



ATTACHMENT 38
LTWP Geotechnical Report

City of Iqaluit

Preliminary Geotechnical Investigation Report – DRAFT

Long Term Water Program – Supply and Storage
Iqaluit, Nunavut

August 2025



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Acronyms and Abbreviations

Arcadis	Arcadis Canada Inc.
ABA	Acid Base Accounting
ABG	Adaptive Baseline Geotechnical Limited
ALS	ALS Canada Limited
ARD	Acid Rock Drainage
Canadrill	Canadrill Limited
CIRNAC	Crown–Indigenous Relations and Northern Affairs Canada
City	City of Iqaluit
cm	centimetres
CSA	Canadian Standards Association
DFO	Fisheries and Oceans Canada
DS	Downhole Seismic
ft	foot
GBR	Geotechnical Baseline Report
g/cm ³	grams per cubic centimeter
GPa	Gigapascal
GPR	Geophysics GPR International
GPS	Global Positioning System
ha	hectares
HASP	Health and Safety Plan
LG	Lake Geraldine
LQ	Lake Qikiqtalik
LTWP	Long Term Water Program
masl	metres above sea level
mbgs	metres below ground surface
m	metre
mm	millimetres
MOE	Modulus of Elasticity
MPa	megapascal
NPR	neutralization potential ratio
OMC	optimum moisture content
PDR	Preliminary Design Report
PNJ	PNJ Engineering Inc.
RQD	Rock Quality Designation
RtN	Road to Nowhere
SPMDD	Standard Proctor Maximum Dry Density
UCS	Uniaxial Compressive Strength

Executive Summary

Arcadis Canada Inc. (Arcadis) has prepared this draft preliminary geotechnical investigation report for the City of Iqaluit (the City) to provide a summary of the geotechnical results obtained as of August 2025 for the Long-Term Water Program – Supply and Storage project. The geotechnical investigations outlined in this report were completed to inform the design and the potential construction of a raw water reservoir and conveyance system.

The geotechnical investigations were conducted on a parcel of untitled City land located northeast of the surveyed portion of the community in Iqaluit, Nunavut (the Site). The Site is approximately 1,150 hectares in size and is mostly undeveloped. Its terrain comprises rolling hills with rocky outcrops and tundra valleys, with finger lakes oriented northwest-southeast. The Niaqunnguk (Apex) River traverses the Site from its northwest boundary to its southern corner. The Site resides in a zone of continuous permafrost.

The geotechnical investigation work conducted at the Site as of July 2025 has consisted of the following:

- Drilling of 37 boreholes into bedrock using a combination of air-rotary and coring methods in the proposed reservoir and access road areas of the Site;
- Drilling of 5 boreholes into bedrock using an air-rotary drill method at the proposed pump station and pipe crossing at the Apex River;
- The logging of the subsurface conditions encountered at each borehole by field observations and downhole camera assessment;
- Installation of 12 piezometers and 10 thermistors in boreholes onsite;
- Survey of all boreholes and piezometer locations to obtain UTM coordinates and elevation data;
- Grain size analysis of soil fractions encountered at boreholes within native overburden cobble fields;
- Acid base accounting and shake flask testing on four bedrock samples;
- Groundwater level measurements and flow direction interpretation;
- Bedrock permeability testing (slug tests in existing piezometers);
- Groundwater sample collection and chemistry analyses;
- Rock Quality Designation (RQD) assessment based on extracted rock cores;
- Rock strength characterization by laboratory testing; and,
- Geophysical testing to obtain site-specific seismic response values to inform structure design.

Air-rotary drilling and piezometer installations were conducted at in the proposed reservoir area between 6 February and 25 March 2024 under the supervision of Adaptive Baseline Engineering. Additional air-rotary drilling was conducted in May 2025 at the proposed pump station and pipeline crossing area along the Apex River while the river was frozen to full depth. Boreholes were advanced to depths ranging from 4.0 to 13.7 metres below ground surface (mbgs).

Native 'soil' was encountered at most air-rotary boreholes advanced in the proposed reservoir area. This 'soil' is considered an interstitial matrix of the cobble beds present across the Site – the native overburden is considered to be a predominantly gravel/cobble/boulder veneer. The interstitial soil was encountered at depths ranging between 0.75 and 3.9mbgs, and consisted of a brown silty sand with gravel and frequent cobbles and boulders within the proposed reservoir area. At the Apex River near the proposed pipeline crossing, the surficial veneer ranges in depth between 2.4 and 12.5mbgs and consists of cobbles and boulders with interstitial sand/silty sand.

Grey granitoid bedrock was encountered at all borehole locations advanced as of May 2025. Poor to excellent quality bedrock based on field observation and downhole camera assessment was encountered at all air track boreholes. In several locations, a frost-riven weathered zone of poor to fair quality bedrock was encountered near

the bedrock surface and ranged from 0.7 to 4.6m thick. Good to excellent quality bedrock was observed to underlie all poor to fair quality bedrock zones in all boreholes.

Core holes were advanced between October 2024 and May 2025 in order to confirm bedrock type, verify previous observations, determine RQD values, and obtain samples for Uniaxial Compressive Strength (UCS) testing. RQD values observed for the core holes that were advanced to a maximum depth of 5.2mbgs ranged from 22 – 100%, with the rock being generally of fair to excellent quality. However, discrete zones of very poor to poor RQD up to 1.5 to 2m thick were also encountered, notably in the narrow throat area between the new reservoir footprint and Lake Geraldine (referred to as the ‘throat’ area). Core samples from boreholes advanced in the throat area were reported to have UCS values between 163 and 272 megapascals (MPa). These values are characteristic of very strong granitoid bedrock.

The acid rock drainage and metal leaching potential of encountered bedrock at the Site was assessed by conducting acid-base accounting and shake flask testing on four bedrock samples. The bedrock at the Site was classified as not-potentially net acidic material as the neutralization potential ratios for all bedrock samples were greater than 2.

Groundwater level monitoring and permeability testing was conducted in August and October 2024 at all 12 monitoring wells. The results indicate groundwater is present between 0.4 and 2.8mbgs at most locations. Most wells (8 of 12 wells) were dry or frozen during the August monitoring program and four wells continued to remain dry or frozen during the October monitoring program. Interpretation of groundwater flow was completed using linear interpolation between measured water elevations and showed groundwater flow is closely tied to the undulating bedrock topography across the Site. Groundwater is estimated to flow from regions of high ground surface elevation to low-lying regions, primarily near waterbodies and watercourses. The *in situ* permeability test results were found to increase from August to October, with hydraulic conductivity ranging from approximately 3.0×10^{-10} to 1.0×10^{-5} m/s, potentially as a result of active layer thaw.

Downhole seismic surveys were completed at two borehole locations by Geophysics GPR during the December 2024 fieldwork. The Geophysics GPR investigation report is included as **Appendix E**. ReflexW software was used to interpret velocity layer contacts and layer velocities for S- and P-waves. Interpreted velocities are characteristic for gravel/boulder overburden in the upper layers, with high velocities indicating sound bedrock below, consistent with the Conceptual Site Model.

The geotechnical work outlined in this report was completed to assist with the ongoing development of the reservoir, conveyance, and pump station designs. As design parameters change and further geotechnical data is obtained, this report will be updated accordingly. Further site investigation is recommended to support detailed design.

1 Introduction

Arcadis Canada Inc. (Arcadis) was retained by the City of Iqaluit (the City) to complete a Preliminary Geotechnical Investigation Report for the parcel of untitled land located northeast of the surveyed portion of the community in Iqaluit, Nunavut (the Site). The field investigations and laboratory testing outlined in this report were carried out to provide geotechnical information to guide the design and the potential construction of a raw water reservoir and conveyance system associated with the City's Long-Term Water Program (LTWP) – Supply and Storage project.

This Geotechnical Report has been prepared in accordance with the requirements outlined in Appendix G – Supplementary Scope of Work of the Request for Proposal 2023-RFP-048 issued by the City.

This document is an interim version of the Preliminary Geotechnical Investigation Report and presents the results of the geotechnical work completed as of May 2025. Further geotechnical investigation and testing are recommended; once complete this report will be updated and expanded.

1.1 Site Description

The Site lies northeast of the residentially developed portion of Iqaluit and is roughly square in shape, with aerial coverage of approximately 1,150 hectares (ha), please refer to **Figure 1** located at the rear of this report. The northeast half of Lake Geraldine (LG) is included in the Site, as is the southwest half of Lake Qikiqtaalik (LQ). The Road to Nowhere leads from a residential area in the southeast portion of Iqaluit to the approximate centre of the Site. An access road splits from the Road to Nowhere north of the Niaqunnguk (Apex) River and leads to the southwest shore of LQ. These site features are shown in **Figure 2** at the rear of this report.

The Site is mostly undeveloped. Topography varies from rolling to rough, with some major and numerous minor ridges and scarps, with tundra valleys and finger lakes oriented northwest-southeast in the direction of glacial scouring. Vegetation is continuous to absent, low Arctic to mid-Arctic. The Niaqunnguk River traverses the Site from its northwest boundary to its southern corner. Water in the Niaqunnguk River flows across the Site and south to Frobisher Bay.

The Site is within the municipal boundary of Iqaluit but outside of the surveyed area and is therefore classified as Untitled Municipal Land by the City's Planning and Development Department.

1.2 Study Area

The Study Area of the Site is based on the raw water reservoir and conveyance system configuration outlined in the Preliminary Design Report (PDR) prepared by Arcadis, dated March 2024. The preliminary reservoir design consists of eight retention structures (Dam 1 and Dykes 2 to 8 – Dyke 7 is designated as the reservoir spillway). These retention structures are to be constructed predominantly of blast rock obtained from the bedrock within the footprint of the proposed reservoir. An access road is proposed from the southeast side of the reservoir to the Road to Nowhere. Several rock quarry sites have been selected along the proposed access road to provide initial construction material. The transfer of water from LQ to the reservoir is to occur through a water conveyance pipeline that generally follows the existing access road before it turns west towards the reservoir. Two intake

pump stations are proposed – at LQ and the Apex River – to draw water from the lake and provide flow through the pipeline. These proposed features are shown on **Figure 2**.

In accordance with preliminary designs, the Study Area of the Site has been restricted to key areas associated with the proposed structures and borrow areas.

1.3 Local Geology

A review of Canadian Geoscience Map 64 indicates that the surficial geology at the Site consists predominantly of a till veneer containing sand, gravel, cobbles, and boulders in a silty sand matrix; generally 0.0 – 2.0 metres (m) thick. Over the reservoir area, the surficial geology is roughly >40% till, <60% rock ledges, knobs, and rubble. The bedrock topography is evident, and very minor colluvium (including talus, colluvial fans, and solifluction lobes) is theoretically present among washed-till boulder fields. The majority of the Site appears to be intact and frost-riven outcrop with a discontinuous cover of rubble, boulders, gravel, and sand; all of which has been glacially scoured.

Approximately central through the Site, generally along the Niaqunnguk (Apex) River basin, the till veneer becomes a thicker till blanket of similar composition 1 – 10m thick, with instances of glaciofluvial outwash deposits including stratified gravel and sand, proglacial floodplains, channeled deltas, terraces, and fans. The till blanket can mask bedrock structure, appears in end moraines, and is affected by periglacial processes such as solifluction lobes, frost boils, and sorted patterns. The till blanket is reportedly also susceptible to thaw slumping on slopes or in excavations. Adjacent to, and intermittent within, the till blanket are areas of glaciofluvial subaerial outwash containing stratified gravel and sand which may be up to 30m thick. These areas may contain ice wedges and massive ice bodies.

As noted, bedrock topography is evident across the Site. A review of the Geological Survey of Canada Map 1860A indicates that bedrock conditions at the Site consist of intrusive igneous rock, further classified as an undivided granitoid (consist predominantly of quartz, plagioclase, and alkali feldspar) from the Paleoproterozoic Cumberland batholith (2100 – 1800 million years ago).

The Site is in a zone of continuous permafrost that generally begins at a depth between 1 to 2 metres below ground surface (mbgs). It is expected that the larger water bodies across the Site (including LG and LQ) serve as heat sinks and depress permafrost formation to greater depths in their immediate area. Taliks, areas of unfrozen ground surrounded by permafrost, are likely to form in areas near or under water bodies at the Site.

The topography of the Site comprises rolling hills to maximum elevations ranging between approximately 205 and 250m above mean sea level (amsl) along the northeast side of the Site near LQ based on GIS data from the Department of Community and Government Services of Nunavut. Surface elevation generally reduces from Qikiqtalik Lake toward LG. The minimum surface elevations along the southwest side of the Site range between approximately 80 and 135masl.

2 Scope of Work

As per the Request for Proposal 2023-RFP-048 issued by the City, the scope of work of the geotechnical investigations were to include the following:

- If permafrost is encountered, its ice content will be recorded.
- If unfrozen soil is present, perform Shelby Tube tests, Atterberg limits, sieves, and soil chemistry as necessary.
- Determine Rock Quality Designation (RQD) of recovered rock core.
- Collect and preserve samples of intact bedrock core for determination of unconfined compressive strength, shear strength and associated parameters.
- Carry out permeability tests at the borehole locations.
- Determine in-place unit weights for soils and rock samples.
- Install monitoring wells in boreholes and collect information on stabilized groundwater levels to infer groundwater flow direction.
- Obtain samples of each soil type encountered, the first sample being at a depth not greater than 750 millimetres (mm) and succeeding samples at not more than 1500mm increments of depth. Record whether samples are dry, moist, or wet.
- Record penetration values of Standard Penetration Test at the top of each soil stratum commencing at 750mm depth and at increments not greater than 750mm down to appropriate bearing stratum.
- Restore the Site to its original state upon completion of on-Site work.
- Develop a geotechnical investigation report which includes but is not limited to: (a) subsurface profiles showing rock and soil materials and geological formations, including presence of faults, buried channels, and weak layers or zones where encountered; and (b) characteristics and properties of soils and the weaker types of rock.
- Remove monitoring wells per applicable regulations upon completion of the project.

It has been further requested that laboratory test results be submitted to the Nunavut Impact Review Board (NIRB) as well as Crown–Indigenous Relations and Northern Affairs Canada (CIRNAC) regarding the acid rock drainage and metal leaching potential of encountered bedrock.

In order to meet the objectives specified and obtain other information required for the proposed structure and system designs, the following items have been completed as of May 2025 for the preliminary geotechnical investigation program:

1. Prepared a site-specific Health and Safety Plan (HASP).
2. Incorporated publicly available information (e.g., Geological Survey of Canada maps) obtained during the Conceptual Design Phase and observations from the preliminary site visit conducted in September 2023 into the strategy for site-specific geotechnical investigation.
3. Advanced 24 boreholes at 22 locations in the proposed reservoir area using an air-rotary drilling method. The air rotary drilling was completed in February and March 2024 while the Site was covered in snow to a) limit the impact the drilling equipment had on the tundra and b) allow the equipment to traverse the rough terrain while accessing the remote borehole locations.

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4. Advanced 5 boreholes in the proposed pump station and pipeline crossing area at the Apex River using an air-rotary drilling method. This air rotary drilling was completed in May 2025 when the Apex River was frozen to its bottom. Approval from the Department of Fisheries and Oceans Canada was obtained.
5. Installed 12 piezometers in the boreholes advanced using the air-rotary drill method.
6. Installed three PVC casings in designated holes to allow for geophysical testing – conducted in December 2024 – to obtain site-specific response values to inform structure design.
7. Monitored groundwater in existing wells in August and October 2024 to confirm groundwater levels and infer groundwater flow direction.
8. Performed slug tests to obtain estimates of rock mass permeability at each monitoring well location.
9. Advanced 13 cored bedrock boreholes between October 2024 and May 2025.
10. Calculated Rock Quality Designation for extracted rock cores.
11. Completed laboratory testing (including unconfined compressive strength testing) to characterize rock strength.
12. Installed nine thermistor strings within the footprints of the proposed reservoir retention structures and one thermistor string within the footprint of the proposed pump station at the Apex River to measure ground temperatures.

Additional geotechnical investigation has been recommended to further inform the design and reduce uncertainty.

A draft Geotechnical Baseline Report, as specified in RFP documents, will be provided under separate cover to be included as part of the project's construction tender documents.

All drilling and excavating activities were conducted in general accordance with Canadian National Standard CAN/BNQ 2501-500: Geotechnical Site Investigations for Building Foundations in Permafrost Zones, Canadian Standards Association (CSA) PLUS 4011:19 Technical guide: Infrastructure in permafrost: A guideline for climate change adaptation, and CSA W205:19 Erosion and sedimentation management for northern community infrastructure. Borehole logging was completed in general accordance with ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes and ASTM D4083 Standard Practice for the Description of Frozen Soils.

3 Investigation Method

3.1 General

The geotechnical investigation has been conducted over multiple mobilizations, from 2024 to 2025. A summary of the programs completed are presented in **Table 3-1**.

Table 3-1: Summary of Geotechnical Programs and Timelines

Dates	Program	Description
September 2023	Initial reconnaissance	Initial site visit. Note features, inspect proposed pipeline, road routes, observe terrain and surficial materials, etc.
February to March 2024	Air-rotary drilling associated with proposed reservoir	A total of 24 boreholes were drilled at 22 locations primarily within the proposed reservoir and under proposed dam/dike locations. Boreholes were advanced to assess overburden and bedrock depth and condition, install piezometers, and collect rock samples for acid base accounting.
August 2024	Preliminary borrow source assessment	Surface soil sampling and preliminary soil volume estimation were conducted at potential borrow source areas across the Site.
August and October 2024	Groundwater monitoring and permeability testing	Groundwater monitoring including groundwater level measurements, permeability testing, and sampling was conducted at 12 piezometers associated with proposed reservoir.
October 2024 to May 2025	Bedrock coring associated with proposed reservoir	Thirteen (13) core holes were advanced using a hand-held exploration coring drill at proposed dam/dike locations. Core holes were advanced to further assess bedrock quality, secure core samples for strength testing, and install nine thermistors.
December 2024	Geophysics testing with proposed reservoir	Geophysics testing was conducted inside the proposed reservoir footprint to obtain seismic velocities and other physical properties.
April to May 2025	Air-rotary drilling associated with proposed pump station and pipeline crossing at Apex River	Five (5) boreholes were drilled using air-rotary drilling equipment near the proposed pump station and pipeline crossing area at the Apex River. Boreholes were advanced to install a thermistor and assess overburden and bedrock depths.

3.2 Drilling Activities

3.2.1 Air-Rotary Boreholes

The initial mobilization consisted of boreholes advanced by air-rotary with downhole hammer drilling equipment. Boreholes were advanced at 22 locations (AT2023-2a to AT2023-21, AT2023-25, and AT2023-27a) to depths of 4.0 to 11.3mbgs to assess the veneer/soil and bedrock conditions onsite. Descriptions of the veneer and interstitial soil stratigraphy are presented on the borehole logs in **Appendix A**. UTM coordinates for all borehole locations are shown on the borehole logs and in **Table 1**.

Drilling and sampling operations were conducted with the use of an air-rotary attachment on a CAT 320D excavator and a sled-mounted compressor, supplied and operated by Canadrill Limited (Canadrill). The boreholes advanced had a diameter of either 102 or 190mm, depending on tooling used. Prior to drilling, snow was removed from above the borehole location. Each hole was then advanced incrementally with 1.22m (4 ft) rods. All boreholes were drilled under the supervision of Adaptive Baseline Engineering Limited (ABG) field personnel.

Soil and rock-chip samples were collected in discrete intervals as each borehole progressed. Overburden samples were collected beginning at a depth of less than 0.75mbgs and succeeding samples, where applicable, were collected in succeeding intervals less than 1.5m apart. The samples were examined at the time of collection for general soil classification purposes (including type, texture, colour, and moisture characteristics). Borehole logs were prepared on the basis of sample and drilling process observations in the field describing the encountered strata. Following field logging, samples were placed into sealed plastic bags and shipped to the ABG laboratory for further inspection and grain size analysis. Sample locations and soil fraction results are shown on the borehole logs in **Appendix A**.

The subsurface interstitial soil and bedrock conditions, as encountered in the boreholes completed during the air-rotary drilling program, are documented in the detailed logs provided in **Appendix A**. A summary of the soil and bedrock conditions encountered at sampling locations is provided in **Section 5**. The reader is cautioned that conditions between and beyond boreholes may vary. It is also noted that the quantity of large rock in the overburden is likely underrepresented by the soil descriptions presented in the air-rotary borehole logs, as the air-rotary with downhole hammer method crushes and pulverizes material as the drill head is advanced, and only interstitial soils were collected for grain size analyses (coarse gravel, cobbles, and boulders left *in situ* and not included).

3.2.2 Diamond Drill (Coring) Boreholes

A total of 13 core holes were advanced by ABG using a hand-held exploration coring drill. The core holes were located within the footprint of the proposed reservoir retention structures (dam/dykes) as shown on **Figure 3**.

The initial phase of bedrock coring occurred between October and December 2024. In this period, a total of six core holes (BH2023-2b, BH2023-4b, BH2023-5b, BH2023-7b, BH2023-17b and BH2023-19b) were advanced. Four of the core holes (BH2023-2b, BH2023-4b, BH2023-5b, and BH2023-7b) were advanced under the proposed footprint of Dam 1, and a thermistor string was installed in BH2023-4b. Core hole BH2023-17b and BH2023-19b were advanced under the footprint of proposed Dyke 6 and Dyke 7, respectively.

The second phase of bedrock coring occurred between April and May 2025. During this period, an additional seven core holes (BH2023-1b, BH2023-9b, BH2023-12b, BH2023-13b, BH2023-15b, BH2023-27b, and BH2023-28b) were advanced. Two of the core holes (BH2023-1b and BH2023-9b) were advanced under the proposed footprint of Dam 1. Core holes BH2023-12b, BH2023-13b, BH2023-15b, BH2023-28b and BH2023-27b were advanced under the footprint of proposed Dyke 2, Dyke 3, Dyke 4, Dyke 6 and Dyke 8, respectively. Several boreholes required multiple attempts to reach target depth due to adverse environmental and drilling conditions.

Core hole locations had to be accessed using all-terrain vehicles and/or snowmobiles due to the rough terrain of the Site and snow conditions at the time of the coring activities. The maximum diameter of the core holes was 40mm while the diameter of the extracted rock cores ranged between 25 and 36mm. The core holes were co-located with air hammer holes in areas where bedrock was at or near surface, to enable comparison and confirmation of air track observations. Core hole depths ranged between 3.1 and 5.2m, as documented on the Core Logs presented in **Appendix B**.

Distances between natural fractures in the core were measured on each core run extracted for RQD assessment. RQD was calculated at core run intervals of 1.5m or less using the following equation.

$$RQD = \frac{\sum \text{Length of core pieces} > 100 \text{ mm}}{\text{Total core run length}} \times 100\%$$

Under the RQD classification system, rock quality is described as ‘excellent’ when RQD is 90 - 100%, ‘good’ when RQD is 75 -100%, ‘fair’ when RQD is 50 - 75%, ‘poor’ when RQD is 25 - 50%, and ‘very poor’ when RQD is 0 - 25%. Core photos and lengths for RQD assessment are documented in the Core Logs presented in **Appendix B**.

A total of 11 rock core samples were submitted to PNJ Engineering Inc. (PNJ) for unit weight, tensile strength, and unconfined compressive strength testing along with modulus of elasticity (MOE) calculation. Tensile strength and unconfined compressive strength tests were conducted in accordance with ASTM D3967 and ASTM D7012, respectively. Geotechnical laboratory certificates of analyses have been included in **Appendix C**.

3.3 Piezometer Installation and Groundwater Assessment

During the initial air-rotary drilling program, 12 boreholes (drilling method described in Section 3.2.1) were completed as piezometers. The piezometers comprised 50mm diameter Schedule 40 PVC riser pipes with a No. 10 slot intake zone (well screen) of varying length. Silica sand was placed around the piping to a height of at least 300mm above the top of the well screen as porous sand pack. The remaining annular space was filled with a bentonite seal or a combination of bentonite and silica sand. A protective steel stick-up monument casing was then sealed in place with bentonite and/or concrete over the top of the well riser.

Boreholes outfitted with piezometers are indicated in **Table 1** and are shown on **Figure 3** and **Figure 4**, at the rear of this report.

3.3.1 Groundwater Level Measurements

Groundwater levels and well depths were recorded at all 12 piezometer wells on 14 August and 2 October 2024. Water level measurements were taken using a Heron interface probe. Measurements were taken from the top

edge of the PVC riser at each well. If water was not detected, the probe head was examined for ice crystals. Groundwater elevations were then calculated using the survey data elevation from each well. Groundwater level measurements are presented in **Table 2**, at the rear of this report.

3.3.2 Bedrock Permeability Testing

Slug tests were conducted on all 12 piezometers in August and again in October 2024. The screens in all wells were installed in bedrock; therefore, the derived K values are considered to be representative of shallow bedrock permeability over the screen intervals.

Prior to conducting the test, the existing water level or depth to bottom was measured at the well using an interface probe. Next, a known volume of water (1 litre, 2 litres, or 8 litres – the ‘slug’) was quickly injected into the well and the water level was measured and recorded at specific times using the interface probe. When possible, the water level in the well was monitored until 90% of the head change had dissipated. Slug tests were completed a minimum of two times per well, after allowing a return to equilibrium between tests.

Slug test data was interpreted using the Hvorslev calculation method. The Hvorslev expression for hydraulic conductivity is:

$$K = \frac{r^2 \ln(L/R)}{2LT_0} \text{ for } \frac{L}{R} > 8$$

where K is hydraulic conductivity, r is casing radius, L is length of the open screen, R is the filter pack radius, and T_0 is the time at which the water level has recovered 37% of the initial head change. This method assumes a homogenous, isotropic medium in which the rock and water are incompressible.

Slug test data and hydraulic conductivity calculations have been included in **Appendix D**.

3.3.3 Groundwater Sampling

A groundwater sample was collected from two wells (MW2023-4a and MW2023-5a) located in the footprint of the dam area (Dam 1) of the proposed reservoir to assess general water chemistry for future concrete considerations. The groundwater samples were collected using a HDPE plastic bailer on 3 October 2024 and placed immediately in sterile, laboratory-provided bottles.

Samples were placed into an insulated cooler with ice for sample preservation. The cooler containing the samples was delivered to Bureau Veritas Laboratories in Ottawa, Ontario, by Arcadis. Bureau Veritas Laboratories is accredited by the Standards Council of Canada and has Canadian Association for Laboratory Accreditation.

3.4 Thermistor Installation

Thermistors were installed by ABG in nine core holes located within the proposed footprints of the reservoir retention structures, as shown on **Figure 3**. Multi-bead thermistor stringers were installed in each hole to a maximum depth of 5m. Thermistors were finished with either a plastic or metal stick-up monument.

Another thirteen-bead thermistor was installed to a depth of 9.1m within the footprint of the proposed pump station at Apex River, as shown on **Figure 4**.

Additional thermistor installations are proposed, pending the verification of the maximum thaw depth. Thermistors will be installed in additional boreholes at areas of interest: near the Apex River bridge along the Road to Nowhere (scheduled for replacement), at the proposed pump station location at LQ; and potentially along the access road to LQ, at one or more major culvert replacements. At each location, one multi-bead thermistor will be installed downhole to allow for ground temperature monitoring. Thermistors will be installed in the open boreholes and allowed to freeze. They will be finished with concrete into the bedrock surface with a locking roadbox or monument.

Multiple thermistor locations are intended to provide evaluation of the ground temperature profile around the proposed reservoir area as a whole, and at areas of interest as noted above. The goal is to provide a baseline and ongoing temperature profiles to assess the presence of a talik in the immediate area, assess the potential for freezeback inside retention structures, and verify the permafrost regime at areas with deeper design features (e.g., pump stations, bridge piles). Local temperature profiles will also influence dam/dyke design.

Further thermistor networks are planned as part of dam/dyke construction and must be monitored continuously over the life of the reservoir.

3.5 Down-Hole Seismic Testing

Geophysics GPR International (GPR) conducted downhole seismic (DS) surveys at the Site between 12 and 14 December 2025. The purpose of the testing was to measure the in-situ seismic velocity profiles. Seismic velocity profiles are required for earthquake design analyses for the proposed structures, and to help inform blasting program designs. The seismic surveys were completed in accordance with ASTM D7400-14 Down-hole Seismic Testing test method.

The DS testing was completed at boreholes AT2023-11A and AT2023-14A, located in the middle and north end of the proposed reservoir respectively. Geophones (tri-axial and vertical) were secured to the PVC casings at both boreholes. The seismic source was located 0.3 and 0.7m from the borehole AT2023-11A and AT2023-14A, respectively. A sledgehammer was used as an energy source. Three seismic records were recorded at each one-meter interval with the tri-axial geophone beginning at the bottom of the borehole and ending at one meter depth.

For additional details on the testing methodology refer to the full geophysical report prepared by GPR included in **Appendix E**.

3.6 Elevation Surveying

The boreholes advanced on the Site were surveyed by ABG. The surveys were conducted using Global Navigation Satellite System (GNSS) observations via a Topcon HiPer-VR Real-Time Kinematic Global Positioning System (RTK GPS) receiver. All observations were on the grid referenced to the 6-degree Universal Transverse Mercator (UTM) projection (Zone 19), central meridian 69-degrees West, based on the horizontal reference frame NAD83 (CSRS), Epoch 2010.0. All elevations are geodetic, referenced to the Canadian Geodetic Vertical Datum of 2013 (CGVD2013).

Coordinate Control Monument No. 28 (CCM28) and control points established in the initial survey of the Site were used as benchmarks to verify the accuracy of the borehole survey data collected. GPS coordinates and elevations of the boreholes can be found in **Table 1** and on the borehole logs provided in **Appendix A** located at the rear of this report. This survey effort and the subsequent information are thoroughly presented Arcadis' *Topographic Survey Report*, provided under separate cover in April 2024.

In September of 2024, the expanded reservoir footprint and Niaqunnguk River Valley was surveyed via drone. Further details can be found in Arcadis' updated *Topographic Survey Report* dated June 2025..

Boreholes, test pits, additional site features, and further controls will be surveyed as work progresses.

3.7 Surficial Test Pit Program (Potential Borrow Sources)

Three test pits were manually advanced at each potential borrow source (as outlined on **Figure 2**) in August 2024. Three test pits per potential source area were advanced to a maximum of 1mbgs with composite samples taken from each location. Borrow source areas were measured and delineated based on surficial observations. These activities were conducted as part of the aggregate assessment program, the results of which are provided under separate cover.

The goal of this program was to obtain soil samples for grain size analyses, assess the suitability of local borrow materials, and provide preliminary volumetric estimates for design and construction. Please refer to Arcadis' *Aggregate Assessment Report*, provided under separate cover, for greater detail.

4 Laboratory Analysis Program

4.1 Geotechnical Testing

Geotechnical laboratory testing was carried out on representative samples recovered from the boreholes and test pits as well as rock core samples. The purpose of the geotechnical laboratory analyses was to classify the various soil strata and rock encountered.

Testing on recovered soil samples included:

- Natural moisture content;
- Grain size analyses;
- Standard Proctor testing;
- Unit weight determination; and
- Interface friction and shear box testing.

Testing/measurement on recovered rock core samples included:

- RQD determination;
- Unconfined compressive strength testing; and
- Unit weight testing.

4.2 Acid Rock Drainage Testing

Acid Base Accounting (ABA) and shake flask testing was conducted on four bedrock chip samples obtained during the initial air-rotary drilling. Samples were collected from four boreholes: AT2023-03, AT2023-14, AT2023-21, and AT2023-25. ABA was completed by the Minerals Engineering Laboratory at Dalhousie University using the modified Sobek method and a sericite schist source material (KZK-1). Shake flask testing to assess leachable metals was conducted by ALS Canada Ltd. (ALS). Certificates of Analysis have been included in **Appendix F**.

4.3 Groundwater Testing

Two groundwater samples (MW2023-4 and MW2023-5) were collected and submitted for laboratory analysis of pH, dissolved sulphate, and dissolved chloride. Analyses were completed by Bureau Veritas Mississauga located at 6740 Campobello Road, Mississauga, Ontario. Certificates of Analysis have been included in **Appendix F**.

5 Subsurface Conditions and Results

A summary of the subsurface conditions encountered in the study area is presented below. The subsurface soil conditions, as encountered in the boreholes completed during this investigation, are documented in the detailed borehole logs provided in **Appendix A**. The reader is cautioned that conditions between and beyond boreholes may vary. It is also noted that the quantity of large rock in the overburden is underrepresented by the soil descriptions presented in the borehole logs as the air-rotary with downhole hammer method crushes and pulverizes material as the drill head is advanced, and only interstitial soil fractions were collected for grain size analyses (coarse gravel, cobbles, and boulders left in-situ). The overburden material across the reservoir site is not considered a 'soil', it is considered a cobble/boulder washed-till veneer. Glaciofluvial soils were encountered in the potential borrow pit areas along the RtN, and analyses carried out on samples retrieved from BPs are considered representative of the overburden material as a whole in that area, unless otherwise stated.

5.1 Surficial Geology Overview

The Study Area of the Site is comprised of rolling hills with boulder fields and exposed bedrock. In areas where an overburden veneer is present, it generally consists of unconsolidated cobbles and boulders with rare interstitial silty sand or gravel, generally to a depth less than 4m bgs. The underlying bedrock is classified as an undivided granitoid (monzogranite of the Paleoproterozoic Cumberland batholith) and is reported to consist predominantly of quartz, plagioclase, and alkali feldspar.

The Site is in an area of continuous permafrost. Only under deeper water bodies (typically greater than about 2m water depth) are unfrozen (talik) conditions expected to exist. The active layer in undisturbed ground is typically 1 to 2m deep, reaching a maximum depth in September/October (even as the ground surface starts to freeze back).

5.2 Fill Soils

No fill soils were encountered during the geotechnical investigation. This was expected, as the Site is predominantly undeveloped with the exception of the roadways, shooting range, Rotary Park and the interim pumping station areas.

Soils used on access roadways are observed to be primarily reworked native soils taken from local borrow sources. Please refer to Arcadis' *Aggregate Assessment Report*, provided under separate cover, for more background information on local borrow sources and soils.

5.3 Native Soils

5.3.1 Cobble/Boulder Veneer

Native overburden was encountered at 18 of the 22 air-rotary borehole locations advanced within the proposed reservoir as of March 2024 – the others were bare bedrock at surface. Overlying interstitial soils at eight locations was a 0.2 to 1m thick layer of cobbles and boulders with significant void space, likely caused by freeze/thaw and/spring melt action (washed till resulting in the boulder fields referenced). Cobbles/boulders were typically covered in vegetation (moss) at surface. The rare interstitial overburden fraction was encountered at depths ranging between 0.75 and 3.9mbgs, and was characterized in the field as a brown silty sand with gravel, along with the predominant gravel, cobble, and boulder fractions.

Moisture content analyses conducted on the interstitial silty sand fractions ranged from 1.4 to 14.1%. No Standard Penetration Testing was possible in this unit due to it being predominantly gravel, cobbles and boulders.

Sieve analyses were conducted on 34 recovered interstitial soil fractions. Grain size analyses indicate that the interstitial media comprises a sand or gravelly sand, with some to trace fines. The results of the grain size analyses on interstitial media are summarized on the borehole logs included in **Appendix A** at the rear of this report.

5.3.2 Organic Soils

No organic soils were encountered at borehole locations. At several locations in the boulder fields a layer of moss was present, but only on the upper surface of boulders/cobbles and less than 10cm thick. Observations and grain size analyses in the reservoir area indicate a thoroughly washed till with very few or no fines remaining.

5.3.3 Glaciofluvial Deposits (Sand)

Sand soils were encountered in test pits advanced at the potential borrow sources (shown on **Figure 2**). These borrow source materials would potentially be used in dam/dyke construction, and were subjected to a variety of tests to obtain parameters required for design. In BP1, BP2, and BP3, soils were described as brown to dark brown sand, homogeneous, and dry to moist. Samples from BP4 were described as a sand till, brown to dark brown, heterogenous, and moist, with frequent instances of cobbles and boulders.

5.3.3.1 Grain Size Analyses

Moisture content in samples from BP1, BP2, and BP3 ranged from 2.8% to 18%. Grain size analyses show the samples to be relatively poorly graded, with a sand fraction of 80% or above. The one exception was sample BP1-A3 (taken from south of the access road), which was described as sandy silt and found to have a silt fraction of 81%. The natural moisture content in this sample was 23% with trace ice noted.

Samples from BP4 were classified in the field as glacial till, with gravel and cobbles (heterogeneous). Grain size curves show the soils were relatively well graded, with a much flatter grain size curve and sand fraction of 64 – 70%. Moisture content ranged from 10 – 18%.

The results of these grain size analyses are presented in Table C at the rear of this report and the laboratory certificates in Appendix C. For a more detailed discussion please refer to Arcadis Aggregate Assessment Report, provided under separate cover.

5.3.3.2 Standard Proctor Testing

Standard Proctor tests were performed on the 12 soil samples from potential borrow sources. Samples from BP1, BP2, and BP3 showed a Standard Proctor Maximum Dry Density (SPMDD) ranging from 1642 to 1840kg/m³, with optimum moisture content from 11.2 to 15.5%.

Samples from BP4 showed SPMDD from 2118 to 2209kg/m³, with corresponding OMC ranging from 4.4 to 7.1%.

The results of the Proctor testing are presented in **Table D** at the rear of this report and the laboratory certificates in **Appendix C**. For a more detailed discussion please refer to Arcadis *Aggregate Assessment Report*, provided under separate cover.

5.3.3.3 Soil Hydraulic Conductivity Testing

Seven samples were submitted for hydraulic conductivity testing. The average *k* ranged from 1.25E-02 (BP2-A1) to 6.46E-05 (BP4-A1).

The results of the hydraulic conductivity testing are presented in **Table E** at the rear of this report, and the laboratory certificates in **Appendix C**. For a more detailed discussion please refer to Arcadis *Aggregate Assessment Report*, provided under separate cover.

5.3.3.4 Direct Shear Testing

Direct shear testing was performed on one sample from each potential borrow source, and index values were determined via graphical analyses of the results. Cohesion values for all soils tested was 0, as expected for granular soils.

Peak internal friction angle ranged from 33 to 38 degrees. The ultimate internal friction angle for samples from BP1, BP2, and BP3 was 27 degrees, and for the BP4 sample was 32 degrees.

The results of the direct shear tests are presented in **Table F** at the rear of this report and the laboratory certificates in **Appendix C**. For a more detailed discussion please refer to Arcadis *Aggregate Assessment Report*, provided under separate cover.

5.3.4 Riverbed Soils

As per the ABG Geotechnical Investigation Report included in **Appendix H**, the soils encountered at the Apex River pump station/crossing location consisted of surficial cobbles and boulders with an interstitial matrix of brown to grey sand to silty sand. The overburden materials here differ somewhat from those in the reservoir areas in that there appears to be a larger percentage of actual soil (sand and smaller particulate – though the cobble/boulder fractions are still high enough to preclude SPT measurements), and the ubiquitous presence of ice. The material was noted to vary between well-bonded with no excess ice, to zones of visible excess ice, to zones of pure ice at depth. Moisture content for samples obtained during drilling ranged from 6.0 to 43.3%.

Grain size analyses performed on the interstitial material show sand fractions generally in excess of 70% with few exceptions, with varying gravel and silt fractions. One outlier sample was measured to have 44% silt. The results of the grain size analyses results are tabulated in ABG’s report.

5.4 Bedrock

Grey granitoid bedrock was encountered at all borehole locations advanced as of May 2025 in the proposed reservoir area. Poor to fair quality bedrock based on field observation and downhole camera assessment was encountered at 10 of the 22 borehole locations (AT2023-4a, AT2023-5a, AT2023-8, AT2023-11B, AT2023-13a, AT2023-15a, AT2023-17a, AT2023-18, AT2023-25, and AT2023-27a). The poor to fair quality bedrock typically started near the bedrock surface and was between 0.7 and 4.6m thick. However, at one borehole (AT2023-11B) located near the centre of the proposed reservoir, an approximately 1m thick zone of poor-quality bedrock was observed at a depth of 6mbgs with a 3.8m thick zone of sound bedrock observed above the poor-quality zone. Good to excellent quality bedrock appears to underlie all poor to fair quality bedrock zones in all boreholes based on core sample and/or camera assessment. Bedrock depths and elevations are shown on **Figures 3** and **Figure 4** at the rear of this report.

5.4.1 Coring Conditions

Coring conditions within the proposed reservoir area were observed to be difficult, given the generally fair – excellent quality, high-strength rock encountered onsite. Core samples retrieved to date confirm the presence of a monzogranite unit of the Cumberland batholith across the proposed reservoir area. Core drilling progress was generally on the order of 0.5 – 1.5m per day, indicating a very hard, competent rock mass, often immediately at surface.

5.4.2 Rock Quality Designation

Core samples retrieved from the proposed reservoir area show RQDs ranging from 51% to 96% over the lengths advanced, with rock quality generally designated as fair to good. RQD results for the 13 core holes advanced to date are presented in **Table 5-5**.

Table 5-1: Rock Quality Designations (RQDs) at Proposed Reservoir Retention Structures

BH No.	Associated Structure	Run 1 RQD	Run 2 RQD	Run 3 RQD	Run 4 RQD	Total Length RQD	Hole Depth (mbgs)
BH2023-1b	Dam 1	78% Good	82% Good	68% Fair	62%* Fair	74% Fair	5.11
BH2023-2b	Dam 1	82% Good	97% Excellent	67% Fair	84%* Good	82% Good	5.00
BH2023-4b	Dam 1	94% Excellent	31% Poor	76% Fair	23%* Very Poor	63% Fair	5.00

BH2023-5b	Dam 1	88% Good	51% Fair	61% Fair	22%* Very Poor	55% Fair	4.81
BH2023-7b	Dam 1	93% Excellent	87% Good	65% Fair	99%* Excellent	79% Good	5.11
BH2023-9b	Dam 1	98% Excellent	97% Excellent	88% Good	100%* Excellent	96% Excellent	5.04
BH2023-12b	Dyke 2	87% Good	100% Excellent	95% Excellent	85%* Good	94% Excellent	5.22
BH2023-13b	Dyke 3	41% Poor	49% Poor	50% Fair	65%* Fair	50% Fair	5.21
BH2023-15b	Dyke 4	66% Fair	80% Good	57% Fair	90%* Excellent	71% Fair	5.18
BH2023-17b	Dyke 6	79% Good	61% Fair	-	-	62% Fair	3.10
BH2023-19b	Dyke 7	96% Excellent	61% Fair	53% Fair	76%* Good	70% Fair	4.98
BH2023-27b	Dyke 8	75% Good	43% Poor	89% Good	100%* Excellent	72% Fair	5.11
BH2023-28b	Dyke 6	54% Fair	67% Fair	91% Excellent	16%* Very Poor	57% Fair	5.03

* Run 4 length was typically less than 1.5m and at the bottom of the hole, making this interval subject to mechanical difficulty, increased risk of breakage, and making the RQD calculation vulnerable to small sample size.

5.4.3 Rock Strength

Uniaxial compressive strength of the eleven rock core samples submitted to date ranged between 163 and 272MPa, indicating very strong rock. Two samples did have a compressive strength test result lower than 163MPa, but those results were considered to be due to pre-existing fractures in the rock, as noted by visual observations and failure behaviour measured by the strain gauges. Tensile and compressive strength results along with unit weights and modules of elasticity for the rock core samples are presented in **Table G** at the rear of this report, and laboratory certificates in **Appendix C**.

5.4.4 Acid Rock Drainage and Metal Leaching Results

The neutralization potential ratios (NPRs) of the four bedrock samples analyzed ranged between 4.35 and 19.58. NPRs were calculated by dividing the neutralization potential result by the acid generation potential result for each sample. The pH of the four samples ranged between 8.05 and 8.55. ABA and leachable metals results have been summarized in **Table J** and **Table K**, respectively, at the rear of this report. Certificates of Analysis have been included in **Appendix F**.

5.5 Groundwater Conditions

Groundwater conditions at the Site were investigated using the 12 piezometers installed between February and March 2024. Water level measurements indicate that groundwater, when present, is between 0.4 and 2.8mbgs. Groundwater was detected in four of the 12 wells in August 2024 and seven of the 12 wells in October 2024, indicating the presence and fluctuation of the active layer (permafrost). Water level measurements for each well are presented in **Table B**, at the rear of this report.

Groundwater flow directions were inferred using linear interpolation between groundwater level measurements collected at the wells in August and October 2024. At wells where groundwater was not detected, shallow groundwater was assumed to be confined to the active layer at a depth of 1.5mbgs. Interpreted groundwater flow directions for the Site are shown on **Figure 5** and **Figure 6**, at the rear of this report.

5.5.1 Bedrock Hydraulic Conductivity Results

The hydraulic conductivity in bedrock at each well location as determined by slug testing is presented in **Table 5-7** below.

Table 5-2 Hydraulic Conductivity Results at Well Locations

Well No.	August 2024		October 2024	
	K (m/s)	Well Status	K (m/s)	Well Status
MW2023-2a	3.06×10^{-8}	Dry/Frozen	2.42×10^{-9}	Dry/Frozen
MW2023-4a	8.41×10^{-8}	Dry/Frozen	1.47×10^{-5} 1.96×10^{-5}	Groundwater Present
MW2023-5a	5.86×10^{-6}	Groundwater Present	8.51×10^{-6}	Groundwater Present
MW2023-7a	8.25×10^{-7}	Groundwater Present	1.94×10^{-6}	Groundwater Present
MW2023-9a	9.30×10^{-6}	Dry/Frozen	3.96×10^{-8}	Dry/Frozen
MW2023-12a	1.39×10^{-8}	Groundwater Present	6.23×10^{-6}	Groundwater Present
MW2023-13a	4.72×10^{-8}	Groundwater Present	5.14×10^{-6}	Groundwater Present
MW2023-15a	1.42×10^{-7}	Dry/Frozen	4.08×10^{-9}	Dry/Frozen
MW2023-17a	6.37×10^{-6}	Dry/Frozen	1.04×10^{-5}	Groundwater Present
MW2023-19a	1.60×10^{-7}	Dry/Frozen	2.94×10^{-10}	Dry/Frozen

Well No.	K (m/s)	Well Status	K (m/s)	Well Status
MW2023-21a	4.16×10^{-8}	Dry/Frozen	1.54×10^{-5}	Groundwater Present
MW2023-27a	3.71×10^{-6}	Dry/Frozen	8.42×10^{-9}	Dry/Frozen

5.5.2 Groundwater Chemistry Results

The analytical results for pH, dissolved sulphate, and dissolved chloride in groundwater samples collected from wells MW2023-4a and MW2023-5a are presented in **Table I** at the rear of this report. pH values were between 7.0 and 7.5, and all ion concentrations, where detected, are considered low (of no concern).

5.6 Ground Temperature Measurements

Thermistors were installed during the 2024/2025 coring work, and ground temperatures were measured in each thermistor after installation. Several thermistors have been monitored multiple times.

Initial thermistor readings generally show temperatures of -6 or -7°C at depths of 5m in the April/May monitoring period. That time of year is expected to be roughly maximum freeze depth, to be verified by subsequent measurements.

Measurements to note occur in T1 (BH2023-4b) during December, which initially showed readings of 0°C at 5mbgs. This reading could potentially be a result of the string being slow to equilibrate, or indicate the depth of ground thaw. More readings are required at all locations.

T4 (APEX2025-05) shows a different thermal profile than the thermistors in the reservoir area. The lowest temperature recorded here is -2°C, at 9mbgs. The thermal profile is expected to be different due to the proximity to the Apex River (large water body).

Temperature readings from thermistors will continue to be taken periodically to measure the ground temperature seasonally. Existing thermistor readings are considered at or close to maximum ground freeze (April/May); thermistor readings from maximum thaw are required to measure seasonal variation. Thermistor reports are presented in **Appendix G**.

5.7 Geophysical Investigation

The summarized results of the DH seismic testing completed at the Site are presented in **Table H** at the rear of this report.

Overburden/frost-riven intervals (0 – 2m in BH2023-11B, and 0 – 4mbgs in BH2023-14B) show S-wave velocities ranging from 497 to 1301m/s. In the sound bedrock intervals underlying the overburden, S-wave velocities are all in excess of 2500m/s. The corresponding assigned shear moduli range from 494 to 4,232MPa for overburden intervals, and from 15,638 to 20,938MPa for bedrock intervals.

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Both S-wave and P-wave Velocity Inversion Models at boreholes AT2023-11A and AT2023-14A are presented in the geophysical report prepared by GPR included in **Appendix E**. Please refer to that report for more detailed results and commentary.

6 Geotechnical Discussion and Recommendations

It is understood that the Site is to be developed to meet the objectives of the LTWP. The primary objectives of the LTWP are to:

- Establish a new long-term water source and the necessary infrastructure to address the City's present and future water demands, ensuring that the water supply system supports population growth; and,
- Construct a new reservoir to secure sufficient year-round water storage capacity by adding a minimum 1.5 increase in the over-winter storage capacity and meeting the current and projected needs of the City (overwinter capacity of 1,643,250m³ needed).

Currently under consideration is the raw-water reservoir and conveyance system configuration outlined in the PDR prepared by Arcadis, dated March 2024. The preliminary reservoir design consists of eight retention structures (Dam 1 and Dykes 2 to 8, including Dyke 7 which is designated as the reservoir spillway), as shown on **Figure 2**. These retention structures are to be founded directly on bedrock and will be constructed predominantly of blast rock obtained from the bedrock within the footprint of the proposed reservoir. Dam and dyke structures are similar in design, the differences being: the size of the structures; the presence of an additional buttress at the rear of the dam; and the water conveyance under the dam allowing water transit from the new reservoir to LG. The general dam/dyke structure is a homogenous rock-fill embankment with internal, filter-graded cushion layers to support the waterproof geosynthetic liner, and riprap armouring on the upstream side to protect against ice impacts.

A reservoir ring road and an access road constructed of crushed rock material is proposed from the southeast side of the reservoir to the Road to Nowhere. Several potential rock quarry sites, shown on **Figure 2**, have been selected near the proposed access road to provide the needed initial construction material.

The transfer of water from LQ to the reservoir is to occur through a water conveyance pipeline that generally follows the existing access road before it turns west to towards the reservoir. This pipeline must cross multiple water courses between LQ and the proposed reservoir, the largest being the Niaqunnguk (Apex) River.

A pump station is proposed at LQ to draw water from the lake and provide flow through the pipeline. A second pump station is proposed at Niaqunnguk (Apex) River to supplement the water draw from LQ. Both these stations will likely be constructed directly on bedrock at the locations shown on **Figure 2**.

Recommendations are provided below to guide building foundation design and construction. Further geotechnical engineering analyses may be required if there are any changes to the final configuration of the proposed development, or if unexpected conditions are encountered during construction.

6.1 Foundation Considerations

The building comments and recommendations presented below apply to the structure footprint zone presented on the PDR drawings. Should the proposed structure be located outside of the zones established in the PDR, or building parameters change, revisions to these recommendations may be required.

6.1.1 Dam and Dykes

The dam and dyke structures are to be founded directly on dressed, debris-free, competent, native granitoid bedrock. Overburden and frost-riven material are to be excavated and sidecast to expose competent rock. Given the estimated strength of the rock, structure loads are not anticipated to be cause for concern.

Angular blast rock with freshly exposed facets is expected to have a higher internal friction angle than existing boulder field material, and is thus recommended for use in the dam and dyke structures at all founding surfaces.

6.1.1.1 Foundation Drainage and Backfill

The recommended blast rock fill is expected to be free-draining and frost-resistant. Founding surfaces must direct water away from retention structure faces and toes (i.e., towards the rear of structures).

Drainage swales, either constructed of blast rock or adequately dressed bedrock surfaces, must be constructed such that surficial runoff, seepage and precipitation is directed away from retention structures. Slopes at the rear of retention structures are to be not less than 1.5%, with drainage swales constructed at greater angles as specified by hydrology event models.

6.1.1.2 Rock Surface Dressing

Founding surfaces should be ripped (i.e., with an excavator outfitted with a ripping tooth or hydraulic hammer attachment) and cleared of deleterious weathered and/or frost-riven material. It is anticipated that in the throat area (i.e., within the footprint of Dam 1) overburden and weathered bedrock will require extensive excavation and removal.

Founding surfaces are to be inspected and approved prior to the placement of concrete or engineered fill. Cobbles and boulders larger than those noted in the dam and dyke material specifications should be removed.

6.1.1.3 Dental Concrete

A certain amount of dental concrete is expected at founding surfaces, and especially around key trenches for liner systems, etc. Analytical results indicate that general use cement is appropriate for the Site.

Any large fractures or open features at surface should be sealed and backfilled using appropriate materials. Any concrete emplacements must be allowed to properly cure before loading or further construction.

6.1.1.4 Liner Embedment

Blasting is anticipated at the toe of each retention structure to construct a key trench for liner embedment. Backfill concrete and appropriate materials must be allowed to cure around the liner toe prior to loading of any kind on the liner segments.

Stepwise construction will be required, given the height of the dams and the nature of design. Underlying layers must be placed and compacted appropriately prior to liner placement. Compaction of upper layers is to be performed carefully and only after an initial settlement period has elapsed. Liner welding and friction hold will proceed concurrently with backfill activities, given the height of the structures.

6.1.1.5 Grout Curtains

A wide range of hydraulic conductivities has been measured onsite, from 1.04×10^{-5} to 1.94×10^{-10} m/s. The combination of excavation of poor quality and frost-riven zones with surface dressing, key trenches and dental concrete, may be expected to mitigate seepage at the retention structure locations. Rock RQD values generally increase with depth, and thus while some immediate areas may experience a limited amount of seepage the bulk of the reservoir volume is expected to be effectively watertight.

Given the goals of the project, additional confirmation of hydraulic conductivity and connectivity over distance is recommended.

The ‘throat’ area under Dam 1 is noted to have instances of poor to fair quality rock. Given the conveyance underneath Dam 1, larger amounts of grout and/or concrete are expected in order to waterproof this structure and the liner key trench. Overburden and/or poor rock quality appears to be more prevalent in this area than in others, and will require special attention during design.

6.1.2 Water Conveyance Pipeline

The water pipeline is expected to be used during the summer months and use the existing topography (generally sloping down from LQ to the Niaqunnguk River) to its advantage. Pipe material selection should consider the loading requirements and material type used to bury the pipe.

6.1.2.1 Foundation Drainage and Backfill

Backfill material is expected to be a combination of local borrow material (i.e., sand) and the same blast rock used to construct the retention structures. These materials are expected to be free-draining and frost-resistant.

As with roadways, founding surfaces should be sloped to promote drainage away from the pipe and fill structures. Drainage swales along the pipe alignment will be required where the natural topography does not slope away from ROW.

6.1.2.2 Pipe Embedment and Cover

Backfill material is expected to be a combination of local borrow material (i.e., sand) and the same blast rock used to construct the retention structures. Granular material compaction should be performed using hand tools immediately around the pipe itself. The blast rock material is expected to be self-compacting and should only need to be placed atop the pipe cushion layers.

Dedicated crossings using culverts are recommended to avoid heavy equipment loading the angular blast rock material on top of the pipe once in place.

6.1.2.3 River Crossing

The river crossing is expected to incorporate a pipe pile/pier design, as is typical in the region. Borehole data along the proposed river crossing indicates bedrock ranges from 7.0 to 12.5 mbgs across the Niaqunnguk (Apex) River bed with the bedrock surface rising to 2.4 mbgs along the northern shore.

Design parameters and considerations for the river crossing using a Rock Socket Steel Pipe Pile design are presented in ABG’s Geotechnical Investigation report in **Appendix H**.

6.1.3 Pump Station (Niaqunnguk River)

The overburden material in and around the Apex River differs somewhat from the washed cobble/boulder veneer present in the reservoir area. Bulk material characteristics are similar, with sand/silty sand forming the interstitial matrix between cobbles/boulders, but with the added component of water and ice throughout. Please refer to the ABG Geotechnical Investigation Report provided in **Appendix H** for greater detail and discussion.

6.1.3.1 Building Foundation

A detailed discussion of recommended pile foundations is included in the aforementioned Geotechnical Investigation Report. Shallow foundations are not recommended in the area due to the presence of ice-rich soils and relatively warmer ground temperatures in proximity to the Apex River.

Concrete footings on bedrock may be possible. Further investigation (test pits) are recommended in the area to verify the depth of overburden across the area of the pump station footprint.

6.1.3.2 Slab Foundations

Seasonal thaw and freezeback of the active layer will result in seasonal movement of any exterior slabs and/or unheated ancillary equipment founded directly on grade, necessitating flexible connections. Slabs should also be sufficiently rigid to accommodate potential differential movement.

6.1.3.3 Rock Surface Dressing

Founding surfaces should be ripped (i.e., with an excavator outfitted with a ripping tooth or hydraulic hammer attachment) and cleared of deleterious weathered and/or frost-riven material. It is anticipated that overburden and weathered bedrock will require extensive excavation and removal. Unlike the dam/dyke foundations, all cobbles and boulders should be removed.

Founding surfaces are to be inspected and approved prior to the placement of concrete or engineered fill.

6.1.3.4 Dental Concrete

A certain amount of dental concrete is expected at founding surfaces, and especially around wet wells, trenches for water conveyances, etc. Analytical results indicate that general use cement is appropriate for the Site.

Any large fractures or open features at surface should be sealed and backfilled using appropriate materials. Any concrete emplacements must be allowed to properly cure before loading or further construction.

6.1.3.5 Grading, Foundation Drainage and Backfill

Final site grades must eliminate the potential for ponding water and ensure drainage away from structures. It is further recommended that cuts into the native soil be avoided, and design grades reached by building above native grades where possible.

Parking areas/roadways are anticipated to be gravel surfaces. A minimum of 200mm of surface/base course material, underlain by at least 300mm of sub-base material, is recommended across all driveway, parking, and roadway areas. Heavy-duty areas (e.g., heavy construction equipment access) should receive an additional 300mm of sub-base material, unless founded directly on sound bedrock. Recommendations for backfill

components, (including Type I and II material specifications), thicknesses, required compaction, etc., are all included in ABG's Geotechnical Investigation Report (**Appendix H**).

All founding surfaces must be inspected by a geotechnical engineer prior to placement of fill or concrete. Construction planning should consider the potential for underlying permafrost soils to thaw/soften during excavations. Excavation should be limited to only those areas deemed necessary, and be carried out in stages to minimize the length of time excavations remain open/below previous grade. Please see **Appendix H** for greater detail and discussion.

6.2 Seismic Considerations

Geophysics GPR International Inc. (GPR) was retained to perform downhole seismic analyses in order to obtain site-specific values from the site. Please refer to their report, provided in **Appendix E**, for more details on methodology and results.

6.2.1 Seismic Site Classification

Given the presence of competent rock at/near surface, the site class for seismic response in the reservoir area considered to be is Class A (hard rock) for the foundations bearing on competent rock. Site surveys confirm this evaluation, with V_{s30} well over 1500 m/s.

The Apex River Pump Station site can be classified as "X_c" for seismic site response, given the presence of a larger soil fraction. Soils are not considered liquefiable.

6.2.2 Seismic Hazard

The Iqaluit area is, historically, an area of low seismic activity. No notable seismic activity has been reported in or around the entire Frobisher Bay area from 1627 – 2015, as best as can be determined.

The seismic loading for designing new dams is determined by the intensity of the ground shaking expected at the dam site, and is not governed by the magnitude of the quake alone. Existing reports (e.g., the LG DSR, Concentric 2021) report using estimated ground motion values as extrapolated by the NBCC seismic estimating tool for the area. These reports typically rationalize using the extrapolated PGA values instead of carrying out S(T_a) analyses, in order to avoid carrying out analyses with overly conservative assumptions for a very stiff structure (the dam is concrete, founded directly on bedrock).

Both methods will be examined during the new structure design process, using the site-specific values obtained in December 2024.

6.2.3 Seismic Modelling

The CDA technical guidance documents specify seismic modelling guidelines for the differing dam risk classes. The existing LG dam and proposed Dam 1 are both classified as Extreme Risk, and thus require definition of earthquake design ground motion (EDGM) parameters using both a) local and regional geotectonic information (of which the seismic parameters obtained in 2024 are a part), and b) statistical analyses of historical earthquakes experienced in the region.

These analyses will be performed as part of the design process.

6.3 Subgrade

The stratigraphy in the area consists mainly of discontinuous frost-riven rubble and washed-till blankets from 0.5 to 2.0m thick. The subgrade is essentially bedrock, of varying condition, and that is the assumed founding surface for all structures/utilities.

6.3.1 Site Grading

Given the majority of the reservoir footprint is to be blasted and excavated, site grading is expected to be fairly rough. Grading inside the reservoir footprint is not of large importance. The rock fill structures should easily incorporate rough grading, which will add a level of friction and stability to founding surfaces, provided they are adequately drained.

Cut and fill structures are expected to be required, in different locations, for access roads and laydown areas. As with other structures, ROW founding surfaces should have deleterious and/or frost-riven material removed and be graded to promote drainage away from footprints. Surficial drainage courses are expected to be required at some sections around access roads, and water discharge points (culverts) will be required at select locations.

6.3.2 Engineered and Native Fill

6.3.2.1 Sand Fill

Sand fill is to be obtained from local borrow pits onsite. Please refer to Arcadis' *Aggregate Assessment Report*, provided under separate cover, for more details regarding these potential sources.

The material encountered at potential borrow sources BP1, BP2, and BP3 during this investigation is predominantly well-graded sand, with the rare exception, and suitable for the intended uses, i.e., liner/pipeline cushion layers, roadway surface courses. Some stockpiling and sorting is expected to be required, depending on exact material specifications for different applications.

Soils from BP4 may be acceptable for use as well, depending on design specifications. Field characterization and laboratory testing show a material is typical of a glacial moraine (till) feature, albeit a relatively well-drained one: compact, heterogeneous, poorly sorted, and with a relatively high density and internal friction angle. Several layers in the dam construction design call for coarser gradations, and BP4 materials may have adequate drainage, shear strength, and internal friction angles to be of potential use. It is anticipated that some processing would be required to render these materials acceptable for use in construction, but with a potentially very large volume available, this resource may be worth developing.

A more extensive test pit program is recommended to more fully define available volumes and confirm material gradation and extents.

Recommendations for backfill components, (including Type I and II material specifications), thicknesses, required compaction, etc., are all included in ABG's Geotechnical Investigation Report (**Appendix H**).

6.3.2.2 Crushed Rock Fill

Multiple gradations of crushed rock fill may be required. It is understood that the blasting program will be designed to produce 150mm minus material, which is appropriate for the intended uses as detailed above, subject to design specification.

The produced material is expected to be angular, rough, free-draining and frost- and erosion-resistant. The majority of the structures will be able to incorporate various particle sizes, to a degree. Sorting after excavation is expected to be minimal. Larger gradations up to 1m in diameter will have applications as riprap, armour stone and vehicular guard obstacles. Very large boulders may need to be crushed or split before use.

6.3.3 Slab on Grade Considerations

Slab-on-grade construction could be appropriate for certain components onsite. Details are not known regarding the floor grade(s); however, topsoil, humus, and the existing surficial silt soils are not considered suitable for support of building floor slabs and should be excavated and removed, along with any other weak/deleterious material (none encountered at borehole locations). Exposed surfaces of the native sand and gravel are considered suitable for slab-on-grade-support, after being proof-rolled to identify soft spots – which should be repaired through excavation and backfilled with an appropriate engineered fill as discussed in **Section 6.3.2**.

Any building floor slabs should be constructed to be independent of the building foundation walls and any other parts of the structure that will be supported by different soils to minimize differential settlement issues.

A minimum 150mm thick layer of compacted, free-draining granular or clear crushed stone material should be placed between any prepared soil subgrade and the building floor slab to provide sub-slab drainage, moisture migration control and support. If any native/reworked material options are used, given the variable subgrade soil potentially present it is recommended that a layer of a non-woven geotextile be placed to separate the crushed stone from the subgrade.

Proof-rolling and geotechnical inspection is required to ensure that founding surfaces are of acceptable, undisturbed native soils prior to placing crushed stone, engineered fill, or concrete.

6.3.4 Groundwater Interpretation

Groundwater at the Site was investigated using piezometers installed across the proposed footprint of the reservoir. Most boreholes, and therefore wells, were advanced in regions directly under proposed dam and dyke structures. The well screens were installed in the surficial bedrock formation to a maximum depth of 8.7mbgs. Data collected as of October 2024 indicates that groundwater, when present, is found between 0.4 and 2.8mbgs. Interpretation of groundwater levels suggest groundwater flow at the Site is closely connected to topography. Groundwater flows from regions of high elevation around the proposed reservoir to the nearby waterbodies and watercourses, as shown in **Figure 5** and **Figure 6**.

Ice formation in the ground strongly influences groundwater behavior at the Site. Thawing of the ground over the summer months results in increased groundwater activity in shallow bedrock as the depth of the active layer above permafrost increases. Preliminary data indicates that groundwater is present in shallow bedrock under the footprint of proposed Dam 1 and Dykes 2 and 3 as early as August. The presence of groundwater in shallow bedrock can be expected to increase into the fall season and deepen in areas where overburden material is removed.

Bedrock permeability at the Site was found to be higher during October than August, expected to be due to fluctuations in the active layer. Preliminary permeability testing indicates that horizontal hydraulic conductivity in thawed bedrock above 5.5mbgs can be expected to range between 1.47×10^{-5} and 8.51×10^{-6} m/s.

6.3.5 Groundwater Considerations

If groundwater is encountered in shallow excavations, it may be able to be managed by pumping from a system of drainage swales and sumps inside the excavation locations.

The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium. Discharged water is expected to be directed toward natural drainage courses that do not feed into LG, unless the appropriate approvals are obtained.

The finished surface grades should be sloped away from the proposed structures to prevent surface ponding and infiltration immediately adjacent to any construction. Backfill adjacent to structures should comprise compacted, free-draining granular materials.

6.3.5.1 Initial Dewatering

The surface water in the reservoir footprint will need to be evacuated prior to drilling and blasting. Given the source and native providence of the water, it is expected that discharge overland to the Niaqunnguk River is an acceptable solution. It is understood that these surface water bodies are filled via the freshet, and refill via groundwater after evacuation is expected to be minimal.

6.3.5.2 Dewatering During Construction

Inferred groundwater flow generally follows the bedrock surface and appears to be primarily driven by the interflow of precipitation.

Given the low amount of precipitation in the area, the presence of permafrost, the quality of bedrock and proximity to the surface, and the depth of excavation required, groundwater infiltration is expected to be minimal. Precipitation events and the annual freshet will require dewatering, although the catchment area is relatively small. Adequate dewatering is expected to be achieved via a series of sumps across the reservoir footprint until excavation targets are reached and structures have been fully constructed.

6.3.6 Permafrost Considerations

The active layer appears to extend from 1.5 to 5.5mbgs within the proposed reservoir area, based on the freeze/thaw of groundwater noted in the monitoring wells placed onsite and initial thermistor readings. This must be verified by subsequent seasonal measurements. This is expected to impact blasting, excavation, and dewatering onsite. Continued monitoring is recommended at the Site to measure active layer fluctuations, timing, speed, and long-term trends.

All founding surfaces must be inspected by a geotechnical engineer prior to placement of fill or concrete. Construction planning should consider the potential for underlying permafrost soils to thaw/soften during excavations. Excavation should be limited to only those areas deemed necessary, and be carried out in stages to minimize the length of time excavations remain open/below previous grade.

Continual monitoring of the active layer and deeper permafrost will be required over the lifespan of the project as the expected talik under the new reservoir expands. Some freezeback may be expected in the retention structures given their size. Free drainage is thus important in these areas. Founding surface drainage and appropriate materials are required for all structures.

Additional thermistors and a long-term monitoring program are recommended.

6.3.7 Bedrock Acid Drainage Potential

The bedrock at the Site is classified as not-potentially net acidic (Non-PAG) material. Based on the criteria established in the Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials (Price, 2009), the Non-PAG classification was considered appropriate as the NPRs for all bedrock samples were greater than 2.

6.4 Future Recommendations

6.4.1 Additional Investigation Work

Further recommendations may be made following the ongoing investigation onsite.

6.4.1.1 Additional Borehole Locations

Given the size and extent of the project construction, additional boreholes are recommended to confirm the findings and data obtained thus far. Additional data will allow for smaller tolerances and less uncertainty in the Geotechnical Baseline Report, to be provided under separate cover. Combined with the recommended test pit program, additional boreholes will provide greater definition of the overburden layer types and depths, and confirm rock types across the reservoir footprint. Additional boreholes are also recommended within the footprints of the proposed retention structures, along the access road to LQ, and at the proposed pump station location at LQ to inform structure design. Added boreholes and greater site coverage will ultimately allow for design refinement, a more precise specification and tender package, and greater certainty and cost control during construction.

Existing and new boreholes would be used to perform the packer testing discussed below. Additional, deeper boreholes advanced via air track would also allow for additional thermistors to be installed. Thermistor installation is planned at each structure location onsite. Maximum ground thaw depths have not yet been verified – seasonal thermistor data is still required – but the active layer, as measured in T1 in December and inferred from frozen monitoring wells onsite, may be deeper than anticipated. Pending seasonal results and verification of the maximum thaw depth, additional thermistors to greater depths are recommended in the reservoir footprint area. This will provide a greater understanding of the current permafrost configuration and allow for more detailed modelling of the active layer, permafrost and potential talik progression over time. A long-term thermistor monitoring program is also recommended.

6.4.1.2 Packer Testing

In order to refine estimates of underlying bedrock permeability, packer testing is recommended at select core holes advanced at each dam, dyke or spillway locations. Given the range of hydraulic conductivities found at

different locations and depths onsite, packer testing is recommended to isolate particular intervals of interest at potential problem locations.

Specific intervals at each borehole (identified through coring) will be isolated using inflatable bladders on an apparatus called a packer system; when lowered to the target depth, the bladders are hydraulically inflated using fluid in drill rods to seal against the edges of the borehole. Permeability testing is then performed on the isolated interval (pressure injections of clean water). Pressure and flow rates are recorded during a test and analytical methods (e.g., Thiem equation) are used to determine the hydraulic conductivity of the unit and transmissivity of the zone. Packer testing also allows for the simulation of increased hydraulic head pressures in the targeted intervals.

Initial permeability calculations have allowed the design to progress to the current stage. Targeting testing is recommended at the areas where seepage could potentially be an issue (e.g. in the throat area) as the design is refined.

6.4.1.3 Test Pit Program

A test pit program is recommended for the summer/fall of 2025, when ground thaw is at the largest extent. Test pits are recommended:

- to assess the depth and extent of potential borrow sources while obtaining samples for further geotechnical testing;
 - Additional testing would include Standard Proctor, column permeability, shear box testing and material interface friction tests, all required to finalize design.
- at locations of interest along the existing roadway/planned pipeline conveyance to aid in road upgrades and pipeline foundation design; and
- in and around the proposed footprints of the pump stations at Apex River and LQ to assess overburden, depth to bedrock, and aid in foundation design.

Four potential borrow sources, previously used during the construction of the road to LQ, have been identified, are shown on **Figure 2**, and are further detailed in Arcadis' *Aggregate Assessment Report*.

A second testpit program is recommended for the summer/fall of 2026 once an access road to the proposed reservoir has been constructed as part of the Early Works construction activities. Test pits are recommended:

- to assess the depth and composition of till veneer in the reservoir area;
- to expose and assess bedrock uniformity along the proposed dam and dyke alignments; and,
- to assess excavation strategies for weathered/frost-riven bedrock at structure footprint locations (constructability).

ABG will mobilize a local excavator and supervise excavation and sampling activities. Test pits will be terminated at either bedrock/permafrost or the maximum reach of the excavator (3m). All test pits will be backfilled and compacted using the bucket of the excavator to closely match the existing grade at test pit locations.

Soil in the testpits will be examined by the Arcadis field technician upon recovery for purposes of soil characterization, which will include noting texture, colour, odour, moisture content as well as evidence of environmental impacts (odour and staining).

Samples from representative stratigraphy at each proposed borrow source will also be obtained. The first sample will be collected at a depth not greater than 750mm and succeeding samples at not more than 1500mm increments of depth. Select soil samples will be submitted to accredited laboratories for geotechnical testing.

6.4.2 Geotechnical Consultation During Design Process

The geotechnical recommendations provided herein to assist preliminary foundation and building design are general in nature as the design of the proposed structures has not yet been finalized. The recommendations will be reviewed by Arcadis prior to final design and construction to assess their applicability to the proposed structure. Site-specific foundation design recommendations will be required for components of the proposed structure.

6.4.3 Geotechnical Supervision During Construction

Development of the Site will require movement of a variety of soil and rock types as well as specialized foundation installations. A qualified geotechnical engineer must be retained to inspect and approve the subgrade prior to placement of any engineered media and to supervise the installation of foundations. Geotechnical supervision should also be provided to ensure that engineered fill placed beneath floor slabs, roadways and other applications is properly compacted and that any weak soil layers are properly removed. Geotechnical inspection of the bearing conditions for the proposed foundation system must also be carried out.

Geotechnical site supervision and review is required during future construction activities. It is recommended that the following material testing and observation program be performed by a licensed geotechnical engineering consultant during construction operations:

- Observation of all bearing surfaces prior to the placement of concrete/crushed stone/engineered fill;
- Sampling and testing of any concrete and fill materials used;
- Periodic observation of the condition of unsupported excavation side slopes, if applicable;
- Observation of all subgrades prior to backfilling;
- Field density tests to determine the level of compaction achieved, as applicable;
- Sampling, testing and verification of construction materials; and
- Verification of spec compliance and any necessary amendments to design specifications.

A report confirming that these construction works have been conducted in general accordance with geotechnical recommendations would then be issued following the completion of a satisfactory material testing and observation program by the geotechnical consultant. It is recommended that all footing excavations be inspected by competent geotechnical personnel to ensure that a proper bearing surface has been attained and that foundation designs are suited to site conditions.

7 Statement of Limitations

This draft iteration of this geotechnical report is not to be distributed, reproduced, or relied upon by any party. Further data and site investigation is expected, and the report will be expanded.

This report, prepared for City of Iqaluit, does not provide certification or warranty, expressed or implied, that the investigation conducted by Arcadis uncovered all potential geotechnical constraints at the Site. The conclusions and recommendations presented in this geotechnical investigation report are based on the information determined at the borehole locations. The information contained within this report in no way reflects the environmental aspect of the Site or soil, unless specifically reported upon. Subsurface and groundwater conditions between and beyond the test locations may differ from those encountered at the specific locations tested, and conditions may be encountered during construction which were not detected and could not be anticipated at the time of the site investigation. It is recommended that Arcadis be retained during construction to confirm that the subsurface conditions throughout the Site do not differ materially from those conditions encountered at the test locations.

The design recommendations provided in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not have been available at the time this report was prepared, it is recommended that Arcadis be retained during future stages of the design process to verify that the design is consistent with the recommendations of this report, and that the assumptions made in the analyses contained in this report are still valid. The need for additional subsurface investigation work and laboratory testing should be reviewed by Arcadis during the course of the detail design work.

The comments given in this report on potential construction problems and possible methods of construction are intended only for the guidance of the designer. The number of boreholes/ groundwater monitoring wells may not be sufficient to determine all of the factors that may affect construction methods and costs (e.g., the thickness of surficial topsoil and fill layers can vary markedly and unpredictably). Contractors bidding on the project or undertaking the construction should, therefore, make their own interpretations of the factual information in this report and draw their own conclusions as to how the subsurface conditions may affect their bid or work.

The material in this report reflects the best judgement of Arcadis based on the information available at the time of preparation, June 2025. Changes to soil and/or groundwater quality in the areas investigated can occur following the date of testing. Any use which a third party makes of the report, or reliance on, or decisions to be based on it, is the responsibility of such third parties. Arcadis accepts no liability, whether in negligence, contract or arising on any other basis for damages or from indemnification arising from decisions or actions by others based on this report.

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Tables

Table A - Borehole Location and Elevations Summary

Borehole Number	Location	Instrument	Ground Surface Elevation	Borehole Depth	Borehole Base Elevation	Depth to Bedrock	Bedrock Elevation	Estimated Competent Bedrock Elevation	Depth to Well Screen	Well Screen Elevation	Easting	Northing
			masl	mbgs	masl	mbgs	masl	masl	mbgs	masl	UTM 19V	UTM 19V
BH2023-1b	Dam 1	Thermistor	133.51	5.1	128.40	0.0	133.51	131.6	--	--	525187	7070208
AT2023-2a	Dam 1	Piezometer	119.88	5.8	114.08	2.5	117.38	117.4	3.0	116.9	525058	7070210
BH2023-2b	Dam 1	--	120.85	5.0	115.85	0.0	120.85	119.2	--	--	525078	7070216
AT2023-3	Dam 1	--	119.33	5.9	113.43	2.5	116.83	116.8	--	--	525013	7070207
AT2023-4a	Dam 1	Piezometer	118.81	5.8	113.01	2.0	116.86	115.8	2.8	116.1	524975	7070238
BH2023-4b	Dam 1	Thermistor	119.18	5.0	114.18	0.0	119.18	118.2	--	--	524996	7070215
AT2023-5a	Dam 1	Piezometer	119.38	5.0	114.38	0.5	118.88	118.2	1.8	117.6	524952	7070302
BH2023-5b	Dam 1	--	119.56	4.8	114.75	0.0	119.56	119.6	--	--	524945	7070304
AT2023-6	Dam 1	--	121.51	7.9	113.61	3.9	117.61	117.6	--	--	524954	7070345
AT2023-7a	Dam 1	Piezometer	124.64	4.7	119.94	1.1	123.54	123.5	1.8	122.9	524952	7070386
BH2023-7b	Dam 1	--	124.15	5.1	119.04	0.0	124.15	123.9	--	--	524940	7070369
AT2023-8	Dam 1	--	125.21	10.2	115.01	2.0	123.21	118.6	--	--	524952	7070436
AT2023-9a	Dam 1	Piezometer	123.54	6.1	117.44	2.4	121.14	121.1	3.0	120.5	524951	7070485
BH2023-9b	Dam 1	Thermistor	123.47	5.0	118.43	0.0	123.47	123.3	--	--	524956	7070482
AT2023-10	Dam 1	--	133.57	5.3	128.27	1.7	131.87	123.1	--	--	524951	7070532
AT2023-11A	Reservoir	--	120.69	8.2	112.49	0.0	120.69	120.7	--	--	525061	7070492
AT2023-11B	Reservoir	--	120.66	11.3	109.36	0.8	119.86	113.7	--	--	525062	7070495
AT2023-12a	Dyke 2	Piezometer	125.50	4.0	121.50	0.0	125.50	125.5	1.0	124.5	524885	7070647
BH2023-12b	Dyke 2	Thermistor	125.03	5.2	119.81	0.0	125.03	124.7	--	--	524883	7070646
AT2023-13a	Dyke 3	Piezometer	125.53	4.7	120.83	1.3	124.23	123.5	1.8	123.8	524796	7070765
BH2023-13b	Dyke 3	Thermistor	126.25	5.2	121.04	0.0	126.25	124.4	--	--	524789	7070772
AT2023-14A	Reservoir	--	121.61	10.1	111.51	0.8	120.86	120.9	--	--	524900	7070797
AT2023-14B	Reservoir	--	121.05	11.3	109.75	1.8	119.25	119.3	--	--	524870	7070791
AT2023-15a	Dyke 4	Piezometer	126.18	6.9	119.28	2.4	123.78	120.0	3.0	123.2	524762	7070906
BH2023-15b	Dyke 4	Thermistor	127.23	5.2	122.05	0.0	127.23	126.2	--	--	524744	7070904
AT2023-16	Dyke 5	--	127.18	7.0	120.18	3.7	123.48	123.5	--	--	524941	7070926
AT2023-17a	Dyke 6	Piezometer	121.73	7.5	114.23	2.1	119.63	118.1	3.0	118.7	525039	7070874
BH2023-17b	Dyke 6	--	122.49	3.1	119.39	0.0	122.49	122.2	--	--	525028	7070862
AT2023-18	Dyke 6	--	122.68	5.6	117.08	1.8	120.88	118.4	--	--	525088	7070815
AT2023-19a	Dyke 7	Piezometer	126.89	6.0	120.89	1.8	125.09	124.5	2.3	124.6	525207	7070709
BH2023-19b	Dyke 7	Thermistor	128.05	5.0	123.07	0.0	128.05	127.0	--	--	525218	7070697
AT2023-20	Dyke 7	--	128.73	11.3	117.43	0.0	128.73	128.7	--	--	525137	7070656
AT2023-21	Reservoir	Piezometer	126.49	6.0	120.49	1.8	124.69	124.7	2.3	124.2	525257	7070416
AT2023-25	Rock Quarry	--	124.03	11.3	112.73	1.1	122.93	121.5	--	--	526040	7069931
AT2023-27a	Dyke 8	Piezometer	120.73	8.7	112.03	1.9	118.83	116.0	2.3	118.5	525549	7070202
BH2023-27b	Dyke 8	Thermistor	125.95	5.1	120.84	0.0	125.95	125.9	--	--	525533	7070246
BH2023-28b	Dyke 6	Thermistor	124.05	5.0	119.02	0.0	124.05	121.9	--	--	525070	7070855
APEX2025-01	Apex River	--	95.40	13.7	81.70	12.5	82.90	13.7	--	--	525848	7070398
APEX2025-02	Apex River	--	95.24	9.1	86.14	7.3	87.94	9.1	--	--	525867	7070408
APEX2025-03	Apex River	--	95.65	9.1	86.55	7.0	88.65	9.1	--	--	525883	7070425
APEX2025-04	Apex River	--	95.56	11.0	84.56	7.9	87.66	11.0	--	--	525848	7070442
APEX2025-05	Apex River	Thermistor	100.08	9.1	90.98	2.4	97.68	9.1	--	--	525884	7070475

Notes:

Not Available or Not Applicable is signified by "--"

Metres above mean sea level (masl)

Metres below ground surface (mbgs)

Screen intervals are 3.05m unless otherwise noted. Elevation given is the top of the screen

Table B - Groundwater Elevations

Well / Piezometer Number	Associated Borehole Number	Location	Ground Surface Elevation	Top of Riser Elevation	Stick Up Height	Top of Well Screen	Bottom of Well Screen	Depth to	Depth to	Water Elevation	Depth to	Depth to	Water Elevation
								Water	Well		Water	Well	
								Bottom	Bottom	August 14, 2024		October 2, 2024	
			masl	masl	mags	mbgs	mbgs	mbgs	mbgs	masl	mbgs	mbgs	masl
MW2023-2a	AT2023-2a	DAM 1	119.88	120.80	0.92	3.00	5.80	ND	5.69	Dry/Frozen	ND	5.41	Dry/Frozen
MW2023-4a	AT2023-4a	DAM 1	118.81	119.76	0.95	2.75	5.80	ND	5.71	Dry/Frozen	1.562	5.44	117.25
MW2023-5a	AT2023-5a	DAM 1	119.38	120.24	0.86	1.75	5.00	2.410	3.65	116.97	2.355	4.95	117.03
MW2023-7a	AT2023-7a	DAM 1	124.64	125.60	0.96	1.75	4.70	2.678	3.13	121.96	2.575	4.00	121.28
MW2023-9a	AT2023-9a	DAM 1	123.54	124.46	0.92	3.00	6.10	ND	6.07	Dry/Frozen	ND	5.96	Dry/Frozen
MW2023-12a	AT2023-12a	Dyke 2	125.50	126.41	0.91	1.00	4.00	0.693	3.33	124.81	1.727	3.90	123.77
MW2023-13a	AT2023-13a	Dyke 3	125.53	126.36	0.83	1.75	4.70	2.326	2.74	123.20	2.784	3.73	122.75
MW2023-15a	AT2023-15a	Dyke 4	126.18	127.15	0.97	3.00	6.90	ND	6.85	Dry/Frozen	ND	6.82	Dry/Frozen
MW2023-17a	AT2023-17a	Dyke 6	121.73	122.39	0.66	3.00	7.50	ND	7.22	Dry/Frozen	1.858	2.85	119.87
MW2023-19a	AT2023-19a	Dyke 7	126.89	127.86	0.97	2.25	6.00	ND	6.15	Dry/Frozen	ND	5.74	Dry/Frozen
MW2023-21	AT2023-21	Reservoir	126.49	127.49	1.00	2.25	6.00	ND	5.99	Dry/Frozen	0.408	3.38	126.08
MW2023-27a	AT2023-27a	Dyke 8	120.73	121.62	0.89	2.25	8.70	ND	8.25	Dry/Frozen	ND	8.10	Dry/Frozen

Notes:

Metres above ground surface (mags)

Metres above mean sea level (masl)

Metres below ground surface (mbgs)

No water detected (ND)

Table C - Grain Size Analyses Summary

Borehole Number	Sample ID	Depth (mbgs)	Gravel	Sand	Silt	Clay	Classification
BP1-A1	composite	0.10	3%	91%	4%	2%	SAND
BP1-A2	composite	0.10	0%	10%	81%	8%	SILT, trace sand and clay
BP1-A3	composite	0.10	0%	89%	9%	2%	SAND, trace silt
BP2-A1	composite	0.10	13%	85%	1%	1%	SAND, some gravel
BP2-A2	composite	0.10	4%	93%	2%	1%	SAND
BP2-A3	composite	0.10	1%	79%	19%	2%	SAND, some silt
BP3-A1	composite	0.10	0%	93%	6%	1%	SAND, trace silt
BP3-A2	composite	0.10	0%	84%	14%	2%	SAND, some silt
BP3-A3	composite	0.10	0%	95%	5%	0%	SAND, trace silt
BP4-A1	composite	0.10	14%	71%	15%	0%	SAND, some gravel and silt
BP4-A2	composite	0.10	15%	69%	15%	1%	SAND, some gravel and silt
BP4-A3	composite	0.10	14%	64%	21%	1%	SAND, some gravel and silt

Notes:

Depth given is the start of sample interval unless otherwise noted.

Grain size analyses were performed by BV Labs, a CCIL accredited laboratory.

Laboratory certificates are provided in the report appendices.

Metres below ground surface (mbgs)

Table D - Proctor Testing Summary

Borehole Number	Sample ID	Depth (mbgs)	Maximum Dry Density (kg/m ³)	Optimum Moisture Content (%)
BP1-A1	composite	0.10	1728.00	14.6
BP1-A2	composite	0.10	1748.00	15.5
BP1-A3	composite	0.10	1647.00	15.4
BP2-A1	composite	0.10	1782 / 1840*	13.4 / 12.4*
BP2-A2	composite	0.10	1672.00	12.0
BP2-A3	composite	0.10	1761.00	11.2
BP3-A1	composite	0.10	1642.00	15.2
BP3-A2	composite	0.10	1718.00	13.0
BP3-A3	composite	0.10	1690.00	14.0
BP4-A1	composite	0.10	2135 / 2209*	5.0 / 4.4*
BP4-A2	composite	0.10	2104 / 2198*	7.1 / 6.0*
BP4-A3	composite	0.10	2010 / 2118*	8.8 / 7.1*

Notes:

Depth given is the start of sample interval unless otherwise noted.

Proctor tests were performed by Stantec, a CCIL accredited laboratory.

Laboratory certificates are provided in the report appendices.

Metres below ground surface (mbgs)

* corrected value

Table E - Conductivity Testing Summary

Borehole Number	Sample ID	Depth (mbgs)	Test No.	k ₂₀ (cm/s)	Average k ₂₀ (cm/s)
BP1-A1	composite	0.10	1	1.28E-03	1.36E-03
BP1-A1	composite	0.10	2	1.42E-03	
BP1-A1	composite	0.10	3	1.39E-03	
BP2-A1	composite	0.10	1	1.49E-02	1.25E-02
BP2-A1	composite	0.10	2	1.13E-02	
BP2-A1	composite	0.10	3	1.13E-02	
BP2-A2	composite	0.10	1	2.27E-03	2.90E-03
BP2-A2	composite	0.10	2	2.76E-03	
BP2-A2	composite	0.10	3	3.67E-03	
BP2-A3	composite	0.10	1	9.10E-04	9.73E-04
BP2-A3	composite	0.10	2	9.79E-04	
BP2-A3	composite	0.10	3	1.03E-03	
BP3-A1	composite	0.10	1	1.46E-03	1.55E-03
BP3-A1	composite	0.10	2	1.54E-03	
BP3-A1	composite	0.10	3	1.65E-03	
BP3-A3	composite	0.10	1	1.30E-03	1.42E-03
BP3-A3	composite	0.10	2	1.45E-03	
BP3-A3	composite	0.10	3	1.50E-03	
BP4-A1	composite	0.10	1	6.54E-05	6.46E-05
BP4-A1	composite	0.10	2	6.48E-05	
BP4-A1	composite	0.10	3	6.36E-05	

Notes:

Depth given is the start of sample interval unless otherwise noted.
 Permeability testing performed by Stantec, a CCIL accredited laboratory.
 Laboratory certificates are provided in the report appendices.
 Metres below ground surface (mbgs)
 * corrected value

Table F - Shear Box Testing Summary

Borehole Number	Sample ID	Depth (mbgs)	Cohesion (kPa)	Peak Friction Angle (degrees)	Ultimate Friction Angle (degrees)
BP1-A1	composite	0.10	0	33	27
BP2-A1	composite	0.10	0	38	27
BP3-A1	composite	0.10	0	33	27
BP4-A1	composite	0.10	0	38	32

Notes:

Depth given is the start of sample interval unless otherwise noted.

Direct shear tests were performed by Stantec, a CCIL accredited laboratory.

Laboratory certificates are provided in the report appendices.

Metres below ground surface (mbgs)

Table G - Unconfined Compressive Strength Testing Summary

Borehole Number	Sample ID	Depth Interval (mbgs)	Unit Weight (g/cm ³)	Tensile Strength (MPa)	Unconfined Compressive Strength (Mpa)	Modulus of Elasticity (GPa)
BH2023-2b	BH2023-02B-76.5-93	0.77 - 0.93	2.708	7.470	271.15	NC ⁽¹⁾
BH2023-2b	BH2023-02B-407-428	4.07 - 4.28	2.704	4.650	206.33	56.84
BH2023-4b	BH2023-04B-00-28	0.00 - 0.28	2.708	5.900	229.07	61.38
BH2023-4b	BH2023-04B-346-367	3.46 - 3.67	2.717	5.780	252.04	73.01
BH2023-5b	BH2023-5B-162-179	1.62 - 1.79	2.729	6.740	238.09	58.81
BH2023-7b	BH2023-7B-318-335	3.18 - 3.35	2.690	NC ⁽²⁾	115.48*	NC ⁽¹⁾
BH2023-13b	13B-258-280	2.58 - 280	2.715	11.035	191.82	66.80
BH2023-15b	15B-45-63	0.45 - 0.63	2.743	4.679	162.95	59.95
BH2023-17b	BH2023-17B-289-310	2.89 - 3.10	2.646	13.300	219.64	61.50
BH2023-19b	BH2023-19B-92-115	0.92 - 1.15	2.720	7.895	238.24	63.71
BH2023-27b	27B-102-126	1.02 - 1.26	2.672	7.317	95.57**	51.50

Notes:

Depth given is the start of sample interval unless otherwise noted.

Testing was performed by PNJ Engineering, a CCIL accredited laboratory.

Laboratory certificates are provided in the report appendices.

Metres below ground surface (mbgs)

(1) MOE could not be calculated due to issues with load data recording.

(2) Tensile could not be accurately calculated as sample failed instantly while seating load.

* sudden failure along a suspected plane of weakness (parallel to loading direction). Measurement is not considered representative for *in situ* rock mass.

** visible fissures and material heterogeneity, and non-linear stress/strain curve from left side strain gauge indicates localized movement. Measurement is not considered representative of *in situ* rock mass.

Table H - Downhole Seismic Testing Summary

Borehole Number	Depth Interval (mbgs)	P-wave Velocity (m/s)	S-wave Velocity (m/s)	Assumed Density (g/cm ³)	Shear Modulus (MPa)	Poisson's Ratio	Modulus of Elasticity (MPa)	Bulk Modulus (MPa)
BH2023-11B	0 - 1	1708	497	2	494	0.45	1436	5176
	1 - 2	3226	1301	2.5	4232	0.4	11873	20376
	2 - 6	5231	2894	2.5	20938	0.28	53579	40491
BH2023-14AB	0 - 3	1546	660	2	871	0.39	2419	3619
	3 - 4	2608	802	2.5	1608	0.45	4656	14860
	4 - 8	4732	2702	2.5	18252	0.26	45926	31644
	8 - 10	4285	2501	2.8	15638	0.24	38833	25053

Notes:

Depth given is the start of sample interval unless otherwise noted.

Testing was performed in the field by GPR International.

Inversion models are provided in the report appendices.

Metres below ground surface (mbgs)

Borehole	Units	MW2023-4	MW2023-5
Sample ID		AFHN15	AFHN16
Collection Date		2024-10-05	2024-10-05
Physical Tests			
pH	pH	7.45	7.23
Dissolved Sulphate (SO ₄)	mg/L	1.2	1.6
Dissolved Chloride (Cl ⁻)	mg/L	>1.0	>1.0

Notes:

All tests were performed by BV Labs, a CALA accredited laboratory.

Laboratory certificates are provided in the report appendices.

Metres below ground surface (mbgs)

Table J - Modified Acid/Base Accounting Results

Borehole		AT2023-03	AT2023-14	AT2023-21	AT2023-25
Sample ID	Units	IQA-G2316 - Sample # 7	IQA-G2316 - Sample # 6	BH21 S3 6.5-9 (March 15)	032324 BH25 S5 17-22
Lab		Dalhousie University	Dalhousie University	Dalhousie University	Dalhousie University
Sample Depth (mbgs)		2.5 - 5.9	0.75 - 10.1	6.5 - 9.0	5.2 - 6.7
Collection Date		2024-02-16	2024-02-15	2024-03-15	2024-03-23
Physical Tests					
Sulfur (Total)	Wt. %	0.048	0.036	0.016	0.037
Sulphate	Wt. %	<0.001	<0.001	0.007	0.007
Sulphide	Wt. %	0.048	0.036	0.009	0.030
Paste pH	-	8.55	8.35	8.32	8.05
Acid Potential (AP)	kg CaCO ₃ /t	1.51	1.13	0.29	0.95
Neutralization Potential (NP)	kg CaCO ₃ /t	8.69	4.92	4.87	18.60
Net NP	kg CaCO ₃ /t	7.18	3.79	4.58	17.65
NP Ratio (NP/AP)	-	5.75	4.35	16.79	19.58

Notes:

Percentage by weight (Wt. %)

Kilograms calcium carbonate equivalent per tonne (kg CaCO₃/t)

Metres above mean sea level (masl)

Metres below ground surface (mbgs)

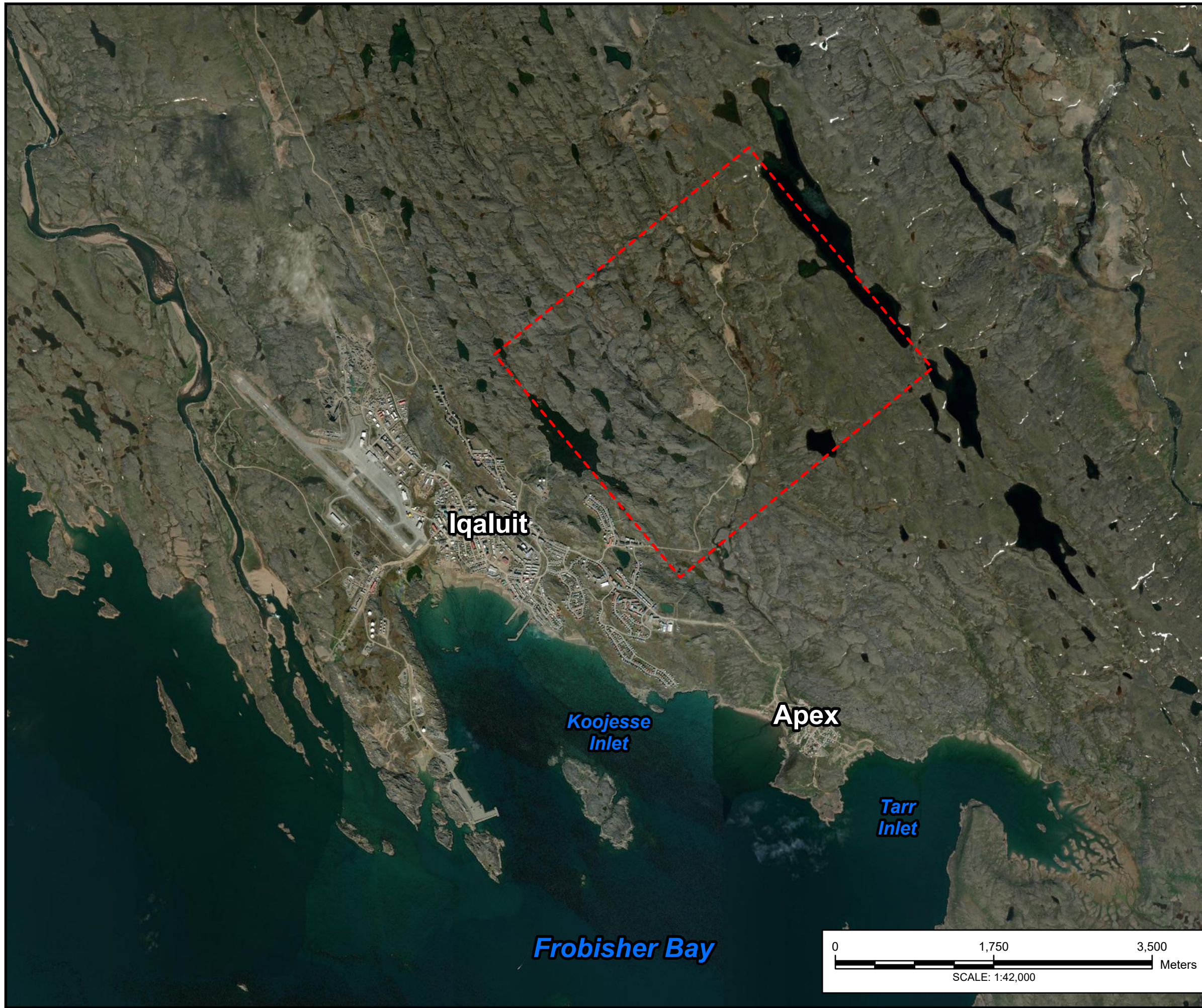
Table K - Leachable Elements Analytical Results Summary

Borehole	Reportable Detection Limit	Units	AT2023-03	AT2023-14	AT2023-21	AT2023-25
Sample ID			BH3 Composite	BH14 Composite	BH 21, S6, 15' - 19'	BH 25, S2, 4' - 8'
Lab ID			VA24A7965-007	VA24A7965-006	HA2401137-001	HA2401137-002
Lab			ALS	ALS	ALS	ALS
Sample Depth (mbgs)			2.5 - 5.9	0.75 - 10.1	4.6 - 5.8	1.2 - 2.4
Collection Date			2024-02-16	2024-02-15	2024-03-15	2024-03-23
Physical Tests						
Solids Total Dissolved (TDS), calculated	1.0	mg/L	32.4	40.3	39.7	58.8
Acidity, leachable (as CaCO3)	4.0	mg/L	<4.0	<4.0	<4.0	<4.0
Conductivity, leachable	2.0	µS/cm	45.4	37.8	46.7	54.8
Moisture	0.25	%	0.55	3.48	0.55	1.33
Oxidation-reduction potential (ORP), leachable	0.10	mV	216	222	269	300
pH	0.10	pH units	8.61	8.11	7.69	7.67
Leachable Anions & Nutrients						
Alkalinity, total (as CaCO3), leachable	2.0	mg/L	22.5	15.8	22.7	26.6
Ammonia, total, leachable (as N)	0.010	mg/L	<0.010	<0.010	<0.010	<0.010
Chloride, leachable	0.50	mg/L	0.73	0.84	1.62	<0.50
Fluoride, leachable	0.020	mg/L	0.038	0.112	0.138	0.362
Nitrate (as N), leachable	0.010	mg/L	<0.010	<0.010	<0.010	<0.010
Nitrite (as N), leachable	0.0010	mg/L	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus, total dissolved	0.0020	mg/L	0.0226	0.0194	0.0299	0.0508
Sulfate, leachable	0.50	mg/L	<0.50	1.24	0.66	0.99
Bromide, leachable	0.050	mg/L	<0.050	<0.050	<0.050	<0.050
Leachable Metals						
Aluminum, leachable	0.0050	mg/L	0.306	1.16	0.657	1.7
Antimony, leachable	0.00010	mg/L	0.00412	0.0004	0.00064	0.00022
Arsenic, leachable	0.0010	mg/L	<0.0010	<0.0010	0.0010	<0.0010
Barium, leachable	0.0010	mg/L	0.0033	0.0165	0.0113	0.0134
Beryllium, leachable	0.00050	mg/L	<0.00050	<0.00050	<0.00050	<0.00050
Bismuth, leachable	0.00050	mg/L	<0.00050	<0.00050	<0.00050	<0.00050
Boron, leachable	0.010	mg/L	0.067	0.062	0.020	0.035
Cadmium, leachable	0.000050	mg/L	<0.000050	<0.000050	<0.000050	<0.000050
Calcium, leachable	0.10	mg/L	5.16	3.55	4.83	5.40
Chromium, leachable	0.00050	mg/L	<0.00050	<0.00050	0.00117	0.00192
Cobalt, leachable	0.00010	mg/L	0.00012	0.00088	0.00033	0.00109
Copper, leachable	0.0010	mg/L	0.0051	0.0025	0.0021	0.0035
Iron, leachable	0.030	mg/L	0.255	1.69	1.22	5.75
Lead, leachable	0.00010	mg/L	<0.00010	0.00084	0.00064	0.00061
Lithium, leachable	0.0050	mg/L	<0.0050	<0.0050	0.0059	0.0118
Magnesium, leachable	0.050	mg/L	1.00	0.961	1.41	2.92
Manganese, leachable	0.00050	mg/L	0.0236	0.0526	0.0367	0.118
Molybdenum, leachable	0.0001	mg/L	0.00092	0.00308	0.0017	0.00082
Nickel, leachable	0.00050	mg/L	<0.00050	<0.00050	0.00052	0.00111
Phosphorus, leachable	0.30	mg/L	<0.30	<0.30	<0.30	<0.30
Potassium, leachable	0.050	mg/L	0.588	1.46	1.52	1.64
Selenium, leachable	0.00050	mg/L	<0.00050	<0.00050	<0.00050	<0.00050
Silicon, leachable	0.050	mg/L	3.21	6.36	4.43	8.12
Silver, leachable	0.000050	mg/L	<0.000050	<0.000050	<0.000050	<0.000050
Sodium, leachable	0.050	mg/L	2.13	2.55	1.98	1.96
Strontium, leachable	0.00050	mg/L	0.0370	0.0310	0.0419	0.0122
Sulfur, leachable	0.50	mg/L	<0.50	<0.50	<0.50	<0.50
Thallium, leachable	0.00010	mg/L	<0.00010	<0.00010	<0.00010	<0.00010
Tin, leachable	0.00050	mg/L	<0.00050	<0.00050	<0.00050	<0.00050
Titanium, leachable	0.010	mg/L	<0.010	0.013	0.017	0.061
Uranium, leachable	0.000010	mg/L	0.000193	0.000114	0.00565	0.000109
Vanadium, leachable	0.0010	mg/L	<0.0010	<0.0010	0.0023	0.0019
Zinc, leachable	0.010	mg/L	<0.010	<0.010	<0.010	0.012
Mercury, leachable	0.000050	mg/L	<0.000050	<0.000050	<0.000050	<0.000050
Hardness (as CaCO3), dissolved	0.60	mg/L	17	12.8	17.9	25.5

Notes:

- Metres above mean sea level (masl)
- Metres below ground surface (mbgs)

Figures

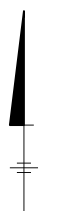


LEGEND

 SITE BOUNDARY

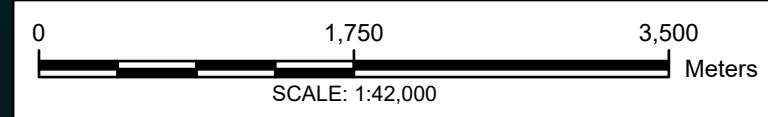
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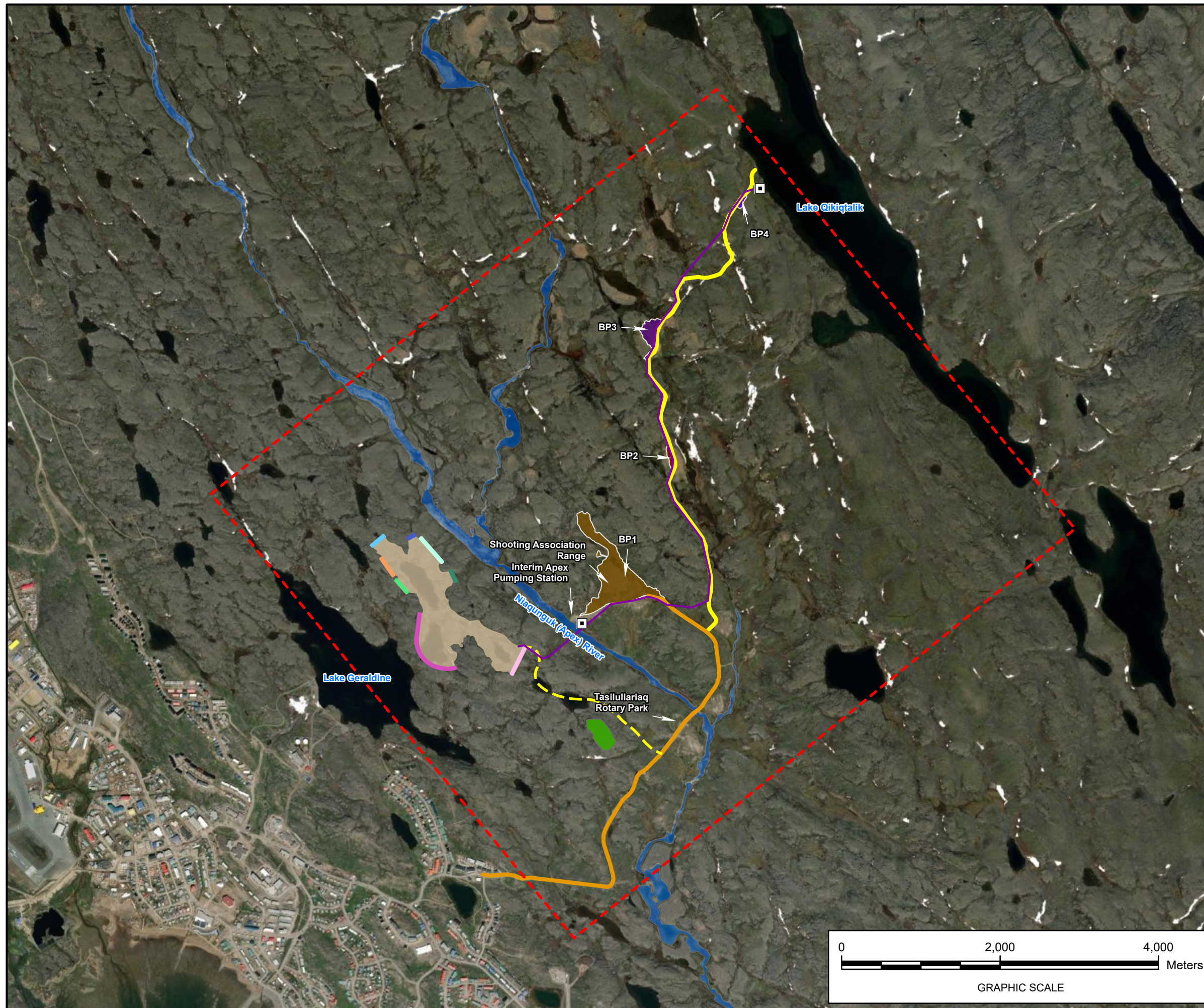
1. HORIZONTAL DATUM: NAD 1983 CSRS UTM ZONE 19N METER.
2. BASEMAP SOURCE: ESRI NAIP IMAGERY WEB SERVICE.



PRELIMINARY GEOTECHNICAL REPORT
 LONG TERM WATER PROGRAM IN IQALUIT, NUNAVUT
 CITY OF IQALUIT

SITE LOCATION PLAN



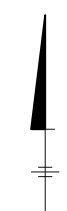


LEGEND

- PROPOSED PUMP STATION
- ACCESS ROAD TO LAKE QIKIQTALIK
- ROAD TO NOWHERE
- PROPOSED WATER CONVEYANCE PIPELINE
- PROPOSED ACCESS ROAD
- SITE BOUNDARY
- PROPOSED RESERVOIR
- WATERCOURSE
- PROPOSED DAM1 CENTRELINE
- PROPOSED DYKE2 CENTRELINE
- PROPOSED DYKE3 CENTRELINE
- PROPOSED DYKE4 CENTRELINE
- PROPOSED DYKE5 CENTRELINE
- PROPOSED DYKE6 CENTRELINE
- PROPOSED DYKE7 (SPILLWAY) CENTRELINE
- PROPOSED DYKE8 CENTRELINE
- PROPOSED ROCK QUARRY (KNOB 09)
- PROPOSED BORROW 1: SHOOTING RANGE
- PROPOSED BORROW 2: LOWER SAND DEPOSIT
- PROPOSED BORROW 3: UPPER SAND DEPOSIT
- PROPOSED BORROW 4: QIKIQTALIK ESKER

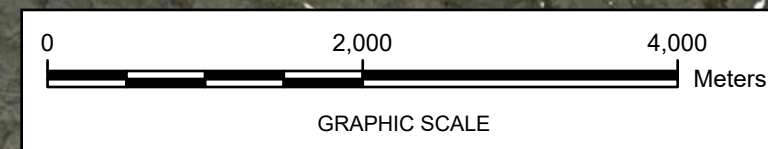
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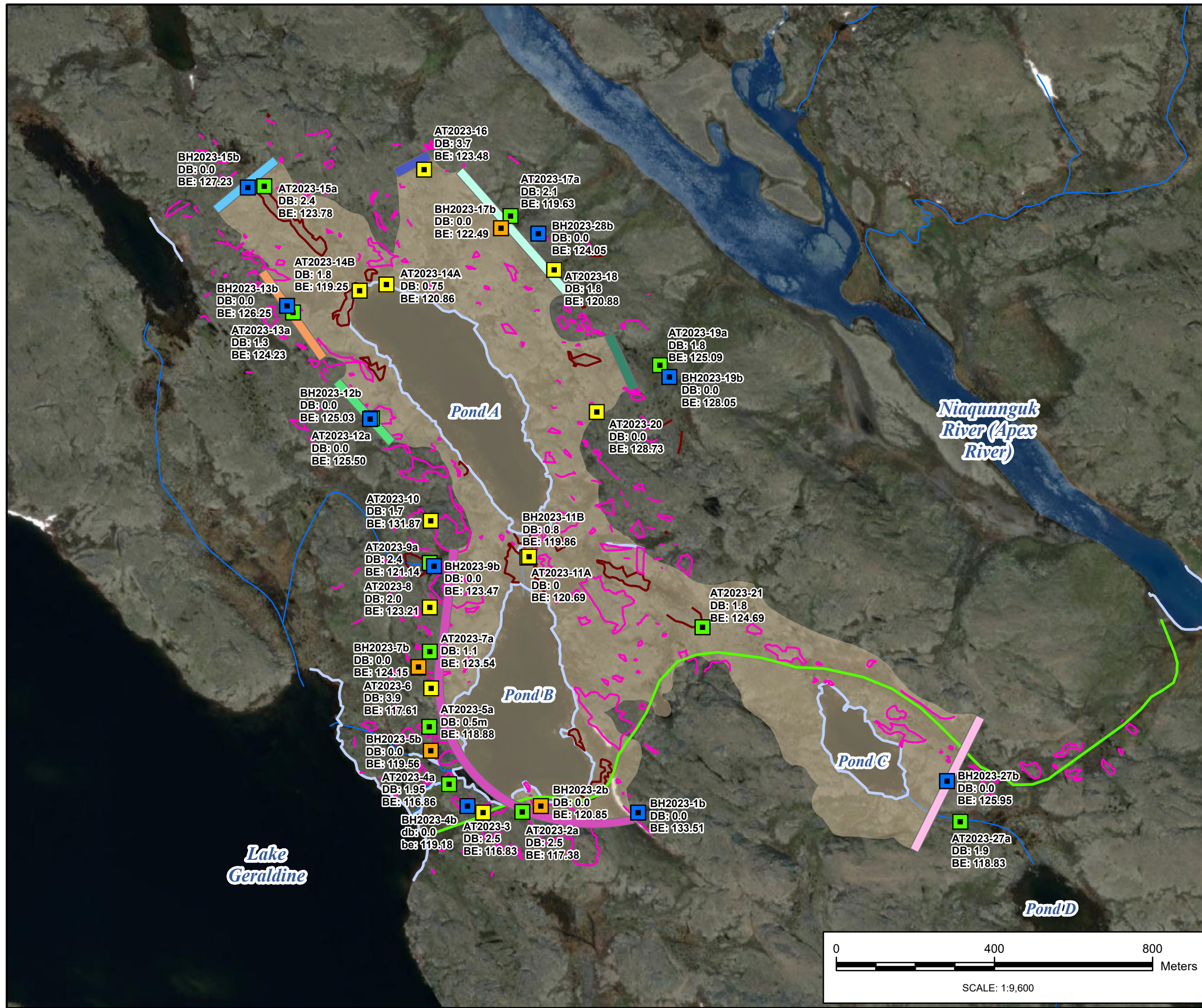
1. HORIZONTAL DATUM: NAD 1983 CSRS UTM ZONE 19N METER.
2. BASEMAP SOURCE: ESRI NAIP IMAGERY WEB SERVICE.



PRELIMINARY GEOTECHNICAL REPORT
LONG TERM WATER PROGRAM IN IQALUIT, NUNAVUT
CITY OF IQALUIT

SITE PLAN





LEGEND

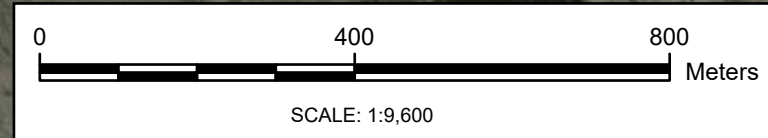
- AIR TRACK BOREHOLE
DB: DEPTH TO BEDROCK (mbgs)
BE: BEDROCK ELEVATION (masl)
- AIR TRACK BOREHOLE WITH WELL
DB: DEPTH TO BEDROCK (mbgs)
BE: BEDROCK ELEVATION (masl)
- BOREHOLE WITH THERMISTOR
DB: DEPTH TO BEDROCK (mbgs)
BE: BEDROCK ELEVATION (masl)
- ROCK CORE BOREHOLE
- EXISTING WATER PIPELINE PATH
- ACCESS ROAD TO APEX RIVER
- TRIBUTARY
- EXPOSED BEDROCK
- LIMIT OF BOULDERS
- EDGE OF WATER
- PROPOSED RESERVOIR
- PROPOSED DAM1 CENTRELINE
- PROPOSED DYKE2 CENTRELINE
- PROPOSED DYKE3 CENTRELINE
- PROPOSED DYKE4 CENTRELINE
- PROPOSED DYKE5 CENTRELINE
- PROPOSED DYKE6 CENTRELINE
- PROPOSED DYKE7(SPILLWAY) CENTRELINE
- PROPOSED DYKE8 CENTRELINE
- WATERCOURSE

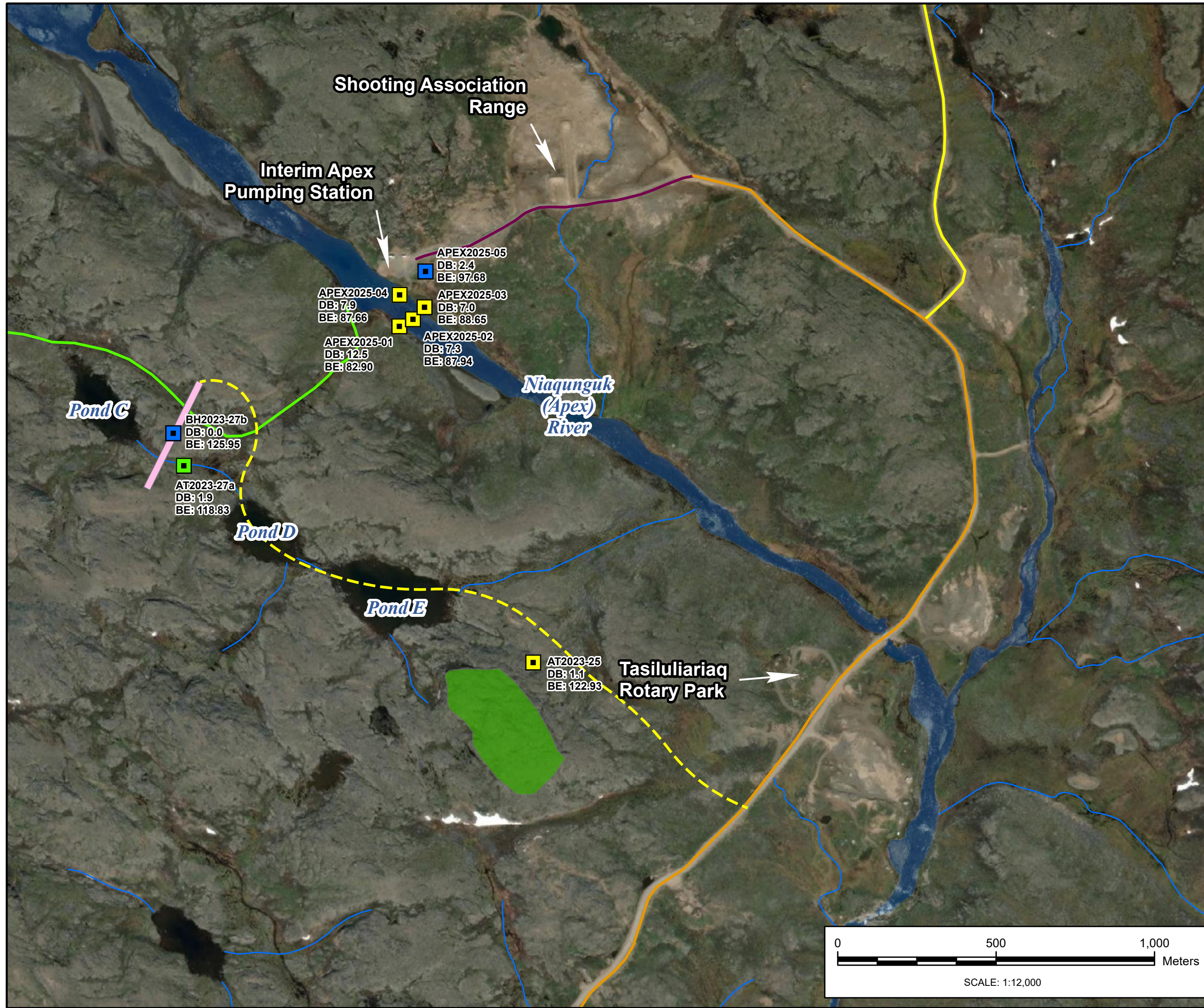
NOTES:

1. HORIZONTAL DATUM: NAD 1983 CSRS UTM ZONE 19N METER.
2. BASEMAP SOURCE: ESRI NAIP IMAGERY WEB SERVICE.

PRELIMINARY GEOTECHNICAL REPORT
LONG TERM WATER PROGRAM IN IQALUIT, NUNAVUT
CITY OF IQALUIT

**INVESTIGATION LOCATIONS
- RESERVOIR**



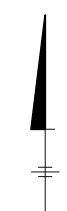


LEGEND

- AIR TRACK BOREHOLE
DB: DEPTH TO BEDROCK (mbgs)
BE: BEDROCK ELEVATION (masl)
- AIR TRACK BOREHOLE WITH WELL
DB: DEPTH TO BEDROCK (mbgs)
BE: BEDROCK ELEVATION (masl)
- BOREHOLE WITH THERMISTOR
DB: DEPTH TO BEDROCK (mbgs)
BE: BEDROCK ELEVATION (masl)
- ACCESS ROAD TO LAKE QIKIQTALIK
- ROAD TO NOWHERE
- PROPOSED ACCESS ROAD
- EXISTING WATER PIPELINE PATH
- ACCESS ROAD TO APEX RIVER
- TRIBUTARY
- WATERCOURSE
- PROPOSED ROCK QUARRY (KNOB 09)
- PROPOSED DYKE8 CENTERLINE

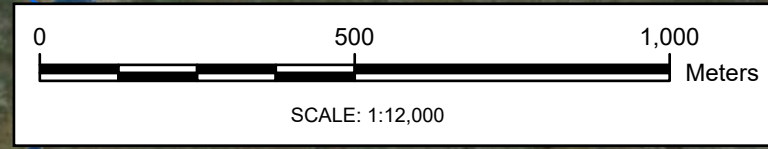
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1. HORIZONTAL DATUM: NAD 1983 CSRS UTM ZONE 19N METER.
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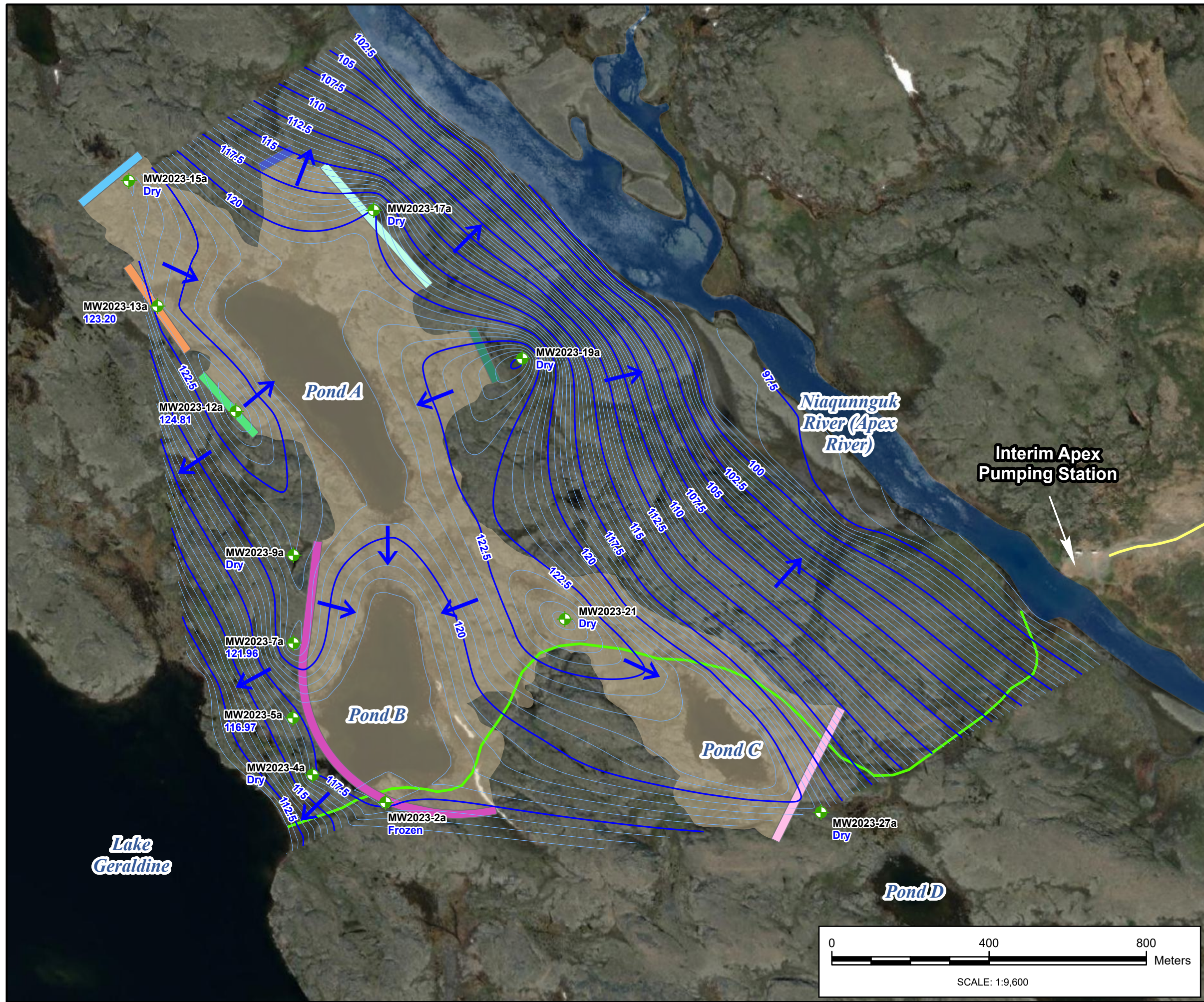


PRELIMINARY GEOTECHNICAL REPORT
LONG TERM WATER PROGRAM IN IQUALUIT, NUNAVUT
CITY OF IQUALUIT

**INVESTIGATION LOCATIONS
- ACCESS ROAD**



City: SYR Div/Group: IM/DV Last Saved By: mayyar7350 T: \\ENV\City of Iqaluit\Pro\City of Iqaluit.aprx\Fig 5 Groundwater Contours - August 2024 22-07-2025 13:43



LEGEND

- MONITORING WELL
- 123.20** GROUNDWATER ELEVATION (MASL)
- INDEX GROUNDWATER CONTOURS (2.5 MASL INTERVALS)
- INTERMEDIATE GROUNDWATER CONTOURS (0.5 MASL INTERVALS)
- INFERRED SHALLOW GROUNDWATER FLOW DIRECTION
- EXISTING WATER PIPELINE PATH
- ACCESS ROAD TO APEX RIVER
- PROPOSED RESERVOIR
- PROPOSED DAM1 CENTRELINE
- PROPOSED DYKE2 CENTRELINE
- PROPOSED DYKE3 CENTRELINE
- PROPOSED DYKE4 CENTRELINE
- PROPOSED DYKE5 CENTRELINE
- PROPOSED DYKE6 CENTRELINE
- PROPOSED DYKE7 (SPILLWAY) CENTRELINE
- PROPOSED DYKE8 CENTRELINE
- WATERCOURSE

NOTES:

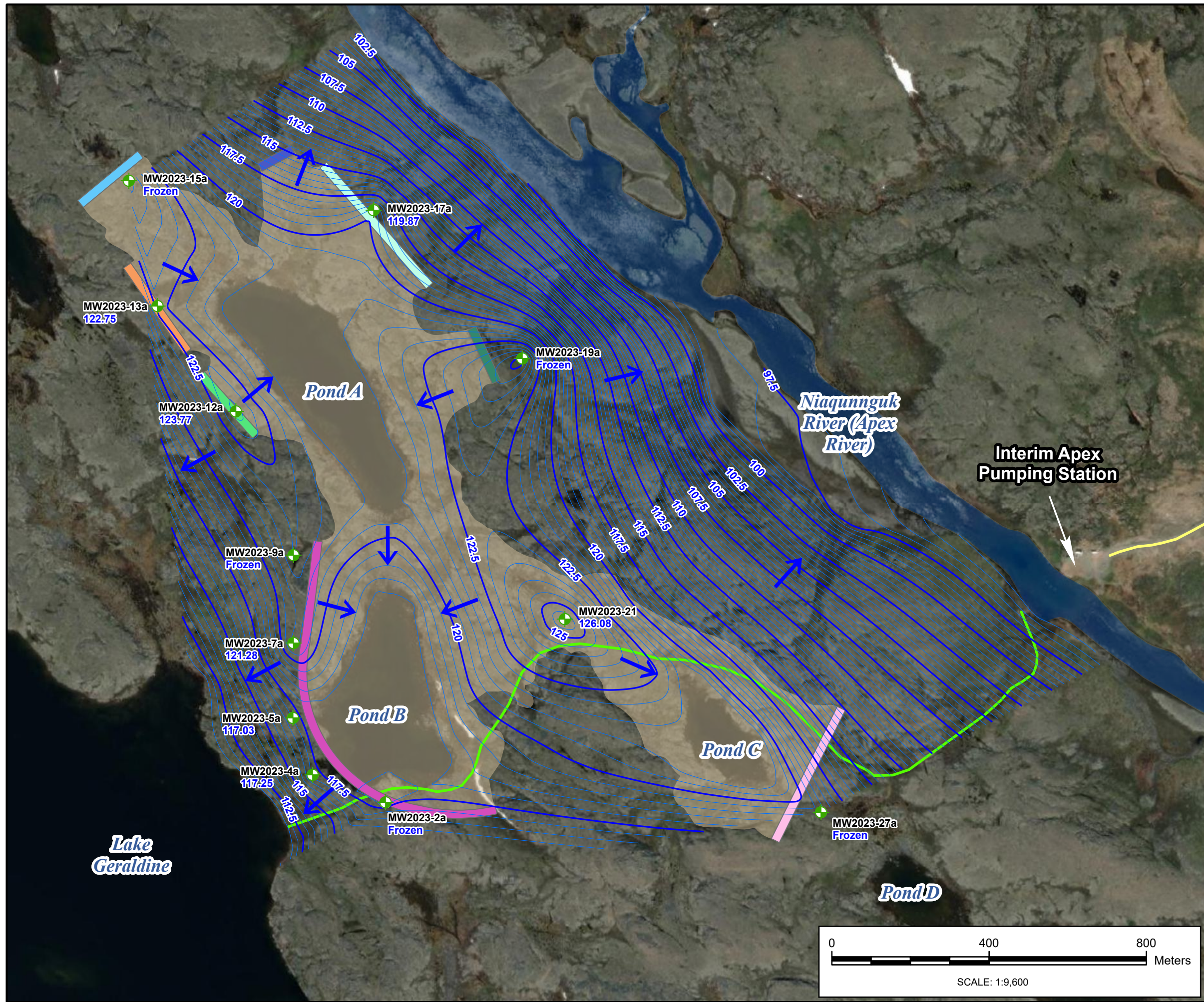
1. HORIZONTAL DATUM: NAD 1983 CSRS UTM ZONE 19N METER.
2. BASEMAP SOURCE: ESRI NAIP IMAGERY WEB SERVICE.
3. CONTOURING BASED ON ARCGIS NATURAL NEIGHBOR TECHNIQUE INTERPOLATION COMPUTER MODELING



PRELIMINARY GEOTECHNICAL REPORT
LONG TERM WATER PROGRAM IN IQALUIT, NUNAVUT
CITY OF IQALUIT

**GROUNDWATER CONTOURS
- AUGUST 2024**

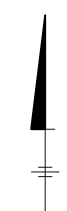
City: SYR Div/Group: IM/DV Last Saved By: mayyar7350 T: \\ENV\City of Iqaluit\Pro\City of Iqaluit.aprx\Fig 6 Groundwater Contours - October 2024 22-07-2025 13:45



LEGEND

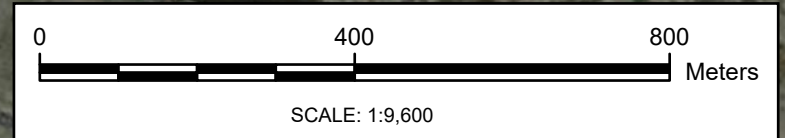
- MONITORING WELL
- 112.50** GROUNDWATER ELEVATION (MASL)
- INDEX GROUNDWATER CONTOURS (2.5 MASL INTERVALS)
- INTERMEDIATE GROUNDWATER CONTOURS (0.5 MASL INTERVALS)
- INFERRED SHALLOW GROUNDWATER FLOW DIRECTION
- EXISTING WATER PIPELINE PATH
- ACCESS ROAD TO APEX RIVER
- PROPOSED RESERVOIR
- PROPOSED DAM1 CENTRELINE
- PROPOSED DYKE2 CENTRELINE
- PROPOSED DYKE3 CENTRELINE
- PROPOSED DYKE4 CENTRELINE
- PROPOSED DYKE5 CENTRELINE
- PROPOSED DYKE6 CENTRELINE
- PROPOSED DYKE7 (SPILLWAY) CENTRELINE
- PROPOSED DYKE8 CENTRELINE
- WATERCOURSE

- NOTES:
1. HORIZONTAL DATUM: NAD 1983 CSRS UTM ZONE 19N METER.
 2. BASEMAP SOURCE: ESRI NAIP IMAGERY WEB SERVICE.
 3. CONTOURING BASED ON ARCGIS NATURAL NEIGHBOR TECHNIQUE INTERPOLATION COMPUTER MODELING



PRELIMINARY GEOTECHNICAL REPORT
LONG TERM WATER PROGRAM IN IQALUIT, NUNAVUT
CITY OF IQALUIT

**GROUNDWATER CONTOURS
- OCTOBER 2024**



Appendix A

A – Air Track Borehole Logs



Adaptive Baseline Geotechnical Ltd.
 17 Industrial Way
 Elmsdale, NS B2S 2L6
 Telephone: (867) 222-0184

BOREHOLE LOG

AT2023-02

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2024.03.18 COMPLETED 2024.03.18
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY JB CHECKED BY SMD

PROJECT NAME LTWP Water Supply & Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION 119.88 m HOLE SIZE 102 mm
 NOTES UTM: 19V 525057.65 m E 7070209.919 m N
Elevation Datum: CGVD2013

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	WELL DIAGRAM	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ MOISTURE CONTENT (%) ▲	
							GRAVEL	SAND	FINES			PL	LL
119.63	Cobbles with thin vegetation												
1	Brown silty SAND with gravel		SM	-BENTONITE	S1	0	4	85	11	8.4		▲	
2	- cobbles and boulders from 1.5 to 2.2 mbg			-SAND UNSLOTTED	S2	0	3	90	7	4.9		▲	
117.38	Excellent to good quality grey BEDROCK			-BENTONITE	B1								
3					B2								
4					B3								
5				-SAND SLOTTED	B4								
114.08													
6	Borehole Terminated at 5.8 m - Reached Target Depth												
7													
8													
9													
10													
11													
12													

CANADRILL BH/TP LOG WITH PIEZOMETER IQA-G2316_BHLOGSFINAL.GPJ GINT STD CANADA.GDT 2024.06.01



Adaptive Baseline Geotechnical Ltd.
 17 Industrial Way
 Elmsdale, NS B2S 2L6
 Telephone: (867) 222-0184

BOREHOLE LOG

AT2023-03

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2024.02.16 COMPLETED 2024.02.16
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY IW CHECKED BY MS

PROJECT NAME LTWP Water Supply & Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION 119.33 m HOLE SIZE 102 mm
 NOTES UTM: 19V 525013.19 m E 7070206.65 m N
Elevation Datum: CGVD2013

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ SPT N VALUE ▲	
							GRAVEL	SAND	FINES			PL	LL
1	Brown silty SAND - cobbles and boulders from 0.7 to 2.2 mbg		SM		S1	3	7	78	15	13.5		20 40 60 80	
2					S2	-	-	-	-	-			
3					S3	-	-	-	-	-			
4					S4	-	-	-	-	-			
5					B1	-	-	-	-	-			
6					B2	-	-	-	-	-			
7					B3	-	-	-	-	-			
8					B4	-	-	-	-	-			
9					B5	-	-	-	-	-			
10					B6	-	-	-	-	-			
11	Borehole Terminated at 5.9 m - Reached Target Depth												
12													

ABG BH/TP LOG IQA-G2316_BHLOGSFINAL.GPJ ABG.GDT 2024.06.01



Adaptive Baseline Geotechnical Ltd.
 17 Industrial Way
 Elmsdale, NS B2S 2L6
 Telephone: (867) 222-0184

BOREHOLE LOG

AT2023-04

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2024.03.18 COMPLETED 2024.03.18
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY JB CHECKED BY SMD

PROJECT NAME LTWP Water Supply & Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION 118.81 m HOLE SIZE 102 mm
 NOTES UTM: 19V 524974.81 m E 7070238.06 m N
Elevation Datum: CGVD2013

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	WELL DIAGRAM	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ MOISTURE CONTENT (%) ▲	
							GRAVEL	SAND	FINES			PL	LL
118.74	Thin vegetation												
1	Brown silty SAND with gravel -frequent cobbles and boulders		SM	-BENTONITE	S1	2.5	3	87	10	7.9		▲	
2	116.86			-SAND -UNSLOTTED	S2	0	6	86	8	4.3		▲	
3	116.41 Good to excellent quality grey BEDROCK Poor to fair quality BEDROCK			-BENTONITE	B1								
4	115.81 Good to excellent quality grey BEDROCK			-SAND -SLOTTED	B2								
5					B3								
6	113.01 Borehole Terminated at 5.8 m - Reached Target Depth												
7													
8													
9													
10													
11													
12													

CANADRILL BH/TP LOG WITH PIEZOMETER IQA-G2316_BHLOGSFINAL.GPJ GINT STD CANADA.GDT 2024.06.01



Adaptive Baseline Geotechnical Ltd.
 17 Industrial Way
 Elmsdale, NS B2S 2L6
 Telephone: (867) 222-0184

BOREHOLE LOG

AT2023-05

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2024.03.18 COMPLETED 2024.03.18
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY JB CHECKED BY SMD

PROJECT NAME LTWP Water Supply & Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION 119.38 m HOLE SIZE 102 mm
 NOTES UTM: 19V 524952.1 m E 7070302.19 m N
Elevation Datum: CGVD2013

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	WELL DIAGRAM	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ MOISTURE CONTENT (%) ▲	
							GRAVEL	SAND	FINES			PL	LL
118.88	Cobbles with thin vegetation		SM	-BENTONITE	S1	0	11	82	7	1.4		▲	
1	Poor to good quality grey BEDROCK			-SAND -UNSLOTTED -BENTONITE	B1								
118.18	Good to excellent quality grey BEDROCK				B2								
2					B3								
3					B4								
4				-SAND -SLOTTED	B5								
5	114.38												
Borehole Terminated at 5 m - Reached Target Depth													
6													
7													
8													
9													
10													
11													
12													

CANADRILL BH/TP LOG WITH PIEZOMETER IQA-G2316_BHLOGSFINAL.GPJ GINT STD CANADA.GDT 2024.06.01



Adaptive Baseline Geotechnical Ltd.
 17 Industrial Way
 Elmsdale, NS B2S 2L6
 Telephone: (867) 222-0184

BOREHOLE LOG

AT2023-06

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2024.02.17 COMPLETED 2024.02.17
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY IW CHECKED BY MS

PROJECT NAME LTWP Water Supply & Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION 121.51 m HOLE SIZE 102 mm
 NOTES UTM: 19V 524953.89 m E 7070345.21 m N
Elevation Datum: CGVD2013

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ SPT N VALUE ▲	
							GRAVEL	SAND	FINES			PL	LL
1	Brown well-graded SAND with silt to silty SAND - cobbles and boulders from 0.7 to 1.7 mbg		SW-SM		S1	3	8	84	8	8.2		20 40 60 80	
2				S2	-	-	-	-	-			20 40 60 80	
3				S3	-	-	-	-	-			20 40 60 80	
4	117.61 Good quality BEDROCK			B1	-	-	-	-	-			20 40 60 80	
5				B2	-	-	-	-	-			20 40 60 80	
6				B3	-	-	-	-	-			20 40 60 80	
7			B4	-	-	-	-	-			20 40 60 80		
8	113.61		B5	-	-	-	-	-			20 40 60 80		
9			B6	-	-	-	-	-			20 40 60 80		
10	Borehole Terminated at 7.9 m - Reached Target Depth												
11													
12													

ABG BH/TP LOG IQA-G2316_BHLOGSFINAL.GPJ ABG.GDT 2024.06.01



Adaptive Baseline Geotechnical Ltd.
 17 Industrial Way
 Elmsdale, NS B2S 2L6
 Telephone: (867) 222-0184

BOREHOLE LOG

AT2023-07

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2024.03.21 COMPLETED 2024.03.21
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY JB CHECKED BY SMD

PROJECT NAME LTWP Water Supply & Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION 124.64 m HOLE SIZE 102 mm
 NOTES UTM: 19V 524952.01 m E 7070386.36 m N
Elevation Datum: CGVD2013

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	WELL DIAGRAM	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ MOISTURE CONTENT (%) ▲	
							GRAVEL	SAND	FINES			PL	LL
124.54	Thin vegetation												
1	Brown SAND with silt and gravel		SM	-BENTONITE	S1	24	14	79	7	2.9		▲	
123.54	-frequent cobbles and boulders			-SAND UNSLOTTED	B1								
2	Excellent to good quality grey BEDROCK			-BENTONITE	B2								
3					B3								
4				-SAND SLOTTED	B4								
119.94													
5	Borehole Terminated at 4.7 m - Reached Target Depth												
6													
7													
8													
9													
10													
11													
12													

CANADRILL BH/TP LOG WITH PIEZOMETER IQA-G2316_BHLOGSFINAL.GPJ GINT STD CANADA.GDT 2024.06.01



Adaptive Baseline Geotechnical Ltd.
 17 Industrial Way
 Elmsdale, NS B2S 2L6
 Telephone: (867) 222-0184

BOREHOLE LOG

AT2023-08

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2024.02.17 COMPLETED 2024.02.17
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY IW CHECKED BY MS

PROJECT NAME LTWP Water Supply & Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION 125.21 m HOLE SIZE 102 mm
 NOTES UTM: 19V 524951.62 m E 7070435.83 m N
Elevation Datum: CGVD2013

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ SPT N VALUE ▲	
							GRAVEL	SAND	FINES			PL	LL
1	Brown SAND with silt -frequent cobbles and boulders		SP-SM		S1	-	-	-	-	-			
					S2	-	-	-	-	-			
2					S3	-	-	-	-	-			
	Poor quality BEDROCK - visible excess ice				B1	-	-	-	-	-			
3					B2	-	-	-	-	-			
4					B3	-	-	-	-	-			
5					B4	-	-	-	-	-			
6					B5	-	-	-	-	-			
					B6	-	-	-	-	-			
7					B7	-	-	-	-	-			
					B8	-	-	-	-	-			
					B9	-	-	-	-	-			
10					B10	-	-	-	-	-			
	Borehole Terminated at 10.2 m - Reached Target Depth												
11													
12													

ABG BH/TP LOG IQA-G2316_BHLOGSFINAL.GPJ ABG.GDT 2024.06.01



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BOREHOLE LOG

AT2023-09

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CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2024.03.21 COMPLETED 2024.03.21
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY JB CHECKED BY SMD

PROJECT NAME LTWP Water Supply & Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION 123.54 m HOLE SIZE 102 mm
 NOTES UTM: 19V 524951.13 m E 7070485.48 m N
Elevation Datum: CGVD2013

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	WELL DIAGRAM	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ MOISTURE CONTENT (%) ▲	
							GRAVEL	SAND	FINES			PL	LL
123.29	Cobbles with thin vegetation												
1	Brown SAND with silt and gravel -frequent cobbles and boulders from 0.4 to 1.0 mbg		SM	-BENTONITE	S1	0	4	87	9	9.4			
2				-SAND UNSLOTTED	S2	0	10	83	7	9.4			
121.14	Good to excellent quality grey BEDROCK			-BENTONITE	B1								
4					B2								
5				-SAND SLOTTED	B3								
6	117.44												
Borehole Terminated at 6.1 m - Reached Target Depth													
7													
8													
9													
10													
11													
12													

CANADRILL BH/TP LOG WITH PIEZOMETER IQA-G2316_BHLOGSFINAL.GPJ GINT STD CANADA.GDT 2024.06.01



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BOREHOLE LOG

AT2023-10

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2024.03.22 COMPLETED 2024.03.22
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY JB CHECKED BY SMD

PROJECT NAME LTWP Water Supply & Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION 124.78 m HOLE SIZE 102 mm
 NOTES UTM: 19V 525011.09 m E 7070526.05 m N
Elevation Datum: CGVD2013

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ SPT N VALUE ▲	
							GRAVEL	SAND	FINES			PL	MC
124.18	Surface cobbles and boulders												
1	Brown SAND with silt and gravel -frequent cobbles and boulders				S1	5	10	85	5	3.7			
123.08	Excellent to good quality grey BEDROCK				S2	4	18	72	10	3.3			
2					B1								
3					B2								
4					B3								
5					B4								
119.48													
6	Borehole Terminated at 5.3 m - Reached Target Depth												
7													
8													
9													
10													
11													
12													

ABG BH/TP LOG IQA-G2316_BHLOGSFINAL.GPJ ABG.GDT 2024.06.01



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BOREHOLE LOG

AT2023-11A

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2024.02.16 COMPLETED 2024.02.16
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY IW CHECKED BY MS

PROJECT NAME LTWP Water Supply & Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION 120.69 m HOLE SIZE 102 mm
 NOTES UTM: 19V 525060.56 m E 7070492.46 m N
Elevation Datum: CGVD2013

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ SPT N VALUE ▲	
							GRAVEL	SAND	FINES			PL	LL
	Good to excellent quality BEDOCK				B1	-							
1			B2	-	-	-	-						
2			B3	-	-	-	-						
3			B4	-	-	-	-						
4			B5	-	-	-	-						
5			B6	-	-	-	-						
6			B7	-	-	-	-						
7			B8	-	-	-	-						
8			B9	-	-	-	-						
			B10	-	-	-	-						
			B11	-	-	-	-						
			B12	-	-	-	-						
112.49	Borehole Terminated at 8.2 m - Reached Target Depth												
9													
10													
11													
12													

ABG BH/TP LOG IQA-G2316_BHLOGSFINAL.GPJ ABG.GDT 2024.06.01



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BOREHOLE LOG

AT2023-11B

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2024.03.22 COMPLETED 2024.03.22
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY JB CHECKED BY SMD

PROJECT NAME LTWP Water Supply & Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION 120.66 m HOLE SIZE 102 mm
 NOTES UTM: 19V 525062.37 m E 7070494.74 m N
Elevation Datum: CGVD2013
Geophys

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ SPT N VALUE ▲	
							GRAVEL	SAND	FINES			PL	LL
119.86	Surface boulders and cobbles with sand												
119.26	Good to poor quality bedrock												
118.46	Poor quality grey BEDROCK												
114.66	Good to excellent quality BEDROCK												
113.66	Poor quality BEDROCK												
109.36	Good to excellent quality BEDROCK												
Borehole Terminated at 11.3 m - Reached Target Depth													

ABG BH/TP LOG IQA-G2316_BHLOGSFINAL.GPJ ABG.GDT 2024.06.01



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BOREHOLE LOG

AT2023-12

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2024.03.16 COMPLETED 2024.03.16
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY JB CHECKED BY SMD

PROJECT NAME LTWP Water Supply & Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION 125.5 m HOLE SIZE 102 mm
 NOTES UTM: 19V 524885.06 m E 7070646.9 m N
Elevation Datum: CGVD2013

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	WELL DIAGRAM	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ MOISTURE CONTENT (%) ▲	
							GRAVEL	SAND	FINES			20	40
1	Excellent to good quality grey BEDROCK			-BENTONITE -UNSLOTTED	B1								
2					B2								
3					B3								
4				121.50									
5	Borehole Terminated at 4 m - Reached Target Depth												
6													
7													
8													
9													
10													
11													
12													

CANADRILL BH/TP LOG WITH PIEZOMETER IQA-G2316_BHLOGSFINAL.GPJ GINT STD CANADA.GDT 2024.06.01



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BOREHOLE LOG

AT2023-13

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2024.03.16 COMPLETED 2024.03.16
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY JB CHECKED BY SMD

PROJECT NAME LTWP Water Supply & Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION 125.53 m HOLE SIZE 102 mm
 NOTES UTM: 19V 524795.72 m E 7070764.59 m N
Elevation Datum: CGVD2013

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	WELL DIAGRAM	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ MOISTURE CONTENT (%) ▲	
							GRAVEL	SAND	FINES			PL	LL
125.43	Thin vegetation												
1	Cobbles with silt, sand and gravel		SM	- BENTONITE - SAND - UNSLOTTED	S1	0	43	53	4	1.9			
124.23	Very poor to poor quality grey BEDROCK			- BENTONITE	B1								
123.53	Excellent to good quality grey BEDROCK				B2								
3					B3								
4				- SAND - SLOTTED	B4								
120.83	Borehole Terminated at 4.7 m - Reached Target Depth												
5													
6													
7													
8													
9													
10													
11													
12													

CANADRILL BH/TP LOG WITH PIEZOMETER IQA-G2316_BHLOGSFINAL.GPJ GINT STD CANADA.GDT 2024.06.01



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BOREHOLE LOG

AT2023-14A

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2024.02.15 COMPLETED 2024.02.15
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY IW CHECKED BY MS

PROJECT NAME LTWP Water Supply & Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION 121.61 m HOLE SIZE 102 mm
 NOTES UTM: 19V 524900.16 m E 7070796.72 m N
Elevation Datum: CGVD2013

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ SPT N VALUE ▲	
							GRAVEL	SAND	FINES			PL	MC
120.86	Brown silty sand		SM		S1	2.5	8	78	14	10.8		●	
1	BEDROCK				B1	-	-	-	-	-			
2					B2	-	-	-	-	-			
3					B3	-	-	-	-	-			
4					B4	-	-	-	-	-			
5					B5	-	-	-	-	-			
6					B6	-	-	-	-	-			
7					B7	-	-	-	-	-			
8					B8	-	-	-	-	-			
9					B9	-	-	-	-	-			
10					B10	-	-	-	-	-			
11					B11	-	-	-	-	-			
11.51					B12	-	-	-	-	-			
	Borehole Terminated at 10.1 m - Reached Target Depth												
12													

ABG BH/TP LOG IQA-G2316_BHLOGSFINAL.GPJ ABG.GDT 2024.06.01



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BOREHOLE LOG

AT2023-14B

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2024.03.22 COMPLETED 2024.03.22
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY JB CHECKED BY SMD

PROJECT NAME LTWP Water Supply & Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION 121.05 m HOLE SIZE 102 mm
 NOTES UTM: 19V 524870.04 m E 7070790.83 m N
Elevation Datum: CGVD2013
Geophys

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ SPT N VALUE ▲	
							GRAVEL	SAND	FINES			PL	LL
120.75	Surface boulders and cobbles												
1	Brown SAND with silt and gravel -frequent cobbles and boulders		SM										
119.25	Excellent to good quality grey BEDROCK												
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
109.75	Borehole Terminated at 11.3 m - Reached Target Depth												
12													

ABG BH/TP LOG IQA-G2316_BHLOGSFINAL.GPJ ABG.GDT 2024.06.01



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BOREHOLE LOG

AT2023-15

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CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2024.03.16 COMPLETED 2024.03.16
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY JB CHECKED BY SMD

PROJECT NAME LTWP Water Supply & Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION 126.18 m HOLE SIZE 102 mm
 NOTES UTM: 19V 524762.34 m E 7070905.59 m N
Elevation Datum: CGVD2013

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	WELL DIAGRAM	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ MOISTURE CONTENT (%) ▲	
							GRAVEL	SAND	FINES			20	40
1	Brown SAND with silt and trace gravel		SM	-BENTONITE	S1	0	5	84	11	11.1		▲	
2				-SAND -UNSLOTTED	S2	0	9	87	7	8.5		▲	
123.78				-BENTONITE	S3	0	9	82	9	14.1		▲	
3	Very poor quality grey BEDROCK												
122.58					B1								
4	Poor to good quality grey BEDROCK				B2								
121.38					B3								
5	Excellent quality grey BEDROCK			-SAND -SLOTTED									
120.78													
6	Poor quality grey BEDROCK												
119.98					B4								
7	Excellent to good quality grey BEDROCK												
119.28													
8	Borehole Terminated at 6.9 m - Reached Target Depth												
9													
10													
11													
12													

CANADRILL BH/TP LOG WITH PIEZOMETER IQA-G2316_BHLOGSFINAL.GPJ GINT STD CANADA.GDT 2024.06.01



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BOREHOLE LOG

AT2023-16

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2024.03.10 COMPLETED 2024.03.10
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY JB CHECKED BY SMD

PROJECT NAME LTWP Water Supply & Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION 127.18 m HOLE SIZE 190 mm
 NOTES UTM: 19V 524941.37 m E 7070925.59 m N
Elevation Datum: CGVD2013

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ SPT N VALUE ▲	
							GRAVEL	SAND	FINES			PL	LL
1	Brown SAND to sandy silt with gravel		SM		S1	0	17	75	8	7.3		●	□
2					S2	0	9	83	8	3.5	●	□	
3					S3	0	21	70	9	7.1	●	□	
4					S4	0	11	73	16	8.1	●	□	
4	123.48 Good to excellent quality grey BEDROCK				B1								
5			B2										
6			B3										
7			B4										
7	120.18 Good to excellent quality grey & red BEDROCK		B5										
8	Borehole Terminated at 7 m - Reached Target Depth												
9													
10													
11													
12													

ABG BH/TP LOG IQA-G2316 BHLOGSFINAL.GPJ ABG.GDT 2024.06.01



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BOREHOLE LOG

AT2023-17

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2024.03.11 COMPLETED 2024.03.11
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY JB CHECKED BY SMD

PROJECT NAME LTWP Water Supply & Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION 121.73 m HOLE SIZE 190 mm
 NOTES UTM: 19V 525038.62 m E 7070874.45 m N
Elevation Datum: CGVD2013

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	WELL DIAGRAM	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ MOISTURE CONTENT (%) ▲	
							GRAVEL	SAND	FINES			PL	LL
1	Brown SAND with silt and trace gravel -frequent cobbles and boulders		SM	-BENTONITE	S1	0	30	66	4	3.1			
2	119.63 Poor to good quality grey BEDROCK			-SAND -UNSLOTTED	S2	0	23	74	3	2.6			
3				-BENTONITE	S3	6	19	79	2	2			
4	118.13 Excellent to good quality grey BEDROCK				B1								
5					B2								
6					B3								
7					B4								
8					B5								
9					B6								
10					B7								
11					B8								
12					B9								
8	Borehole Terminated at 7.5 m - Reached Target Depth												

CANADRILL BH/TP LOG WITH PIEZOMETER IQA-G2316_BHLOGSFINAL.GPJ GINT STD CANADA.GDT 2024.06.01



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BOREHOLE LOG

AT2023-18

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2024.03.18 COMPLETED 2024.03.18
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY JB CHECKED BY SMD

PROJECT NAME LTWP Water Supply & Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION 122.68 m HOLE SIZE 190 mm
 NOTES UTM: 19V 525088.01 m E 7070814.59 m N
Elevation Datum: CGVD2013

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ SPT N VALUE ▲	
							GRAVEL	SAND	FINES			PL	MC
1	Brown SAND with silt and gravel -frequent cobbles and boulders		SM		S1	0	23	69	8	5.2		●	
2	120.88 Poor to fair quality grey BEDROCK				S2	0	26	68	6	2.6		●	
3	119.68 Fair to good quality grey BEDROCK				B1	0	31	63	6	4.5		●	
4					B2								
5	118.38 Excellent to good quality grey BEDROCK				B3								
6	117.08 Borehole Terminated at 5.6 m - Reached Target Depth				B4								
7					B5								
8					B6								
9													
10													
11													
12													

ABG BH/TP LOG IQA-G2316_BHLOGSFINAL.GPJ ABG.GDT 2024.06.01



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BOREHOLE LOG

AT2023-19

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2024.03.13 COMPLETED 2024.03.13
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY JB CHECKED BY SMD

PROJECT NAME LTWP Water Supply & Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION 126.89 m HOLE SIZE 102 mm
 NOTES UTM: 19V 525207.36 m E 7070708.85 m N
Elevation Datum: CGVD2013

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	WELL DIAGRAM	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ MOISTURE CONTENT (%) ▲	
							GRAVEL	SAND	FINES			PL	LL
126.79	Thin vegetation												
1	Brown SAND with silt and gravel		SM	-BENTONITE	S1	0	9	86	5	2.2			
	-frequent cobbles and boulders			-SAND -UNSLOTTED	S2	0	22	74	4	1.3			
125.09				-BENTONITE									
2	Fair to good quality grey BEDROCK												
124.49													
3	Excellent quality grey BEDROCK				B1								
4					B2								
5					B3								
6	120.89												
Borehole Terminated at 6 m - Reached Target Depth													
7													
8													
9													
10													
11													
12													

CANADRILL BH/TP LOG WITH PIEZOMETER IQA-G2316_BHLOGSFINAL.GPJ GINT STD CANADA.GDT 2024.06.01



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BOREHOLE LOG

AT2023-20

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2024.03.15 COMPLETED 2024.03.15
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY JB CHECKED BY SMD

PROJECT NAME LTWP Water Supply & Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION 128.73 m HOLE SIZE 102 mm
 NOTES UTM: 19V 525137.1 m E 7070655.94 m N
Elevation Datum: CGVD2013
Geophys

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ SPT N VALUE ▲	
							GRAVEL	SAND	FINES			PL	LL
	Excellent to good quality grey BEDROCK											20 40 60 80	
1			B1	0	16	81	3	0.5				20 40 60 80	
2			B2										
3			B3										
4			B4										
5			B5										
6			B6										
7			B7										
8			B8										
9		B9											
10													
11													
11.73	Borehole Terminated at 11.3 m - Reached Target Depth												
12													

ABG BH/TP LOG IQA-G2316_BHLOGSFINAL.GPJ ABG.GDT 2024.06.01



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BOREHOLE LOG

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CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2024.03.15 COMPLETED 2024.03.15
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY JB CHECKED BY SMD

PROJECT NAME LTWP Water Supply & Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION 126.49 m HOLE SIZE 102 mm
 NOTES UTM: 19V 525257.49 m E 7070416.01 m N
Elevation Datum: CGVD2013

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	WELL DIAGRAM	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ MOISTURE CONTENT (%) ▲	
							GRAVEL	SAND	FINES			PL	LL
1	Brown SAND with silt and gravel		SM	-BENTONITE	S1	0	4	79	17	10.6		▲ □	
	-cobbles and boulders from 1.1 to 1.5 mbg			-SAND UNSLOTTED									
2	124.69 Excellent to good quality grey BEDROCK			-BENTONITE	S2	0	4	83	13	4.1		▲ □	
3					B1								
4					B2								
5				-SAND SLOTTED	B3								
6	120.49				B4								
Borehole Terminated at 6 m - Reached Target Depth													
7													
8													
9													
10													
11													
12													

CANADRILL BH/TP LOG WITH PIEZOMETER IQA-G2316_BHLOGSFINAL.GPJ GINT STD CANADA.GDT 2024.06.01



Adaptive Baseline Geotechnical Ltd.
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BOREHOLE LOG

AT2023-25

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2024.03.23 COMPLETED 2024.03.23
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY JB CHECKED BY SMD

PROJECT NAME LTWP Water Supply & Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION 124.03 m HOLE SIZE 102 mm
 NOTES UTM: 19V 526039.95 m E 7069931.07 m N
Elevation Datum: CGVD2013

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ SPT N VALUE ▲	
							GRAVEL	SAND	FINES			PL	LL
1 122.93	Brown SAND with silt and gravel - boulder from 0.3 to 0.9 m		SM		S1	0	16	77	7	2			
2 122.33	Good quality grey BEDROCK				B1								
3 121.43	Fair to poor quality grey BEDROCK				B2								
4 120.53	Good to excellent quality grey BEDROCK				B3								
5	Excellent quality grey BEDROCK				B4								
6					B5								
7					B6								
8					B7								
9													
10													
11 112.73													
12	Borehole Terminated at 11.3 m - Reached Target Depth												

ABG BH/TP LOG IQA-G2316_BHLOGSFINAL.GPJ ABG.GDT 2024.06.01



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BOREHOLE LOG

AT2023-27

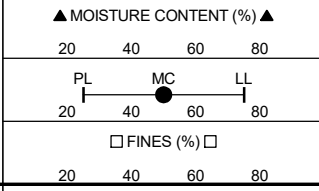
PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2024.03.23 COMPLETED 2024.03.23
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY JB CHECKED BY SMD

PROJECT NAME LTWP Water Supply & Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION 120.73 m HOLE SIZE 102 mm
 NOTES UTM: 19V 525548.9 m E 7070202.28 m N
Elevation Datum: CGVD2013

CANADRILL BH/TP LOG WITH PIEZOMETER IQA-G2316_BHLOGSFINAL.GPJ GINT STD CANADA.GDT 2024.06.01

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	WELL DIAGRAM	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ MOISTURE CONTENT (%) ▲	
							GRAVEL	SAND	FINES			PL	LL
120.33	Thin vegetation with cobbles			-BENTONITE									
1	Poor quality BEDROCK		SM	-SAND -UNSLOTTED -BENTONITE	S1	0	8	85	7	5.9		▲	
2					S2	0	6	83	11	9		▲	
118.53	Good quality grey BEDROCK				B1	0	7	87	6	6.8		▲	
3					B2								
4					B3								
116.03	Excellent to good quality grey BEDROCK			-SAND -SLOTTED	B4								
5													
6													
7													
8													
112.03	Borehole Terminated at 8.7 m - Reached Target Depth												
9													
10													
11													
12													





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BOREHOLE LOG

APEX2025-01

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2025.05.03 COMPLETED 2025.05.03
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY IW CHECKED BY MS

PROJECT NAME LTWP Water Supply and Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION n/a HOLE SIZE 190 mm
 NOTES UTM: 19V 525848 m E 7070398 m N

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ SPT N VALUE ▲	
							GRAVEL	SAND	FINES			PL	LL
0.90	Boulders and ice												
1.50	Grey brown silty SAND with gravel		SM	Nbe	S1	2.0	16	71	13	15.4		●	
2.00	Brown poorly graded SAND to poorly graded SAND with silt and gravel		SP-SM	Nbn	S2	5.0	26	66	8	9.6		●	
3.00				Nbe	S3	1.0	7	88	5	19.9		□	
4.30				Nbe	S4	2.0	6	87	7	15.8		□	
4.60	Boulder												
5.00	Grey silty SAND to well-graded SAND with silt		SM	Nbe	S5	1.5	7	65	28	17.4		● □	
6.00				Nbn	S6	2.5	13	73	14	6.5		● □	
7.00													
8.00	- boulder at 7.9 mbg												
9.00				Nbn	S7	2.5	4	83	13	6.0		● □	
10.00				Nbn	S8	3.0	2	86	12	6.8		● □	
12.20													
12.50	Ice												
13.00	Inferred BEDROCK				B1	-	-	-	-	-			
13.70													
14.00	Borehole Terminated at 13.7 m - Inferred sound bedrock												
15.00													

ABG BH/TP LOG IQA-G2316 APEXRIVER.GPJ ABG.GDT 2025.06.10



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BOREHOLE LOG

APEX2025-02

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CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2025.05.03 COMPLETED 2025.05.03
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY IW CHECKED BY MS

PROJECT NAME LTWP Water Supply and Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION n/a HOLE SIZE 190 mm
 NOTES UTM: 19V 525867 m E 7070408 m N

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ SPT N VALUE ▲	
							GRAVEL	SAND	FINES			PL	MC
0.30	Ice												
1	Brown silty SAND with gravel - frequent cobbles and boulders		SM	-	S1	-	-	-	-				
2	2.10 Brown silty SAND		SM	Nbe	S2	0.0	8	73	19	19.3			
3	3.00 Grey silty SAND		SM	Nbe	S3	0.0	3	79	18	20.4			
4				Nbe	S4	0.0	1	85	14	22.5			
5				Nbe	S5	0.0	2	54	44	21.2			
6	7.30 Inferred BEDROCK				B1								
7													
8													
9	9.10 Borehole Terminated at 9.1 m - Inferred sound bedrock												
10													
11													
12													
13													
14													
15													

ABG BH/TP LOG IQA-G2316_APEXRIVER.GPJ ABG.GDT 2025.06.10



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BOREHOLE LOG

APEX2025-03

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2025.05.03 COMPLETED 2025.05.03
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY IW CHECKED BY MS

PROJECT NAME LTWP Water Supply and Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION n/a HOLE SIZE 190 mm
 NOTES UTM: 19V 525883 m E 7070425 m N

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ SPT N VALUE ▲	
							GRAVEL	SAND	FINES			PL	MC
1	Boulders												
1.80	Brown silty SAND - occasional cobbles and boulders		SM	-	S1	-	-	-	-				
3				Nbe	S2	0.0	5	83	12	19.3		□ ●	
3.40	Grey silty SAND												
4			SM	Nbe	S3	0.0	5	82	13	19.1		□ ●	
5													
6			SM	Nbe	S4	0.0	2	74	24	22.6		●	
7					S5	-	-	-	-	-			
7.00	Inferred BEDROCK												
8					B1	-	-	-	-	-			
9													
9.10	Borehole Terminated at 9.1 m - Inferred sound bedrock												
10													
11													
12													
13													
14													
15													

ABG BH/TP LOG IQA-G2316_APEXRIVER.GPJ ABG.GDT 2025.06.10



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BOREHOLE LOG

APEX2025-04

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2025.05.03 COMPLETED 2025.05.03
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY IW CHECKED BY MS

PROJECT NAME LTWP Water Supply and Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION n/a HOLE SIZE 190 mm
 NOTES UTM: 19V 525848 m E 7070442 m N

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ SPT N VALUE ▲	
							GRAVEL	SAND	FINES			PL	LL
0.50	Ice												
0.80	Dark brown silty SAND with gravel		SM	Vx	S1	1.6	18	69	13	43.3			
1.50	Brown well-graded SAND with silt		SW-SM	Nbe	S2	5.0	10	83	7	13.0			
2.00	Brown poorly graded SAND with silt		SP-SM	Nbe	S3	0.0	0	92	8	21.9			
3.00				Nbe	S4	0.0	0	89	11	21.5			
4.00				Nbe	S5	0.0	1	89	10	24.4			
5.20	Grey silty SAND		SM	Nbe	S6	0.0	1	80	19	20.9			
7.00		Nbe		S7	0.0	5	77	18	17.7				
7.90	Inferred BEDROCK			-	B1	-	-	-	-	-			
9.00				-	B2	-	-	-	-	-			
11.00	Borehole Terminated at 11 m - Inferred sound bedrock												

ABG BH/TP LOG IQA-G2316 APEXRIVER.GPJ ABG.GDT 2025.06.10



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BOREHOLE LOG

APEX2025-05

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2025.05.02 COMPLETED 2025.05.02
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY IW CHECKED BY MS

PROJECT NAME LTWP Water Supply and Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION n/a HOLE SIZE 190 mm
 NOTES UTM: 19V 525884 m E 7070475 m N
Multibead thermistor installed

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ SPT N VALUE ▲	
							GRAVEL	SAND	FINES			PL	LL
0.80	Brown poorly graded SAND with silt		SP-SM	Nbn	S1	0.0	4	88	8	7.5	20	80	
2.40	Brown silty SAND with gravel - occasional cobbles and boulders		SM	-	S2	-	-	-	-	-	20	80	
					S3	-	-	-	-	-	20	80	
3	Inferred BEDROCK				B1	-	-	-	-	-	20	80	
4											20	80	
5					B2	-	-	-	-	-	20	80	
6											20	80	
7					B3	-	-	-	-	-	20	80	
8											20	80	
9					B4	-	-	-	-	-	20	80	
9.10	Borehole Terminated at 9.1 m - Inferred sound bedrock										20	80	
10											20	80	
11											20	80	
12											20	80	
13											20	80	
14											20	80	
15											20	80	

ABG BH/TP LOG IQA-G2316 APEXRIVER.GPJ ABG.GDT 2025.06.10




Appendix B

B – Coring Logs



Rock Quality Designation Data Sheet


PROJECT No.:	IQA-G2316	PAGE:	1 of 2
PROJECT NAME:	LTWP Raw Water Supply	DATE DRILLED:	2025.05.17-2025.05.21
PROJECT LOCATION:	Iqaluit, NU	LOCATION:	BH 1B
CORE DIAMETER:	36 mm	TOTAL CORE LENGTH:	511 cm

ROW 1	ROW 2	ROW 3
 <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 18.5 cm</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 19.5 cm</p> <p style="text-align: center;">L = 35 cm</p> <p style="text-align: center;">L = 19 cm</p> <p style="text-align: center;">L = 13 cm</p> <p style="text-align: center;">L = 0 cm</p>	 <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 10 cm</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 14 cm</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 19 cm</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 62 cm</p>	 <p style="text-align: center;">L = 57.5 cm</p> <p style="text-align: center;">L = 10 cm</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 12 cm</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 14 cm</p>



Rock Quality Designation Data Sheet




PROJECT No.:	IQA-G2316	PAGE:	2 of 2
PROJECT NAME:	LTWP Raw Water Supply	DATE DRILLED:	2025.05.17-2025.05.21
PROJECT LOCATION:	Iqaluit, NU	LOCATION:	BH 1B
CORE DIAMETER:	36 mm	TOTAL CORE LENGTH:	511 cm

ROW 4		
 <p style="margin-left: 40px;">L = 56 cm</p> <p style="margin-left: 40px;">L = 0 cm</p> <p style="margin-left: 40px;">L = 17.5 cm</p> <p style="margin-left: 40px;">L = 0 cm</p>		<p>RQD = 377/511 = 73.8%</p>



Rock Quality Designation Data Sheet


PROJECT No.:	IQA-G2316	PAGE:	1 of 2
PROJECT NAME:	LTWP Raw Water Supply	DATE DRILLED:	2024.09.26-2024.09.29
PROJECT LOCATION:	Iqaluit, NU	LOCATION:	BH 2B
CORE DIAMETER:	36 mm	TOTAL CORE LENGTH:	500 cm

ROW 1	ROW 2	ROW 3
 <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 14 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 27.5 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 11.5 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 16.5 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 19 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 12 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 10 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 13 cm</p> <p style="text-align: center;">-----</p>	 <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 12.5 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 42 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 19 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 25 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 11.5 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 35 cm</p> <p style="text-align: center;">-----</p>	 <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 11 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 24 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 20 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 10 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 33.5 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p>



Rock Quality Designation Data Sheet




PROJECT No.:	IQA-G2316	PAGE:	2 of 2
PROJECT NAME:	LTWP Raw Water Supply	DATE DRILLED:	2024.09.26-2024.09.29
PROJECT LOCATION:	Iqaluit, NU	LOCATION:	BH 2B
CORE DIAMETER:	36 mm	TOTAL CORE LENGTH:	500 cm

ROW 4		
 <p>L = 12.5 cm</p> <p>L = 0 cm</p> <p>L = 10 cm</p> <p>L = 18 cm</p>		$RQD = 407.5/500 = 81.5\%$



Rock Quality Designation Data Sheet

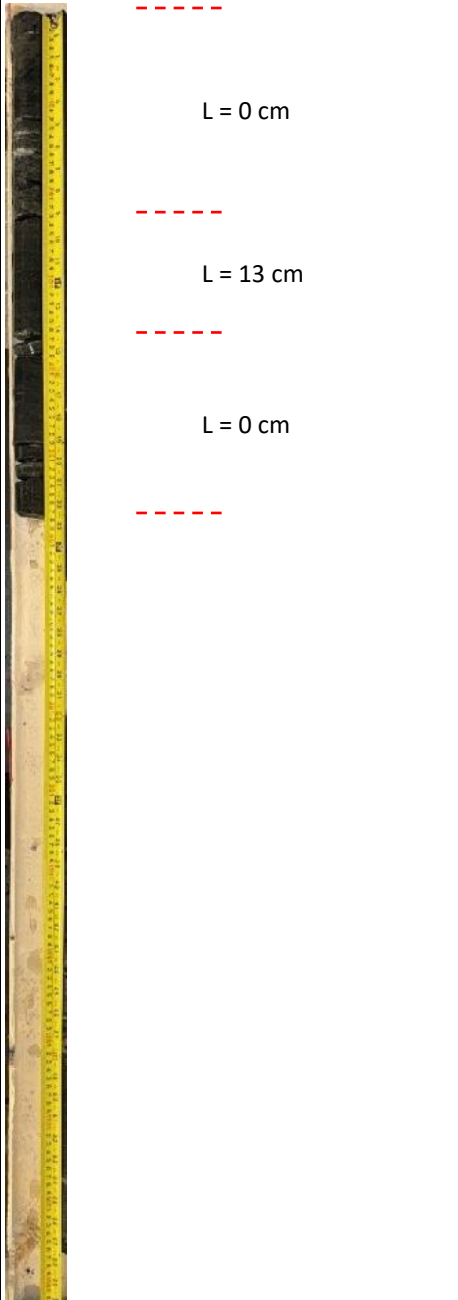
PROJECT No.:	IQA-G2316	PAGE:	1 of 2
PROJECT NAME:	LTWP Raw Water Supply	DATE DRILLED:	2024.09.09-2024.10.3
PROJECT LOCATION:	Iqaluit, NU	LOCATION:	BH 4B
CORE DIAMETER:	36 mm	TOTAL CORE LENGTH:	500 cm

ROW 1	ROW 2	ROW 3
 <p>----- L = 28 cm ----- L = 40 cm ----- L = 0 cm ----- L = 22.5 cm ----- L = 12.5 cm ----- L = 0 cm ----- L = 41 cm -----</p>	 <p>----- L = 0 cm ----- L = 36 cm ----- L = 0 cm ----- L = 11 cm ----- L = 0 cm ----- -----</p>	 <p>----- L = 52 cm ----- L = 12 cm ----- L = 32 cm ----- L = 0 cm ----- L = 15 cm ----- L = 0 cm -----</p>



Rock Quality Designation Data Sheet




PROJECT No.:	IQA-G2316	PAGE:	2 of 2
PROJECT NAME:	LTWP Raw Water Supply	DATE DRILLED:	2024.09.09-2024.10.3
PROJECT LOCATION:	Iqaluit, NU	LOCATION:	BH 4B
CORE DIAMETER:	36 mm	TOTAL CORE LENGTH:	500 cm

ROW 4		
 <p>L = 0 cm</p> <p>L = 13 cm</p> <p>L = 0 cm</p>		$RQD = 315/500 = 63\%$



Rock Quality Designation Data Sheet


PROJECT No.:	IQA-G2316	PAGE:	1 of 2
PROJECT NAME:	LTWP Raw Water Supply	DATE DRILLED:	2025.04.22-2025.04.29
PROJECT LOCATION:	Iqaluit, NU	LOCATION:	BH 5B
CORE DIAMETER:	36 mm	TOTAL CORE LENGTH:	481 cm

ROW 1	ROW 2	ROW 3
 <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 23 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 46 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 12.5 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 15 cm</p> <p style="text-align: center;">-----</p>	 <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 40.5 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 19.5 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p>	 <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 58.5 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 12 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 16 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p>



Rock Quality Designation Data Sheet




PROJECT No.:	IQA-G2316	PAGE:	2 of 2
PROJECT NAME:	LTWP Raw Water Supply	DATE DRILLED:	2025.04.22-2025.04.29
PROJECT LOCATION:	Iqaluit, NU	LOCATION:	BH 5B
CORE DIAMETER:	36 mm	TOTAL CORE LENGTH:	481 cm

ROW 4		
 <p style="margin-left: 40px;">L = 0 cm</p> <p style="margin-left: 40px;">L = 11.5 cm</p> <p style="margin-left: 40px;">L = 0 cm</p> <p style="margin-left: 40px;">L = 10 cm</p> <p style="margin-left: 40px;">L = 0 cm</p>		<p>RQD = 264.5/481 = 55.0%</p>



Rock Quality Designation Data Sheet


PROJECT No.:	IQA-G2316	PAGE:	1 of 2
PROJECT NAME:	LTWP Raw Water Supply	DATE DRILLED:	2024.10.06-2024.10.13
PROJECT LOCATION:	Iqaluit, NU	LOCATION:	BH 7B
CORE DIAMETER:	36 mm / 25 mm	TOTAL CORE LENGTH:	511 cm

ROW 1	ROW 2	ROW 3
 <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 23.5 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 57.5 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 34 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 15.5 cm</p> <p style="text-align: center;">-----</p>	 <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 18.5 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 41 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 56 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 10 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p>	 <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 12 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 13 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 17 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 24 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 13.5 cm</p> <p style="text-align: center;">-----</p>



Rock Quality Designation Data Sheet




PROJECT No.:	IQA-G2316	PAGE:	2 of 2
PROJECT NAME:	LTWP Raw Water Supply	DATE DRILLED:	2024.10.06-2024.10.13
PROJECT LOCATION:	Iqaluit, NU	LOCATION:	BH 7B
CORE DIAMETER:	36 mm / 25 mm	TOTAL CORE LENGTH:	511 cm

ROW 4		
		RQD = 407.5/511 = 79.4%



Rock Quality Designation Data Sheet


PROJECT No.:	IQA-G2316	PAGE:	1 of 2
PROJECT NAME:	LTWP Raw Water Supply	DATE DRILLED:	2025.05.01-2025.05.11
PROJECT LOCATION:	Iqaluit, NU	LOCATION:	BH 9B
CORE DIAMETER:	36 mm	TOTAL CORE LENGTH:	504 cm

ROW 1	ROW 2	ROW 3
 <p style="margin-left: 20px;">----- L = 0 cm -----</p> <p style="margin-left: 20px;">L = 12 cm -----</p> <p style="margin-left: 20px;">L = 19.5 cm -----</p> <p style="margin-left: 20px;">L = 67.5 cm -----</p> <p style="margin-left: 20px;">L = 16 cm -----</p> <p style="margin-left: 20px;">L = 41.5 cm (Continues in Row 2) -----</p>	 <p style="margin-left: 20px;">----- See Row 1 -----</p> <p style="margin-left: 20px;">L = 19.5 cm -----</p> <p style="margin-left: 20px;">L = 0 cm -----</p> <p style="margin-left: 20px;">L = 48.5 cm -----</p> <p style="margin-left: 20px;">L = 18.5 cm -----</p> <p style="margin-left: 20px;">L = 14.5 cm -----</p> <p style="margin-left: 20px;">L = 22 cm -----</p>	 <p style="margin-left: 20px;">----- L = 39.5 cm -----</p> <p style="margin-left: 20px;">L = 0 cm -----</p> <p style="margin-left: 20px;">L = 19 cm -----</p> <p style="margin-left: 20px;">L = 0 cm -----</p> <p style="margin-left: 20px;">L = 18 cm -----</p> <p style="margin-left: 20px;">L = 28.5 cm -----</p> <p style="margin-left: 20px;">L = 0 cm -----</p>



Rock Quality Designation Data Sheet




PROJECT No.:	IQA-G2316	PAGE:	2 of 2
PROJECT NAME:	LTWP Raw Water Supply	DATE DRILLED:	2025.05.01-2025.05.11
PROJECT LOCATION:	Iqaluit, NU	LOCATION:	BH 9B
CORE DIAMETER:	36 mm	TOTAL CORE LENGTH:	504 cm

ROW 4		
 <p>L = 42 cm</p> <p>L = 18.5 cm</p> <p>L = 21.5 cm</p> <p>L = 18 cm</p>		$RQD = 484.5/504 = 96.1\%$



Rock Quality Designation Data Sheet

PROJECT No.:	IQA-G2316	PAGE:	1 of 2
PROJECT NAME:	LTWP Raw Water Supply	DATE DRILLED:	2025.04.22-2025.04.26
PROJECT LOCATION:	Iqaluit, NU	LOCATION:	BH 12B
CORE DIAMETER:	36 mm	TOTAL CORE LENGTH:	522 cm

ROW 1	ROW 2	ROW 3
 <p style="text-align: center;">L = 22 cm</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 11 cm</p> <p style="text-align: center;">L = 69 cm</p> <p style="text-align: center;">L = 0 cm</p>	 <p style="text-align: center;">L = 36.5 cm</p> <p style="text-align: center;">L = 34.5 cm</p> <p style="text-align: center;">L = 32.5 cm</p> <p style="text-align: center;">L = 46.5 cm (Continues in Row 3)</p>	 <p style="text-align: center;">See Row 2</p> <p style="text-align: center;">L = 14.5 cm</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 65 cm</p> <p style="text-align: center;">L = 31.5 cm</p> <p style="text-align: center;">L = 39 cm (Continues in Row 4)</p>



Rock Quality Designation Data Sheet




PROJECT No.:	IQA-G2316	PAGE:	1 of 2
PROJECT NAME:	LTWP Raw Water Supply	DATE DRILLED:	2025.04.22-2025.04.26
PROJECT LOCATION:	Iqaluit, NU	LOCATION:	BH 12B
CORE DIAMETER:	36 mm	TOTAL CORE LENGTH:	522 cm

ROW 4		
<p style="text-align: center;">See Row 3</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 11 cm</p> <p style="text-align: center;">L = 31 cm</p> <p style="text-align: center;">L = 46.5 cm</p>		<p>RQD = 490.5/522 = 94.0%</p>



Rock Quality Designation Data Sheet


PROJECT No.:	IQA-G2316	PAGE:	1 of 2
PROJECT NAME:	LTWP Raw Water Supply	DATE DRILLED:	2025.05.21-2025.05.22
PROJECT LOCATION:	Iqaluit, NU	LOCATION:	BH 13B
CORE DIAMETER:	36 mm	TOTAL CORE LENGTH:	521 cm

ROW 1	ROW 2	ROW 3
 <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 10 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 10 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 11 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 11 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 17 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p>	 <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 43.5 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 22 cm</p> <p style="text-align: center;">-----</p>	 <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 11.5 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 14 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 13.5 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 17.5 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 14 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p>



Rock Quality Designation Data Sheet




PROJECT No.:	IQA-G2316	PAGE:	2 of 2
PROJECT NAME:	LTWP Raw Water Supply	DATE DRILLED:	2025.05.21-2025.05.22
PROJECT LOCATION:	Iqaluit, NU	LOCATION:	BH 13B
CORE DIAMETER:	36 mm	TOTAL CORE LENGTH:	521 cm

ROW 4		
 <p style="margin-left: 40px;">L = 12.5 cm</p> <p style="margin-left: 40px;">L = 0 cm</p> <p style="margin-left: 40px;">L = 12.5 cm</p> <p style="margin-left: 40px;">L = 0 cm</p> <p style="margin-left: 40px;">L = 12 cm</p> <p style="margin-left: 40px;">L = 0 cm</p> <p style="margin-left: 40px;">L = 11 cm</p> <p style="margin-left: 40px;">L = 16 cm</p> <p style="margin-left: 40px;">L = 0 cm</p> <p style="margin-left: 40px;">L = 0 cm</p> <p style="margin-left: 40px;">L = 0 cm</p>		<p>RQD = 259/521 = 49.7%</p>



Rock Quality Designation Data Sheet

PROJECT No.:	IQA-G2316	PAGE:	1 of 2
PROJECT NAME:	LTWP Raw Water Supply	DATE DRILLED:	2025.05.22-2025.05.24
PROJECT LOCATION:	Iqaluit, NU	LOCATION:	BH 15B
CORE DIAMETER:	36 mm	TOTAL CORE LENGTH:	518 cm

ROW 1	ROW 2	ROW 3
 <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 12 cm</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 23 cm</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 17.5 cm</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 46 cm (Continues in Row 2)</p>	 <p style="text-align: center;">See Row 1 L = 0 cm</p> <p style="text-align: center;">L = 45.5 cm</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 64.5 cm</p> <p style="text-align: center;">L = 0 cm</p>	 <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 39 cm</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 10.5 cm</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 21.5 cm</p>



Rock Quality Designation Data Sheet



PROJECT No.:	IQA-G2316	PAGE:	2 of 2
PROJECT NAME:	LTWP Raw Water Supply	DATE DRILLED:	2025.05.22-2025.05.24
PROJECT LOCATION:	Iqaluit, NU	LOCATION:	BH 15B
CORE DIAMETER:	36 mm	TOTAL CORE LENGTH:	518 cm

ROW 4		
<p style="text-align: center;">L = 32 cm</p> <p style="text-align: center;">L = 36.5 cm</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 18 cm</p>		<p>RQD = 366/518 = 70.7%</p>



Rock Quality Designation Data Sheet




PROJECT No.:	IQA-G2316	PAGE:	1 of 1
PROJECT NAME:	LTWP Raw Water Supply	DATE DRILLED:	2024.12.04-2024.12.08
PROJECT LOCATION:	Iqaluit, NU	LOCATION:	BH 17B
CORE DIAMETER:	36 mm	TOTAL CORE LENGTH:	310 cm

ROW 1	ROW 2	
 <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 18 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 43 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 30 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 22 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">No Recovery 146 - 174 cm</p>	 <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 21 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 18 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 17.5 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 21 cm</p> <p style="text-align: center;">-----</p>	<p>RQD = 190.5/310 = 61.5%</p>



Rock Quality Designation Data Sheet

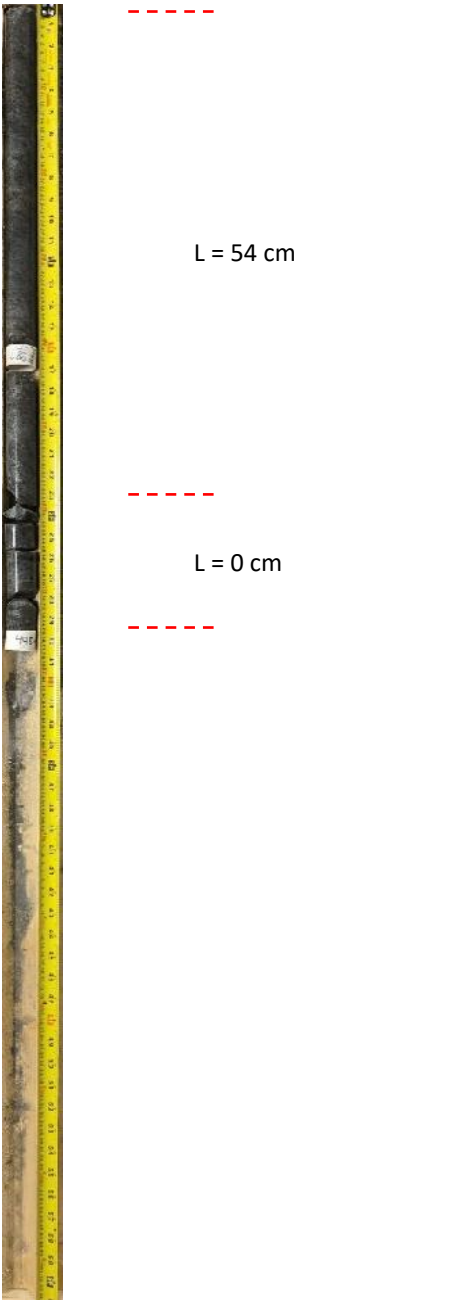
PROJECT No.:	IQA-G2316	PAGE:	1 of 2
PROJECT NAME:	LTWP Raw Water Supply	DATE DRILLED:	2024.12.05-2025.04.21
PROJECT LOCATION:	Iqaluit, NU	LOCATION:	BH 19B
CORE DIAMETER:	36 mm	TOTAL CORE LENGTH:	498 cm

ROW 1	ROW 2	ROW 3
 <p style="text-align: center;">----- L = 0 cm -----</p> <p style="text-align: center;">L = 13 cm -----</p> <p style="text-align: center;">L = 15.5 cm -----</p> <p style="text-align: center;">L = 24 cm -----</p> <p style="text-align: center;">L = 11.5 cm -----</p> <p style="text-align: center;">L = 11 cm -----</p> <p style="text-align: center;">L = 10.5 cm -----</p> <p style="text-align: center;">L = 23 cm -----</p> <p style="text-align: center;">L = 25 cm -----</p>	 <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 72 cm -----</p> <p style="text-align: center;">L = 0 cm -----</p> <p style="text-align: center;">L = 13 cm -----</p> <p style="text-align: center;">L = 0 cm -----</p>	 <p style="text-align: center;">-----</p> <p style="text-align: center;">L = 0 cm -----</p> <p style="text-align: center;">L = 14.5 cm -----</p> <p style="text-align: center;">L = 0 cm -----</p> <p style="text-align: center;">L = 10.5 cm -----</p> <p style="text-align: center;">L = 0 cm -----</p> <p style="text-align: center;">L = 11 cm -----</p> <p style="text-align: center;">L = 17.5 cm -----</p> <p style="text-align: center;">L = 0 cm -----</p> <p style="text-align: center;">L = 10.5 cm -----</p> <p style="text-align: center;">L = 0 cm -----</p> <p style="text-align: center;">L = 11 cm -----</p>



Rock Quality Designation Data Sheet




PROJECT No.:	IQA-G2316	PAGE:	2 of 2
PROJECT NAME:	LTWP Raw Water Supply	DATE DRILLED:	2024.12.05-2025.04.21
PROJECT LOCATION:	Iqaluit, NU	LOCATION:	BH 19B
CORE DIAMETER:	36 mm	TOTAL CORE LENGTH:	498 cm

ROW 4		
 <p>L = 54 cm</p> <p>L = 0 cm</p>		$RQD = 347.5/498 = 69.8\%$



Rock Quality Designation Data Sheet


PROJECT No.:	IQA-G2316	PAGE:	1 of 2
PROJECT NAME:	LTWP Raw Water Supply	DATE DRILLED:	2025.05.17-2025.05.19
PROJECT LOCATION:	Iqaluit, NU	LOCATION:	BH 27B
CORE DIAMETER:	36 mm	TOTAL CORE LENGTH:	511 cm

ROW 1	ROW 2	ROW 3
 <p style="text-align: center;">L = 61 cm</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 24 cm</p> <p style="text-align: center;">L = 21 cm</p>	 <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 44.5 cm</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 16 cm</p> <p style="text-align: center;">L = 0 cm</p>	 <p style="text-align: center;">L = 19 cm</p> <p style="text-align: center;">L = 31 cm</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 10.5 cm</p> <p style="text-align: center;">L = 18 cm</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 100.5 cm (Continues in Row 4)</p>



Rock Quality Designation Data Sheet

PROJECT No.:	IQA-G2316	PAGE:	2 of 2
PROJECT NAME:	LTWP Raw Water Supply	DATE DRILLED:	2025.05.17-2025.05.19
PROJECT LOCATION:	Iqaluit, NU	LOCATION:	BH 27B
CORE DIAMETER:	36 mm	TOTAL CORE LENGTH:	511 cm

ROW 4		
 <p style="text-align: center;">See Row 3</p> <p style="text-align: center;">L = 23 cm</p>		<p>RQD = 368.5/511 = 72.1%</p>



Rock Quality Designation Data Sheet


PROJECT No.:	IQA-G2316	PAGE:	1 of 2
PROJECT NAME:	LTWP Raw Water Supply	DATE DRILLED:	2025.05.27
PROJECT LOCATION:	Iqaluit, NU	LOCATION:	BH 28B-2
CORE DIAMETER:	36 mm	TOTAL CORE LENGTH:	503 cm

ROW 1	ROW 2	ROW 3
<p style="text-align: center;">L = 22 cm</p> <p style="text-align: center;">L = 13 cm</p> <p style="text-align: center;">L = 13 cm</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 12.5 cm</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 15 cm</p> <p style="text-align: center;">L = 0 cm</p>	<p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 10 cm</p> <p style="text-align: center;">L = 11 cm</p> <p style="text-align: center;">L = 48 cm</p> <p style="text-align: center;">L = 10.5 cm</p>	<p style="text-align: center;">L = 23 cm</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 12.5 cm</p> <p style="text-align: center;">L = 0 cm</p> <p style="text-align: center;">L = 16 cm</p> <p style="text-align: center;">L = 50.5 cm</p> <p style="text-align: center;">L = 21 cm</p>



Rock Quality Designation Data Sheet

PROJECT No.:	IQA-G2316	PAGE:	2 of 2
PROJECT NAME:	LTWP Raw Water Supply	DATE DRILLED:	2025.05.27
PROJECT LOCATION:	Iqaluit, NU	LOCATION:	BH 28B-2
CORE DIAMETER:	36 mm	TOTAL CORE LENGTH:	503 cm

ROW 4		
 <p>L = 0 cm</p> <p>L = 10 cm</p> <p>L = 0 cm</p>	$RQD = 288/503 = 57.3\%$	

Appendix C

C – Geotechnical Certificates of Analyses



Your Project #: 30192375-01
Your C.O.C. #: N/A

Attention: Ryan Janzen

ARCADIS Canada Inc
500-333 Preston Street
Ottawa, ON
CANADA K1S 5N4

Report Date: 2024/09/30
Report #: R8342058
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C4T0005

Received: 2024/09/16, 14:31

Sample Matrix: Soil
Samples Received: 12

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Moisture (1)	12	N/A	2024/09/19	CAM SOP-00445	Carter 2nd ed 70.2 m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, EPA, APHA or the Quebec Ministry of Environment.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by Bureau Veritas Mississauga, 6740 Campobello Rd , Mississauga, ON, L5N 2L8



Your Project #: 30192375-01
Your C.O.C. #: N/A

Attention: Ryan Janzen

ARCADIS Canada Inc
500-333 Preston Street
Ottawa, ON
CANADA K1S 5N4

Report Date: 2024/09/30
Report #: R8342058
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C4T0005

Received: 2024/09/16, 14:31

Encryption Key

Please direct all questions regarding this Certificate of Analysis to:
Katherine Szozda, Project Manager
Email: Katherine.Szozda@bureauveritas.com
Phone# (613)274-0573 Ext:7063633

=====
This report has been generated and distributed using a secure automated process.
Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation, please refer to the Validation Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by Rodney Major, General Manager responsible for Ontario Environmental laboratory operations.



RESULTS OF ANALYSES OF SOIL

Bureau Veritas ID		ADAW69	ADAW70	ADAW71	ADAW72	ADAW73	ADAW74	ADAW75		
Sampling Date		2024/09/15	2024/09/15	2024/09/15	2024/09/15	2024/09/15	2024/09/15	2024/09/15		
COC Number		N/A	N/A	N/A	N/A	N/A	N/A	N/A		
	UNITS	BP1-A1	BP1-A2	BP1-A3	BP2-A1	BP2-A2	BP2-A3	BP3-A1	RDL	QC Batch

Inorganics										
Moisture	%	3.5	16	23	13	2.8	11	7.1	1.0	9649631
RDL = Reportable Detection Limit										
QC Batch = Quality Control Batch										

Bureau Veritas ID		ADAW76	ADAW77	ADAW78	ADAW79	ADAW80		
Sampling Date		2024/09/15	2024/09/15	2024/09/15	2024/09/15	2024/09/15		
COC Number		N/A	N/A	N/A	N/A	N/A		
	UNITS	BP3-A2	BP3-A3	BP4-A1	BP4-A2	BP4-A3	RDL	QC Batch

Inorganics								
Moisture	%	18	14	12	9.7	18	1.0	9649631
RDL = Reportable Detection Limit								
QC Batch = Quality Control Batch								



TEST SUMMARY

Bureau Veritas ID: ADAW69
Sample ID: BP1-A1
Matrix: Soil

Collected: 2024/09/15
Shipped:
Received: 2024/09/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	9649631	N/A	2024/09/19	Muhammad Chhaidan

Bureau Veritas ID: ADAW70
Sample ID: BP1-A2
Matrix: Soil

Collected: 2024/09/15
Shipped:
Received: 2024/09/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	9649631	N/A	2024/09/19	Muhammad Chhaidan

Bureau Veritas ID: ADAW71
Sample ID: BP1-A3
Matrix: Soil

Collected: 2024/09/15
Shipped:
Received: 2024/09/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	9649631	N/A	2024/09/19	Muhammad Chhaidan

Bureau Veritas ID: ADAW72
Sample ID: BP2-A1
Matrix: Soil

Collected: 2024/09/15
Shipped:
Received: 2024/09/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	9649631	N/A	2024/09/19	Muhammad Chhaidan

Bureau Veritas ID: ADAW73
Sample ID: BP2-A2
Matrix: Soil

Collected: 2024/09/15
Shipped:
Received: 2024/09/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	9649631	N/A	2024/09/19	Muhammad Chhaidan

Bureau Veritas ID: ADAW74
Sample ID: BP2-A3
Matrix: Soil

Collected: 2024/09/15
Shipped:
Received: 2024/09/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	9649631	N/A	2024/09/19	Muhammad Chhaidan

Bureau Veritas ID: ADAW75
Sample ID: BP3-A1
Matrix: Soil

Collected: 2024/09/15
Shipped:
Received: 2024/09/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	9649631	N/A	2024/09/19	Muhammad Chhaidan



BUREAU
VERITAS

Bureau Veritas Job #: C4T0005
Report Date: 2024/09/30

ARCADIS Canada Inc
Client Project #: 30192375-01
Sampler Initials: RJ

TEST SUMMARY

Bureau Veritas ID: ADAW76
Sample ID: BP3-A2
Matrix: Soil

Collected: 2024/09/15
Shipped:
Received: 2024/09/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	9649631	N/A	2024/09/19	Muhammad Chhaidan

Bureau Veritas ID: ADAW77
Sample ID: BP3-A3
Matrix: Soil

Collected: 2024/09/15
Shipped:
Received: 2024/09/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	9649631	N/A	2024/09/19	Muhammad Chhaidan

Bureau Veritas ID: ADAW78
Sample ID: BP4-A1
Matrix: Soil

Collected: 2024/09/15
Shipped:
Received: 2024/09/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	9649631	N/A	2024/09/19	Muhammad Chhaidan

Bureau Veritas ID: ADAW79
Sample ID: BP4-A2
Matrix: Soil

Collected: 2024/09/15
Shipped:
Received: 2024/09/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	9649631	N/A	2024/09/19	Muhammad Chhaidan

Bureau Veritas ID: ADAW80
Sample ID: BP4-A3
Matrix: Soil

Collected: 2024/09/15
Shipped:
Received: 2024/09/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	9649631	N/A	2024/09/19	Muhammad Chhaidan



BUREAU
VERITAS

Bureau Veritas Job #: C4T0005
Report Date: 2024/09/30

ARCADIS Canada Inc
Client Project #: 30192375-01
Sampler Initials: RJ

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	24.0°C
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Results relate only to the items tested.



BUREAU
VERITAS

Bureau Veritas Job #: C4T0005
Report Date: 2024/09/30

QUALITY ASSURANCE REPORT

ARCADIS Canada Inc
Client Project #: 30192375-01
Sampler Initials: RJ

QC Batch	Parameter	Date	RPD	
			Value (%)	QC Limits
9649631	Moisture	2024/09/19	3.8	20
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.				



BUREAU
VERITAS

Bureau Veritas Job #: C4T0005
Report Date: 2024/09/30

ARCADIS Canada Inc
Client Project #: 30192375-01
Sampler Initials: RJ

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Cristina Carriere

Cristina Carriere, Senior Scientific Specialist

Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation, please refer to the Validation Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by Rodney Major, General Manager responsible for Ontario Environmental laboratory operations.



NONT-2024-09-3288

Invoice Information		Invoice to (requires report) <input type="checkbox"/>		Report Information (if differs from invoice)				Project Information							
Company:	Arcadis Canada Inc.			Company:				Quotation #:							
Contact Name:	Ryan Janzen			Contact Name:				P.O. # / APER:							
Street Address:	333 Preston St.			Street Address:				Project #:							
City:	Ottawa	Prov:	ON	Postal Code:	K1S 2L5		City:		Prov:		Postal Code:		Site #:		
Phone:	613-721-0555			Phone:				Site Location:							
Email:	ryan.janzen@arcadis.com			Email:				Site Location Province:							
Copies:	jacob.holder@arcadis.com			Copies:				Sampled by:							
<p>REG 153</p> <p><input type="checkbox"/> Table 1 <input type="checkbox"/> Res/Park <input type="checkbox"/> Med/Fine <input type="checkbox"/> CCME <input type="checkbox"/> Reg 406, Table</p> <p><input type="checkbox"/> Table 2 <input type="checkbox"/> Ind/Comm <input type="checkbox"/> Coarse <input type="checkbox"/> Reg 558* <input type="checkbox"/> Sanitary Sewer Bylaw</p> <p><input type="checkbox"/> Table 3 <input type="checkbox"/> Agri/Other <input type="checkbox"/> For RSC <input type="checkbox"/> *min 3 day TAT <input type="checkbox"/> Storm Sewer Bylaw</p> <p><input type="checkbox"/> Table <input type="checkbox"/> MISA <input type="checkbox"/> Municipality</p> <p><input type="checkbox"/> Other:</p> <p>Include Criteria on Certificate of Analysis (check if yes): <input type="checkbox"/></p>															
<p>SAMPLES MUST BE KEPT COOL (6°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BUREAU VERITAS</p>															
Sample Identification (Please print or Type)		Date Sampled		Time (24hr)		Matrix						Regular Turnaround Time (TAT)			
		YYYY	MM	DD	HR	MM						<input type="checkbox"/> 5 to 7 Day <input type="checkbox"/> 10 Day <input type="checkbox"/> Rush Turnaround Time (TAT) <input type="checkbox"/> Surcharges apply			
1	BP1-A1	2024	08	15				FIELD FILTERED							
2	BP1-A2							FIELD PRESERVED							
3	BP1-A3							LAB FILTRATION REQUIRED							
4	BP2-A1							2TEX/FL							
5	BP2-A2							72-14							
6	BP2-A3							WPC							
7	BP3-A1							Reg 153 metals and inorganics							
8	BP3-A2							Reg 153 metals							
9	BP3-A3							Reg 153 metals							
10	BP4-A1							Reg 153 metals							
11	BP4-A2							Reg 153 metals							
12	BP4-A3							Reg 153 metals							
<p>*UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BUREAU VERITAS STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS AND CONDITIONS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVNA.COM/TERMS-AND-CONDITIONS OR BY CALLING THE LABORATORY LISTED ABOVE TO OBTAIN A COPY</p>															
LAB USE ONLY		Yes	No	LAB USE ONLY		Yes	No	LAB USE ONLY		Yes	No	LAB USE ONLY		Yes	No
Seal present				Seal present				Seal present				Seal present			
Seal intact				Seal intact				Seal intact				Seal intact			
Cooling media present				Cooling media present				Cooling media present				Cooling media present			
Relinquished by: (Signature/ Print)		Date		Time		Received by: (Signature/ Print)		Date		Time		Special instructions			
Ryan Janzen		YYYY	MM	DD	HH	MM	Acropolis Scientific		YYYY	MM	DD	HH	MM		
Ryan J		2024	09	16	14	20	ABA		2024	09	16	14	31		
							Janzen		2024	09	17	09	30		

please hold half of each sample. May want to do hydrometer depending on initial results.

Received in Ottawa



BUREAU VERITAS

Grain Size Analysis Report

Client Sample ID: ADAW69-BP1-A1
Maxxam Sample ID: CWA660-01
Maxxam Job #: C475010

Tot. Sample Wt (g)*: 13.84 Batch # (Sieve): B538002
> 2 mm Sample Wt (g)*: 0.47 Batch # (Hydro): B536879

* Dry mass based on Sieve Aliquot

Analysis Date (Sieve): 9/26/2024
Analysis Date (Hydro): 9/25/2024

	Description	Particle Size (mm)	Percent Passing
Sieve	Sieve 4	4.750	100.0
	Sieve 10	2.000	96.6
	Sieve 20	0.850	93.4
	Sieve 40	0.425	81.9
	Sieve 100	0.150	33.2
	Sieve 200	0.075	11.4
Hydrometer	R1min	0.0519	5.7
	R3min	0.0301	4.7
	R10min	0.0167	1.9
	R30min	0.0096	1.9
	R90min	0.0055	1.9
	R270min	0.0032	1.9
	R1080min	0.0016	1.9

Grain Size Proportion (%)**:

	Min (mm)	Max (mm)	Percentage
Sand	0.050	2.000	94.2
Silt	0.002	0.050	3.8
Clay	-	0.002	2.0

** Calculations based only on sub 2 mm fraction.
Compatible with USDA and Canadian Soil Triangles

Soil Classification***:

Based on the entire sample

Percentage (by mass) less than 0.075 mm = 11.4

Classification = Coarse Textured Soil

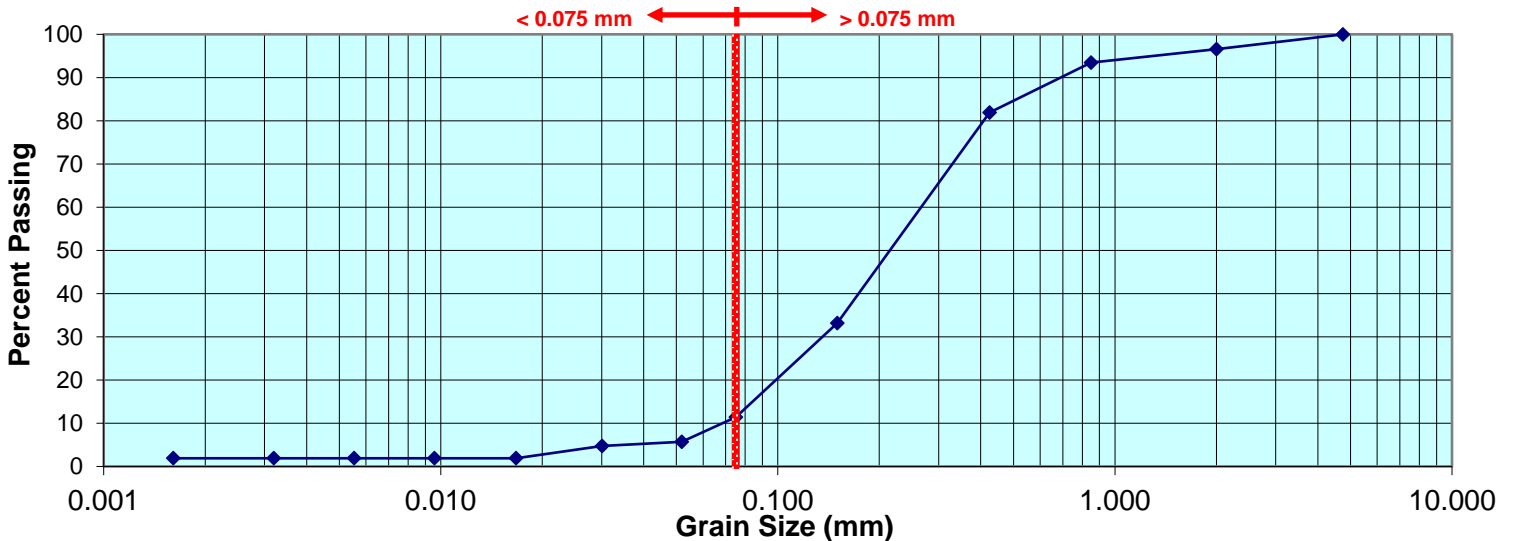
Based on the < 2 mm fraction ****

Percentage (by mass) less than 0.075 mm = 11.8

Classification = Coarse Textured Soil

**** Grain size analysis performed to classify the soil material according to the criteria prescribed in Section 42.2 of Ontario Regulation 153/04 as amended by Ontario Regulation 511/09, and conducted in accordance with test procedures outlined in ASTM D422.

CLAY < 0.002 mm	SILT			SAND			GRAVEL	
	Fine 0.002 - 0.0063 mm	Medium 0.0063 - 0.02 mm	Coarse 0.02 - 0.05 mm	Fine 0.05 - 0.2 mm	Medium 0.2 - 0.63 mm	Coarse 0.63 - 2 mm	Fine 2 - 6.3 mm	Med > 6.3



*** ON Regulation 153/04 requires coarse:fine determination on the < 2 mm fraction. Other jurisdictions may require the entire sample, thus both classifications are provided

Note: Clay/Silt/Sand/Gravel Graphic above Graph: Sand | Silt | Clay fractions in accordance with USDA and Canadian System of Soil Classification. Sub fractions in accordance with the British (BSI) system for information purposes.



**BUREAU
VERITAS**

Grain Size Analysis Report

Client Sample ID: **ADAW69-BP1-A1**
 Maxxam Sample ID: **DUP CWA660-01**
 Maxxam Job #: **C475010**

Tot. Sample Wt (g)*: **14.07** Batch # (Sieve): **B538002**
 > 2 mm Sample Wt (g)*: **0.72** Batch # (Hydro): **B536879**

* Dry mass based on Sieve Aliquot

Analysis Date (Sieve): **9/26/2024**

Analysis Date (Hydro): **9/25/2024**

Grain Size Proportion (%)**:

	Min (mm)	Max (mm)	Percentage
Sand	0.050	2.000	94.1
Silt	0.002	0.050	4.9
Clay	-	0.002	1.0

** Calculations based only on sub 2 mm fraction.
 Compatible with USDA and Canadian Soil Triangles

	Description	Particle Size (mm)	Percent Passing
Sieve	Sieve 4	4.750	96.1
	Sieve 10	2.000	94.9
	Sieve 20	0.850	91.6
	Sieve 40	0.425	79.2
	Sieve 100	0.150	30.5
	Sieve 200	0.075	9.8
Hydrometer	R1min	0.0519	5.7
	R3min	0.0301	3.8
	R10min	0.0168	1.0
	R30min	0.0096	1.0
	R90min	0.0056	1.0
	R270min	0.0032	1.0
	R1080min	0.0016	1.0

Soil Classification***:

Based on the entire sample

Percentage (by mass) less than 0.075 mm = 9.8

Classification = Coarse Textured Soil

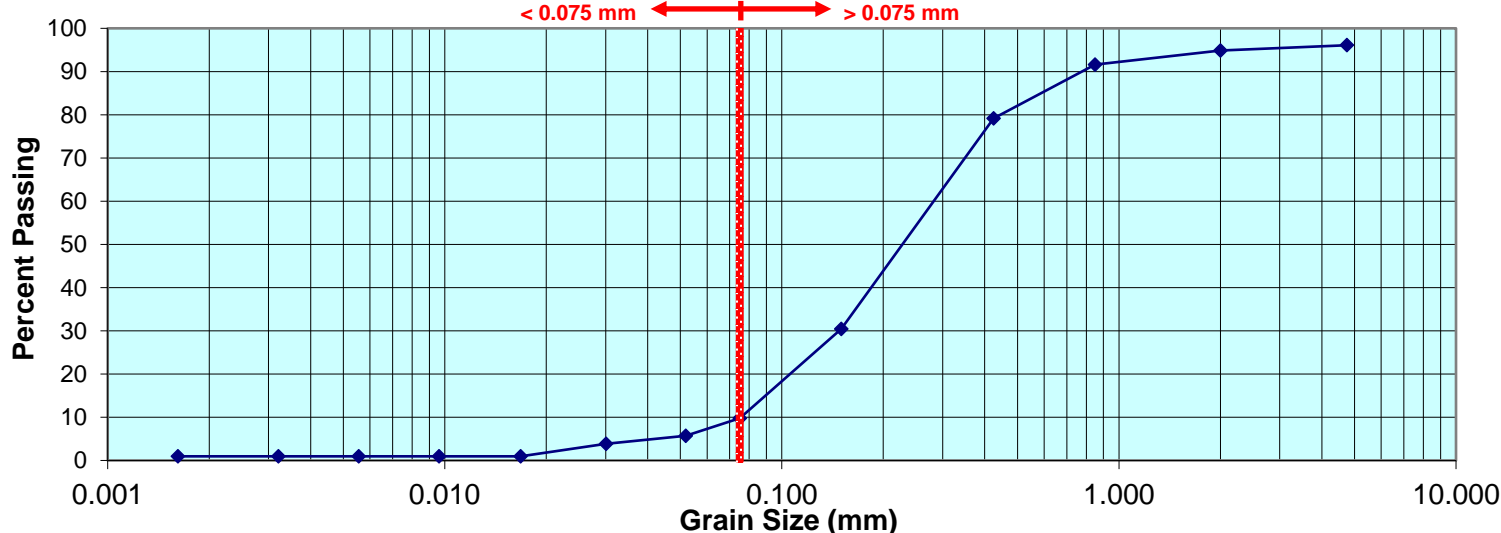
Based on the < 2 mm fraction ****

Percentage (by mass) less than 0.075 mm = 10.3

Classification = Coarse Textured Soil

**** Grain size analysis performed to classify the soil material according to the criteria prescribed in Section 42.2 of Ontario Regulation 153/04 as amended by Ontario Regulation 511/09, and conducted in accordance with test procedures outlined in ASTM D422.

CLAY < 0.002 mm	SILT			SAND			GRAVEL	
	Fine 0.002 - 0.0063 mm	Medium 0.0063 - 0.02 mm	Coarse 0.02 - 0.05 mm	Fine 0.05 - 0.2 mm	Medium 0.2 - 0.63 mm	Coarse 0.63 - 2 mm	Fine 2 - 6.3 mm	Med > 6.3



*** ON Regulation 153/04 requires coarse:fine determination on the < 2 mm fraction. Other jurisdictions may require the entire sample, thus both classifications are provided

Note: Clay/Silt/Sand/Gravel Graphic above Graph: Sand | Silt | Clay fractions in accordance with USDA and Canadian System of Soil Classification. Sub fractions in accordance with the British (BSI) system for information purposes.



Grain Size Analysis Report

BUREAU
VERITAS

Client Sample ID: ADAW69-BP1-A1
Maxxam Sample ID: DUP CWA660-01
Maxxam Job #: C475010

Tot. Sample Wt (g)*: 10.02 Batch # (Sieve): B538002
> 2 mm Sample Wt (g)*: 0.07 Batch # (Hydro): B536879

* Dry mass based on Sieve Aliquot

Analysis Date (Sieve): 9/26/2024
Analysis Date (Hydro): 9/25/2024

	Description	Particle Size (mm)	Percent Passing
Sieve	Sieve 4	4.750	100.0
	Sieve 10	2.000	99.3
	Sieve 20	0.850	95.9
	Sieve 40	0.425	83.1
	Sieve 100	0.150	34.9
	Sieve 200	0.075	19.5
Hydrometer	R1min	0.0519	6.0
	R3min	0.0301	4.0
	R10min	0.0168	1.0
	R30min	0.0096	1.0
	R90min	0.0056	1.0
	R270min	0.0032	1.0
	R1080min	0.0016	1.0

Grain Size Proportion (%)**:

	Min (mm)	Max (mm)	Percentage
Sand	0.050	2.000	94.1
Silt	0.002	0.050	4.9
Clay	-	0.002	1.0

** Calculations based only on sub 2 mm fraction.
Compatible with USDA and Canadian Soil Triangles

Soil Classification***:

Based on the entire sample

Percentage (by mass) less than 0.075 mm = 19.5

Classification = Coarse Textured Soil

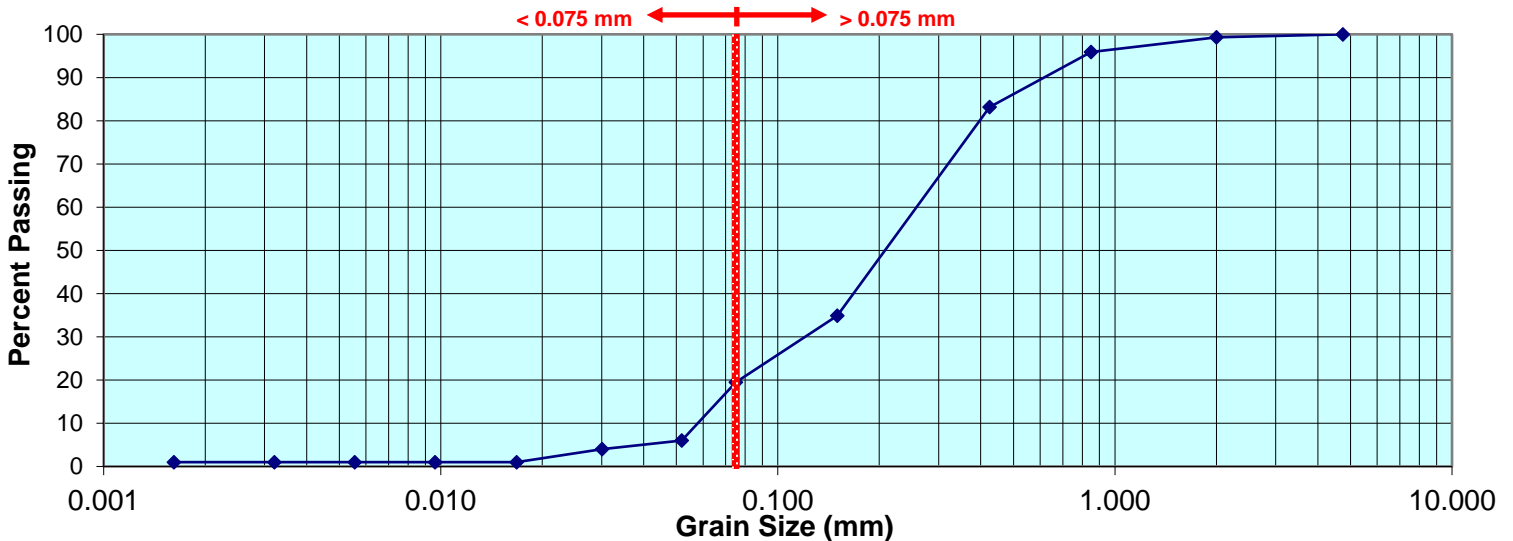
Based on the < 2 mm fraction ****

Percentage (by mass) less than 0.075 mm = 19.6

Classification = Coarse Textured Soil

**** Grain size analysis performed to classify the soil material according to the criteria prescribed in Section 42.2 of Ontario Regulation 153/04 as amended by Ontario Regulation 511/09, and conducted in accordance with test procedures outlined in ASTM D422.

CLAY < 0.002 mm	SILT			SAND			GRAVEL	
	Fine 0.002 - 0.0063 mm	Medium 0.0063 - 0.02 mm	Coarse 0.02 - 0.05 mm	Fine 0.05 - 0.2 mm	Medium 0.2 - 0.63 mm	Coarse 0.63 - 2 mm	Fine 2 - 6.3 mm	Med > 6.3



*** ON Regulation 153/04 requires coarse:fine determination on the < 2 mm fraction. Other jurisdictions may require the entire sample, thus both classifications are provided

Note: Clay/Silt/Sand/Gravel Graphic above Graph: Sand | Silt | Clay fractions in accordance with USDA and Canadian System of Soil Classification. Sub fractions in accordance with the British (BSI) system for information purposes.



BUREAU
VERITAS

Grain Size Analysis Report

Client Sample ID: ADAW70-BP1-A2

Maxxam Sample ID: CWA661-01

Maxxam Job #: C475010

Tot. Sample Wt (g)*: 10.24

Batch # (Sieve): B538002

> 2 mm Sample Wt (g)*: 0.00

Batch # (Hydro): B536879

* Dry mass based on Sieve Aliquot

Analysis Date (Sieve): 9/26/2024

Analysis Date (Hydro): 9/25/2024

Grain Size Proportion (%)**:

	Min (mm)	Max (mm)	Percentage
Sand	0.050	2.000	10.3
Silt	0.002	0.050	81.4
Clay	-	0.002	8.3

** Calculations based only on sub 2 mm fraction.
Compatible with USDA and Canadian Soil Triangles

	Description	Particle Size (mm)	Percent Passing
Sieve	Sieve 4	4.750	100.0
	Sieve 10	2.000	100.0
	Sieve 20	0.850	100.0
	Sieve 40	0.425	100.0
	Sieve 100	0.150	99.9
	Sieve 200	0.075	99.6
Hydrometer	R1min	0.0448	87.6
	R3min	0.0266	72.8
	R10min	0.0155	46.3
	R30min	0.0093	23.2
	R90min	0.0055	13.2
	R270min	0.0032	8.3
	R1080min	0.0016	8.3

Soil Classification***:

Based on the entire sample

Percentage (by mass) less than 0.075 mm = 99.6

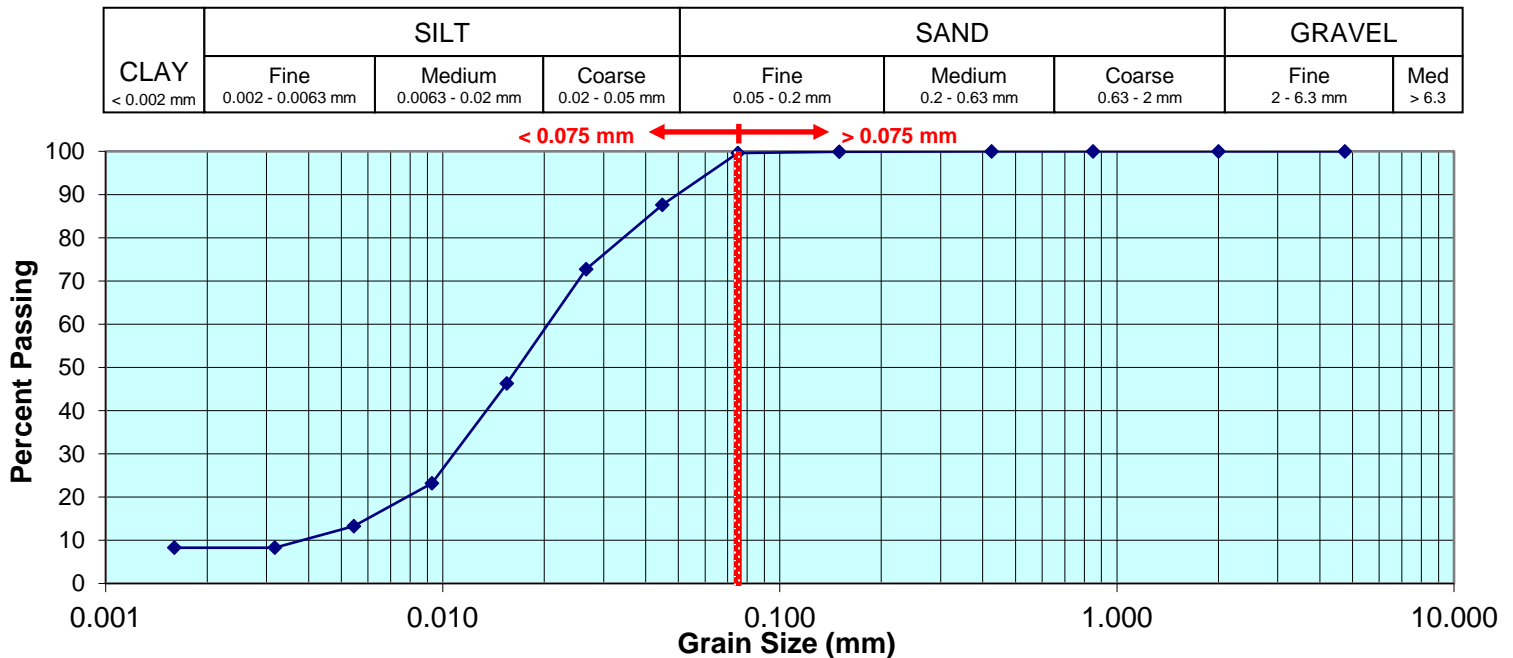
Classification = Fine Textured Soil

Based on the < 2 mm fraction ****

Percentage (by mass) less than 0.075 mm = 99.6

Classification = Fine Textured Soil

**** Grain size analysis performed to classify the soil material according to the criteria prescribed in Section 42.2 of Ontario Regulation 153/04 as amended by Ontario Regulation 511/09, and conducted in accordance with test procedures outlined in ASTM D422.



*** ON Regulation 153/04 requires coarse:fine determination on the < 2 mm fraction. Other jurisdictions may require the entire sample, thus both classifications are provided

Note: Clay/Silt/Sand/Gravel Graphic above Graph: Sand | Silt | Clay fractions in accordance with USDA and Canadian System of Soil Classification. Sub fractions in accordance with the British (BSI) system for information purposes.



BUREAU VERITAS

Grain Size Analysis Report

Client Sample ID: ADAW71-BP1-A3
Maxxam Sample ID: CWA662-01
Maxxam Job #: C475010

Tot. Sample Wt (g)*: 11.23 Batch # (Sieve): B538002
> 2 mm Sample Wt (g)*: 0.01 Batch # (Hydro): B536879

* Dry mass based on Sieve Aliquot

Analysis Date (Sieve): 9/26/2024
Analysis Date (Hydro): 9/25/2024

	Description	Particle Size (mm)	Percent Passing
Sieve	Sieve 4	4.750	100.0
	Sieve 10	2.000	99.9
	Sieve 20	0.850	99.6
	Sieve 40	0.425	98.6
	Sieve 100	0.150	77.3
	Sieve 200	0.075	37.7
Hydrometer	R1min	0.0508	11.0
	R3min	0.0300	4.7
	R10min	0.0167	1.6
	R30min	0.0096	1.6
	R90min	0.0055	1.6
	R270min	0.0032	1.6
	R1080min	0.0016	1.6

Grain Size Proportion (%)**:

	Min (mm)	Max (mm)	Percentage
Sand	0.050	2.000	89.3
Silt	0.002	0.050	9.2
Clay	-	0.002	1.6

** Calculations based only on sub 2 mm fraction.
Compatible with USDA and Canadian Soil Triangles

Soil Classification***:

Based on the entire sample

Percentage (by mass) less than 0.075 mm = 37.7

Classification = Coarse Textured Soil

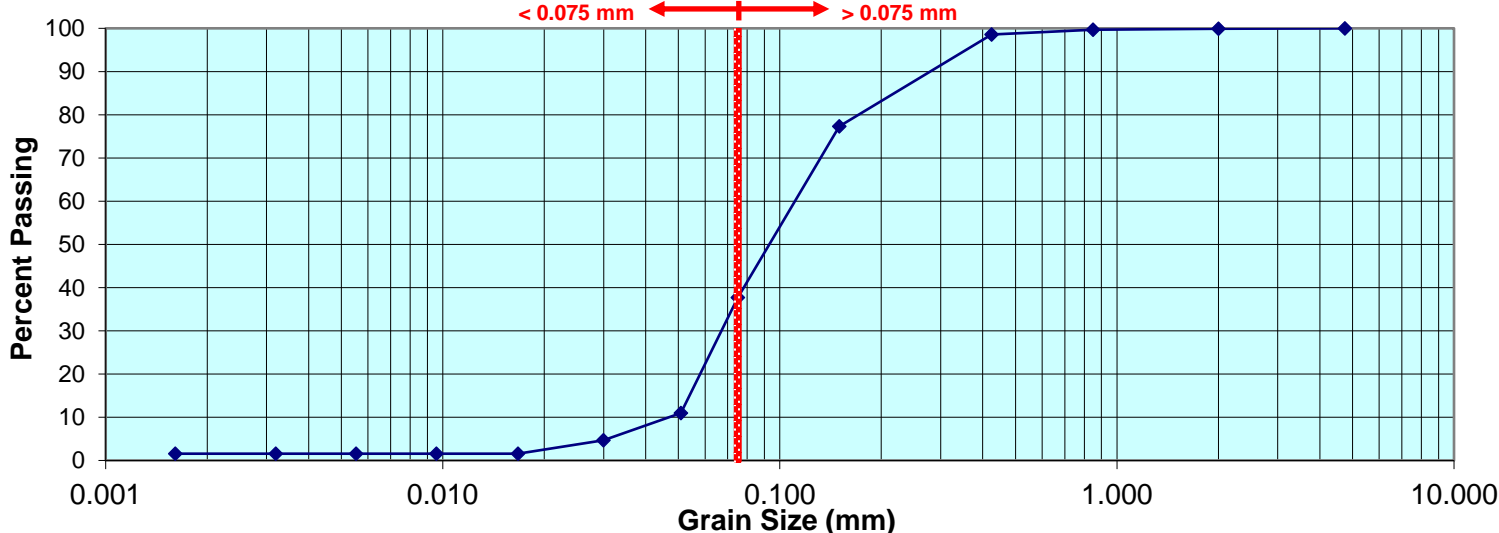
Based on the < 2 mm fraction ****

Percentage (by mass) less than 0.075 mm = 37.7

Classification = Coarse Textured Soil

**** Grain size analysis performed to classify the soil material according to the criteria prescribed in Section 42.2 of Ontario Regulation 153/04 as amended by Ontario Regulation 511/09, and conducted in accordance with test procedures outlined in ASTM D422.

CLAY < 0.002 mm	SILT			SAND			GRAVEL	
	Fine 0.002 - 0.0063 mm	Medium 0.0063 - 0.02 mm	Coarse 0.02 - 0.05 mm	Fine 0.05 - 0.2 mm	Medium 0.2 - 0.63 mm	Coarse 0.63 - 2 mm	Fine 2 - 6.3 mm	Med > 6.3



*** ON Regulation 153/04 requires coarse:fine determination on the < 2 mm fraction. Other jurisdictions may require the entire sample, thus both classifications are provided

Note: Clay/Silt/Sand/Gravel Graphic above Graph: Sand | Silt | Clay fractions in accordance with USDA and Canadian System of Soil Classification. Sub fractions in accordance with the British (BSI) system for information purposes.



**BUREAU
VERITAS**

Grain Size Analysis Report

Client Sample ID: **ADAW72-BP2-A1**
 Maxxam Sample ID: **CWA663-01**
 Maxxam Job #: **C475010**

Tot. Sample Wt (g)*: **11.95** Batch # (Sieve): **B538002**
 > 2 mm Sample Wt (g)*: **1.60** Batch # (Hydro): **B536879**

* Dry mass based on Sieve Aliquot

Analysis Date (Sieve): **9/26/2024**
 Analysis Date (Hydro): **9/25/2024**

Grain Size Proportion (%)**:

	Min (mm)	Max (mm)	Percentage
Sand	0.050	2.000	97.8
Silt	0.002	0.050	0.7
Clay	-	0.002	1.5

** Calculations based only on sub 2 mm fraction.
 Compatible with USDA and Canadian Soil Triangles

	Description	Particle Size (mm)	Percent Passing
Sieve	Sieve 4	4.750	94.8
	Sieve 10	2.000	86.6
	Sieve 20	0.850	65.9
	Sieve 40	0.425	33.4
	Sieve 100	0.150	2.2
	Sieve 200	0.075	0.7
Hydrometer	R1min	0.0525	1.9
	R3min	0.0303	1.9
	R10min	0.0167	1.3
	R30min	0.0096	1.3
	R90min	0.0055	1.3
	R270min	0.0032	1.3
	R1080min	0.0016	1.3

Soil Classification***:

Based on the entire sample

Percentage (by mass) less than 0.075 mm = 0.7

Classification = Coarse Textured Soil

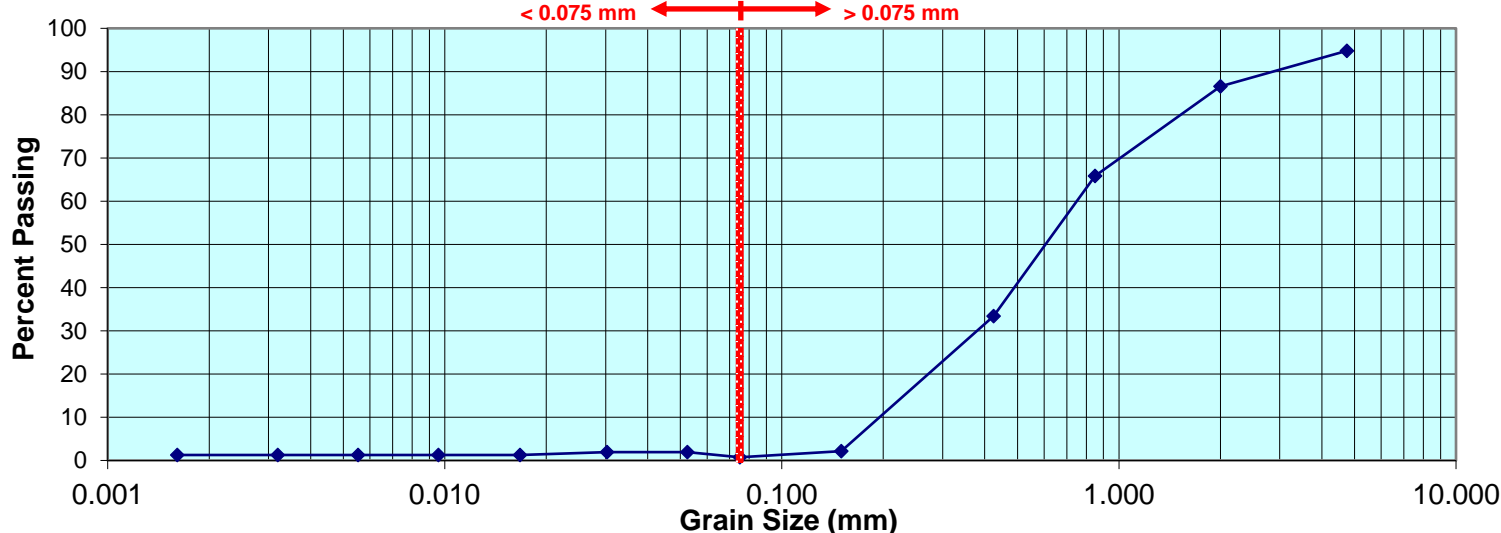
Based on the < 2 mm fraction ****

Percentage (by mass) less than 0.075 mm = 0.9

Classification = Coarse Textured Soil

**** Grain size analysis performed to classify the soil material according to the criteria prescribed in Section 42.2 of Ontario Regulation 153/04 as amended by Ontario Regulation 511/09, and conducted in accordance with test procedures outlined in ASTM D422.

CLAY < 0.002 mm	SILT			SAND			GRAVEL	
	Fine 0.002 - 0.0063 mm	Medium 0.0063 - 0.02 mm	Coarse 0.02 - 0.05 mm	Fine 0.05 - 0.2 mm	Medium 0.2 - 0.63 mm	Coarse 0.63 - 2 mm	Fine 2 - 6.3 mm	Med > 6.3



*** ON Regulation 153/04 requires coarse:fine determination on the < 2 mm fraction. Other jurisdictions may require the entire sample, thus both classifications are provided

Note: Clay/Silt/Sand/Gravel Graphic above Graph: Sand | Silt | Clay fractions in accordance with USDA and Canadian System of Soil Classification. Sub fractions in accordance with the British (BSI) system for information purposes.



BUREAU VERITAS

Grain Size Analysis Report

Client Sample ID: ADAW73-BP2-A2
Maxxam Sample ID: CWA664-01
Maxxam Job #: C475010

Tot. Sample Wt (g)*: 10.10 Batch # (Sieve): B538002
> 2 mm Sample Wt (g)*: 0.38 Batch # (Hydro): B536879

* Dry mass based on Sieve Aliquot

Analysis Date (Sieve): 9/26/2024
Analysis Date (Hydro): 9/25/2024

Grain Size Proportion (%)**:

	Min (mm)	Max (mm)	Percentage
Sand	0.050	2.000	96.9
Silt	0.002	0.050	2.3
Clay	-	0.002	0.8

** Calculations based only on sub 2 mm fraction.
Compatible with USDA and Canadian Soil Triangles

	Description	Particle Size (mm)	Percent Passing
Sieve	Sieve 4	4.750	100.0
	Sieve 10	2.000	96.2
	Sieve 20	0.850	87.6
	Sieve 40	0.425	65.8
	Sieve 100	0.150	12.7
	Sieve 200	0.075	2.2
Hydrometer	R1min	0.0521	3.1
	R3min	0.0303	2.3
	R10min	0.0168	0.8
	R30min	0.0096	0.8
	R90min	0.0056	0.8
	R270min	0.0032	0.8
	R1080min	0.0016	0.8

Soil Classification***:

Based on the entire sample

Percentage (by mass) less than 0.075 mm = 2.2

Classification = Coarse Textured Soil

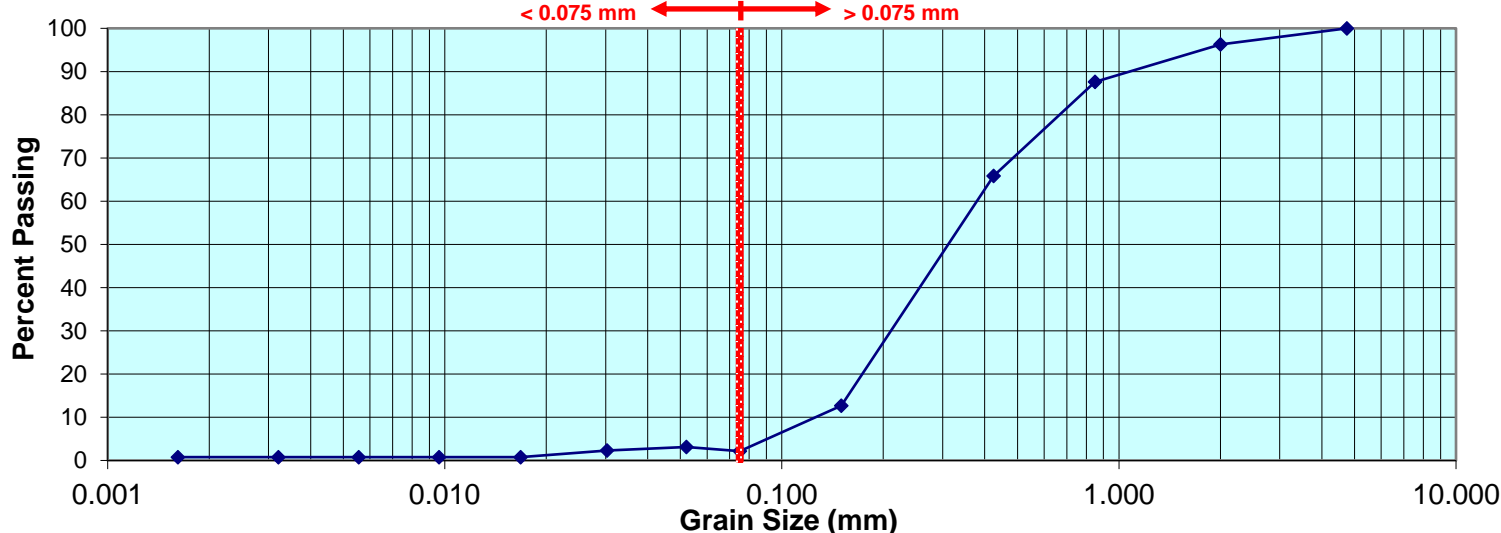
Based on the < 2 mm fraction ****

Percentage (by mass) less than 0.075 mm = 2.3

Classification = Coarse Textured Soil

**** Grain size analysis performed to classify the soil material according to the criteria prescribed in Section 42.2 of Ontario Regulation 153/04 as amended by Ontario Regulation 511/09, and conducted in accordance with test procedures outlined in ASTM D422.

CLAY < 0.002 mm	SILT			SAND			GRAVEL	
	Fine 0.002 - 0.0063 mm	Medium 0.0063 - 0.02 mm	Coarse 0.02 - 0.05 mm	Fine 0.05 - 0.2 mm	Medium 0.2 - 0.63 mm	Coarse 0.63 - 2 mm	Fine 2 - 6.3 mm	Med > 6.3



*** ON Regulation 153/04 requires coarse:fine determination on the < 2 mm fraction. Other jurisdictions may require the entire sample, thus both classifications are provided

Note: Clay/Silt/Sand/Gravel Graphic above Graph: Sand | Silt | Clay fractions in accordance with USDA and Canadian System of Soil Classification. Sub fractions in accordance with the British (BSI) system for information purposes.



BUREAU VERITAS

Grain Size Analysis Report

Client Sample ID: ADAW74-BP2-A3
Maxxam Sample ID: CWA665-01
Maxxam Job #: C475010

Tot. Sample Wt (g)*: 10.27 Batch # (Sieve): B538002
> 2 mm Sample Wt (g)*: 0.06 Batch # (Hydro): B536879

* Dry mass based on Sieve Aliquot

Analysis Date (Sieve): 9/26/2024
Analysis Date (Hydro): 9/25/2024

	Description	Particle Size (mm)	Percent Passing
Sieve	Sieve 4	4.750	100.0
	Sieve 10	2.000	99.4
	Sieve 20	0.850	97.4
	Sieve 40	0.425	91.5
	Sieve 100	0.150	70.0
	Sieve 200	0.075	43.7
Hydrometer	R1min	0.0493	19.6
	R3min	0.0295	9.8
	R10min	0.0167	2.5
	R30min	0.0096	1.6
	R90min	0.0055	1.6
	R270min	0.0032	1.6
	R1080min	0.0016	1.6

Grain Size Proportion (%)**:

	Min (mm)	Max (mm)	Percentage
Sand	0.050	2.000	79.6
Silt	0.002	0.050	18.8
Clay	-	0.002	1.6

** Calculations based only on sub 2 mm fraction.
Compatible with USDA and Canadian Soil Triangles

Soil Classification***:

Based on the entire sample

Percentage (by mass) less than 0.075 mm = 43.7

Classification = Coarse Textured Soil

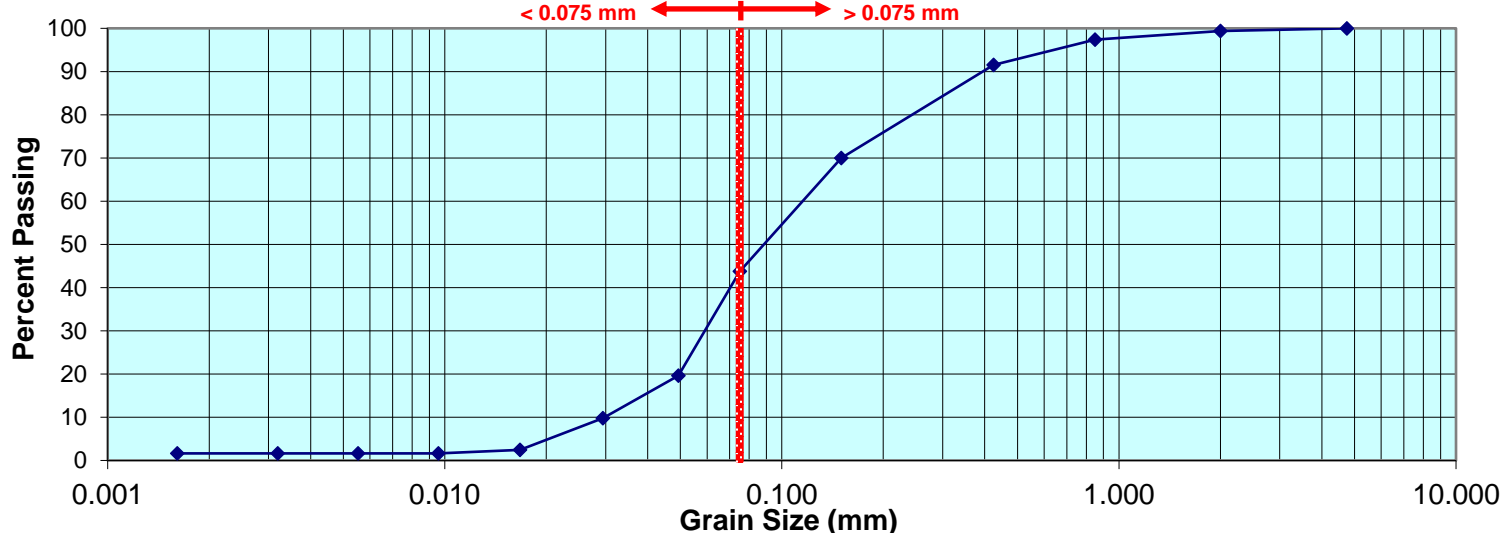
Based on the < 2 mm fraction ****

Percentage (by mass) less than 0.075 mm = 44.0

Classification = Coarse Textured Soil

**** Grain size analysis performed to classify the soil material according to the criteria prescribed in Section 42.2 of Ontario Regulation 153/04 as amended by Ontario Regulation 511/09, and conducted in accordance with test procedures outlined in ASTM D422.

CLAY < 0.002 mm	SILT			SAND			GRAVEL	
	Fine 0.002 - 0.0063 mm	Medium 0.0063 - 0.02 mm	Coarse 0.02 - 0.05 mm	Fine 0.05 - 0.2 mm	Medium 0.2 - 0.63 mm	Coarse 0.63 - 2 mm	Fine 2 - 6.3 mm	Med > 6.3



*** ON Regulation 153/04 requires coarse:fine determination on the < 2 mm fraction. Other jurisdictions may require the entire sample, thus both classifications are provided

Note: Clay/Silt/Sand/Gravel Graphic above Graph: Sand | Silt | Clay fractions in accordance with USDA and Canadian System of Soil Classification. Sub fractions in accordance with the British (BSI) system for information purposes.



**BUREAU
VERITAS**

Grain Size Analysis Report

Client Sample ID: **ADAW75-BP3-A1**
 Maxxam Sample ID: **CWA666-01**
 Maxxam Job #: **C475010**

Tot. Sample Wt (g)*: **10.27** Batch # (Sieve): **B538002**
 > 2 mm Sample Wt (g)*: **0.00** Batch # (Hydro): **B536879**

* Dry mass based on Sieve Aliquot

Analysis Date (Sieve): **9/26/2024**

Analysis Date (Hydro): **9/25/2024**

Grain Size Proportion (%)**:

	Min (mm)	Max (mm)	Percentage
Sand	0.050	2.000	93.2
Silt	0.002	0.050	6.0
Clay	-	0.002	0.8

** Calculations based only on sub 2 mm fraction.
 Compatible with USDA and Canadian Soil Triangles

	Description	Particle Size (mm)	Percent Passing
Sieve	Sieve 4	4.750	100.0
	Sieve 10	2.000	100.0
	Sieve 20	0.850	100.0
	Sieve 40	0.425	100.0
	Sieve 100	0.150	66.3
	Sieve 200	0.075	18.1
Hydrometer	R1min	0.0517	7.1
	R3min	0.0301	3.2
	R10min	0.0168	0.8
	R30min	0.0096	0.8
	R90min	0.0056	0.8
	R270min	0.0032	0.8
	R1080min	0.0016	0.8

Soil Classification***:

Based on the entire sample

Percentage (by mass) less than 0.075 mm = 18.1

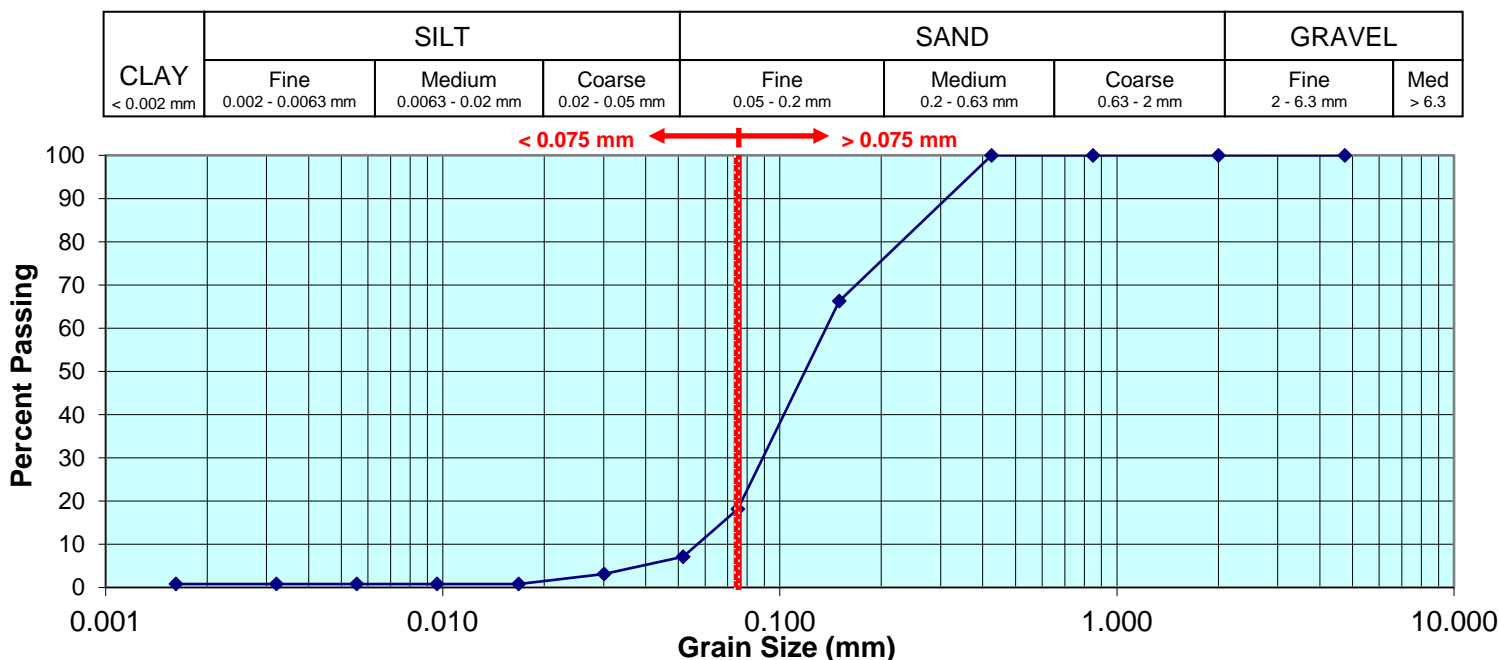
Classification = Coarse Textured Soil

Based on the < 2 mm fraction ****

Percentage (by mass) less than 0.075 mm = 18.1

Classification = Coarse Textured Soil

**** Grain size analysis performed to classify the soil material according to the criteria prescribed in Section 42.2 of Ontario Regulation 153/04 as amended by Ontario Regulation 511/09, and conducted in accordance with test procedures outlined in ASTM D422.



*** ON Regulation 153/04 requires coarse:fine determination on the < 2 mm fraction. Other jurisdictions may require the entire sample, thus both classifications are provided

Note: Clay/Silt/Sand/Gravel Graphic above Graph: Sand | Silt | Clay fractions in accordance with USDA and Canadian System of Soil Classification. Sub fractions in accordance with the British (BSI) system for information purposes.



**BUREAU
VERITAS**

Grain Size Analysis Report

Client Sample ID: **ADAW76-BP3-A2**

Maxxam Sample ID: **CWA667-01**

Maxxam Job #: **C475010**

Tot. Sample Wt (g)*: **10.26**

Batch # (Sieve): **B538002**

> 2 mm Sample Wt (g)*: **0.00**

Batch # (Hydro): **B536879**

* Dry mass based on Sieve Aliquot

Analysis Date (Sieve): **9/26/2024**

Analysis Date (Hydro): **9/25/2024**

Grain Size Proportion (%)**:

	Min (mm)	Max (mm)	Percentage
Sand	0.050	2.000	84.1
Silt	0.002	0.050	14.3
Clay	-	0.002	1.6

** Calculations based only on sub 2 mm fraction.
Compatible with USDA and Canadian Soil Triangles

	Description	Particle Size (mm)	Percent Passing
Sieve	Sieve 4	4.750	100.0
	Sieve 10	2.000	100.0
	Sieve 20	0.850	100.0
	Sieve 40	0.425	99.3
	Sieve 100	0.150	79.8
	Sieve 200	0.075	43.6
Hydrometer	R1min	0.0498	15.7
	R3min	0.0297	7.8
	R10min	0.0167	1.6
	R30min	0.0096	1.6
	R90min	0.0055	1.6
	R270min	0.0032	1.6
	R1080min	0.0016	1.6

Soil Classification***:

Based on the entire sample

Percentage (by mass) less than 0.075 mm = 43.6

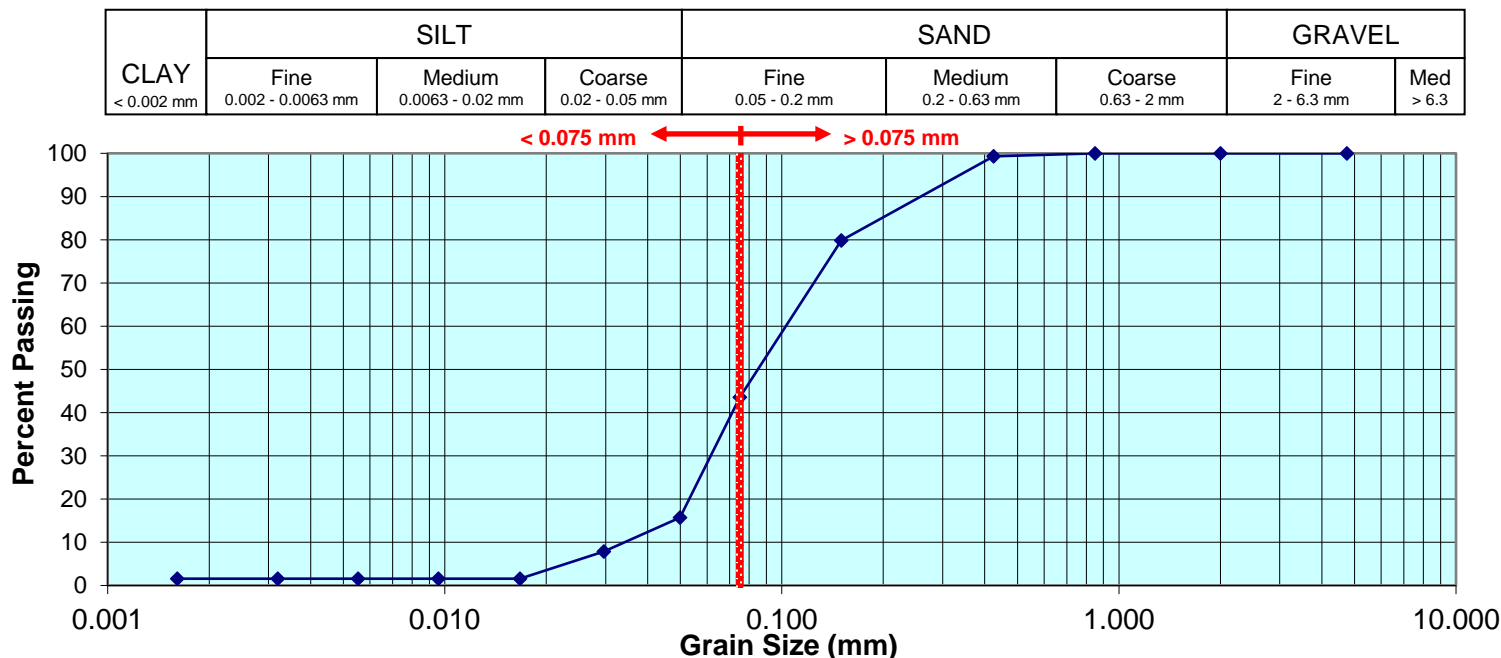
Classification = Coarse Textured Soil

Based on the < 2 mm fraction ****

Percentage (by mass) less than 0.075 mm = 43.6

Classification = Coarse Textured Soil

**** Grain size analysis performed to classify the soil material according to the criteria prescribed in Section 42.2 of Ontario Regulation 153/04 as amended by Ontario Regulation 511/09, and conducted in accordance with test procedures outlined in ASTM D422.



*** ON Regulation 153/04 requires coarse: fine determination on the < 2 mm fraction. Other jurisdictions may require the entire sample, thus both classifications are provided

Note: Clay/Silt/Sand/Gravel Graphic above Graph: Sand | Silt | Clay fractions in accordance with USDA and Canadian System of Soil Classification. Sub fractions in accordance with the British (BSI) system for information purposes.



BUREAU VERITAS

Grain Size Analysis Report

Client Sample ID: ADAW77-BP3-A3

Maxxam Sample ID: CWA668-01

Maxxam Job #: C475010

Tot. Sample Wt (g)*: 10.32

Batch # (Sieve): B538002

> 2 mm Sample Wt (g)*: 0.00

Batch # (Hydro): B536879

* Dry mass based on Sieve Aliquot

Analysis Date (Sieve): 9/26/2024

Analysis Date (Hydro): 9/25/2024

Grain Size Proportion (%)**:

	Min (mm)	Max (mm)	Percentage
Sand	0.050	2.000	95.2
Silt	0.002	0.050	4.8
Clay	-	0.002	0.0

** Calculations based only on sub 2 mm fraction.
Compatible with USDA and Canadian Soil Triangles

	Description	Particle Size (mm)	Percent Passing
Sieve	Sieve 4	4.750	100.0
	Sieve 10	2.000	100.0
	Sieve 20	0.850	99.9
	Sieve 40	0.425	92.3
	Sieve 100	0.150	31.8
	Sieve 200	0.075	6.9
Hydrometer	R1min	0.0519	4.8
	R3min	0.0300	4.8
	R10min	0.0168	0.0
	R30min	0.0096	0.0
	R90min	0.0056	0.0
	R270min	0.0032	0.0
	R1080min	0.0016	0.0

Soil Classification***:

Based on the entire sample

Percentage (by mass) less than 0.075 mm = 6.9

Classification = Coarse Textured Soil

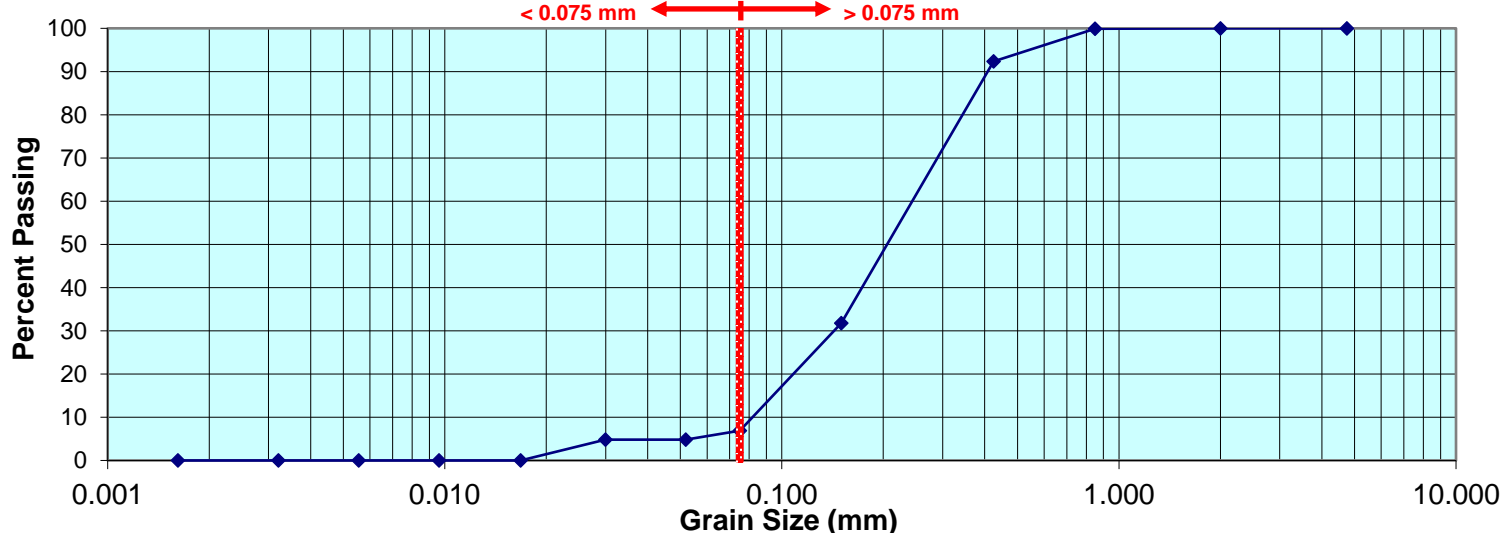
Based on the < 2 mm fraction ****

Percentage (by mass) less than 0.075 mm = 6.9

Classification = Coarse Textured Soil

**** Grain size analysis performed to classify the soil material according to the criteria prescribed in Section 42.2 of Ontario Regulation 153/04 as amended by Ontario Regulation 511/09, and conducted in accordance with test procedures outlined in ASTM D422.

CLAY < 0.002 mm	SILT			SAND			GRAVEL	
	Fine 0.002 - 0.0063 mm	Medium 0.0063 - 0.02 mm	Coarse 0.02 - 0.05 mm	Fine 0.05 - 0.2 mm	Medium 0.2 - 0.63 mm	Coarse 0.63 - 2 mm	Fine 2 - 6.3 mm	Med > 6.3



*** ON Regulation 153/04 requires coarse:fine determination on the < 2 mm fraction. Other jurisdictions may require the entire sample, thus both classifications are provided

Note: Clay/Silt/Sand/Gravel Graphic above Graph: Sand | Silt | Clay fractions in accordance with USDA and Canadian System of Soil Classification. Sub fractions in accordance with the British (BSI) system for information purposes.



BUREAU VERITAS

Grain Size Analysis Report

Client Sample ID: ADAW78-BP4-A1
Maxxam Sample ID: CWA669-01
Maxxam Job #: C475010

Tot. Sample Wt (g)*: 12.04 Batch # (Sieve): B538002
> 2 mm Sample Wt (g)*: 1.66 Batch # (Hydro): B536879

* Dry mass based on Sieve Aliquot

Analysis Date (Sieve): 9/26/2024
Analysis Date (Hydro): 9/25/2024

	Description	Particle Size (mm)	Percent Passing
Sieve	Sieve 4	4.750	97.2
	Sieve 10	2.000	86.2
	Sieve 20	0.850	73.3
	Sieve 40	0.425	59.7
	Sieve 100	0.150	38.3
	Sieve 200	0.075	26.1
Hydrometer	R1min	0.0502	15.4
	R3min	0.0293	12.0
	R10min	0.0164	8.6
	R30min	0.0095	5.1
	R90min	0.0055	2.6
	R270min	0.0032	0.9
	R1080min	0.0016	0.0

Grain Size Proportion (%)**:

	Min (mm)	Max (mm)	Percentage
Sand	0.050	2.000	82.1
Silt	0.002	0.050	17.6
Clay	-	0.002	0.2

** Calculations based only on sub 2 mm fraction.
Compatible with USDA and Canadian Soil Triangles

Soil Classification***:

Based on the entire sample

Percentage (by mass) less than 0.075 mm = 26.1

Classification = Coarse Textured Soil

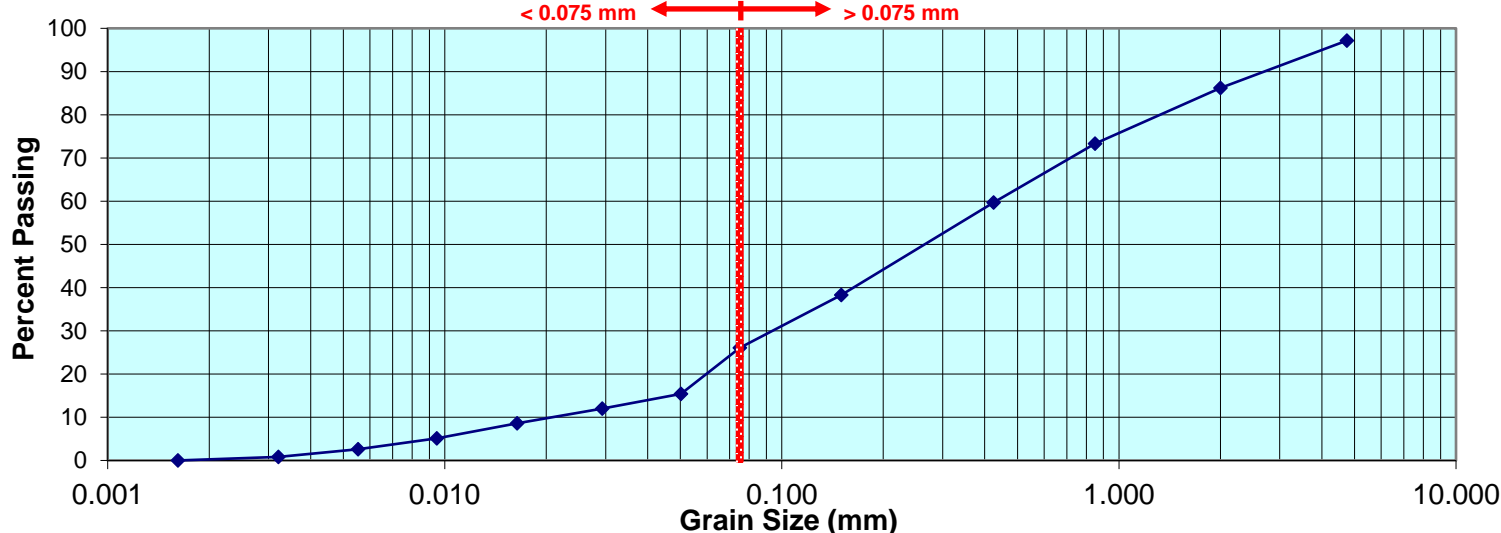
Based on the < 2 mm fraction ****

Percentage (by mass) less than 0.075 mm = 30.3

Classification = Coarse Textured Soil

**** Grain size analysis performed to classify the soil material according to the criteria prescribed in Section 42.2 of Ontario Regulation 153/04 as amended by Ontario Regulation 511/09, and conducted in accordance with test procedures outlined in ASTM D422.

CLAY < 0.002 mm	SILT			SAND			GRAVEL	
	Fine 0.002 - 0.0063 mm	Medium 0.0063 - 0.02 mm	Coarse 0.02 - 0.05 mm	Fine 0.05 - 0.2 mm	Medium 0.2 - 0.63 mm	Coarse 0.63 - 2 mm	Fine 2 - 6.3 mm	Med > 6.3



*** ON Regulation 153/04 requires coarse:fine determination on the < 2 mm fraction. Other jurisdictions may require the entire sample, thus both classifications are provided

Note: Clay/Silt/Sand/Gravel Graphic above Graph: Sand | Silt | Clay fractions in accordance with USDA and Canadian System of Soil Classification. Sub fractions in accordance with the British (BSI) system for information purposes.



BUREAU VERITAS

Grain Size Analysis Report

Client Sample ID: ADAW79-BP4-A2
Maxxam Sample ID: CWA670-01
Maxxam Job #: C475010

Tot. Sample Wt (g)*: 12.49 Batch # (Sieve): B538002
> 2 mm Sample Wt (g)*: 1.90 Batch # (Hydro): B536879

* Dry mass based on Sieve Aliquot

Analysis Date (Sieve): 9/26/2024
Analysis Date (Hydro): 9/25/2024

	Description	Particle Size (mm)	Percent Passing
Sieve	Sieve 4	4.750	100.0
	Sieve 10	2.000	84.8
	Sieve 20	0.850	72.1
	Sieve 40	0.425	59.7
	Sieve 100	0.150	38.8
	Sieve 200	0.075	27.9
Hydrometer	R1min	0.0495	16.1
	R3min	0.0293	10.2
	R10min	0.0164	8.0
	R30min	0.0095	4.4
	R90min	0.0055	2.9
	R270min	0.0032	1.5
	R1080min	0.0016	1.5

Grain Size Proportion (%)**:

	Min (mm)	Max (mm)	Percentage
Sand	0.050	2.000	80.8
Silt	0.002	0.050	17.5
Clay	-	0.002	1.7

** Calculations based only on sub 2 mm fraction.
Compatible with USDA and Canadian Soil Triangles

Soil Classification***:

Based on the entire sample

Percentage (by mass) less than 0.075 mm = 27.9

Classification = Coarse Textured Soil

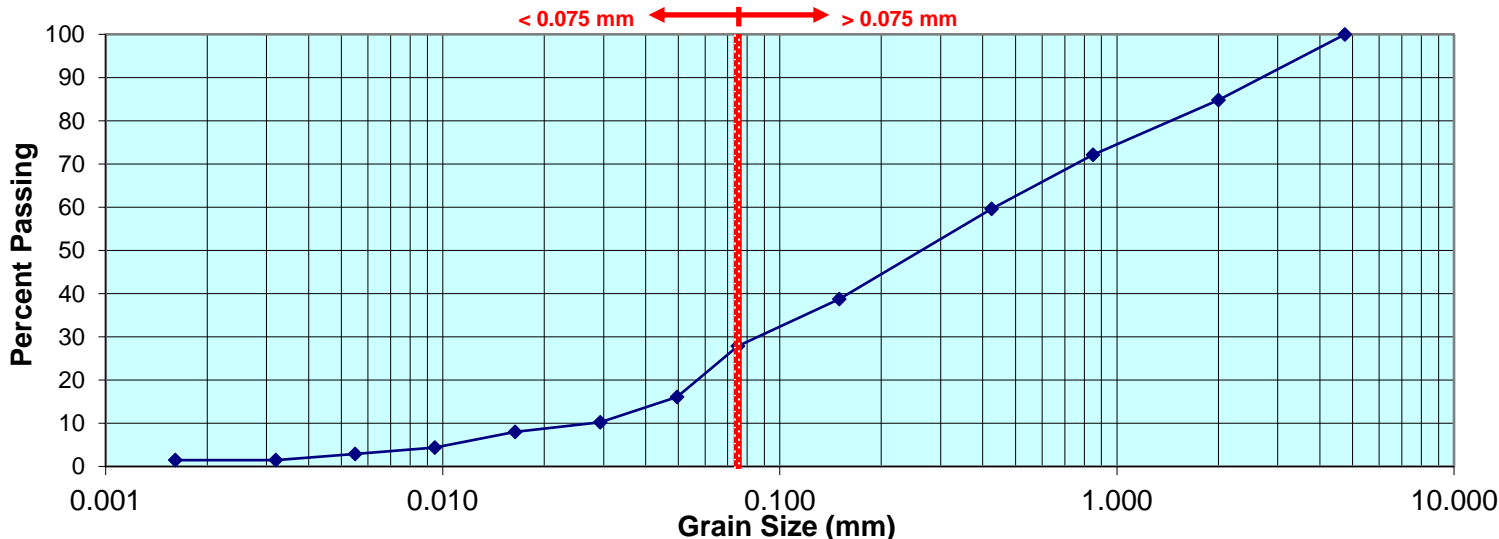
Based on the < 2 mm fraction ****

Percentage (by mass) less than 0.075 mm = 32.9

Classification = Coarse Textured Soil

**** Grain size analysis performed to classify the soil material according to the criteria prescribed in Section 42.2 of Ontario Regulation 153/04 as amended by Ontario Regulation 511/09, and conducted in accordance with test procedures outlined in ASTM D422.

CLAY < 0.002 mm	SILT			SAND			GRAVEL	
	Fine 0.002 - 0.0063 mm	Medium 0.0063 - 0.02 mm	Coarse 0.02 - 0.05 mm	Fine 0.05 - 0.2 mm	Medium 0.2 - 0.63 mm	Coarse 0.63 - 2 mm	Fine 2 - 6.3 mm	Med > 6.3



*** ON Regulation 153/04 requires coarse:fine determination on the < 2 mm fraction. Other jurisdictions may require the entire sample, thus both classifications are provided

Note: Clay/Silt/Sand/Gravel Graphic above Graph: Sand | Silt | Clay fractions in accordance with USDA and Canadian System of Soil Classification. Sub fractions in accordance with the British (BSI) system for information purposes.



BUREAU VERITAS

Grain Size Analysis Report

Client Sample ID: ADAW80-BP4-A3
Maxxam Sample ID: CWA671-01
Maxxam Job #: C475010

Tot. Sample Wt (g)*: 12.38 Batch # (Sieve): B538002
> 2 mm Sample Wt (g)*: 1.67 Batch # (Hydro): B536879

* Dry mass based on Sieve Aliquot

Analysis Date (Sieve): 9/26/2024
Analysis Date (Hydro): 9/25/2024

	Description	Particle Size (mm)	Percent Passing
Sieve	Sieve 4	4.750	96.2
	Sieve 10	2.000	86.5
	Sieve 20	0.850	74.7
	Sieve 40	0.425	63.5
	Sieve 100	0.150	45.6
	Sieve 200	0.075	33.9
Hydrometer	R1min	0.0495	22.4
	R3min	0.0290	18.3
	R10min	0.0162	14.3
	R30min	0.0094	9.2
	R90min	0.0055	4.1
	R270min	0.0032	2.0
	R1080min	0.0016	1.0

Grain Size Proportion (%)**:

	Min (mm)	Max (mm)	Percentage
Sand	0.050	2.000	73.8
Silt	0.002	0.050	24.7
Clay	-	0.002	1.5

** Calculations based only on sub 2 mm fraction.
Compatible with USDA and Canadian Soil Triangles

Soil Classification***:

Based on the entire sample

Percentage (by mass) less than 0.075 mm = 33.9

Classification = Coarse Textured Soil

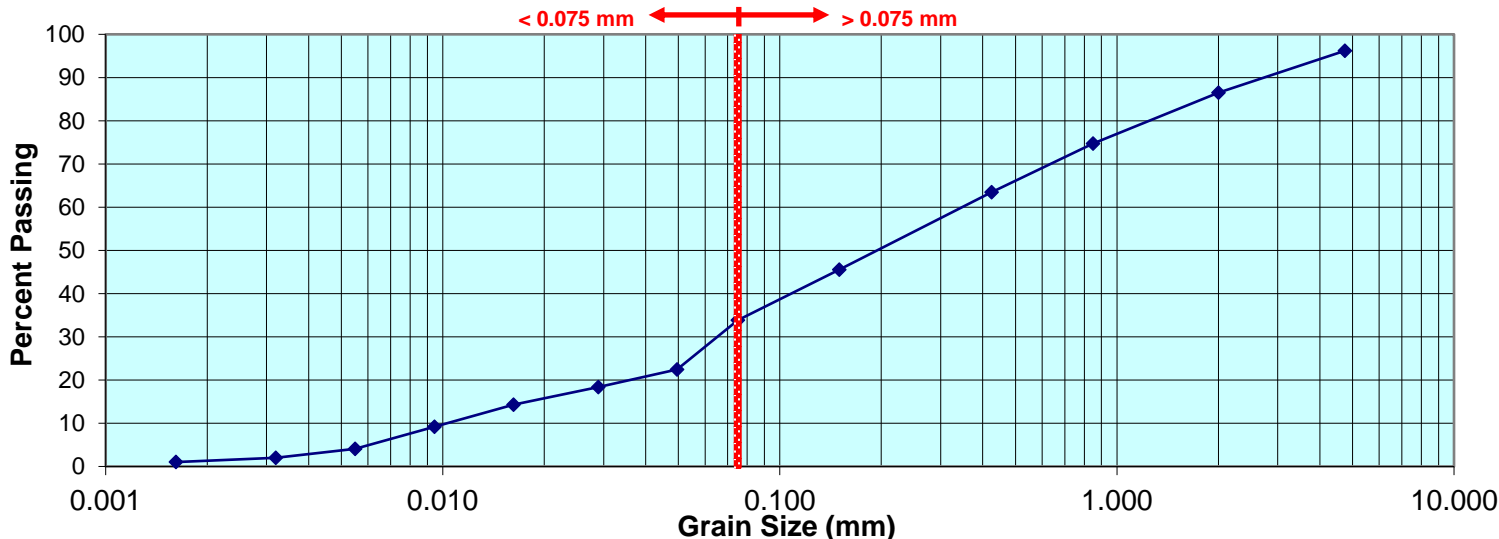
Based on the < 2 mm fraction ****

Percentage (by mass) less than 0.075 mm = 39.1

Classification = Coarse Textured Soil

**** Grain size analysis performed to classify the soil material according to the criteria prescribed in Section 42.2 of Ontario Regulation 153/04 as amended by Ontario Regulation 511/09, and conducted in accordance with test procedures outlined in ASTM D422.

CLAY < 0.002 mm	SILT			SAND			GRAVEL	
	Fine 0.002 - 0.0063 mm	Medium 0.0063 - 0.02 mm	Coarse 0.02 - 0.05 mm	Fine 0.05 - 0.2 mm	Medium 0.2 - 0.63 mm	Coarse 0.63 - 2 mm	Fine 2 - 6.3 mm	Med > 6.3



*** ON Regulation 153/04 requires coarse:fine determination on the < 2 mm fraction. Other jurisdictions may require the entire sample, thus both classifications are provided

Note: Clay/Silt/Sand/Gravel Graphic above Graph: Sand | Silt | Clay fractions in accordance with USDA and Canadian System of Soil Classification. Sub fractions in accordance with the British (BSI) system for information purposes.



Grain Size Analysis Report (QA-SRM)

**BUREAU
VERITAS**

Sieve Batch #: B538002

Hydrometer Batch #: B536879

Standard Reference Material

	Fraction	% Recovery	Acceptance Limits	
			Minimum	Maximum
Sieve	> 0.075 mm	102	75	125
	< 0.075 mm	99	75	125
Hydrometer	Sand	105	75	125
	Silt	100	75	125
	Clay	95	75	125



Grain Size Analysis Report (QA-DUP)

**BUREAU
VERITAS**

Sieve Batch #: B538002

Hydrometer Batch #: B536879

Maxxam Job #: C475010

Duplicate Sample ID: CWA660

	Fraction (mm)	% RPD	Acceptance Limit
			Maximum
Sieve	4.750	200.0	30
	2.000	95.0	30
	0.850	NC	30
	0.425	7.9	30
	0.150	NC	30
	0.075	5.0	30
Hydrometer	0.0519	NC	30
	0.0301	NC	30
	0.0168	NC	30
	0.0096	NC	30
	0.0056	NC	30
	0.0032	NC	30
	0.0016	NC	30



Grain Size Analysis Report (QA-DUP)

**BUREAU
VERITAS**

Sieve Batch #: B538002

Hydrometer Batch #: B536879

Maxxam Job #: C475010

Duplicate Sample ID: CWA660

	Fraction (mm)	% RPD	Acceptance Limit
			Maximum
Sieve	4.750	nc	30
	2.000	131.8	30
	0.850	nc	30
	0.425	10.5	30
	0.150	1.0	30
	0.075	34.4	30
Hydrometer	0.0519	NC	30
	0.0301	NC	30
	0.0168	NC	30
	0.0096	NC	30
	0.0056	NC	30
	0.0032	NC	30
	0.0016	NC	30



Stantec Consulting Ltd.
300 - 1331 Clyde Avenue, Ottawa ON K2C 3G4

January 21, 2025
File: 121626167

Attention: Jacob Elliott Holden, P. Eng
Environmental Engineer
Arcadis Canada Inc.
333 Preston Street, Suite 500
Ottawa, Ontario, Canada, K1S 5N4
Tel: 613-703-3818, C: 613-809-4651
E-mail: Jcacob.Holden@arcadis.com

Dear Mr. Holden,

Reference: Standard Proctor Tests Results-ASTM D698, Arcadis Canada Inc., File# 30192375

This letter presents the results of eight Standard Proctor tests results in accordance with ASTM D698 respectively. The test results are summarized below.

Table: Summary of Tests Completed on Selected Samples

Sample ID	Max Dry D- kg/m ³	Corrected Max DD- kg/m ³	As received MC (%)	OMC (%)
BP1-A1	1728	-	2.4	14.6
BP1-A3	1647	-	9.1	15.4
BP2-A1	1782	1840	1.5	13.4/*12.4
BP2-A2	1672	-	3.4	12.0
BP3-A1	1642	-	6.1	15.2
BP3-A2	1718	-	9.2	13.0
BP3-A3	1690	-	2.5	14.0
BP4-A1	2135	2209	5.8	5.0/*4.4

**Corrected OMC*

This letter provides test results only and does not constitute any interpretation or engineering recommendations with respect to material suitability or specification compliance.

We trust the information presented herein meets your present requirements. Should you have any questions or require additional information, please do not hesitate to contact us.

Regards,

STANTEC CONSULTING LTD.

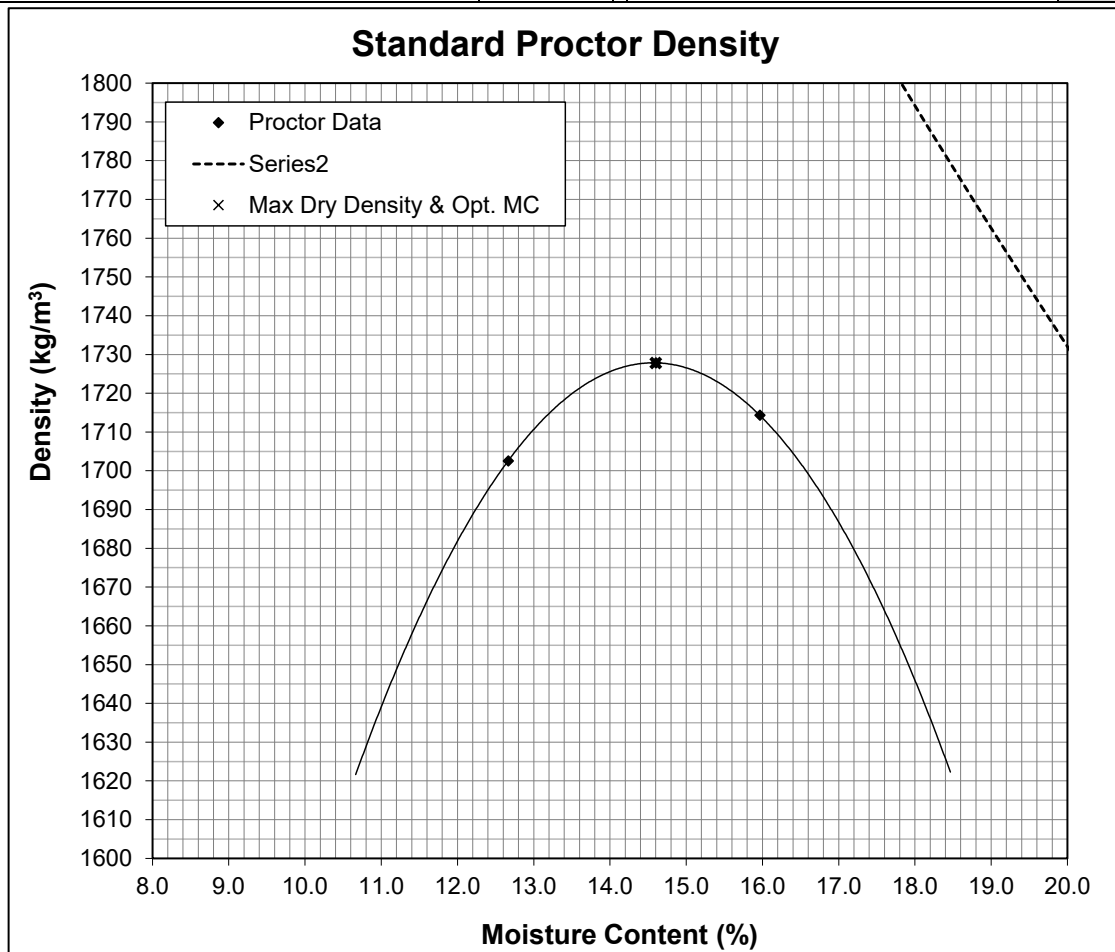
Brian Prevost
Laboratory Supervisor
Direct: 613 722-4420
Mobile: 613 612-5860
Brian.Prevost@stantec.com

Design with community in mind

Client: Arcadis Canada Ltd.
 Project: 30192375 Iqaluit TWP Geotech
 Material Description: Coarse Textured Soil
 Sampled From: BP1-A1
 Sampled By: Arcadis Canada Ltd.
 Tested By: Daniel Boateng

Project No.: 121626167
 Supplier: N/A
 Source: Native Material
 Sample No.: BP1-A1
 Date Sampled: N/A
 Date Tested: December 9, 2024

Test Results			
Corrected Maximum Dry Density (kg/m ³):	N/A	Maximum Wet Density (kg/m ³):	1980
Corrected Maximum Dry Density (g/cm ³):	N/A	Maximum Wet Density (g/cm ³):	1.980
Corrected Maximum Dry Unit Weight (kN/m ³):	N/A	Maximum Dry Density (kg/m ³):	1728
Corrected Optimum Moisture Content (%):	N/A	Optimum Moisture Content (%):	14.60



Remarks: _____

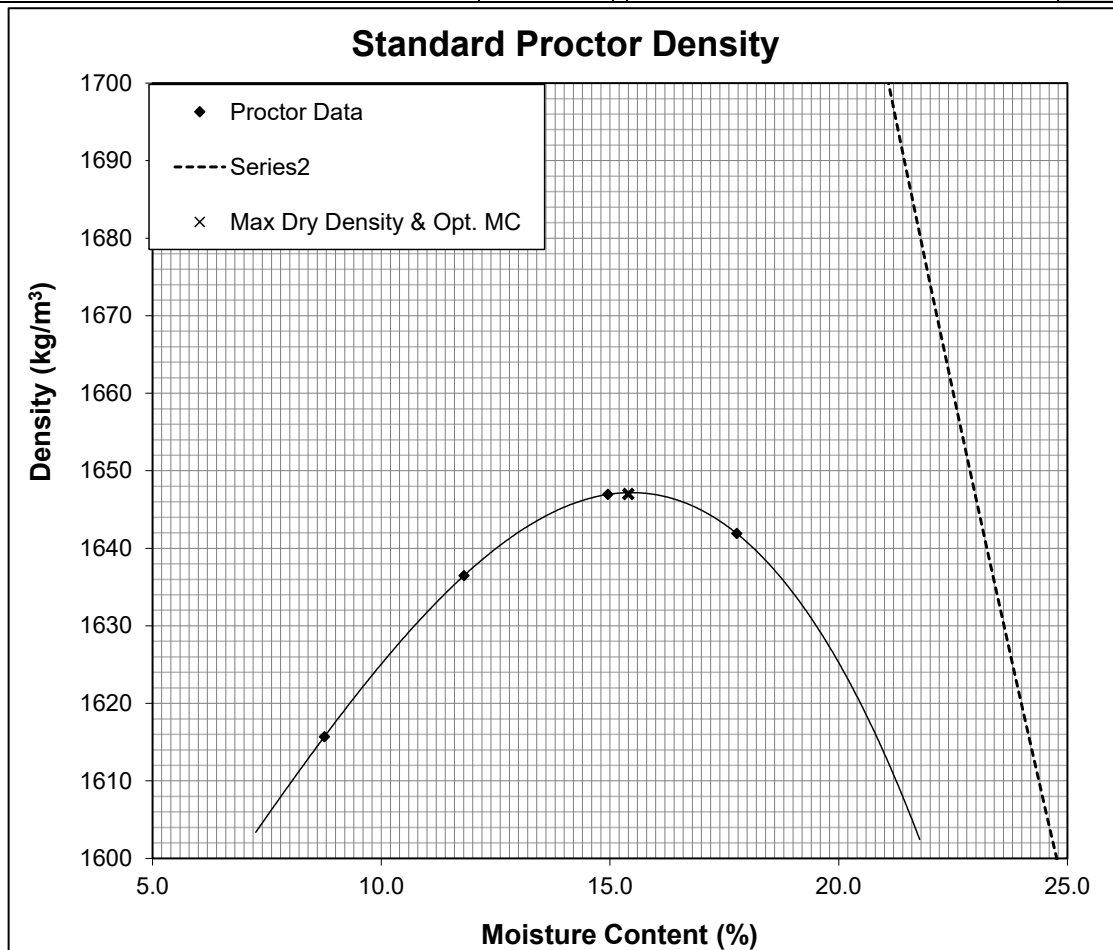
Reviewed By: Brian Prevost
 Name

January 20, 2025
 Date

Client: Arcadis Canada Ltd.
 Project: 30192375 Iqaluit TWP Geotech
 Material Description: Coarse Textured Soil
 Sampled From: BP1-A3
 Sampled By: Arcadis Canada Ltd.
 Tested By: Daniel Boateng

Project No.: 121626167
 Supplier: N/A
 Source: Native Material
 Sample No.: BP1-A3
 Date Sampled: N/A
 Date Tested: December 9, 2024

Test Results			
Corrected Maximum Dry Density (kg/m ³):	N/A	Maximum Wet Density (kg/m ³):	1901
Corrected Maximum Dry Density (g/cm ³):	N/A	Maximum Wet Density (g/cm ³):	1.901
Corrected Maximum Dry Unit Weight (kN/m ³):	N/A	Maximum Dry Density (kg/m ³):	1647
Corrected Optimum Moisture Content (%):	N/A	Optimum Moisture Content (%):	15.40



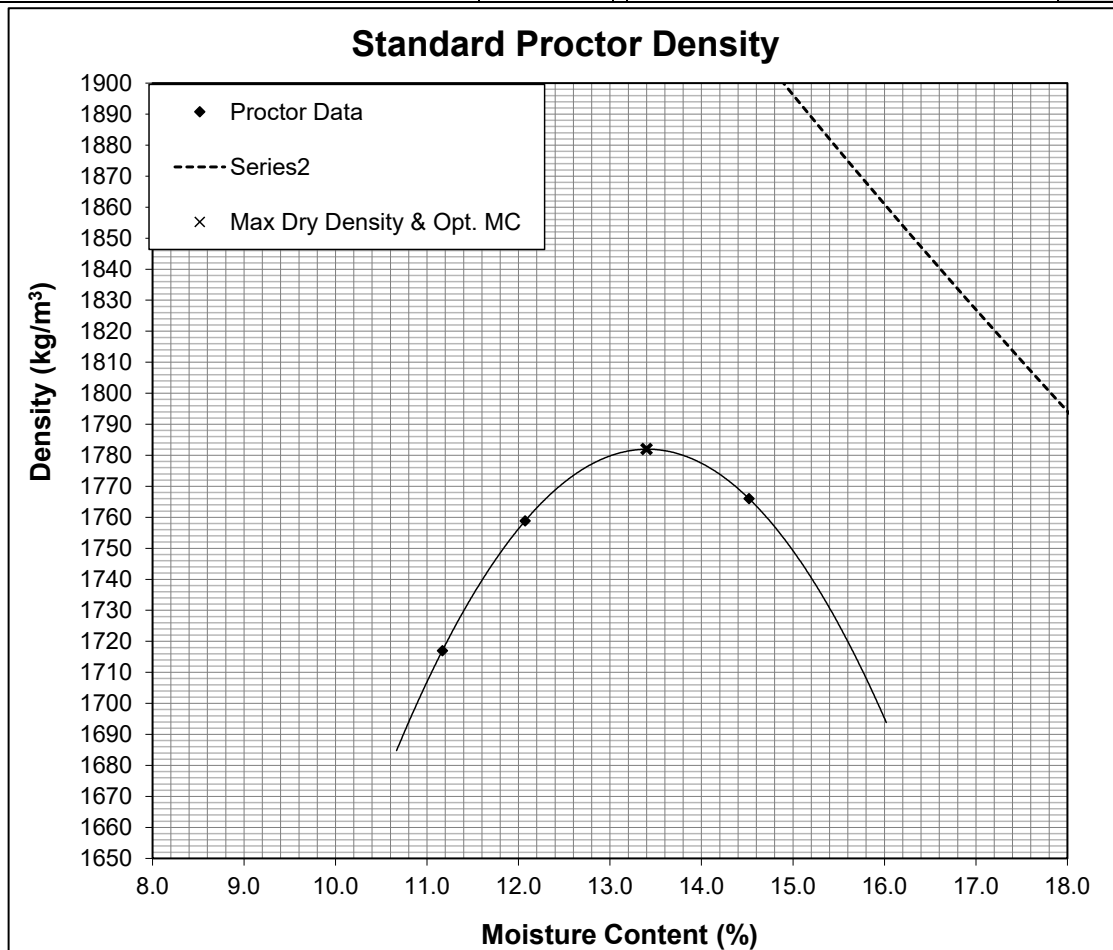
Remarks: _____

Reviewed By: Brian Prevost
 Name

January 20, 2025
 Date

Client:	<u>Arcadis Canada Ltd.</u>	Project No.:	<u>121626167</u>
Project:	<u>30192375 Iqaluit TWP Geotech</u>	Supplier:	<u>N/A</u>
Material Description:	<u>Coarse Textured Soil</u>	Source:	<u>Native Material</u>
Sampled From:	<u>BP2-A1</u>	Sample No.:	<u>BP2-A1</u>
Sampled By:	<u>Arcadis Canada Ltd.</u>	Date Sampled:	<u>N/A</u>
Tested By:	<u>Daniel Boateng</u>	Date Tested:	<u>December 9, 2024</u>

Test Results			
Corrected Maximum Dry Density (kg/m ³):	1836	Maximum Wet Density (kg/m ³):	2021
Corrected Maximum Dry Density (g/cm ³):	1.836	Maximum Wet Density (g/cm ³):	2.021
Corrected Maximum Dry Unit Weight (kN/m ³):	18.009	Maximum Dry Density (kg/m ³):	1782
Corrected Optimum Moisture Content (%):	12.39	Optimum Moisture Content (%):	13.40



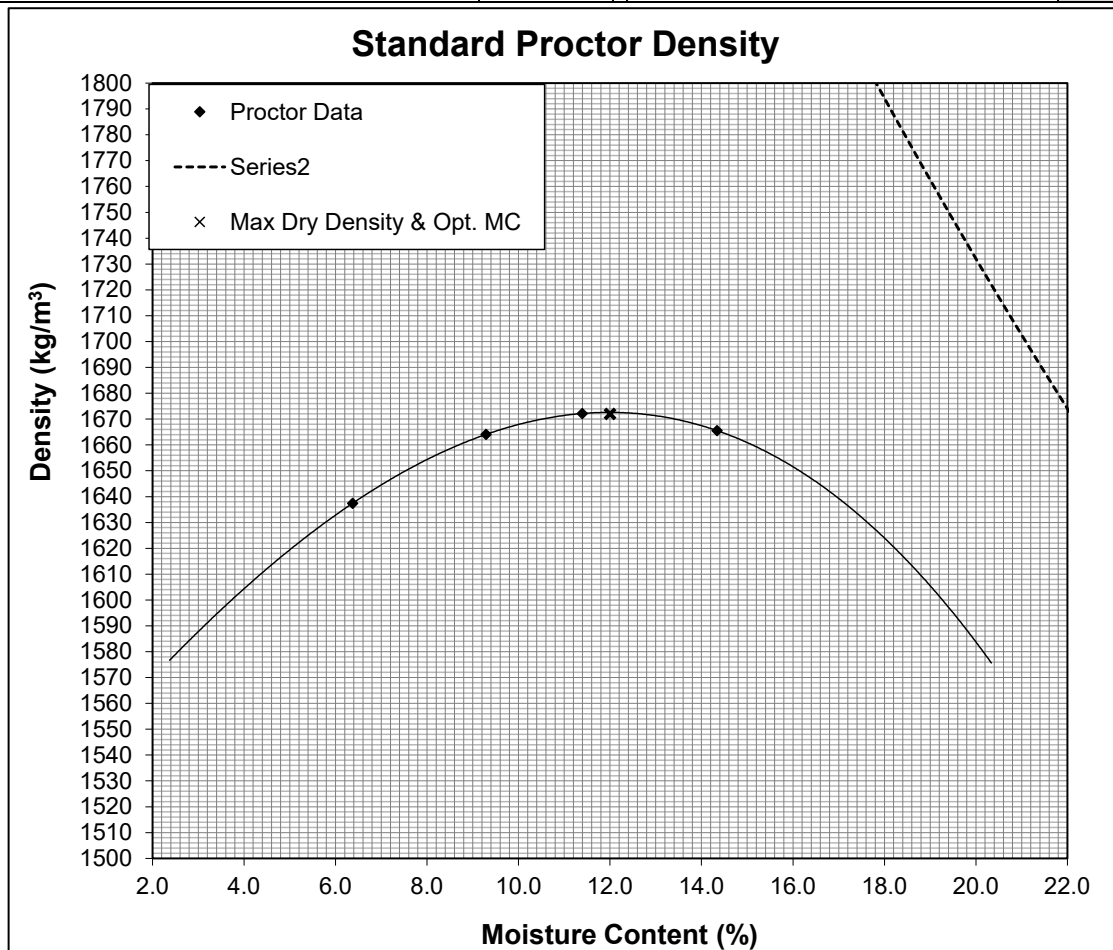
Remarks: _____

Reviewed By: Brian Prevost January 20, 2025
 Name Date

Client: Arcadis Canada Ltd.
 Project: 30192375 Iqaluit TWP Geotech
 Material Description: Coarse Textured Soil
 Sampled From: BP2-A2
 Sampled By: Arcadis Canada Ltd.
 Tested By: Daniel Boateng

Project No.: 121626167
 Supplier: N/A
 Source: Native Material
 Sample No.: BP2-A2
 Date Sampled: N/A
 Date Tested: December 12, 2024

Test Results			
Corrected Maximum Dry Density (kg/m ³):	N/A	Maximum Wet Density (kg/m ³):	1873
Corrected Maximum Dry Density (g/cm ³):	N/A	Maximum Wet Density (g/cm ³):	1.873
Corrected Maximum Dry Unit Weight (kN/m ³):	N/A	Maximum Dry Density (kg/m ³):	1672
Corrected Optimum Moisture Content (%):	N/A	Optimum Moisture Content (%):	12.00



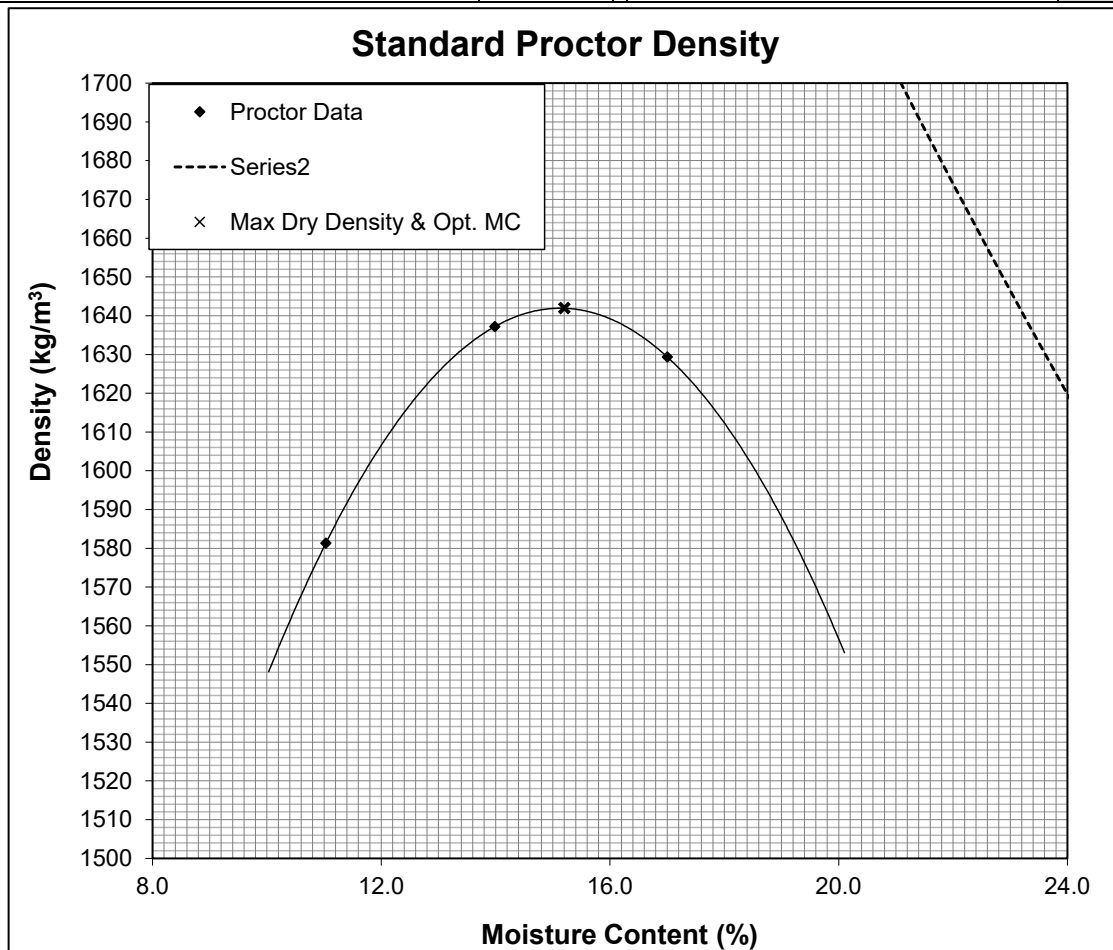
Remarks: _____

Reviewed By: Brian Prevost January 20, 2025
 Name Date

Client: Arcadis Canada Ltd.
 Project: 30192375 Iqaluit TWP Geotech
 Material Description: Coarse Textured Soil
 Sampled From: BP3-A1
 Sampled By: Arcadis Canada Ltd.
 Tested By: Daniel Boateng

Project No.: 121626167
 Supplier: N/A
 Source: Native Material
 Sample No.: BP3-A1
 Date Sampled: N/A
 Date Tested: December 9, 2024

Test Results			
Corrected Maximum Dry Density (kg/m ³):	N/A	Maximum Wet Density (kg/m ³):	1892
Corrected Maximum Dry Density (g/cm ³):	N/A	Maximum Wet Density (g/cm ³):	1.892
Corrected Maximum Dry Unit Weight (kN/m ³):	N/A	Maximum Dry Density (kg/m ³):	1642
Corrected Optimum Moisture Content (%):	N/A	Optimum Moisture Content (%):	15.20



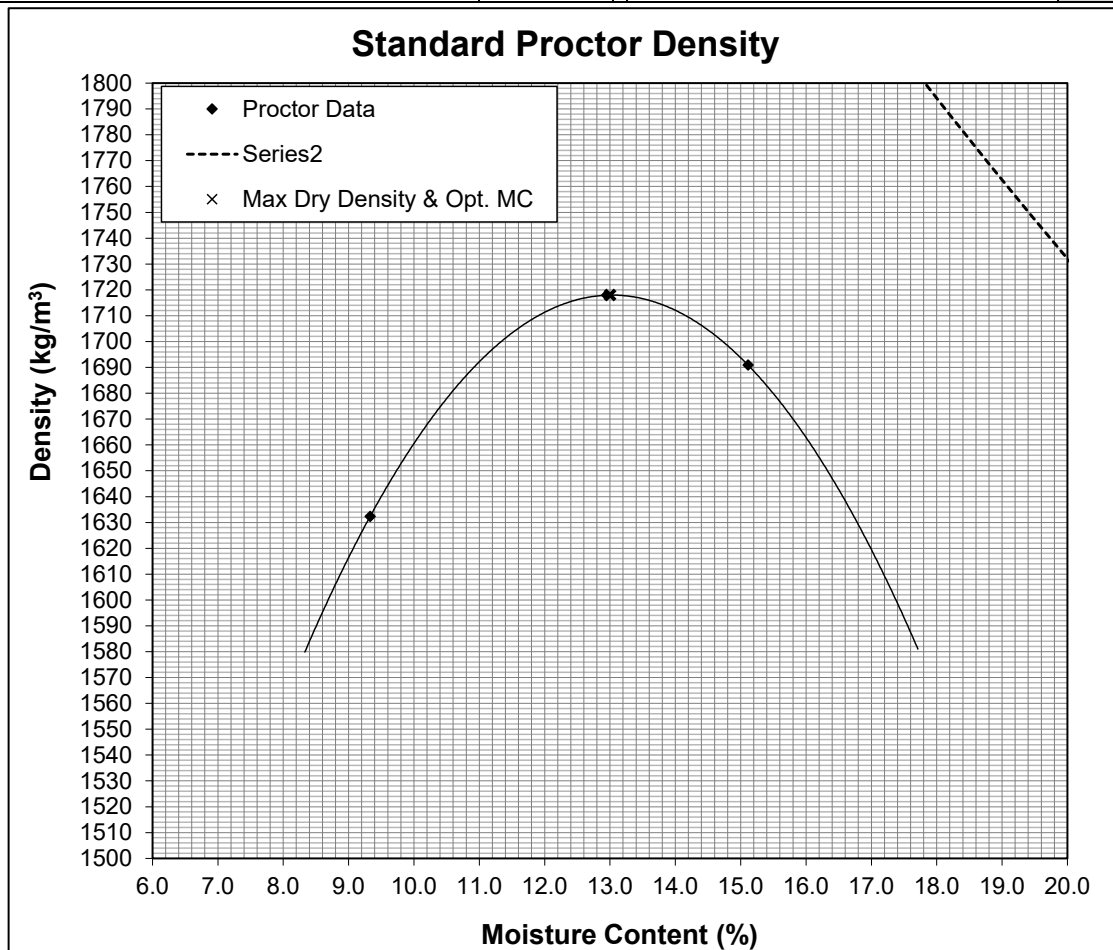
Remarks: _____

Reviewed By: Brian Prevost January 20, 2025
 Name Date

Client: Arcadis Canada Ltd.
 Project: 30192375 Iqaluit TWP Geotech
 Material Description: Coarse Textured Soil
 Sampled From: BP3-A2
 Sampled By: Arcadis Canada Ltd.
 Tested By: Daniel Boateng

Project No.: 121626167
 Supplier: N/A
 Source: Native Material
 Sample No.: BP3-A2
 Date Sampled: N/A
 Date Tested: December 12, 2024

Test Results			
Corrected Maximum Dry Density (kg/m ³):	N/A	Maximum Wet Density (kg/m ³):	1941
Corrected Maximum Dry Density (g/cm ³):	N/A	Maximum Wet Density (g/cm ³):	1.941
Corrected Maximum Dry Unit Weight (kN/m ³):	N/A	Maximum Dry Density (kg/m ³):	1718
Corrected Optimum Moisture Content (%):	N/A	Optimum Moisture Content (%):	13.00

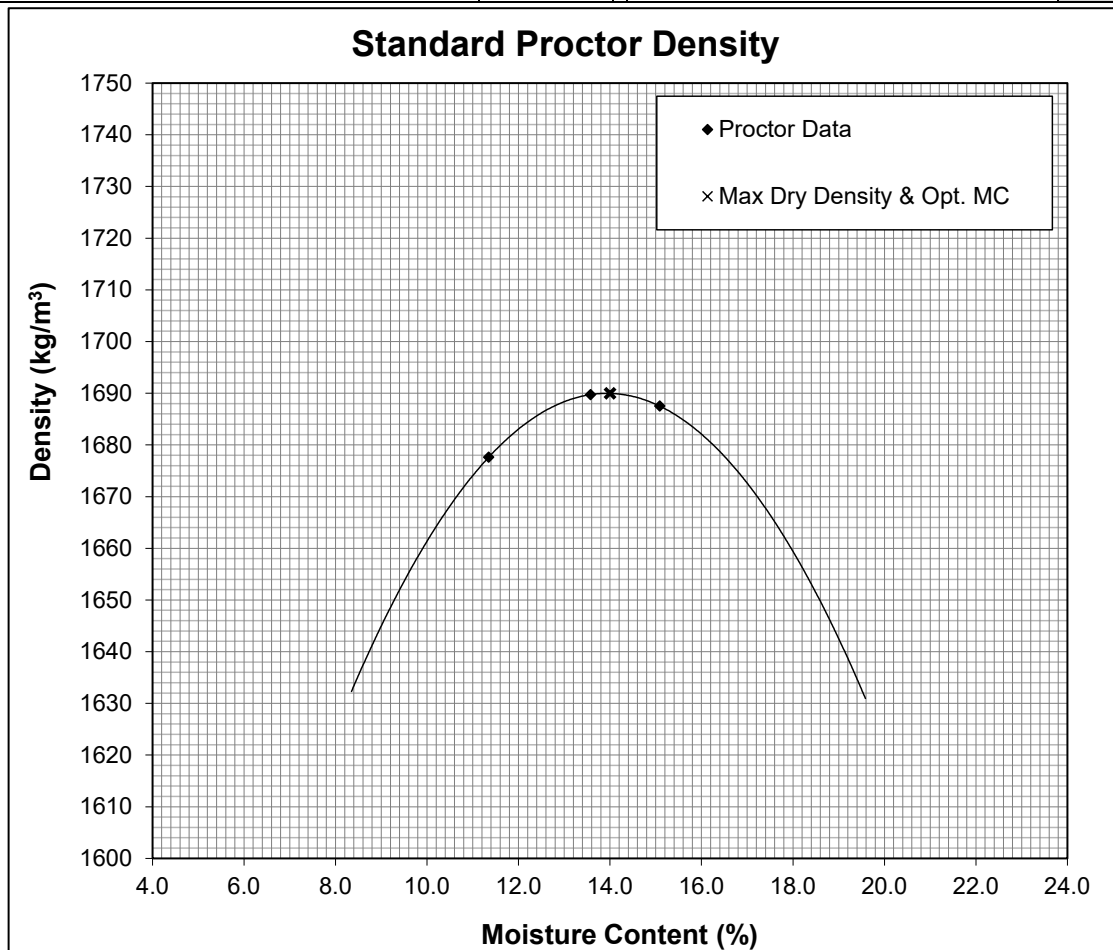


Remarks: _____

Reviewed By: Brian Prevost January 20, 2025
 Name Date

Client: <u>Arcadis Canada Ltd.</u>	Project No.: <u>121626167</u>
Project: <u>30192375 Iqaluit TWP Geotech</u>	Supplier: <u>N/A</u>
Material Description: <u>Coarse Textured Soil</u>	Source: <u>Native Material</u>
Sampled From: <u>BP3-A3</u>	Sample No: <u>BP3-A3</u>
Sampled By: <u>Arcadis Canada Ltd.</u>	Date Sampled: <u>N/A</u>
Tested By: <u>Daniel Boateng</u>	Date Tested: <u>January 15, 2025</u>

Test Results			
Corrected Maximum Dry Density (kg/m ³):	N/A	Maximum Wet Density (kg/m ³):	1927
Corrected Maximum Dry Density (g/cm ³):	N/A	Maximum Wet Density (g/cm ³):	1.927
Corrected Maximum Dry Unit Weight (kN/m ³):	N/A	Maximum Dry Density (kg/m ³):	1690
Corrected Optimum Moisture Content (%):	N/A	Optimum Moisture Content (%):	14.00



Remarks: _____

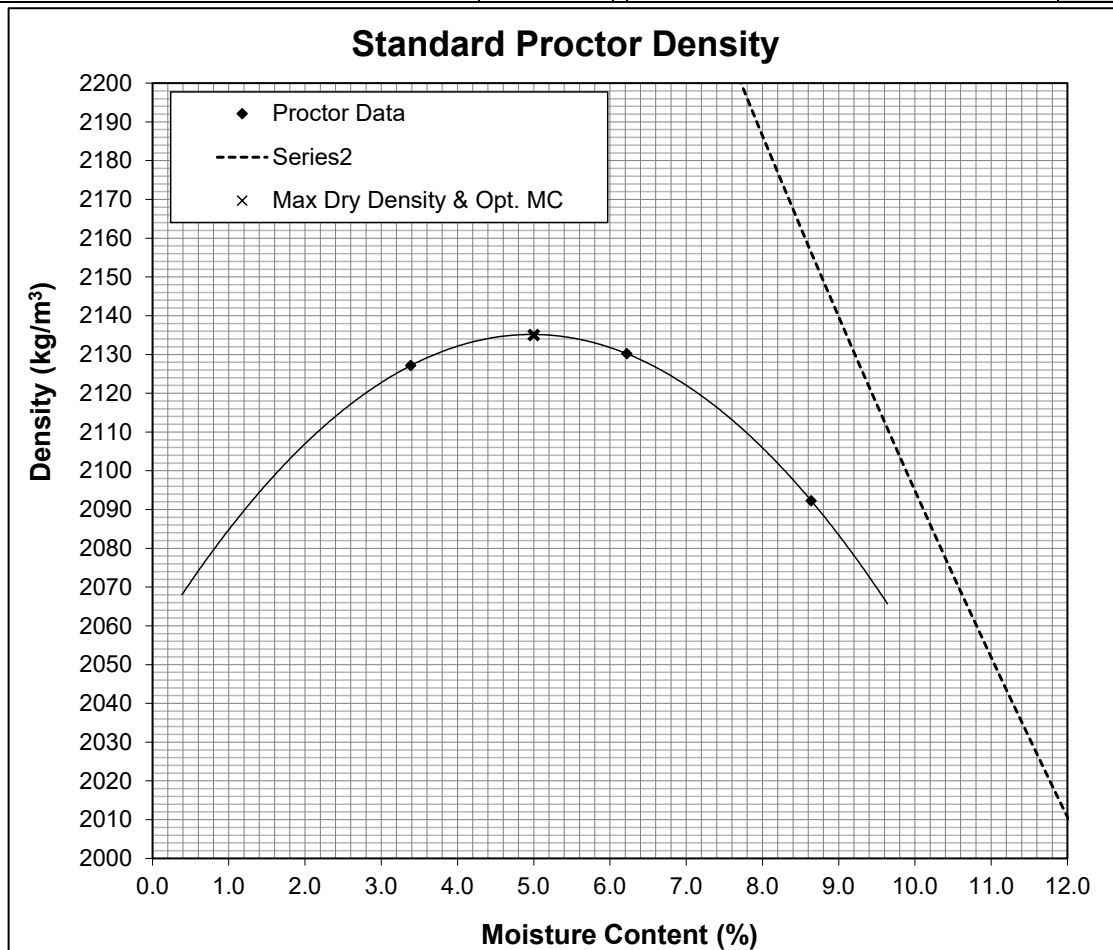
Reviewed By: Brian Prevost January 20, 2025

Name Date

Client: Arcadis Canada Ltd.
 Project: 30192375 Iqaluit TWP Geotech
 Material Description: Coarse Textured Soil
 Sampled From: BP4-A1
 Sampled By: Arcadis Canada Ltd.
 Tested By: Daniel Boateng

Project No.: 121626167
 Supplier: N/A
 Source: Native Material
 Sample No.: BP4-A1
 Date Sampled: N/A
 Date Tested: December 11, 2024

Test Results			
Corrected Maximum Dry Density (kg/m ³):	2199	Maximum Wet Density (kg/m ³):	2242
Corrected Maximum Dry Density (g/cm ³):	2.199	Maximum Wet Density (g/cm ³):	2.242
Corrected Maximum Dry Unit Weight (kN/m ³):	21.567	Maximum Dry Density (kg/m ³):	2135
Corrected Optimum Moisture Content (%):	4.36	Optimum Moisture Content (%):	5.00



Remarks: _____

Reviewed By: Brian Prevost
 Name

January 20, 2025
 Date



Stantec Consulting Ltd.
300 - 1331 Clyde Avenue, Ottawa ON K2C 3G4

April 16, 2025
File: 121626167

Attention: Jacob Elliott Holden, P. Eng
Environmental Engineer
Arcadis Canada Inc.
333 Preston Street, Suite 500
Ottawa, Ontario, Canada, K1S 5N4
Tel: 613-703-3818, C: 613-809-4651
E-mail: Jcobb.Holden@arcadis.com

Dear Mr. Holden,

Reference: Standard Proctor Tests Results-ASTM D698, Arcadis Canada Inc., File# 30192375

This letter presents the results of four Standard Proctor tests results in accordance with ASTM D698 respectively. The test results are summarized below.

Table: Summary of Tests Completed on Selected Samples

Sample ID	Max Dry D- kg/m ³	Corrected Max DD- kg/m ³	As received MC (%)	OMC (%)
BP1-A2	1748	-	20.0	15.5
BP2-A3	1761	-	13.6	11.2
BP4-A2	2104	2198	7.4	7.1/*6.0
BP4-A3	2010	2118	7.9	8.8/*7.1

**Corrected OMC*

This letter provides test results only and does not constitute any interpretation or engineering recommendations with respect to material suitability or specification compliance.

We trust the information presented herein meets your present requirements. Should you have any questions or require additional information, please do not hesitate to contact us.

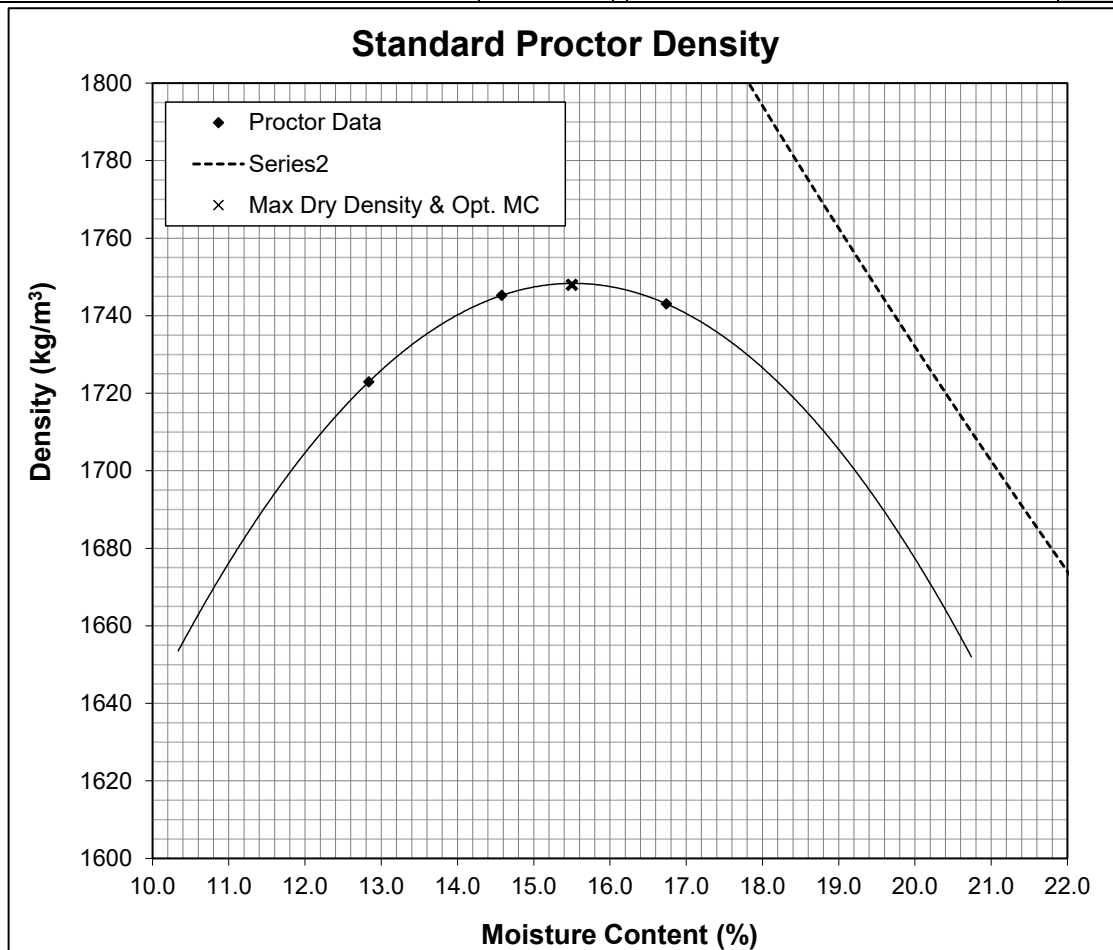
Regards,

STANTEC CONSULTING LTD.

Brian Prevost
Laboratory Supervisor
Direct: 613 722-4420
Mobile: 613 612-5860
Brian.Prevost@stantec.com

Client:	<u>Arcadis Canada Ltd.</u>	Project No.:	<u>121626167</u>
Project:	<u>30192375 Iqaluit TWP Geotech</u>	Supplier:	<u>N/A</u>
Material Description:	<u>Coarse Textured Soil</u>	Source:	<u>Native Material</u>
Sampled From:	<u>BP1-A2</u>	Sample No.:	<u>BP1-A2</u>
Sampled By:	<u>Arcadis Canada Ltd.</u>	Date Sampled:	<u>N/A</u>
Tested By:	<u>Denis Rodriguez</u>	Date Tested:	<u>March 17, 2025</u>

Test Results			
Corrected Maximum Dry Density (kg/m ³):	N/A	Maximum Wet Density (kg/m ³):	2019
Corrected Maximum Dry Density (g/cm ³):	N/A	Maximum Wet Density (g/cm ³):	2.019
Corrected Maximum Dry Unit Weight (kN/m ³):	N/A	Maximum Dry Density (kg/m ³):	1748
Corrected Optimum Moisture Content (%):	N/A	Optimum Moisture Content (%):	15.5



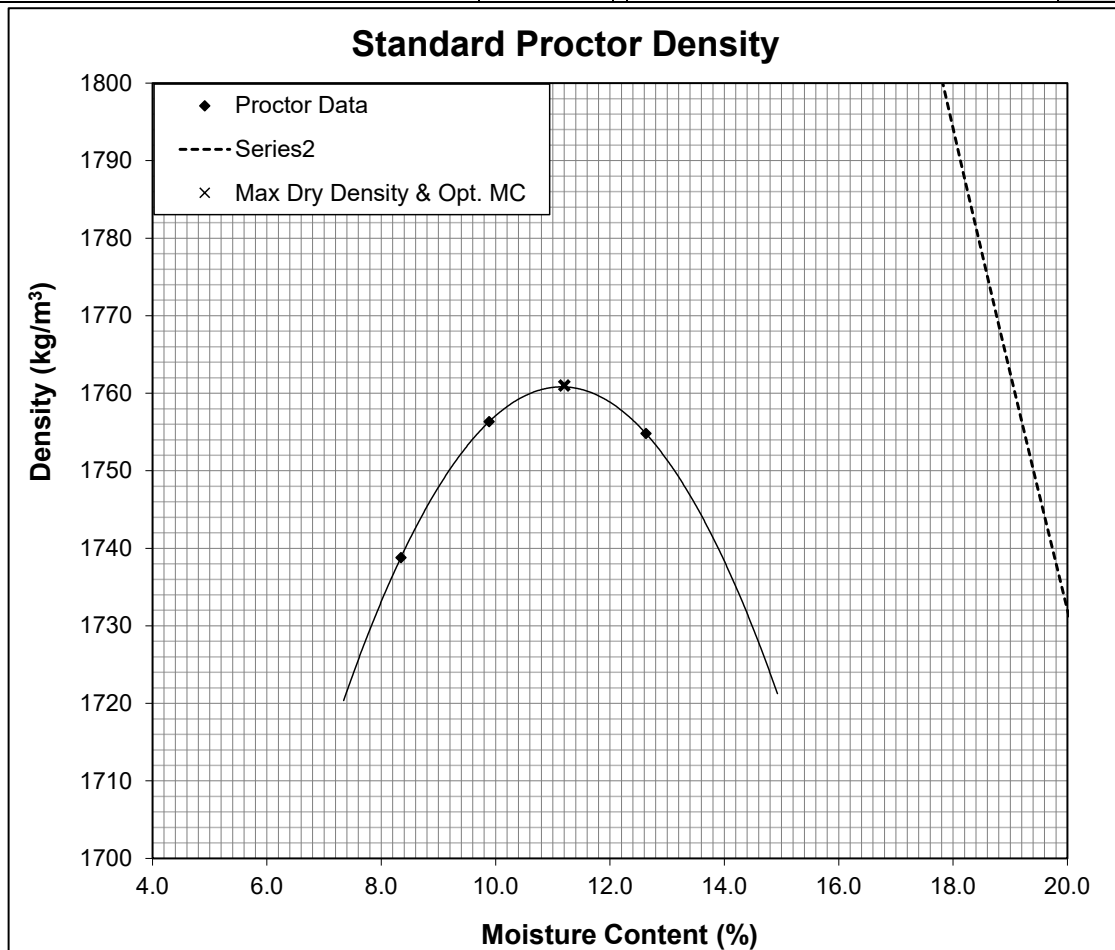
Remarks: Proctor Method: A
0% Oversize Retained on the 4.75mm Sieve

Reviewed By: Brian Prevost April 7, 2025
 Name Date

Client: Arcadis Canada Ltd.
 Project: 30192375 Iqaluit TWP Geotech
 Material Description: Coarse Textured Soil
 Sampled From: BP2-A3
 Sampled By: Arcadis Canada Ltd.
 Tested By: Denis Rodriguez

Project No.: 121626167
 Supplier: N/A
 Source: Native Material
 Sample No.: BP2-A3
 Date Sampled: N/A
 Date Tested: March 17, 2025

Test Results			
Corrected Maximum Dry Density (kg/m ³):	N/A	Maximum Wet Density (kg/m ³):	1958
Corrected Maximum Dry Density (g/cm ³):	N/A	Maximum Wet Density (g/cm ³):	1.958
Corrected Maximum Dry Unit Weight (kN/m ³):	N/A	Maximum Dry Density (kg/m ³):	1761
Corrected Optimum Moisture Content (%):	N/A	Optimum Moisture Content (%):	11.2

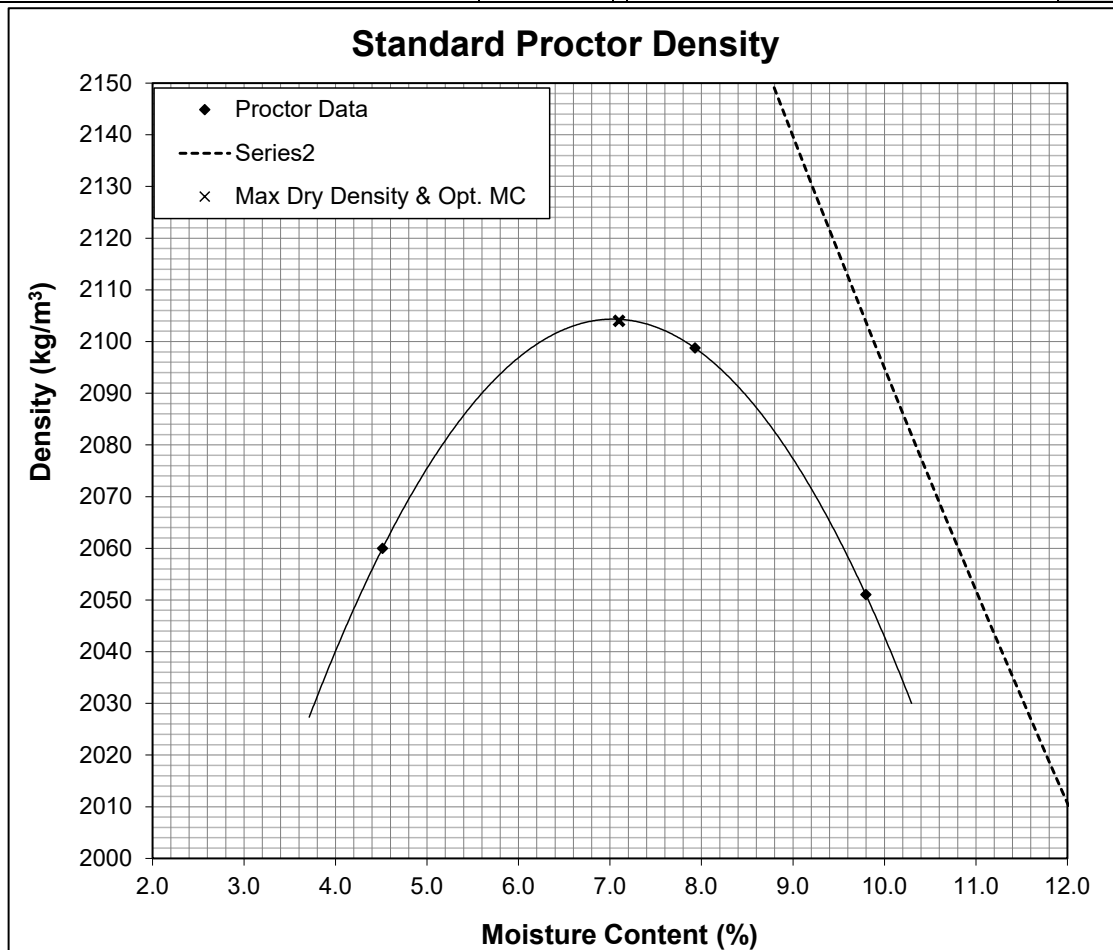


Remarks: Proctor Method: B
0.3% Oversize Retained on the 9.5mm Sieve

Reviewed By: Brian Prevost April 7, 2025
 Name Date

Client:	<u>Arcadis Canada Ltd.</u>	Project No.:	<u>121626167</u>
Project:	<u>30192375 Iqaluit TWP Geotech</u>	Supplier:	<u>N/A</u>
Material Description:	<u>Coarse Textured Soil</u>	Source:	<u>Native Material</u>
Sampled From:	<u>BP4-A2</u>	Sample No.:	<u>BP4-A2</u>
Sampled By:	<u>Arcadis Canada Ltd.</u>	Date Sampled:	<u>N/A</u>
Tested By:	<u>Denis Rodriguez</u>	Date Tested:	<u>March 17, 2025</u>

Test Results			
Corrected Maximum Dry Density (kg/m ³):	2198	Maximum Wet Density (kg/m ³):	2253
Corrected Maximum Dry Density (g/cm ³):	2.198	Maximum Wet Density (g/cm ³):	2.253
Corrected Maximum Dry Unit Weight (kN/m ³):	21.55	Maximum Dry Density (kg/m ³):	2104
Corrected Optimum Moisture Content (%):	6.0	Optimum Moisture Content (%):	7.1



Remarks: Proctor Method: B

20.7% Oversize Retained on the 9.5mm Sieve

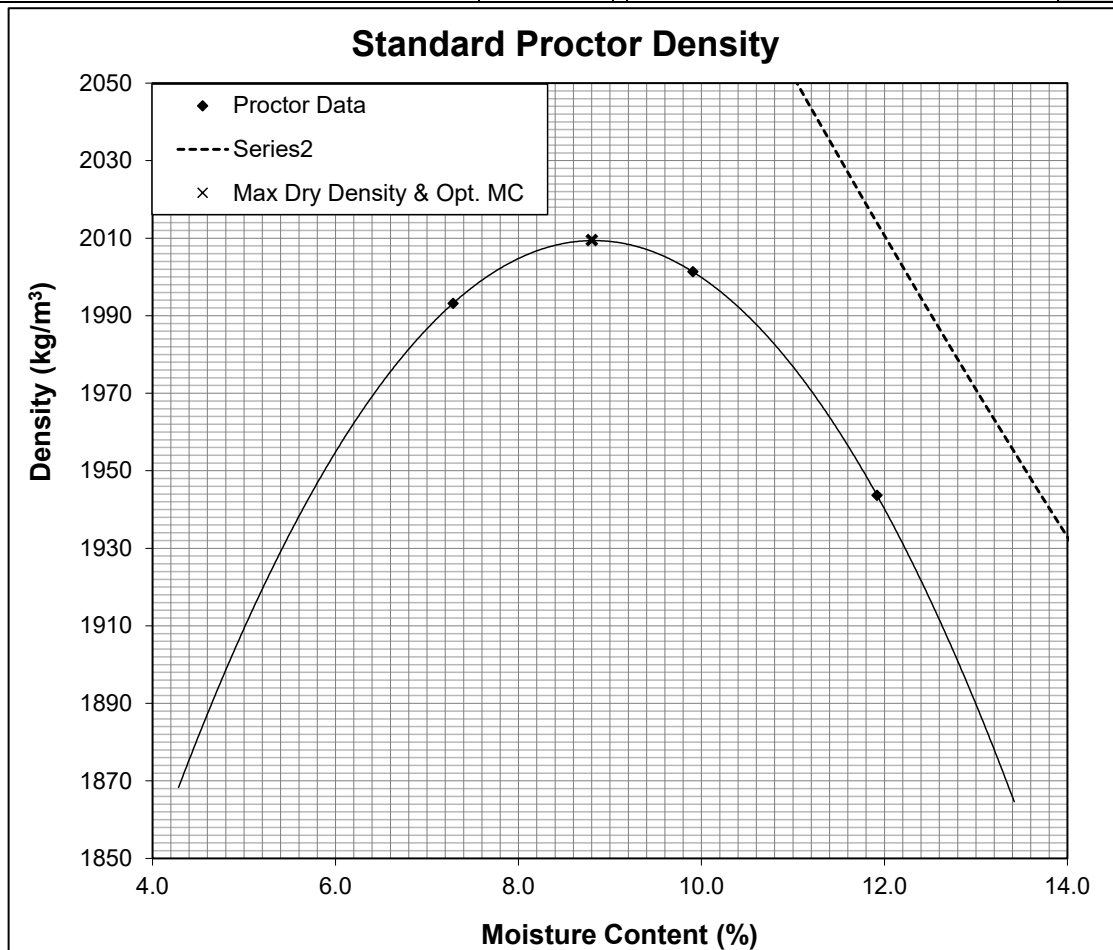
Reviewed By: Brian Prevost April 7, 2025

Name Date

Client: Arcadis Canada Ltd.
 Project: 30192375 Iqaluit TWP Geotech
 Material Description: Coarse Textured Soil
 Sampled From: BP4-A3
 Sampled By: Arcadis Canada Ltd.
 Tested By: Denis Rodriguez

Project No.: 121626167
 Supplier: N/A
 Source: Native Material
 Sample No.: BP4-A3
 Date Sampled: N/A
 Date Tested: March 17, 2025

Test Results			
Corrected Maximum Dry Density (kg/m ³):	2118	Maximum Wet Density (kg/m ³):	2187
Corrected Maximum Dry Density (g/cm ³):	2.118	Maximum Wet Density (g/cm ³):	2.187
Corrected Maximum Dry Unit Weight (kN/m ³):	20.77	Maximum Dry Density (kg/m ³):	2010
Corrected Optimum Moisture Content (%):	7.1	Optimum Moisture Content (%):	8.8



Remarks: Proctor Method: B
21.3% Oversize Retained on the 9.5mm Sieve

Reviewed By: Brian Prevost April 7, 2025
 Name Date



Stantec Consulting Ltd.
300 - 1331 Clyde Avenue, Ottawa ON K2C 3G4

January 30, 2025
File: 121626167

Attention: Jacob Elliott Holden, P. Eng.
Environmental Engineer
Arcadis Canada Inc.
333 Preston Street, Suite 500
Ottawa, Ontario, Canada, K1S 5N4
Tel: 613-703-3818, C: 613-809-4651
E-mail: Jacob.Holden@arcadis.com

Dear Mr. Holden,

**Reference: Measurement of Hydraulic Conductivity of Coarse-Grained Soils,
Arcadis Canada Inc., File # 30192375**

This letter presents the results of six Hydraulic Conductivity tests carried out in accordance with ASTM D2434. The test results are provided in the attached tables and figures.

Table 1: Summary of Tests Completed

Sample ID	Depth	Test Number
BP1-A1	N/A	1
BP2-A1	N/A	2
BP2-A2	N/A	3
BP3-A1	N/A	4
BP3-A3	N/A	5
BP4-A1	N/A	6

This letter provides test results only and does not constitute any interpretation or engineering recommendations with respect to material suitability or specification compliance.

We trust the information presented herein meets your present requirements. Should you have any questions or require additional information, please do not hesitate to contact us.

Regards,

STANTEC CONSULTING LTD.

Ramin Ghassemi Ph.D., P.Eng.
Geotechnical Engineer
Direct: 613 722-4420 Mobile: 437 775-7625
Ramin.ghassemi@stantec.com

HYDRAULIC CONDUCTIVITY OF COARSE-GRAINED SOILS (CONSTANT HEAD) TEST (ASTM D2434)

Figure 1

SPECIMEN IDENTIFICATION

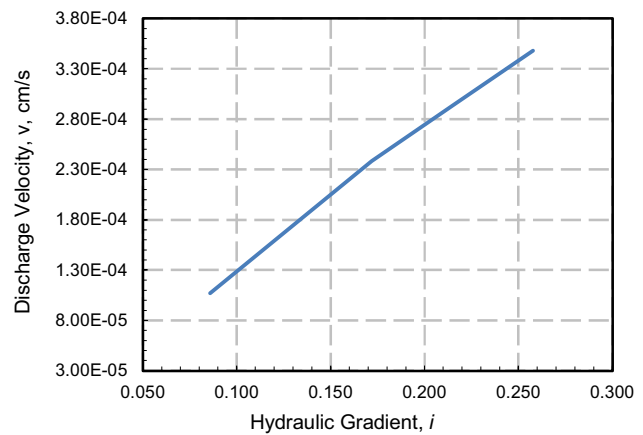
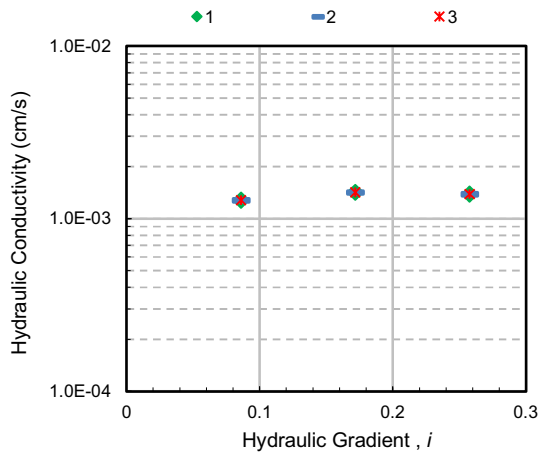
Project:	30192375 Iqaluit TWP Geotech	Borehole/Sample No.:	BP1-A1
Client:	Arcadis Canada Inc	Sample Depth (-):	N/A
Sample Type:	Reconstituted	Specific Gravity (G_s):	2.65 <i>Assumed</i>
Material Description:	Coarse Textured Sand as provided by Project Engineer		

SPECIMEN DIMENSIONS AND PROPERTIES

Specimen Height, (cm)	11.64	Compacted Wet Density (kg/m^3)	1818
Specimen Diameter, (cm)	15.25	Compacted Dry Density (kg/m^3)	1643
Specimen Area, (cm^2)	182.73	Void Ratio, e_o	0.61
Initial Moist Specimen Weight, (g)	3867.8	Initial Water Content, (%)	10.7
		Final Water Content, (%)	16.1

HYDRAULIC CONDUCTIVITY

Test No.	Manometer Readings		Head, h (cm)	Flow, Q (cm^3)	Time, t (s)	Velocity, v Q/At (cm/s)	i = h/L	Temp. of Water ($^{\circ}\text{C}$)	Viscosity of Water at Test Temp. (X) ($1 \times 10^{-6} \text{ m}^2/\text{s}$)	Viscosity of Water at 20° C. (Y) ($1 \times 10^{-6} \text{ m}^2/\text{s}$)	Ratio = X/Y	k_{20} (cm/s) corrected
	H1 (cm)	H2 (cm)										
1	4	3	1	3.52	180	1.07E-04	0.086	19.0	1.030	1.003	1.027	1.28E-03
2				7.04	360	1.07E-04		19.0	1.030			
3				11.73	600	1.07E-04		19.0	1.030			
1	5	3	2	7.84	180	2.38E-04	0.172	19.0	1.030	1.003	1.027	1.42E-03
2				15.68	360	2.38E-04		19.0	1.030			
3				26.13	600	2.38E-04		19.0	1.030			
1	6	3	3	11.45	180	3.48E-04	0.258	19.0	1.030	1.003	1.027	1.39E-03
2				22.90	360	3.48E-04		19.0	1.030			
3				38.16	600	3.48E-04		19.0	1.030			



Test Notes: *Sample reconstituted by compaction to 95% of SPMD*

Average Corrected Hydraulic Conductivity, k (cm/s): 1.36E-03

Project No.: 121626167
Date: January 8, 2025



Prepared By: DB
Checked By: RG

HYDRAULIC CONDUCTIVITY OF COARSE-GRAINED SOILS (CONSTANT HEAD) TEST (ASTM D2434)

Figure 1

SPECIMEN IDENTIFICATION

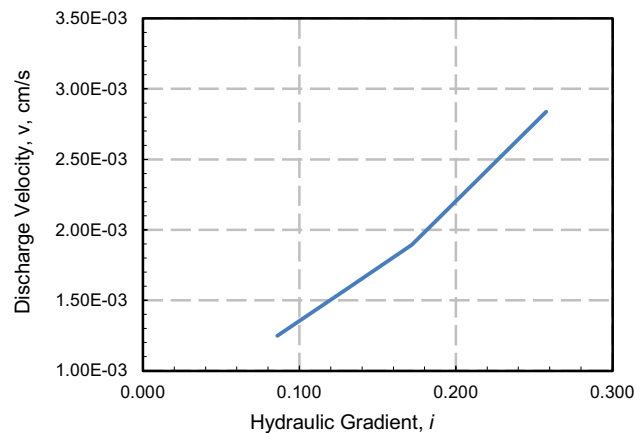
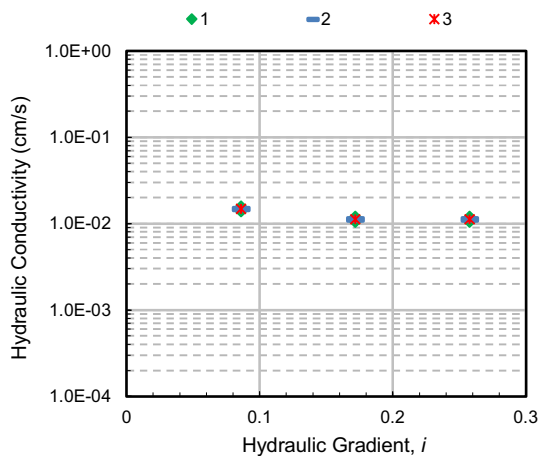
Project:	30192375 Iqaluit TWP Geotech	Borehole/Sample No.:	BP2-A1
Client:	Arcadis Canada Inc	Sample Depth (-):	N/A
Sample Type:	Reconstituted	Specific Gravity (G_s):	2.65 <i>Assumed</i>
Material Description:	Coarse Textured Sand as provided by the project engineer		

SPECIMEN DIMENSIONS AND PROPERTIES

Specimen Height, (cm)	11.64	Compacted Wet Density (kg/m^3)	1956
Specimen Diameter, (cm)	15.25	Compacted Dry Density (kg/m^3)	1750
Specimen Area, (cm^2)	182.73	Void Ratio, e_o	0.51
Initial Moist Specimen Weight, (g)	4161.0	Initial Water Content, (%)	11.8
		Final Water Content, (%)	16.0

HYDRAULIC CONDUCTIVITY

Test No.	Manometer Readings		Head, h (cm)	Flow, Q (cm^3)	Time, t (s)	Velocity, v Q/At (cm/s)	$i = h/L$	Temp. of Water ($^{\circ}\text{C}$)	Viscosity of Water at Test Temp. (X) ($1 \times 10^{-6} \text{ m}^2/\text{s}$)	Viscosity of Water at 20 $^{\circ}$ C. (Y) ($1 \times 10^{-6} \text{ m}^2/\text{s}$)	Ratio = X/Y	k_{20} (cm/s) corrected
	H1 (cm)	H2 (cm)										
1	4	3	1	41.02	180	1.25E-03	0.086	19.0	1.030	1.003	1.027	1.49E-02
2				82.04	360	1.25E-03		19.0	1.030			
3				136.73	600	1.25E-03		19.0	1.030			
1	5	3	2	62.24	180	1.89E-03	0.172	19.0	1.030	1.003	1.027	1.13E-02
2				124.48	360	1.89E-03		19.0	1.030			
3				207.47	600	1.89E-03		19.0	1.030			
1	6	3	3	93.36	180	2.84E-03	0.258	19.0	1.030	1.003	1.027	1.13E-02
2				186.72	360	2.84E-03		19.0	1.030			
3				311.20	600	2.84E-03		19.0	1.030			



Test Notes: *Sample reconstituted by compaction to 95% of corrected SPMDD*

Average Corrected Hydraulic Conductivity, k (cm/s): 1.25E-02

Project No.: 121626167
Date 1 January 9, 2025



Prepared By: DB
Checked By: RG

HYDRAULIC CONDUCTIVITY OF COARSE-GRAINED SOILS (CONSTANT HEAD) TEST (ASTM D2434)

Figure 1

SPECIMEN IDENTIFICATION

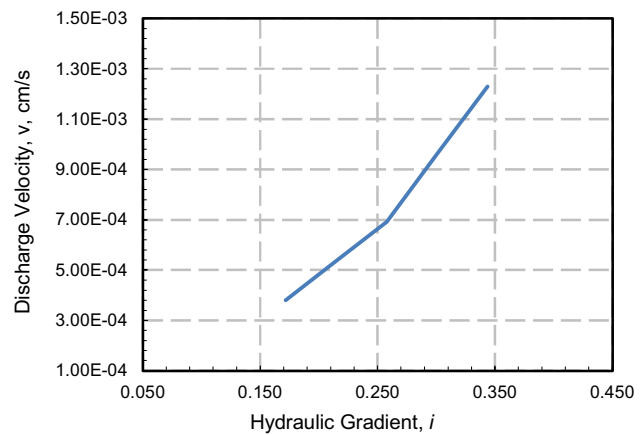
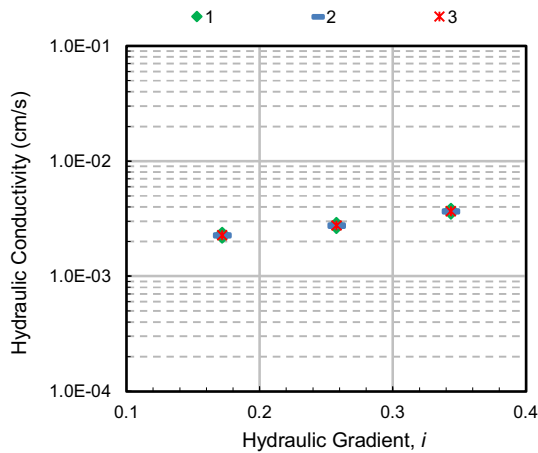
Project:	30192375 Iqaluit TWP Geotech	Borehole/Sample No.:	BP2-A2
Client:	Arcadis Canada Inc	Sample Depth (-):	N/A
Sample Type:	Reconstituted	Specific Gravity (G_s):	2.65 <i>Assumed</i>
Material Description:	Coarse Textured Sand as provided by the project engineer		

SPECIMEN DIMENSIONS AND PROPERTIES

Specimen Height, (cm)	11.64	Compacted Wet Density (kg/m^3)	1641
Specimen Diameter, (cm)	15.25	Compacted Dry Density (kg/m^3)	1587
Specimen Area, (cm^2)	182.73	Void Ratio, e_o	0.67
Initial Moist Specimen Weight, (g)	3489.5	Initial Water Content, (%)	3.4
		Final Water Content, (%)	17.0

HYDRAULIC CONDUCTIVITY

Test No.	Manometer Readings		Head, h (cm)	Flow, Q (cm^3)	Time, t (s)	Velocity, v Q/At (cm/s)	i = h/L	Temp. of Water ($^{\circ}\text{C}$)	Viscosity of Water at Test Temp. (X) ($1 \times 10^{-6} \text{ m}^2/\text{s}$)	Viscosity of Water at 20 $^{\circ}$ C. (Y) ($1 \times 10^{-6} \text{ m}^2/\text{s}$)	Ratio = X/Y	k_{20} (cm/s) corrected
	H1 (cm)	H2 (cm)										
1	5	3	2	12.52	180	3.81E-04	0.172	19.0	1.030	1.003	1.027	2.27E-03
2				25.04	360	3.81E-04		19.0	1.030			
3				41.73	600	3.81E-04		19.0	1.030			
1	6	3	3	22.77	180	6.92E-04	0.258	19.0	1.030	1.003	1.027	2.76E-03
2				45.54	360	6.92E-04		19.0	1.030			
3				75.90	600	6.92E-04		19.0	1.030			
1	7	3	4	40.44	180	1.23E-03	0.344	19.0	1.030	1.003	1.027	3.67E-03
2				80.88	360	1.23E-03		19.0	1.030			
3				134.80	600	1.23E-03		19.0	1.030			



Test Notes: *Sample reconstituted by compaction to 95% of SPMD*

Average Corrected Hydraulic Conductivity, k (cm/s): 2.90E-03

Project No.: 121626167
Date: January 14, 2025



Prepared By: DB
Checked By: RG

HYDRAULIC CONDUCTIVITY OF COARSE-GRAINED SOILS (CONSTANT HEAD) TEST (ASTM D2434)

Figure 1

SPECIMEN IDENTIFICATION

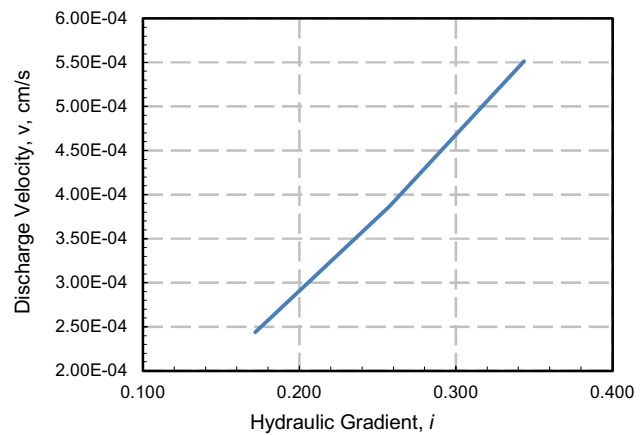
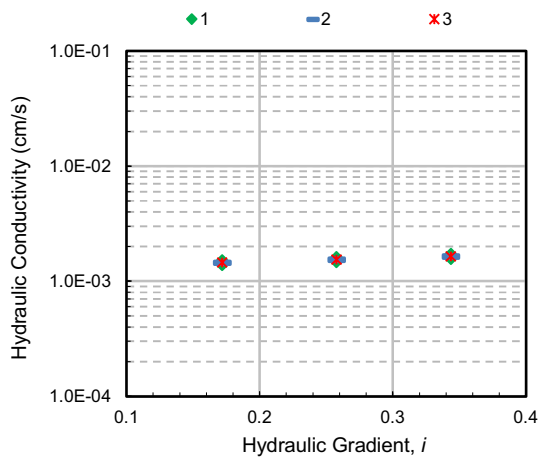
Project:	30192375 Iqaluit TWP Geotech	Borehole/Sample No.:	BP3-A1
Client:	Arcadis Canada Inc	Sample Depth (-):	N/A
Sample Type:	Reconstituted	Specific Gravity (G_s):	2.65 <i>Assumed</i>
Material Description:	Coarse Textured Sand as provided by the project engineer		

SPECIMEN DIMENSIONS AND PROPERTIES

Specimen Height, (cm)	11.64	Compacted Wet Density (kg/m^3)	1726
Specimen Diameter, (cm)	15.25	Compacted Dry Density (kg/m^3)	1561
Specimen Area, (cm^2)	182.73	Void Ratio, e_o	0.70
Initial Moist Specimen Weight, (g)	3672.0	Initial Water Content, (%)	10.6
		Final Water Content, (%)	21.4

HYDRAULIC CONDUCTIVITY

Test No.	Manometer Readings		Head, h (cm)	Flow, Q (cm^3)	Time, t (s)	Velocity, v Q/At (cm/s)	$i = h/L$	Temp. of Water ($^{\circ}\text{C}$)	Viscosity of Water at Test Temp. (X) ($1 \times 10^{-6} \text{ m}^2/\text{s}$)	Viscosity of Water at 20° C. (Y) ($1 \times 10^{-6} \text{ m}^2/\text{s}$)	Ratio = X/Y	k_{20} (cm/s) corrected
	H1 (cm)	H2 (cm)										
1	5	3	2	8.02	180	2.44E-04	0.172	19.0	1.030	1.003	1.027	1.46E-03
2				16.03	360	2.44E-04		19.0	1.030			
3				26.72	600	2.44E-04		19.0	1.030			
1	6	3	3	12.72	180	3.87E-04	0.258	19.0	1.030	1.003	1.027	1.54E-03
2				25.44	360	3.87E-04		19.0	1.030			
3				42.40	600	3.87E-04		19.0	1.030			
1	7	3	4	18.14	180	5.52E-04	0.344	19.0	1.030	1.003	1.027	1.65E-03
2				36.28	360	5.52E-04		19.0	1.030			
3				60.47	600	5.52E-04		19.0	1.030			



Test Notes: *Sample reconstituted by compaction to 95% of SPMD*

Average Corrected Hydraulic Conductivity, k (cm/s): 1.55E-03

Project No.: 121626167
Date: January 10, 2025



Prepared By: DB
Checked By: RG

HYDRAULIC CONDUCTIVITY OF COARSE-GRAINED SOILS (CONSTANT HEAD) TEST (ASTM D2434)

Figure 1

SPECIMEN IDENTIFICATION

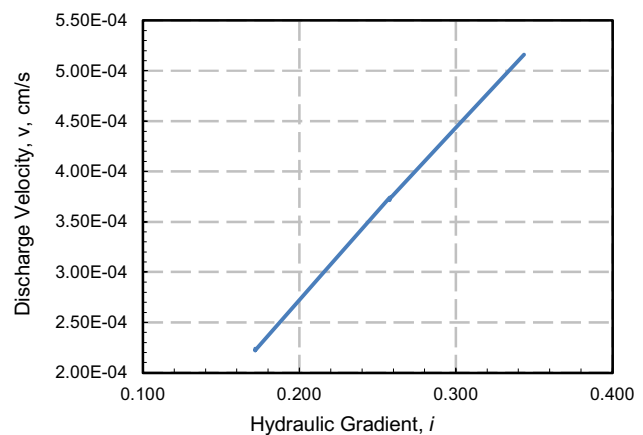
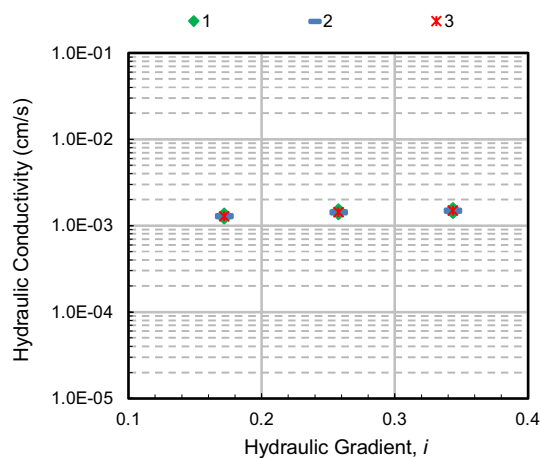
Project:	30192375 Iqaluit TWP Geotech	Borehole/Sample No.:	BP3-A3
Client:	Arcadis Canada Inc	Sample Depth (-):	N/A
Sample Type:	Reconstituted	Specific Gravity (G_s):	2.65 <i>Assumed</i>
Material Description:	Coarse Textured Sand as provided by the project engineer		

SPECIMEN DIMENSIONS AND PROPERTIES

Specimen Height, (cm)	11.64	Compacted Wet Density (kg/m^3)	1718
Specimen Diameter, (cm)	15.25	Compacted Dry Density (kg/m^3)	1604
Specimen Area, (cm^2)	182.73	Void Ratio, e_o	0.65
Initial Moist Specimen Weight, (g)	3655.0	Initial Water Content, (%)	7.1
		Final Water Content, (%)	17.1

HYDRAULIC CONDUCTIVITY

Test No.	Manometer Readings		Head, h (cm)	Flow, Q (cm^3)	Time, t (s)	Velocity, v Q/At (cm/s)	$i = h/L$	Temp. of Water ($^{\circ}\text{C}$)	Viscosity of Water at Test Temp. (X) ($1 \times 10^{-6} \text{ m}^2/\text{s}$)	Viscosity of Water at 20 $^{\circ}$ C. (Y) ($1 \times 10^{-6} \text{ m}^2/\text{s}$)	Ratio = X/Y	k_{20} (cm/s) corrected
	H1 (cm)	H2 (cm)										
1	5	3	2	7.37	180	2.24E-04	0.172	20.0	1.000	1.003	0.997	1.30E-03
2				14.63	360	2.22E-04		20.0	1.000		0.997	1.29E-03
3				24.36	600	2.22E-04		20.0	1.000		0.997	1.29E-03
1	6	3	3	12.30	180	3.74E-04	0.258	20.0	1.000	1.003	0.997	1.45E-03
2				24.43	360	3.71E-04		20.0	1.000		0.997	1.44E-03
3				40.86	600	3.73E-04		20.0	1.000		0.997	1.44E-03
1	7	3	4	16.98	180	5.16E-04	0.344	29.0	1.000	1.003	0.997	1.50E-03
2				33.96	360	5.16E-04		20.0	1.000		0.997	1.50E-03
3				56.60	600	5.16E-04		20.0	1.000		0.997	1.50E-03



Test Notes: *Sample reconstituted by compaction to 95% of SPMD*

Average Corrected Hydraulic Conductivity, k (cm/s): 1.41E-03

Project No.: 121626167
Date: January 16, 2025



Prepared By: DB
Checked By: RG

HYDRAULIC CONDUCTIVITY OF COARSE-GRAINED SOILS (CONSTANT HEAD) TEST (ASTM D2434)

Figure 1

SPECIMEN IDENTIFICATION

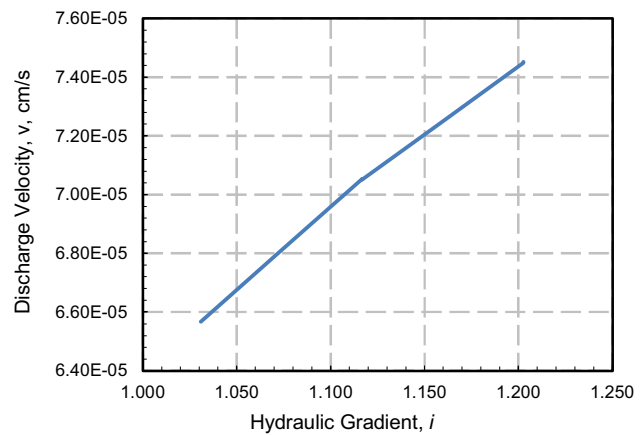
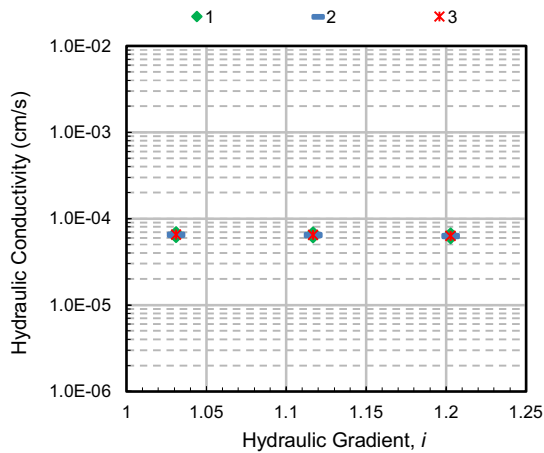
Project:	30192375 Iqualuit TWP Geotech	Borehole/Sample No.:	BP4-A1
Client:	Arcadis Canada Inc	Sample Depth (-):	N/A
Sample Type:	Reconstituted	Specific Gravity (G_s):	2.65 <i>Assumed</i>
Material Description:	Coarse Textured Sand as provided by the project engineer		

SPECIMEN DIMENSIONS AND PROPERTIES

Specimen Height, (cm)	11.64	Compacted Wet Density (kg/m^3)	2190
Specimen Diameter, (cm)	15.25	Compacted Dry Density (kg/m^3)	2099
Specimen Area, (cm^2)	182.73	Void Ratio, e_o	0.26
Initial Moist Specimen Weight, (g)	4658.2	Initial Water Content, (%)	4.4
		Final Water Content, (%)	9.3

HYDRAULIC CONDUCTIVITY

Test No.	Manometer Readings		Head, h (cm)	Flow, Q (cm^3)	Time, t (s)	Velocity, v Q/At (cm/s)	i = h/L	Temp. of Water ($^{\circ}\text{C}$)	Viscosity of Water at Test Temp. (X) ($1 \times 10^{-6} \text{ m}^2/\text{s}$)	Viscosity of Water at 20 $^{\circ}$ C. (Y) ($1 \times 10^{-6} \text{ m}^2/\text{s}$)	Ratio = X/Y	k_{20} (cm/s) corrected
	H1 (cm)	H2 (cm)										
1	15	3	12	2.16	180	6.57E-05	1.031	19.0	1.030	1.003	1.027	6.54E-05
2				4.32	360	6.57E-05		19.0	1.030		1.027	6.54E-05
3				7.20	600	6.57E-05		19.0	1.030		1.027	6.54E-05
1	16	3	13	2.32	180	7.05E-05	1.117	19.0	1.030	1.003	1.027	6.48E-05
2				4.64	360	7.05E-05		19.0	1.030		1.027	6.48E-05
3				7.73	600	7.05E-05		19.0	1.030		1.027	6.48E-05
1	17	3	14	2.45	180	7.45E-05	1.203	19.0	1.030	1.003	1.027	6.36E-05
2				4.90	360	7.45E-05		19.0	1.030		1.027	6.36E-05
3				8.17	600	7.45E-05		19.0	1.030		1.027	6.36E-05



Test Notes: *Sample reconstituted by compaction to 95% of corrected SPMDD*

Average Corrected Hydraulic Conductivity, k (cm/s): 6.46E-05

Project No.: 121626167
Date: January 13, 2025



Prepared By: DB
Checked By: RG

HYDRAULIC CONDUCTIVITY OF COARSE-GRAINED SOILS (CONSTANT HEAD) TEST (ASTM D2434)

Figure 1

SPECIMEN IDENTIFICATION

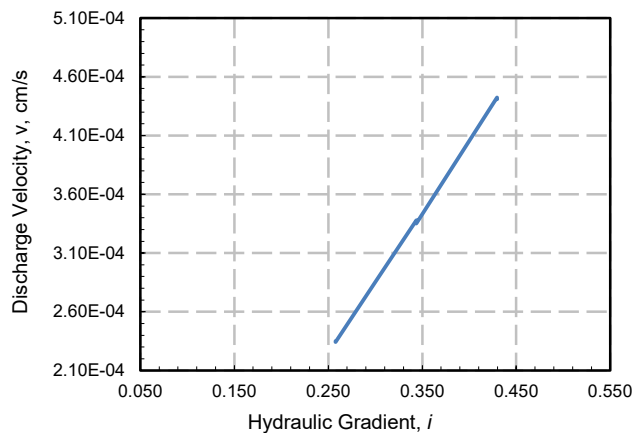
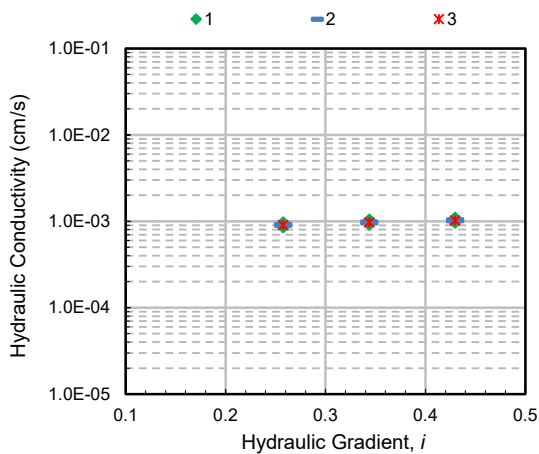
Project:	30192375 Iqaluit TWP Geotech	Borehole/Sample No.:	BP2-A3
Client:	Arcadis Canada Inc	Sample Depth (-):	N/A
Sample Type:	Reconstituted	Specific Gravity (G_s):	2.65 <i>Assumed</i>
Material Description:	Coarse Textured Sand as provided by the project engineer		

SPECIMEN DIMENSIONS AND PROPERTIES

Specimen Height, (cm)	11.64	Compacted Wet Density (kg/m^3)	1777
Specimen Diameter, (cm)	15.25	Compacted Dry Density (kg/m^3)	1686
Specimen Area, (cm^2)	182.73	Void Ratio, e_o	0.57
Initial Moist Specimen Weight, (g)	3779.6	Initial Water Content, (%)	5.4
		Final Water Content, (%)	16.1

HYDRAULIC CONDUCTIVITY

Test No.	Manometer Readings		Head, h (cm)	Flow, Q (cm^3)	Time, t (s)	Velocity, v Q/At (cm/s)	$i = h/L$	Temp. of Water ($^{\circ}\text{C}$)	Viscosity of Water at Test Temp. (X) ($1 \times 10^{-6} \text{ m}^2/\text{s}$)	Viscosity of Water at 20 $^{\circ}$ C. (Y) ($1 \times 10^{-6} \text{ m}^2/\text{s}$)	Ratio = X/Y	k_{20} (cm/s) corrected		
	H1 (cm)	H2 (cm)												
1	6	3	3	7.73	180	2.35E-04	0.258	20.0	1.003	1.003	1.000	9.12E-04		
2				15.44	360	2.35E-04		20.0	1.003				1.000	9.10E-04
3				25.68	600	2.34E-04		20.0	1.003				1.000	9.08E-04
1	7	3	4	11.11	180	3.38E-04	0.344	20.0	1.003	1.003	1.000	9.83E-04		
2				22.11	360	3.36E-04		20.0	1.003				1.000	9.78E-04
3				36.74	600	3.35E-04		20.0	1.003				1.000	9.75E-04
1	8	3	5	14.55	180	4.42E-04	0.430	20.0	1.003	1.003	1.000	1.03E-03		
2				29.06	360	4.42E-04		20.0	1.003				1.000	1.03E-03
3				48.33	600	4.41E-04		20.0	1.003				1.000	1.03E-03



Test Notes: *Sample reconstituted by compaction to 95% of SPMD*

Average Corrected Hydraulic Conductivity, k (cm/s): 9.72E-04

Project No.: 121626167
Date: April 14, 2025



Prepared By: DR
Checked By: RG



Stantec Consulting Ltd.
300 - 1331 Clyde Avenue, Ottawa ON K2C 3G4

January 20, 2025
File: 121626167

Attention: Jacob Elliott Holden, P. Eng.
Environmental Engineer
Arcadis Canada Inc.
333 Preston Street, Suite 500
Ottawa, Ontario, Canada, K1S 5N4
Tel: 613-703-3818, C: 613-809-4651
E-mail: Jacob.Holden@arcadis.com

Dear Mr. Holden,

Reference: Direct Shear Tests Results, Arcadis Canada Inc., File # 30192375

This letter presents the results of 12 Direct Shear tests carried out in accordance with ASTM D3080/D3080M. The test results are provided in the attached tables and figures.

Table 1: Summary of Tests Completed

Sample ID	Depth	Test Number
BP1-A1	N/A	1,2,3
BP2-A1	N/A	4,5,6
BP3-A1	N/A	7,8,9
BP4-A1	N/A	10,11,12

This letter provides test results only and does not constitute any interpretation or engineering recommendations with respect to material suitability or specification compliance.

We trust the information presented herein meets your present requirements. Should you have any questions or require additional information, please do not hesitate to contact us.

Regards,

STANTEC CONSULTING LTD.

Ramin Ghassemi Ph.D., P.Eng.
Geotechnical Engineer
Direct: 613 722-4420
Mobile: 437 775-7625
Ramin.ghassemi@stantec.com



Stantec Consulting Ltd.

Direct Shear Test of Soils Under Consolidated Drained Conditions ASTM D3080/D3080M

January 20, 2025
January 20, 2025

Date:
Date:
D. Boateng
R. Ghassemi

Prepared by:
Checked by:

V:\01216\active\laboratory_standing_offers\2024 Laboratory Standing Offers\121626
January 20, 2025

Specimen Details	Test # 1	Test # 2	Test # 3
Project Name	30192375 Iqaluit LTWP_Geotech Testing		
Project Location	Iqaluit, Nunavut		
Bulk Sample	Coarse Textured Sand	Coarse Textured Sand	Coarse Textured Sand
Sample No.	BP1-A1	BP1-A1	BP1-A1
Depth	N/A	N/A	N/A
Sample Date	N/A	N/A	N/A

Soil Description and Classification as provided by the Project Engineer
<i>Coarse Textured Sand</i>

Initial Specimen Conditions				
Height	mm	31.70	31.70	31.70
Diameter	mm	63.50	63.50	63.50
Mass	g	182.30	182.70	182.40
Dry Mass	g	166.87	165.45	162.98
Wet Density	Mg/m ³	1.82	1.82	1.82
Dry Density	Mg/m ³	1.66	1.65	1.62
Moisture Content	%	9.25	10.43	11.91
Degree of Saturation	%	41.5	45.7	50.2
Specific Gravity (Assumed)		2.65	2.65	2.65
Void Ratio		0.59	0.60	0.63

Final Specimen Conditions				
Normal Stress	kPa	5	150	350
Time to Failure	min	23	7	9
Rate of Displacement	mm/min	0.300	0.300	0.300
Peak Shear Stress	kPa	15.3	112.6	296.9
Shear Stress at the end of test	kPa	4.8	92.0	222.9
H. Displacement-Peak	mm	7.0	2.2	2.7
Moisture Content	%	18.42	17.92	18.42

Tests Notes:

1. Testing were completed at 95% of SPMDD
2. Material retained on the 4.75 mm sieve were screened before the direct shear tests
3. Test specimens were inundated throughout the tests
4. Testing were completed following the desired normal stresses of 0, 150 and 350 kPa respectively provided by the Client
5. 5 kPa normal stress for first point due to placement of the loading cap and the top split-box assembly
6. Specific gravities were assumed

Direct Shear Test of Soils Under Consolidated Drained Conditions
ASTM D3080/D3080M

January 20, 2025
January 20, 2025

Date:
Date:

D. Boateng
R. Chasseemi

Prepared by:
Checked by:

V:\01216\active\laboratory_standing_offers\2024 Laboratory Standing Offers\12

Filename:
Date:

Test # 1

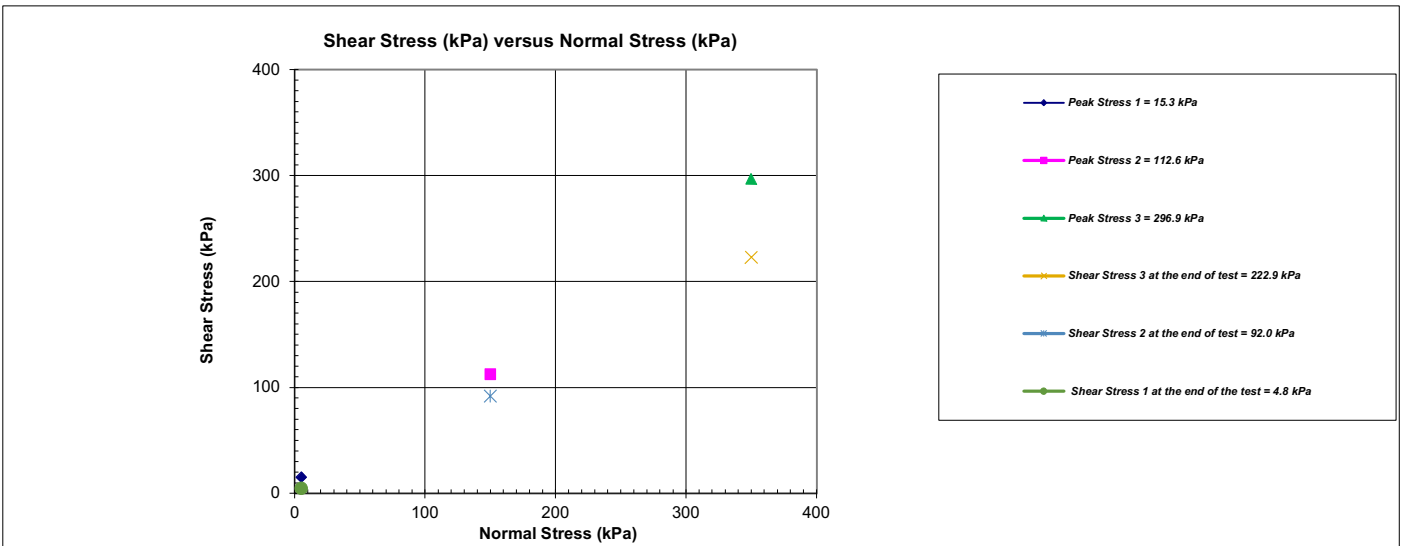
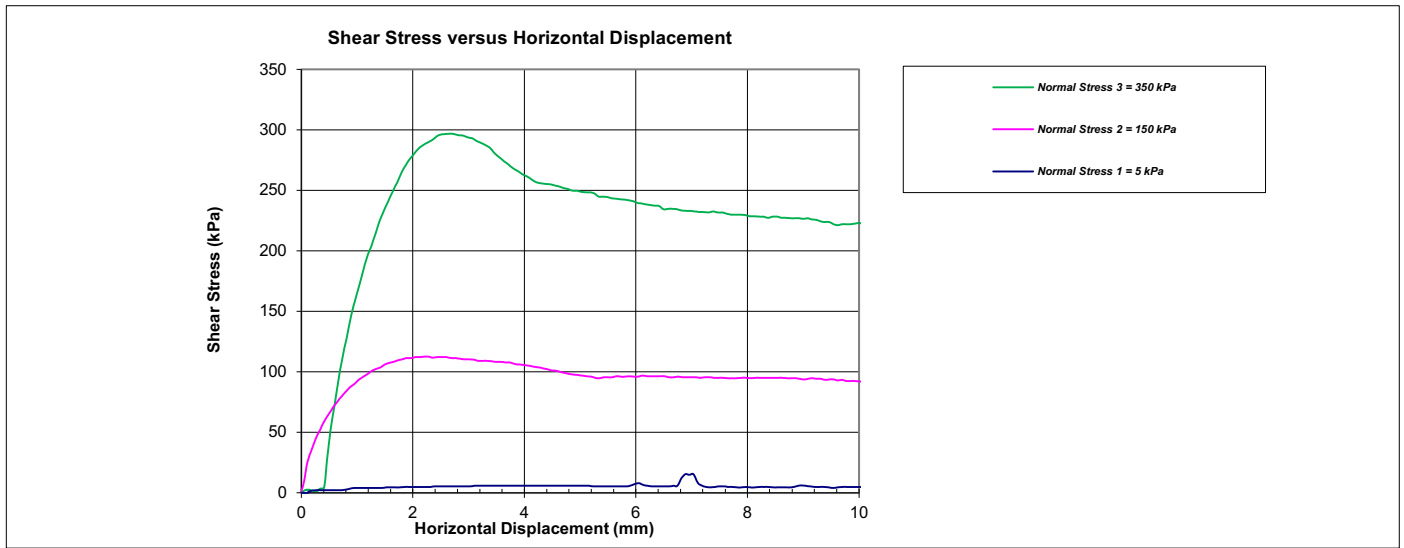
Test # 2

Test # 3

Specimen Details

Project Name	30192375 Iqaluit LTWP_Geotech Testing		
Project Location	Iqaluit, Nunavut		
Borehole	Coarse Textured Sand	Coarse Textured Sand	Coarse Textured Sand
Sample No.	BP1-A1	BP1-A1	BP1-A1
Depth	N/A	N/A	N/A
Sample Date	N/A	N/A	N/A

Shearing Stages





Direct Shear Test of Soils Under Consolidated Drained Conditions
ASTM D3080/D3080M

January 20, 2025
January 20, 2025

Date:
Date:

D. Boateng
R. Ghassemi

Prepared by:
Checked by:

V:\01216\active\laboratory_standing_offers\2024 Laboratory Standing Offers\12
January 20, 2025

Test # 1

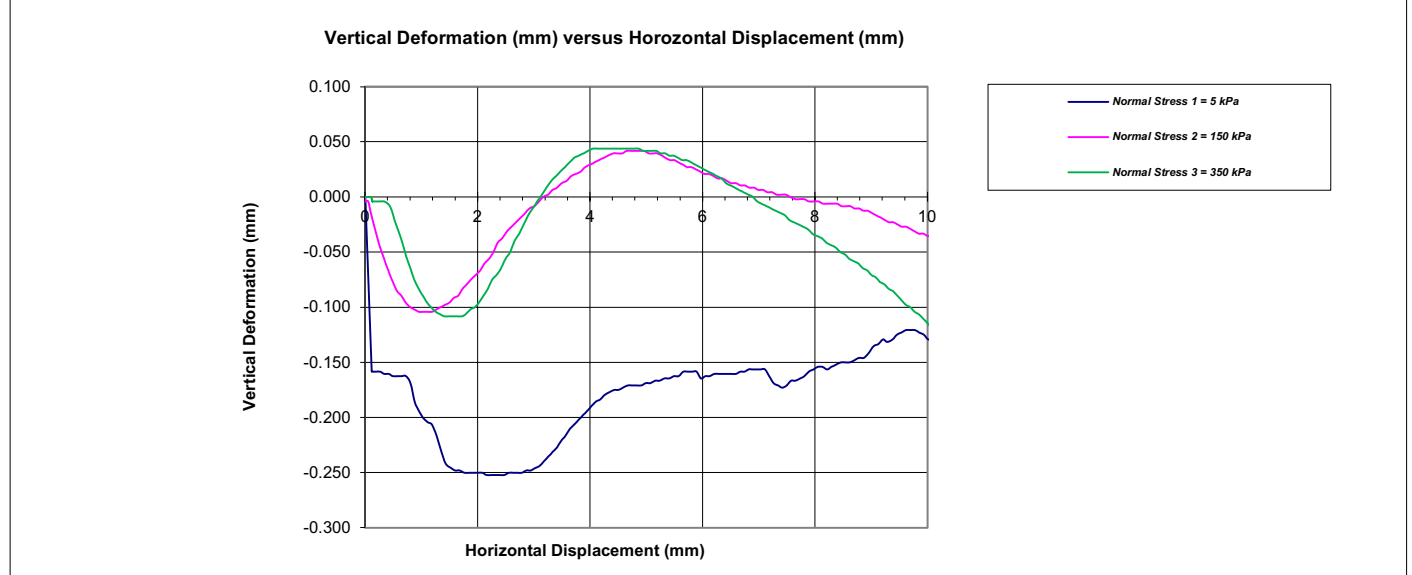
Test # 2

Test # 3

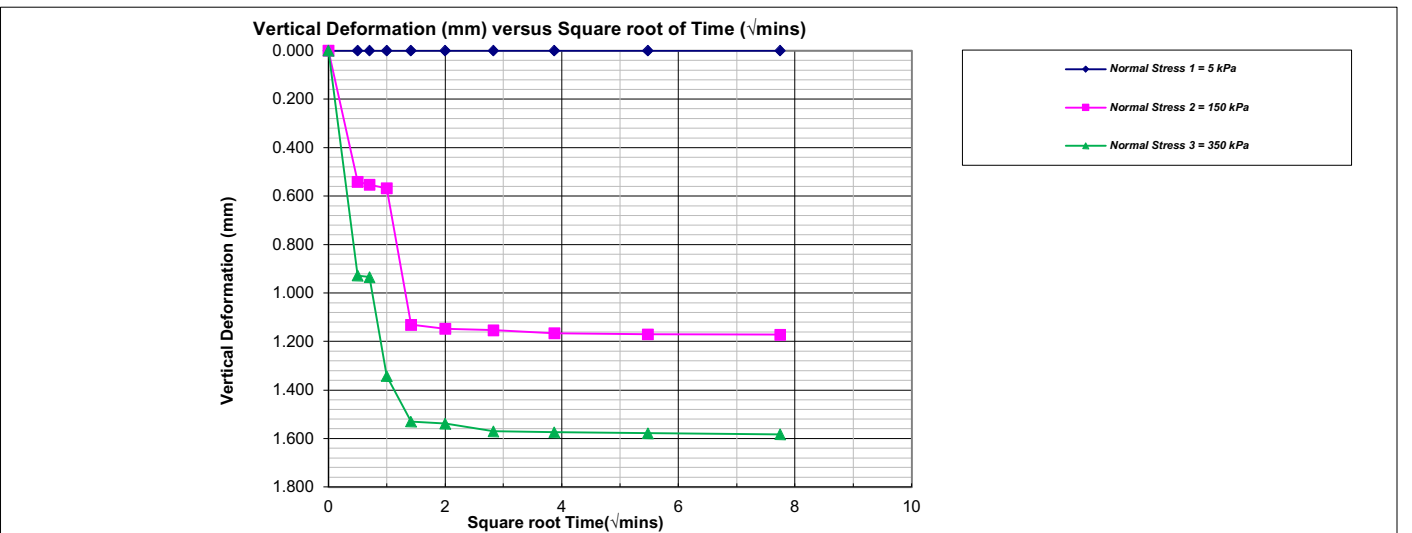
Specimen Details

Project Name		30192375 Iqaluit LTWP_Geotech Testing		
Project Location		Iqaluit, Nunavut		
Borehole		Coarse Textured Sand	Coarse Textured Sand	Coarse Textured Sand
Sample No.		BP1-A1	BP1-A1	BP1-A1
Depth		N/A	N/A	N/A
Sample Date		N/A	N/A	N/A

Shearing Stages



Consolidation curves





Project No.: 121626167

Project Name: 30192375 Iqaluit TWP Geotech

Photo Log



Photo No.: 1

Borehole: BP1-A1

Test # 3



Photo No.: 2

Borehole: BP1-A1

Test # 3



Stantec Consulting Ltd.

Direct Shear Test of Soils Under Consolidated Drained Conditions ASTM D3080/D3080M

January 20, 2025
January 20, 2025

Date:
Date:
D. Boateng
R. Ghassemi

Prepared by:
Checked by:

V:\01216\active\laboratory_standing_offers\2024 Laboratory Standing Offers\121626
January 20, 2025

Specimen Details	Test # 4	Test # 5	Test # 6
Project Name	30192375 Iqaluit LTWP_Geotech Testing		
Project Location	Iqaluit, Nunavut		
Bulk Sample	Coarse Textured Sand	Coarse Textured Sand	Coarse Textured Sand
Sample No.	BP2-A1	BP2-A1	BP2-A1
Depth	N/A	N/A	N/A
Sample Date	N/A	N/A	N/A

Soil Description and Classification as provided by the Project Engineer
<i>Coarse Textured Sand</i>

Initial Specimen Conditions				
Height	mm	31.70	31.70	31.70
Diameter	mm	63.50	63.50	63.50
Mass	g	196.20	196.20	198.40
Dry Mass	g	177.98	177.01	177.75
Wet Density	Mg/m ³	1.95	1.95	1.98
Dry Density	Mg/m ³	1.77	1.76	1.77
Moisture Content	%	10.24	10.84	11.62
Degree of Saturation	%	55.2	57.5	62.4
Specific Gravity (Assumed)		2.65	2.65	2.65
Void Ratio		0.49	0.50	0.49

Final Specimen Conditions				
Normal Stress	kPa	5	150	350
Time to Failure	min	24	7	11
Rate of Displacement	mm/min	0.300	0.300	0.300
Peak Shear Stress	kPa	9.6	148.0	332.9
Shear Stress at the end of test	kPa	7.0	90.7	234.3
H. Displacement-Peak	mm	7.3	2.0	3.2
Moisture Content	%	19.62	16.76	16.06

Tests Notes:

1. Testing were completed at 95% of corrected SPMDD
2. Material retained on the 4.75 mm sieve were screened before direct shear tests
3. Test specimens were inundated throughout the tests
4. Testing were completed following the desired normal stresses of 0, 150 and 350 kPa respectively provided by the Client
5. 5 kPa normal stress for first point due to placement of the loading cap and the top split-box assembly
6. Specific gravities were assumed

Direct Shear Test of Soils Under Consolidated Drained Conditions
ASTM D3080/D3080M

January 20, 2025
January 20, 2025

Date: Date:

D. Boateng R. Chasseemi

Prepared by: Checked by:

V:\01216\active\laboratory_standing_offers\2024 Laboratory Standing Offers\12

Filename: Date:

Test # 4

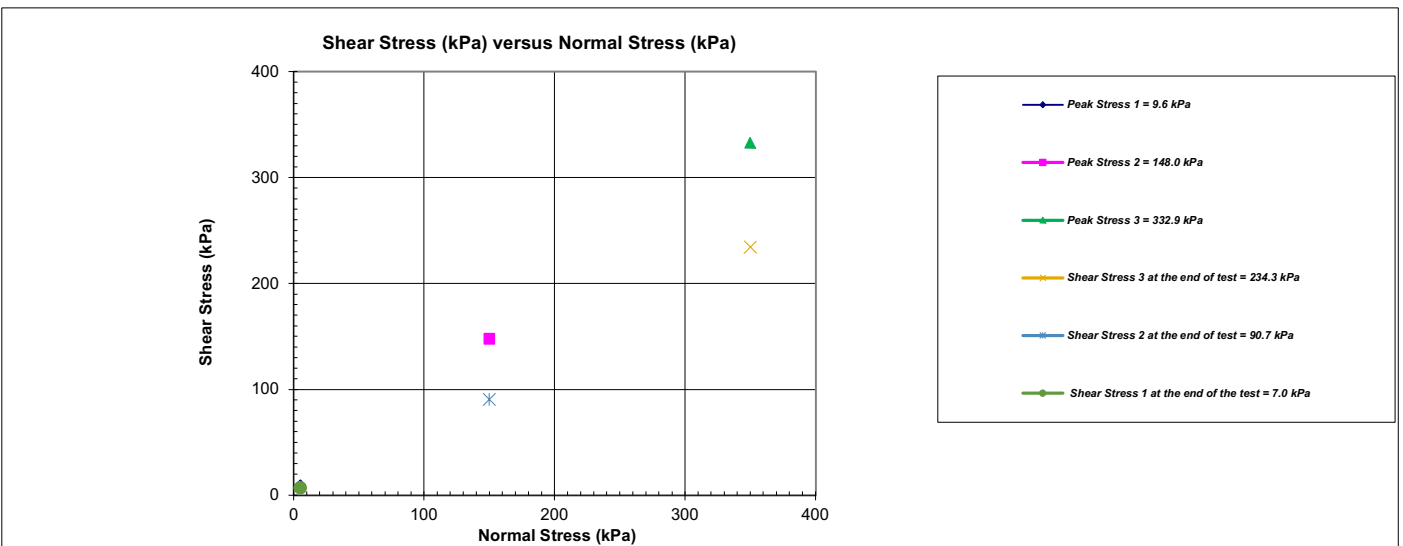
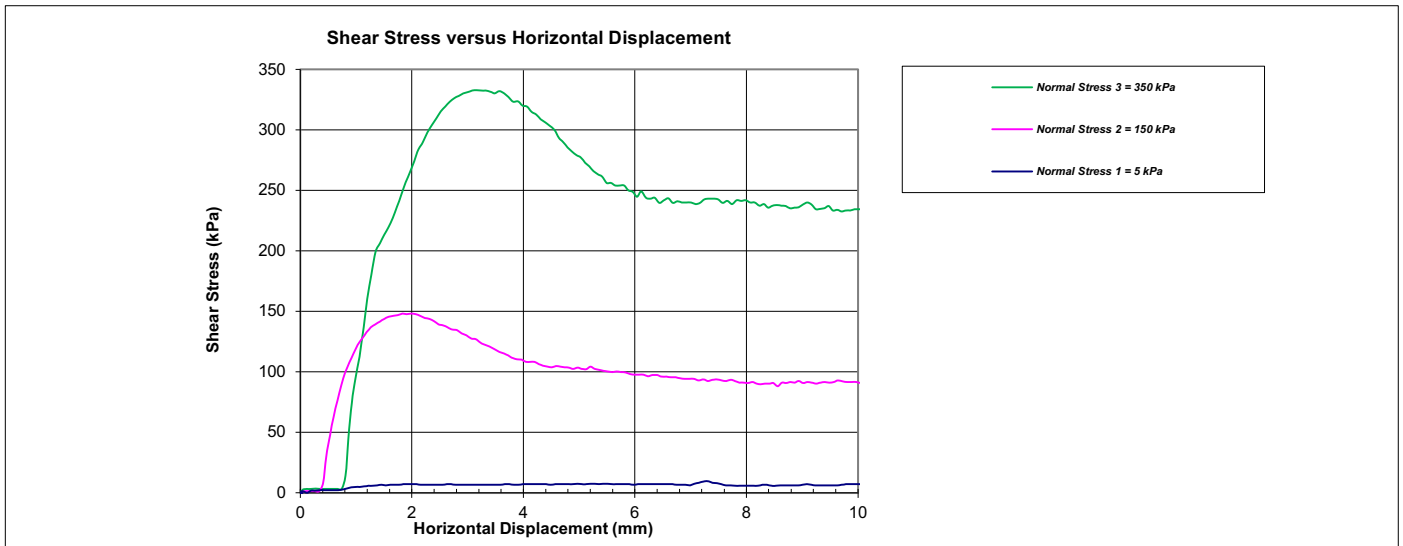
Test # 5

Test # 6

Specimen Details

Project Name	30192375 Iqaluit LTWP_Geotech Testing		
Project Location	Iqaluit, Nunavut		
Borehole	Coarse Textured Sand	Coarse Textured Sand	Coarse Textured Sand
Sample No.	BP2-A1	BP2-A1	BP2-A1
Depth	N/A	N/A	N/A
Sample Date	N/A	N/A	N/A

Shearing Stages





Direct Shear Test of Soils Under Consolidated Drained Conditions
ASTM D3080/D3080M

January 20, 2025
January 20, 2025

Date:
Date:

D. Boateng
R. Ghassemi

Prepared by:
Checked by:

V:\01216\active\laboratory_standing_offers\2024 Laboratory Standing Offers\12
January 20, 2025

Test # 4

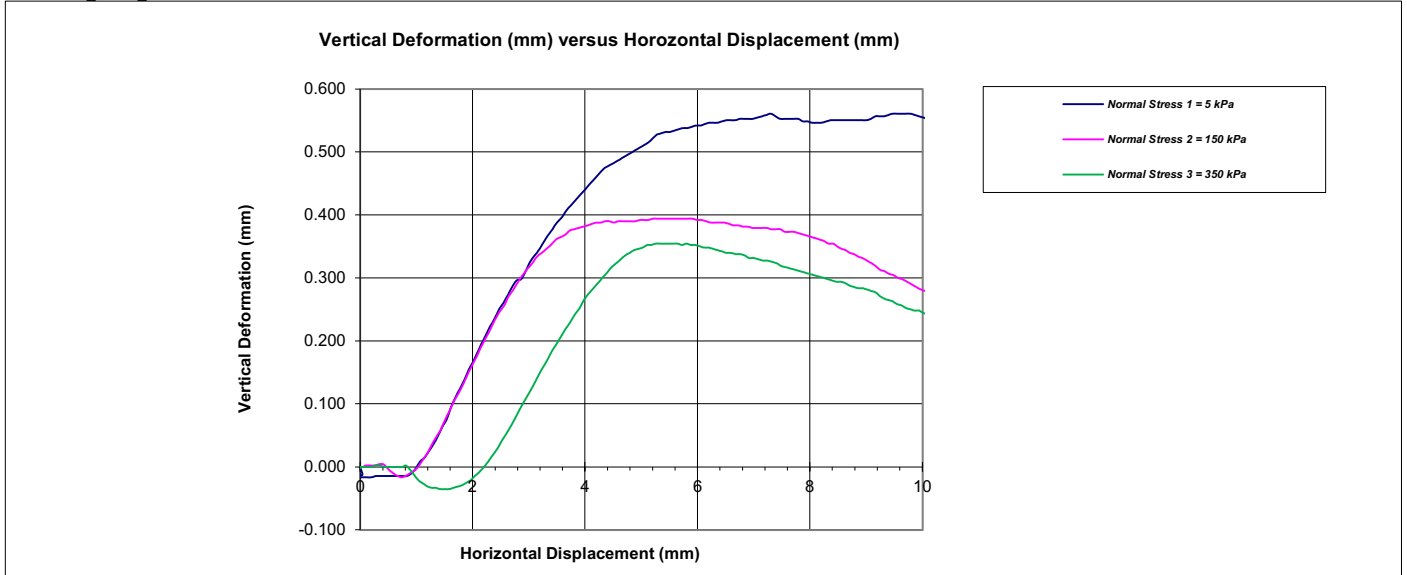
Test # 5

Test # 6

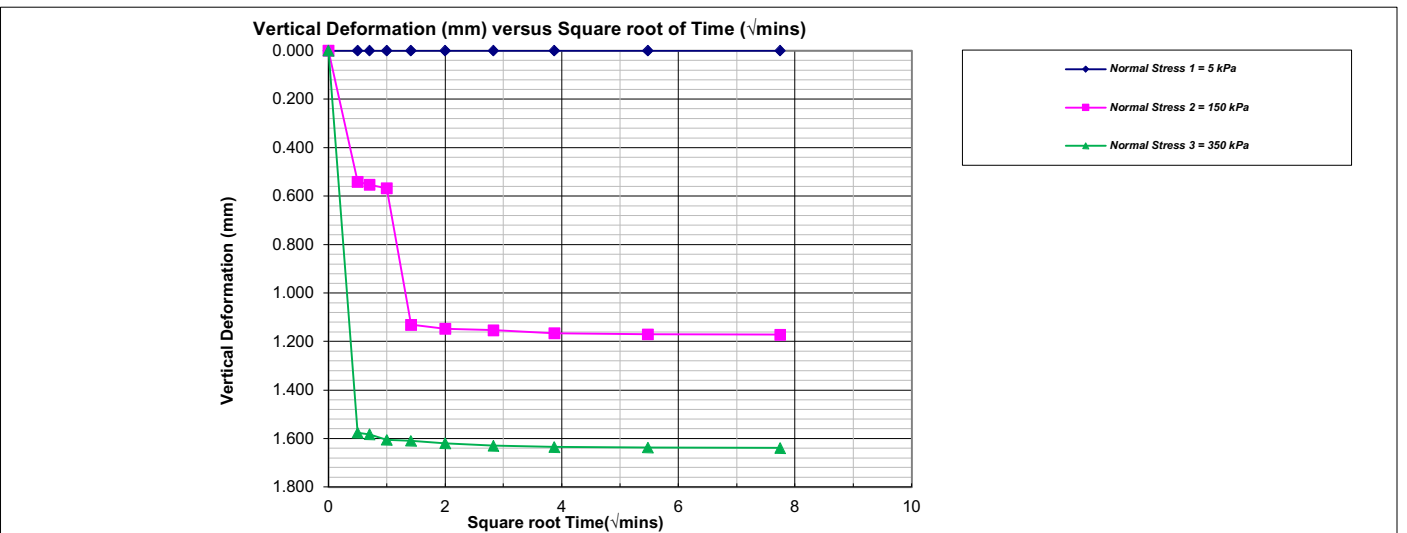
Specimen Details

Project Name		30192375 Iqaluit LTWP_Geotech Testing		
Project Location		Iqaluit, Nunavut		
Borehole		Coarse Textured Sand	Coarse Textured Sand	Coarse Textured Sand
Sample No.		BP2-A1	BP2-A1	BP2-A1
Depth		N/A	N/A	N/A
Sample Date		N/A	N/A	N/A

Shearing Stages



Consolidation curves





Project No.: 121626167

Project Name: 30192375 Iqaluit TWP Geotech

Photo Log



Photo No.:

1

Borehole:

BP2-A1

Test #

5

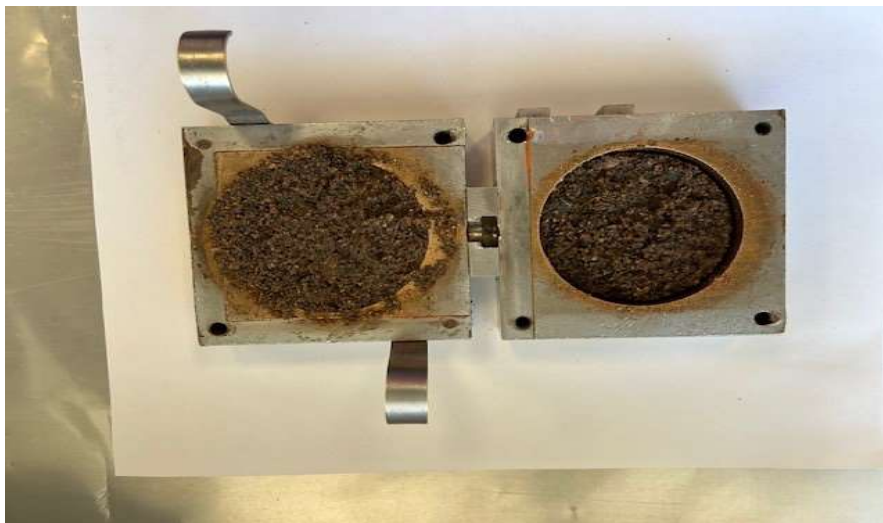


Photo No.:

2

Borehole:

BP2-A1

Test #

5



Stantec Consulting Ltd.

Direct Shear Test of Soils Under Consolidated Drained Conditions
ASTM D3080/D3080M

January 20, 2025
 January 20, 2025

Date:
 Date:
 D. Boateng
 R. Ghassemi

Prepared by:
 Checked by:

V:\01216\active\laboratory_standing_offers\2024 Laboratory Standing Offers\121626
 January 20, 2025

Specimen Details		Test # 7	Test # 8	Test # 9
Project Name		30192375 Iqaluit LTWP_Geotech Testing		
Project Location		Iqaluit, Nunavut		
Bulk Sample		Coarse Textured Sand	Coarse Textured Sand	Coarse Textured Sand
Sample No.		BP3-A1	BP3-A1	BP3-A1
Depth		N/A	N/A	N/A
Sample Date		N/A	N/A	N/A

Soil Description and Classification as provided by the Project Engineer	
Coarse Textured Sand	

Initial Specimen Conditions		Test # 7	Test # 8	Test # 9
Height	mm	31.70	31.70	31.70
Diameter	mm	63.50	63.50	63.50
Mass	g	173.60	173.80	173.20
Dry Mass	g	158.22	157.10	156.82
Wet Density	Mg/m ³	1.73	1.73	1.73
Dry Density	Mg/m ³	1.58	1.56	1.56
Moisture Content	%	9.72	10.63	10.44
Degree of Saturation	%	38.0	40.8	40.0
Specific Gravity (Assumed)		2.65	2.65	2.65
Void Ratio		0.68	0.69	0.69

Final Specimen Conditions		Test # 7	Test # 8	Test # 9
Normal Stress	kPa	5	150	350
Time to Failure	min	6	7	16
Rate of Displacement	mm/min	0.300	0.300	0.300
Peak Shear Stress	kPa	13.1	131.8	272.9
Shear Stress at the end of test	kPa	8.3	93.3	218.5
H. Displacement-Peak	mm	1.7	2.1	4.7
Moisture Content	%	23.19	22.41	22.18

Tests Notes:

1. Testing were completed at 95% of SPMDD
2. Material retained on the 4.75 mm sieve were screened before the direct shear tests
3. Test specimens were inundated throughout the tests
4. Testing were completed following the desired normal stresses of 0, 150 and 350 kPa respectively provided by the Client
5. 5 kPa normal stress for first point due to placement of the loading cap and the top cap split-box assembly
6. Specific gravities were assumed

Direct Shear Test of Soils Under Consolidated Drained Conditions
ASTM D3080/D3080M

January 20, 2025
January 20, 2025

Date:
Date:
D. Boateng
R. Chasseemi

Prepared by:
Checked by:

V:\01216\active\laboratory_standing_offers\2024 Laboratory Standing Offers\12
January 20, 2025

Filename:
Date:

Test # 7

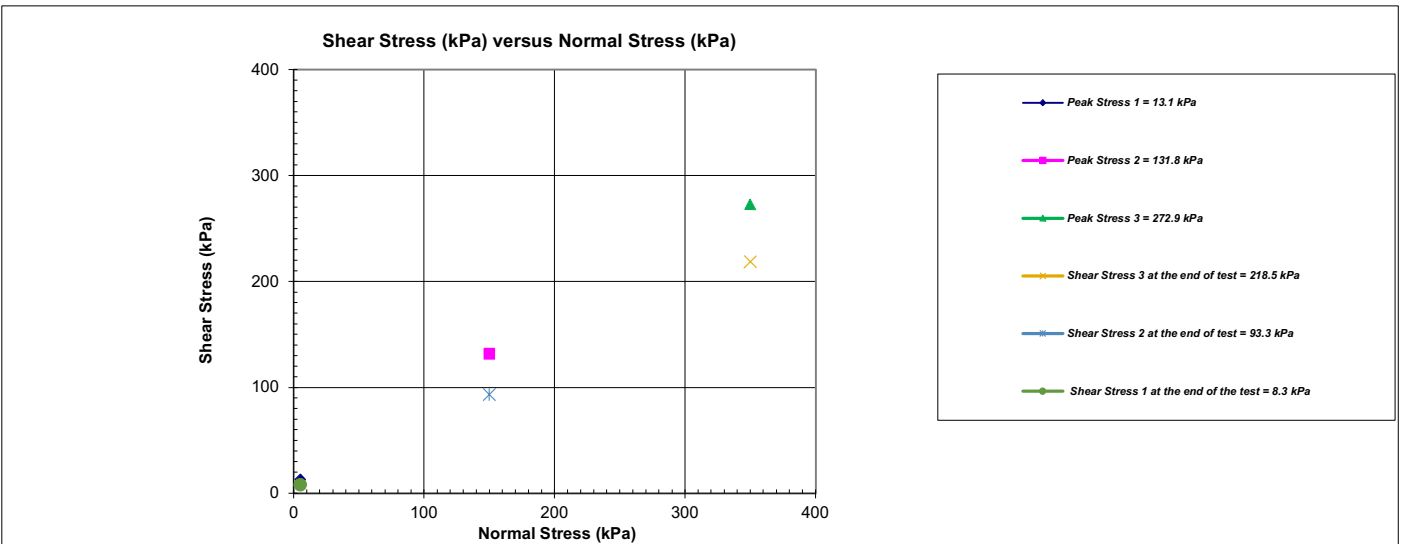
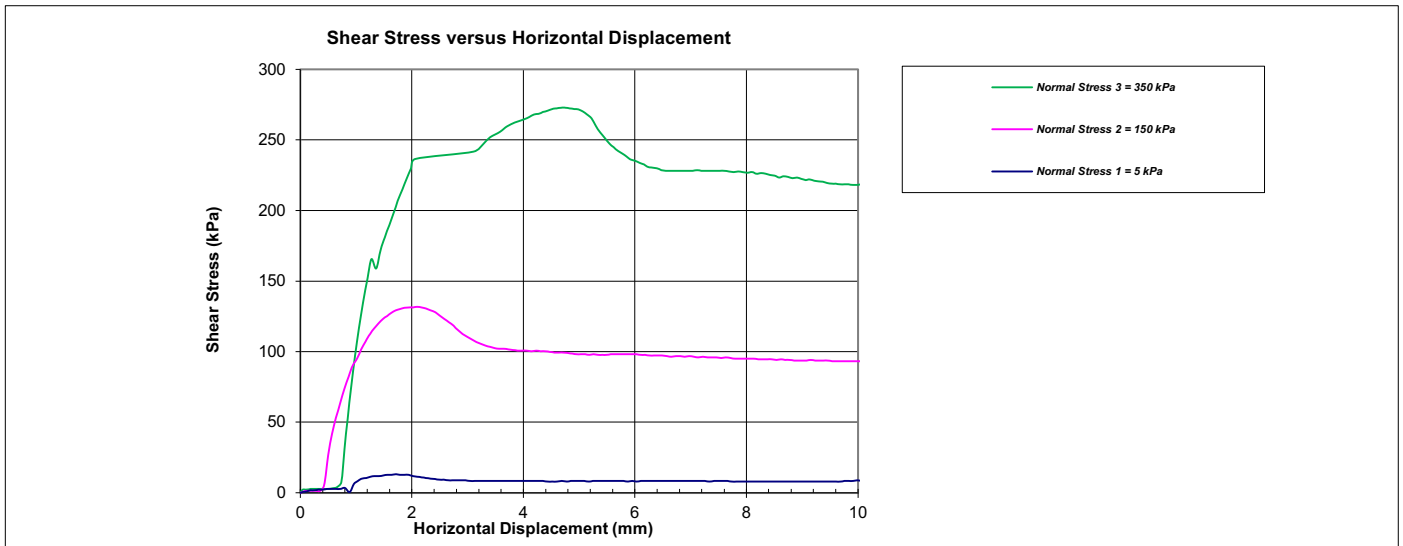
Test # 8

Test # 9

Specimen Details

Project Name	30192375 Iqaluit LTWP_Geotech Testing		
Project Location	Iqaluit, Nunavut		
Borehole	Coarse Textured Sand	Coarse Textured Sand	Coarse Textured Sand
Sample No.	BP3-A1	BP3-A1	BP3-A1
Depth	N/A	N/A	N/A
Sample Date	N/A	N/A	N/A

Shearing Stages





Direct Shear Test of Soils Under Consolidated Drained Conditions
ASTM D3080/D3080M

January 20, 2025
January 20, 2025

Date:
Date:
D. Boateng
R. Ghassemi

Prepared by:
Checked by:

V:\01216\active\laboratory_standing_offers\2024 Laboratory Standing Offers\12
January 20, 2025

Filename:
Date:

Test # 7

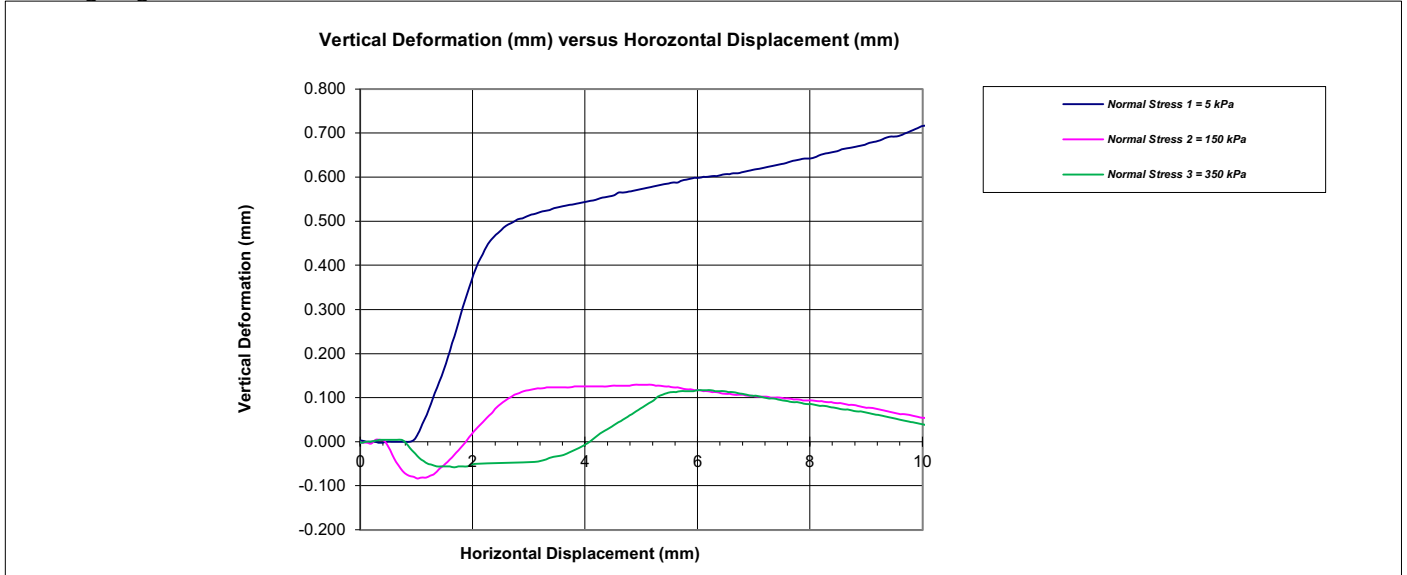
Test # 8

Test # 9

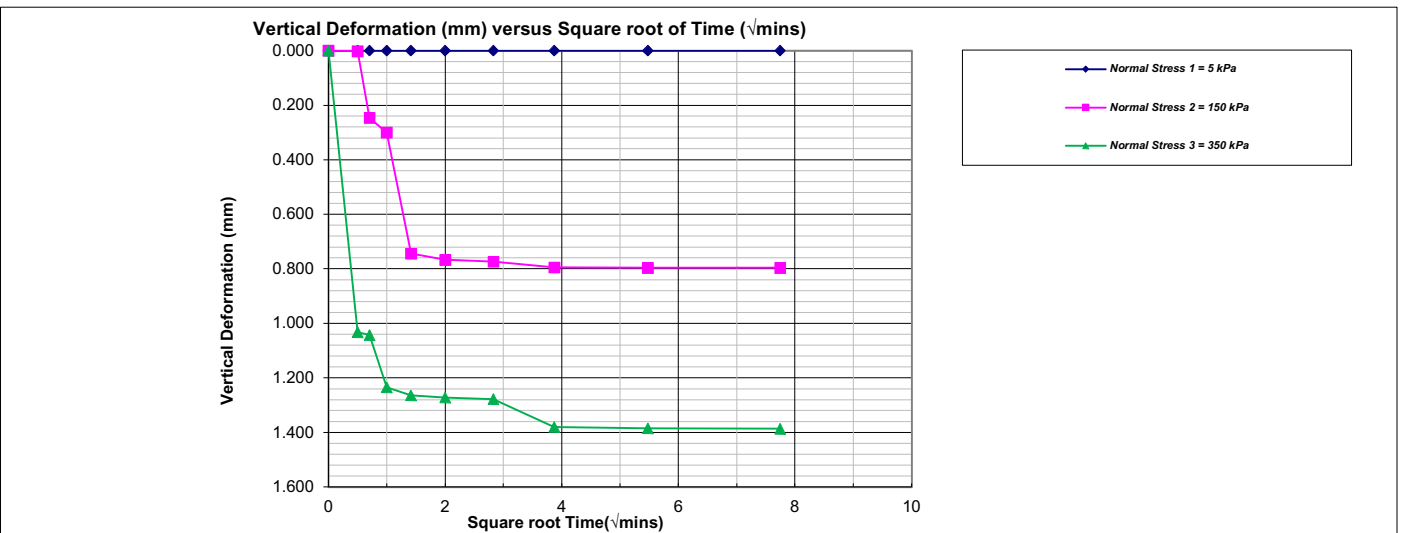
Specimen Details

Project Name		30192375 Iqaluit LTWP_Geotech Testing		
Project Location		Iqaluit, Nunavut		
Borehole		Coarse Textured Sand	Coarse Textured Sand	Coarse Textured Sand
Sample No.		BP3-A1	BP3-A1	BP3-A1
Depth		N/A	N/A	N/A
Sample Date		N/A	N/A	N/A

Shearing Stages



Consolidation curves





Project No.: 121626167

Project Name: 30192375 Iqaluit TWP Geotech

Photo Log



Photo No.:

1

Borehole:

BP3-A1

Test #

9



Photo No.:

2

Borehole:

BP3-A1

Test #

9



Stantec Consulting Ltd.

Direct Shear Test of Soils Under Consolidated Drained Conditions
ASTM D3080/D3080M

January 20, 2025
 January 20, 2025

Date:
 Date:
 D. Boateng
 R. Ghassemi

Prepared by:
 Checked by:

V:\01216\active\laboratory_standing_offers\2024 Laboratory Standing Offers\121626
 January 20, 2025

Test # 10

Test # 11

Test # 12

Specimen Details

Project Name		30192375 Iqaluit LTWP_Geotech Testing		
Project Location		Iqaluit, Nunavut		
Bulk Sample		Coarse Textured Sand	Coarse Textured Sand	Coarse Textured Sand
Sample No.		BP4-A1	BP4-A1	BP4-A1
Depth		N/A	N/A	N/A
Sample Date		N/A	N/A	N/A

Soil Description and Classification as provided by the Project Engineer

Coarse Textured Sand

Initial Specimen Conditions

Height	mm	31.70	31.70	31.70
Diameter	mm	63.50	63.50	63.50
Mass	g	220.00	220.30	219.70
Dry Mass	g	206.04	211.69	210.78
Wet Density	Mg/m ³	2.19	2.19	2.19
Dry Density	Mg/m ³	2.05	2.11	2.10
Moisture Content	%	6.77	4.07	4.23
Degree of Saturation	%	62.3	42.5	43.2
Specific Gravity (Assumed)		2.65	2.65	2.65
Void Ratio		0.29	0.25	0.26

Final Specimen Conditions

Normal Stress	kPa	5	150	350
Time to Failure	min	33	11	10
Rate of Displacement	mm/min	0.300	0.300	0.300
Peak Shear Stress	kPa	7.4	136.6	338.1
Shear Stress at the end of test	kPa	7.0	120.9	270.7
H. Displacement-Peak	mm	10.0	3.2	3.1
Moisture Content	%	13.81	10.12	9.73

Tests Notes:

1. Testing were completed at 95% of corrected SPMDD
2. Material retained on the 4.75 mm sieve were screened before the direct shear tests
3. Test specimens were inundated throughout the tests
4. Testing were completed following the desired normal stresses of 0, 150 and 350 kPa respectively provided by the Client
5. 5 kPa normal stress for first point due to placement of the loading cap and the top split-box assembly
6. Specific gravities were assumed

Direct Shear Test of Soils Under Consolidated Drained Conditions
ASTM D3080/D3080M

January 20, 2025
January 20, 2025

Date:
Date:

D. Boateng
R. Chasseani

Prepared by:
Checked by:

V:\01216\active\laboratory_standing_offers\2024 Laboratory Standing Offers\12

Filename:
Date:

Test # 10

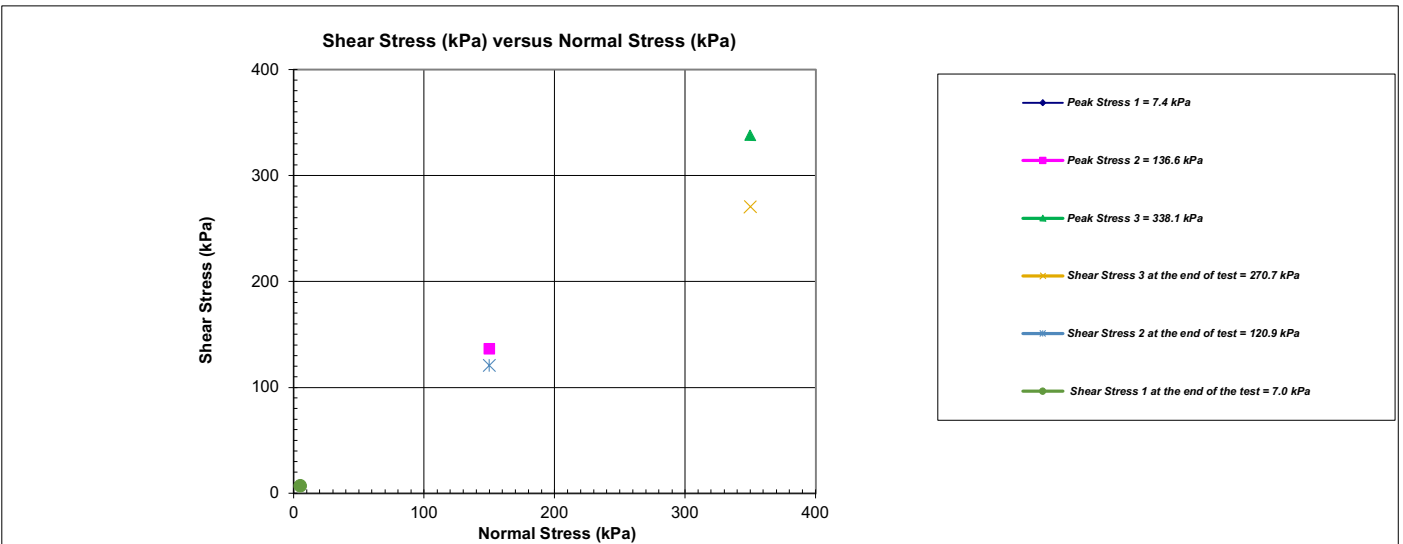
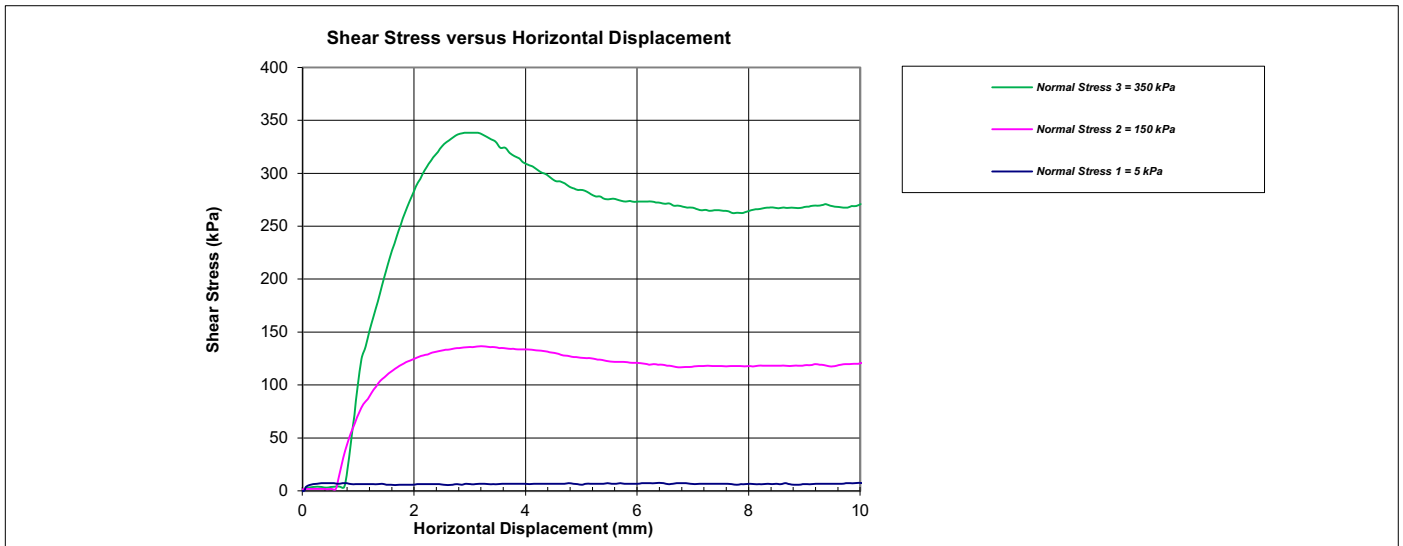
Test # 11

Test # 12

Specimen Details

Project Name	30192375 Iqaluit LTWP_Geotech Testing		
Project Location	Iqaluit, Nunavut		
Borehole	Coarse Textured Sand	Coarse Textured Sand	Coarse Textured Sand
Sample No.	BP4-A1	BP4-A1	BP4-A1
Depth	N/A	N/A	N/A
Sample Date	N/A	N/A	N/A

Shearing Stages





Direct Shear Test of Soils Under Consolidated Drained Conditions
ASTM D3080/D3080M

January 20, 2025
January 20, 2025

Date:
Date:
D. Boateng
R. Ghassemi

Prepared by:
Checked by:

V:\01216\active\laboratory_standing_offers\2024 Laboratory Standing Offers\12
January 20, 2025
Filename:
Date:

Test # 10

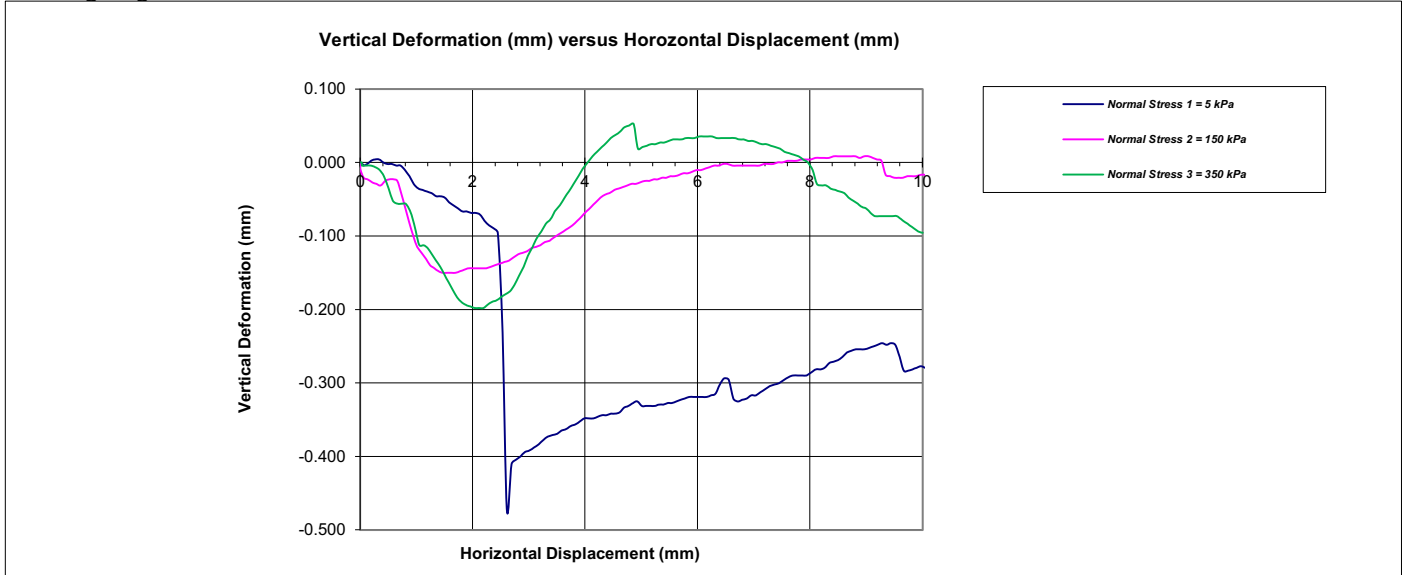
Test # 11

Test # 12

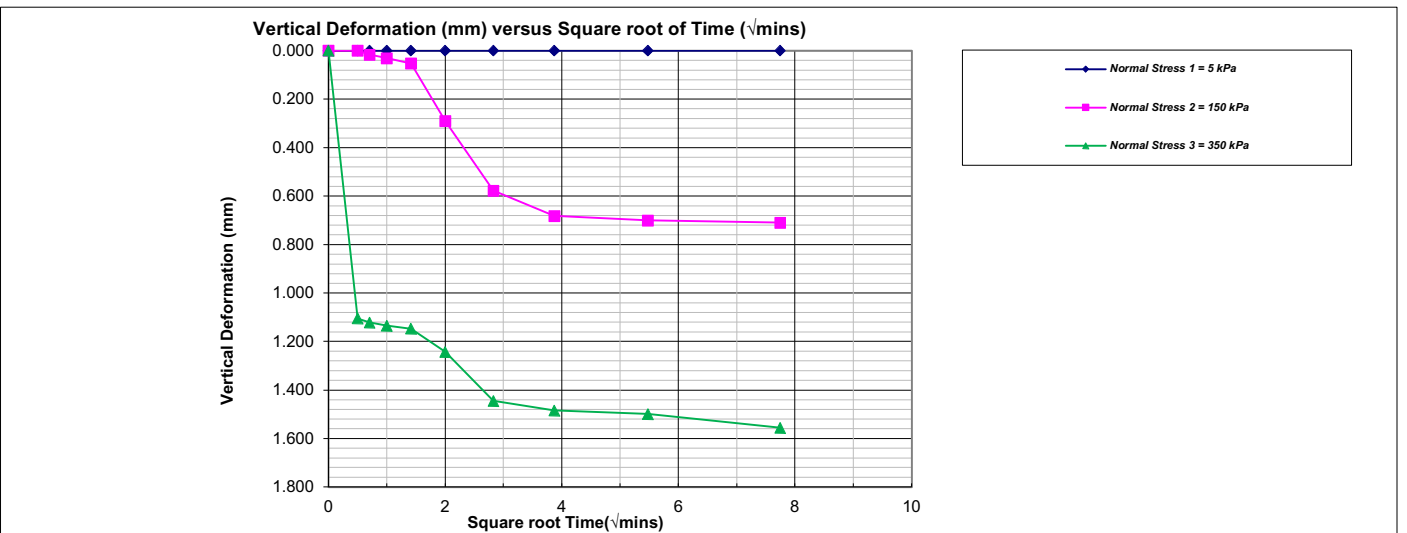
Specimen Details

Project Name		30192375 Iqaluit LTWP_Geotech Testing		
Project Location		Iqaluit, Nunavut		
Borehole		Coarse Textured Sand	Coarse Textured Sand	Coarse Textured Sand
Sample No.		BP4-A1	BP4-A1	BP4-A1
Depth		N/A	N/A	N/A
Sample Date		N/A	N/A	N/A

Shearing Stages



Consolidation curves





Project No.: 121626167

Project Name: 30192375 Iqaluit TWP Geotech

Photo Log



Photo No.: 1

Borehole: BP4-A1

Test # 12



Photo No.: 2

Borehole: BP4-A1

Test # 12

Split Tensile Test ASTM D3967

SPECIMEN DATA

Specimen ID	BH2023-02B-76.5-93	Material type	Rock (Limestone)
Specimen age [dd]		Preparation date	2024-12-17
Thickness (avg) (mm)	20.876	Diameter (avg) (mm)	35.93
Density		Area [mm²]	2357.67
Surface preparation	Cut	Test Location/Depth	02B-76.5-93
Preload [kN]	5	Specimen type	Core
Fiber type		Project #	24-1211-02
Sampling date	2023	Sampling details	Cored and Cut
Testing Machine	Controls Compression Machine CE001	Test date	2024-12-17

FAILURE DISCRIPTION

Certificate number	T1	Certificate date	2024-12-17
Client	ARCADIS	Reference	ASTM D3967

TEST RESULT

Fp [kN]	8.8	Tensile Strength (MPa)	7.47
Load Rate (N/s)	25	Reference	
Time to Failure (s)	185		

Figure 1 Specimen Failure



Test Performed by: Kunjan Rupakheti (KR)

Project Manger: Abid Sahi P.Ge., P.Eng

UCS Test (Rock) with MOE ASTM D7012

SPECIMEN DATA

Specimen ID	BH2023-02B-76.5-93	Material type	Rock (Limestone)
Specimen age [dd]		Preparation date	2024-12-17
Length (avg) (mm)	75.06	Diameter (avg) (mm)	35.883
Density (g/cm³)	2.708	Area [mm²]	1011.242
Surface preparation	Grinded	Test Location/Depth	02B-76.5-93
Preload [kN]	5	Specimen type	Core
Fiber type		Project #	24-1211-02
Sampling date	2023	Sampling details	Cored
Testing Machine	Controls Compression Machine CE001	Test date	2024-12-17

FAILURE DISCRIPTION

Certificate number	T4	Certificate date	2024-12-17
Client	ARCADIS	Reference	ASTM D7012

TEST RESULT

Fp [kN]	274.2	MOE (GPa)	N/A
UCS (Mpa)	271.15	Reference	
Time to Failure (s)	331		

Note: Data from load cell was not saved. Only Peak value was recorded. Strain Data was saved but without the Load graph, only the UCS can be provided.

Figure 1: Sample As Received

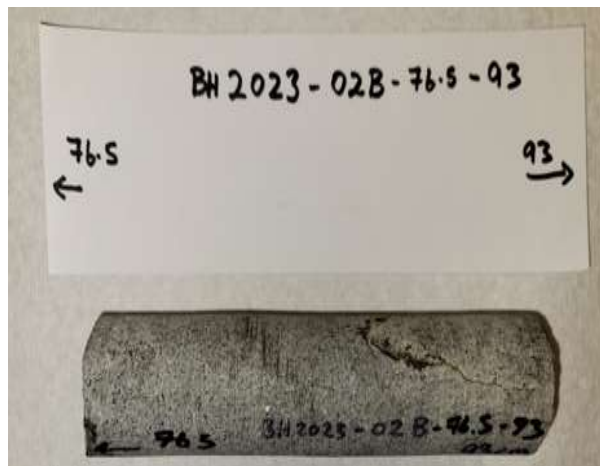
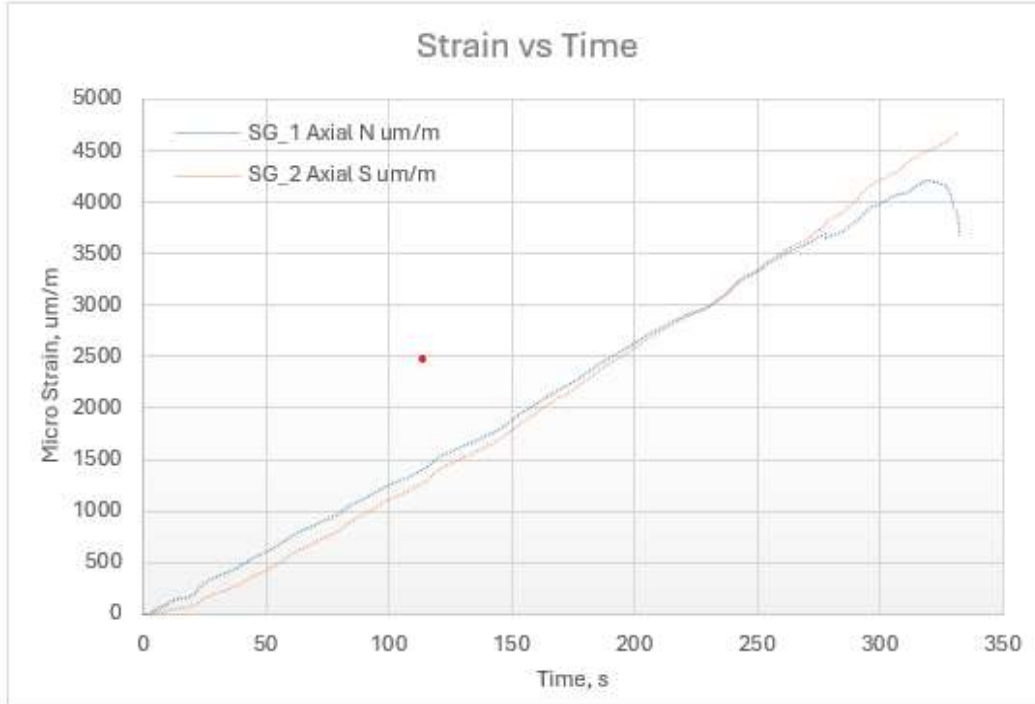


Figure 2: Sample ready for Testing



Test Performed by: Kunjan Rupakheti (KR)

Project Manger: Abid Sahi P.Geo., P.Eng



Split Tensile Test ASTM D3967

SPECIMEN DATA

Specimen ID	BH2023-02B-407-428	Material type	Rock (Limestone)
Specimen age [dd]		Preparation date	2024-12-17
Thickness (avg) (mm)	22.11	Diameter (avg) (mm)	35.91
Density		Area [mm²]	2495.6
Surface preparation	Cut	Test Location/Depth	02B-407-428
Preload [kN]	3	Specimen type	Core
Fiber type		Project #	24-1211-02
Sampling date	2023	Sampling details	Cored and Cut
Testing Machine	Controls Compression Machine CE001	Test date	2024-12-17

FAILURE DISCRIPTION

Certificate number	T1	Certificate date	2024-12-17
Client	ARCADIS	Reference	ASTM D3967

TEST RESULT

Fp [kN]	5.8	Tensile Strength (MPa)	4.65
Load Rate (N/s)	25	Reference	
Time to Failure (s)	143		

Figure 1 Specimen Failure



Test Performed by: Kunjan Rupakheti (KR)

Project Manger: Abid Sahi P.Geo., P.Eng

UCS Test (Rock) with MOE ASTM D7012

SPECIMEN DATA

Specimen ID	BH2023-02B-407-428	Material type	Rock (Limestone)
Specimen age [dd]		Preparation date	2024-12-17
Length (avg) (mm)	87.335	Diameter (avg) (mm)	35.93
Density (g/cm³)	2.704	Area [mm²]	1013.92
Surface preparation	Grinded	Test Location/Depth	02B-407-428
Preload [kN]	5	Specimen type	Core
Fiber type		Project #	24-1211-02
Sampling date	2023	Sampling details	Cored
Testing Machine	Controls Compression Machine CE001	Test date	2024-12-17

FAILURE DISCRIPTION

Certificate number	T2	Certificate date	2024-12-17
Client	ARCADIS	Reference	ASTM D7012

TEST RESULT

Fp [kN]	209.503	MOE (GPa)	56.84
UCS (Mpa)	206.33	Reference	10.3.5.2 (41-68%)
Time to Failure (s)	413		

Figure 1: Sample As Received

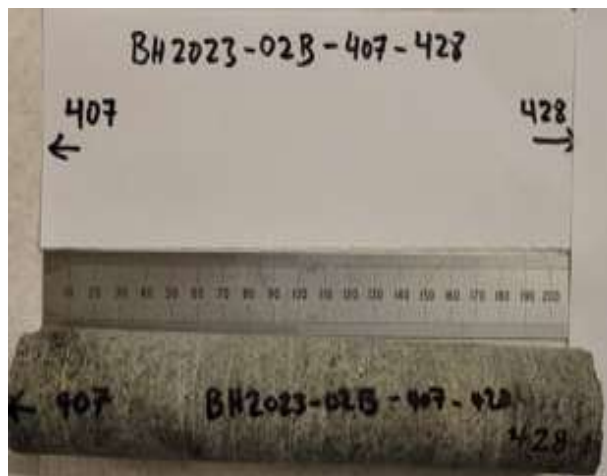
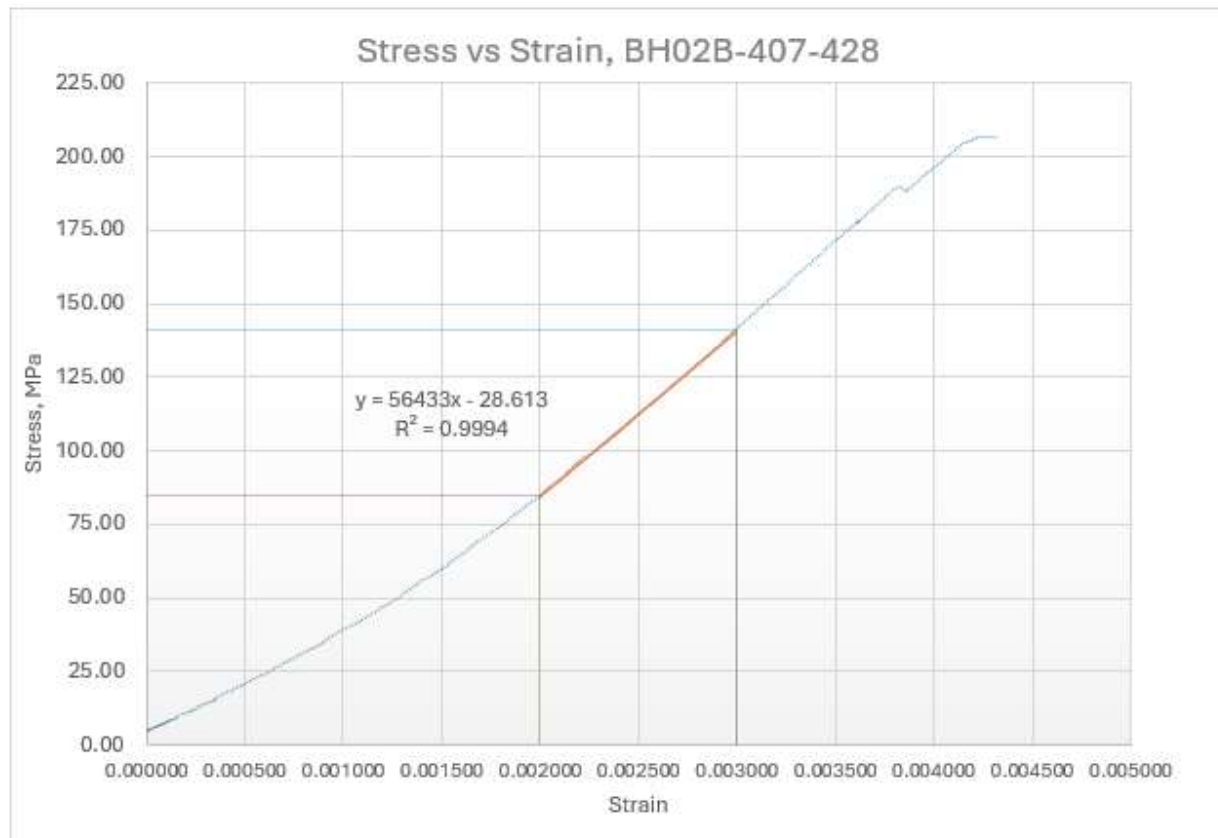
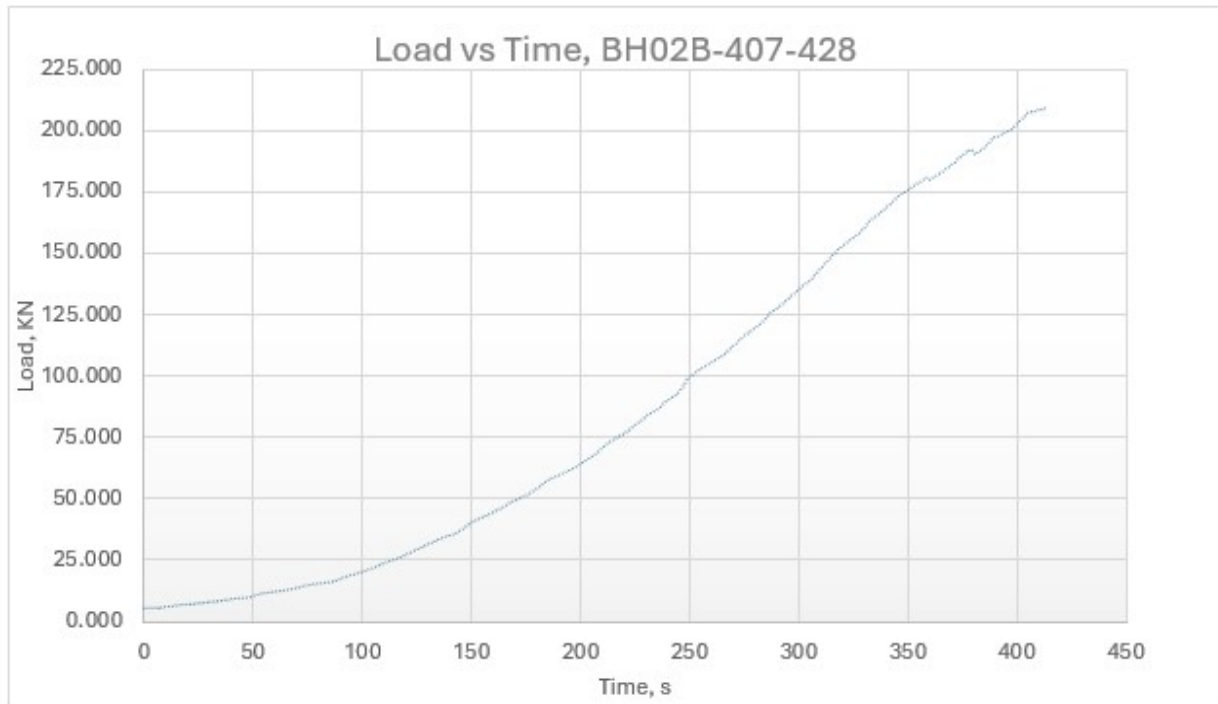


Figure 2: Sample ready for Testing



Test Performed by: Kunjan Rupakheti (KR)

Project Manger: Abid Sahi P.Geo., P.Eng



Split Tensile Test ASTM D3967

SPECIMEN DATA

Specimen ID	BH2023-04B-00-28	Material type	Rock (Limestone)
Specimen age [dd]		Preparation date	2024-12-17
Thickness (avg) (mm)	21.05	Diameter (avg) (mm)	35.89
Density		Area [mm²]	2374.38
Surface preparation	Cut	Test Location/Depth	04B-00-28
Preload [kN]	3	Specimen type	Core
Fiber type		Project #	24-1211-02
Sampling date	2023	Sampling details	Cored and Cut
Testing Machine	Controls Compression Machine CE001	Test date	2024-12-17

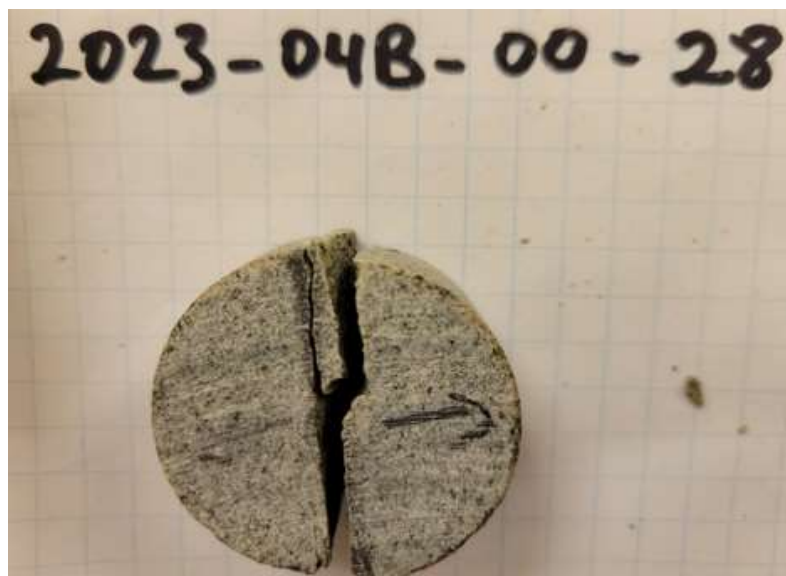
FAILURE DISCRIPTION

Certificate number	T1	Certificate date	2024-12-17
Client	ARCADIS	Reference	ASTM D3967

TEST RESULT

Fp [kN]	7	Tensile Strength (MPa)	5.9
Load Rate (N/s)	25	Reference	
Time to Failure (s)	158		

Figure 1 Specimen Failure



Test Performed by: Kunjan Rupakheti(KR)

Project Manger: Abid Sahi P.Geo., P.Eng

UCS Test (Rock) with MOE ASTM D7012

SPECIMEN DATA

Specimen ID	BH2023-04B-00-28	Material type	Rock (Limestone)
Specimen age [dd]		Preparation date	2024-12-17
Length (avg) (mm)	84.99	Diameter (avg) (mm)	35.97
Density (g/cm³)	2.708	Area [mm²]	1016.18
Surface preparation	Grinded	Test Location/Depth	04B-00-28
Preload [kN]	5	Specimen type	Core
Fiber type		Project #	24-1211-02
Sampling date	2023	Sampling details	Cored
Testing Machine	Controls Compression Machine CE001	Test date	2024-12-17

FAILURE DISCRPTION

Certificate number	T1	Certificate date	2024-12-17
Client	ARCADIS	Reference	ASTM D7012

TEST RESULT

Fp [kN]	232.76	MOE (GPa)	61.38
UCS (Mpa)	229.07	Reference	10.3.5.2 (40-67%)
Time to Failure (s)	338		

Figure 1: Sample As Received

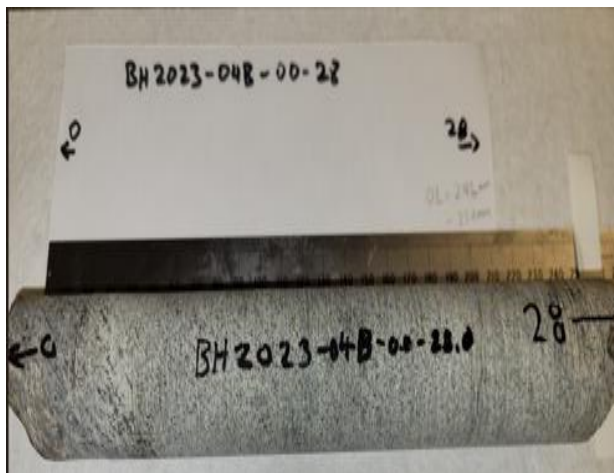
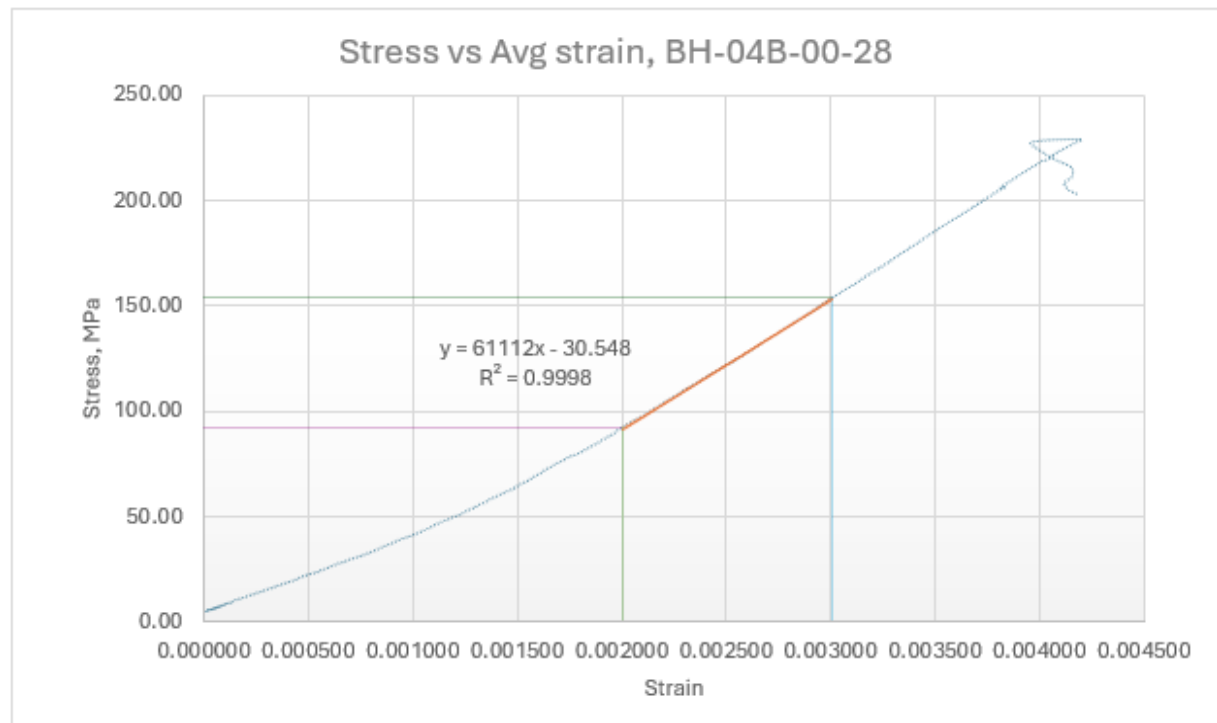
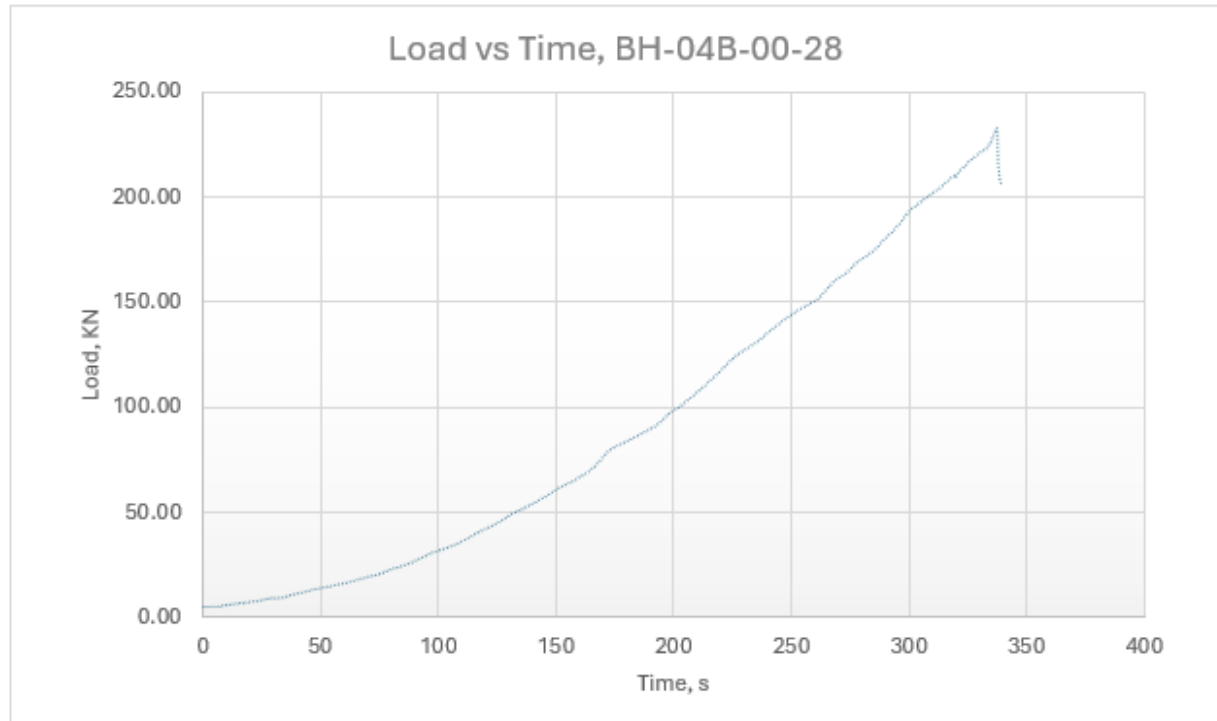


Figure 2: Sample ready for Testing. The rock core sample is prepared with strain gauges and wires, with a ruler for scale showing the length is approximately 85 mm.



Test Performed by: Kunjan Rupakheti (KR)

Project Manger: Abid Sahi P.Geo., P.Eng



Split Tensile Test ASTM D3967

SPECIMEN DATA

Specimen ID	BH2023-04B-346-367	Material type	Rock (Limestone)
Specimen age [dd]		Preparation date	2024-12-17
Thickness (avg) (mm)	21.486	Diameter (avg) (mm)	36.13
Density		Area [mm²]	2439.84
Surface preparation	Cut	Test Location/Depth	04B-346-367
Preload [kN]	3	Specimen type	Core
Fiber type		Project #	24-1211-02
Sampling date	2023	Sampling details	Cored and Cut
Testing Machine	Controls Compression Machine CE001	Test date	2024-12-17

FAILURE DISCRIPTION

Certificate number	T1	Certificate date	2024-12-17
Client	ARCADIS	Reference	ASTM D3967

TEST RESULT

Fp [kN]	7.05	Tensile Strength (MPa)	5.78
Load Rate (N/s)	25	Reference	
Time to Failure (s)	160		

Figure 1 Specimen Failure



Test Performed by: Kunjan Rupakheti (KR)

Project Manger: Abid Sahi P.Geo., P.Eng

UCS Test (Rock) with MOE ASTM D7012

SPECIMEN DATA

Specimen ID	BH2023-04B-346-367	Material type	Rock (Limestone)
Specimen age [dd]		Preparation date	2024-12-17
Length (avg) (mm)	85.045	Diameter (avg) (mm)	36.045
Density (g/cm³)	2.717	Area [mm²]	1020.42
Surface preparation	Grinded	Test Location/Depth	04B-346-367
Preload [kN]	5	Specimen type	Core
Fiber type		Project #	24-1211-02
Sampling date	2023	Sampling details	Cored
Testing Machine	Controls Compression Machine CE001	Test date	2024-12-17

FAILURE DISCRIPTION

Certificate number	T1	Certificate date	2024-12-17
Client	ARCADIS	Reference	ASTM D7012

TEST RESULT

Fp [kN]	257.19	MOE (GPa)	73.01
UCS (Mpa)	252.04	Reference	10.3.5.2 (40-65%)
Time to Failure (s)	307		

Figure 1: Sample As Received

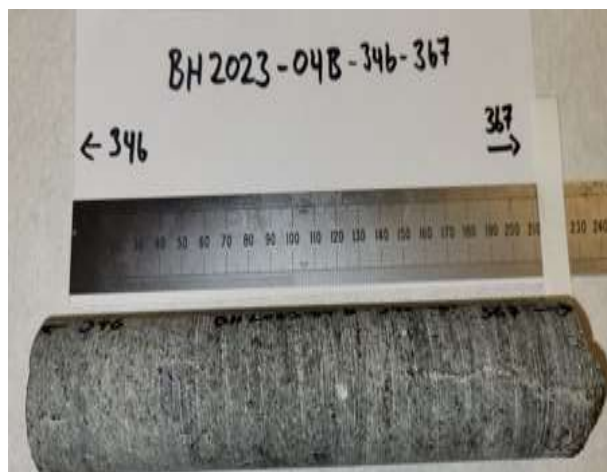
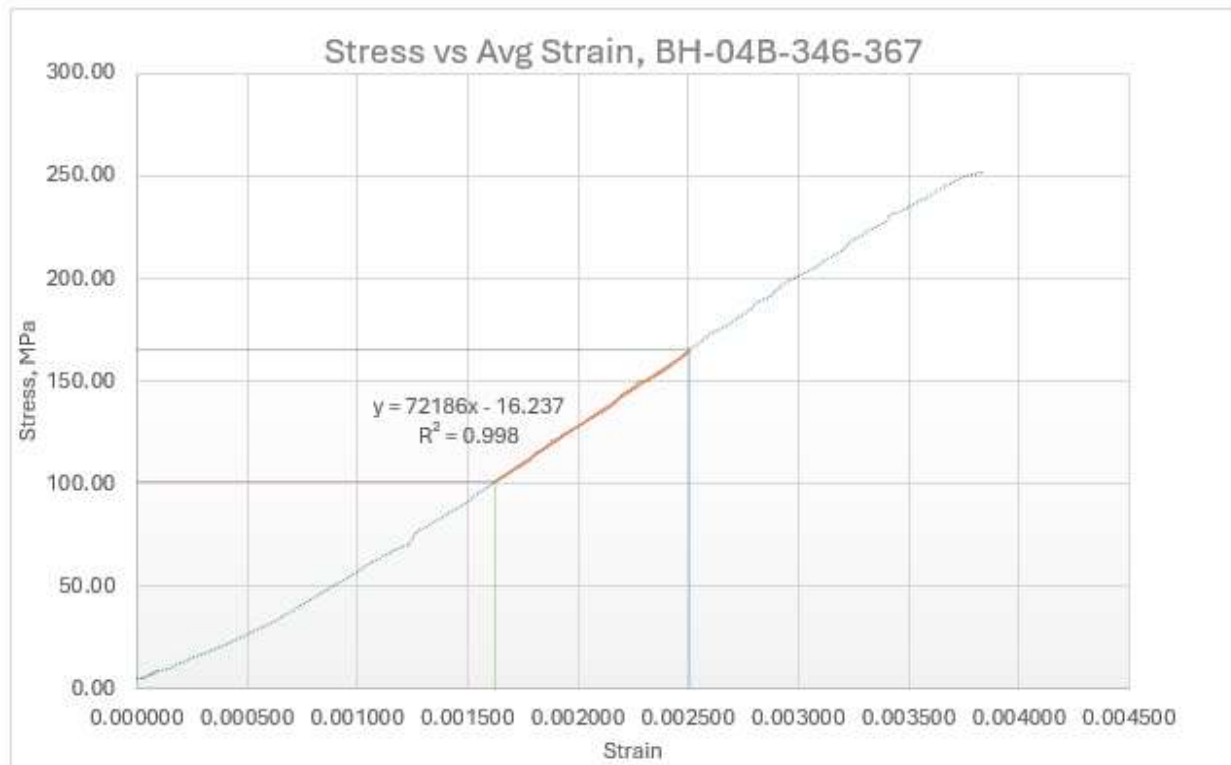
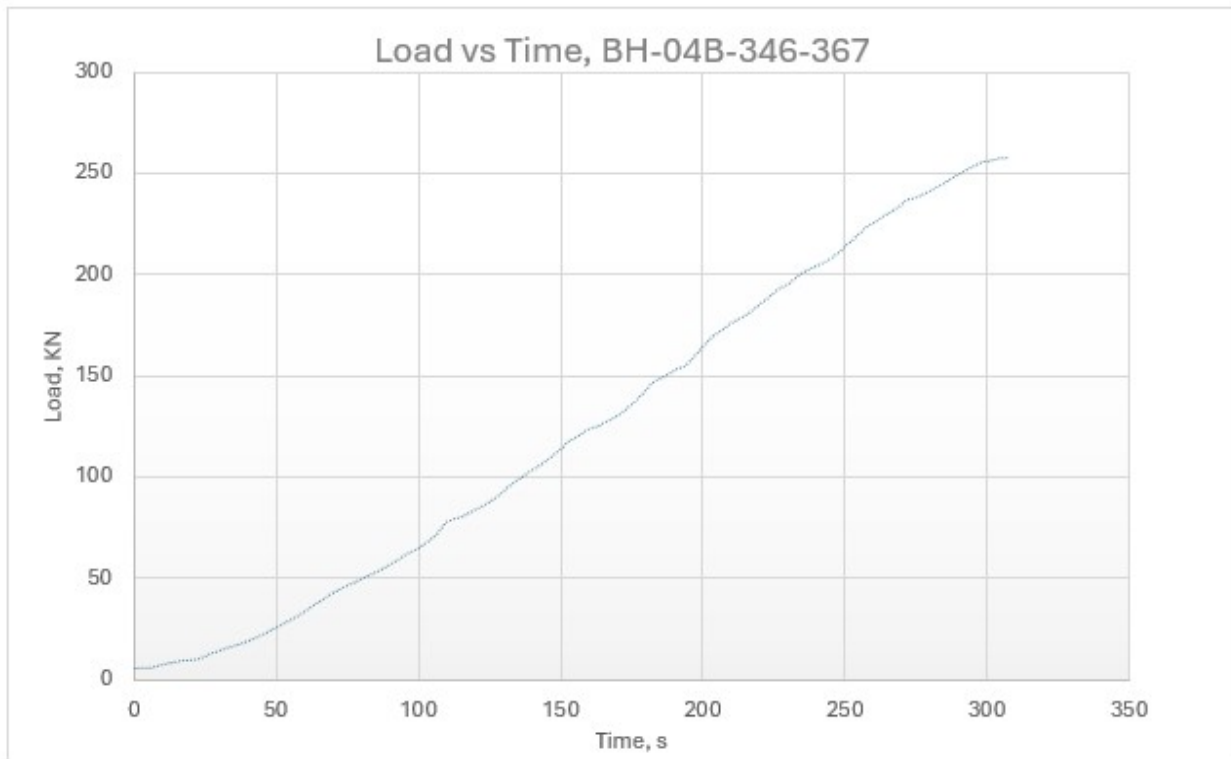


Figure 2: Sample ready for Testing



Test Performed by: Kunjan Rupakheti (KR)

Project Manger: Abid Sahi P.Geo., P.Eng



Split Tensile Test ASTM D3967

SPECIMEN DATA

Specimen ID	BH2023-5B-162-179	Material type	Rock
Specimen age [dd]		Preparation date	2025-02-05
Thickness (avg) (mm)	18.845	Diameter (avg) (mm)	36.11
Density	2.729	Area [mm²]	2137.8
Surface preparation	Cut	Test Location/Depth	5B-162-179
Preload [kN]	3	Specimen type	Core
Fiber type		Project #	
Sampling date	2023	Sampling details	Cored and Cut
Testing Machine	Controls Compression Machine CE001	Test date	2025-02-06

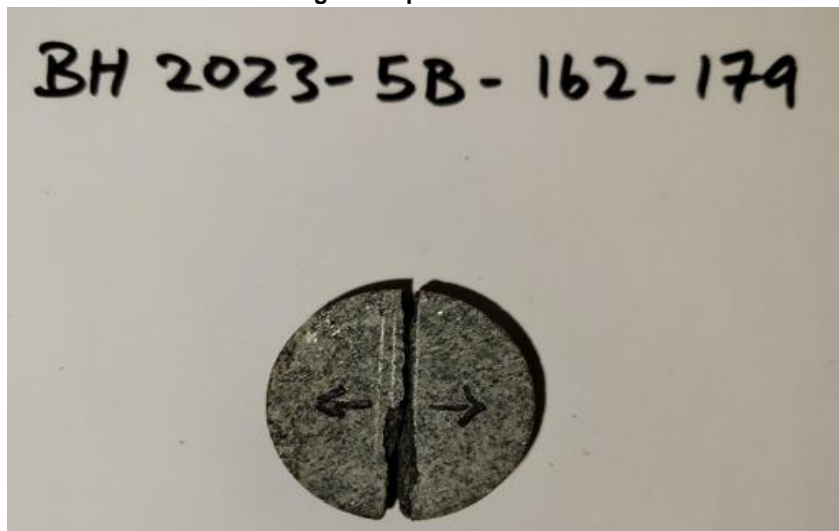
FAILURE DESCRIPTION

Certificate number	T10	Certificate date	2025-02-06
Client		Reference	ASTM D3967

TEST RESULT

Fp [kN]	7.2	Tensile Strength (MPa)	6.736
Load Rate (N/s)	25	Reference	
Time to Failure (s)	274		

Figure 1 Specimen Failure



Test Performed by: Kunjan Rupakheti (KR)

Project Manger: Abid Sahi P.Geo., P.Eng



UCS Test (Rock) with MOE ASTM D7012

SPECIMEN DATA

Specimen ID	BH2023-5B-162-179	Material type	Rock
Specimen age [dd]		Preparation date	2025-02-06
Length (avg) (mm)	73.47	Diameter (avg) (mm)	36.09
Density (g/cm³)	2.748	Area [mm²]	1022.972
Surface preparation	Grinded	Test Location/Depth	5B -162-179
Preload [kN]	3	Specimen type	Core
Fiber type		Project #	
Sampling date	2023	Sampling details	Cored
Testing Machine	Controls Compression Machine CE001	Test date	2025-02-07

FAILURE DISCRPTION

Certificate number	T5	Certificate date	2025-02-07
Client		Reference	ASTM D7012

TEST RESULT

Fp [kN]	243.56	MOE (GPa)	58.81
UCS (Mpa)	238.086	Reference	10.3.5.2 (30-67%)
Time to Failure (s)	376		

Figure 1: Sample As Received

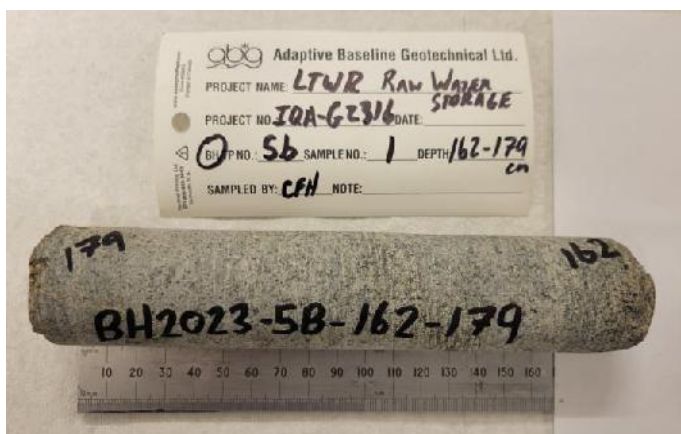


Figure 2: Sample ready for Testing

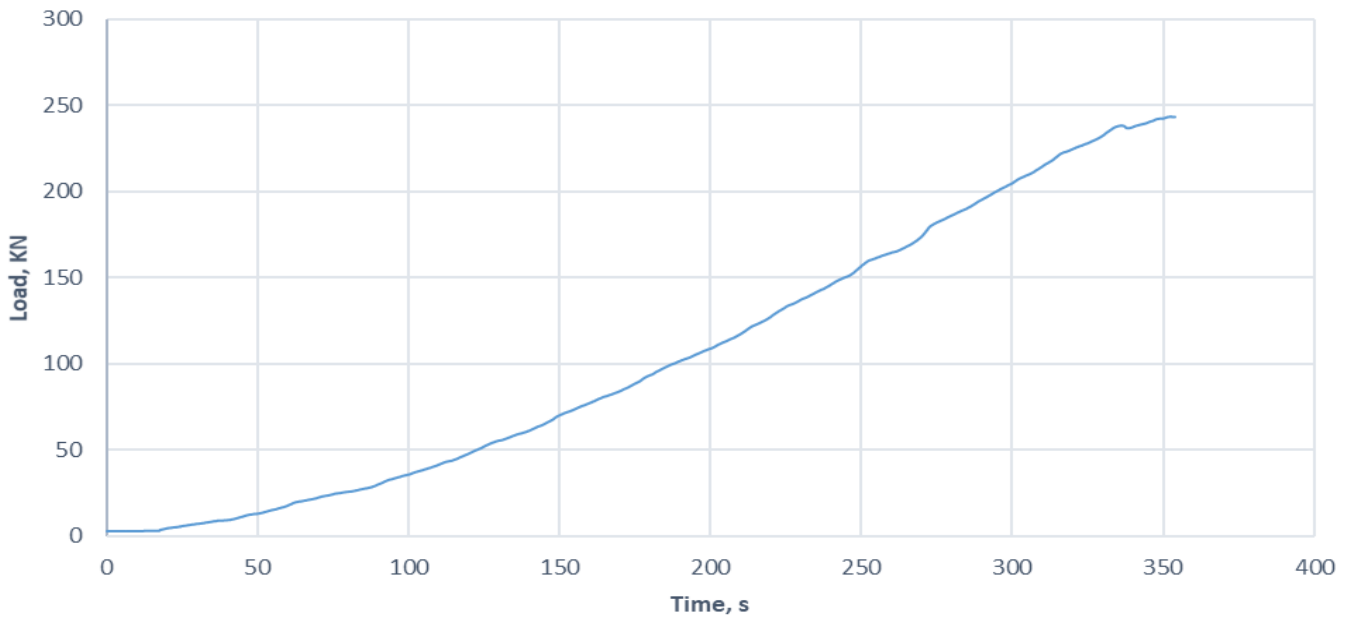


Test Performed by: Kunjan Rupakheti (KR)

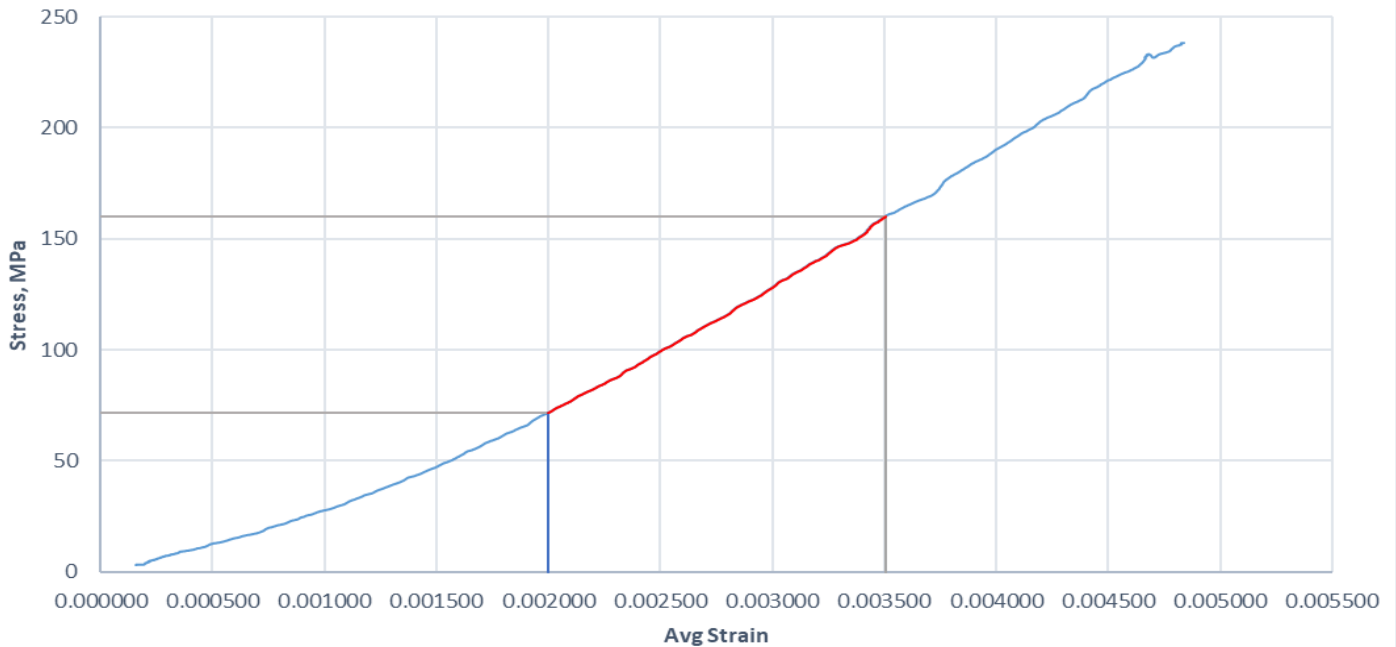
Project Manger: Abid Sahi P.Geo., P.Eng



Load vs time, BH2023-5B-162-179



Stress vs Strain, BH2023-5B-162-179



Split Tensile Test ASTM D3967

SPECIMEN DATA

Specimen ID	BH2023-7B-318-335	Material type	Rock
Specimen age [dd]		Preparation date	2025-02-05
Thickness (avg) (mm)	11.935	Diameter (avg) (mm)	24.04
Density	2.69	Area [mm²]	901.3776
Surface preparation	Cut	Test Location/Depth	7B-318-335
Preload [kN]	3	Specimen type	Core
Fiber type		Project #	
Sampling date	2023	Sampling details	Cored and Cut
Testing Machine	Controls Compression Machine CE001	Test date	2025-02-06

FAILURE DESCRIPTION

Certificate number	T12	Certificate date	2025-02-06
Client		Reference	ASTM D3967
Notes	Specimen Failed during seating. Sample too small for reliable result		

TEST RESULT

F_p [kN]	2.4 (max recorded)	Tensile Strength (MPa)	Unreliable
Load Rate (N/s)	25	Reference	
Time to Failure (s)	Instant (Failure during seating load)		Time to failure outside of Specification

Figure 1 Specimen Failure



Test Performed by: Kunjan Rupakheti (KR)

Project Manger: Abid Sahi P.Geo., P.Eng

UCS Test (Rock) with MOE ASTM D7012

SPECIMEN DATA

Specimen ID	BH2023-7B-318-335	Material type	Rock
Specimen age [dd]		Preparation date	2025-02-05
Length (avg) (mm)	60.38	Diameter (avg) (mm)	23.625
Density (g/cm³)	2.67	Area [mm²]	438.37
Surface preparation	Grinded	Test Location/Depth	7B-318-335
Preload [kN]	3	Specimen type	Core
Fiber type		Project #	
Sampling date	2023	Sampling details	Cored
Testing Machine	Controls Compression Machine CE001	Test date	2025-02-06

FAILURE DISCRIPTION

Certificate number	T8	Certificate date	2025-02-06
Client		Reference	ASTM D7012
Notes	Sudden Failure, Parallel to loading direction, suspected plane of weakness		

TEST RESULT

Fp [kN]	50.62	MOE (GPa)	NA
UCS (Mpa)	115.48	Reference	
Time to Failure (s)	192		

Figure 1: Sample As Received

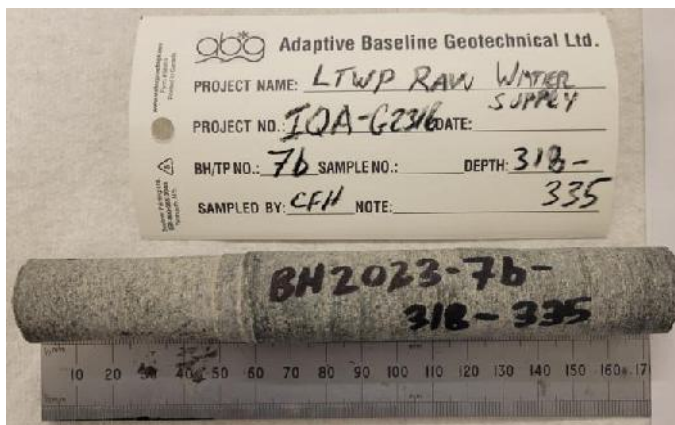
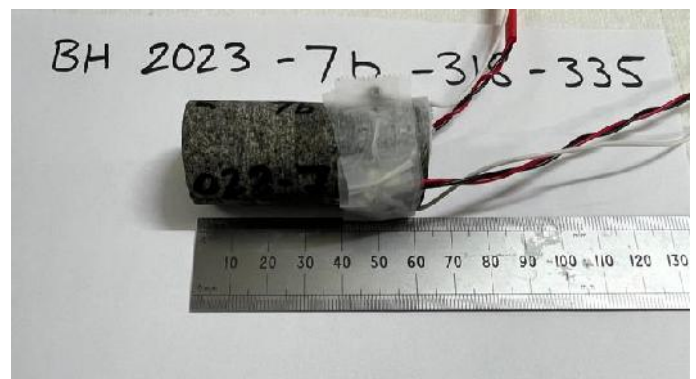


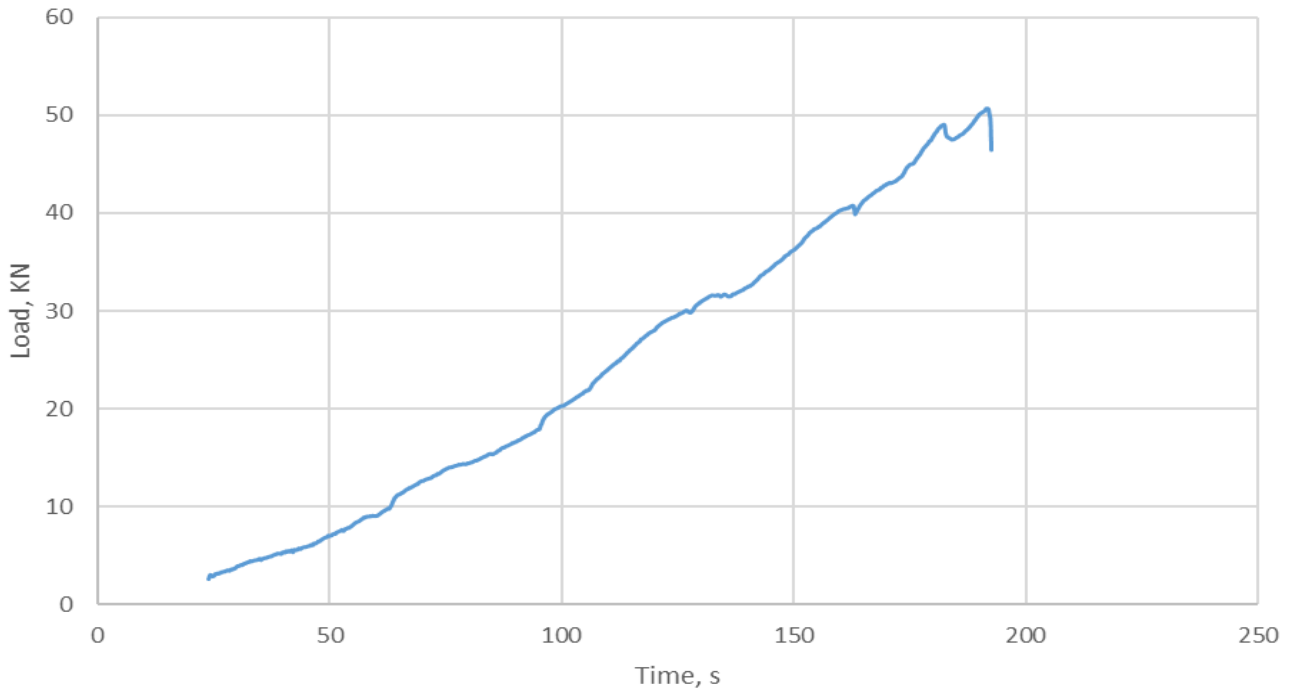
Figure 2: Sample ready for Testing



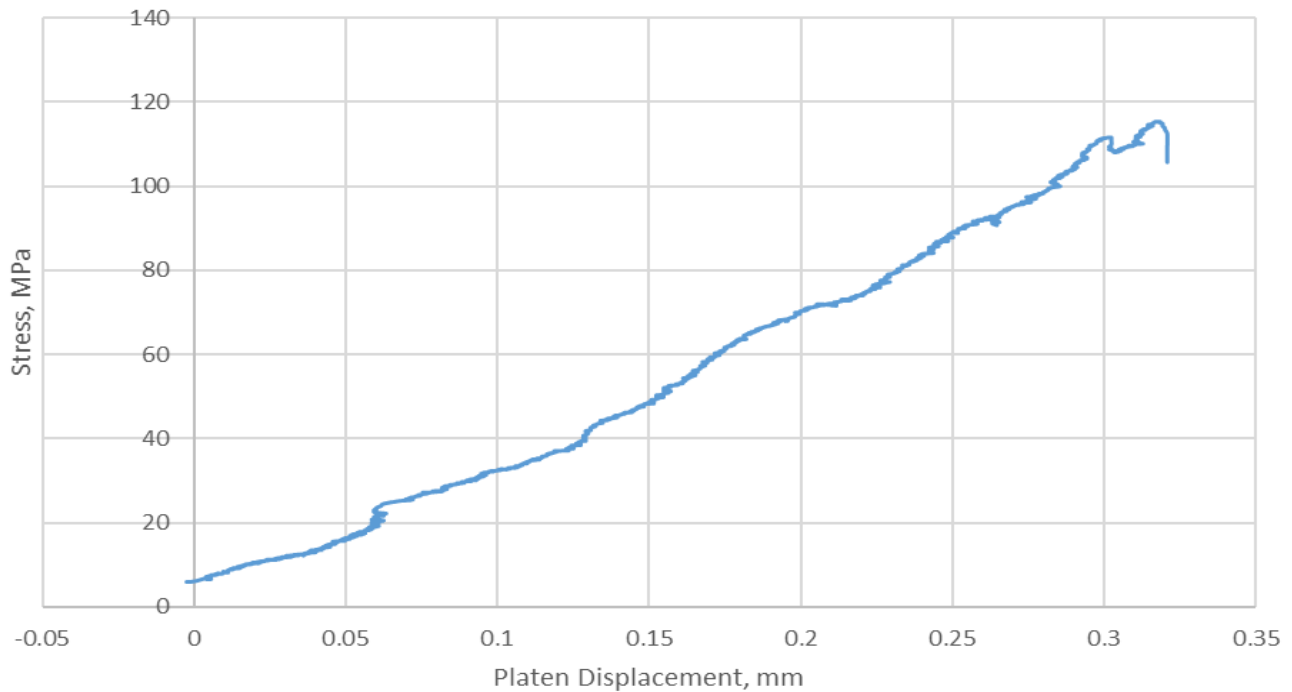
Test Performed by: Kunjan Rupakheti (KR)

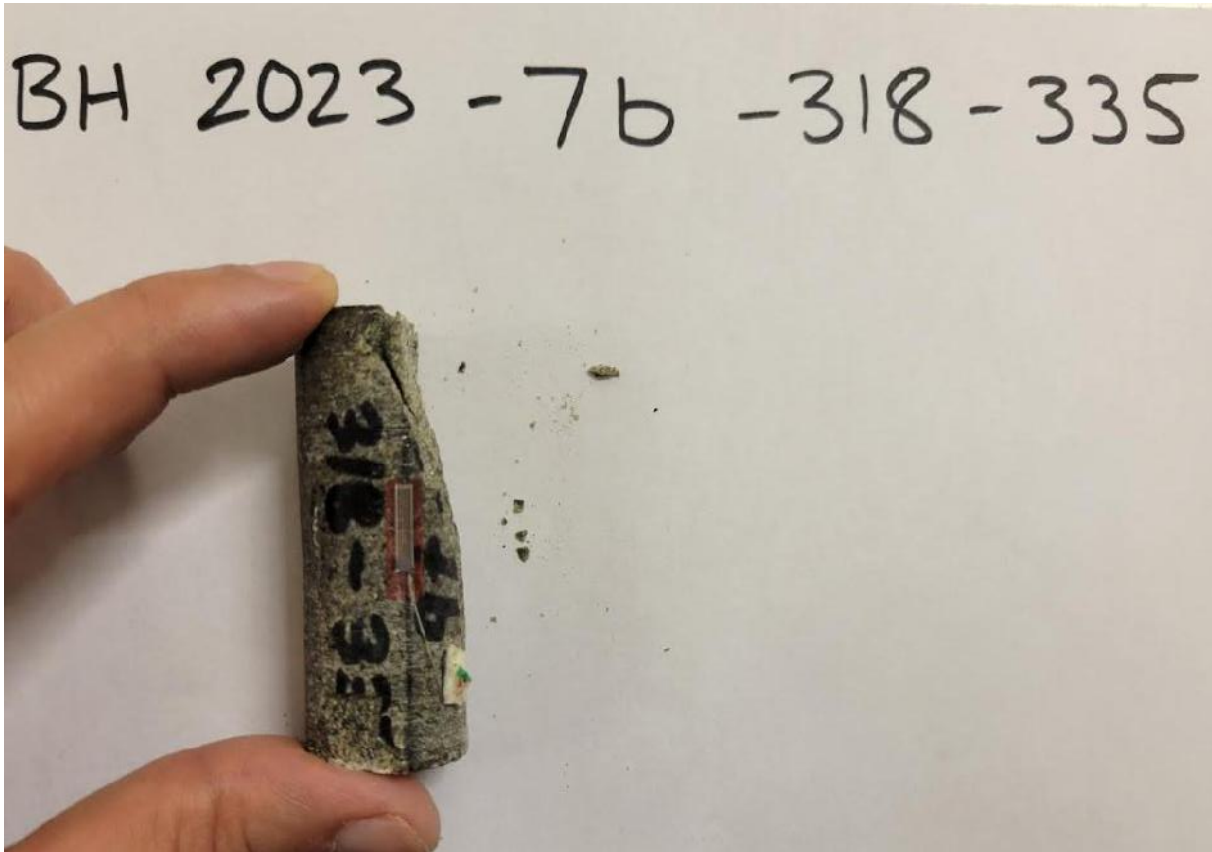
Project Manger: Abid Sahi P.Geo., P.Eng

UCS - Load vs Time - BH-2023-7B-318-335



UCS - Stress vs Displacement - BH-2023-7B-318-335





Split Tensile Test ASTM D3967

SPECIMEN DATA

Specimen ID	13B-258-280	Material type	Rock
Specimen age [dd]		Preparation date	08/13/2025
Thickness (avg) (mm)	23.043	Diameter (avg) (mm)	33.58
Density (g/cm³)	2.715	Area [mm²]	2430.86
Surface preparation	Cut	Test Location/Depth	258-280
Preload [kN]	2	Specimen type	Core
Fiber type		Project #	24-1211-02
Sampling date	2025	Sampling details	Cored and Cut
Testing Machine	Compression Machine CE002	Test date	08/14/2025

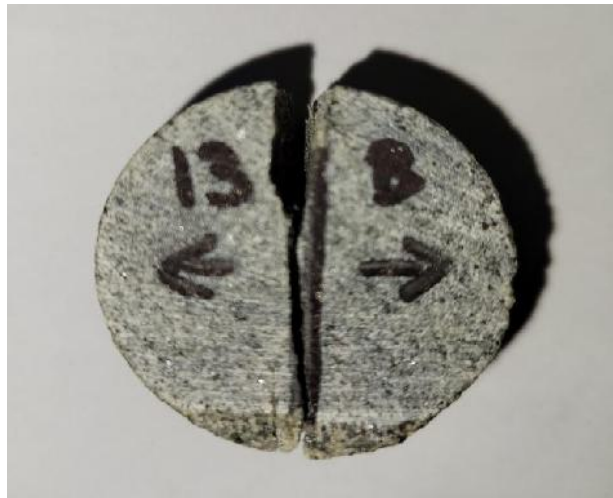
FAILURE DESCRIPTION

Certificate number	T24	Certificate date	08/15/2025
Client		Reference	ASTM D3967
Comment	Typical (see picture)		

TEST RESULT

Fp [kN]	13.412	Tensile Strength (MPa)	11.035
Load Rate avg (mm/min)	0.1	Reference	9.1
Time to Failure (s)	198		

Figure 1 Specimen Failure



Test Performed by: RR **Project Manger:** AS

UCS Test (Rock) with MOE ASTM D7012

SPECIMEN DATA

Specimen ID	13B-258-280	Material type	Rock
Specimen age [dd]		Preparation date	08/13/2025
Length (avg) (mm)	74.065	Diameter (avg) (mm)	33.905
Density (g/cm³)	2.705	Area [mm²]	902.8537
Surface preparation	Grinded	Test Location/Depth	258-280
Preload [kN]	5	Specimen type	Core
Fiber type		Project #	24-1211-02
Sampling date	2023	Sampling details	Cored
Testing Machine	Compression Machine CE002	Test date	08/14/2025

FAILURE DISCRPTION

Certificate number	T21	Certificate date	08/15/2025
Client	Arcadis	Reference	ASTM D7012

TEST RESULT

Fp [kN]	173.2	MOE (GPa)	66.8
UCS (Mpa)	191.82	Reference	10.3.5.2
Time to Failure (s)	358		

Figure 1: Sample As Received

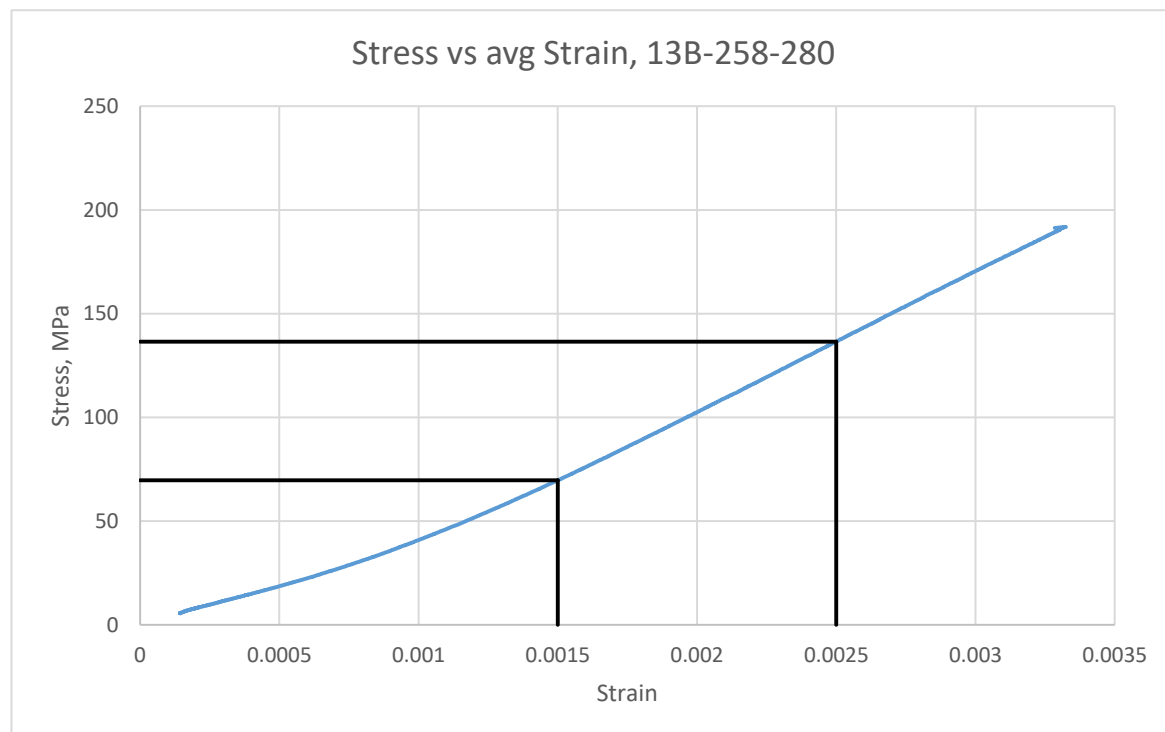
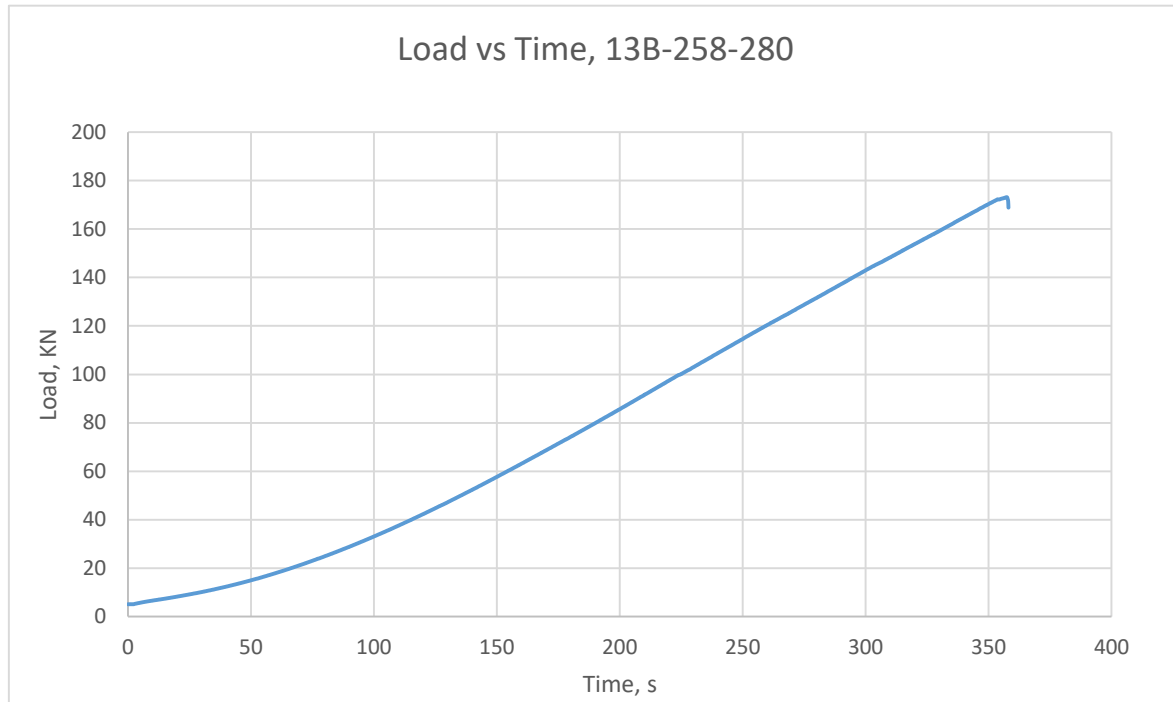


Figure 2: Sample ready for Testing



Test Performed by: RR **Project Manger:** AS





Split Tensile Test ASTM D3967

SPECIMEN DATA

Specimen ID	15B-45-63	Material type	Rock
Specimen age [dd]		Preparation date	08/13/2025
Thickness (avg) (mm)	22.168	Diameter (avg) (mm)	33.878
Density (g/cm³)	2.743	Area [mm²]	2359.27
Surface preparation	Cut	Test Location/Depth	45-63
Preload [kN]	2	Specimen type	Core
Fiber type		Project #	24-1211-02
Sampling date	2025	Sampling details	Cored and Cut
Testing Machine	Compression Machine CE002	Test date	08/14/2025

FAILURE DESCRIPTION

Certificate number	T25	Certificate date	08/15/2025
Client	Arcadis	Reference	ASTM D3967
Comment	Typical (see picture)		

TEST RESULT

F_p [kN]	5.52	Tensile Strength (MPa)	4.679
Load Rate avg (mm/min)	0.1	Reference	9.1
Time to Failure (s)	303		

Figure 1 Specimen Failure



Test Performed by: RR Project Manger: AS

UCS Test (Rock) with MOE ASTM D7012

SPECIMEN DATA

Specimen ID	15B-45-63	Material type	Rock
Specimen age [dd]		Preparation date	08/13/2025
Length (avg) (mm)	69.143	Diameter (avg) (mm)	33.713
Density (g/cm³)	2.754	Area [mm²]	892.67
Surface preparation	Grinded	Test Location/Depth	45-63
Preload [kN]	5.8	Specimen type	Core
Fiber type		Project #	24-1211-02
Sampling date	2023	Sampling details	Cored
Testing Machine	Compression Machine CE002	Test date	08/14/2025

FAILURE DISCRIPTION

Certificate number	T22	Certificate date	08/15/2025
Client	Arcadis	Reference	ASTM D7012

TEST RESULT

Fp [kN]	145.5	MOE (GPa)	59.95
UCS (Mpa)	162.95	Reference	10.3.5.2
Time to Failure (s)	320		

Figure 1: Sample As Received

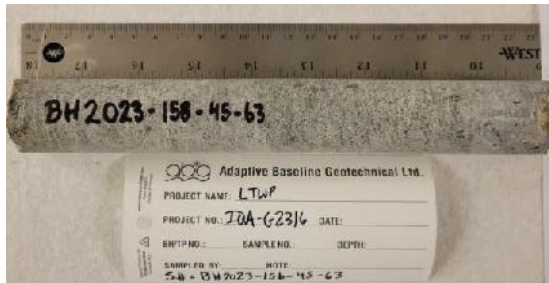
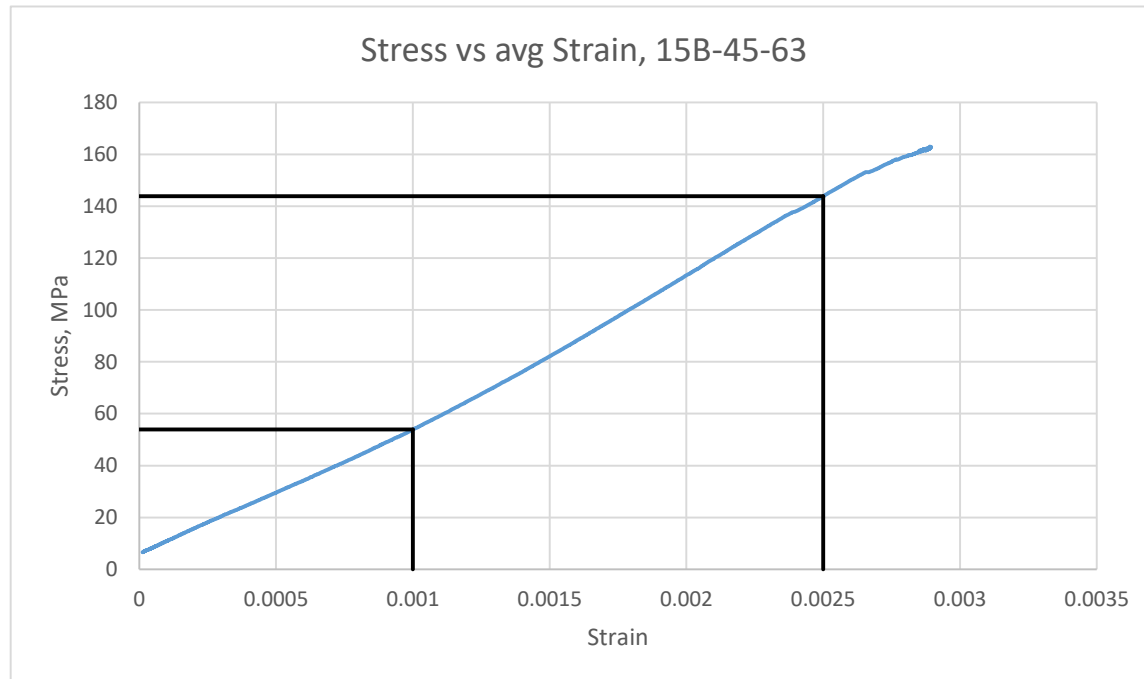
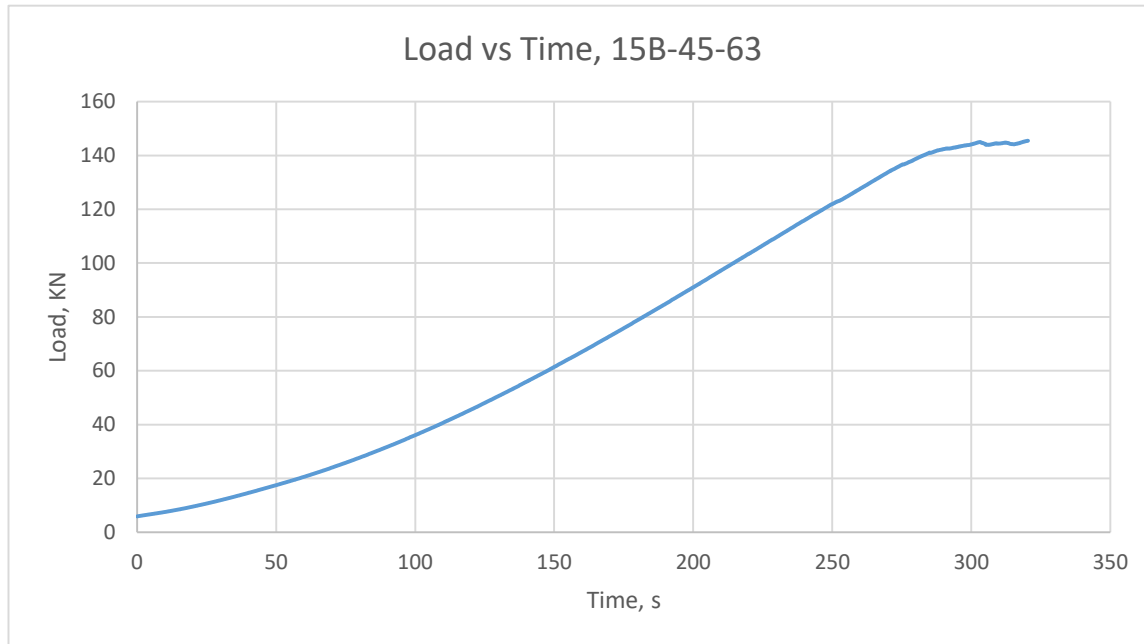


Figure 2: Sample ready for Testing



Test Performed by: RR **Project Manger:** AS





Split Tensile Test ASTM D3967

SPECIMEN DATA

Specimen ID	BH2023-17B-289-310	Material type	Rock
Specimen age [dd]		Preparation date	2025-02-05
Thickness (avg) (mm)	12.8975	Diameter (avg) (mm)	33.6875
Density	2.646	Area [mm²]	1364.973
Surface preparation	Cut	Test Location/Depth	17B-289-310
Preload [kN]	3	Specimen type	Core
Fiber type		Project #	
Sampling date	2023	Sampling details	Cored and Cut
Testing Machine	Controls Compression Machine CE001	Test date	2025-02-06

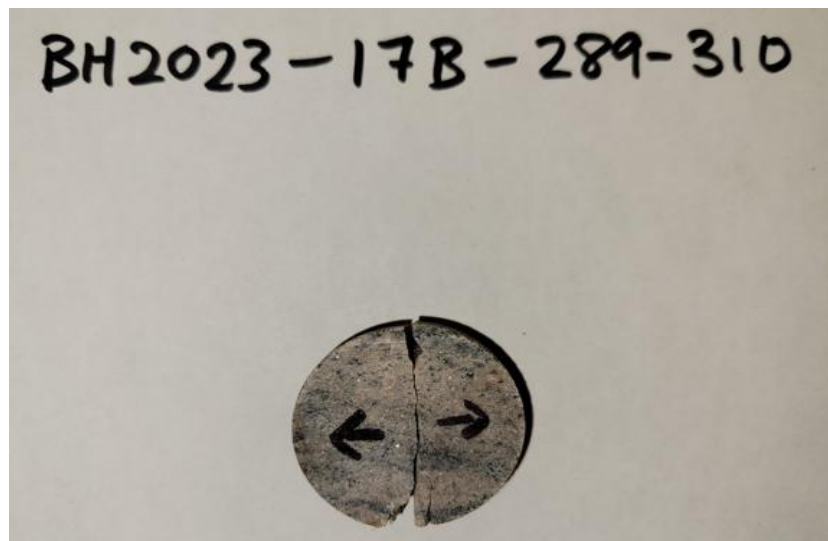
FAILURE DESCRIPTION

Certificate number	T9	Certificate date	2025-02-06
Client		Reference	ASTM D3967

TEST RESULT

Fp [kN]	9.1	Tensile Strength (MPa)	13.3
Load Rate (N/s)	25	Reference	
Time to Failure (s)	373		

Figure 1 Specimen Failure



Test Performed by: Kunjan Rupakheti (KR)

Project Manger: Abid Sahi P.Geo., P.Eng

UCS Test (Rock) with MOE ASTM D7012

SPECIMEN DATA

Specimen ID	BH2023-17B-289-310	Material type	Rock
Specimen age [dd]		Preparation date	2025-02-05
Length (avg) (mm)	75.53	Diameter (avg) (mm)	33.733
Density (g/cm³)	2.697	Area [mm²]	893.734
Surface preparation	Grinded	Test Location/Depth	17B-289-310
Preload [kN]	3	Specimen type	Core
Fiber type		Project #	
Sampling date	2023	Sampling details	Cored
Testing Machine	Controls Compression Machine CE001	Test date	2025-02-06

FAILURE DISCIPTION

Certificate number	T6	Certificate date	2025-02-06
Client		Reference	ASTM D7012

TEST RESULT

Fp [kN]	196.3	MOE (GPa)	61.5
UCS (Mpa)	219.64	Reference	10.3.5.2 (29-71%)
Time to Failure (s)	219		

Figure 1: Sample As Received

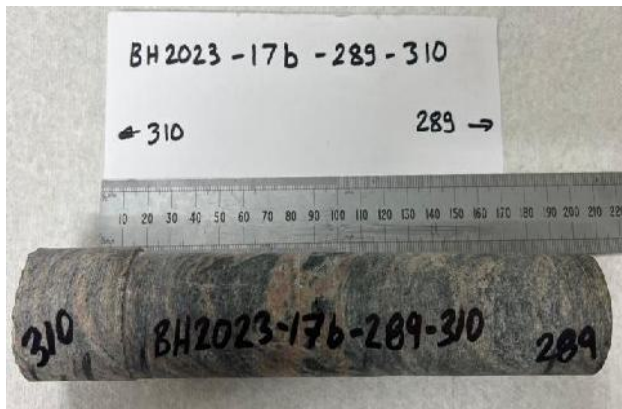


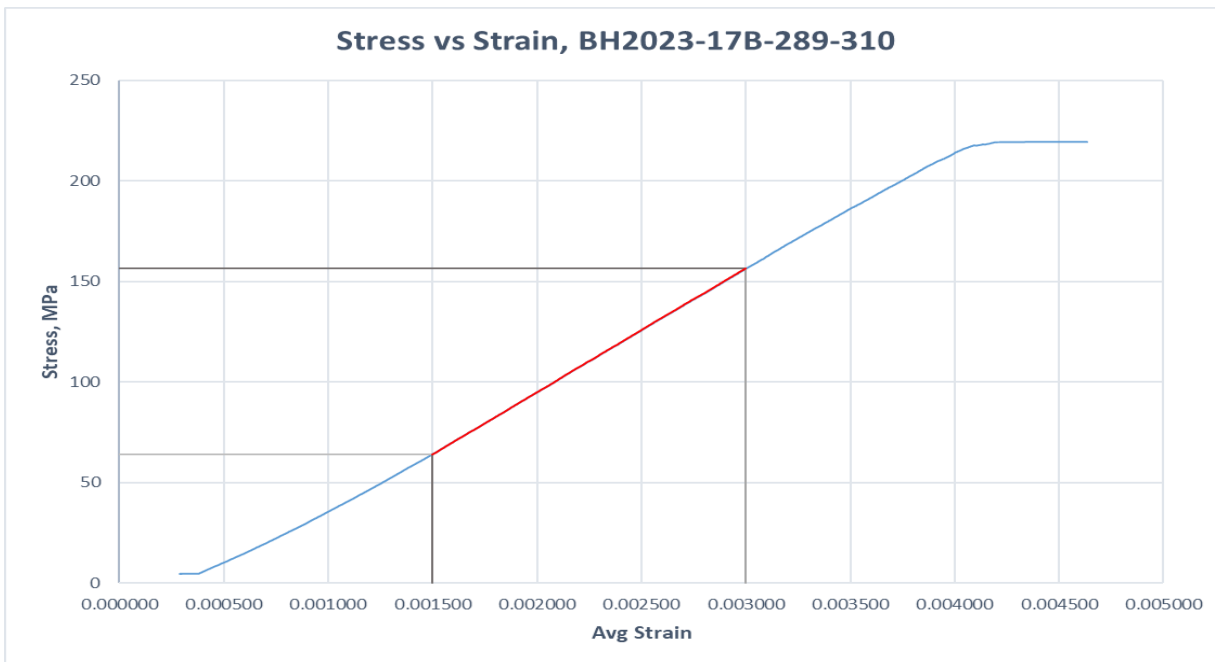
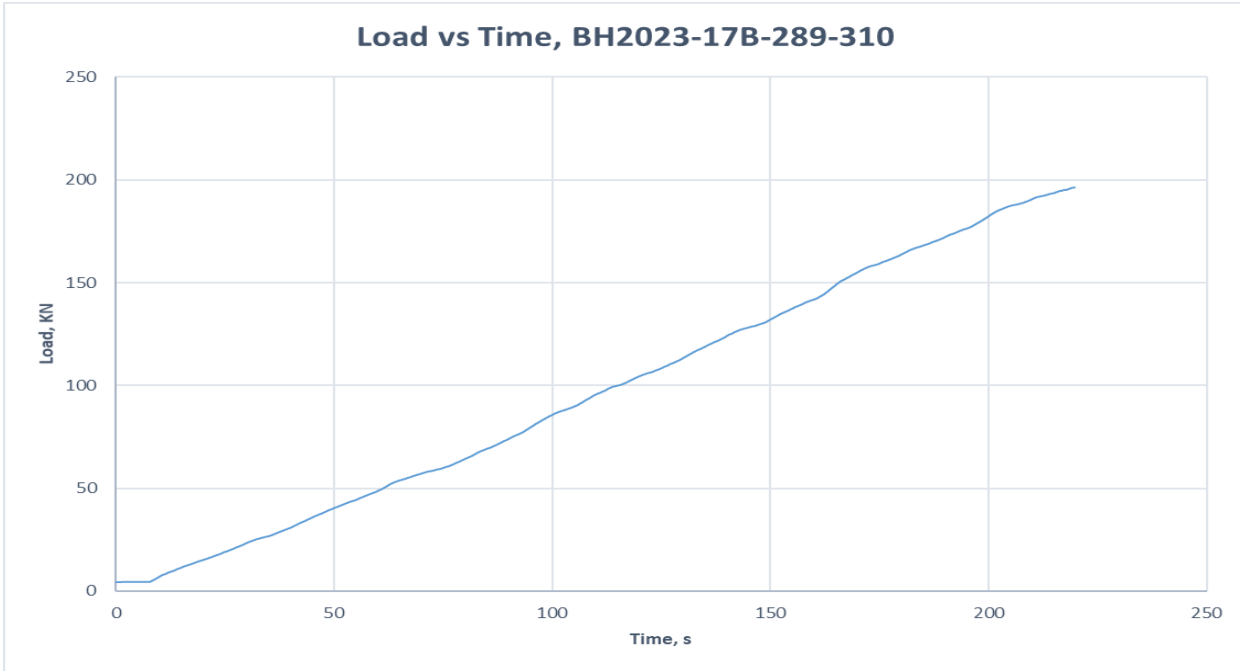
Figure 2: Sample ready for Testing



Test Performed by: Kunjan Rupakheti (KR)

Project Manger: Abid Sahi P.Geo., P.Eng





Split Tensile Test ASTM D3967

SPECIMEN DATA

Specimen ID	BH2023-19B-92-115	Material type	Rock
Specimen age [dd]		Preparation date	2025-02-05
Thickness (avg) (mm)	26.485	Diameter (avg) (mm)	33.49
Density	2.72	Area [mm²]	2786.538
Surface preparation	Cut	Test Location/Depth	19B-92-115
Preload [kN]	3	Specimen type	Core
Fiber type		Project #	
Sampling date	2023	Sampling details	Cored and Cut
Testing Machine	Controls Compression Machine CE001	Test date	2025-02-06

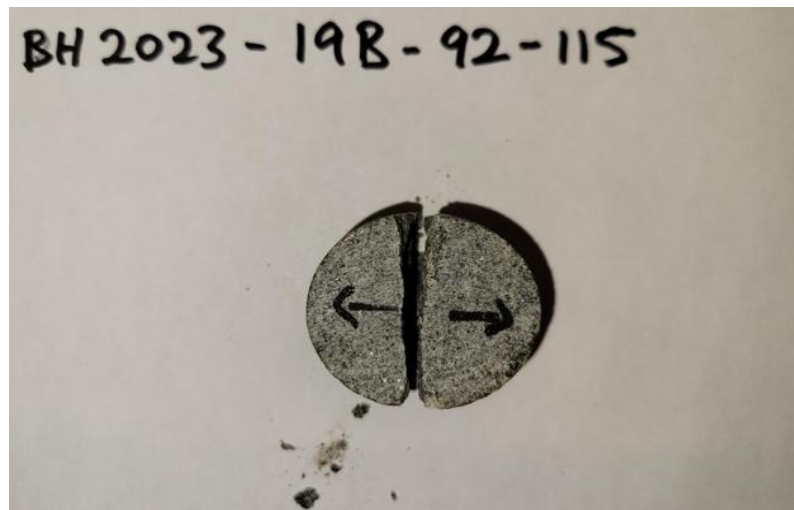
FAILURE DESCRIPTION

Certificate number	T11	Certificate date	2025-02-06
Client		Reference	ASTM D3967

TEST RESULT

Fp [kN]	11	Tensile Strength (MPa)	7.895
Load Rate (N/s)	25	Reference	
Time to Failure (s)	403		

Figure 1 Specimen Failure



Test Performed by: Kunjan Rupakheti (KR)

Project Manger: Abid Sahi P.Geo., P.Eng

UCS Test (Rock) with MOE ASTM D7012

SPECIMEN DATA

Specimen ID	2023-19B-92-115	Material type	Rock
Specimen age [dd]		Preparation date	2025-02-05
Length (avg) (mm)	66.58	Diameter (avg) (mm)	33.505
Density (g/cm³)	2.73	Area [mm²]	881.68
Surface preparation	Grinded	Test Location/Depth	19B-92-115
Preload [kN]	3	Specimen type	Core
Fiber type		Project #	
Sampling date	2023	Sampling details	Cored
Testing Machine	Controls Compression Machine CE001	Test date	2025-02-06

FAILURE DISCRIPTION

Certificate number	T7	Certificate date	2025-02-06
Client		Reference	ASTM D7012

TEST RESULT

F_p [kN]	210.05	MOE (GPa)	63.705
UCS (Mpa)	238.24	Reference	10.3.5.2 (24-78%)
Time to Failure (s)	312		

Figure 1: Sample As Received

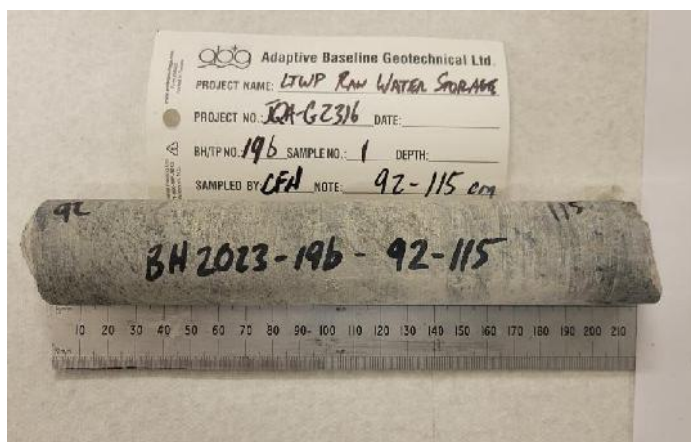


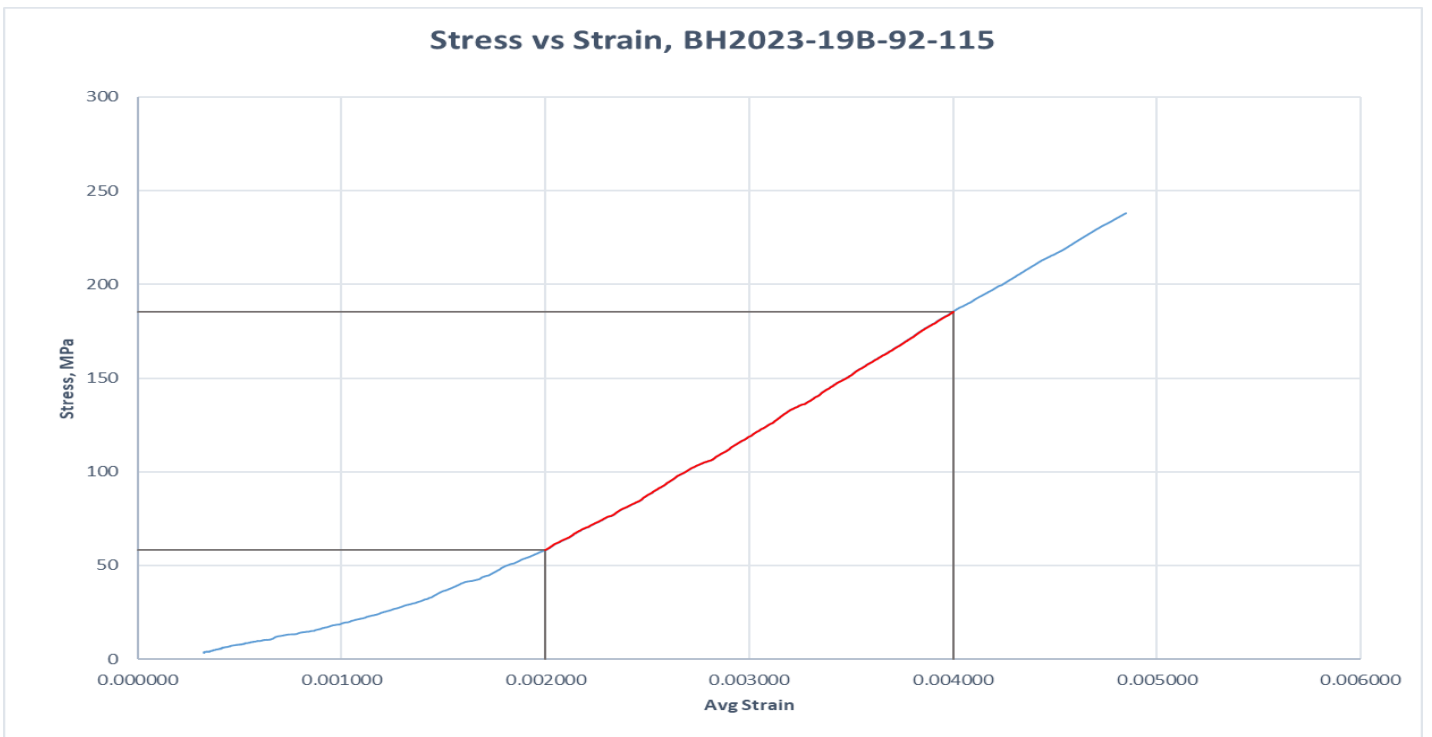
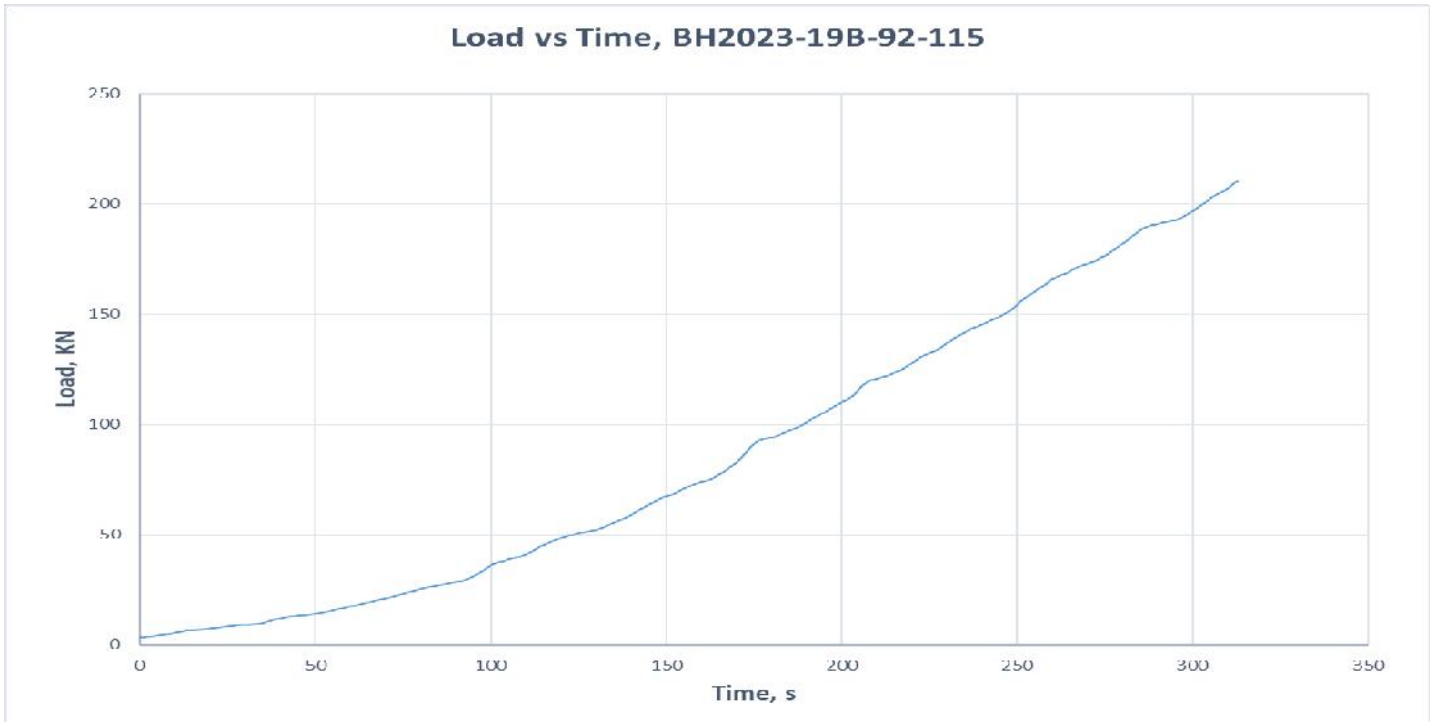
Figure 2: Sample ready for Testing



Test Performed by: Kunjan Rupakhetti (KR)

Project Manger: Abid Sahi P.Geo., P.Eng





Split Tensile Test ASTM D3967

SPECIMEN DATA

Specimen ID	27B-102-126	Material type	Rock
Specimen age [dd]		Preparation date	08/13/2025
Thickness (avg) (mm)	21.868	Diameter (avg) (mm)	33.483
Density (g/cm³)	2.672	Area [mm²]	2300.21
Surface preparation	Cut	Test Location/Depth	102-126
Preload [kN]	2	Specimen type	Core
Fiber type		Project #	24-1211-02
Sampling date	2025	Sampling details	Cored and Cut
Testing Machine	Compression Machine CE002	Test date	08/14/2025

FAILURE DESCRIPTION

Certificate number	T26	Certificate date	08/15/2025
Client	Arcadis	Reference	ASTM D3967
Comment	Typical (see picture)		

TEST RESULT

Fp [kN]	8.415	Tensile Strength (MPa)	7.317
Load Rate avg (mm/min)	0.1	Reference	9.1
Time to Failure (s)	150.1		

Figure 1 Specimen Failure



Test Performed by: RR **Project Manger:** AS



UCS Test (Rock) with MOE ASTM D7012

SPECIMEN DATA

Specimen ID	27B-102-126	Material type	Rock
Specimen age [dd]		Preparation date	08/13/2025
Length (avg) (mm)	68.825	Diameter (avg) (mm)	33.75
Density (g/cm³)	2.627	Area [mm²]	894.62
Surface preparation	Grinded	Test Location/Depth	102-126
Preload [kN]	4.25	Specimen type	Core
Fiber type		Project #	24-1211-02
Sampling date	2023	Sampling details	Cored
Testing Machine	Compression Machine CE002	Test date	08/14/2025

FAILURE DISCRPTION

Certificate number	T23	Certificate date	08/15/2025
Client	Arcadis	Reference	ASTM D7012

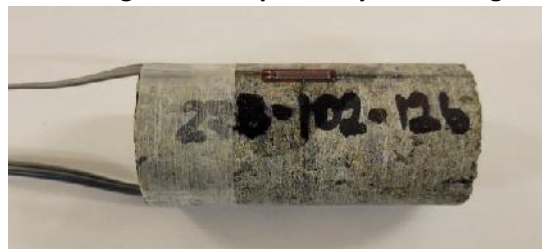
TEST RESULT

Fp [kN]	85.5	MOE (GPa)	51.5
UCS (Mpa)	95.57	Reference	10.3.5.2
Time to Failure (s)	266.8		

Figure 1: Sample As Received

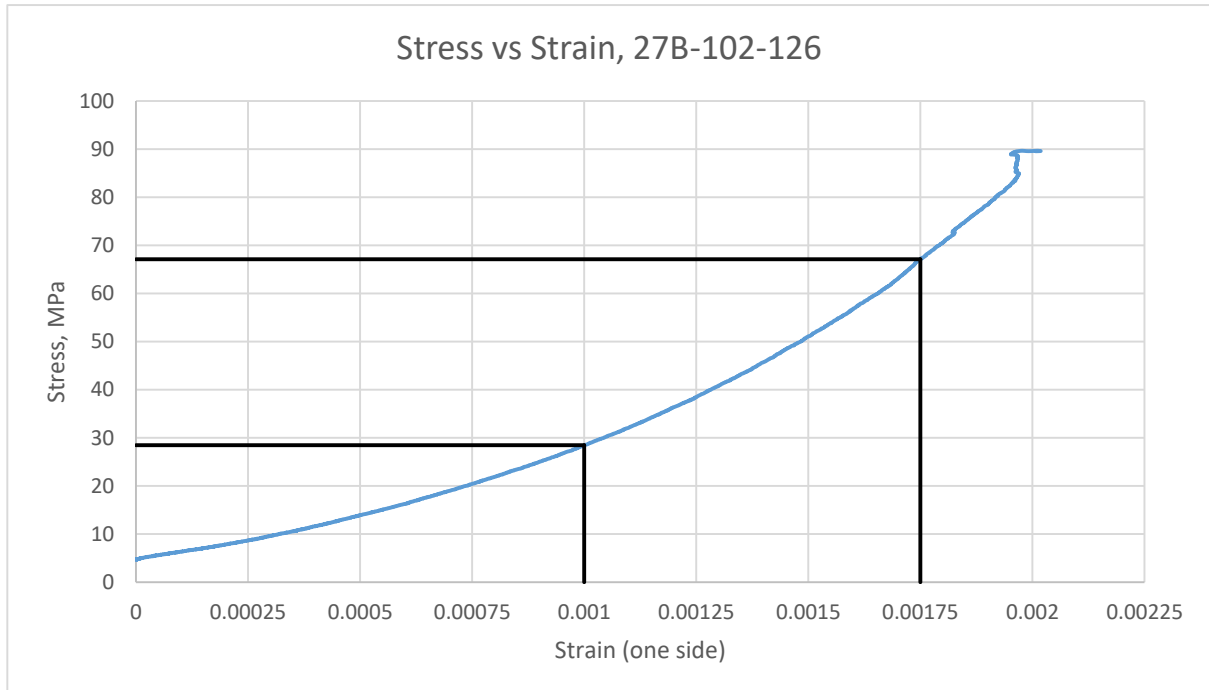
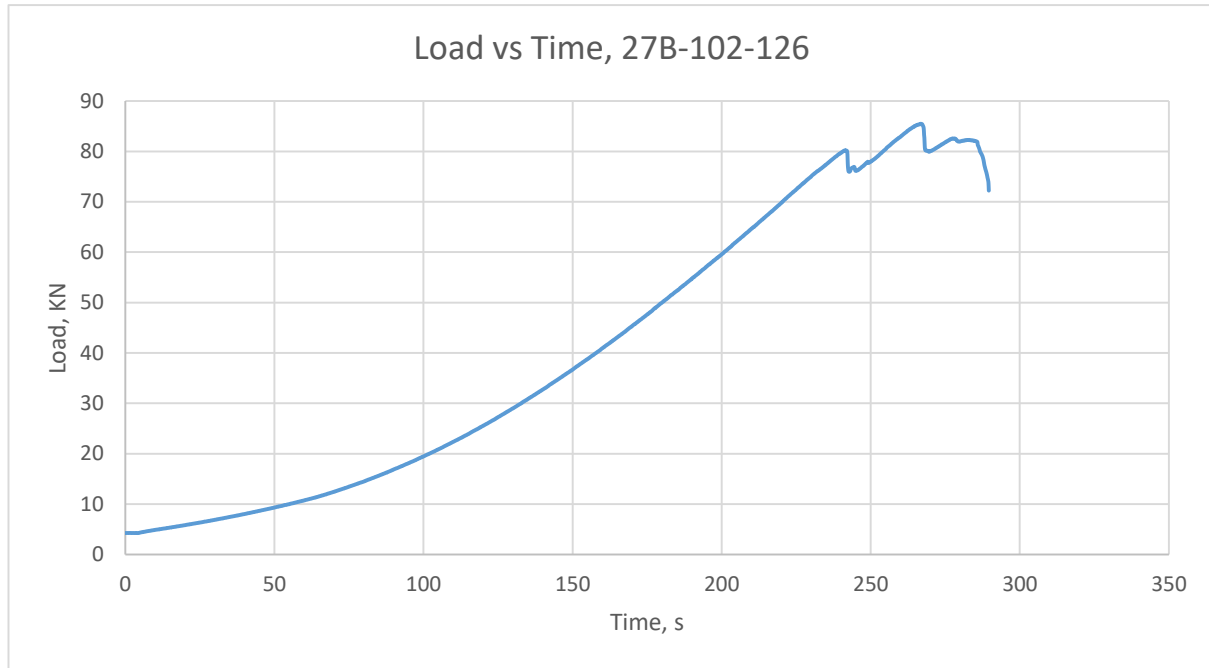


Figure 2: Sample ready for Testing



Test Performed by: RR

Project Manger: AS



Additional Notes



Stress-strain behavior: Clearly nonlinear — lower modulus than other samples

Sample ID: 27B-102-126

Test Type: Uniaxial Compressive Test

Modulus of Elasticity (E): Approx. 50 GPa (based on strain from right-side gauge)

Observations:

The rock core exhibited visible fissures and material heterogeneity prior to testing.

During the test, the left-side strain gauge produced anomalous data, initially showing positive strain, which then decreased and became negative.

This suggests possible localized movement or stress redistribution, likely associated with a pre-existing fissure on that side of the core.

The data from the right-side gauge was stable and consistent and was therefore used exclusively to calculate the modulus.



Appendix D

D – Hydraulic Conductivity Calculations

Well ID
Date of test

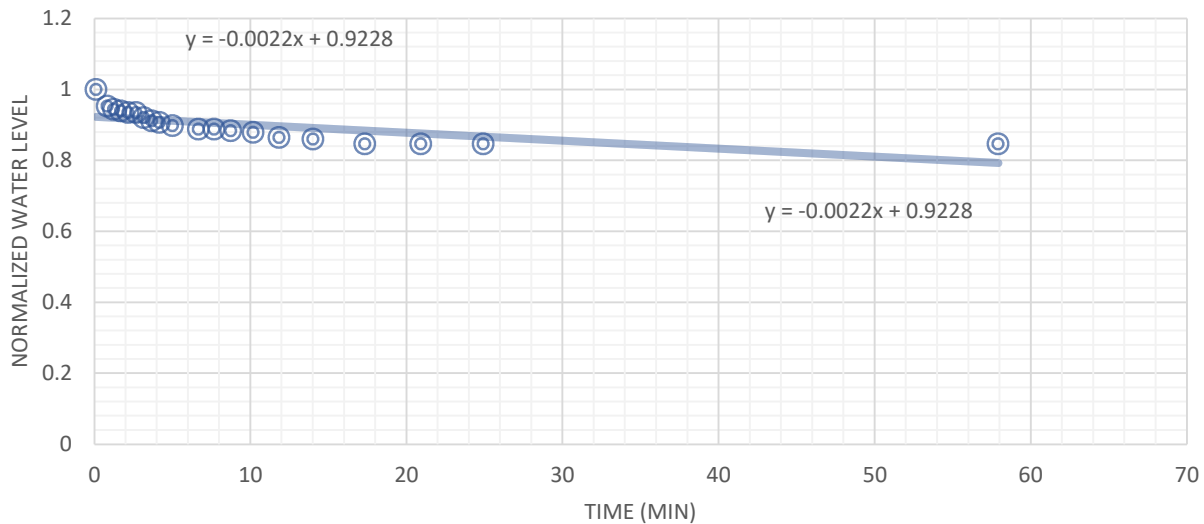
MW2023-2a
August 15, 2024



t37 (min)				
y	=	-0.0022 x	+	0.9228
0.37	=	-0.0022 x	+	0.9228
-0.5528	=	-0.0022 x		
251.27273	=	x		

Hvorslev's expression for hydraulic conductivity (K)

K	$rc^2 \ln(L_e/R) / 2Le t_{37}$				K= 3.06E-08
rc	2.54 cm	rc ²	6.4516	(m/s)	
le	280 cm	Ln(L _e /R)	4.00555		
R or r(w)	5.1 cm	rc ² *ln(le/r)	25.8422		
t37	15076.364 sec	2Le*t37	8442764		
le	280 cm				
r(w)	5.1 cm				
le/r(w)	55 >8	TRUE			



Well ID
Date of test

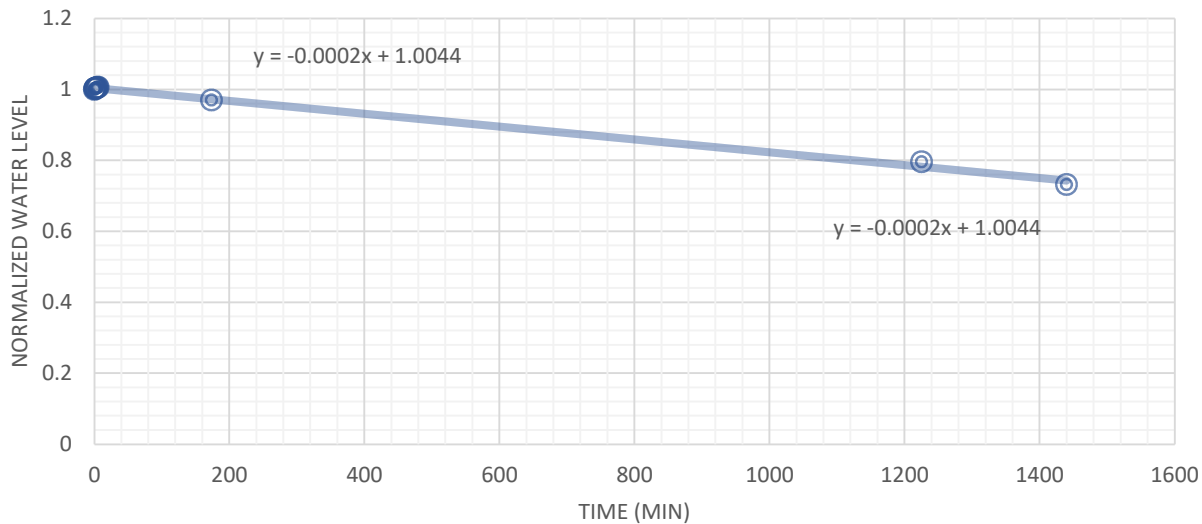
MW2023-2a
Oct. 4, 2024



t37 (min)				
y	=	-0.0002 x	+	1.0044
0.37	=	-0.0002 x	+	1.0044
-0.6344	=	-0.0002 x		
3172	=	x		

Hvorslev's expression for hydraulic conductivity (K)

K	rc ² ln(Le/R)/2Let37			K= 2.42E-09
rc	2.54 cm	rc ²	6.4516	(m/s)
le	280 cm	Ln(Le/R)	4.00555	
R or r(w)	5.1 cm	rc ² *ln(le/r)	25.8422	
t37	190320 sec	2Le*t37	1.1E+08	
le	280 cm			
r(w)	5.1 cm			
le/r(w)	55 >8	TRUE		



Well ID
Date of test

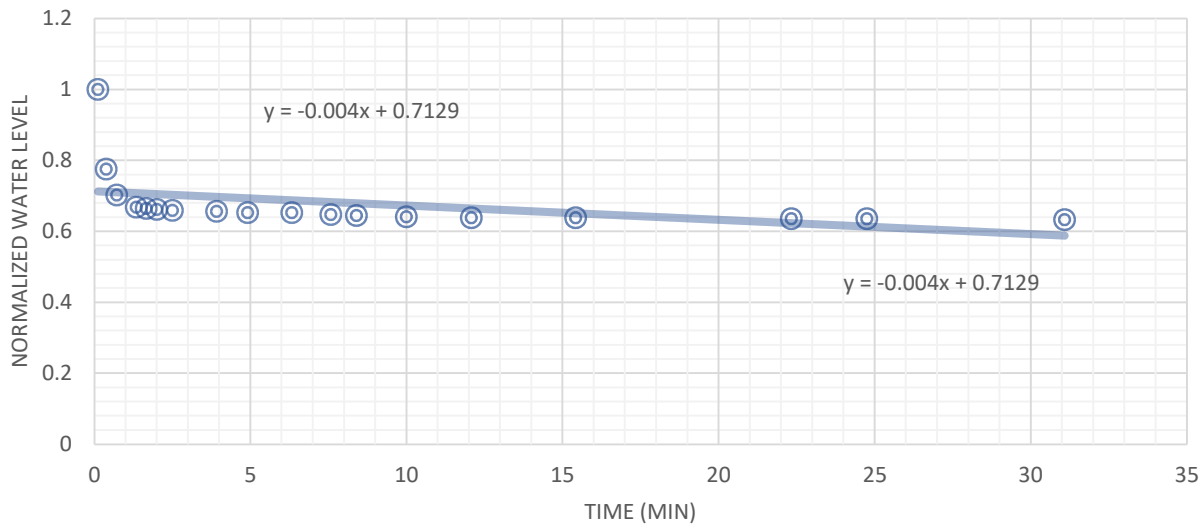
MW2023-4a
August 15, 2024



t37 (min)				
y	=	-0.004 x	+	0.7129
0.37	=	-0.004 x	+	0.7129
-0.3429	=	-0.004 x		
85.725	=	x		

Hvorslev's expression for hydraulic conductivity (K)

K	$rc^2 \ln(Le/R) / 2Le t_{37}$			K= 8.41E-08
rc	2.54 cm	rc ²	6.4516	(m/s)
le	305 cm	Ln(Le/R)	4.09107	
R or r(w)	5.1 cm	rc ² *ln(le/r)	26.394	
t37	5143.5 sec	2Le*t37	3137535	
le	305 cm			
r(w)	5.1 cm			
le/r(w)	60 >8	TRUE		



Well ID
Date of test

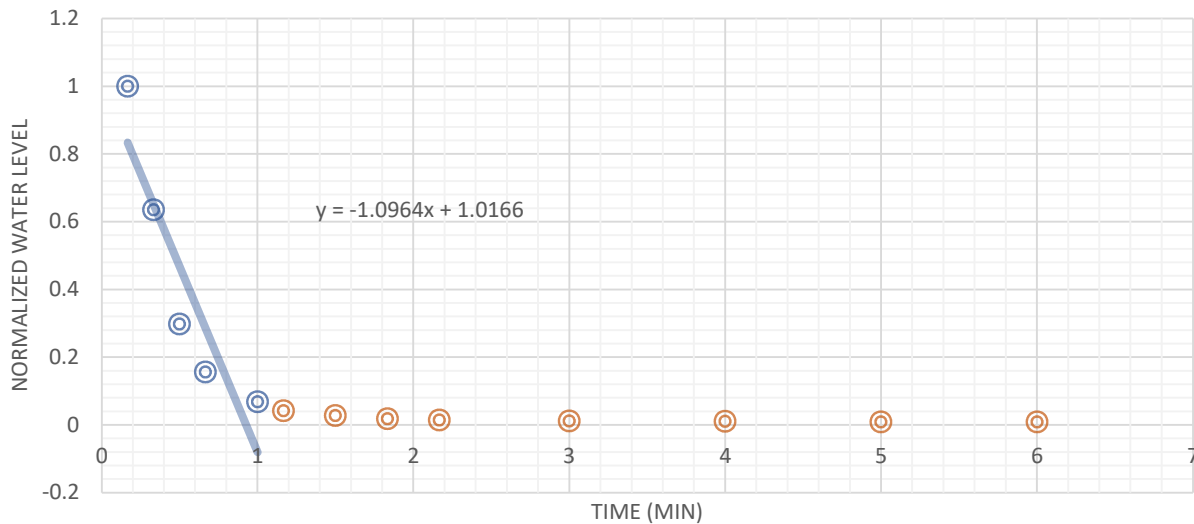
MW2023-4a
Oct. 2, 2024



t37 (min)				
y	=	-1.0964 x	+	1.0166
0.37	=	-1.0964 x	+	1.0166
-0.6466	=	-1.0964 x		
0.5897483	=	x		

Hvorslev's expression for hydraulic conductivity (K)

K	$rc^2 \ln(L_e/R) / 2Le t_{37}$				K=	1.47E-05
rc	2.54 cm	rc ²	6.4516		(m/s)	
le	305 cm	Ln(L _e /R)	4.09107			
R or r(w)	5.1 cm	rc ² *ln(le/r)	26.394			
t37	29.487413 sec	2Le*t37	17987.3			
le	305 cm					
r(w)	5.1 cm					
le/r(w)	60 >8	TRUE				



Well ID
Date of test

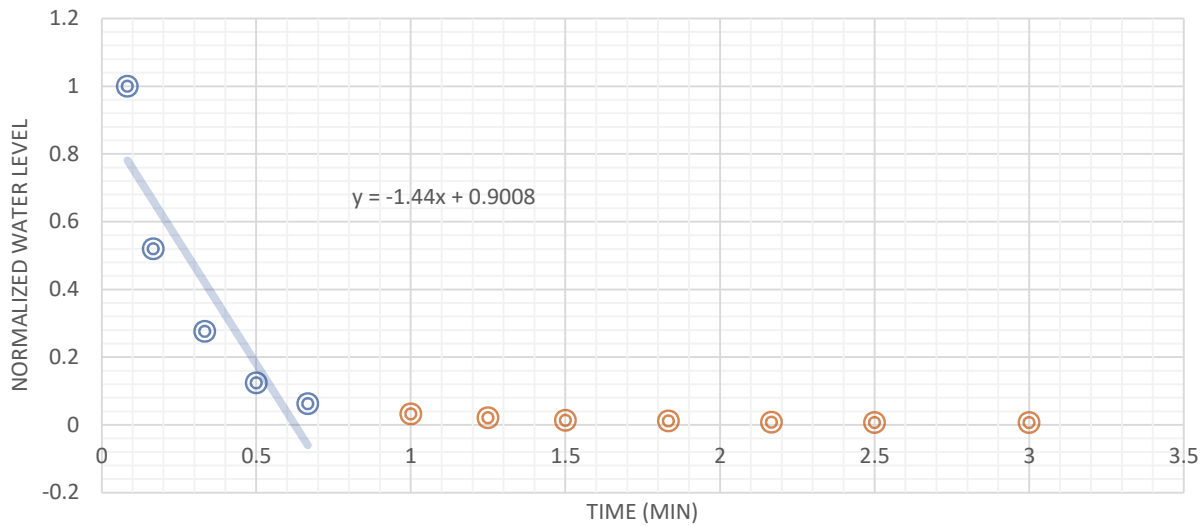
MW2023-4a
Oct. 5, 2024



t37 (min)				
y	=	-1.44 x	+	0.9008
0.37	=	-1.44 x	+	0.9008
-0.5308	=	-1.44 x		
0.3686111	=	x		

Hvorslev's expression for hydraulic conductivity (K)

K	rc ² ln(Le/R)/2Let37				K= 1.96E-05
rc	2.54 cm	rc ²	6.4516	(m/s)	
le	305 cm	Ln(Le/R)	4.09107		
R or r(w)	5.1 cm	rc ² *ln(le/r)	26.394		
t37	22.116667 sec	2Le*t37	13491.2		
le	305 cm				
r(w)	5.1 cm				
le/r(w)	60 >8	TRUE			



Well ID
Date of test

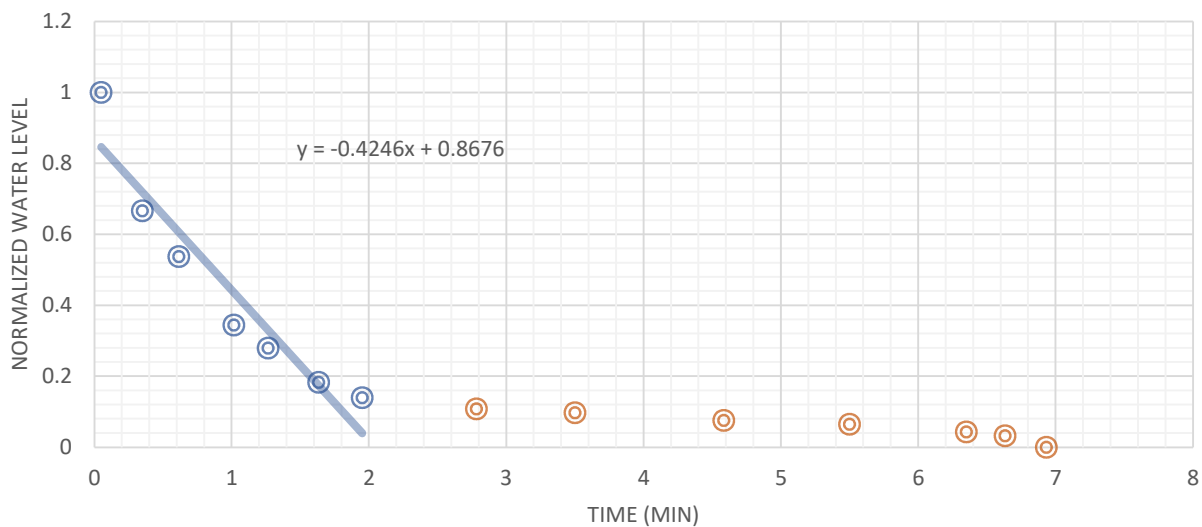
MW2023-5a
August 15, 2024



t37 (min)				
y	=	-0.4246 x	+	0.8676
0.37	=	-0.4246 x	+	0.8676
-0.4976	=	-0.4246 x		
1.1719265	=	x		

Hvorslev's expression for hydraulic conductivity (K)

K	rc ² ln(Le/R)/2Le*t37				K= 5.86E-06
rc	2.54 cm	rc ²	6.4516	(m/s)	
le	325 cm	Ln(Le/R)	4.15458		
R or r(w)	5.1 cm	rc ² *ln(le/r)	26.8037		
t37	70.315591 sec	2Le*t37	45705.1		
le	325 cm				
r(w)	5.1 cm				
le/r(w)	64 >8	TRUE			



Well ID
Date of test

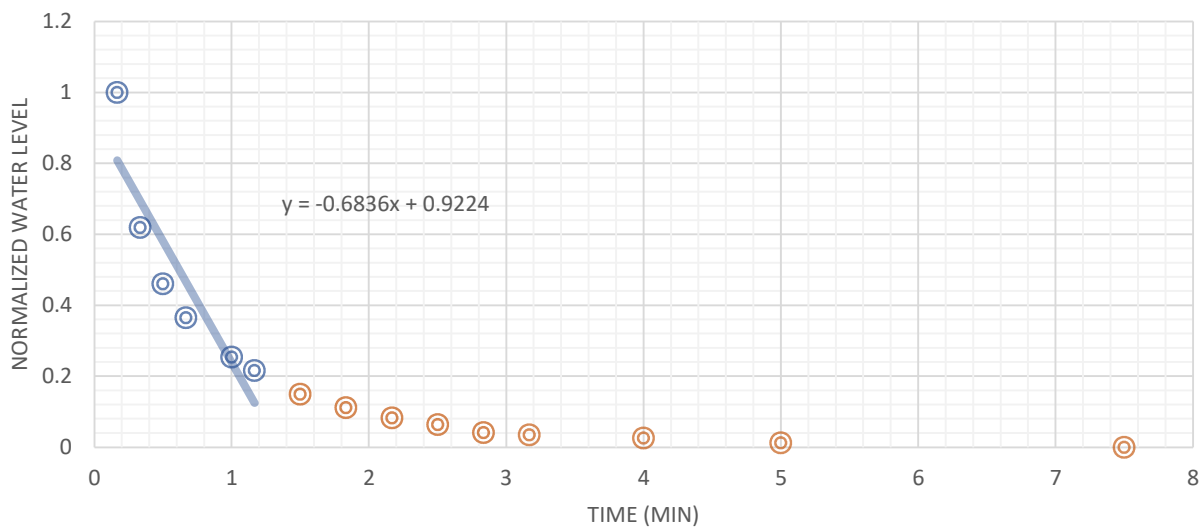
MW2023-5a
Oct. 2, 2024



t37 (min)				
y	=	-0.6836 x	+	0.9224
0.37	=	-0.6836 x	+	0.9224
-0.5524	=	-0.6836 x		
0.8080749	=	x		

Hvorslev's expression for hydraulic conductivity (K)

K	rc ² ln(Le/R)/2Let37				K= 8.51E-06
rc	2.54 cm	rc ²	6.4516	(m/s)	
le	325 cm	Ln(Le/R)	4.15458		
R or r(w)	5.1 cm	rc ² *ln(le/r)	26.8037		
t37	48.484494 sec	2Le*t37	31514.9		
le	325 cm				
r(w)	5.1 cm				
le/r(w)	64 >8	TRUE			



Well ID
Date of test

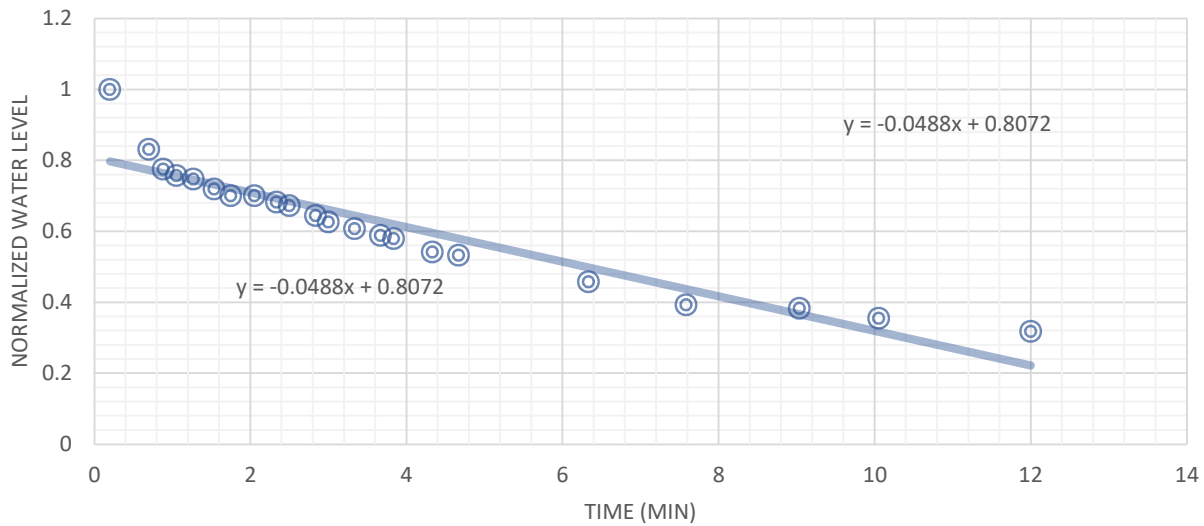
MW2023-7a
August 15, 2024



t37 (min)				
y	=	-0.0488 x	+	0.8072
0.37	=	-0.0488 x	+	0.8072
-0.4372	=	-0.0488 x		
8.9590164	=	x		

Hvorslev's expression for hydraulic conductivity (K)

K	$rc^2 \ln(L_e/R) / 2Le t_{37}$				K= 8.25E-07
rc	2.54 cm	rc ²	6.4516	(m/s)	
le	295 cm	Ln(L _e /R)	4.05773		
R or r(w)	5.1 cm	rc ² *ln(le/r)	26.1789		
t37	537.54098 sec	2Le*t37	317149		
le	295 cm				
r(w)	5.1 cm				
le/r(w)	58 >8	TRUE			



Well ID
Date of test

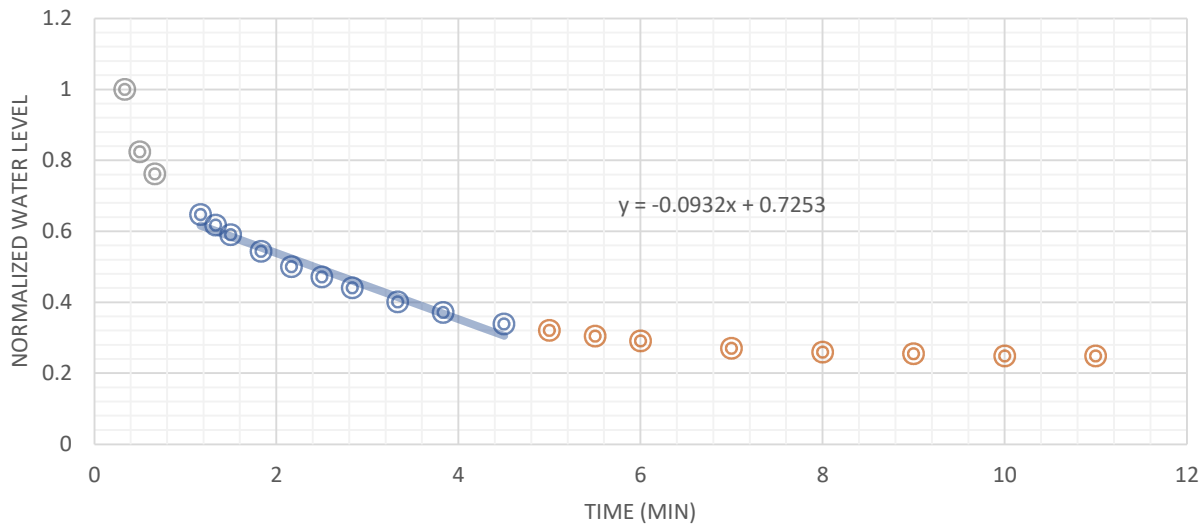
MW2023-7a
Oct. 2, 2024



t37 (min)				
y	=	-0.0932 x	+	0.7253
0.37	=	-0.0932 x	+	0.7253
-0.3553	=	-0.0932 x		
3.8122318	=	x		

Hvorslev's expression for hydraulic conductivity (K)

K	rc ² ln(Le/R)/2Let37				K= 1.94E-06
rc	2.54 cm	rc ²	6.4516	(m/s)	
le	295 cm	Ln(Le/R)	4.05773		
R or r(w)	5.1 cm	rc ² *ln(le/r)	26.1789		
t37	228.73391 sec	2Le*t37	134953		
le	295 cm				
r(w)	5.1 cm				
le/r(w)	58 >8	TRUE			



Well ID
Date of test

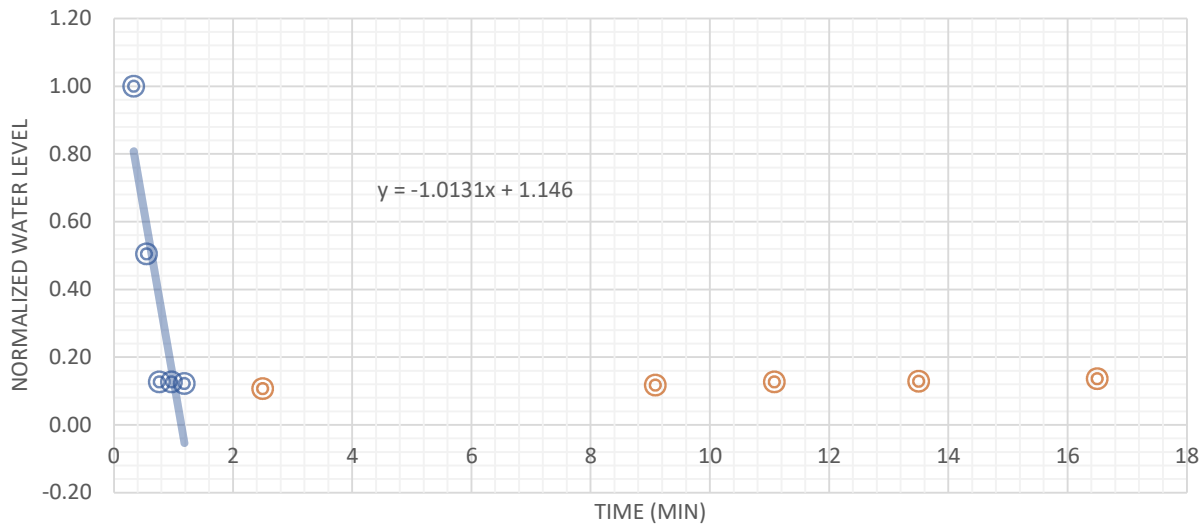
MW2023-9a
August 15, 2024



t37 (min)				
y	=	-1.0131 x	+	1.146
0.37	=	-1.0131 x	+	1.146
-0.776	=	-1.0131 x		
0.7659658	=	x		

Hvorslev's expression for hydraulic conductivity (K)

K	rc ² ln(Le/R)/2Le*t37				K=	9.30E-06
rc	2.54 cm	rc ²	6.4516		(m/s)	
le	310 cm	Ln(Le/R)	4.10733		(m/s)	
R or r(w)	5.1 cm	rc ² *ln(le/r)	26.4989			
t37	45.957951 sec	2Le*t37	28493.9			
le	310 cm					
r(w)	5.1 cm					
le/r(w)	61 >8	TRUE				



Well ID
Date of test

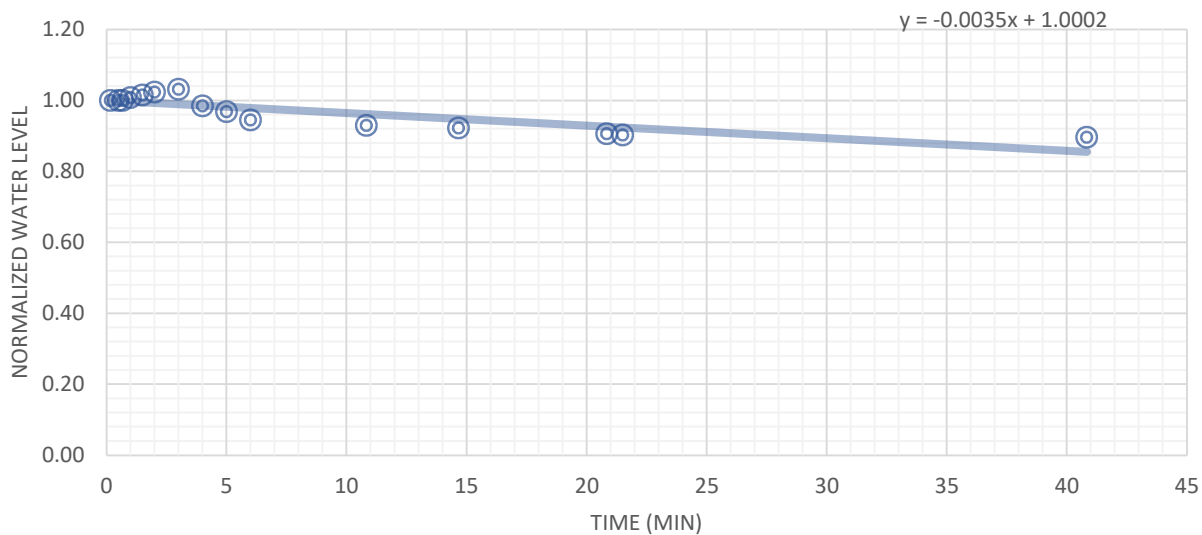
MW2023-9a
Oct. 2, 2024



t37 (min)					
y	=	-0.0035	x	+	1.0002
0.37	=	-0.0035	x	+	1.0002
-0.6302	=	-0.0035	x		
180.05714	=		x		

Hvorslev's expression for hydraulic conductivity (K)

K	$rc^2 \ln(L_e/R) / 2Le t_{37}$				K=	3.96E-08
rc	2.54 cm	rc ²	6.4516			(m/s)
le	310 cm	Ln(L _e /R)	4.10733			
R or r(w)	5.1 cm	rc ² *ln(le/r)	26.4989			
t37	10803.429 sec	2Le*t37	6698126			
le	310 cm					
r(w)	5.1 cm					
le/r(w)	61 >8	TRUE				



Well ID
Date of test

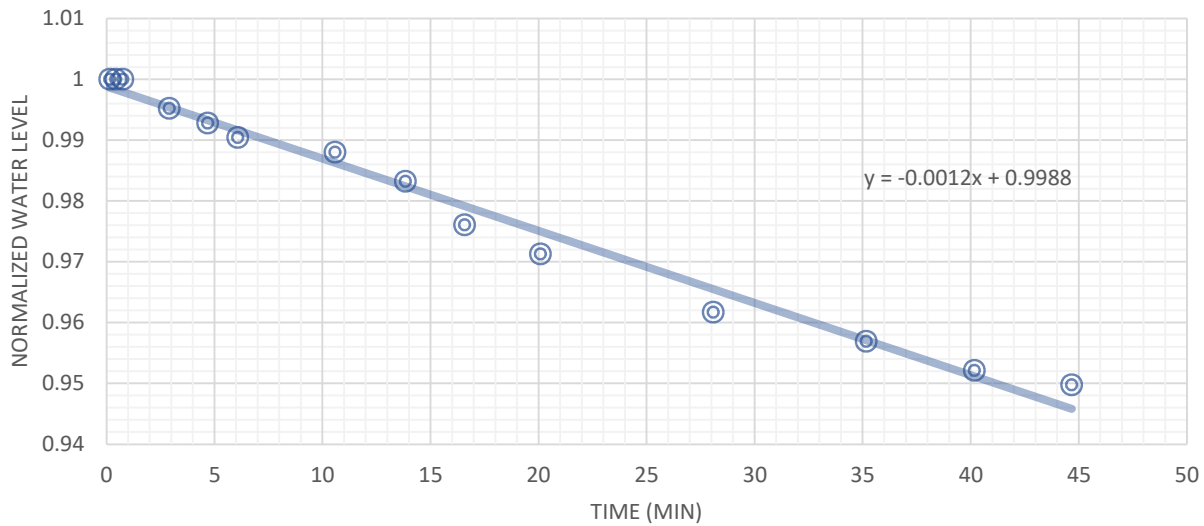
MW2023-12a
August 15, 2024



t37 (min)				
y	=	-0.0012 x	+	0.9988
0.37	=	-0.0012 x	+	0.9988
-0.6288	=	-0.0012 x		
524	=	x		

Hvorslev's expression for hydraulic conductivity (K)

K	$rc^2 \ln(L_e/R) / 2Le t_{37}$				K= 1.39E-08
rc	2.54 cm	rc ²	6.4516	(m/s)	
le	300 cm	Ln(L _e /R)	4.07454		
R or r(w)	5.1 cm	rc ² *ln(le/r)	26.2873		
t37	31440 sec	2Le*t37	1.9E+07		
le	300 cm				
r(w)	5.1 cm				
le/r(w)	59 >8	TRUE			



Well ID
Date of test

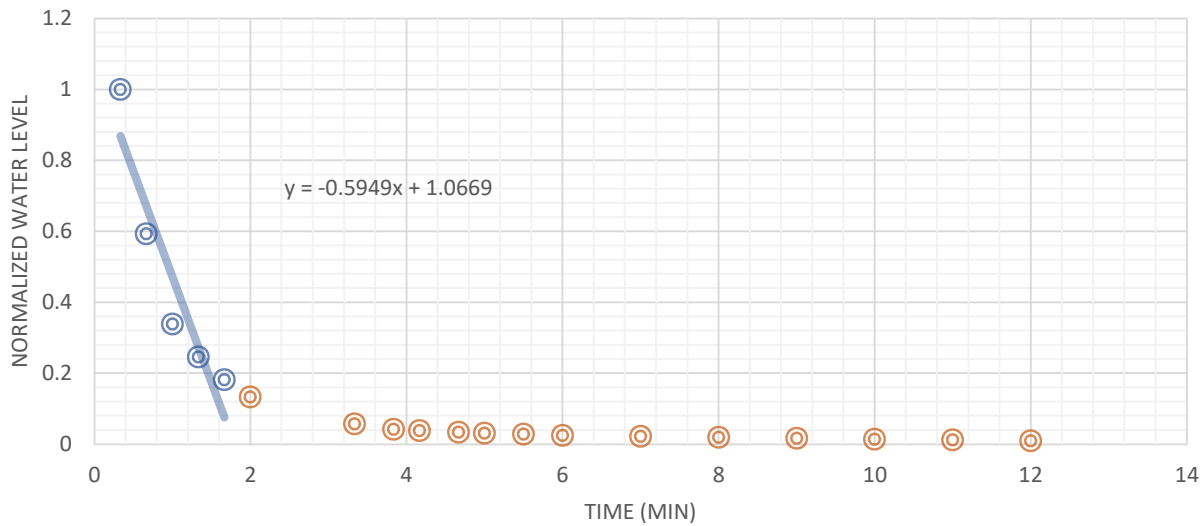
MW2023-12a
Oct. 3, 2024



t37 (min)				
y	=	-0.5949 x	+	1.0669
0.37	=	-0.5949 x	+	1.0669
-0.6969	=	-0.5949 x		
1.1714574	=	x		

Hvorslev's expression for hydraulic conductivity (K)

K	$rc^2 \ln(Le/R) / 2Le t_{37}$				K= 6.23E-06
rc	2.54 cm	rc ²	6.4516	(m/s)	
le	300 cm	Ln(Le/R)	4.07454		
R or r(w)	5.1 cm	rc ² *ln(le/r)	26.2873		
t37	70.287443 sec	2Le*t37	42172.5		
le	300 cm				
r(w)	5.1 cm				
le/r(w)	59 >8	TRUE			



Well ID
Date of test

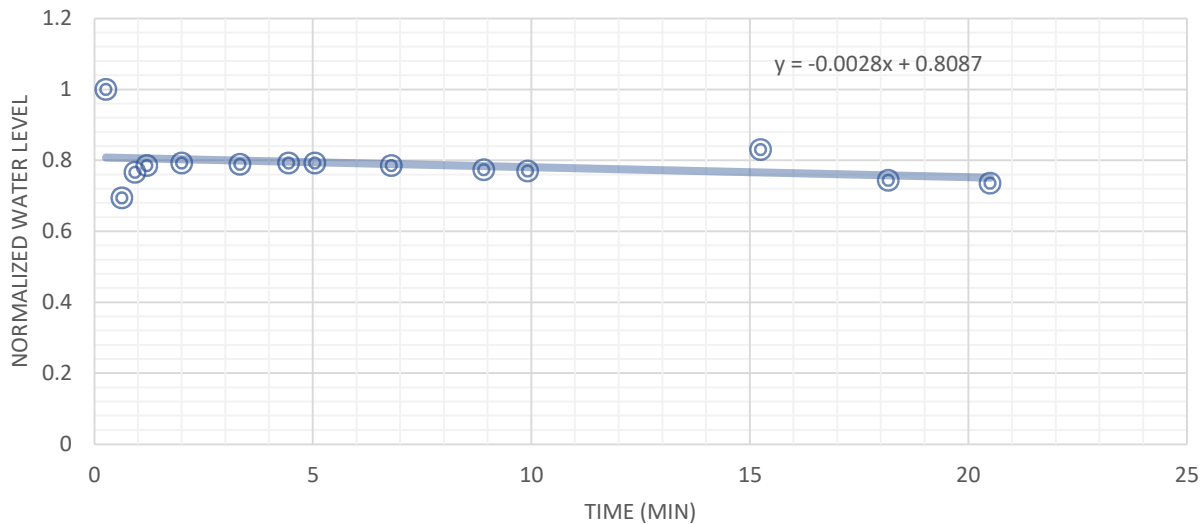
MW2023-13a
August 15, 2024



t37 (min)				
y	=	-0.0028 x	+	0.8087
0.37	=	-0.0028 x	+	0.8087
-0.4387	=	-0.0028 x		
156.67857	=	x		

Hvorslev's expression for hydraulic conductivity (K)

K	rc ² ln(Le/R)/2Le*t37				K= 4.72E-08
rc	2.54 cm	rc ²	6.4516	(m/s)	
le	295 cm	Ln(Le/R)	4.05773		
R or r(w)	5.1 cm	rc ² *ln(le/r)	26.1789		
t37	9400.7143 sec	2Le*t37	5546421		
le	295 cm				
r(w)	5.1 cm				
le/r(w)	58 >8	TRUE			



Well ID
Date of test

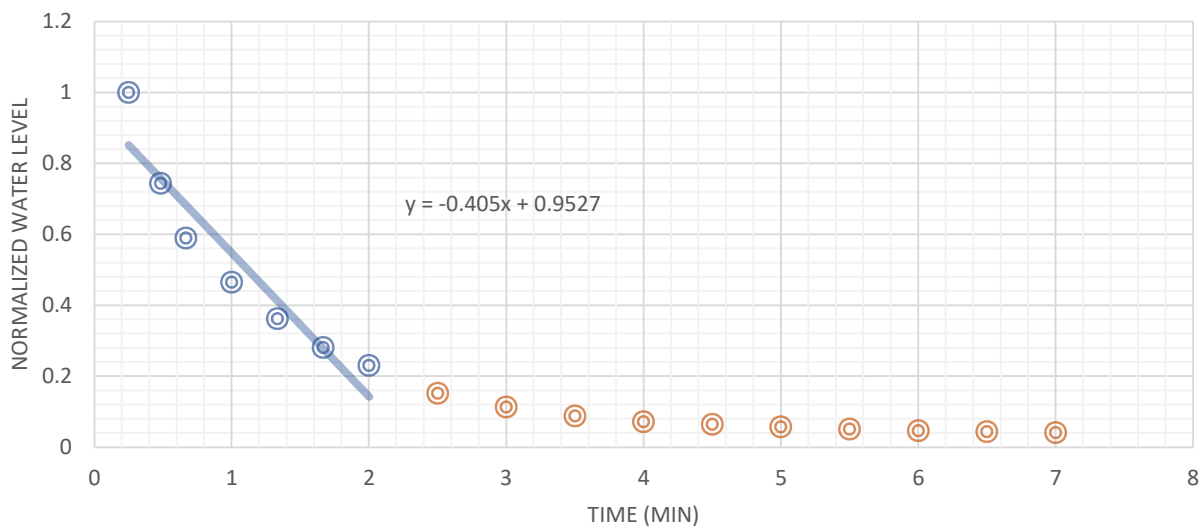
MW2023-13a
Oct. 3, 2024



t37 (min)				
y	=	-0.405 x	+	0.9527
0.37	=	-0.405 x	+	0.9527
-0.5827	=	-0.405 x		
1.4387654	=	x		

Hvorslev's expression for hydraulic conductivity (K)

K	$rc^2 \ln(Le/R) / 2Le t_{37}$				K= 5.14E-06
rc	2.54 cm	rc ²	6.4516	(m/s)	
le	295 cm	Ln(Le/R)	4.05773		
R or r(w)	5.1 cm	rc ² *ln(le/r)	26.1789		
t37	86.325926 sec	2Le*t37	50932.3		
le	295 cm				
r(w)	5.1 cm				
le/r(w)	58 >8	TRUE			



Well ID
Date of test

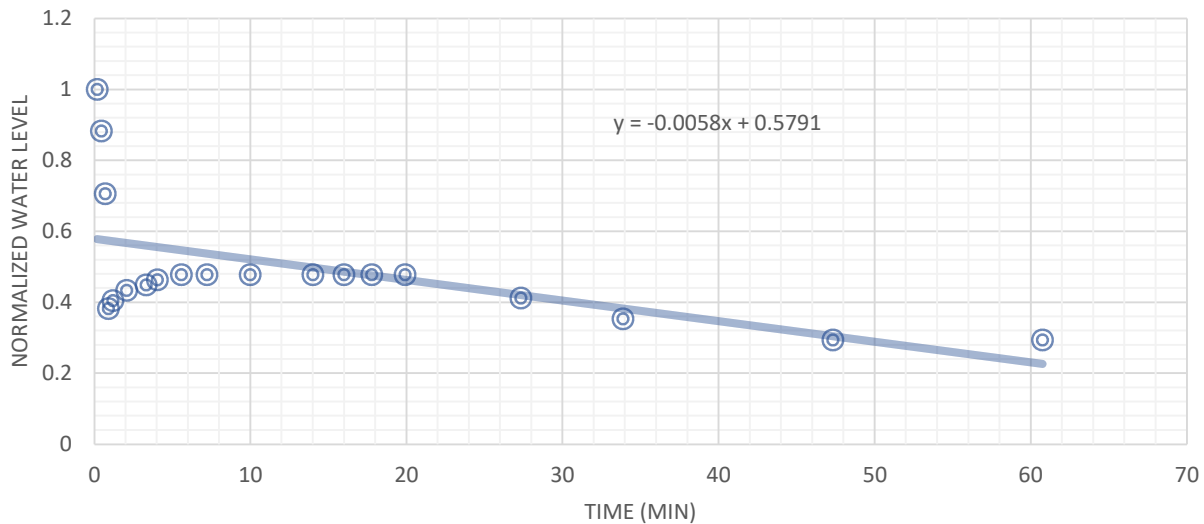
MW2023-15a
August 15, 2024



t37 (min)				
y	=	-0.0058 x	+	0.5791
0.37	=	-0.0058 x	+	0.5791
-0.2091	=	-0.0058 x		
36.051724	=	x		

Hvorslev's expression for hydraulic conductivity (K)

K	$rc^2 \ln(Le/R) / 2Le t_{37}$				K= 1.42E-07
rc	2.54 cm	rc ²	6.4516	(m/s)	
le	390 cm	Ln(Le/R)	3.71485		
R or r(w)	9.5 cm	rc ² *ln(le/r)	23.9668		
t37	2163.1034 sec	2Le*t37	1687221		
le	390 cm				
r(w)	9.5 cm				
le/r(w)	41 >8	TRUE			



Well ID
Date of test

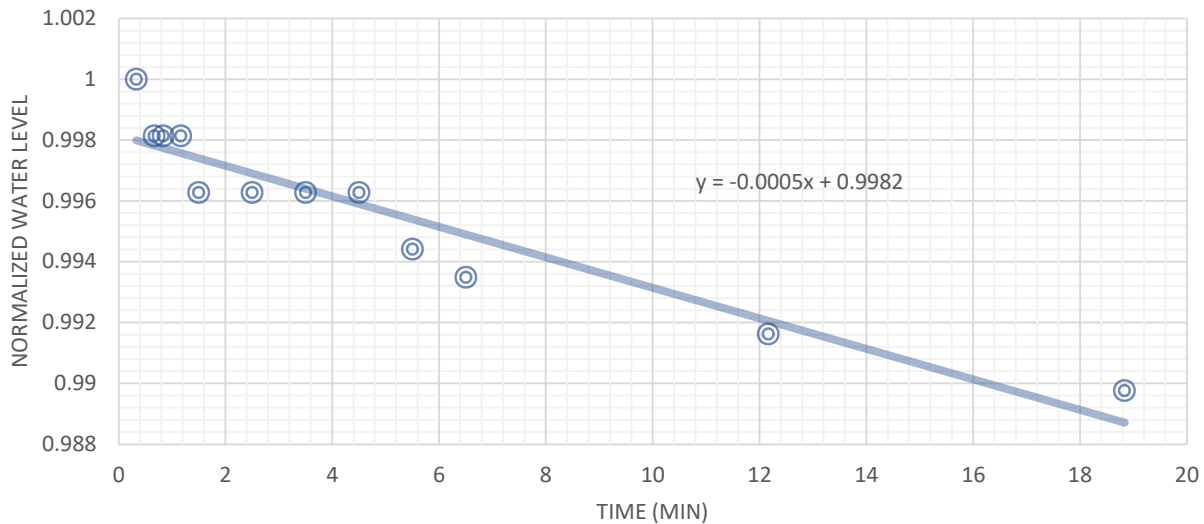
MW2023-15a
Oct. 3, 2024



t37 (min)				
y	=	-0.0005 x	+	0.9982
0.37	=	-0.0005 x	+	0.9982
-0.6282	=	-0.0005 x		
1256.4	=	x		

Hvorslev's expression for hydraulic conductivity (K)

K	$rc^2 \ln(L_e/R) / 2Le t_{37}$				K= 4.08E-09
rc	2.54 cm	rc ²	6.4516	(m/s)	
le	390 cm	ln(L _e /R)	3.71485		
R or r(w)	9.5 cm	rc ² * ln(le/r)	23.9668		
t37	75384 sec	2Le * t37	5.9E+07		
le	390 cm				
r(w)	9.5 cm				
le/r(w)	41 >8	TRUE			



Well ID
Date of test

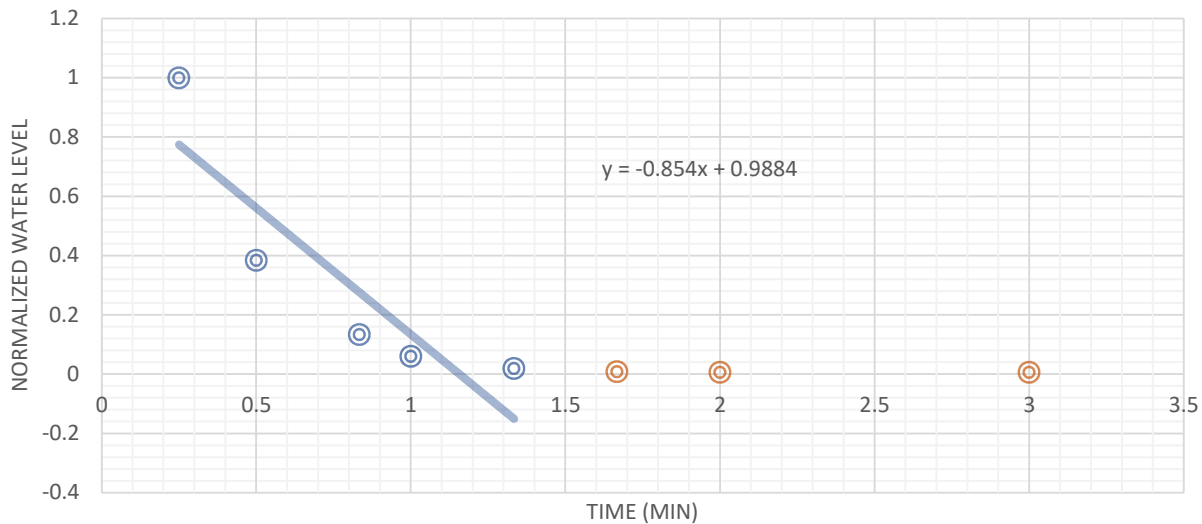
MW2023-17a
Oct. 3, 2024



t37 (min)				
y	=	-0.854 x	+	0.9884
0.37	=	-0.854 x	+	0.9884
-0.6184	=	-0.854 x		
0.7241218	=	x		

Hvorslev's expression for hydraulic conductivity (K)

K	$rc^2 \ln(Le/R) / 2Le t_{37}$			K= 6.37E-06
rc	2.54 cm	rc ²	6.4516	(m/s)
le	450 cm	Ln(Le/R)	3.85796	
R or r(w)	9.5 cm	rc ² *ln(le/r)	24.89	
t37	43.447307 sec	2Le*t37	39102.6	
le	450 cm			
r(w)	9.5 cm			
le/r(w)	47 >8	TRUE		



Well ID
Date of test

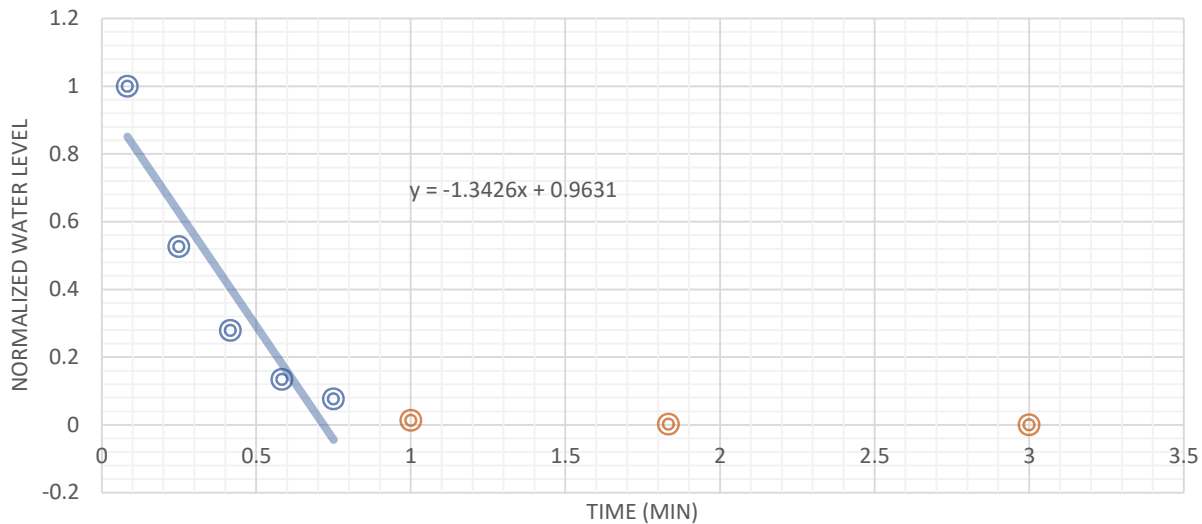
MW2023-17a
Oct. 4, 2024



t37 (min)				
y	=	-1.3426 x	+	0.9631
0.37	=	-1.3426 x	+	0.9631
-0.5931	=	-1.3426 x		
0.4417548	=	x		

Hvorslev's expression for hydraulic conductivity (K)

K	rc ² ln(Le/R)/2Let37				K= 1.04E-05
rc	2.54 cm	rc ²	6.4516	(m/s)	
le	450 cm	ln(Le/R)	3.85796		
R or r(w)	9.5 cm	rc ² ln(le/r)	24.89		
t37	26.505288 sec	2Le*t37	23854.8		
le	450 cm				
r(w)	9.5 cm				
le/r(w)	47 >8	TRUE			



Well ID
Date of test

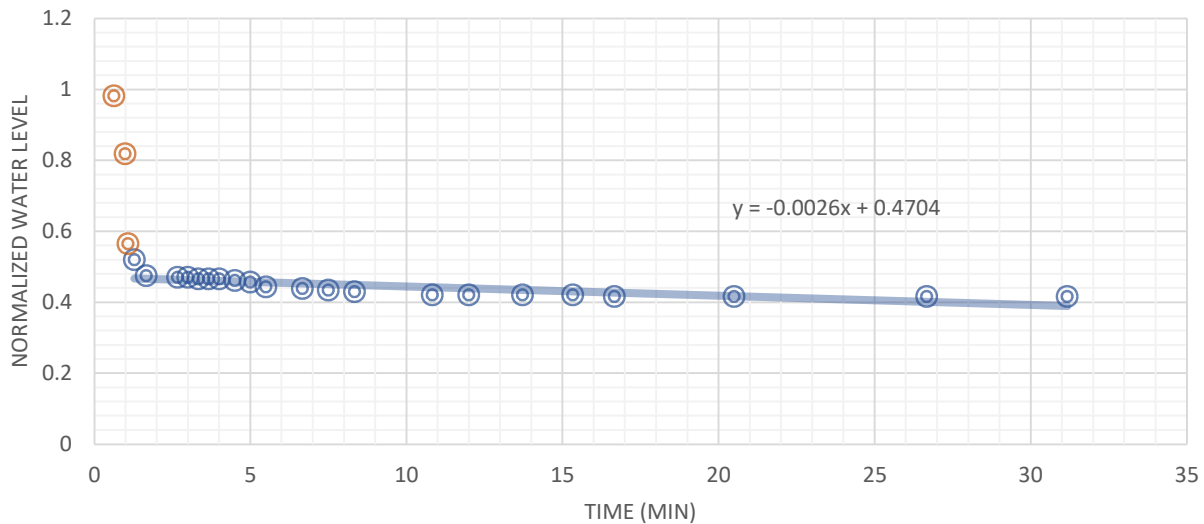
MW2023-19a
August 15, 2024



t37 (min)				
y	=	-0.0026 x	+	0.4704
0.37	=	-0.0026 x	+	0.4704
-0.1004	=	-0.0026 x		
38.615385	=	x		

Hvorslev's expression for hydraulic conductivity (K)

K	rc ² ln(Le/R)/2Let37				K= 1.60E-07
rc	2.54 cm	rc ²	6.4516	(m/s)	
le	375 cm	Ln(Le/R)	4.29769		
R or r(w)	5.1 cm	rc ² *ln(le/r)	27.7269		
t37	2316.9231 sec	2Le*t37	1737692		
le	375 cm				
r(w)	5.1 cm				
le/r(w)	74 >8	TRUE			



Well ID
Date of test

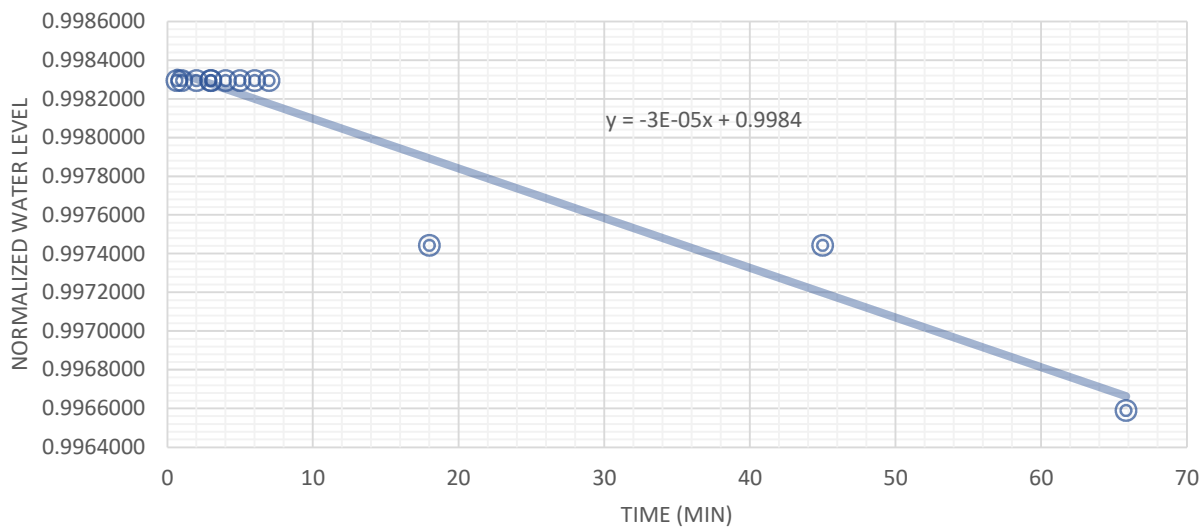
MW2023-19a
Oct. 4, 2024



t37 (min)				
y	=	-3.00E-05 x	+	0.9984
0.37	=	-0.00003 x	+	0.9984
-0.6284	=	-0.00003 x		
20946.667	=	x		

Hvorslev's expression for hydraulic conductivity (K)

K	$rc^2 \ln(Le/R) / 2Le t_{37}$				K= 2.94E-10
rc	2.54 cm	rc ²	6.4516	(m/s)	
le	375 cm	Ln(Le/R)	4.29769		
R or r(w)	5.1 cm	rc ² *ln(le/r)	27.7269		
t37	1256800 sec	2Le*t37	9.4E+08		
le	375 cm				
r(w)	5.1 cm				
le/r(w)	74 >8	TRUE			



Well ID
Date of test

MW2023-21
August 15, 2024



t37 (min)				
y	=	-0.0025 x	+	0.7405
0.37	=	-0.0025 x	+	0.7405
-0.3705	=	-0.0025 x		
148.2	=	x		

Hvorslev's expression for hydraulic conductivity (K)

K	$rc^2 \ln(Le/R) / 2Le t_{37}$				K= 4.16E-08
rc	2.54 cm	rc ²	6.4516	(m/s)	
le	375 cm	Ln(Le/R)	4.29769		
R or r(w)	5.1 cm	rc ² *ln(le/r)	27.7269		
t37	8892 sec	2Le*t37	6669000		
le	375 cm				
r(w)	5.1 cm				
le/r(w)	74 >8	TRUE			



Well ID
Date of test

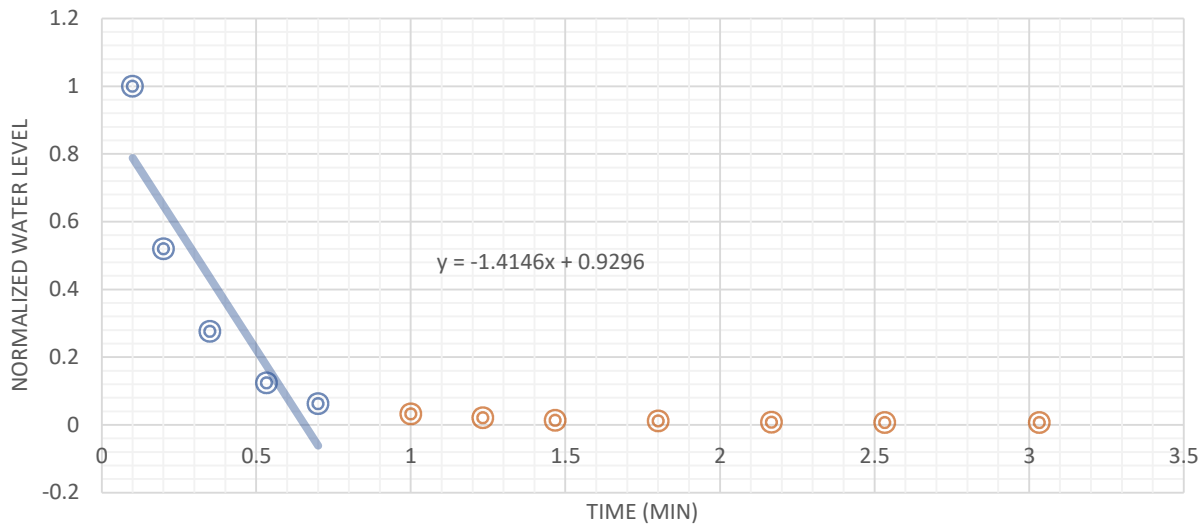
MW2023-21
Oct. 4, 2024



t37 (min)				
y	=	-1.4146 x	+	0.9296
0.37	=	-1.4146 x	+	0.9296
-0.5596	=	-1.4146 x		
0.3955889	=	x		

Hvorslev's expression for hydraulic conductivity (K)

K	$rc^2 \ln(Le/R) / 2Le t_{37}$				K= 1.56E-05
rc	2.54 cm	rc ²	6.4516	(m/s)	
le	375 cm	Ln(Le/R)	4.29769		
R or r(w)	5.1 cm	rc ² *ln(le/r)	27.7269		
t37	23.735332 sec	2Le*t37	17801.5		
le	375 cm				
r(w)	5.1 cm				
le/r(w)	74 >8	TRUE			



Well ID
Date of test

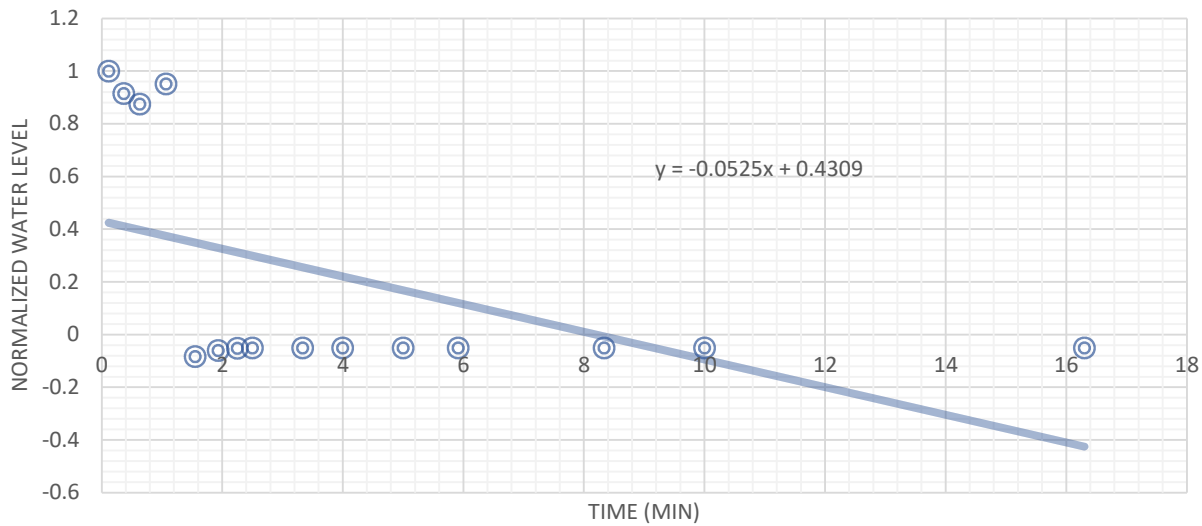
MW2023-27a
August 15, 2024



t37 (min)				
y	=	-0.0525 x	+	0.4309
0.37	=	-0.0525 x	+	0.4309
-0.0609	=	-0.0525 x		
1.16	=	x		

Hvorslev's expression for hydraulic conductivity (K)

K	$rc^2 \ln(L_e/R) / 2Le t_{37}$				K= 3.71E-06
rc	2.54 cm	rc ²	6.4516	(m/s)	
le	595 cm	Ln(L _e /R)	4.75932		
R or r(w)	5.1 cm	rc ² *ln(le/r)	30.7052		
t37	69.6 sec	2Le*t37	82824		
le	595 cm				
r(w)	5.1 cm				
le/r(w)	117 >8	TRUE			



Well ID
Date of test

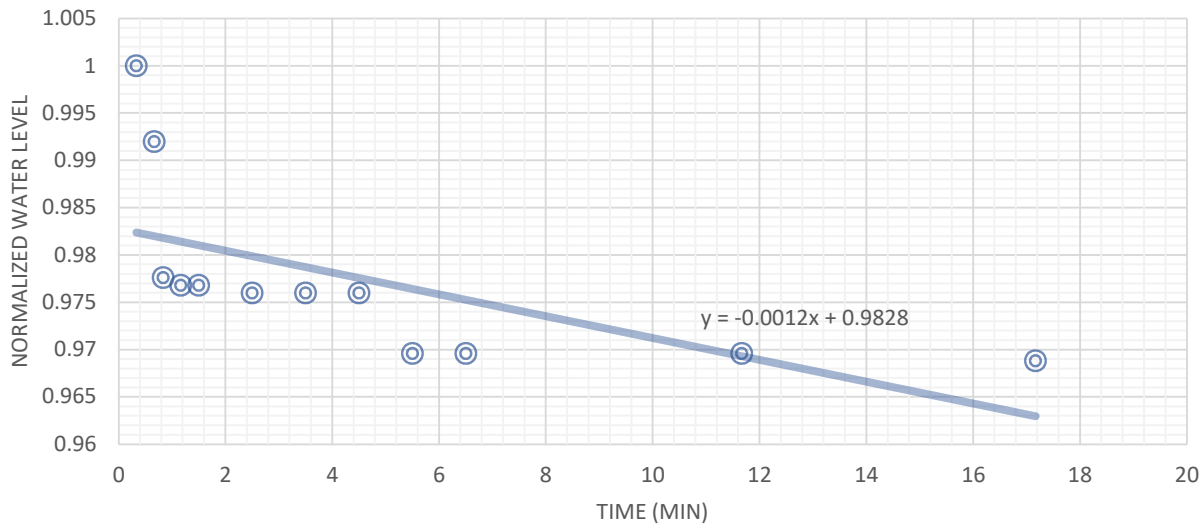
MW2023-27a
Oct. 4, 2024



t37 (min)				
y	=	-0.0012 x	+	0.9828
0.37	=	-0.0012 x	+	0.9828
-0.6128	=	-0.0012 x		
510.66667	=	x		

Hvorslev's expression for hydraulic conductivity (K)

K	$rc^2 \ln(L_e/R) / 2Le t_{37}$				K= 8.42E-09
rc	2.54 cm	rc ²	6.4516	(m/s)	
le	595 cm	Ln(L _e /R)	4.75932		
R or r(w)	5.1 cm	rc ² *ln(le/r)	30.7052		
t37	30640 sec	2Le*t37	3.6E+07		
le	595 cm				
r(w)	5.1 cm				
le/r(w)	117 >8	TRUE			



Appendix E

E – Geophysical Investigation Report



January 10, 2025,

Transmitted by email: jsmith@adaptivegeotechnical.com

Our ref: GPR-24-5905

Mr. Jason A. Smith P. Eng
Senior Permafrost & Geotechnical Engineer

Adaptive Baseline Geotechnical Ltd.

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Elmsdale, NS
B2S 2L6
M: +1 867 222 0184

Downhole seismic survey in boreholes BH11 and BH14 north of Iqaluit, Nunavut

Dear Sir,

Geophysics GPR International Inc. has been requested by Adaptive Baseline Geotechnical Ltd. to carry out downhole seismic surveys within two boreholes at a site north of Iqaluit, Nunavut. Figure 1 shows the approximate location of the boreholes.

The data collection was carried out between December 12 to 14, 2024, by GPR's Geophysicist Duro Zeljkovic and Adaptive Baseline Geotechnical field crew.

The purpose of the testing was to measure the in-situ shear-wave (S-wave) velocities to determine soil/rock strength. The ASTM D7400-14 Down-hole Seismic Testing test method was applied.

The following paragraphs describe the survey design, the principles of the test method, the methodology for interpreting the data, and provide a culmination of the results in table and chart format.



Figure 1: Approximate location of the tested boreholes, Iqaluit, Nunavut.

METHODOLOGY

Seismic Down-hole

The purpose of the investigation was to provide the seismic shear-wave (S-wave) velocity depth profile to generate an interpreted layer model.

Basic Theory

The seismic down-hole method relies on the accurate measurement of the transit time for a generated wave to travel from a shot-point on the surface to a receiver (geophone) at sequential depths within a borehole. The velocities at which the waves propagate are then recorded separately for waves with preferential shear (S) wave components and compressional (P) wave components. The seismic "P" wave velocity depends mainly on volumetric elastic ratio of the constituent soil particles and pore water. The seismic "S" wave determined from the arrival times of the impulse signals. Arrival time records are velocity depends more on the structural elasticity of the material, which is influenced by the size, form, and tightness of the particles (for the case of unconsolidated sediments). Unlike the P-wave, a polarized S-wave is easily generated.

Survey Design

A tri-axial geophone, containing two orthogonal horizontal geophones, for detecting the shear (S) wave arrivals, and a vertical geophone for detecting the compressional (P) wave arrivals, was used as the receiver. The geophone was held firm to the borehole casing by a motorized wall-lock.

Data were recorded with an ABEM Pro 2 seismograph. The sampling interval was set to 20 μ s with 16,384 samples for a total record length of 326.4 ms with a pre-trigger delay of 10 ms. The seismic source was located 0.3 m from the borehole BH11 and 0.7 m from borehole BH14.

A 10-lb sledgehammer was used as an energy source with a minimum of three stacks per shot.

Three seismic records were recorded at each one-meter interval with the tri-axial geophone beginning at the bottom of the borehole and ending at one meter depth. There are records for the downward hammer blow, which generates a very strong compressional wave from surface to the receiver. The second hammer strike is applied to the side of a block of wood that is orientated perpendicular to the borehole and offset approximately 0.3 m from BH11 and 0.7 m from BH14. The block stays rigid on the ground by putting a weight (person) on top. The last strike is applied to the opposite side of the block. The second and third strikes generate polarized shear waves of opposite polarity to aid in identification. Figure 2 is an example of a single seismic shot record from a preferential P-wave generated shot.

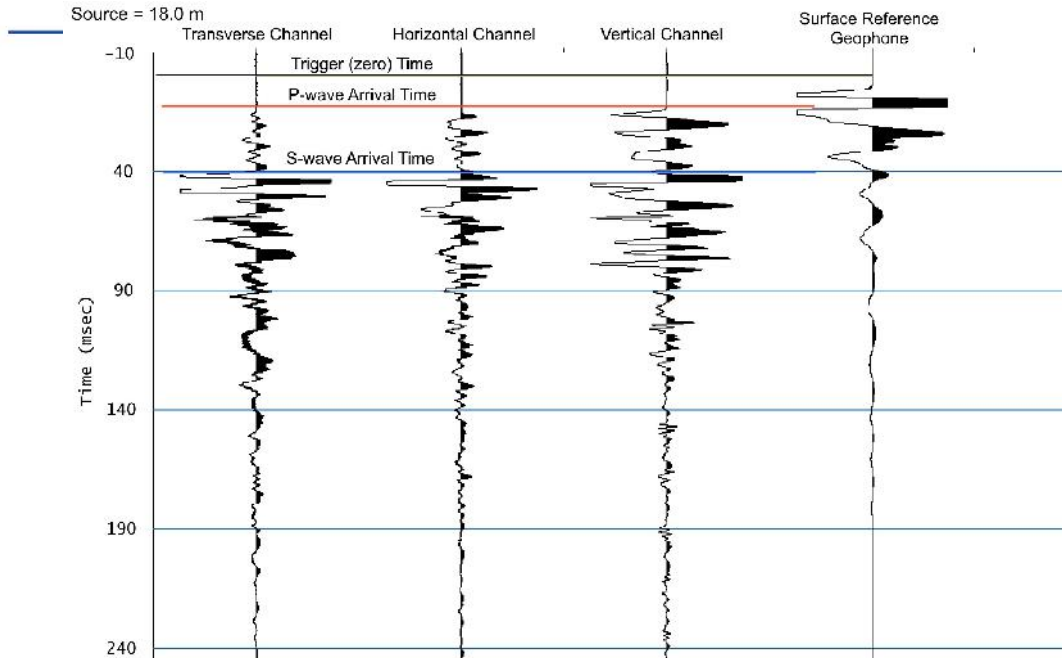


Figure 2: Typical example shot record; preferential P-wave generated.

Interpretation Method and Accuracy of Results

Interpretation of the down-hole seismic data involves identifying the first arrival times of the P-waves and S-waves from the shot records at each depth interval. The seismic traces from each depth interval can be combined into one image with the S-wave traces from opposite polarizations overlapped to aid in the interpretation.

The preferred method for analyzing down-hole data is to produce time-distance plots and calculate the velocities from the slope of the best-fit lines. The selection of the best-fit lines can be visually interpreted by the analyst or can be computer aided. The geologic contacts identified in available borehole data along with visual interpretation of changes in slope of the time-distance plots are used to assign velocity layer contacts. The ReflexW software developed by Dr. Karl Jozef Sandmeier was used for interactive interpretation of the velocity layer contacts and inversion calculations for determining the layer velocities, accounting for refractions and pick confidence. ReflexW was used to pick the first arrivals of both the P- and S-waves. A detailed description of the software used for the interpretation can be found in the ReflexW Manual which can be found on Sandmeier's website.

RESULTS & CONCLUSIONS

The lowest geophone depth was 9.7 m for BH14 and 5.9 m for BH11. The signal-to-noise ratio for the downhole seismic data was good.

The inversion models for the S-wave and P-wave data for BH11 are presented in Figures 3 and 4 and for BH14 in Figures 5 and 6.

The data are tabulated in Tables 1 through 4. The moduli calculations are based on assumed densities. If known densities are available the values can be recalculated.

Downhole seismic data generally matches the borehole logs. Lower velocities of P and S waves indicate overburden and weathered rock 2 m below the surface, while high velocities confirm the presence of sound rock below 2 m depth for BH11. In BH14 lower velocities are present in the top 4 m, while high velocities that are characteristic for solid rock are below.

Processing of the seismic data was performed by Duro Zeljkovic, GIT. This report has been written by Carolyn Boone, P. Geo.

Sincerely,



Carolyn Boone, P. Geo.

Geophysicist



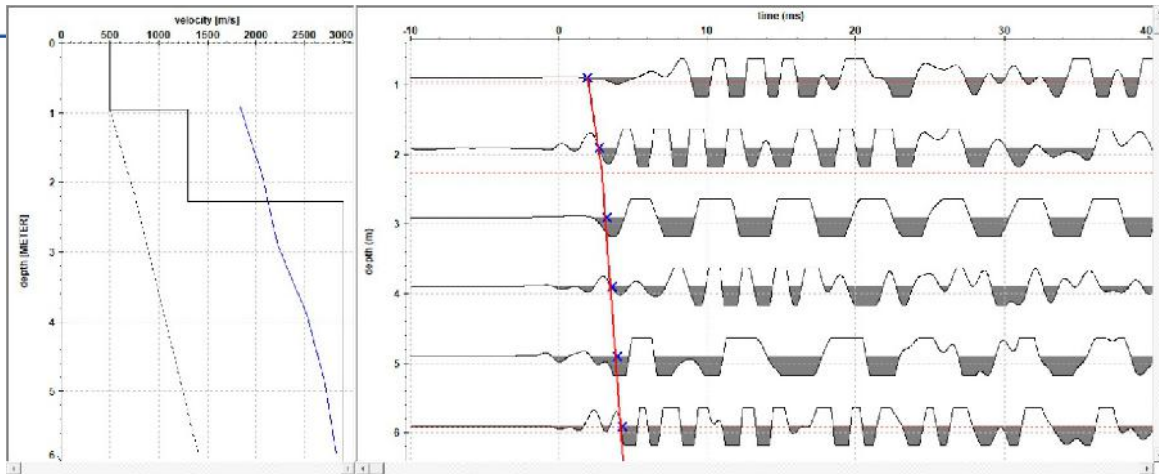


Figure 3: Borehole BH11 S-wave Velocity Inversion Model

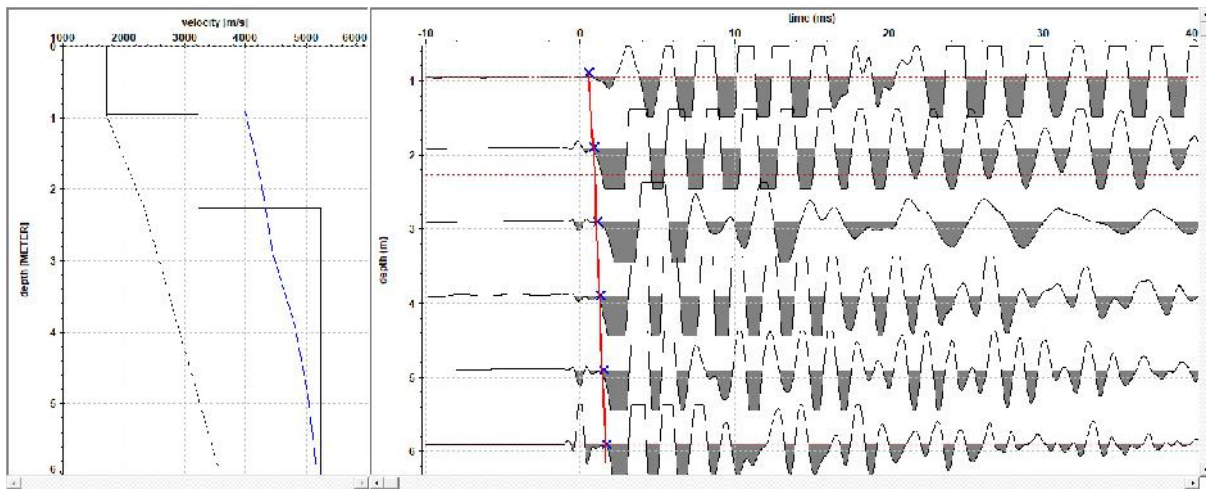


Figure 4: Borehole BH11 P-wave Velocity Inversion Model

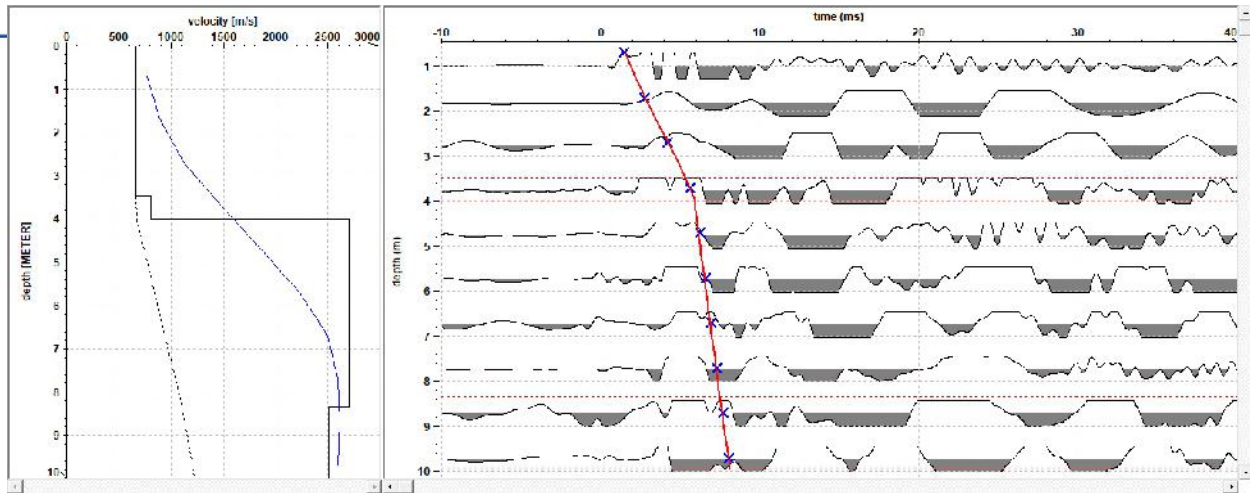


Figure 5: Borehole BH14 S-wave Velocity Inversion Model

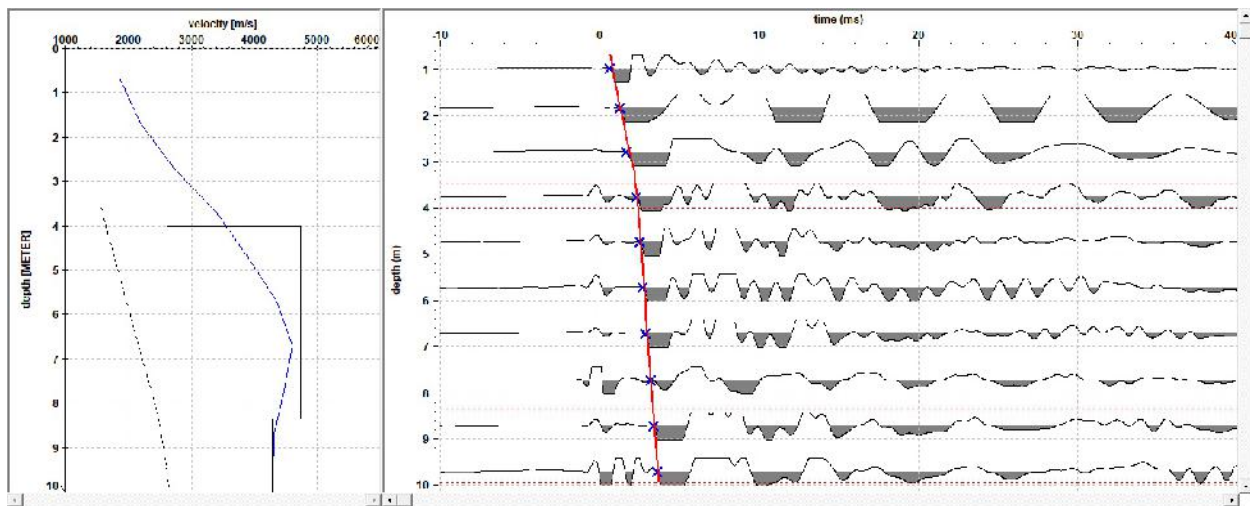


Figure 6: Borehole BH14 P-wave Velocity Inversion Model

Table 1: BH11-Arrival Time Data and Interval Calculations

Geophone Depth (m)	P-wave Arrival Time (ms)	S-Wave Arrival Time (ms)	Slant-Distance P-wave (m)	Slant-Distance S-wave (m)	Interval Velocity P-wave (m/s)	Interval Velocity S-wave (m/s)	Density (assumed) (g/cm ³)	Shear Modulus (MPa)	Poisson's Ratio	Young's Modulus (MPa)	Bulk Modulus (MPa)
0.9	0.56	1.91	0.95	0.95	1694	497	2	493	0.45	1434	5082
1.9	0.88	2.72	1.92	1.92	3046	1204	2.5	3621	0.41	10194	18373
2.9	1.11	3.22	2.92	2.92	4313	1984	2.5	9839	0.37	26877	33381
3.9	1.30	3.56	3.91	3.91	5242	2930	2.5	21456	0.27	54624	40098
4.9	1.49	3.90	4.91	4.91	5251	2934	2.5	21525	0.27	54801	40228
5.9	1.68	4.25	5.91	5.91	5255	2853	2.5	20345	0.29	52534	41911

Table 2: BH11 Modelled Data Summary and Elastic Moduli Calculation Results

Depth Interval (m)	P-wave Velocity (m/s)	S-wave Velocity (m/s)	Density (Assumed) (g/cm ³)	Shear Modulus (MPa)	Poisson's Ratio	Young's Modulus (MPa)	Bulk Modulus (MPa)
0 to 1	1708	497	2.0	494	0.45	1436	5176
1 to 2	3226	1301	2.5	4232	0.40	11873	20376
2 to 6	5231	2894	2.5	20938	0.28	53579	40491

Table 3: BH14 -Arrival Time Data and Interval Calculations

Geophone Depth (m)	P-wave Arrival Time (ms)	S-Wave Arrival Time (ms)	Slant-Distance P-wave (m)	Slant-Distance S-wave (m)	Interval Velocity P-wave (m/s)	Interval Velocity S-wave (m/s)	Density (assumed) (g/cm ³)	Shear Modulus (MPa)	Poisson's Ratio	Young's Modulus (MPa)	Bulk Modulus (MPa)
0.7	0.58	1.48	0.99	0.99	1707	669	2	895	0.41	2522	4633
1.7	1.21	2.76	1.84	1.84	1347	663	2	879	0.34	2356	2456
2.7	1.61	4.17	2.79	2.79	2377	674	2	909	0.46	2649	10087
3.7	2.28	5.57	3.77	3.77	1457	697	2.5	1216	0.35	3287	3688
4.7	2.49	6.21	4.75	4.75	4696	1541	2.5	5936	0.44	17093	47221
5.7	2.67	6.56	5.74	5.74	5505	2831	2.5	20042	0.32	52918	49053
6.7	2.90	6.92	6.74	6.74	4320	2760	2.5	19046	0.16	44001	21266
7.7	3.12	7.28	7.73	7.73	4524	2765	2.5	19109	0.20	45936	25689
8.7	3.33	7.65	8.73	8.73	4745	2693	2.5	18129	0.26	45772	32106
9.7	3.55	8.02	9.73	9.73	4532	2695	2.5	18156	0.23	44539	27147

Table 4: BH14 Modelled Data Summary and Elastic Moduli Calculation Results

Depth Interval (m)	P-wave Velocity (m/s)	S-wave Velocity (m/s)	Density (Assumed) (g/cm ³)	Shear Modulus (MPa)	Poisson's Ratio	Young's Modulus (MPa)	Bulk Modulus (MPa)
0 to 3	1546	660	2.0	871	0.39	2419	3619
3 to 4	2608	802	2.5	1608	0.45	4656	14860
4 to 8	4732	2702	2.5	18252	0.26	45926	31644
8 to 10	4285	2501	2.5	15638	0.24	38833	25053

Appendix F

F – Chemical Certificates of Analysis



Your Project #: 30192375.01
 Site Location: IQALUIT LTWP
 Your C.O.C. #: C#1016532-01-01

Attention: Charles Gravelle

ARCADIS Canada Inc
 500-333 Preston Street
 Ottawa, ON
 CANADA K1S 5N4

Report Date: 2024/10/11
 Report #: R8358535
 Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C4V7016

Received: 2024/10/08, 10:40

Sample Matrix: Ground Water
 # Samples Received: 2

Analyses	Quantity	Date	Date	Laboratory Method	Analytical Method
		Extracted	Analyzed		
Chloride by Automated Colourimetry (1)	2	N/A	2024/10/11	CAM SOP-00463	SM 24 4500-CI E m
pH (1, 2)	2	2024/10/10	2024/10/11	CAM SOP-00413	SM 24th - 4500H+ B
Sulphate by Automated Turbidimetry (1)	2	N/A	2024/10/11	CAM SOP-00464	SM 24 4500-SO42- E m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, EPA, APHA or the Quebec Ministry of Environment.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by Bureau Veritas Mississauga, 6740 Campobello Rd , Mississauga, ON, L5N 2L8

(2) "The CCME method and Analytical Protocol (O. Reg 153/04, O. Reg. 406/19) requires pH to be analyzed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the CCME and Analytical Protocol (O. Reg 153/04, O. Reg. 406/19) holding time. Bureau Veritas endeavors to analyze samples as soon as possible after receipt."



Your Project #: 30192375.01
Site Location: IQALUIT LTWP
Your C.O.C. #: C#1016532-01-01

Attention: Charles Gravelle

ARCADIS Canada Inc
500-333 Preston Street
Ottawa, ON
CANADA K1S 5N4

Report Date: 2024/10/11
Report #: R8358535
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C4V7016

Received: 2024/10/08, 10:40

Encryption Key

Please direct all questions regarding this Certificate of Analysis to:
Katherine Szozda, Project Manager
Email: Katherine.Szozda@bureauveritas.com
Phone# (613)274-0573 Ext:7063633

=====
This report has been generated and distributed using a secure automated process.
Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation, please refer to the Validation Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by Rodney Major, General Manager responsible for Ontario Environmental laboratory operations.



BUREAU
VERITAS

Bureau Veritas Job #: C4V7016
Report Date: 2024/10/11

ARCADIS Canada Inc
Client Project #: 30192375.01
Site Location: IQALUIT LTWP
Sampler Initials: EH

RESULTS OF ANALYSES OF GROUND WATER

Bureau Veritas ID		AFHN15	AFHN16	AFHN16		
Sampling Date		2024/10/05 10:40	2024/10/05 11:00	2024/10/05 11:00		
COC Number		C#1016532-01-01	C#1016532-01-01	C#1016532-01-01		
	UNITS	MW2023-4	MW2023-5	MW2023-5 Lab-Dup	RDL	QC Batch
Inorganics						
pH	pH	7.45	7.23	7.27		9695939
Dissolved Sulphate (SO4)	mg/L	1.2	1.6	1.6	1.0	9695948
Dissolved Chloride (Cl-)	mg/L	<1.0	<1.0	<1.0	1.0	9695943
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Lab-Dup = Laboratory Initiated Duplicate						



BUREAU
VERITAS

Bureau Veritas Job #: C4V7016
Report Date: 2024/10/11

ARCADIS Canada Inc
Client Project #: 30192375.01
Site Location: IQALUIT LTWP
Sampler Initials: EH

TEST SUMMARY

Bureau Veritas ID: AFHN15
Sample ID: MW2023-4
Matrix: Ground Water

Collected: 2024/10/05
Shipped:
Received: 2024/10/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	SKAL	9695943	N/A	2024/10/11	Massarat Jan
pH	AT	9695939	2024/10/10	2024/10/11	Kien Tran
Sulphate by Automated Turbidimetry	SKAL	9695948	N/A	2024/10/11	Massarat Jan

Bureau Veritas ID: AFHN16
Sample ID: MW2023-5
Matrix: Ground Water

Collected: 2024/10/05
Shipped:
Received: 2024/10/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	SKAL	9695943	N/A	2024/10/11	Massarat Jan
pH	AT	9695939	2024/10/10	2024/10/11	Kien Tran
Sulphate by Automated Turbidimetry	SKAL	9695948	N/A	2024/10/11	Massarat Jan

Bureau Veritas ID: AFHN16 Dup
Sample ID: MW2023-5
Matrix: Ground Water

Collected: 2024/10/05
Shipped:
Received: 2024/10/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	SKAL	9695943	N/A	2024/10/11	Massarat Jan
pH	AT	9695939	2024/10/10	2024/10/11	Kien Tran
Sulphate by Automated Turbidimetry	SKAL	9695948	N/A	2024/10/11	Massarat Jan



BUREAU
VERITAS

Bureau Veritas Job #: C4V7016
Report Date: 2024/10/11

ARCADIS Canada Inc
Client Project #: 30192375.01
Site Location: IQALUIT LTWP
Sampler Initials: EH

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	1.7°C
-----------	-------

Results relate only to the items tested.



BUREAU
VERITAS

Bureau Veritas Job #: C4V7016

Report Date: 2024/10/11

QUALITY ASSURANCE REPORT

ARCADIS Canada Inc

Client Project #: 30192375.01

Site Location: IQALUIT LTWP

Sampler Initials: EH

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
9695939	pH	2024/10/11			101	98 - 103			0.64	N/A
9695943	Dissolved Chloride (Cl-)	2024/10/11	91	80 - 120	94	80 - 120	<1.0	mg/L	NC	20
9695948	Dissolved Sulphate (SO4)	2024/10/11	92	75 - 125	96	80 - 120	<1.0	mg/L	2.1	20

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).



BUREAU
VERITAS

Bureau Veritas Job #: C4V7016
Report Date: 2024/10/11

ARCADIS Canada Inc
Client Project #: 30192375.01
Site Location: IQALUIT LTWP
Sampler Initials: EH

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Cristina Carriere

Cristina Carriere, Senior Scientific Specialist

Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation, please refer to the Validation Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by Rodney Major, General Manager responsible for Ontario Environmental laboratory operations.

C4V7016
2024/10/08 10:40

IMMEDIATE

Bureau Veritas
0740 Campbell Road, Mississauga, Ontario Canada L4N 2T8 Tel: (905) 817-6700 Toll-free: 800-563-6286 Fax: (905) 817-5777 www.bvna.com

Received in Ottawa

Page 1 of 1



NONT-2024-10-2142

Only:

INVOICE TO:
Company Name: #10988 ARCADIS Canada Inc
Attention: Accounts Payable Canada
Address: 500-333 Preston Street
Ottawa ON K1S 5N4
Tel: (613) 721-0555 Fax: (613) 721-0029
Email: invoices_ca@arcadis.com

REPORT TO:
Company Name:
Attention: Charles Gravelle
Address:
Tel:
Email: charles.gravelle@arcadis.com

PROJECT INFORMATION:
Quotation #: C35903
P.O. #:
Project: 30192375.01
Project Name:
Site #:
Sampled By: *Lydia + LTPD Elliott Holden*

Bottle Order #:
1015532
Project Manager:
Katherine Szozda

COC #:
011016632 01 01

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BUREAU VERITAS DRINKING WATER CHAIN OF CUSTODY.

Regulation 153 (2011)	Other Regulations	Special Instructions
<input type="checkbox"/> Table 1 <input type="checkbox"/> Res/Park <input type="checkbox"/> Medium/Fine <input type="checkbox"/> Table 2 <input type="checkbox"/> Ind/Comm <input type="checkbox"/> Coarse <input type="checkbox"/> Table 3 <input type="checkbox"/> Agr/Other <input type="checkbox"/> For RSC <input type="checkbox"/> Table _____	<input type="checkbox"/> CCME <input type="checkbox"/> Sanitary Sewer Bylaw <input type="checkbox"/> Reg 556 <input type="checkbox"/> Storm Sewer Bylaw <input type="checkbox"/> MISA <input type="checkbox"/> Municipality _____ <input type="checkbox"/> PWOD <input type="checkbox"/> Reg 400 Table _____ <input type="checkbox"/> Other _____	<i>* Also send report to Jacob.holden@arcadis.com</i>

ANALYSIS REQUESTED (PLEASE BE SPECIFIC):

Field Filtered (please circle): Metals / Hg / Cr / VI	Suppressed by Automated Turbidity	Suppressed by Automated Conductivity
X	X	X
X	X	X

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects.

Regular (Standard) TAT:
(will be applied if Rush TAT is not specified)
Standard TAT = 5 - 7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dissolved Phosphorus are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (it applies to entire submission)
Date Required: _____ Time Required: _____
Rush Confirmation Number: _____ (call lab for #)

Sample Container Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr / VI	Suppressed by Automated Turbidity	Suppressed by Automated Conductivity	# of Bottles	Comments
	MW2023-4	24/10/05	10:40	GW	X	X	X	1	
	MW2023-5	24/10/05	11:00	GW	X	X	X	1	

Received in Ottawa

ICE PACKS

* RELINQUISHED BY: (Signature/Print) <i>Elliott Holden</i>	Date: (YY/MM/DD) 24/10/08	Time 10:20	RECEIVED BY: (Signature/Print) <i>Katherine Szozda</i>	Date: (YY/MM/DD) 2024/10/08	Time 10:40	# jars used and not submitted	Laboratory Use Only
						Time Sensitive	Temperature (°C) on Receipt 11.3
						Custody Seal Present	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
						Custody Seal Intact	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BUREAU VERITAS'S STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVNA.COM/ENVIRONMENTAL-LABORATORIES/RESOURCES/COG-TERMS-AND-CONDITIONS.
* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.
** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVNA.COM/ENVIRONMENTAL-LABORATORIES/RESOURCES/CHAIN-CUSTODY-FORMS-COCS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BUREAU VERITAS

White: Bureau Veritas Yellow: Client
Custody Seal Present Intact
Seal, Media Yes No

CERTIFICATE OF ANALYSIS

Work Order : HA2401137
Client : Adaptive Baseline Geotechnical Ltd.
Contact : Matthew Shillington
Address : 17 Industrial Way
 Elmsdale NS Canada B2S 2L6
Telephone : ----
Project : LTWP - G2316
PO : ----
C-O-C number : 20-1021578
Sampler : ----
Site : ----
Quote number : Adaptive Baseline Geotechnical Ltd. Testing
No. of samples received : 2
No. of samples analysed : 2

Page : 1 of 4
Laboratory : ALS Environmental - Halifax
Account Manager : Virginia Smith
Address : 13-100 Wright Ave
 Dartmouth NS Canada B3B 1L2
Telephone : +1 902 707 4888
Date Samples Received : 22-May-2024 10:50
Date Analysis Commenced : 30-May-2024
Issue Date : 04-Jun-2024 22:35

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Laboratory Department</i>
Chau Tran	Analyst	Metals, Burnaby, British Columbia
Cindy Tang	Team Leader - Inorganics	Inorganics, Burnaby, British Columbia
Janice Leung	Supervisor - Organics Instrumentation	Organics, Burnaby, British Columbia
Miles Gropen	Department Manager - Inorganics	Inorganics, Burnaby, British Columbia
Owen Cheng		Metals, Burnaby, British Columbia



General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

<i>Unit</i>	<i>Description</i>
%	percent
µS/cm	microsiemens per centimetre
mg/L	milligrams per litre
mV	millivolts
pH units	pH units

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior 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.

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

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.



Analytical Results

Sub-Matrix: Rock/Rock Core

Client sample ID

(Matrix: Soil/Solid)

					BH 21, S6, 15' - 19'	BH 25, S2, 4' - 8'	----	----	----
Client sampling date / time					15-Mar-2024 00:00	23-Mar-2024 00:00	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	HA2401137-001	HA2401137-002	-----	-----	-----
					Result	Result	----	----	----
Physical Tests									
Acidity, leachable (as CaCO3)	----	E285/VA	4.0	mg/L	<4.0	<4.0	----	----	----
Conductivity, leachable	----	E103/VA	2.0	µS/cm	46.7	54.8	----	----	----
Moisture	----	E144/VA	0.25	%	0.55	1.33	----	----	----
Oxidation-reduction potential [ORP], leachable	----	E127/VA	0.10	mV	269	300	----	----	----
pH	----	E116/VA	0.10	pH units	7.69	7.67	----	----	----
Solids, total dissolved [TDS], calculated	----	EC103/VA	1.0	mg/L	39.7	58.8	----	----	----
Leachable Anions & Nutrients									
Alkalinity, total (as CaCO3), leachable	----	E294/VA	2.0	mg/L	22.7	26.6	----	----	----
Ammonia, total, leachable (as N)	7664-41-7	E300/VA	0.010	mg/L	<0.010	<0.010	----	----	----
Bromide, leachable	24959-67-9	E243.Br/VA	0.050	mg/L	<0.050	<0.050	----	----	----
Phosphorus, total dissolved	7723-14-0	E381/VA	0.0020	mg/L	0.0299	0.0508	----	----	----
Chloride, leachable	16887-00-6	E243.Cl/VA	0.50	mg/L	1.62	<0.50	----	----	----
Fluoride, leachable	16984-48-8	E243.F/VA	0.020	mg/L	0.138	0.362	----	----	----
Nitrite (as N), leachable	14797-65-0	E243.NO2/VA	0.0010	mg/L	<0.0010	<0.0010	----	----	----
Nitrate (as N), leachable	14797-55-8	E243.NO3/VA	0.010	mg/L	<0.010	<0.010	----	----	----
Sulfate, leachable	14808-79-8	E243.SO4/VA	0.50	mg/L	0.66	0.99	----	----	----
Leachable Metals									
Aluminum, leachable	7429-90-5	E446/VA	0.0050	mg/L	0.657	1.70	----	----	----
Antimony, leachable	7440-36-0	E446/VA	0.00010	mg/L	0.00064	0.00022	----	----	----
Arsenic, leachable	7440-38-2	E446/VA	0.0010	mg/L	0.0010	<0.0010	----	----	----
Barium, leachable	7440-39-3	E446/VA	0.0010	mg/L	0.0113	0.0134	----	----	----
Beryllium, leachable	7440-41-7	E446/VA	0.00050	mg/L	<0.00050	<0.00050	----	----	----
Bismuth, leachable	7440-69-9	E446/VA	0.00050	mg/L	<0.00050	<0.00050	----	----	----
Boron, leachable	7440-42-8	E446/VA	0.010	mg/L	0.020	0.035	----	----	----
Cadmium, leachable	7440-43-9	E446/VA	0.000050	mg/L	<0.000050	<0.000050	----	----	----
Calcium, leachable	7440-70-2	E446/VA	0.10	mg/L	4.83	5.40	----	----	----
Chromium, leachable	7440-47-3	E446/VA	0.00050	mg/L	0.00117	0.00192	----	----	----
Cobalt, leachable	7440-48-4	E446/VA	0.00010	mg/L	0.00033	0.00109	----	----	----
Copper, leachable	7440-50-8	E446/VA	0.0010	mg/L	0.0021	0.0035	----	----	----



Analytical Results

Sub-Matrix: Rock/Rock Core

Client sample ID

(Matrix: Soil/Solid)

					BH 21, S6, 15' - 19'	BH 25, S2, 4' - 8'	----	----	----
Client sampling date / time					15-Mar-2024 00:00	23-Mar-2024 00:00	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	HA2401137-001	HA2401137-002	-----	-----	-----
					Result	Result	---	---	---
Leachable Metals									
Iron, leachable	7439-89-6	E446/VA	0.030	mg/L	1.22	5.75	---	---	---
Lead, leachable	7439-92-1	E446/VA	0.00010	mg/L	0.00064	0.00061	---	---	---
Lithium, leachable	7439-93-2	E446/VA	0.0050	mg/L	0.0059	0.0118	---	---	---
Magnesium, leachable	7439-95-4	E446/VA	0.050	mg/L	1.41	2.92	---	---	---
Manganese, leachable	7439-96-5	E446/VA	0.00050	mg/L	0.0367	0.118	---	---	---
Mercury, leachable	7439-97-6	E515/VA	0.000050	mg/L	<0.000050	<0.000050	---	---	---
Molybdenum, leachable	7439-98-7	E446/VA	0.00010	mg/L	0.00170	0.00082	---	---	---
Nickel, leachable	7440-02-0	E446/VA	0.00050	mg/L	0.00052	0.00111	---	---	---
Phosphorus, leachable	7723-14-0	E446/VA	0.30	mg/L	<0.30	<0.30	---	---	---
Potassium, leachable	7440-09-7	E446/VA	0.050	mg/L	1.52	1.64	---	---	---
Selenium, leachable	7782-49-2	E446/VA	0.00050	mg/L	<0.00050	<0.00050	---	---	---
Silicon, leachable	7440-21-3	E446/VA	0.050	mg/L	4.43	8.12	---	---	---
Silver, leachable	7440-22-4	E446/VA	0.000050	mg/L	<0.000050	<0.000050	---	---	---
Sodium, leachable	7440-23-5	E446/VA	0.050	mg/L	1.98	1.96	---	---	---
Strontium, leachable	7440-24-6	E446/VA	0.00050	mg/L	0.0419	0.0122	---	---	---
Sulfur, leachable	7704-34-9	E446/VA	0.50	mg/L	<0.50	<0.50	---	---	---
Thallium, leachable	7440-28-0	E446/VA	0.00010	mg/L	<0.00010	<0.00010	---	---	---
Tin, leachable	7440-31-5	E446/VA	0.00050	mg/L	<0.00050	<0.00050	---	---	---
Titanium, leachable	7440-32-6	E446/VA	0.010	mg/L	0.017	0.061	---	---	---
Uranium, leachable	7440-61-1	E446/VA	0.000010	mg/L	0.00565	0.000109	---	---	---
Vanadium, leachable	7440-62-2	E446/VA	0.0010	mg/L	0.0023	0.0019	---	---	---
Zinc, leachable	7440-66-6	E446/VA	0.010	mg/L	<0.010	0.012	---	---	---
Hardness (as CaCO3), dissolved	----	E446/VA	0.60	mg/L	17.9	25.5	---	---	---

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

CERTIFICATE OF ANALYSIS

Work Order : **VA24A7965**
Client : **Adaptive Baseline Geotechnical Ltd.**
Contact : Matthew Shillington
Address : 17 Industrial Way
 Elmsdale NS Canada B2S 2L6
Telephone : ----
Project : IQA-G2316 (LTWP)
PO : ----
C-O-C number : 20-1021552
Sampler : ----
Site : ----
Quote number : Adaptive Baseline Geotechnical Ltd. Testing
No. of samples received : 7
No. of samples analysed : 2

Page : 1 of 4
Laboratory : ALS Environmental - Vancouver
Account Manager : Virginia Smith
Address : 8081 Lougheed Highway
 Burnaby BC Canada V5A 1W9
Telephone : +1 604 253 4188
Date Samples Received : 15-Apr-2024 08:25
Date Analysis Commenced : 22-Apr-2024
Issue Date : 08-May-2024 11:02

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Laboratory Department</i>
Ilmaz Badbezanchi	Supervisor - Metals Prep & Mercury	Metals, Burnaby, British Columbia
Kate Dimitrova	Supervisor - Inorganic	Inorganics, Burnaby, British Columbia
Owen Cheng		Metals, Burnaby, British Columbia
Rebecca Sit	Supervisor - Organics Extractions	Organics, Burnaby, British Columbia



General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

<i>Unit</i>	<i>Description</i>
%	percent
µS/cm	microsiemens per centimetre
mg/L	milligrams per litre
mV	millivolts
pH units	pH units

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior 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.

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

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Workorder Comments

Samples composited according to client instructions: Combine all 3 sample bags from BH3 together and combine 2 sample bags from BH14 together.



Analytical Results

Sub-Matrix: Crushed Rock

Client sample ID

(Matrix: Soil/Solid)

					BH14 Composite	BH3 Composite	----	----	----
Client sampling date / time					15-Feb-2024 00:00	16-Feb-2024 00:00	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	VA24A7965-006 Result	VA24A7965-007 Result	-----	-----	-----
Physical Tests									
Acidity, leachable (as CaCO3)	----	E285/VA	4.0	mg/L	<4.0	<4.0	----	----	----
Conductivity, leachable	----	E103/VA	2.0	µS/cm	37.8	45.4	----	----	----
Moisture	----	E144/VA	0.25	%	3.48	0.55	----	----	----
Oxidation-reduction potential [ORP], leachable	----	E127/VA	0.10	mV	222	216	----	----	----
pH	----	E116/VA	0.10	pH units	8.11	8.61	----	----	----
Solids, total dissolved [TDS], calculated	----	EC103/VA	1.0	mg/L	40.3	32.4	----	----	----
Leachable Anions & Nutrients									
Alkalinity, total (as CaCO3), leachable	----	E294/VA	2.0	mg/L	15.8	22.5	----	----	----
Ammonia, total, leachable (as N)	7664-41-7	E300/VA	0.010	mg/L	<0.010	<0.010	----	----	----
Bromide, leachable	24959-67-9	E243.Br/VA	0.050	mg/L	<0.050	<0.050	----	----	----
Phosphorus, total dissolved	7723-14-0	E381/VA	0.0020	mg/L	0.0194	0.0226	----	----	----
Chloride, leachable	16887-00-6	E243.Cl/VA	0.50	mg/L	0.84	0.73	----	----	----
Fluoride, leachable	16984-48-8	E243.F/VA	0.020	mg/L	0.112	0.038	----	----	----
Nitrite (as N), leachable	14797-65-0	E243.NO2/VA	0.0010	mg/L	<0.0010	<0.0010	----	----	----
Nitrate (as N), leachable	14797-55-8	E243.NO3/VA	0.010	mg/L	<0.010	<0.010	----	----	----
Sulfate, leachable	14808-79-8	E243.SO4/VA	0.50	mg/L	1.24	<0.50	----	----	----
Leachable Metals									
Aluminum, leachable	7429-90-5	E446/VA	0.0050	mg/L	1.16	0.306	----	----	----
Antimony, leachable	7440-36-0	E446/VA	0.00010	mg/L	0.00040	0.00412	----	----	----
Arsenic, leachable	7440-38-2	E446/VA	0.0010	mg/L	<0.0010	<0.0010	----	----	----
Barium, leachable	7440-39-3	E446/VA	0.0010	mg/L	0.0165	0.0033	----	----	----
Beryllium, leachable	7440-41-7	E446/VA	0.00050	mg/L	<0.00050	<0.00050	----	----	----
Bismuth, leachable	7440-69-9	E446/VA	0.00050	mg/L	<0.00050	<0.00050	----	----	----
Boron, leachable	7440-42-8	E446/VA	0.010	mg/L	0.062	0.067	----	----	----
Cadmium, leachable	7440-43-9	E446/VA	0.000050	mg/L	<0.000050	<0.000050	----	----	----
Calcium, leachable	7440-70-2	E446/VA	0.10	mg/L	3.55	5.16	----	----	----
Chromium, leachable	7440-47-3	E446/VA	0.00050	mg/L	<0.00050	<0.00050	----	----	----
Cobalt, leachable	7440-48-4	E446/VA	0.00010	mg/L	0.00088	0.00012	----	----	----
Copper, leachable	7440-50-8	E446/VA	0.0010	mg/L	0.0025	0.0051	----	----	----



Analytical Results

Sub-Matrix: Crushed Rock

Client sample ID

(Matrix: Soil/Solid)

					BH14 Composite	BH3 Composite	----	----	----
Client sampling date / time					15-Feb-2024 00:00	16-Feb-2024 00:00	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	VA24A7965-006	VA24A7965-007	-----	-----	-----
					Result	Result	---	---	---
Leachable Metals									
Iron, leachable	7439-89-6	E446/VA	0.030	mg/L	1.69	0.255	---	---	---
Lead, leachable	7439-92-1	E446/VA	0.00010	mg/L	0.00084	<0.00010	---	---	---
Lithium, leachable	7439-93-2	E446/VA	0.0050	mg/L	<0.0050	<0.0050	---	---	---
Magnesium, leachable	7439-95-4	E446/VA	0.050	mg/L	0.961	1.00	---	---	---
Manganese, leachable	7439-96-5	E446/VA	0.00050	mg/L	0.0526	0.0236	---	---	---
Mercury, leachable	7439-97-6	E515/VA	0.000050	mg/L	<0.000050	<0.000050	---	---	---
Molybdenum, leachable	7439-98-7	E446/VA	0.00010	mg/L	0.00308	0.00092	---	---	---
Nickel, leachable	7440-02-0	E446/VA	0.00050	mg/L	<0.00050	<0.00050	---	---	---
Phosphorus, leachable	7723-14-0	E446/VA	0.30	mg/L	<0.30	<0.30	---	---	---
Potassium, leachable	7440-09-7	E446/VA	0.050	mg/L	1.46	0.588	---	---	---
Selenium, leachable	7782-49-2	E446/VA	0.00050	mg/L	<0.00050	<0.00050	---	---	---
Silicon, leachable	7440-21-3	E446/VA	0.050	mg/L	6.36	3.21	---	---	---
Silver, leachable	7440-22-4	E446/VA	0.000050	mg/L	<0.000050	<0.000050	---	---	---
Sodium, leachable	7440-23-5	E446/VA	0.050	mg/L	2.55	2.13	---	---	---
Strontium, leachable	7440-24-6	E446/VA	0.00050	mg/L	0.0310	0.0370	---	---	---
Sulfur, leachable	7704-34-9	E446/VA	0.50	mg/L	<0.50	<0.50	---	---	---
Thallium, leachable	7440-28-0	E446/VA	0.00010	mg/L	<0.00010	<0.00010	---	---	---
Tin, leachable	7440-31-5	E446/VA	0.00050	mg/L	<0.00050	<0.00050	---	---	---
Titanium, leachable	7440-32-6	E446/VA	0.010	mg/L	0.013	<0.010	---	---	---
Uranium, leachable	7440-61-1	E446/VA	0.000010	mg/L	0.000114	0.000193	---	---	---
Vanadium, leachable	7440-62-2	E446/VA	0.0010	mg/L	<0.0010	<0.0010	---	---	---
Zinc, leachable	7440-66-6	E446/VA	0.010	mg/L	<0.010	<0.010	---	---	---
Hardness (as CaCO3), dissolved	----	E446/VA	0.60	mg/L	12.8	17.0	---	---	---

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

10-Apr-24

Adaptive Baseline Geotechnical Ltd.
17 Industrial Way
Elmsdale, NS
B2S 2L6
Atten: Lee Fougere

minerals.engineering.dal.ca
Tel: 902.497.3958
Email: mec@dal.ca

Re: Results of analysis on submitted samples.
Modified Acid Base Accounting - Lawrence

Sample	Wt. %			Paste pH	kg CaCO ₃ /t		
	S(Total)	Sulphate	Sulphide		AP	NP	Net NP
IQA-G2316 - Sample # 6	0.036	<0.001	0.036	8.35	1.13	4.92	3.79
IQA-G2316 - Sample # 7	0.048	<0.001	0.048	8.55	1.51	8.69	7.18
IQA-G2316 - Sample # 7 Dup.	0.043						

Certified Ref. Sa.	Wt. %			Paste pH	kg CaCO ₃ /t		
	S(Total)	Sulphate	Sulphide		AP	NP	Net NP
KZK-1 (0.80% S)	0.802				25.05	52.35	27.30

Daniel Chevalier, MASc
Manager, Minerals Engineering Laboratory

06-Jun-24

Adaptive Baseline Geotechnical Ltd.
17 Industrial Way
Elmsdale, NS
B2S 2L6
Atten: Lee Fougere

minerals.engineering.dal.ca
Tel: 902.497.3958
Email: mec@dal.ca

Re: Results of analysis on submitted samples.
Modified Acid Base Accounting - Lawrence

LTWP-PN G2316

Sample	Wt. %			Paste pH	kg CaCO ₃ /t		
	S(Total)	Sulphate	Sulphide		AP	NP	Net NP
BH21 S3 6.5-9 (March 15)	0.016	0.007	0.009	8.32	0.29	4.87	4.58
032324 BH25 S5 17-22	0.037	0.007	0.030	8.05	0.95	18.6	17.65

Certified Ref. Sa.	Wt. %
	S(Total)
KZK-1 (0.80% S)	0.796

Daniel Chevalier, MASc
Manager, Minerals Engineering Laboratory

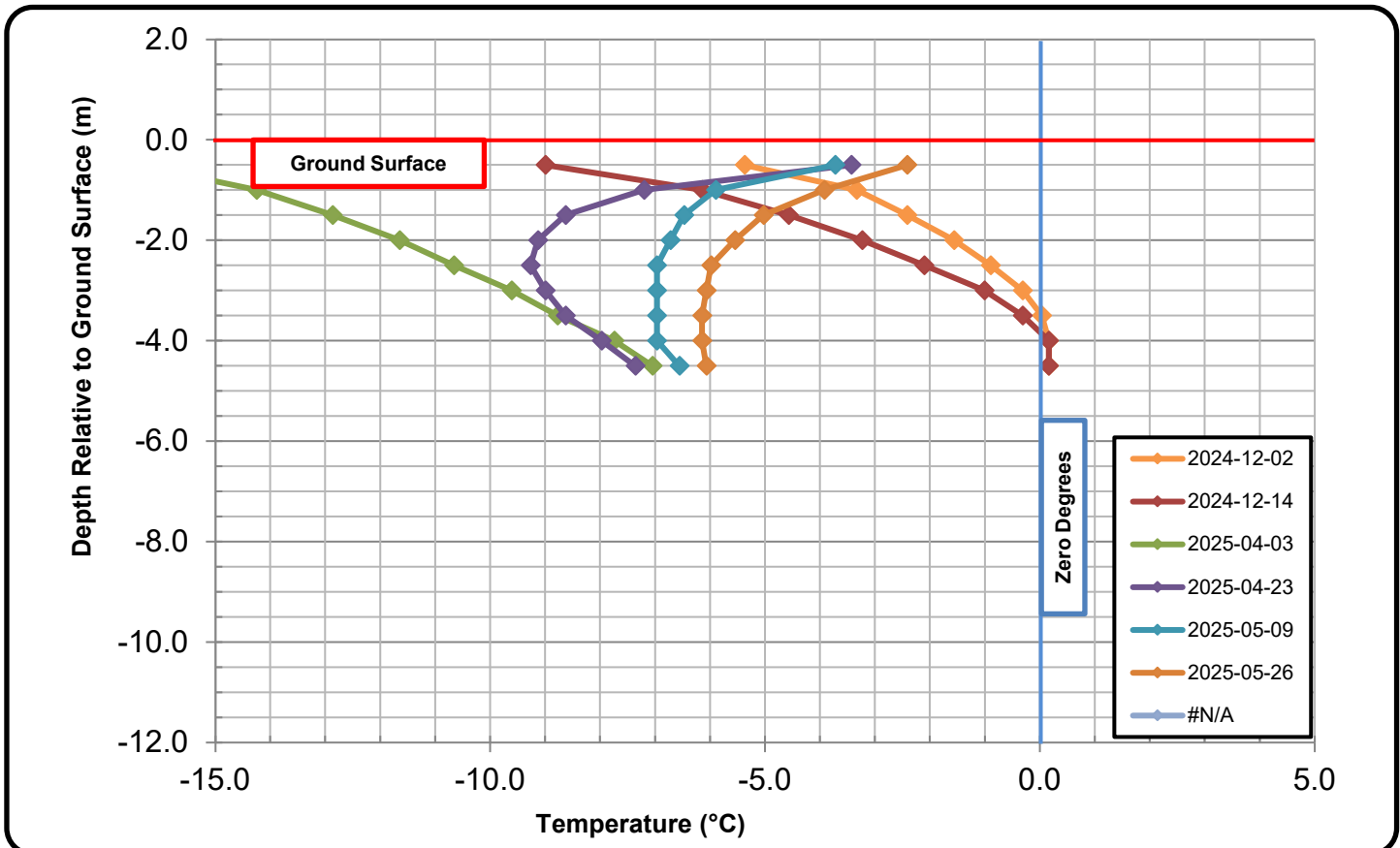
Appendix G

G – Thermistor Reports



Thermistor Report - T1

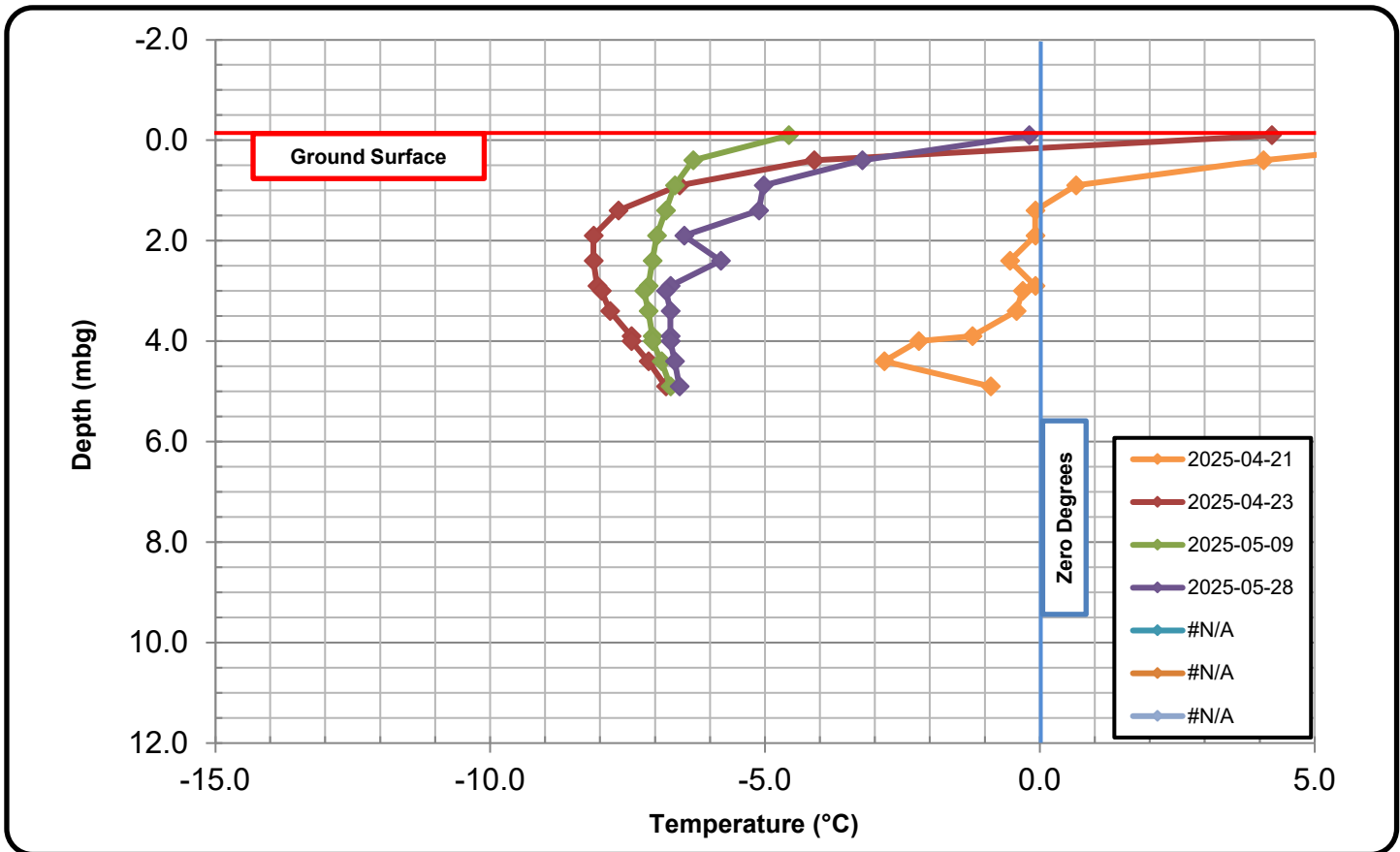
PROJECT No.:		IQA-G2316			THERMISTOR No.:		T1	
PROJECT NAME:		LTWP			DATE INSTALLED:		October 7, 2024	
PROJECT LOCATION:		Iqaluit			LOCATION:		BH2023-4b	
Date of Reading :		2024-12-02	2024-12-14	2025-04-03	2025-04-23	2025-05-09	2025-05-26	
Thermistor Bulb	Depth (m)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)
AIR	1.5							
1	-0.5	-5.4	-9.0	-16.4	-3.4	-3.7	-2.4	
2	-1.0	-3.3	-6.1	-14.3	-7.2	-5.9	-3.9	
3	-1.5	-2.4	-4.6	-12.9	-8.6	-6.5	-5.0	
4	-2.0	-1.6	-3.2	-11.6	-9.1	-6.7	-5.5	
5	-2.5	-0.9	-2.1	-10.7	-9.3	-7.0	-6.0	
6	-3.0	-0.3	-1.0	-9.6	-9.0	-7.0	-6.1	
7	-3.5	0.0	-0.3	-8.8	-8.6	-7.0	-6.1	
8	-4.0	0.2	0.2	-7.7	-8.0	-7.0	-6.1	
9	-4.5	0.2	0.2	-7.0	-7.4	-6.6	-6.1	
10								
11								
12								
13								





Thermistor Report - T2

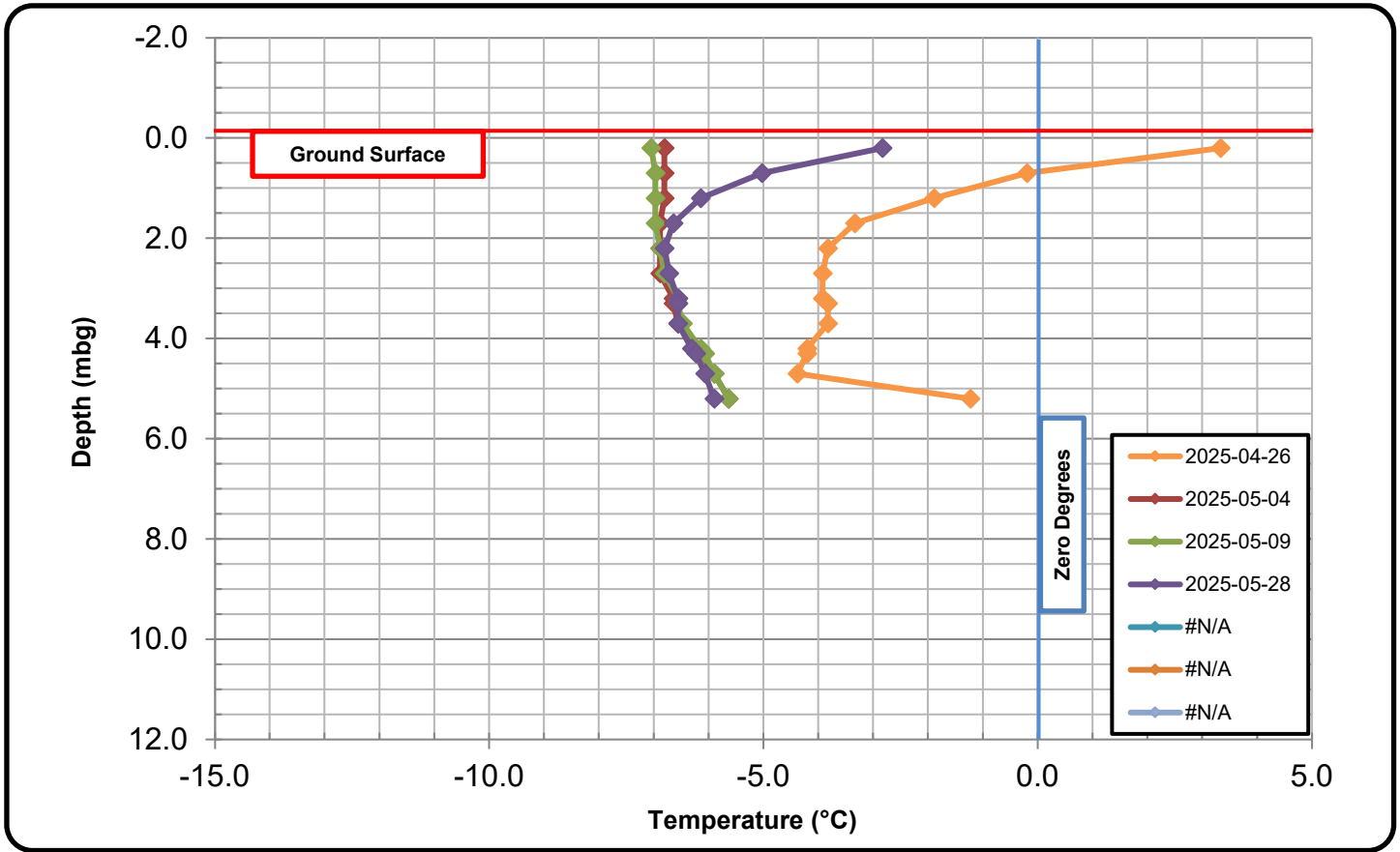
PROJECT No.:		IQA-G2316			THERMISTOR No.:		T2	
PROJECT NAME:		LTWP			DATE INSTALLED:		April 21, 2025	
PROJECT LOCATION:		Iqaluit			LOCATION:		BH2023-19b	
DATE OF READING:		2025-04-21	2025-04-23	2025-05-09	2025-05-28			
Thermistor Bulb	Depth (mbg)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)
1	-0.1	8.5	4.2	-4.6	-0.2			
2	0.4	4.1	-4.1	-6.3	-3.2			
3	0.9	0.7	-6.6	-6.6	-5.0			
4	1.4	-0.1	-7.7	-6.8	-5.1			
5	1.9	-0.1	-8.1	-7.0	-6.5			
6	2.4	-0.5	-8.1	-7.0	-5.8			
7	2.9	-0.1	-8.1	-7.1	-6.7			
8	3.0	-0.3	-8.0	-7.2	-6.8			
9	3.4	-0.4	-7.8	-7.1	-6.7			
10	3.9	-1.2	-7.4	-7.0	-6.7			
11	4.0	-2.2	-7.4	-7.0	-6.7			
12	4.4	-2.8	-7.1	-6.9	-6.6			
13	4.9	-0.9	-6.8	-6.7	-6.6			





Thermistor Report - T3

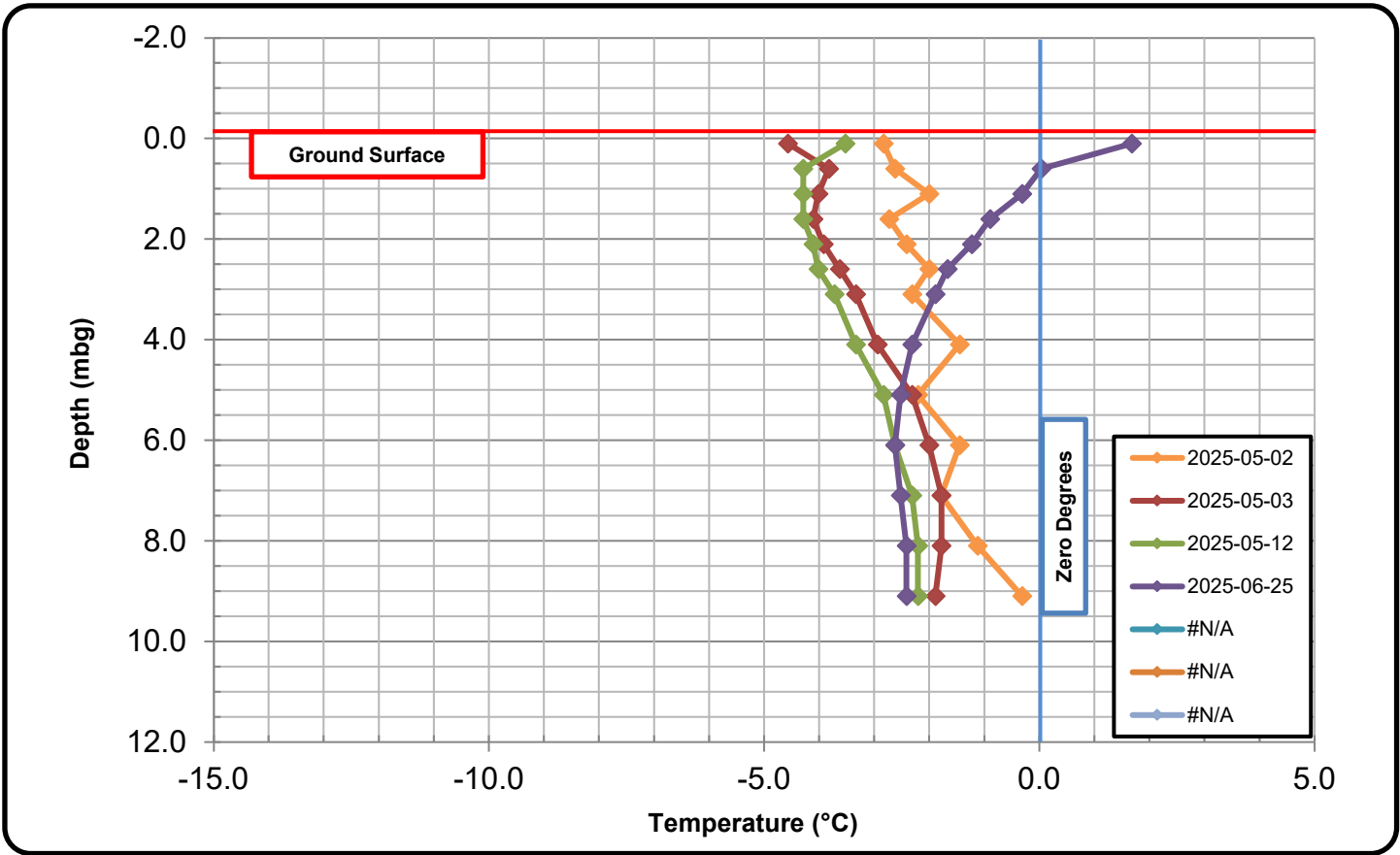
PROJECT No.:		IQA-G2316			THERMISTOR No.:		T3	
PROJECT NAME:		LTWP			DATE INSTALLED:		April 26, 2025	
PROJECT LOCATION:		Iqaluit			LOCATION:		BH2023-12b	
DATE OF READING:		2025-04-26	2025-05-04	2025-05-09	2025-05-28			
Thermistor Bulb	Depth (mbg)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)
1	0.2	3.3	-6.8	-7.0	-2.8			
2	0.7	-0.2	-6.8	-7.0	-5.0			
3	1.2	-1.9	-6.8	-7.0	-6.1			
4	1.7	-3.3	-6.9	-7.0	-6.6			
5	2.2	-3.8	-6.9	-6.9	-6.8			
6	2.7	-3.9	-6.9	-6.8	-6.7			
7	3.2	-3.9	-6.6	-6.6	-6.6			
8	3.3	-3.8	-6.6	-6.6	-6.6			
9	3.7	-3.8	-6.6	-6.5	-6.6			
10	4.2	-4.2	-6.2	-6.1	-6.3			
11	4.3	-4.2	-6.1	-6.1	-6.2			
12	4.7	-4.4	-5.9	-5.9	-6.1			
13	5.2	-1.2	-5.6	-5.6	-5.9			





Thermistor Report - T4

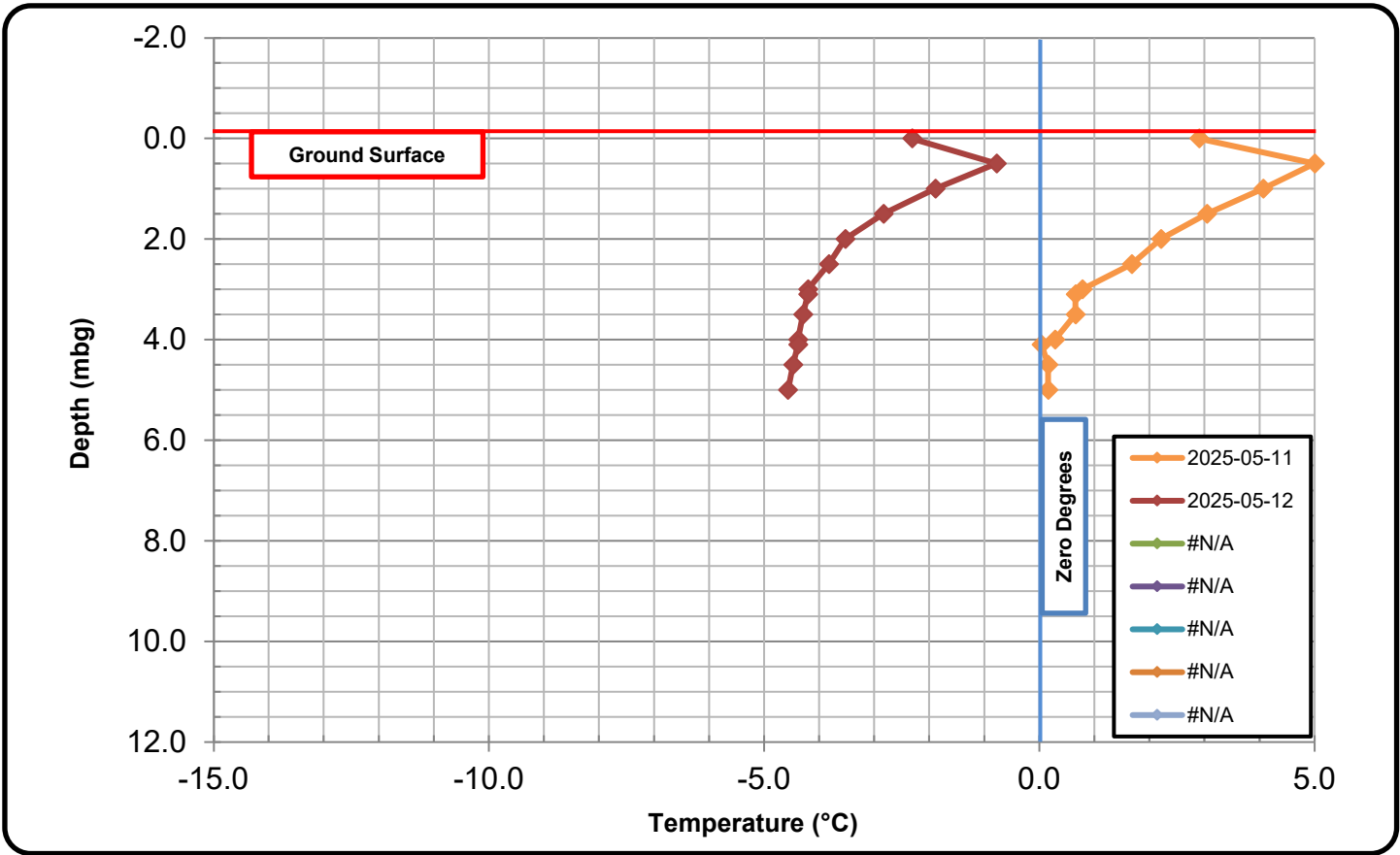
PROJECT No.:		IQA-G2316			THERMISTOR No.:		T4	
PROJECT NAME:		LTWP			DATE INSTALLED:		May 2, 2025	
PROJECT LOCATION:		Iqaluit			LOCATION:		APEX2025-05	
DATE OF READING:		2025-05-02	2025-05-03	2025-05-12	2025-06-25			
Thermistor Bulb	Depth (mbg)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)
1	0.1	-2.8	-4.6	-3.5	1.7			
2	0.6	-2.6	-3.8	-4.3	0.0			
3	1.1	-2.0	-4.0	-4.3	-0.3			
4	1.6	-2.7	-4.1	-4.3	-0.9			
5	2.1	-2.4	-3.9	-4.1	-1.2			
6	2.6	-2.0	-3.6	-4.0	-1.7			
7	3.1	-2.3	-3.3	-3.7	-1.9			
8	4.1	-1.5	-2.9	-3.3	-2.3			
9	5.1	-2.2	-2.3	-2.8	-2.5			
10	6.1	-1.5	-2.0	-2.6	-2.6			
11	7.1	-1.8	-1.8	-2.3	-2.5			
12	8.1	-1.1	-1.8	-2.2	-2.4			
13	9.1	-0.3	-1.9	-2.2	-2.4			





Thermistor Report - T5

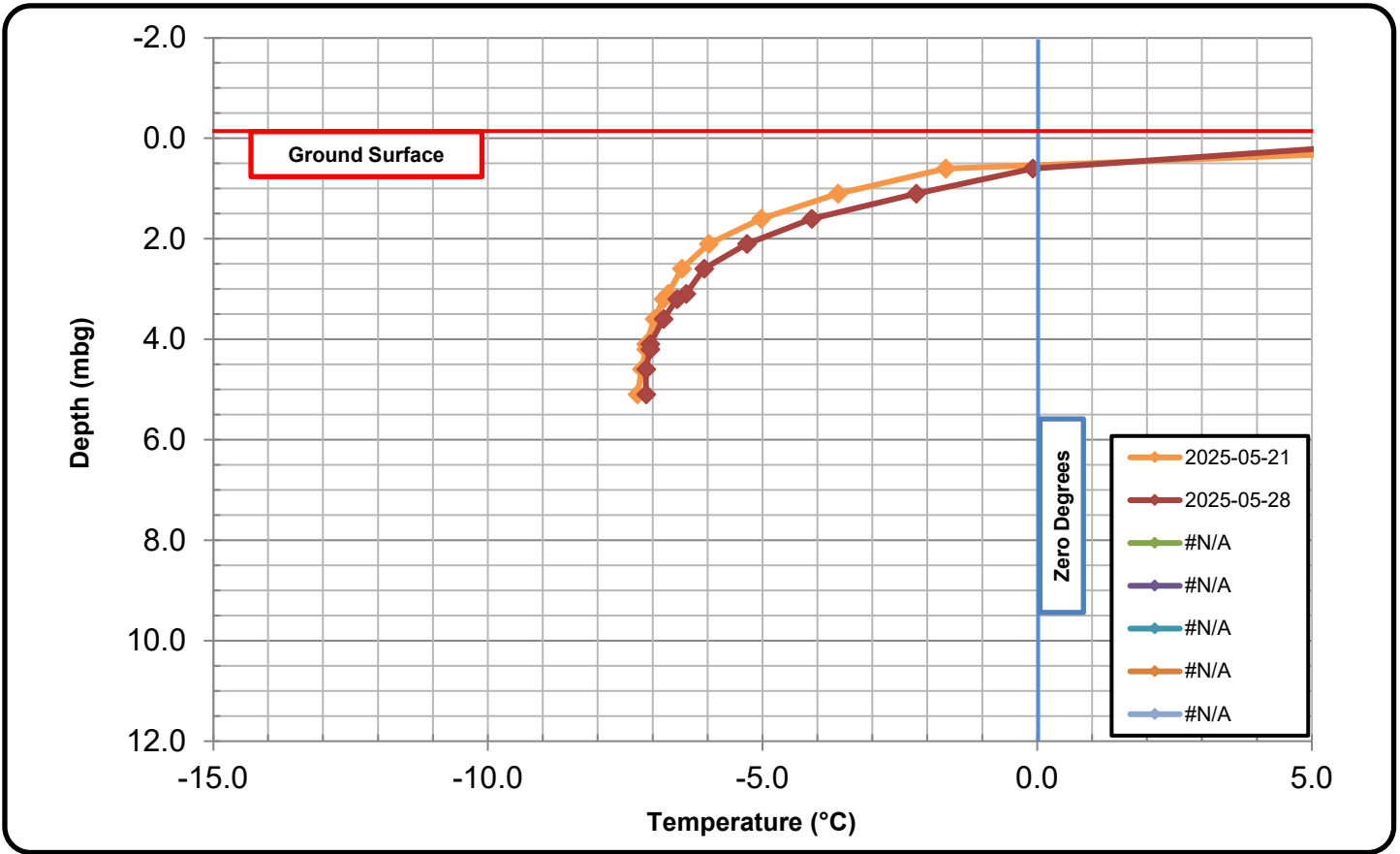
PROJECT No.:		IQA-G2316			THERMISTOR No.:		T5	
PROJECT NAME:		LTWP			DATE INSTALLED:		May 11, 2025	
PROJECT LOCATION:		Iqaluit			LOCATION:		BH2023-9b	
DATE OF READING:		2025-05-11	2025-05-12					
Thermistor Bulb	Depth (mbg)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)
1	0.0	2.9	-2.3					
2	0.5	5.0	-0.8					
3	1.0	4.1	-1.9					
4	1.5	3.0	-2.8					
5	2.0	2.2	-3.5					
6	2.5	1.7	-3.8					
7	3.0	0.8	-4.2					
8	3.1	0.7	-4.2					
9	3.5	0.7	-4.3					
10	4.0	0.3	-4.4					
11	4.1	0.0	-4.4					
12	4.5	0.2	-4.5					
13	5.0	0.2	-4.6					





Thermistor Report - T6

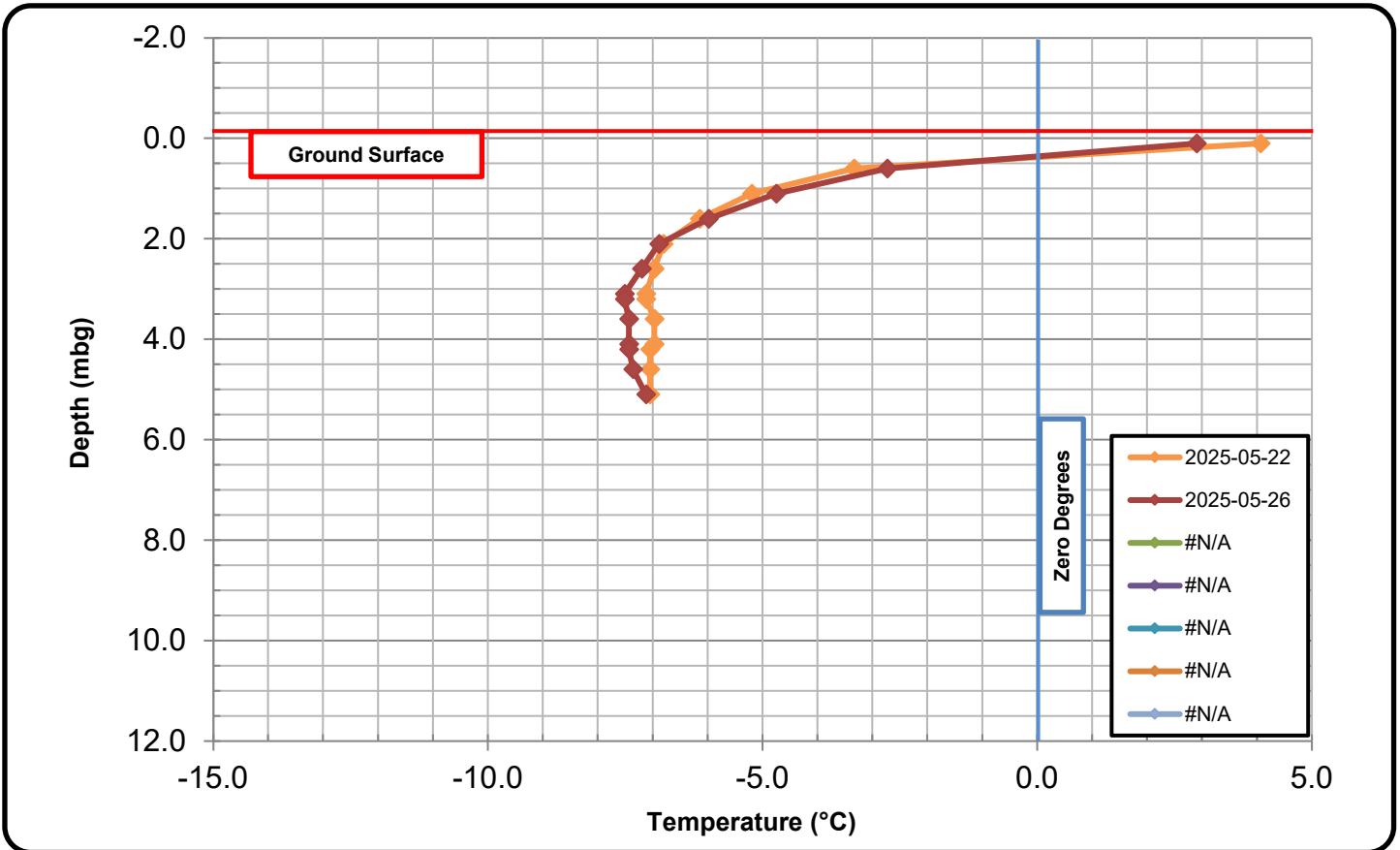
PROJECT No.:		IQA-G2316			THERMISTOR No.:		T6	
PROJECT NAME:		LTWP			DATE INSTALLED:		May 20, 2025	
PROJECT LOCATION:		Iqaluit			LOCATION:		BH2023-27b	
DATE OF READING:		2025-05-21	2025-05-28					
Thermistor Bulb	Depth (mbg)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)
1	0.1	10.5	6.5					
2	0.6	-1.7	-0.1					
3	1.1	-3.6	-2.2					
4	1.6	-5.0	-4.1					
5	2.1	-6.0	-5.3					
6	2.6	-6.5	-6.1					
7	3.1	-6.7	-6.4					
8	3.2	-6.8	-6.6					
9	3.6	-7.0	-6.8					
10	4.1	-7.1	-7.0					
11	4.2	-7.1	-7.0					
12	4.6	-7.2	-7.1					
13	5.1	-7.3	-7.1					





Thermistor Report - T7

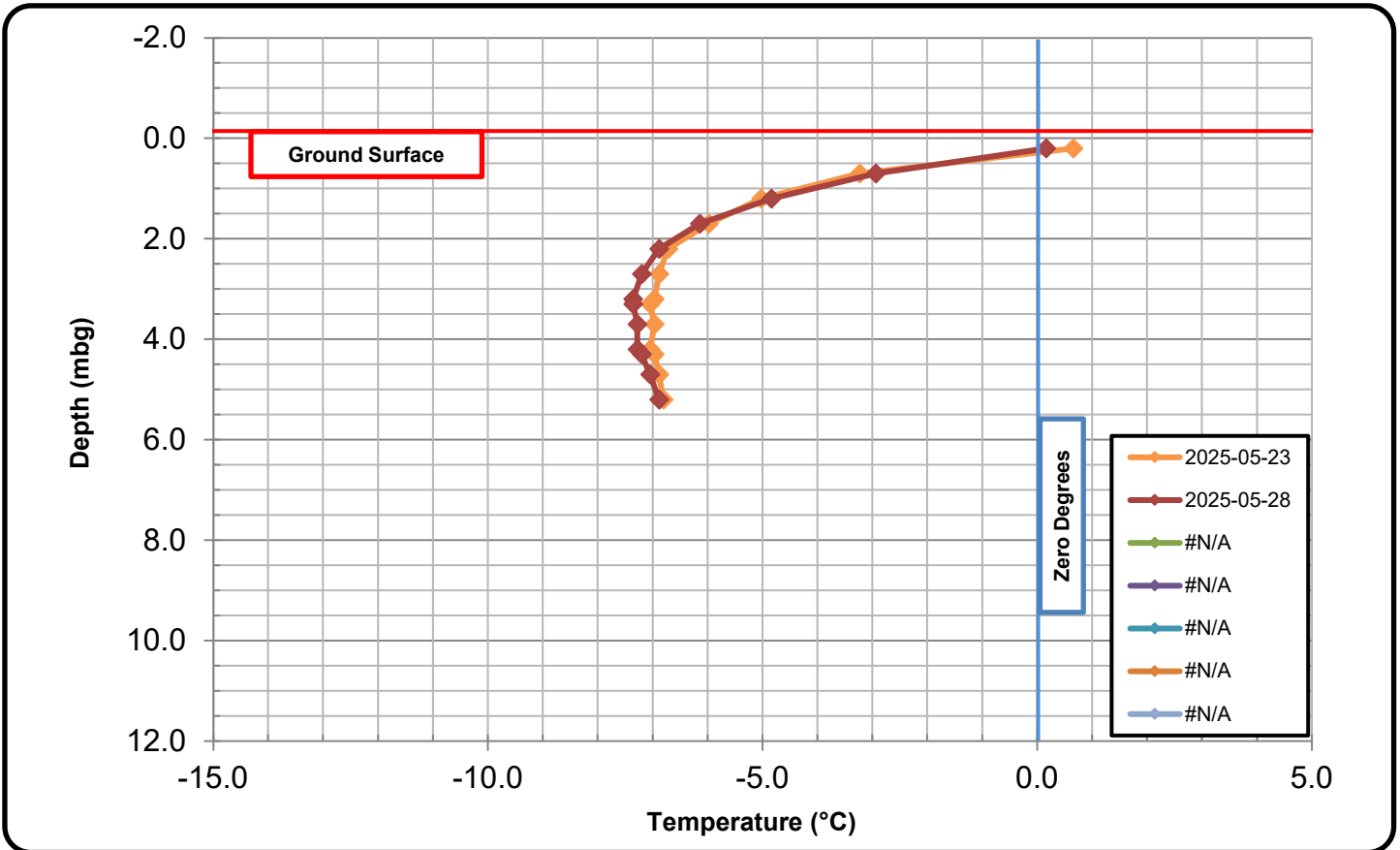
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PROJECT NAME:		LTWP			DATE INSTALLED:		May 21, 2025	
PROJECT LOCATION:		Iqaluit			LOCATION:		BH2023-1b	
DATE OF READING:		2025-05-22	2025-05-26					
Thermistor Bulb	Depth (mbg)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)
1	0.1	4.1	2.9					
2	0.6	-3.3	-2.7					
3	1.1	-5.2	-4.8					
4	1.6	-6.1	-6.0					
5	2.1	-6.8	-6.9					
6	2.6	-7.0	-7.2					
7	3.1	-7.1	-7.5					
8	3.2	-7.1	-7.5					
9	3.6	-7.0	-7.4					
10	4.1	-7.0	-7.4					
11	4.2	-7.0	-7.4					
12	4.6	-7.0	-7.4					
13	5.1	-7.0	-7.1					





Thermistor Report - T8

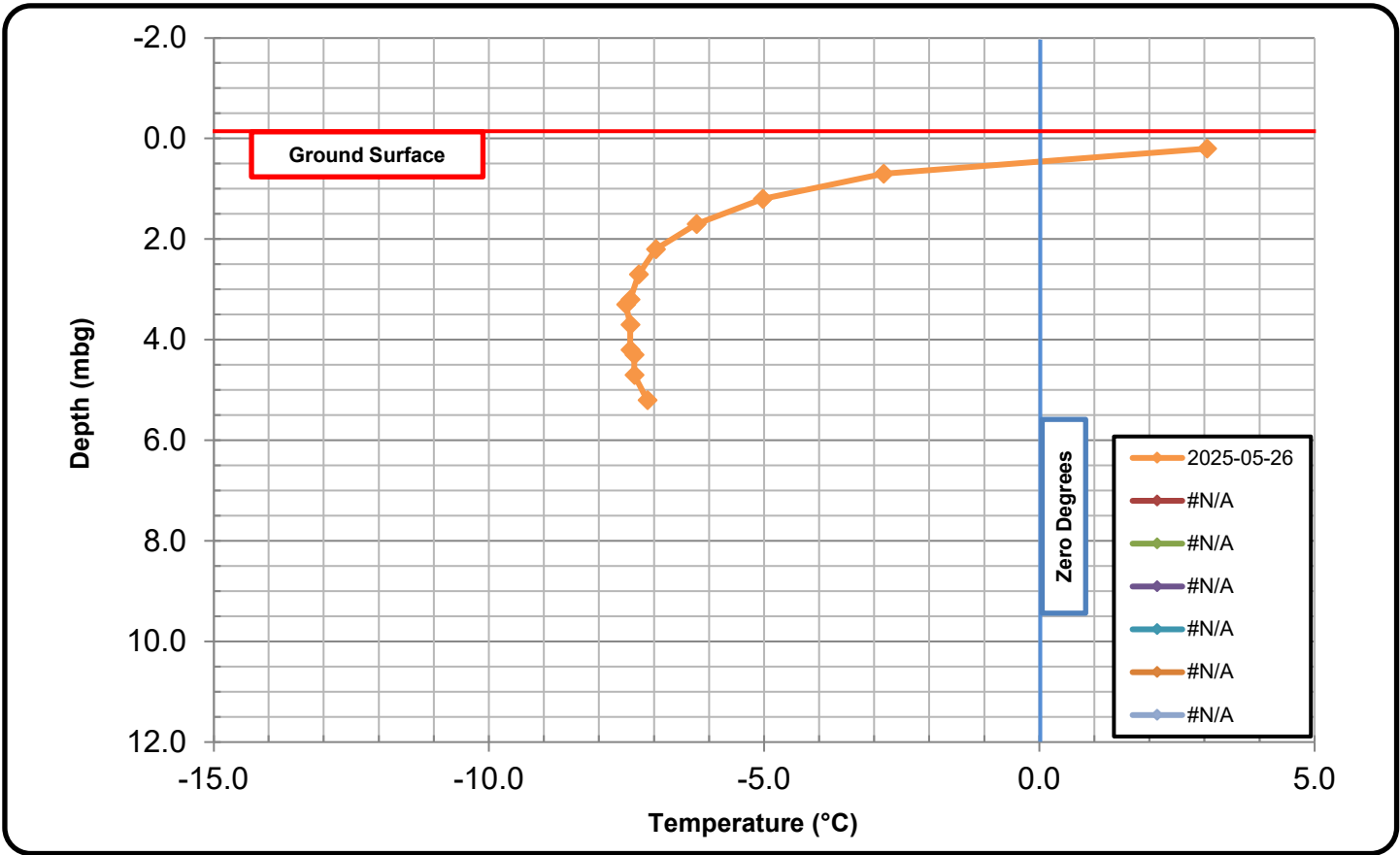
PROJECT No.:		IQA-G2316			THERMISTOR No.:		T8	
PROJECT NAME:		LTWP			DATE INSTALLED:		May 22, 2025	
PROJECT LOCATION:		Iqaluit			LOCATION:		BH2023-13b-2	
DATE OF READING:		2025-05-23	2025-05-28					
Thermistor Bulb	Depth (mbg)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)
1	0.2	0.7	0.2					
2	0.7	-3.2	-2.9					
3	1.2	-5.0	-4.8					
4	1.7	-6.0	-6.1					
5	2.2	-6.7	-6.9					
6	2.7	-6.9	-7.2					
7	3.2	-7.0	-7.4					
8	3.3	-7.0	-7.4					
9	3.7	-7.0	-7.3					
10	4.2	-7.0	-7.3					
11	4.3	-7.0	-7.2					
12	4.7	-6.9	-7.0					
13	5.2	-6.8	-6.9					





Thermistor Report - T9

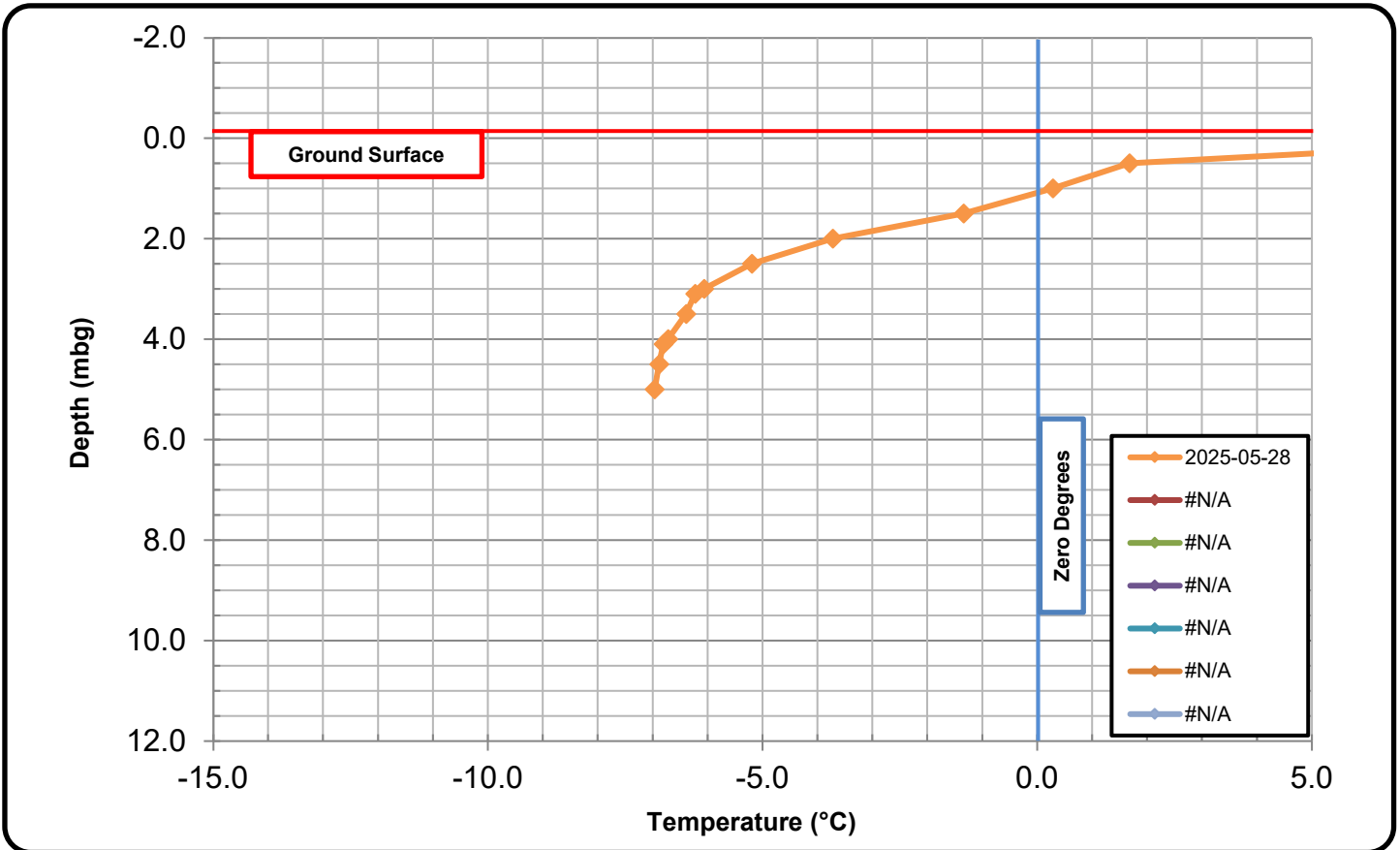
PROJECT No.:		IQA-G2316			THERMISTOR No.:		T9	
PROJECT NAME:		LTWP			DATE INSTALLED:		May 24, 2025	
PROJECT LOCATION:		Iqaluit			LOCATION:		BH2023-15b-2	
DATE OF READING:		2025-05-26						
Thermistor Bulb	Depth (mbg)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)
1	0.2	3.0						
2	0.7	-2.8						
3	1.2	-5.0						
4	1.7	-6.2						
5	2.2	-7.0						
6	2.7	-7.3						
7	3.2	-7.4						
8	3.3	-7.5						
9	3.7	-7.4						
10	4.2	-7.4						
11	4.3	-7.4						
12	4.7	-7.4						
13	5.2	-7.1						





Thermistor Report - T10

PROJECT No.:		IQA-G2316			THERMISTOR No.:		T10	
PROJECT NAME:		LTWP			DATE INSTALLED:		May 27, 2025	
PROJECT LOCATION:		Iqaluit			LOCATION:		BH2023-28b-2	
DATE OF READING:		2025-05-28						
Thermistor Bulb	Depth (mbg)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)
1	0.0	10.1						
2	0.5	1.7						
3	1.0	0.3						
4	1.5	-1.3						
5	2.0	-3.7						
6	2.5	-5.2						
7	3.0	-6.1						
8	3.1	-6.2						
9	3.5	-6.4						
10	4.0	-6.7						
11	4.1	-6.8						
12	4.5	-6.9						
13	5.0	-7.0						



Appendix H

**H – Apex River Pump Station and Pipeline Crossing
Investigation Report**

GEOTECHNICAL INVESTIGATION

APEX RIVER LTWP PUMP STATION & PIPELINE CROSSING

IQALUIT, NU

FINAL REPORT

PREPARED FOR:

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PROJECT NUMBER:

IQA-G2316

SUBMITTED:

June 27, 2025





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Statement of General Conditions



1.0 Introduction

Adaptive Baseline Geotechnical Limited (ABG) has carried out the following geotechnical investigation of a pump station and pipeline crossing site in Iqaluit, NU as part of the long term water program (LTWP). The geotechnical investigation presented herein has been carried out in general accordance with the most recent editions of the National Standard of Canada CAN/BNQ 2501-500/2017 *Geotechnical Site Investigations for Building Foundations in Permafrost* and Canada Standards Association (CSA) PLUS 4011:19 *TECHNICAL GUIDE Infrastructure in permafrost: A guide for climate change adaptation*.

ABG's geotechnical personnel conducted a site-specific geotechnical borehole drilling program as part of this investigation. All third-party information reviewed by ABG has been taken at face value.

2.0 Project Background and Understanding

It is currently understood that a new pump station and pipeline crossing are to be constructed at the site. The site location is shown on Figure 1. The purpose of the geotechnical investigation presented herein is to assess the surface/subsurface conditions at the site and provide geotechnical recommendations to support the design and construction of the pump station and pipeline crossing foundations, associated roadway/parking areas and general site grading.

3.0 Scope of Services

Based on our current understanding of the project requirements, the following scope of services was completed for this portion of the project:

- **Compilation and Review of Available Information:** ABG compiled and reviewed available information related to climate, site topography, surface drainage features and subsurface conditions.
- **Geotechnical Field Program:** A field engineer from ABG visited the site and conducted a geotechnical field program using a local air-rotary drill rig. The primary objective was to assess subsurface conditions throughout the site and evaluate the presence of ice-rich soils and depth to bedrock.
- **Laboratory Testing:** ABG conducted a laboratory testing program sufficient to classify the soils encountered, verify in-situ moisture/ice contents, gradations and porewater salinity.
- **Geotechnical Reporting:** ABG prepared this geotechnical report summarizing the observations and findings of the borehole investigation and laboratory testing program with recommendations to support the design and construction of the pump station and pipeline crossing foundations as well as any associated roadway/parking areas and general site grading required.



4.0 Available Information

ABG has reviewed the following available information as part of this geotechnical investigation:

1. (ABG, 2024). Geotechnical Investigation, Astro Hill Lookout Development, Iqaluit, NU;
2. (CGD, 2023). Pile installation Summary Report and Laboratory Testing, Astro Hill Gate, Iqaluit, NU;
3. (ABG, 2022a). Geotechnical Investigation, 2022 Drainage Improvements, Iqaluit, NU;
4. (ABG, 2022b). Pile Installation Monitoring and Laboratory Testing, Frobisher Inn Building Addition, Lot 4-2-1-1, Plan 697, Iqaluit, NU;
5. (ABG, 2021). Geotechnical Assessment, New 18-Plex, Lots 9, 10 & 11, Block 242, Plan 4716, Iqaluit, NU;
6. (CGD, 2021a). Geotechnical Investigation, Long Term Care Facility, Site C (Lot 35, Block 242, Plan 4716), Iqaluit, NU;
7. (CGD, 2021b). Pile Installation Summary Report, 2 New Multiplexes, Joamie Court, Lots 7 & 8, Block 242, Iqaluit, NU;
8. (CGD, 2020a). Geotechnical Investigation, Long Term Care Facility, Site B (Lot 1, Group 1087, Plan 0184), Iqaluit, NU;
9. (CGD, 2020b). Geotechnical Investigation, Wellness Hub, Lot 17 & 18, CLSR 56039, Iqaluit, NU;
10. (CGD, 2020c). Pile Installation Summary Table, Lot 31 Joamie Court, Iqaluit, NU;
11. (CGD, 2020d). Pile Installation Summary Table, Nakasuk School Stairs and Ramp Replacement, Iqaluit, NU;
12. (CGD, 2020e). Pile Installation Summary Report, Northern Store Warehouse Addition, Iqaluit, NU;
13. (CGD, 2019). Pile Installation Monitoring Table, North Mart Ramp, Iqaluit, NU;
14. (exp, 2016a). Geotechnical Investigation, North Mart Site, Iqaluit, NU;
15. (exp, 2016b). Geotechnical Investigation, Proposed Joamie Subdivision, Iqaluit, NU;
16. (Journeaux, 2015). Geotechnical Investigation, Arctic College Campus Expansion, Iqaluit, NU;
17. (Tetra Tech, 2015). Pile Installation Monitoring, Creekside Village, 900 Block, Iqaluit, NU;
18. Available satellite imagery, Google Earth (2003, 2006, 2009, 2011, 2015, 2017, 2021 and 2023);
19. Available LiDAR survey data for Iqaluit, NU (2018);
20. Environment Canada, historical weather data for the community of Iqaluit, NU; and
21. Studies and literature related to the distribution of saline permafrost and ground temperature data throughout Nunavut (i.e., Canadian Geotechnical Journals).



5.0 Field Program Methodology

The geotechnical field program was carried out on May 2 and 3, 2025 when the site was snow covered and the river was frozen to bottom. The field program consisted of drilling five boreholes, soil sampling and installation of one multi-bead thermistor. The borehole locations are shown on Figure 2.

Boreholes were advanced to depths ranging from 7.9 to 12.2 meter below grade (mbg) using an air-rotary drill. The field program was supervised on a full-time basis by one of ABG's field engineers experienced with air-rotary drilling and permafrost soils. Soil samples were collected at regular intervals from drill cuttings returned to the surface and visually examined and logged in accordance with ASTM D2487 (Standard Practice for Classification of Soils for Engineering Purposes, Unified Soil Classification System), ASTM D 2488 (Standard Practice for Description and Identification of Soils, Visual-Manual Procedure) and ASTM D 4083-8 (Standard Practice for Description of Frozen Soils, Visual-Manual Procedure).

Collected soil samples were stored in moisture tight containers and transported to a southern laboratory for further classification and testing. Prior to sample shipment, the initial weights were obtained for all samples to ensure that the moisture contents obtained were representative. Laboratory testing included the determination of natural moisture contents, salinity and grain-size analyses on select samples.

A multi-bead thermistor (T4) was installed to a depth of 9.1 mbg in APEX2025-05 to assess and monitor the ground temperature profile beneath the pump house location. Following the thermistor installation, the borehole was backfilled to surface with drill cuttings. It is noted that thermistor installations within the APEX River were not possible per Department of Fisheries requirements.

Borehole locations were determined in the field using a commercial grade handheld GPS unit (reported accuracy of ± 3 m). All depths reported herein are referenced to mbg as no site-specific topographical information was available.

6.0 Historical Climate and Permafrost Conditions

Iqaluit is located at 63°76' N and 68°54' W on the southeastern coast of Baffin Island, in the Qikiqtaaluk Region of Nunavut. Based on current permafrost mapping, the community is located within the zone of continuous permafrost. As outlined above, a site-specific multi-bead thermistor was installed during our field program. The individual thermistor depths and readings obtained by ABG are summarized on the attached thermistor report and discussed below in relation to other available information from the community.

Mean Annual Air Temperature (MAAT) and Indices: A review of Environment Canada climate records for the community revealed a relatively complete set of historical monthly air temperatures spanning the period from 1995 to 2024. The data indicates the MAAT over this time period was -8.0°C and the average thawing and freezing indices were approximately 697 and 3613°C-days, respectively.

Active Layer Thickness: Based on the above-noted historical air temperature data, simplified empirical methods and active layer thickness measurements (including multiple thermistors installation throughout the community), it is estimated that the active layer currently varies between approximately 1.5 and 2.3 m, depending on site-specific variables (such as surficial cover, site drainage, sun exposure and in-situ



moisture content). An accurate determination of the current active layer on site could not be determined due to winter conditions; however, based on our experience throughout Iqaluit, it is currently assumed the current maximum active layer thickness beneath the APEX River (area of pipe line crossing) may be up to 5.0 m and the area of the pump station will be up to 2.3 m.

Mean Annual Ground Temperature (MAGT): Based on a review of the available ground temperature data for the community and the site-specific thermistor, we have assumed a current MAGT of -2.0°C at the site.

7.0 Site Conditions

In general, the site soils consisted surficial cobbles and boulders mixed and underlain by sand containing additional frequent cobbles and boulders, with pockets of apparently pure ice and ice rich soils at depth down to bedrock. The river and underlying soils were frozen at the time of our investigation. The principal strata encountered at the site are outlined in the following table and subsections. Further details are provided within the borehole logs. The presented information depicts subsurface conditions only at specific locations and the identified soil boundaries are intended to reflect approximate transition zones for geotechnical design and should not be interpreted as exact planes of geological change for estimation or construction purposes.

TABLE 1 - Borehole Summary

Location	Total Depth (mbg)	Stratigraphy Thickness (m)	Depth to Inferred Bedrock (mbg)
		SAND with silt to silty SAND w/ frequent BOULDERS and PURE ICE	
APEX2025-01	13.7	0.0 – 12.5	12.5
APEX2025-02	9.1	0.0 – 7.3	7.3
APEX2025-03	9.1	0.0 – 7.0	7.0
APEX2025-04	11.0	0.0 – 7.9	7.9
APEX2025-05	9.1	0.0 – 2.4	2.4

It is recommended that the subsurface conditions be further evaluated/confirmed at the time of construction by a geotechnical engineer experienced with northern construction and registered with Northwest Territories and Nunavut Association of Professional Engineers and Geoscientists (NAPEG), or their representative.

7.1 Soils

The soils throughout the explored areas of the site consisted of surficial cobbles and boulders mixed with and underlain by brown to grey sand to silty sand containing frequent cobbles and boulders, underlain by bedrock. The soils were generally observed to be well-bonded with no excess ice to zones of visible excess ice noted at the time of drilling (N_{bn} to V_x), as well as pockets of apparently pure ice at depth. The moisture content for thirty samples obtained throughout the site soils ranged from 6.0 to 43.3%, with an average of 17.9%. Gradation and moisture content test results for the samples tested from the soil at the site are summarized in the following table and shown in greater detail on the attached laboratory test results.



TABLE 2 - Soils Gradation and Moisture Content Summary

Location	Sample	Depth (mbg)	Soil Fraction (%)			Moisture Content (%)	Soil Description
			Gravel	Sand	Silt		
APEX2025-01	S1	0.9 - 1.5	16	71	13	15.4	Silty SAND with gravel
APEX2025-01	S2	1.5 - 2.4	26	66	8	9.6	Poorly graded SAND with silt and gravel
APEX2025-01	S3	2.4 - 3.7	7	88	5	19.9	Poorly graded SAND
APEX2025-01	S4	3.7 - 4.3	6	87	7	15.8	Poorly graded SAND with silt
APEX2025-01	S5	4.6 - 6.1	7	65	28	17.4	Silty SAND
APEX2025-01	S6	6.1 - 7.9	13	73	14	6.5	Silty SAND
APEX2025-01	S7	8.5 - 9.8	4	83	13	6.0	Silty SAND
APEX2025-02	S2	2.1 - 3.0	8	73	19	19.3	Silty SAND
APEX2025-02	S3	3.0 - 4.3	3	79	18	20.4	Silty SAND
APEX2025-02	S4	4.3 - 6.1	1	85	14	22.5	Silty SAND
APEX2025-02	S5	6.1 - 7.3	2	54	44	21.2	Silty SAND
APEX2025-03	S2	2.4 - 3.4	5	83	12	19.3	Silty SAND
APEX2025-03	S3	3.4 - 4.9	5	82	13	19.1	Silty SAND
APEX2025-03	S4	4.9 - 6.1	2	74	24	22.6	Silty SAND
APEX2025-04	S1	0.5 - 0.8	18	69	13	43.3	Silty SAND with gravel
APEX2025-04	S2	0.8 - 1.5	10	83	7	13.0	Well-graded SAND with silt
APEX2025-04	S3	1.5 - 2.7	0	92	8	21.9	Poorly graded SAND with silt
APEX2025-04	S4	2.7 - 3.7	0	89	11	21.5	Poorly graded SAND with silt
APEX2025-04	S5	3.7 - 5.2	1	89	10	24.4	Poorly graded SAND with silt
APEX2025-04	S6	5.2 - 7.0	1	80	19	20.9	Silty SAND
APEX2025-04	S7	7.0 - 7.9	5	77	18	17.7	Silty SAND
APEX2025-05	S1	0.0 - 0.8	4	88	8	7.5	Poorly graded SAND with silt

7.2 Bedrock

Based on available geological maps for the area, it is anticipated that bedrock throughout the community consists of gneiss and granite bedrock. This was verified by ABG based on bedrock chips from drill cuttings. Bedrock throughout Iqaluit can be highly variable and change by several meters over a short distance, with the upper 0.5 to 2.0 m or more being highly frost shattered and/or severely fractured. Bedrock depth in the pipeline crossing boreholes ranged from 7.0 to 12.5 mbg and bedrock depth at the location of the proposed pump station was approximately 2.4 mbg.

7.3 Groundwater

No groundwater seepage was observed during the drilling of any boreholes at the site as the ground was completely frozen; however, groundwater flow through the site is anticipated to be moderate to heavy during the spring freshet and likely ponded below grade, travelling along the bottom of the active layer or top bedrock during thaw. It is anticipated that piling may have to contend with higher than average amounts of groundwater at the site during thaw. It is also anticipated that groundwater levels will fluctuate with seasonal weather trends, during precipitation events, and with significant site disturbance and construction activities.



7.4 Porewater Salinity

A total of twenty-three samples from this investigation were tested for salinity in general accordance with ASTM D 4542-95 (Pore Water Extraction and Determination of the Soluble Salt Content of Soils by Refractometer) and standard methodologies. The salinity test results ranged from 0.0 to 5.0 parts per thousand (ppt), with an average of 1.1 ppt.

8.0 Climate Change in Foundation Design

ABG anticipates that the current maximum active layer thickness throughout the pipeline crossing and at the pump station site are approximately 5.0 and 2.3 m, respectively. The current MAGT is approximately -2.0°C . Changes to the active layer thickness and MAGT throughout the life of the structure will depend on many variables, possibly including but not limited to actual current values, changes to MAAT, snow cover, precipitation, surface/groundwater flow, material gradation and in-situ ice content.

CSA PLUS 4011:19 provides that under a high green house gas scenario the MAAT in Iqaluit is estimated to increase by approximately 2.2°C over the next 30 years (by 2055) compared to the historic temperature trends which were available up to 2024. It is noted however, that recent research infers that greenhouse gas emissions over the next 30 years and beyond may be even higher than previously anticipated and new scenarios continue to be produced by global experts. Therefore, accurately estimating what the active layer thickness and MAGT will be 30 years from now is well beyond the scope of this investigation.

To support the current project, we have adjusted the historical temperature data to incorporate the above-noted changes to the MAAT and utilized the same simplified empirical methods from Section 6.0 to generate an estimated maximum active layer thickness 30 years from now. We have also assumed (conservatively) that the MAGT will change in step with the MAAT over this period. The process results in future estimated values for the maximum active layer thickness of 5.5 m through the APEX River footprint (pipeline crossing) and 2.5 m at the pump station. The future estimated MAGT is 0.1°C .

Given the inherent uncertainties surrounding the effects that climate change and site development will have on active layer thickness and MAGT at the site, we recommend introducing some additional conservatism by the way of engineering judgement. For this reason, we have used an active layer thickness of 6.0 m along the pipeline crossing and 2.8 m at the pump station for design.

It is generally recommended that a series of thermistors be installed along with select pile installations (where piles are used for the project) such that ground temperature monitoring can be carried out to establish the actual site-specific ground temperature profile over time. Where surficial foundations are utilized it is worth considering the installation of a horizontal string of thermistors within the fill pad and as near as possible to original grade (native soils), such that seasonal thaw penetration can be monitored (to some degree). In this way, the assumptions made to support design can be confirmed based on the real-world conditions and any issues that may occur can be better understood and dealt with accordingly.

It is noted that CSA PLUS 4011:19 states *“The requirement for monitoring, reporting, and reacting to any changes that are noted must be recognized early in the project. The responsibilities need to be defined at the project outset and budgets allocated to collect and summarize the data. An annual review by the geotechnical engineer is recommended with more frequent reviews if undesirable trends appear. Monitoring is pointless unless the data collected are evaluated”*. This speaks to the importance of



implementing a proper and consistent ground temperature monitoring program that includes review and input from qualified geotechnical personnel as part of responsibly addressing climate change in relation to foundation design and maintenance.

9.0 Site Classification for Seismic Site Response

Based on the anticipated subsurface conditions, the site can be classified as “X_c” for seismic site response in accordance with the requirements of Section 4.1.8.4 of the National Building Code of Canada (NBCC), 2020. In addition, the overburden soils are also considered to be non-liquefiable.

10.0 Discussion and Recommendations

It is recommended that a rock socket steel pipe pile foundation be used for both the pump station and pipeline crossing. Based on our review of available information as discussed herein, the site is considered suitable for the use of rock socket steel pipe pile foundations. The use of a surficial foundations for the pump station may carry undue risk given the presence of ice-rich soils and relatively warmer than anticipated ground temperatures (high likelihood for problematic long-term differential movement). If surficial foundations are preferred, ABG can further discuss this option and potentially provide geotechnical recommendations to support design upon request.

It is noted that the bedrock surface was apparently shallow enough to support a footings on bedrock approach for the pump station; however, we would recommend a series of test pits at the actual pump station location prior to final decision and design as this option can routinely encounter deeper than anticipated sound bedrock and extra costs at the time of construction.

It is further noted that the piles for the pipeline crossing will need to be drilled in the winter such that the river and ground below is fully frozen, otherwise the work would not be possible.

Recommendations to support the design and construction of rock socket steel pipe piles, as well as ancillary equipment pads, access road/turn around and general grading at the site are included below.

10.1 Rock Socket Steel Pipe Piles

Rock socket steel pipe piles carry the applied loads through a grouted bond between the pipe pile and the bedrock socket. The rock socket bond is used to resist both compression and uplift loads. The following tables provide unfactored ultimate limit state (ULS) and serviceability limit state (SLS) rock socket bond capacities for anticipated pile diameters, as well as the required minimum embedment from a geotechnical perspective.

The minimum embedment presented below is intended to provide enough resistance to avoid frost jacking of piles based on the design active layer thickness. Given the difficulties in accurately estimating the active layer thickness, it is also recommended that a suitable bond breaker be provided through the design active layer thickness of each pile, or to within 0.3 m of the top of the rock socket bond zone, as a secondary measure. The bond breaker can be excluded if sound bedrock is encountered within 1 m of design grade.



TABLE 3a – APEX RIVER PIPELINE CROSSING Rock Socket Pile Design Parameters

Pile Outside Diameter (mm)	Unfactored ULS Grout-to-Rock Bond Capacity (kPa)	SLS Grout-to-Rock Bond Capacity (kPa)	Minimum Embedment into Sound Bedrock (m)
114 to 141	1500	N/A	3.0

- Notes:**
- 1) ULS unfactored bond capacity is based on the use of 30 MPa grout through the rock socket.
 - 2) ULS geotechnical resistance factor of 0.4 should be applied for compression loads.
 - 3) ULS geotechnical resistance factor of 0.3 should be applied for tension loads.
 - 4) Minimum embedment is based on engineering judgement taking into consideration the requirement to resist a design frost jacking force of 150 kPa through the design active layer thickness and incorporating some additional embedment to help counter the possible unknown effects of climate change.

TABLE 3b – PUMP STATION Rock Socket Pile Design Parameters

Pile Outside Diameter (mm)	Unfactored ULS Grout-to-Rock Bond Capacity (kPa)	SLS Grout-to-Rock Bond Capacity (kPa)	Minimum Embedment into Sound Bedrock (m)
114 to 141	1500	N/A	1.0

- Notes:**
- 1) ULS unfactored bond capacity is based on the use of 30 MPa grout through the rock socket.
 - 2) ULS geotechnical resistance factor of 0.4 should be applied for compression loads.
 - 3) ULS geotechnical resistance factor of 0.3 should be applied for tension loads.
 - 4) Minimum embedment is based on engineering judgement taking into consideration the requirement to resist a design frost jacking force of 150 kPa through the design active layer thickness and incorporating some additional embedment to help counter the possible unknown effects of climate change.

It is noted that the frost jacking force of 150 kPa is a recommended design force based on anticipated soil conditions and the use of steel pipe piles; therefore, the design frost jacking force does not require the application of a load factor during pile design and shall be considered together with other uplift forces acting on the structure (e.g., wind) to determine the actual pile embedment/socket length required for final design.

For uplift loading, it will also be necessary to check the total pullout resistance of the mass of rock around the socket. Based on standard practices, the pullout resistance of the rock mass can be calculated as the weight of rock and soil present within an inverted cone having its apex at the middle of the socket. The cone can be assumed to extend out at 45° from vertical through the bedrock and 30° from vertical through sand and silt overburden (assumed worse-case). Assumed unit weights for sand and silt can be taken as 1950 kg/m³ and the bedrock can be taken as 2650 kg/m³. This process may result in a requirement to found the rock socket some minimum distance below the actual bedrock surface, such that the weight of the rock mass within the cone is sufficient to meet project requirements for pull out.

For lateral design, we have estimated values of horizontal subgrade modulus based on the anticipated stratigraphy and our installation methods, as shown in the following tables. If additional lateral capacity is required, ABG can work with the structural designer to determine a more specific lateral load capacity of the piles given the anticipated design loads and potentially less conservative assumptions (e.g., L-Pile analyses).



TABLE 4a – APEX RIVER PIPELINE CROSSING Estimated Horizontal Subgrade Modulus Values

Assumed Soil Profile	Depth (mbg)	Coefficient of Subgrade Reaction (k_s , kN/m ³)
Sand (thawed, active layer, above groundwater)	0.1	1,000
Sand (thawed, active layer, above groundwater)	0.5	7,000
Sand (thawed, active layer, below groundwater)	1.0	10,000
Sand (thawed, active layer, below groundwater)	1.5	21,000
Sand (thawed, active layer, below groundwater)	2.0	42,000
Sand (thawed, active layer, below groundwater)	2.5	70,000
Sand (thawed, active layer, below groundwater)	3.0	89,000
Sand (thawed, active layer, below groundwater)	3.5	109,000
Sand (thawed, active layer, below groundwater)	4.0	124,000
Sand (thawed, active layer, below groundwater)	4.5	140,000
Sand (thawed, active layer, below groundwater)	5.0	156,000
Sand (thawed, active layer, below groundwater)	5.5	171,000
Sand (thawed, active layer, below groundwater)	6.0	187,000
Sand (frozen, permafrost)	6.5	190,000
Sand (frozen, permafrost)	7.0	194,000
Sand (frozen, permafrost)	7.5	199,000
Sand (frozen, permafrost)	8.0	204,000
Sand (frozen, permafrost)	8.5	209,000
Sand (frozen, permafrost)	9.0	213,000
Sand (frozen, permafrost)	9.5	218,000
Sand (frozen, permafrost)	10.0	223,000
Sand (frozen, permafrost)	10.5	228,000
Sand (frozen, permafrost)	11.0	232,000
Sand (frozen, permafrost)	11.5	237,000
Sand (frozen, permafrost)	12.0	242,000
Sand (frozen, permafrost)	12.5	247,000
Bedrock (grouted socket)	12.6	2,234,000
Bedrock (grouted socket)	13.0	2,304,000
Bedrock (grouted socket)	13.5	2,393,000
Bedrock (grouted socket)	14.0	2,482,000
Bedrock (grouted socket)	14.5	2,570,000

Notes: 1) Coefficient of subgrade reaction calculated for a 141 mm steel pipe pile.



TABLE 4a – APEX RIVER PIPELINE CROSSING Estimated Horizontal Subgrade Modulus Values

Assumed Soil Profile	Depth (mbg)	Coefficient of Subgrade Reaction (k_s , kN/m ³)
Sand (thawed, active layer, above groundwater)	0.1	1,000
Sand (thawed, active layer, above groundwater)	0.5	7,000
Sand (thawed, active layer, below groundwater)	1.0	10,000
Sand (thawed, active layer, below groundwater)	1.5	21,000
Sand (thawed, active layer, below groundwater)	2.0	42,000
Sand (thawed, active layer, below groundwater)	2.3	65,000
Bedrock (grouted socket)	2.4	425,000
Bedrock (grouted socket)	2.5	443,000
Bedrock (grouted socket)	3.0	531,000
Bedrock (grouted socket)	3.5	620,000

Notes: 1) Coefficient of subgrade reaction calculated for a 141 mm steel pipe pile.

It is noted that the bearing capacity of the piles may be reduced by improper seating of the pile on the bedrock or by poor bond at the grout/pile interface; therefore, the portion of the pile to be grouted must be free of paint, lacquer, oil and dirt. Each pile shall be vibrated into place to assure a good seat is achieved on sound bedrock.

To avoid group effect considerations, individual piles should be at least 3 pile diameters apart center to center. Further recommendations pertaining to consideration of group effect can be provided upon request if closer pile spacing is required.

The piles should be installed in pre-drilled oversize holes at least 50 mm larger than the pile diameter. The bedrock socket should be filled with an approved fast setting arctic grout, such as SIKA ARCTIC 100 or equivalent. The procedure for mixing, handling and installing the grout should be in accordance with the manufacturer's recommendations. Mix ratios of the grout should be closely monitored throughout placement to ensure proper ratios are utilized. Test cubes of the prepared grout should be cast and tested for unconfined compressive strength (UCS) each day. If grout installation to the bottom of the rock socket is carried out in the wet, the grout must be tremied to the bottom or include an adequate additive to avoid dispersion and dilution.

The piles should be installed open ended through the grout and vibrated to assure a good seat as noted above. The remaining annular space between the pile and the hole should be filled with sand to the final grade. Drill cuttings are suitable for this purpose. Loads should not be applied to the pile for at least three days after installation.

For a building supported on rock socket piles, a multi-bead thermistor should be installed to a depth below the assumed design active layer in one rock socket pile with adequately spaced thermistor beads. This thermistor string will allow for the verification of active layer design assumptions in addition to long-term monitoring, as recommended in Section 8.0. The base of the building should be at least 200 mm above final grade to provide an adequate gap between the structure and the ground surface to avoid unexpected uplift forces during seasonal heave of near-surface soils. If an adequate gap cannot be provided, the use of a suitable thickness of void form between the underside of the structure and the ground surface can



be considered. It is noted that when heated structures are built on rock socket steel pipe piles or founded directly on grade, some settlement of grades around the structure would be expected over time.

10.2 Exterior Slabs and Unheated Ancillary Equipment

Seasonal thaw and freeze back of the active layer will result in seasonal movement of any exterior slabs and/or unheated ancillary equipment founded directly on grade. For this reason, the connections between any exterior on grade equipment (e.g., fuel tank, backup generator) and the structure should be designed to accommodate some movement. Furthermore, the concrete footings/slabs that support such equipment should be sufficiently rigid (i.e., mat slab) to accommodate potential differential movement or the equipment should be founded on a stable foundation type, such as rock socket piles or insulated fill pad (further recommendations on this option can be provided upon request).

10.3 Parking Area, Site Grading and Drainage

The final site grades should be designed to eliminate the potential for ponding water around and ensure positive drainage away from the foundation elements onsite. In general, it is recommended that the final grades provide at least 3% grade away from the foundation elements in all directions.

It is anticipated that all driveway/parking areas will be gravel surfaced and the near surface soils onsite will consist predominantly of sand. Therefore, fill pads for the parking area and general site grading purposes should perform well and require minimal regrading each year if constructed in accordance with the recommendations below.

It is recommended that all driveway/parking areas receive at least 200 mm of Type 1 material (surface/base course), underlain by at least 300 mm of Type 2 material (sub-base), placed and compacted atop an approved subgrade. Any heavy-duty traffic areas should receive an additional 300 mm of compacted Type 2 material (600 mm Type 2 sub-base material total) unless the subgrade is bedrock. Areas of bedrock subgrade should receive at least 150 mm of compacted Type 2 sub-base material to reduce the potential of the bedrock surface profile being reflected throughout the surface of the roadway/parking areas.

The satisfactory performance of driveway/parking areas will be dependant on the provision of adequate surface/subsurface drainage via professionally designed ditches, swales and culverts at the site.

It is recommended that cuts into the native soils be avoided and design grades be achieved by building atop the native grades of the site. Prior to any material placement, the native subgrade should be inspected by qualified geotechnical personnel to determine if any areas of concern exist (i.e., areas of extensive soft soils) and if so, the extent and nature of the concern should be discussed with the design team to determine the best area-specific treatment. Priority should always be given to maintaining the native organic mat wherever possible, even if some short-term regrading may be required as this material settles under use.

If it is determined that excavation and replacement is warranted to improve the native subgrade, the excavation should conform to the requirements of the Occupational Health and Safety Act (OSHA) and consider the potential for underlying permafrost soils to thaw/soften during excavation creating an increasingly worse situation. Excavations should be limited to only those areas deemed necessary and



carried out in stages such that excavation and replacement back to current grade or higher occurs within hours (dependant on the observed rate of thaw and native soil behaviour).

All driveway/parking area fill material should be placed in maximum 300 mm thick lifts and compacted to 98% of the SPMDD within 300 mm of the subgrade surface and 95% of the SPMDD below this depth. The Type 1/Type 2 granular materials should be compacted to 100% of the SPMDD. Density testing is recommended to confirm each lift receives an adequate level of compaction prior to subsequent lifts. All permanent slopes for driveway/parking areas prepared as outlined herein shall be 2.5H:1V or gentler, unless approved by the geotechnical engineer of record for the project.

The table below provides recommended gradation requirements for subgrade materials at the site. Other gradations may also be suitable, subject to review and approval by the geotechnical engineer of record.

TABLE 5 - Recommended Gradation for Type 1, Type 2 and Select Subgrade Materials

Gradation (sieve/% passing)	Type 1 (Base)	Type 2 (Sub-Base)	Select Subgrade
150 mm	–	–	100
75.0 mm	–	100	–
37.5 mm	–	–	–
25.0 mm	100	50 – 100	50 – 100
19.0 mm	75 – 100	–	45 – 100
9.5 mm	50 – 85	–	–
4.75 mm	35 – 65	20 – 55	20 – 70
2.0 mm	25 – 50	–	–
0.425 mm	15 – 30	5 – 35	5 – 45
0.300 mm	–	–	–
0.150 mm	–	–	–
0.075 mm	5 – 8	0 – 8	0 – 20

11.0 Requirement for Qualified Geotechnical Monitoring

As noted above, inspection and monitoring of foundation installations is an important component of the design process. Specialty quality assurance services (field observations and testing) during construction are a necessary part of the evaluation of subsurface conditions and site preparation activities. Qualified geotechnical personnel must assess the site at some point during the design and construction process.

Section 4.2.2.3 of the NBCC states that *“a field review shall be carried out by the designer or by another suitably qualified person to ascertain that the subsurface conditions are consistent with the design and that construction is carried out in accordance with the design and good engineering practice. The review required by Sentence (1) shall be carried out on a continuous basis during the construction of all deep foundation units with all pertinent information recorded for each foundation unit.”*



Therefore, each steel pipe pile installation requires full-time monitoring by qualified geotechnical personnel familiar with air-rotary drilling and permafrost soils, to confirm subsurface conditions are consistent with the design and that construction is carried out in accordance with design. During rock socket pile installations, onsite geotechnical personnel shall monitor for bedrock depth/quality and observe grout mixing procedures closely, sampling the grout daily for UCS tests.

It is also recommended that qualified geotechnical personnel be onsite throughout parking/driveway area preparation to assure the native subgrade preparation and material placement/compaction meets project requirements.

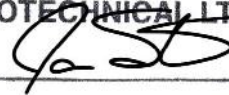
12.0 Closure

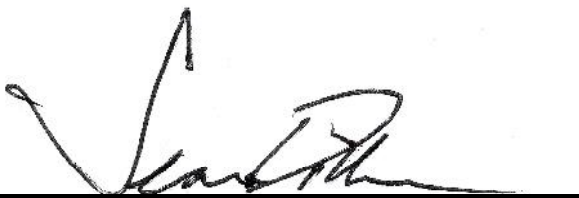
The use of this report is subject to the attached statement of general conditions. It is the responsibility of Arcadis Canada Incorporated, who is identified as “the Client” within the statement of general conditions and its agents to review the conditions and to notify ABG should any of these not be satisfied. The statement of general conditions addresses use of the report, basis of the report, standard of care, interpretation of site conditions, varying or unexpected site conditions, planning, design and construction.

We trust the information contained herein is adequate for your present purposes. Should you have any questions about the contents of this report, or if we can be of any further assistance, please do not hesitate to contact the undersigned at your convenience.

Sincerely,

Adaptive Baseline Geotechnical Limited

PERMIT TO PRACTICE ADAPTIVE BASELINE GEOTECHNICAL LTD.	
Signature	
Date	27-June-2025
PERMIT NUMBER: P 1501	
NT/NU Association of Professional Engineers and Geoscientists	



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*Geotechnical Investigation
Apex River LTWP Pump Station & Pipeline Crossing
Iqaluit, NU
IQA-G2316*



ATTACHMENTS



Photograph 1 – May 2, 2025
Drilling APEX2025-05.



Photograph 2 – May 2, 2025
Thermistor installed in APEX2025-05.



Photograph 3 – May 3, 2025
Drilling APEX2025-02.



Photograph 4 – May 3, 2025
Clearing snow to access borehole locations.



Site

ADAPTIVE BASELINE GEOTECHNICAL LTD.

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Figure No.: 1	Client: Arcadis Canada Inc.
Project No.: IQA-G2316	Project: Geotechnical Investigation – Apex River LTWP Pump Station and Pipeline Crossing, Iqaluit, NU
Scale: as shown	Title: Site Location Plan

Notes: (1) Google Earth image used is from 2023; therefore, unknown differences may exist between current site conditions and those shown.
(2) This figure should only be used in conjunction with this report.

500 m



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LEGEND



BH# BOREHOLE LOCATION

(#)

DEPTH TO INFERRED
BEDROCK (mbg)

Figure No.: 2	Client: Arcadis Canada Inc.
Project No.: IQA-G2316	Project: Geotechnical Investigation – Apex River LTWP Pump Station and Pipeline Crossing, Iqaluit, NU
Scale: as shown	Title: Site Location Plan

Notes: (1) Google Earth image used is from 2023; therefore, unknown differences may exist between current site conditions and those shown.
(2) This figure should only be used in conjunction with this report.

25 m



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BOREHOLE LOG

APEX2025-01

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2025.05.03 COMPLETED 2025.05.03
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY IW CHECKED BY MS

PROJECT NAME LTWP Water Supply and Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION n/a HOLE SIZE 190 mm
 NOTES UTM: 19V 525848 m E 7070398 m N

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ SPT N VALUE ▲	
							GRAVEL	SAND	FINES			PL	LL
0.90	Boulders and ice												
1.50	Grey brown silty SAND with gravel		SM	Nbe	S1	2.0	16	71	13	15.4			
2.00	Brown poorly graded SAND to poorly graded SAND with silt and gravel		SP-SM	Nbn	S2	5.0	26	66	8	9.6			
3.00				Nbe	S3	1.0	7	88	5	19.9			
4.30				Nbe	S4	2.0	6	87	7	15.8			
4.60	Boulder												
5.00	Grey silty SAND to well-graded SAND with silt		SM	Nbe	S5	1.5	7	65	28	17.4			
6.00				Nbn	S6	2.5	13	73	14	6.5			
7.00													
8.00	- boulder at 7.9 mbg												
9.00				Nbn	S7	2.5	4	83	13	6.0			
10.00				Nbn	S8	3.0	2	86	12	6.8			
12.20													
12.50	Ice												
13.00	Inferred BEDROCK												
13.70					B1	-	-	-	-	-			
14.00	Borehole Terminated at 13.7 m - Inferred sound bedrock												
15.00													

ABG BH/TP LOG IQA-G2316 APEXRIVER.GPJ ABG.GDT 2025.06.10



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BOREHOLE LOG

APEX2025-02

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2025.05.03 COMPLETED 2025.05.03
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY IW CHECKED BY MS

PROJECT NAME LTWP Water Supply and Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION n/a HOLE SIZE 190 mm
 NOTES UTM: 19V 525867 m E 7070408 m N

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ SPT N VALUE ▲	
							GRAVEL	SAND	FINES			PL	MC
0.30	Ice												
1	Brown silty SAND with gravel - frequent cobbles and boulders		SM	-	S1	-	-	-	-				
2	2.10 Brown silty SAND		SM	Nbe	S2	0.0	8	73	19	19.3		■	
3	3.00 Grey silty SAND		SM	Nbe	S3	0.0	3	79	18	20.4		□	
4				Nbe	S4	0.0	1	85	14	22.5		□	
5				Nbe	S5	0.0	2	54	44	21.2		□	
6													
7	7.30 Inferred BEDROCK				B1	-	-	-	-				
8													
9	9.10 Borehole Terminated at 9.1 m - Inferred sound bedrock												
10													
11													
12													
13													
14													
15													

ABG BH/TP LOG IQA-G2316_APEXRIVER.GPJ ABG.GDT 2025.06.10



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BOREHOLE LOG

APEX2025-03

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2025.05.03 COMPLETED 2025.05.03
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY IW CHECKED BY MS

PROJECT NAME LTWP Water Supply and Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION n/a HOLE SIZE 190 mm
 NOTES UTM: 19V 525883 m E 7070425 m N

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ SPT N VALUE ▲	
							GRAVEL	SAND	FINES			PL	LL
1	Boulders												
1.80	Brown silty SAND - occasional cobbles and boulders		SM	-	S1	-	-	-	-				
3				Nbe	S2	0.0	5	83	12	19.3		□ ●	
3.40	Grey silty SAND												
4			SM	Nbe	S3	0.0	5	82	13	19.1		□ ●	
5				Nbe	S4	0.0	2	74	24	22.6		●	
6				-	S5	-	-	-	-	-			
7	7.00												
8	Inferred BEDROCK												
8				-	B1	-	-	-	-	-			
9	9.10												
10	Borehole Terminated at 9.1 m - Inferred sound bedrock												
11													
12													
13													
14													
15													

ABG BH/TP LOG IQA-G2316_APEXRIVER.GPJ ABG.GDT 2025.06.10



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BOREHOLE LOG

APEX2025-04

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2025.05.03 COMPLETED 2025.05.03
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY IW CHECKED BY MS

PROJECT NAME LTWP Water Supply and Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION n/a HOLE SIZE 190 mm
 NOTES UTM: 19V 525848 m E 7070442 m N

DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ SPT N VALUE ▲	
							GRAVEL	SAND	FINES			PL	MC
0.50	Ice												
0.80	Dark brown silty SAND with gravel		SM	Vx	S1	1.6	18	69	13	43.3			
	Brown well-graded SAND with silt		SW-SM	Nbe	S2	5.0	10	83	7	13.0			
1.50													
	Brown poorly graded SAND with silt												
			SP-SM	Nbe	S3	0.0	0	92	8	21.9			
2													
5.20	Grey silty SAND												
6													
7.90	Inferred BEDROCK												
8													
11.00	Borehole Terminated at 11 m - Inferred sound bedrock												
12													
13													
14													
15													

ABG BH/TP LOG IQA-G2316 APEXRIVER.GPJ ABG.GDT 2025.06.10



Adaptive Baseline Geotechnical
 17 Industrial Way
 Elmsdale, NS B2S 2L6
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BOREHOLE LOG

APEX2025-05

PAGE 1 OF 1

CLIENT Arcadis Canada Inc.
 PROJECT NUMBER IQA-G2316
 DATE STARTED 2025.05.02 COMPLETED 2025.05.02
 DRILLING CONTRACTOR Canadrill Ltd.
 DRILLING METHOD Air Rotary
 LOGGED BY IW CHECKED BY MS

PROJECT NAME LTWP Water Supply and Storage Geo Inv
 PROJECT LOCATION Iqaluit, NU
 GROUND ELEVATION n/a HOLE SIZE 190 mm
 NOTES UTM: 19V 525884 m E 7070475 m N
Multibead thermistor installed

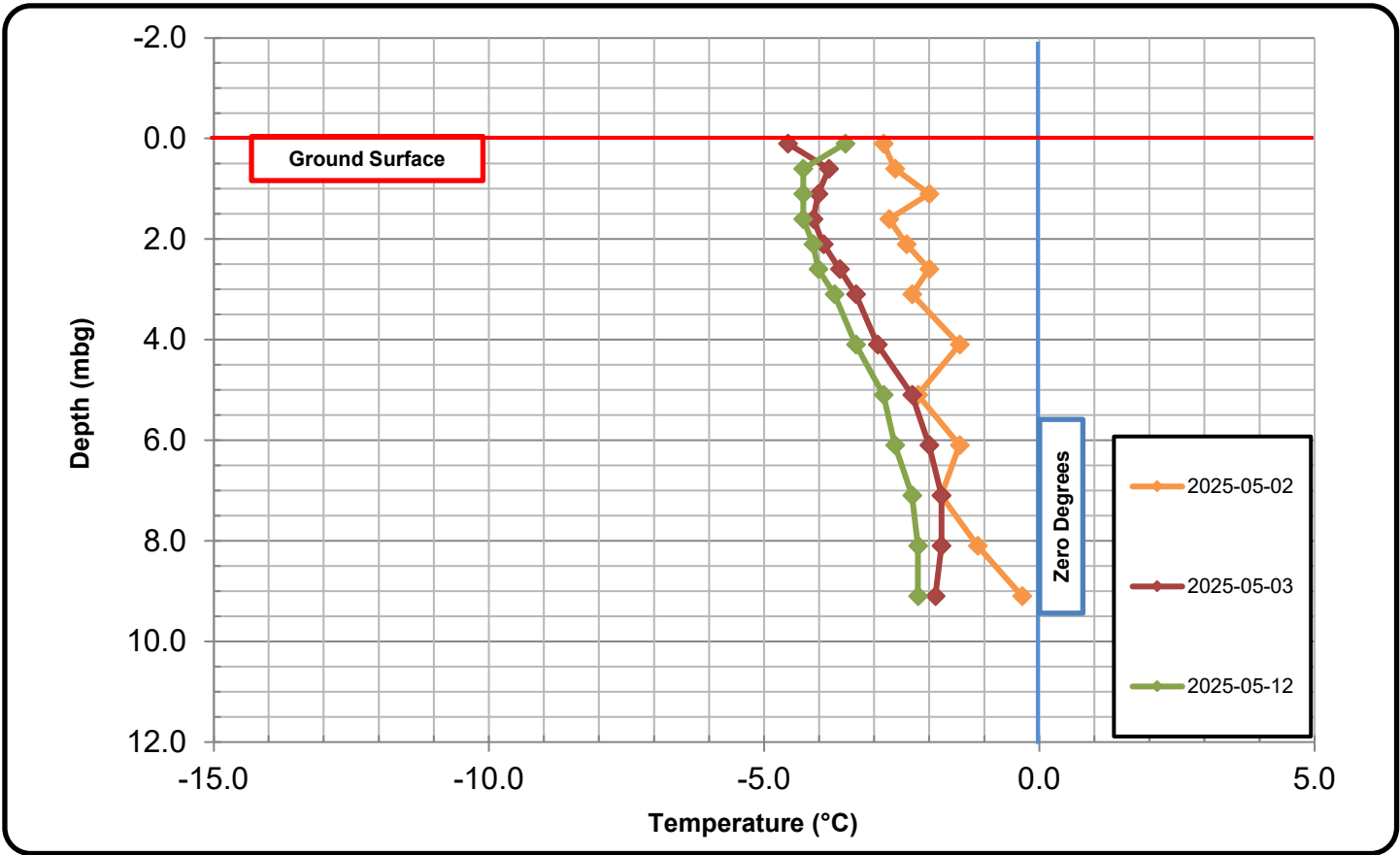
DEPTH (m)	MATERIAL DESCRIPTION	GRAPHIC LOG	USCS	GROUND ICE DESCRIPTION	SAMPLE NUMBER	SALINITY (ppt)	SOIL FRACTION (%)			MOISTURE CONTENT (%)	RQD (%)	▲ SPT N VALUE ▲	
							GRAVEL	SAND	FINES			PL	LL
0.80	Brown poorly graded SAND with silt		SP-SM	Nbn	S1	0.0	4	88	8	7.5	20	80	
2.40	Brown silty SAND with gravel - occasional cobbles and boulders		SM	-	S2	-	-	-	-	-	20	80	
					S3	-	-	-	-	-	20	80	
3	Inferred BEDROCK				B1	-	-	-	-	-	20	80	
4											20	80	
5					B2	-	-	-	-	-	20	80	
6											20	80	
7					B3	-	-	-	-	-	20	80	
8											20	80	
9					B4	-	-	-	-	-	20	80	
9.10	Borehole Terminated at 9.1 m - Inferred sound bedrock										20	80	
10											20	80	
11											20	80	
12											20	80	
13											20	80	
14											20	80	
15											20	80	

ABG BH/TP LOG IQA-G2316 APEXRIVER.GPJ ABG.GDT 2025.06.10



Thermistor Report - T4

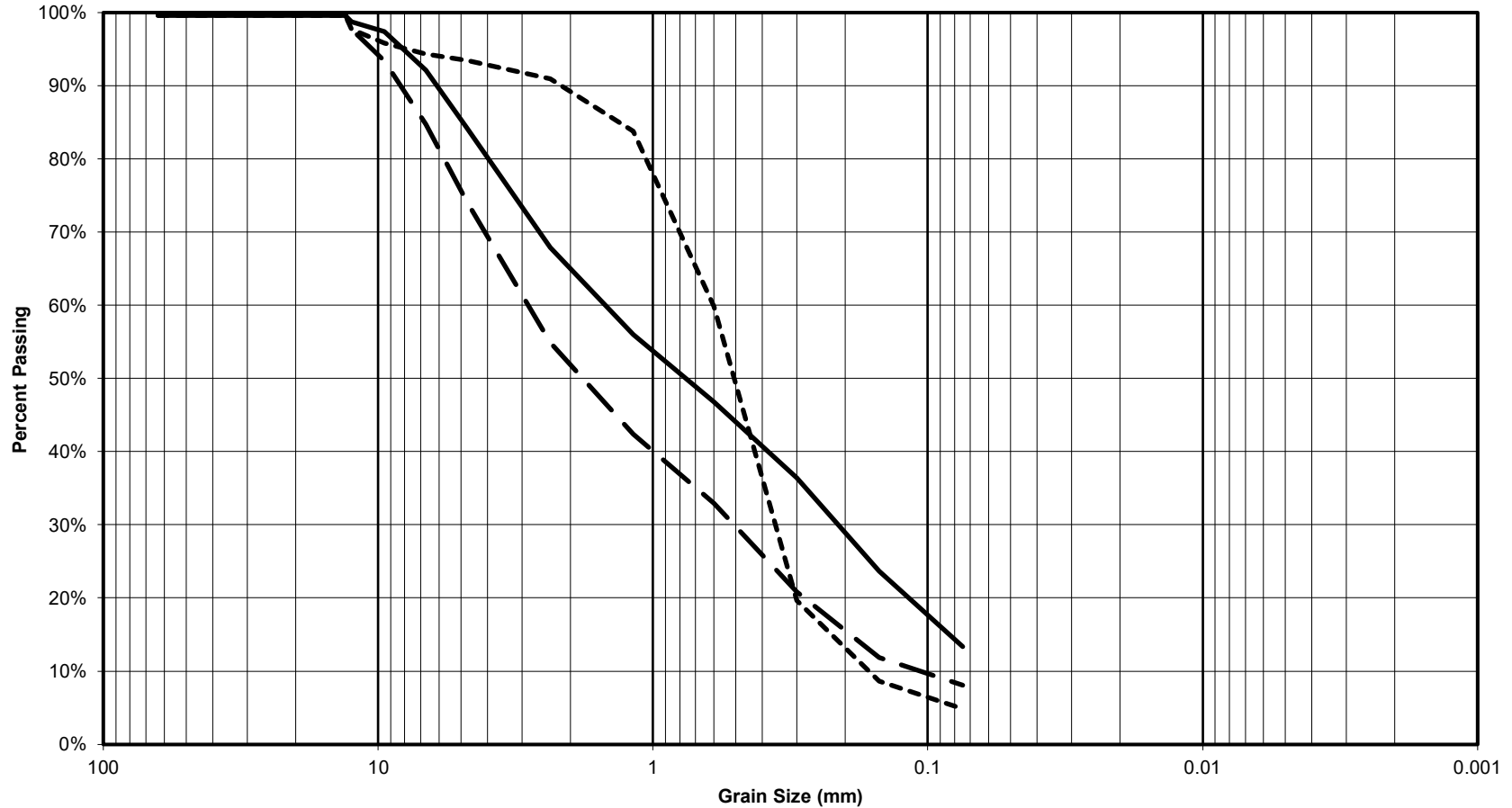
PROJECT No.:		IQA-G2316			THERMISTOR No.:		T4	
PROJECT NAME:		LTWP			DATE INSTALLED:		May 2, 2025	
PROJECT LOCATION:		Iqaluit			LOCATION:		APEX2025-05	
DATE OF READING:		2025-05-02	2025-05-03	2025-05-12				
Thermistor Bulb	Depth (mbg)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)	Temp (°C)
1	0.1	-2.8	-4.6	-3.5				
2	0.6	-2.6	-3.8	-4.3				
3	1.1	-2.0	-4.0	-4.3				
4	1.6	-2.7	-4.1	-4.3				
5	2.1	-2.4	-3.9	-4.1				
6	2.6	-2.0	-3.6	-4.0				
7	3.1	-2.3	-3.3	-3.7				
8	4.1	-1.5	-2.9	-3.3				
9	5.1	-2.2	-2.3	-2.8				
10	6.1	-1.5	-2.0	-2.6				
11	7.1	-1.8	-1.8	-2.3				
12	8.1	-1.1	-1.8	-2.2				
13	9.1	-0.3	-1.9	-2.2				





Grain Size Analysis

Project: IQA-G2316



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

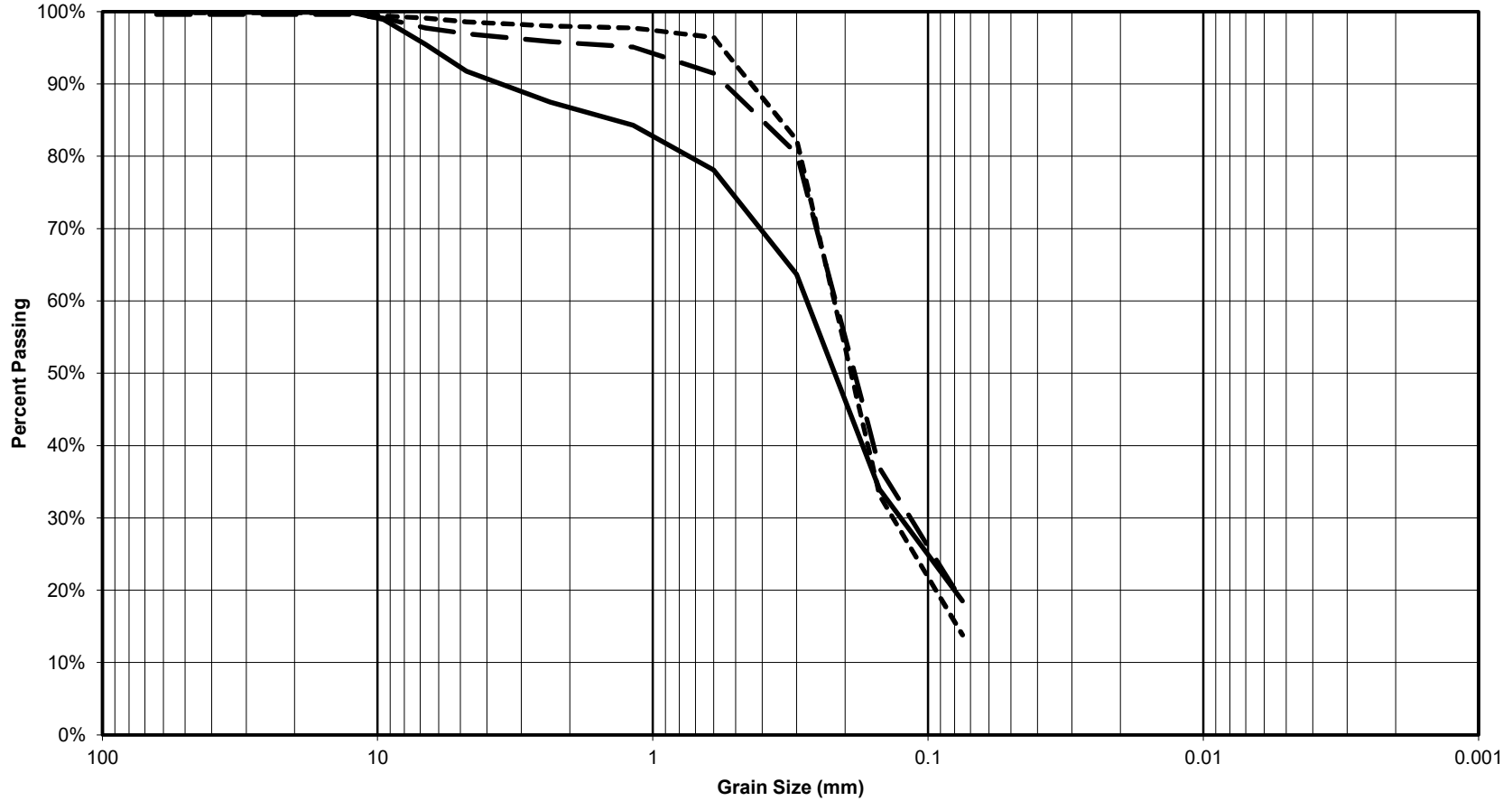
Unified Soil Classification System ASTM D 2487/2488

Curve	Borehole/Testpit	Sample	Depth (mbg)	Soil Fractions			Moisture Content	Soil Description
				Gravel	Sand	Silt/Clay		
—	APEX2025-01	S1	0.9 - 1.5	16%	71%	13%	15.4%	Silty SAND with gravel
- -	APEX2025-01	S2	1.5 - 2.4	26%	66%	8%	9.6%	Poorly graded SAND with silt and gravel
- - -	APEX2025-01	S3	2.4 - 3.7	7%	88%	5%	19.9%	Poorly graded SAND



Grain Size Analysis

Project: IQA-G2316



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

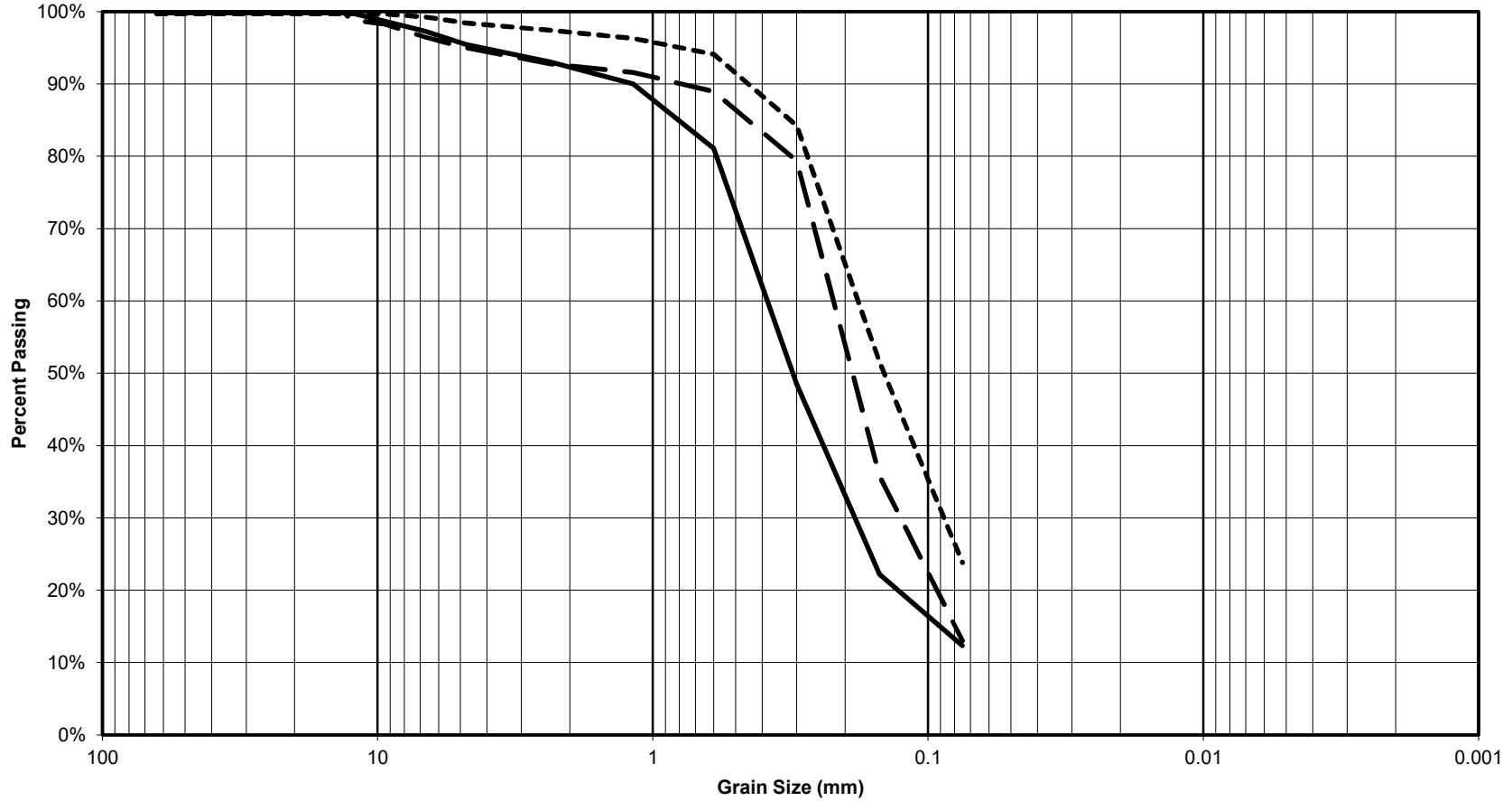
Unified Soil Classification System ASTM D 2487/2488

Curve	Borehole/Testpit	Sample	Depth (mbg)	Soil Fractions			Moisture Content	Soil Description
				Gravel	Sand	Silt/Clay		
—	APEX2025-02	S2	2.1 - 3.0	8%	73%	19%	19.3%	Silty SAND
- -	APEX2025-02	S3	3.0 - 4.3	3%	79%	18%	20.4%	Silty SAND
- - -	APEX2025-02	S4	4.3 - 6.1	1%	85%	14%	22.5%	Silty SAND



Grain Size Analysis

Project: IQA-G2316



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

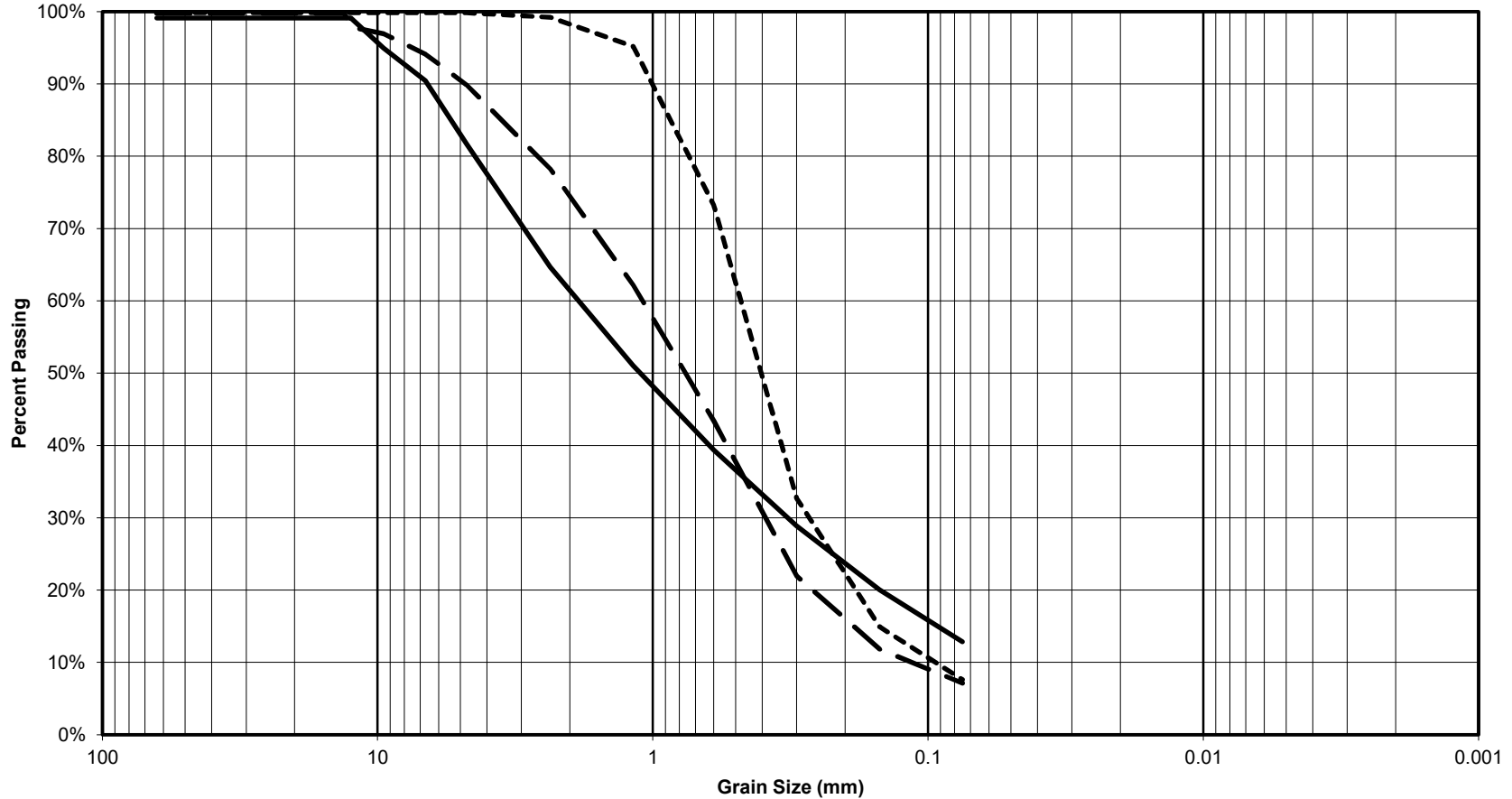
Unified Soil Classification System ASTM D 2487/2488

Curve	Borehole/Testpit	Sample	Depth (mbg)	Soil Fractions			Moisture Content	Soil Description
				Gravel	Sand	Silt/Clay		
—	APEX2025-03	S2	2.4 - 3.4	5%	83%	12%	19.3%	Silty SAND
- -	APEX2025-03	S3	3.4 - 4.9	5%	82%	13%	19.1%	Silty SAND
- - -	APEX2025-03	S4	4.9 - 6.1	2%	74%	24%	22.6%	Silty SAND



Grain Size Analysis

Project: IQA-G2316



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

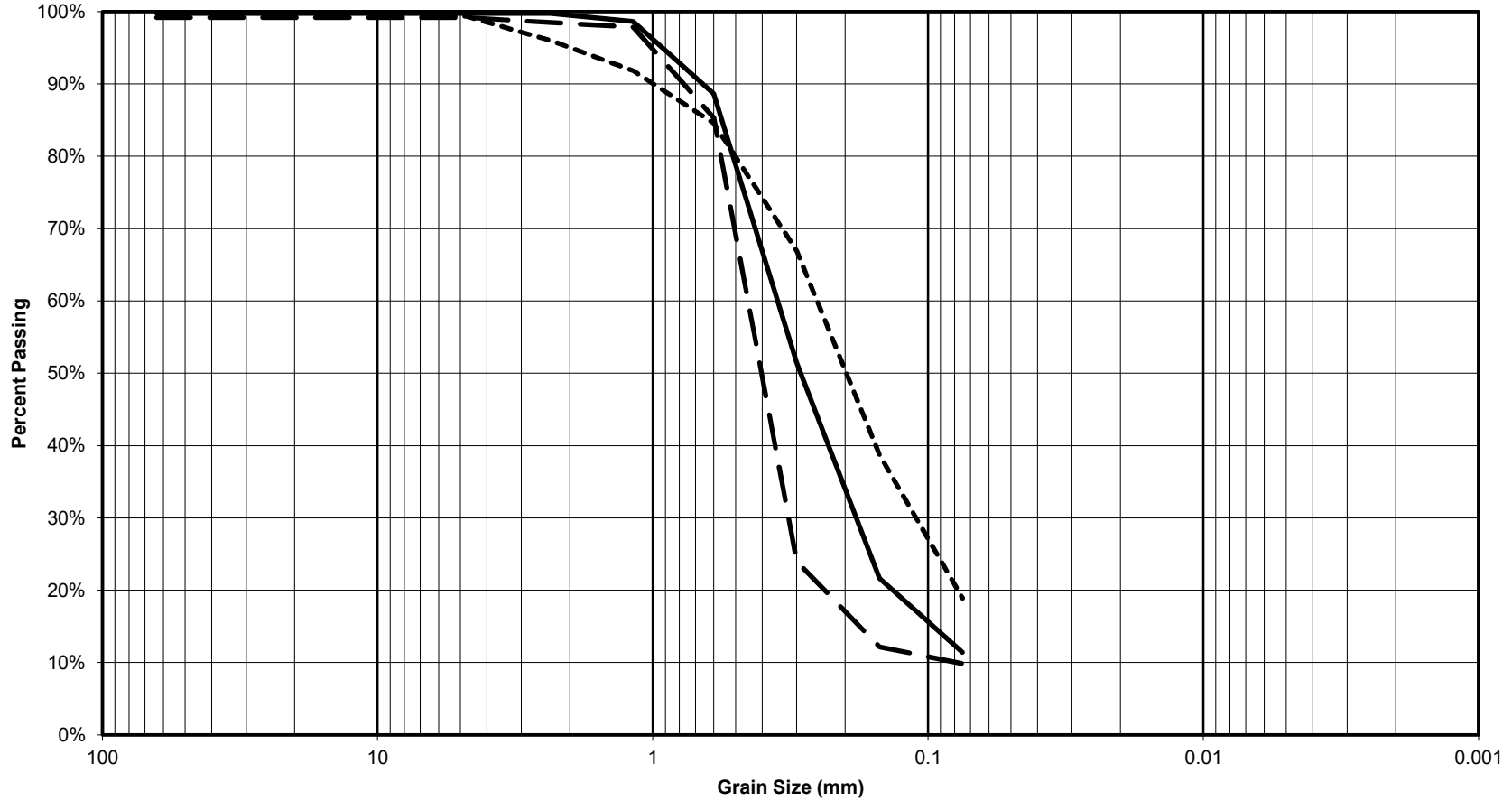
Unified Soil Classification System ASTM D 2487/2488

Curve	Borehole/Testpit	Sample	Depth (mbg)	Soil Fractions			Moisture Content	Soil Description
				Gravel	Sand	Silt/Clay		
—	APEX2025-04	S1	0.5 - 0.8	18%	69%	13%	43.3%	Silty SAND with gravel
- -	APEX2025-04	S2	0.8 - 1.5	10%	83%	7%	13.0%	Well-graded SAND with silt
- - -	APEX2025-04	S3	1.5 - 2.7	0%	92%	8%	21.9%	Poorly graded SAND with silt



Grain Size Analysis

Project: IQA-G2316



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Unified Soil Classification System ASTM D 2487/2488

Curve	Borehole/Testpit	Sample	Depth (mbg)	Soil Fractions			Moisture Content	Soil Description
				Gravel	Sand	Silt/Clay		
—	APEX2025-04	S4	2.7 - 3.7	0%	89%	11%	21.5%	Poorly graded SAND with silt
- -	APEX2025-04	S5	3.7 - 5.2	1%	89%	10%	24.4%	Poorly graded SAND with silt
- - -	APEX2025-04	S6	5.2 - 7.0	1%	80%	19%	20.9%	Silty SAND



STATEMENT OF GENERAL CONDITIONS

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Basis of the Report: The information, opinions, and/or recommendations made in this report are in accordance with ABG's present understanding of the site-specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time of the investigation or study. If the proposed site-specific project differs or is modified from what is described in this report, or if the site conditions are altered, this report is no longer valid unless ABG is requested by the Client to review and revise the report to reflect the differing or modified project specifics and/or the altered site conditions.

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Interpretation of Site Conditions: Where ABG has carried out a test pit or borehole field program, the soil, rock or other material descriptions and statements regarding their condition made in this report are based on site conditions encountered by ABG at the time of the work and at the specified testing and/or sampling locations. Classifications and statements of condition have been made in accordance with normally accepted practices which are judgement in nature; no specific description should be considered exact, but rather reflective of the anticipated material behavior. Extrapolation of in-situ conditions can only be made to some limited extent beyond the sampling or test points. The extent depends on variability of the soil, rock and groundwater conditions as influenced by geological processes, construction activity and site use. In the case of a desktop assessment the previous reports and information prepared by other parties has been taken at face value.

Varying or Unexpected Conditions: Should any site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, ABG must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the report conclusions or recommendations are required. ABG will not be responsible to any party for damages incurred as a result of failing to notify us that differing site or sub-surface conditions are present upon becoming aware of such conditions.

Planning, Design or Construction: Development or design plans and specifications should be reviewed by ABG sufficiently ahead of initiating the next project stage (property acquisition, tender, construction, etc.) to confirm that this report completely addresses the elaborated project specifics and that the contents of this report have been properly interpreted. Specialty quality assurance services (field observations and testing) during construction are a necessary part of the evaluation of sub-surface conditions and site preparation works. Site work relating to the recommendations included in this report should only be carried out in the presence of a qualified geotechnical engineer; ABG cannot be responsible for site work carried out without being present.

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