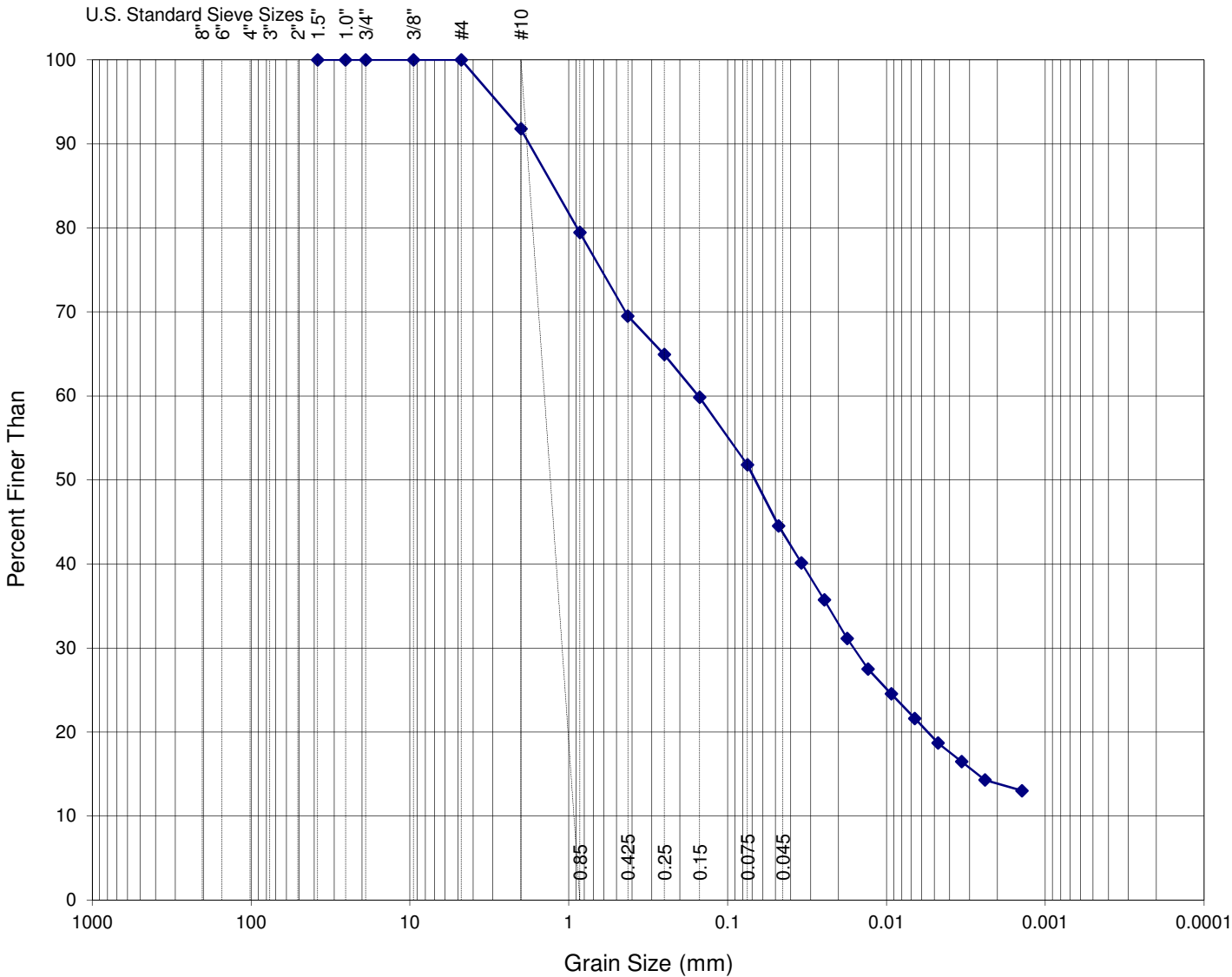
Lab Sample ID L1603922-84

Date Sample Received 27-Apr-15

Test Completion Date: 07-May-15

Analyst: SHC

BOULDERS	COBBLES	GRAVEL		SAND SIZES			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		



METHOD DESCRIPTION		SUMMARY OF RESULTS		
Method Reference: ASTM D 422 - 63 (2002)		GRAIN SIZE	WT %	DIA. RANGE (mm)
Dispersion method: Mechanical		% GRAVEL :	<1	> 4.75
Dispersion period: 1 minute		% COARSE SAND :	8.22	2.0 - 4.75
Soil classification system used: ASTM D422-63 Classification		% MEDIUM SAND :	22.27	0.425 - 2.0
DESCRIPTION OF SAND AND GRAVEL PARTICLES		% FINE SAND :	17.70	0.075 - 0.425
Shape: Angular		% SILT :	32.63	0.075 - 0.005
Hardness: Hard		% CLAY :	19.17	< 0.005

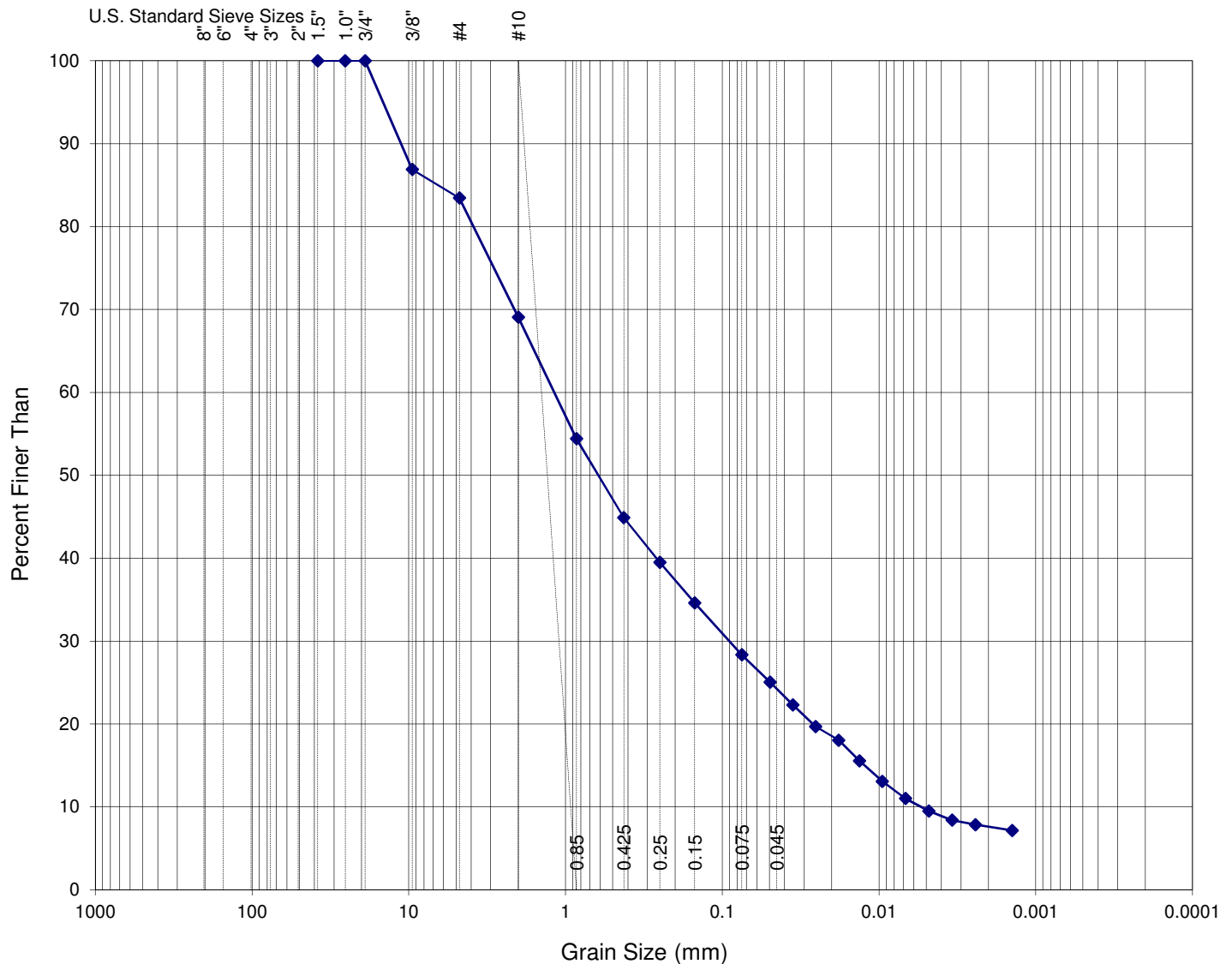
ALS Laboratory Group

819-58th Street, Saskatoon, SK

PARTICLE SIZE DISTRIBUTION CURVE

Client Name: BGC ENGINEERING INC.
Project Number:
Client Sample ID CH15-107-MW015-C4
Lab Sample ID L1603922-86
Date Sample Received 27-Apr-15
Test Completion Date: 07-May-15
Analyst: SHC

BOULDERS	COBBLES	GRAVEL		SAND SIZES			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		



METHOD DESCRIPTION

Method Reference: ASTM D 422 - 63 (2002)

Dispersion method: Mechanical

Dispersion period: 1 minute cm/s

Soil classification system used: ASTM D422-63 Classification

DESCRIPTION OF SAND AND GRAVEL PARTICLES

Shape: Angular

Hardness: Hard

SUMMARY OF RESULTS

GRAIN SIZE	WT %	DIA. RANGE (mm)
% GRAVEL :	16.55	> 4.75
% COARSE SAND :	14.40	2.0 - 4.75
% MEDIUM SAND :	24.18	0.425 - 2.0
% FINE SAND :	16.54	0.075 - 0.425
% SILT :	18.67	0.075 - 0.005
% CLAY :	9.67	< 0.005

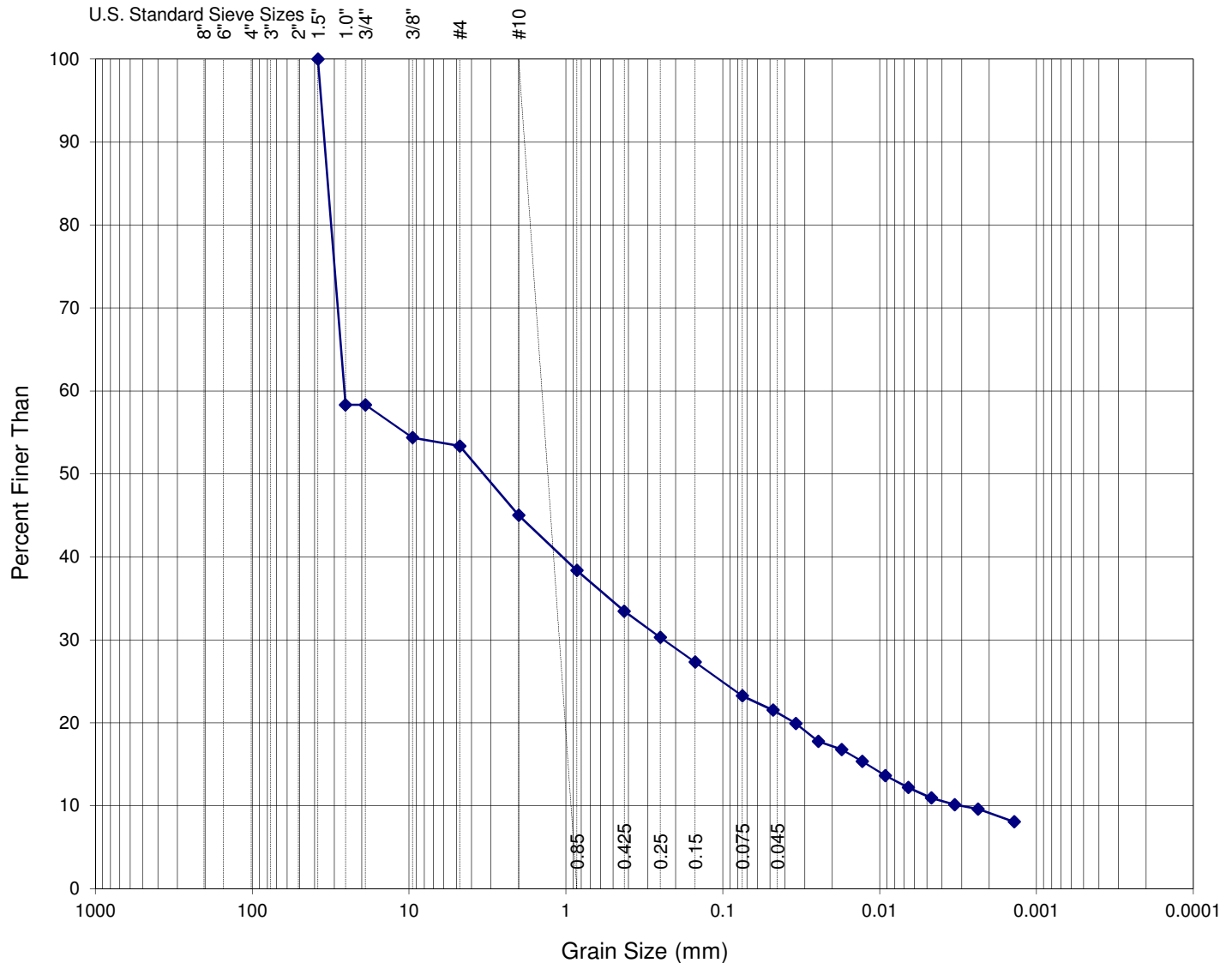
ALS Laboratory Group

819-58th Street, Saskatoon, SK

PARTICLE SIZE DISTRIBUTION CURVE

Client Name: BGC ENGINEERING INC.
Project Number:
Client Sample ID CH15-107-MW015-SPT2
Lab Sample ID L1603922-93
Date Sample Received 27-Apr-15
Test Completion Date: 07-May-15
Analyst: SHC

BOULDERS	COBBLES	GRAVEL		SAND SIZES			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		



METHOD DESCRIPTION

Method Reference: ASTM D 422 - 63 (2002)

Dispersion method: Mechanical

Dispersion period: 1 minute cm/s

Soil classification system used: ASTM D422-63 Classification

DESCRIPTION OF SAND AND GRAVEL PARTICLES

Shape: Angular

Hardness: Hard

SUMMARY OF RESULTS

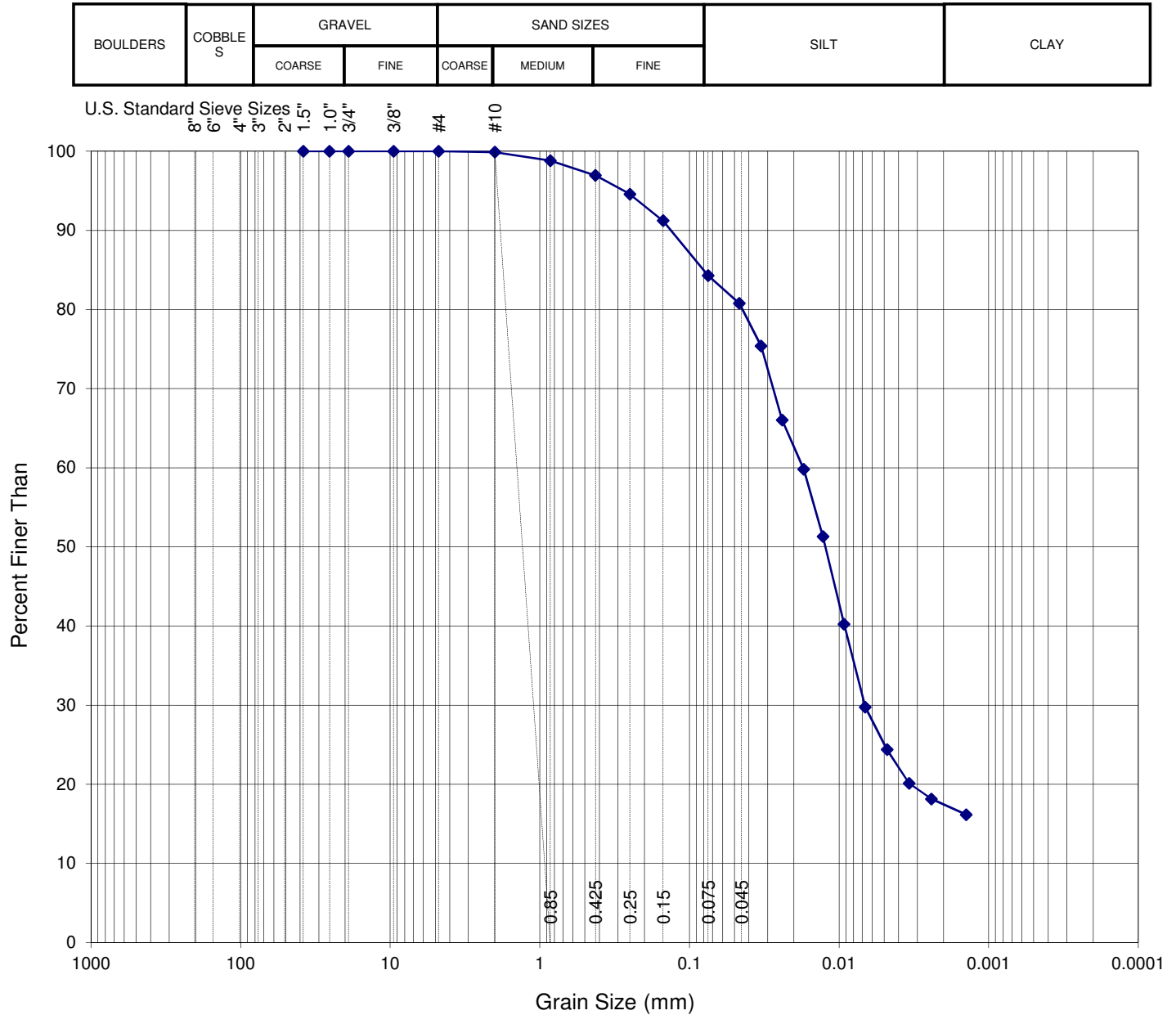
GRAIN SIZE	WT %	DIA. RANGE (mm)
% GRAVEL :	46.64	> 4.75
% COARSE SAND :	8.34	2.0 - 4.75
% MEDIUM SAND :	11.57	0.425 - 2.0
% FINE SAND :	10.20	0.075 - 0.425
% SILT :	12.05	0.075 - 0.005
% CLAY :	11.20	< 0.005

ALS Laboratory Group

819-58th Street, Saskatoon, SK

PARTICLE SIZE DISTRIBUTION CURVE

Client Name: BGC ENGINEERING INC.
Project Number:
Client Sample ID CH15-107-MW016-C2
Lab Sample ID L1603922-98
Date Sample Received 27-Apr-15
Test Completion Date: 07-May-15
Analyst: SHC



METHOD DESCRIPTION

Method Reference: ASTM D 422 - 63 (2002)

Dispersion method: Mechanical

Dispersion period: 1 minute cm/s

Soil classification system used: ASTM D422-63 Classification

DESCRIPTION OF SAND AND GRAVEL PARTICLES

Shape: Angular

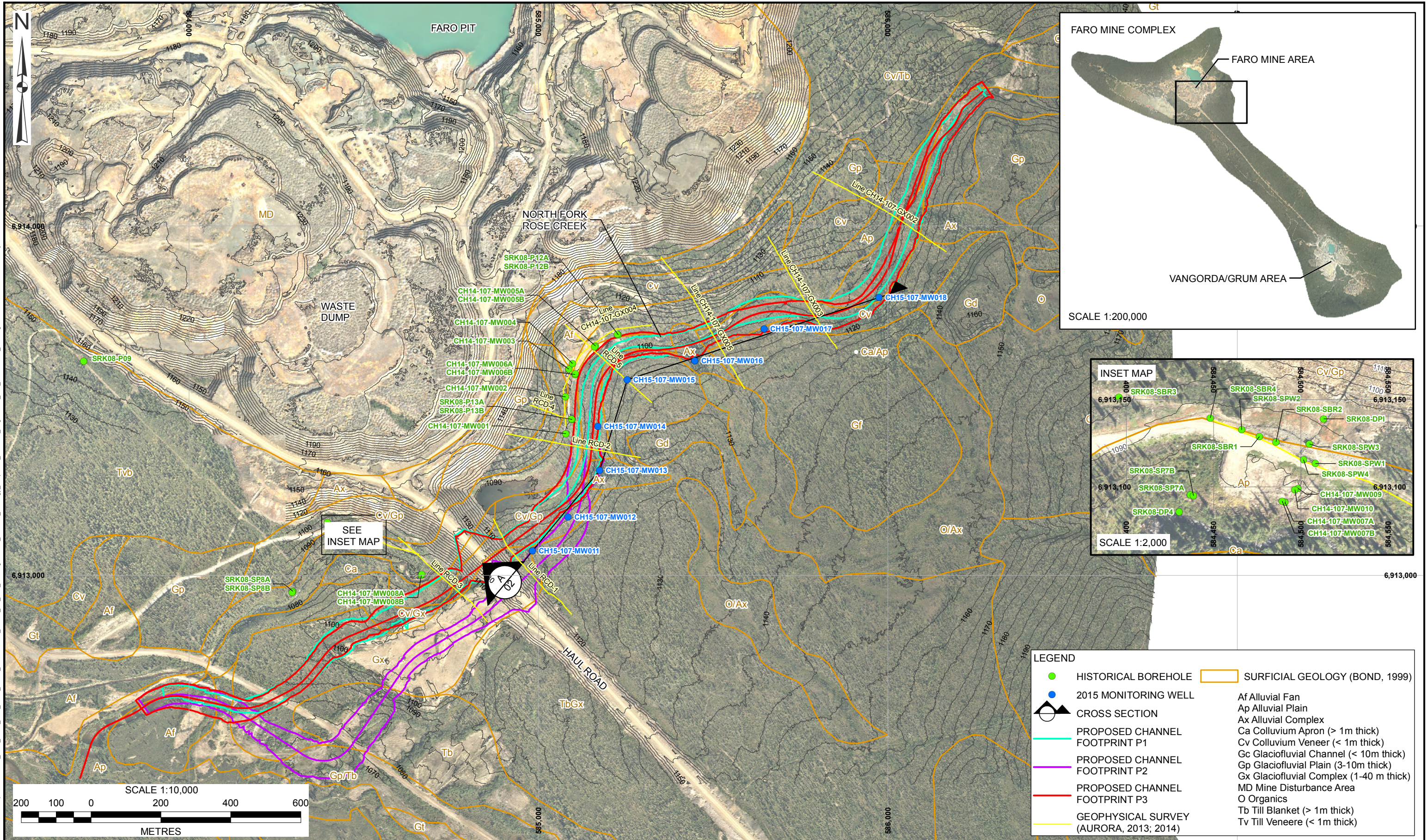
Hardness: Hard

SUMMARY OF RESULTS

GRAIN SIZE	WT %	DIA. RANGE (mm)
% GRAVEL :	<1	> 4.75
% COARSE SAND :	<1	2.0 - 4.75
% MEDIUM SAND :	2.96	0.425 - 2.0
% FINE SAND :	12.65	0.075 - 0.425
% SILT :	59.16	0.075 - 0.005
% CLAY :	25.13	< 0.005

DRAWINGS

X:\Projects\1085-CH2M\007\GIS\Production\Report\20150414_Faro_North_Fork_Rose_Creek_Remediation_Phase_1A_Site_Investigation01_Surficial_Geology_Proposed_Channel_Alignments_and_Subsurface_Investigations.mxd Date: Wednesday, June 10, 2015 Time: 4:05 PM



NOTES:
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. THIS DRAWING MUST BE READ IN CONJUNCTION WITH BGC'S REPORT TITLED "FARO NORTH FORK ROSE CREEK REMEDIATION PHASE 1A SITE INVESTIGATION", AND DATED JUNE 2015.
3. BASE TOPOGRAPHIC DATA PROVIDED BY CH2M HILL CANADA LTD., BASED ON LIDAR SURVEY CONDUCTED OCTOBER 2012. CONTOUR INTERVAL IS 5.0 m.
4. HISTORIC BOREHOLE LOCATIONS PROVIDED BY CH2M HILL CANADA LTD, APRIL 14, 2015.
5. ORTHOPHOTO PROVIDED BY CH2M HILL CANADA LTD., DATED OCTOBER 2012.
6. SURFICIAL GEOLOGY FROM BOND (1999).
7. CHANNEL LAYOUT BASED ON WORKING DESIGN PROVIDED BY CH2M HILL ON MAY 7, 2015.

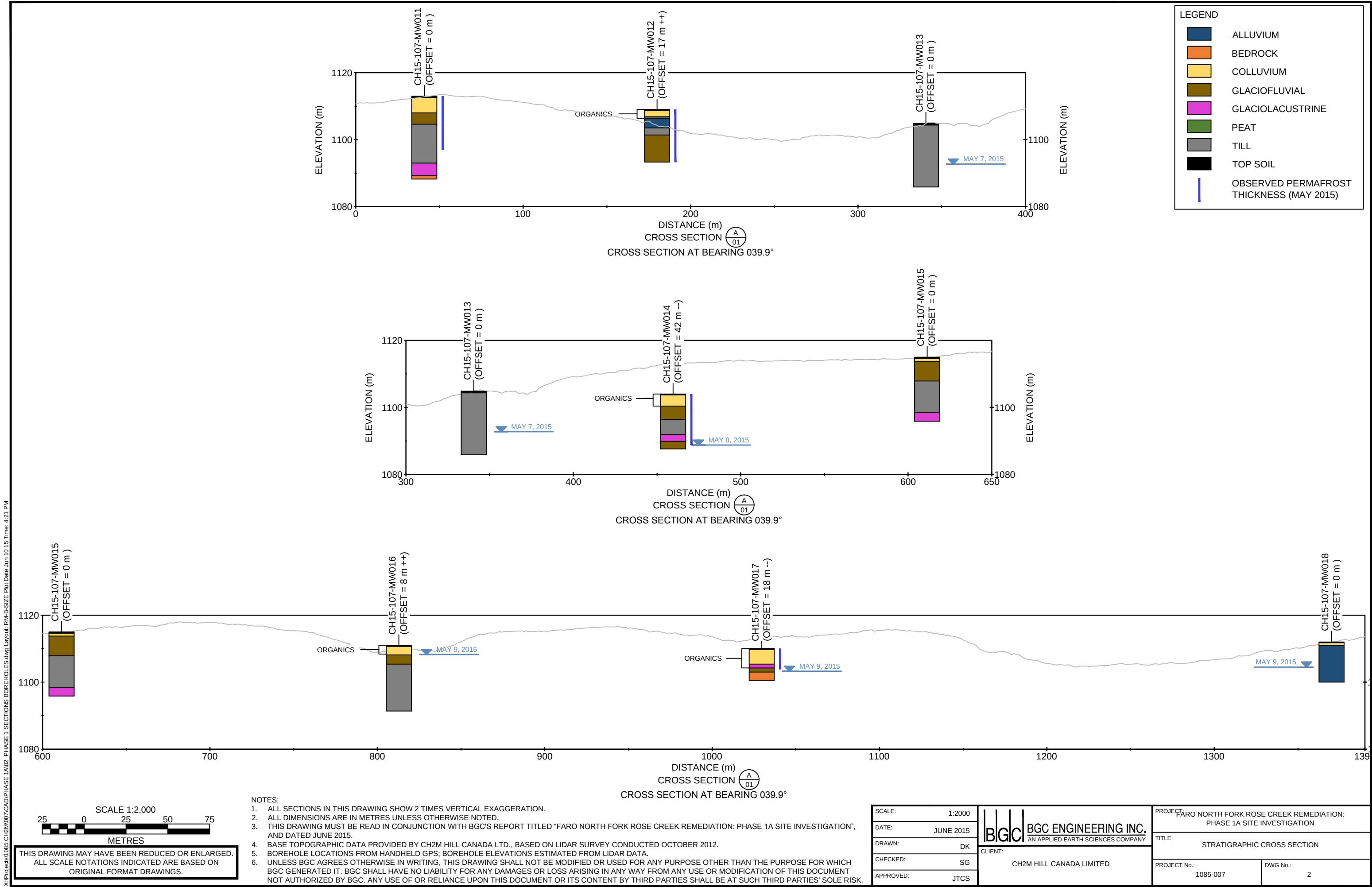
8. PROJECTION IS UTM NAD83 ZONE 9.
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SCALE:	1:10,000
DATE:	JUN 2015
DRAWN:	LL
CHECKED:	JS
APPROVED:	JWC

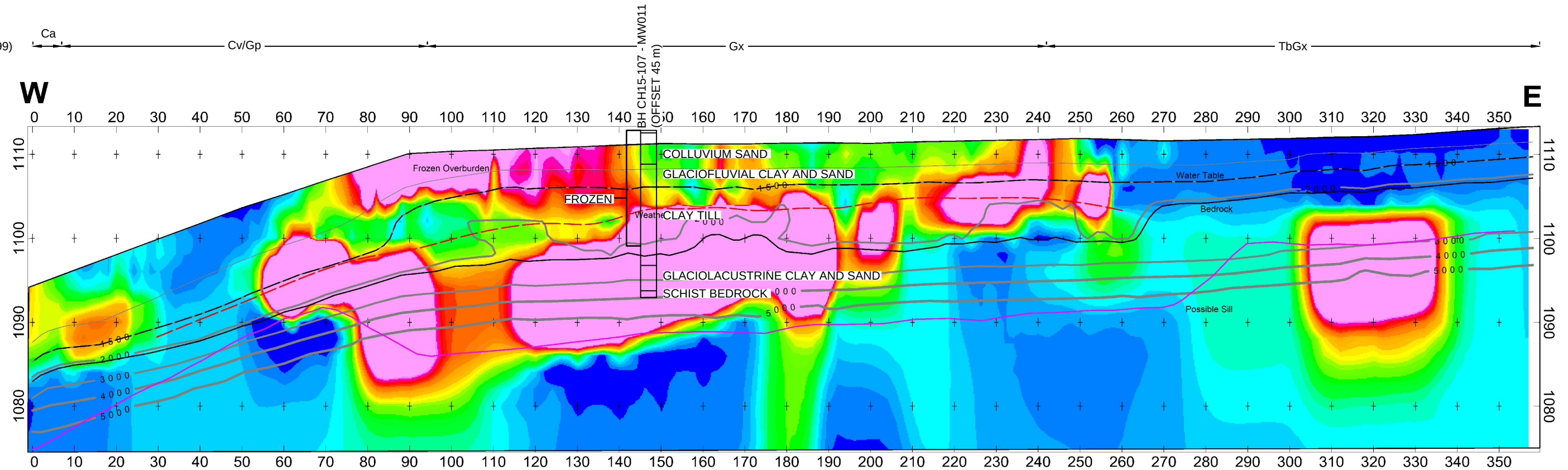
BGC	BGC ENGINEERING INC. AN APPLIED EARTH SCIENCES COMPANY
CLIENT:	CH2M HILL CANADA LTD.

PROJECT:	FARO NORTH FORK ROSE CREEK REMEDIATION PHASE 1A SITE INVESTIGATION
TITLE:	SURFICIAL GEOLOGY, PROPOSED CHANNEL ALIGNMENTS, AND SUBSURFACE INVESTIGATIONS
PROJECT No.:	1085-007
	01

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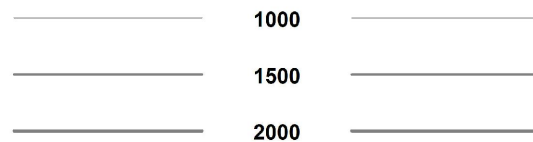
SURFICIAL
GEOLOGY
(BOND, 1999)



LEGEND

Seismic Velocity Contours

CONTOUR INTERVALS (m/sec)

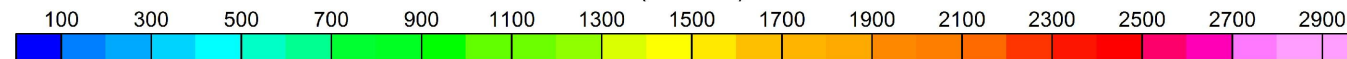


Water Table

Bedrock

Weathered Bedrock

Possible Sill

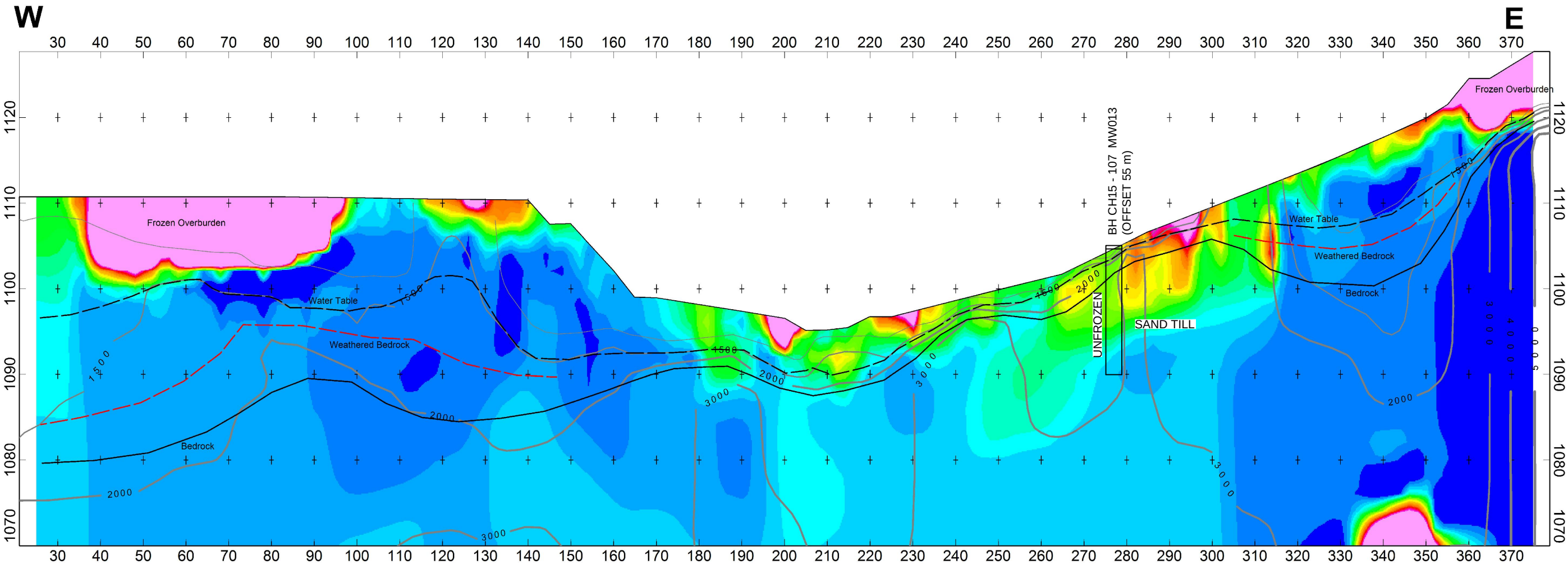
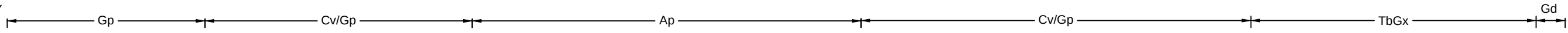
Resistivity
(Ohm-m)

NOTES:

- NOTES:
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 2. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE NOTED.
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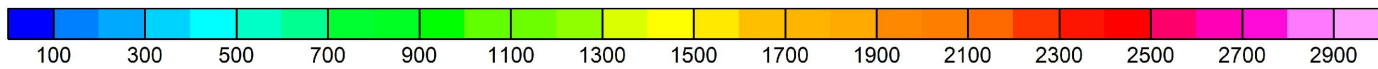
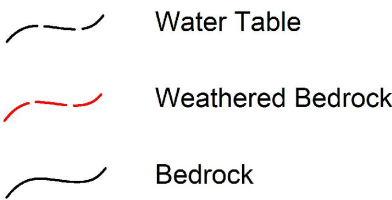
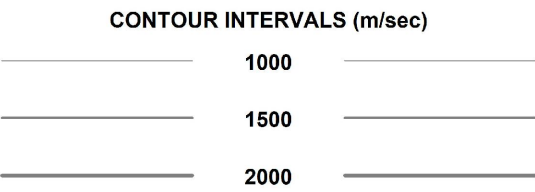
SCALE:	NTS	 BGC ENGINEERING INC. AN APPLIED EARTH SCIENCES COMPANY	PROJECT: FARO NORTH FORK ROSE CREEK REMEDIATION: PHASE 1A SITE INVESTIGATION	
DATE:	JUNE 2015		TITLE: LINE RCD-1	
DRAWN:	DK			
CHECKED:	JTCS			
APPROVED:	JWC		CLIENT: CH2M HILL CANADA LIMITED	PROJECT No.: 1085-007

SURFICIAL GEOLOGY
(BOND 1999)



LEGEND

Seismic Velocity Contours



Resistivity
(Ohm-m)

NOTES:
1. GEOPHYSICAL PROFILES AND INTERPRETATION FROM AURORA GEOSCIENCES (2013).
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3. THIS DRAWING MUST BE READ IN CONJUNCTION WITH BGC'S REPORT TITLED "FARO NORTH FORK ROSE CREEK REMEDIATION: PHASE 1A SITE INVESTIGATION", AND DATED JUNE 2015.
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SCALE:	NTS
DATE:	JUNE 2015
DRAWN:	DK
CHECKED:	JTCS
APPROVED:	JWC

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

CLIENT:
CH2M HILL CANADA LIMITED

PROJECT: FARO NORTH FORK ROSE CREEK REMEDIATION: PHASE 1A SITE INVESTIGATION	
TITLE: LINE RCD-2	
PROJECT No.: 1085-007	DWG No.: 04

