REPORT

GEOTECHNICAL INVESTIGATION

Phase 2 Geotechnical Investigation Condenser Cooling Water System Darlington New Nuclear Project

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1.0 INTRODUCTION

1.1 General

Ontario Power Generation (OPG) has commenced the renewal process of the federal approvals for site preparation, construction, and operation of a new small modular nuclear reactor to be constructed within the eastern parts of the Darlington site. The proposed new project is referred to herein as the Darlington New Nuclear Project (DNNP).

WSP Golder, a member of WSP Canada Inc. (WSP) has prepared this report for E.S. Fox Limited Nuclear Services (E.S. Fox), on behalf of OPG, in accordance with the Engineering Specification, Darlington New Nuclear (ESDNN) for the Onshore/Offshore Geotechnical Investigation - Darlington New Nuclear Project (DNNP), Document No. NK054-REP-01210-00117-R003 and subsequent clarifications (collectively called the “Specification” or “ESDNN”).

The overall geotechnical investigations for the DNNP project have been divided into 3 phases as follows:

Phase 1 – Onshore - Power Block (which was completed by WSP Golder in 2021, reported in 2022);

Phase 2 –Onshore and Offshore - Condenser Cooling Water System; and,

Phase 3 – Onshore - Additional Boreholes (scope not defined at the time of this report)

This report provides the results of Phase 2 of the geotechnical investigation program which was carried out onshore and offshore in support of the Condenser Cooling Water (CCW) intake and outfall/discharge tunnel structures.

A geotechnical investigation was also carried out for Phase 1 Power Block completed in 2021, which should be referenced when reading this report. The results and interpretations were contained in the following report referred to as “WSP Golder Phase 1 Report”:

- *Phase 1 Geotechnical Investigation (Power Block), Darlington New Nuclear Project, Volume 1 (Factual Geotechnical Data) and Volume 2 (Geotechnical Interpretation and Design Parameters)*, by WSP Golder (Golder Associates Ltd.), R3, dated December 9, 2022.

In addition, geophysical studies were carried out offshore in the area of the CCW intake and outfall/discharge tunnels and the results and interpretations are contained in the following report referred to as “WSP Offshore Geophysics Report”:

- *Offshore Geophysical Investigation, Ontario Power Generation, Darlington New Nuclear Project*, by WSP Golder (Golder Associates Ltd.), R1 dated March 14, 2023.

The reader is referred to the “Important Information and Limitations of This Report” which is attached and forms an integral part of this document.

1.2 Purpose and Overview

The purpose of this geotechnical investigation was to advance exploratory onshore and offshore boreholes and conduct in situ geotechnical, geophysical and laboratory testing to obtain the required geotechnical data, as outlined in the Specification, and to provide geotechnical engineering design parameters for the design of the CCW intake and discharge tunnels and associated structures.

This report has been divided into two parts; Part A provides a summary of the procedures and the equipment used for the field investigations and laboratory testing and the resulting factual subsurface information from the investigations and testing and Part B of this report provides discussions of the results and the geotechnical engineering design parameters associated with each stratigraphic unit.

PART A

Factual Geotechnical Data

2.0 SITE AND PROJECT DESCRIPTION

2.1 Site Description

The proposed DNNP site, as shown on Figure 1, is located within the eastern sections of the existing Darlington Nuclear Generating Station (DNGS) property at 1 Holt Road South, Bowmanville, Ontario. The proposed DNNP site is surrounded by Lake Ontario (the Lake) to the south, an existing storage building, a gravel parking lot and laydown areas to the west, a roadway (Second Line) to the north and undeveloped lands to the east. The DNNP site is currently utilized as a laydown area, except for the northeast portion of the site, which is vegetated with grass and trees and a drainage swale. The site slopes moderately within the vegetated areas and gently within gravel surfaced areas, generally sloping downward from northeast to southwest. The Condenser Cooling Water (CCW) intake and discharge tunnels are located along the western/ southwestern portions of the overall DNNP site and extend offshore into Lake Ontario. A steep bluff is present at the southern edge of the site with a small beach area at the base adjacent to the Lake.

2.2 Project Description

The CCW project, which forms part of the overall DNNP project, consists of two tunnels (intake tunnel and outfall/discharge tunnel) and their associated onshore and offshore shafts/structures. We understand that the tunnels will be advanced within the bedrock using a tunnel boring machine (TBM). The tunnel alignments are shown on Figure 1.

According to the latest drawings of the CCW project provided by Black & Veatch, the tunnels are described as follows, with the tunnel diameter(s) to be finalized during the course of the design:

- **Intake Tunnel**: at the launch shaft, the invert and obvert of the tunnel are at Elevations 38.41 m and 44.76 m, respectively. The 1,155 m long tunnel has an inside/outside diameter of 6.05 m/6.65 m and the tunnel slopes upwards offshore at 0.1%. The excavation diameter of the tunnel is approximately 6.95 m. The launch shaft onshore has an approximate diameter of 14 m with its base at approximate Elevation 35.1 m, or about 53 m below the existing ground surface. At the intake structure, the invert and obvert of the tunnel are at Elevations 39.55 m and 45.90 m, respectively. At the end of the tunnel there is a 6.05 m diameter intake riser structure extending upwards to the lake bottom.

- **Outfall/Discharge Tunnel:** at the launch shaft, the invert and obvert of the tunnel are at Elevation 39.44 m and 45.79 m, respectively. The 1,120 m long tunnel has an inside/outside diameter of 6.05/6.65 m and slopes offshore at 0.1%. The excavation diameter of the tunnel is approximately 6.95 m. The launch shaft has an approximate diameter of 14 m with its base at approximate Elevation 35.14 m, or about 49.5 m below the existing ground surface. At the end of the tunnel, the invert and obvert of the tunnel are at Elevations 40.55 m and 46.90 m, respectively. The last 300 m of the outfall tunnel has 32 evenly spaced diffuser risers extending up to the lake bottom.

3.0 FIELD INVESTIGATION AND LABORATORY PROCEDURES

3.1 General

Phase 2 of the geotechnical investigation was carried out between May 16, 2022, and September 28, 2022. The field investigation scope for Phase 2 was completed at 15 offshore borehole locations, and 7 onshore borehole locations. Two of the onshore boreholes were drilled at an incline and all other boreholes were vertical. Upon completion, all onshore boreholes that did not have a monitoring well were abandoned to the ground surface using grout mixture comprising 96% Type HSb-8SF Portland cement and 4% bentonite. All offshore boreholes were abandoned to the lakebed surface upon completion with a grout mixture comprising 98% Type 50 Sulphate resistant class G cement and 2% calcium chloride ($CaCl_2$), in accordance with the Ontario Ministry of Natural Resources and Forestry (MNRF), Oil, Gas and Salt Resources of Ontario, Provincial Operating Standards. The borehole identification (Borehole ID), locations and exploration depths completed for Phase 2 are provided below in Table 3-1 and Table 3-2.

Table 3-1: Onshore Borehole Coordinates, Elevations and Depths

BH ID	Type of Equipment Utilized to Advance the Borehole	Northing(1) (m)	Easting(1) (m)	Ground Surface Elevation(2) (m)	Total Vertical Exploration Depth (m)	Vertical Overburden Exploration Depth (m)	Vertical Rock Coring Depth (m)
BH21(3)	Acker Renegade I	4860024.76	683775.82	87.26	67.35	23.15	44.20
BH22(3)	Acker Renegade I	4859852.05	683890.35	85.08	66.08	22.79	43.29
BH23	Diedrich 120	4859898.80	683833.09	85.31	78.11	22.78	55.33
BH24	Diedrich 50	4860135.33	683745.15	89.00	79.63	25.00	54.63
BH25	Diedrich 120	4860087.78	683752.91	88.30	28.71	24.05	4.66
BH26	Diedrich 50	4859832.55	683916.52	85.10	75.04	22.31	52.73
BH82	Diedrich 120	4860165.38	683719.13	89.26	28.81	25.80	3.01

Notes:

1) Coordinates are grid and are referenced to UTM Zone 17N, NAD83 (CSRS) (2010.0).
2) The elevations are referenced to GSC Benchmark No. 0011910U178 having an elevation of 90.025m (referencing CGVD 1928:1978 adjustment)
3) BH21 and BH22 were inclined, and the details are on the Record of Boreholes. No soil sampling/testing was conducted within the overburden in BH21 and BH22.

Table 3-2: Offshore Borehole Coordinates, Elevations and Depths

BH ID	Equipment Type (Barge, Drill Rig)	Northing[1] (m)	Easting[1] (m)	Barge Deck Elevation[2] (m)	Lakebed Elevation[2] (m)	Total Exploration Depth from Barge Deck (m)	Vertical Overburden Exploration (m)	Vertical Rock Coring (m)
BH202	JU600, Diedrich 120	4859648.42	684020.72	78.30	72.15	62.00	10.23	45.62
BH203	JU600, Diedrich 120	4859488.56	684015.94	78.62	70.77	69.65	8.30	53.50
BH204	JU600, Diedrich 120	4859404.61	684127.45	79.39	69.03	63.38	7.01	46.01
BH205	JU50, Diedrich 120	4859265.57	684126.30	78.16	66.53	70.39	4.65	54.11
BH206	JU50, Diedrich 120	4859186.99	684222.32	78.46	63.07	60.87	1.98	43.50
BH207	JU50, Diedrich 120	4859056.47	684255.27	78.85	62.09	71.38	0.03	54.59
BH301	JU600, Diedrich 120	4859780.93	684079.19	78.09	72.35	60.64	10.52	44.38
BH302	JU600, Diedrich 120	4859665.83	684177.79	78.82	71.35	70.88	9.33	54.08
BH303	JU600, Diedrich 120	4859647.01	684327.84	78.84	70.46	61.69	7.31	46.00
BH304	JU600, Diedrich 120	4859536.18	684425.05	79.40	69.95	71.47	6.04	55.98
BH305	JU600, Diedrich 120	4859517.43	684574.02	78.37	68.87	60.62	6.70	44.42
BH306	JU50, Diedrich 120	4859406.21	684686.37	79.17	67.13	70.28	6.63	51.61
BH307	JU50, Diedrich 120	4859394.50	684833.78	78.90	66.16	60.98	6.36	41.88
BH308	JU50, Diedrich 120	4859279.18	684944.13	78.60	64.43	68.63	6.86	47.60
BH309	JU50, Diedrich 120	4859188.25	685151.90	78.52	61.78	60.85	2.40	41.71

Notes:

1) Coordinates are grid and are referred to UTM Zone 17N, NAD83 (CSRS) (2010.0).
2) The elevations are referenced to GSC Benchmark No. 0011910U178 having an elevation of 90.025m (referencing CGVD 1928:1978 adjustment).

The locations of the boreholes are shown on the Borehole Location Plan, Figure 1. Details of the fieldwork program are discussed in the following sections.

3.2 Drilling and Sampling

3.2.1 Utility Locates and Survey Control

Onshore borehole locations were marked in the field by the project surveyor on behalf of E.S. Fox. The survey work was completed by J.D. Barnes Limited of Whitby, Ontario (Ontario Land Surveyor) using the coordinates provided by OPG in the Specification. Onshore borehole locations and ground surface elevations were surveyed at the time the boreholes were laid out in the field. J.D. Barnes Limited assisted with navigating the drill barge to the offshore borehole locations. Offshore borehole locations and the barge deck elevations were surveyed after the barges had been jacked up into place. The barge deck was the vertical point of reference for the offshore boreholes. The geo-referenced coordinates are based on NAD83 Coordinate system, UTM Zone 17N. The geodetic elevations are referred to GSC Benchmark No. 0011910U178, Elevation 90.025 m (CGVD-1928:1978 adjustment).

Utility clearances at the onshore borehole locations were carried out by E.S. Fox and/or OPG. WSP Golder reviewed the utility locates prior to drilling.

Utility clearance at the offshore borehole locations were reviewed by using data from side scan sonar, bathymetry and magnetometer surveys completed by WSP Golder. Obstructions or debris, if any, at the borehole locations on the lakebed were avoided by using an underwater camera (operated by the barge crew) to check that the drill collar or barge spud locations were clear. Any boulders that conflicted with the drill collar or barge spud locations were moved by divers, as needed.

3.2.2 Soil and Rock Sampling

The fieldwork was monitored by WSP Golder personnel who determined the sequence of boreholes (in conjunction with E.S. Fox), coordinated the drilling operations, geotechnically logged the borehole samples and carried out or witnessed the in situ testing.

Onshore soil samples were obtained from each borehole at 0.75 m intervals of depth in the upper 6 m and 1.5 m intervals below 6 m in depth until bedrock was reached. The sampling intervals in Boreholes BH24 and BH26 onshore and all offshore boreholes were continuous from ground surface (onshore boreholes) or lakebed (offshore boreholes) to bedrock. In the "continuous sampling" boreholes, samples were collected every 0.6 m. No soil sampling was carried out in inclined Boreholes BH21 and BH22.

Sampling in the boreholes was carried out using a 50 mm outer diameter split spoon sampler driven using an automatic hammer in accordance with the requirements of ASTM International Standard D1586/D1586M-18. The split spoon samplers used in the investigation have an inside diameter of 38.1 mm and limit the maximum particle size that can be sampled and tested to about 35 mm. Therefore, particles or objects that exist within the soils that are larger than this dimension would not be sampled or represented in the attached grain size distributions.

The SPT samples were driven 45 centimetres (cm) or to "refusal" (100 blows for less than 15 cm of penetration). The blow counts for each 15 cm of the drive, or portion thereof, were recorded on the field borehole logs. The sum of the blow counts for the second and third 15 cm increments of the drive, or portion thereof, was taken as the field 'N' value. The results of the in situ field tests (i.e., SPT 'N' values) as presented on the Record of Borehole Sheets and discussed in the following sections of this report are the values measured directly in the field and are unfactored.

In Boreholes BH24 and BH26, after completing the standard 50 mm outer diameter split spoon sampling/testing, a nominal 75 mm diameter split spoon sampler was also utilized to obtain additional soil samples for complex laboratory testing. Split spoons were advanced up to 60 cm, where possible, to obtain more sample volume for laboratory testing purposes.

Hammer energy measurements for the drill rigs used to complete this geotechnical investigation were performed in accordance with ASTM International Standard D4633-16 on May 12, 2022, and June 20, 2022. SPT hammer energy calibration was carried out by Walker Drilling for the equipment utilized during this geotechnical investigation and the reports are shown in Appendix A.

The drill rigs advanced the onshore boreholes using rotary wash boring (i.e., mud rotary) within the overburden. Drill casing used during rotary wash boring for borehole stability was HWT steel casing (except for BH24 and BH26 which used PW Casing to facilitate pitcher barrel sampling of the clay deposit) as defined by the Diamond Core Drilling Manufacture's Association (ASTM D2113-14). The drill equipment used to carry out the onshore geotechnical field investigation consisted of two track-mounted drill rigs. The drill rigs were supplied and operated by Walker Drilling Ltd. (Walker Drilling) of Utopia, Ontario, subcontracted to E.S. Fox.

Walker Drilling also supplied and operated two track-mounted drill rigs which were set up on two jack-up barges (known as JU600 and JU50). The jack-up drill barges along with the supporting boats were supplied and operated by McKeil Marine Ltd. (McKeil) of Burlington, Ontario, subcontracted to E.S. Fox.

Upon completing an initial SPT into the lakebed soils, the borehole drilling offshore proceeded by extending a UW casing from the drill barge deck and rotating it into the lakebed subsoils (or slightly into rock as required where little/no overburden was present as was the case for BH207) to sufficient depth to establish a seal between the outside of the casing and the subsoils and/or rock. During UW casing advancement, drilling fluids were not utilized. Increasing drill torque and charging the casing with fresh water were used as a guide to ensure an adequate seal. Where needed, the casing was further rotated into the subsoils. Upon establishing the seal, drilling continued using mud rotary techniques (using a 159 mm tricone drill bit on drill rods) until the bedrock was reached. Bedrock coring commenced using an HQ3 size core barrel to 3 m into competent bedrock. After reaming the bedrock, an HW casing with a backoff collar was permanently cemented into bedrock with grout mixture comprising Type 50 Portland cement with 2% Calcium Chloride (CaCl2). The cement was allowed to set up for a minimum of one day (24 hours). Cementing was witnessed and sampled by an MNRF certified “Class 1 Examiner”, subcontracted to Walker Drilling.

Once the cement reached the minimum set up time, a blowout preventor (BOP) was attached to the HW casing to allow for pressurized gasses and water, that might be encountered during drilling operations, to be safely evacuated and vented from the borehole. The BOP was checked by a BOP specialist (subcontracted to Walker Drilling) prior to resuming bedrock coring. Once the BOP was installed, a pressure test was conducted in the bedrock to ensure an adequate seal and normal drilling operations were resumed. Small sections of the bedrock may have been lost during the drilling for the pressure test. The monitoring of gasses was conducted during the drilling operations for H2S, Methane, Carbon Monoxide and Carbon Dioxide as well as Oxygen levels. These gasses were monitored for the health and safety of the field crew. The quantities of any gases encountered were not measured or recorded in any detail. The BOP utilized was a manually activating system the use of which was determined by the BOP specialist on this site. The BOP was not required to be activated during the offshore drilling investigation.

Once the borehole reached terminal depth, the BOP was disconnected and the HW casing was disconnected using the back off collar and cemented below the lakebed as required by to “Oil, Gas and Salt Resources of Ontario”, Provincial Operating Standards, Version 2.0, dated January 24, 2022, approved by the Ministry of Natural Resources on March 27, 2002.

The SPT samples were digitally photographed in colour before placing the samples in 0.5 Liter (L) glass jars which were sealed with vapour-seal screw lids and labeled with a unique identifier. The samples were split longitudinally in half and drilling fluid, if any, removed from samples prior to photographing. Each photograph included a tape measure laid beside the samples for dimensional reference. A whiteboard was also included to document sample information. The SPT photographs are shown in Appendix B.

Representative soil specimens were selected from the SPT samples to perform unit weight testing (ASTM D7263-21) in WSP Golder’s laboratory in Mississauga.

Field vane shear tests were carried out in softer clayey soils (within cohesive soils with SPT ‘N’ values of 10 or less) for determination of undrained shear strengths in accordance with ASTM D2573/D2573M-18 using Standard ‘N’ size vanes.

In Boreholes BH24 and BH26, pitcher barrel sampling was used to advance 75 mm outside diameter Shelby tubes to obtain relatively intact cohesive samples at a deeper depth. Pitcher barrel samples were taken in accordance with the manufacturer’s recommended procedures.

A total of 9 thin-walled Shelby tube samples obtained from BH24 and BH26 were sent to GeoTesting Express (in Acton, Massachusetts, USA) to attempt complex laboratory testing on samples BH24-SA32, BH24-SA33, BH26- SA23, BH26-SA24, BH26-SA25, BH26-SA27, BH26-SA28, BH26-SA29, and BH26-SA30.

Pocket penetrometer tests were performed on the trimmed bottom of Shelby tube samples in the field. Both ends of the sample were sealed with hot microcrystalline wax. Clean dry sand was used to fill the gap at the tops of the tubes. The tubes were sealed with plastic caps and taped to preserve moisture. Each tube was then labeled with the project information and a unique identifier.

All Shelby tubes were stored vertically in tube racks that allowed for secure storage and/or transportation of tubes. Tube samples were preserved and transported in accordance with ASTM D4220/D4220M-14 for Group D samples, including the appropriate Chain of Custody to the Geo Testing Express laboratory.

Additionally, soil samples were selected from all boreholes (except for BH21 and BH22, which did not have soil sampling in the overburden) from different soil units for chemical testing for corrosion parameters. Soil chemical analysis included oxidation-reduction potential, pH, sulfide test, water-soluble chloride ion content, water-soluble sulfate content, calculated soil resistivity and conductivity. Sample containers were cleaned and supplied by an accredited analytical laboratory (AGAT Laboratories). Samples were placed in a sealed container in accordance with the laboratory requirements and shipped under Chain of Custody Records.

Upon encountering bedrock, continuous bedrock core samples were obtained using an ‘HQ3’ size (96 mm OD) triple tube rock core barrel. Core runs were generally between 1.52 m and 3.05 m. The bedrock core was logged at the drill rig site by WSP Golder’s personnel. Bedrock quality and discontinuity data were recorded based on visual inspections of the recovered bedrock core once extracted from the core barrel. The core runs were placed in wooden core boxes for storage.

All onshore soil and rock samples were transported to a secured storage facility on site on a daily basis. The sample storage facility/trailer was maintained at a temperature of between 10 and 32 degrees Celsius. The offshore soil and rock samples were removed from the barge and brought to the temperature-controlled storage trailer on a weekly basis; the samples were temporarily stored in sea-containers on the barge.

Upon completion of the drilling operations and examination of soil samples in the storage trailer, the SPT soil samples from the boreholes were transported, including the appropriate Chain of Custody, to the WSP Golder laboratories in Whitby and/or Mississauga for selected laboratory testing (except for BH24 and BH26 soils, which were sent to GeoTesting Express laboratory for complex laboratory testing).

Bedrock samples were also collected from the rock cores and submitted for geotechnical testing at third party laboratories with the appropriate Chain of Custody.

3.2.3 Investigation Equipment Listing

Table 3-3 provides the specifics of all equipment used on site for this investigation:

Table 3-3: Summary of Investigation Equipment

Equipment	Manufacturer	Model / Serial Number	Calibration Date (if applicable)
Diedrich 120 Drill Rig	Diedrich Drill	D120-122	June 20, 2022(1)
Diedrich 120 Drill Rig	Diedrich Drill	D120-121	June 20, 2022(1)
Diedrich 120 Drill Rig	Diedrich Drill	D120-104	May 12, 2022(1)
Diedrich 50 Drill Rig	Diedrich Drill	D57	June 20, 2022(1)
Acker Renegade Drill Rig	Acker Drill	A110910506	Cored Bedrock in Inclined BH21 and BH22.
Barge Jack-Up 600	Supplied and Operated by McKeil		
Barge Jack-Up 50	Supplied and Operated by McKeil		
USBM deformation gauge	Geokon	Model 5000 / SN97, SN1013906, SN1840939, SN1840940	January 2022
Biaxial Cell	-	RCH 600	January 2022

Notes:
1) SPT hammer calibration date.

3.3 Dilatometer Testing in Bedrock

Bedrock Dilatometer Tests (RPMT) were carried out in accordance with US Bureau of Reclamation Standard Designation USBR 6575-09 by In-Depth Geotechnical Inc. of Hamilton, Ontario, subcontracted to WSP Golder. RPMT tests were completed in offshore Boreholes BH203, BH302, and BH307 after completion of rock drilling. RPMTs were carried out in a predrilled diameter-controlled hole and were completed to determine the deformation modulus of the rock mass at specific intervals along the boreholes.

3.4 Monitoring Well Installations

One monitoring well was installed in Borehole BH23 during the Phase 2 fieldwork. The monitoring well location was selected by OPG, and the stratigraphic unit to be screened was selected in consultation with OPG. Details of the well depth and location are presented on the Record of Borehole in Appendix A and shown on Figure 1.

To avoid issues with sloughing of the borehole sidewall, the borehole sidewalls within the overburden were supported by the HWT casings. The interval between the bottom of the borehole and the bottom of the monitoring well was grouted using a mixture comprised of 96% Type HSb-8SF Portland cement and 4% bentonite, mixed to a specific gravity of about 1.7, placed via tremie methods to a depth as close as possible to the bottom of the designed monitoring well. The grout was allowed to set up overnight for the well installation the following day(s). The space between the sand filter pack and the hardened grout was sealed using bentonite prior to well installation.

The monitoring well in BH23 was comprised of nominal 50 mm (2-inch) diameter Schedule 40 PVC machined 10-slot well screen and riser pipe. Centralizers were utilized at maximum 5 m spacings to centre the screen and riser pipe within the borehole annulus. Sand filter pack was placed around the screen, extending 0.6 m above and 0.3 m below the monitoring well screen. The filter pack was placed by pouring the sand in from the ground surface.

Approximately 0.8 m of bentonite seal was placed in the annular space above the sand filter pack and allowed to hydrate. Then the annular space between the PVC pipe and borehole above the bentonite seal was backfilled to the ground surface with bentonite slurry using tremie methods. The monitoring well was completed with an above ground steel protective casing set in concrete with a lockable cap and padlock.

3.5 In Situ Rock Stress Measurements (Overcoring)

In situ stress measurements were carried out in five boreholes: BH23 (onshore), and Boreholes BH202, BH205, BH304, and BH307 (offshore). The testing was carried out using the United States Bureau of Mines (USBM) overcoring method in general accordance with ASTM 4623-962, with the exception that the testing was carried out in HQ size boreholes. The in situ stress testing program was carried out from June 9 to September 9, 2022. All boreholes were drilled into the Lindsay Formation where the in situ overcoring tests were undertaken. The boreholes were core-drilled vertically by Walker Drilling, using a Diedrich 120 diamond drill equipped with HQ triple-tube (HQ3) drill equipment. Between 3 and 7 test attempts were conducted in each borehole to acquire a minimum of three successful test results per borehole to allow analysis of the in situ stresses. Details of the overcoring method can be found in Appendix G.

3.6 In Situ Hydraulic Conductivity Testing

In situ hydrogeological (packer) testing was carried out in the bedrock in selected onshore and offshore boreholes to determine the hydraulic conductivity of the bedrock. Up to three tests were carried out in each borehole, depending on the depth of cored bedrock, for a total of 3 tests in 1 onshore borehole and 12 tests in 5 offshore boreholes. The tests were carried out between June 14, and September 23, 2022.

Wireline packer testing was carried out as the rock coring advanced within the borehole using a double packer assembly. Packer tests were conducted at intervals of approximately 20 m in depth. All packer intervals were set up to overlap adjacent intervals so that testing coverage of the entire length of the cored borehole could be achieved. The number of tests per borehole was determined based on the length of cored bedrock within each borehole.

Testing intervals were set by removing drilling rods so that the drill bit was located near the top of the testing interval. The packer assembly was then lowered down the drill rods by wireline until the two packers sat above and below the drill bit. Once the packers were seated at the desired depths, they were inflated using compressed nitrogen gas, and the groundwater in the test interval was allowed to recover for up to 30 minutes.

Falling head tests were carried out in all packer testing intervals. If the recovery time within the testing interval was deemed to be too fast during the falling head test, defined as full recovery within 20 minutes, a constant head step test or constant rate injection test was then conducted in the same interval. Two intervals, both in offshore boreholes, required a constant head step test.

An in situ pressure transducer with internal memory, held within the packer assembly, was used to measure and record the interval pressure during the tests. A secondary pressure transducer was also used at surface during falling head tests while a water level indicator tape was used to verify the downhole water level. The packer equipment was provided by Walker. The pressure transducers and water level indicator tapes were provided by WSP Golder.

Assessment of the packer testing results is dependent on the estimate of each interval's static water level. In low permeability bedrock formations, such as those encountered in many of these boreholes, it is not practical to wait the extended period of time that would be required to allow the interval to fully recover to static after inflation of the packers. Therefore, the open hole water level was used in the assessment for the intervals where applicable.

3.7 Geophysical Testing

Geophysical testing was completed in selected boreholes. The geophysical testing consisted of televiewer imaging of onshore boreholes and televiewer imaging and full waveform sonic logging of offshore boreholes. Televiewer imaging was carried out in the following onshore boreholes: BH21, BH22, BH23, BH24, and BH26. Televiewer was not carried out in onshore Boreholes BH25 and BH82 as they did not extend deep enough into the bedrock. Televiewer imaging was also carried out in all offshore boreholes. Full waveform sonic logging was carried out in the following offshore boreholes: BH205, BH207, BH303, BH307, and BH308. The geophysical testing methodologies are described below.

3.7.1 Full Waveform Sonic Logging

Full waveform sonic logging was performed within the fluid filled portion of each borehole. The sonic/acoustic probe had an integrated transmitter, 3 receivers, and a diameter suitable for the chosen boring diameter. The shear and compression wave velocities were recorded at 0.05 m intervals. Testing was performed starting at the bottom of the borehole and progressed upwards to the level of the fluid in the borehole. Data acquisition software was used which recorded the amplitude, frequency and velocity of the shear and compression waves.

The Mount Sopris wireline logging borehole system and QL40-FWS full waveform sonic probe were used to collect the full waveform sonic data.

The QL40-FWS probe was run at a logging speed of approximately 1 to 1.5 m per minute and data was collected at 0.05 m intervals within the rock portion of the borehole.

The seismic velocities were calculated using semblance analysis of the waveforms from each geophone receiver for each measurement point.

3.7.2 Televiewer Imaging

High resolution televiewer imaging was used to observe the rock surface of the borehole wall directly to assess the subsurface lithology, and structural features, such as fractures, fracture infillings, foliation, and bedding planes. The optical televiewer required a dry borehole or clear fluid within the borehole for proper imagery. The acoustic televiewer could only be logged in the fluid filled portion of the borehole but did not require a clear borehole fluid as it utilized focused sonic beams to image the borehole wall. As such, the acoustic and optical televiewer probes complemented each other. Acoustic televiewer was completed in all boreholes while optical televiewer was complete in BH22, BH23, BH24, BH204, BH207, BH303, BH304, BH306, and BH307. The televiewer logging was carried out after completion of the borehole, with a surface casing set through to the top of rock. As such, only the exposed rock portion of the hole was logged. All discontinuities logged using the televiewers have dip direction with reference to true north.

The Mount Sopris wireline logging borehole system and Advanced Logic Technology QL40-OBI and QL40-ABI probes were used to collect the televiewer data.

3.8 Gas Monitoring

Prior to fieldwork each day, a GX6000 multi-gas air monitoring meter able to measure organic vapour and combustible gas concentrations including Methane (CH_4), Carbon Monoxide (CO), Hydrogen Sulfide (H_2S), Oxygen (O_2) and Volatile Organic Compounds (VOC) was calibrated using compressed gas cylinders with known concentrations (as supplied by the manufacturer) and used for active gas monitoring at each drill rig during the investigation for safety of drilling crew purposes.

The gas meters were mounted onto each drill rig to monitor the gas readings from the open boreholes during drilling and rock coring, and during well installation and well development at each respective borehole location. Each gas meter was set to a double alarm system for each measurable gas parameter (per the manufacturer's recommendations and WSP Golder's site-specific Health and Safety Plan and Safe Work Plan) as follows:

- CH_4 – 5% Lower Explosive Limit (LEL), and 50% LEL (secondary alarm)
- CO – 20 Parts Per Million (PPM) and 100 PPM (secondary alarm)
- H_2S – 10 PPM and 15 PPM (secondary alarm)
- O_2 – 19.5% and decreasing, and 23.5% and increasing (secondary alarm)
- VOC – 400 PPM and 1000 PPM (secondary alarm)

During drilling, if an alarm sounded from a gas monitoring unit, the procedures in our Geotechnical Investigation Work Plan and Health and Safety Plan were followed, with the drill rig being shut down and the area safe stated until either the gas dissipated or returned to the established safe working levels before resuming work.

During drilling, various boreholes encountered subsurface gas with readings that exceeded the alarm limits as set on the gas monitors at different depths and locations. The details of the depth and type of gas encountered are included on the notes section of the individual Record of Borehole Logs in Appendix A. A summary of these details is provided in Section 5.7.1.

3.9 Monitoring Wells and Groundwater Testing

One monitoring well was installed in Borehole BH23. The table below summarizes the pre-drilling geodetic ground surface and estimated top of riser pipe elevation, the nominal well diameter, the length of the screened section, and the total well depth below grade.

Table 3-4: Summary of Monitoring Well Installation

BH ID	Ground Surface Elevation(1) (m)	Est. Top of Riser Pipe Elevation(2) (m)	Nominal Well Diameter (mm)	Well Screen Length (m)	Well Depth (m)	Soil Unit Screened
BH23	85.31	86.33	50	1.52	19.51	Unit 4- Silt (ML)

Notes:
1) Elevation surveyed relative to geodetic datum CGVD28:1978 adjustment.
2) Based on a manual stick-up measurement of 1.02 m.

3.9.1 Groundwater Level Monitoring Method

The depth to groundwater in BH23 was manually measured with an electronic water level tape relative to a mark on the riser pipe. The water level data were collected on three monitoring events: August 9, September 29 and September 30, 2022. The groundwater level depths and approximate elevations are summarized in Section 4.3.1.

3.9.2 Single Well Response Testing Method

Prior to testing, well development activities were carried out by Walker Drilling Limited to remove drilling fluids and skin effects from drilling activities, and to develop the geological unit(s) adjacent to the screened interval. Development was achieved by “air” lifting the drilling fluids and water in the well with compressed nitrogen on August 9, 2022. The discharge quality during well development was regularly monitored by WSP Golder with the use of a Horiba U-52 multi-parameter water quality field meter and visual indicators that development had been achieved. Monitoring well development was considered to have been achieved once at least five well volumes had been removed and it was visually confirmed that drilling fluid (i.e., diluted drilling mud and/or grout) was absent.

To estimate the bulk hydraulic conductivity (K) of the soil materials adjacent to the screened interval at BH23, two single-well response tests were carried out after the completion of the well development activities. The tests were completed by rapidly purging water from the well with dedicated Waterra™ tubing and foot valve. The water level recovery was monitored manually with an electronic water level tape until static conditions were achieved. Automatic data loggers were used in conjunction with manual measurements.

The Bouwer and Rice (1976)[1] method was applied to the recovery data, using the confined solution. The data were analyzed using the AQTESOLV for Windows version 4.50 Professional software. The estimated hydraulic conductivity result is presented in Section 4.3.2. A summary of the single-well response test data and analysis for each test is presented in the AQTESOLV printouts provided in Appendix F, including the input parameters used.

Curve fitting for the displacement vs time plot for the Bouwer and Rice (1976) solution was completed following the Butler (1998)[2] recommended head range.

Coefficients A, B, and C are determined as described by Bouwer and Rice (1976) as a function of well type (ex fully penetrating or partially penetrating) and well geometry (the ratio of well screen length to well radius), using the parameter listed in Appendix F and assuming a partially penetrating well. The coefficients used to calculate the effective test radius (the distance in the aquifer at which the test would have no effect). In this application, AQTESOLV is parameterized with the well type and geometry, which the software uses to calculate the appropriate coefficients to determine the effective test radius.

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[1] Bouwer, H. and R.C. Rice, 1976. A slug test method for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells, Water Resources Research, vol. 12, no. 3, pp. 423-428.

[2] Butler, J.J., Jr., 1998. The Design, Performance, and Analysis of Slug Tests (1st ed.), Lewis Publishers, New York, 252p

3.10 Geotechnical Logging

3.10.1 Soil Logging

WSP Golder geotechnical staff continuously logged the boreholes during drilling activities. During drilling operations, Imperial units for depths were recorded on the field logs for consistency with the drill equipment and crew.

The logs recorded descriptions of the subsurface soils according to ASTM D2487/D2488, stratigraphy change, the depth and type of samples or in situ tests; sample intervals, sample recovery, blow counts during SPT sampling/testing, any drilling fluid loss and mitigation action to restore drilling fluid, if applicable, groundwater observations where possible as mud-rotary was used, and pocket penetrometer test measurements on the bottom of the Shelby tubes.

The presence of cobbles/boulders as inferred from drilling resistance/ SPT sampling refusal/ drill bit chattering/ auger grinding observations were also recorded on the logs. Where encountered, gas occurrences were communicated immediately by field staff on site to the site supervisor and documented on the borehole logs and daily reports, which were submitted to E.S. Fox, with the appropriate health and safety measures undertaken.

With regard to offshore borehole logging, the “depths” on the borehole logs are all from the surveyed drill barge deck (not lakebed); as such, the elevations on the logs provide a better indication of the subsurface strata location.

Lake water levels were manually measured by the drilling crew daily when possible and the average of the lake water level during the duration of each borehole is indicated on the logs.

Further detail is provided in the *Abbreviations and Terms Used on Record of Boreholes and Test Pits* and *List of Symbols* given in Appendix A.

3.10.2 Rock Logging

Rock logging was carried out in accordance with the International Society for Rock Mechanics (ISRM) Suggested Methods for Rock Characterization, Testing and Monitoring[3], modified as required for local geology. Bedrock quality and discontinuity data were recorded based on a visual inspection of the recovered rock core extracted from the core barrel. The following parameters were routinely recorded as part of the geotechnical rock core logging:

- Rock type and geotechnical description;
- Total Core Recovery (TCR);
- Solid Core Recovery (SCR);
- Rock Quality Designation (RQD);
- Estimation of location and thickness of hard layers that were greater than 2 cm (based on visual logging in Blue Mountain Formation only);

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[3] Brown, E.T. (ed.) 1981. Suggested Methods for Rock Characterization Testing and Monitoring, International Society for Rock Mechanics. Oxford: Pergamon.

- Estimation of location and thickness of weak (R0 and R1) layers (based on visual logging).
- Fracture index per 0.25 m;
- Field estimation of rock strength;
- Weathering classification;
- Discontinuity type;
- Discontinuity properties; and
- The depths of lost core and broken core zones.

TCR is the total length of core recovered expressed as a percentage of the measured length drilled for each core run. SCR is estimated by measuring the cumulative length of solid core, recovered at full diameter and is expressed as a percentage of the total length drilled. RQD is defined as the cumulative length of intact pieces of core which are 100 mm or more in length and is expressed as a percentage of the total length drilled. The RQD does not typically include core with a rock strength of R0 (extremely weak) nor does it consider mechanical breaks in the core. The RQD value was calculated in accordance with Deere and Deere (1988) and ASTM D6032-17.

Fracture index is the number of natural fractures which occur over the length of core examined on a per unit length. The fracture index was measured at 0.25 m increments for each core run. By using a 0.25 m increment for fracture index, the fracture frequency can be determined by adding all the fractures for 1 m intervals.

The field strength classification was recorded on a per core run basis during the geotechnical core logging. The field strength classification, as defined by ISRM (1981), is a field-level estimation of the rock strength which ranges from R0 (extremely weak rock) to R6 (extremely strong rock). Where rock samples were selected for laboratory strength testing, the field strength estimation is superseded by the laboratory strength test.

The degree of weathering was recorded on a per core run basis during the geotechnical core logging. The weathering process describes the breakdown of rock by physical process. The degree of weathering, as defined by the ISRM (1981), provides a qualitative measure of the degree of weathering for the original rock material.

The type, shape and roughness of natural discontinuities were described. The following types of discontinuities were identified:

- *Bedding (BD)* – Discontinuities associated with stratigraphic layering (i.e., bedding).
- *Joint (JN)* – Discontinuities which show persistence, full separation, some aperture, and often some form of staining, alteration, coating or infill.
- Broken Core – Typically characterized by pieces that do not form full circumferential segments. Broken core generally consists of angular fragments and have the same intact rock strength as the surrounding core. Where broken core was encountered, it had a fracture index of 1 fracture per centimeter.
- Lost Core – occurs when the recovered core length is less than the drilled length. This can be due to natural voids, mechanically degraded core from the drilling process, or unconsolidated materials.

Further detail is provided in the *Lithological and Geotechnical Rock Description Terminology* in Appendix A.

3.11 Laboratory Testing

Routine laboratory testing was carried out on selected soil samples included water contents (ASTM D2216-16), Atterberg Limits (ASTM D4318-17), particle size distribution and hydrometer analyses (ASTM D6913/D6913M-17 and ASTM D422), unit weight (ASTM D7263), specific gravity (ATM D854-14), minimum (ASTM D4254-16) and maximum (ASTM D4253-16) index density and soil resistivity (ASTM G57-20) using the four-electrode method.

Complex geotechnical testing (BH24 and BH26 only) consisted of one-dimensional consolidation (ASTM D2435/D2435M-11(2020), hydraulic conductivity (ASTM D2434-19/ASTM D5084-16a), CAD Triaxial and CKoU Triaxial testing.

To estimate the hydraulic conductivity of various soil materials encountered during the subsurface investigation in BH24 and BH26, cohesive samples were obtained using Shelby tubes in order to collect intact samples and the remaining samples were obtained from split spoon samples. The split spoon samples were then reconstituted by the laboratory based on target soil parameter values to approximate conditions at the depths the samples were collected, and the test results represent reconstituted hydraulic conductivity. All samples were saturated prior to testing as per the ASTM procedures.

Hydraulic conductivity was measured by the laboratory using a flexible wall permeameter in accordance with ASTM D5084 for fine-grained soil samples with hydraulic conductivities less than about $1\text{x}10^{-7}$ m/s typically using a constant volume technique, except for BH26, Sample 15 where a constant gradient technique was used.

Where required for laboratory testing, reconstitution of the samples was carried out using moist tamping combined with the undercompaction method, where the initial layer is compacted to lower density than the succeeding layers so that the final density of each specimen is approximately uniform.

Laboratory testing carried out on selected rock core samples included petrographic analysis, Unconfined Compressive Strength (UCS) testing (ASTM D4543-19 and ASTM D7012-14, Method C and D) with and without stress-strain measurements, slake durability (ASTM D4644-16), direct shear testing (constant displacement ASTM D5607), triaxial strength testing (ASTM D7012-14 and ASTM D4543-19), Brazilian disc testing (ASTM D3967-16), point load (PLT) testing (ASTM D5731-16), punch penetration testing (ISRM), Cerchar abrasivity testing (ASTM D7625), specific gravity (ASTM D6476-15) and swell testing (Lo et al.,1978, 1989, 1990). The Young's modulus was generally determined at 50% of the unconfined compressive strength.

Brazilian samples were obtained directly from rock cores, with bedding planes parallel to the long axis of the disc. Diametral loads were then applied parallel to the bedding to generate tensile stresses between bedding planes.

Three types of swell tests were carried out on HQ core samples: Free Swell, Semi-Confined and Null Tests. For the Free Swell tests, the rock specimen was permitted to deform without any restrictions in all directions under constant temperature and 100% relative humidity with direct access to fresh (tap) water. For Semi-confined Swell tests, the rock specimen was submerged in tap water while strain changes in only one direction, either vertical or horizontal, were monitored by a dial gauge reading while a constant pressure was applied to the rock sample in the direction of measurement and deformations in perpendicular directions remained unrestricted. The selected applied pressures varied from 0.04 MPa to 0.08 MPa. For the Null swell tests, the critical pressure required to completely suppress swelling in the vertical or horizontal directions was measured. This test arrangement consists of the loading support frame, the load cell and loading–cap assembly, deformation monitoring system and the container where the sample is submerged in tap water. Details regarding the swell testing procedures are contained in Appendix D.

Table 3-5 indicates the list of the laboratories completed the testing on the specimens collected during Phase 2.

Table 3-5: Summary of Testing Laboratories

Laboratory Name	Address	Test Types
WSP Golder Whitby/Mississauga	100 Scotia Court, Whitby Ontario L1N 8Y6/ 2900 Argentia Road #15, Mississauga, Ontario L5N 7X9	Water Content, Sieve and Hydrometer Analysis, Bulk Density/Unit Weight, Specific Gravity, Atterberg Limits, Organic Content, Soil Resistivity, Petrographic analysis
Geomechanica Inc.	#900-390 Bay St. Toronto, ON	Direct Shear-Rock, Uniaxial Compression – Rock, Uniaxial Compression – Rock, Slake Durability – Rock, Triaxial Compression – Rock, Brazilian Disc - Rock, Point Load – Rock, Punch Penetration – Rock, Cerchar Abrasivity – Rock, Specific Gravity – Rock
GeoTesting Express	125 Nagog Park, Acton, MA, 01720, United States	One Dimensional Oedometer, Consolidated Undrained Triaxial (CK0U), Consolidated Drained Triaxial (CAD), Hydraulic Conductivity, Min/Max Density, Water Content, Sieve and Hydrometer Analysis, Specific Gravity, Atterberg Limits
K. Y. Lo Inc.	Geotechnical Research Centre, Faculty of Engineering, Western University, 1151 Richmond Street N., London, ON, N6A 5B9	Swell Testing (Free Swell, Horizontal Semi Confined, Vertical Semi Confined, Horizontal Null test, Vertical Null test)
AGAT Laboratories	5835 Coopers Ave, Mississauga, ON L4Z 1Y2	Chemical and Physical Characteristics of Soil and Corrosion Potential

4.0 REGIONAL GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

4.1.1 General

The DNNP site is located in an area within which approximately 22 m to 24 m (onshore) and 0 m to 10 m (offshore) of Pleistocene soils overlie Ordovician shale and limestone bedrock. The major geological features of the site are a complex section of glacial tills and interglacial soils up to about 24 m thick (onshore along the CCW tunnel alignments) overlying subhorizontally bedded(2) Ordovician limestone and shale of the Simcoe Group.

4.1.2 Physiographic Region

As delineated in the Physiography of Southern Ontario[4], the site lies within the minor physiographic region known as the Iroquois plain. The Iroquois plain region is characterized by till plains, drumlins, and areas of silty lacustrine deposits along the north shore of Lake Ontario.

The Iroquois Plain region covers the border of the lake shore extending from the City of Trenton in the east to the City of St. Catharines in the southwest. The Iroquois Plain refers to an area of lowlands that border the present-day Lake Ontario which was formed within the basin of Glacial Lake Iroquois, which was a larger and higher version of Lake Ontario. Lake Iroquois sediments consist both of granular soils (silt and sand) and finer-

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[4] Chapman, L.J. and Putnam, D.F., 1984. *The Physiography of Southern Ontario*, Ontario Geological Survey. Special Volume 2, Third Edition. Accompanied by Map P.2715, Scale 1:600,000. Ontario Ministry of Natural Resources

grained silt and clay soils. Apart from the naturally deposited soils, fills such as structure and infrastructure backfill, engineered fills and landscape fills are to be expected within the study area.

The findings of this geotechnical investigation indicate that the subsoil conditions are generally consistent with the characteristics of the physiographic region (the Iroquois Plain). Section 4.2 further outlines the geologic units (from ground surface/ lakebed to depth) that have been used as the basis for the reporting of subsurface conditions in this report.

4.1.3 Bedrock Geology

The site is located within the tectonically stable interior of the North American continent, which is characterized by low rates of historical seismicity[5]. The region is underlain by thick sequences of subhorizontal dipping[2] early Paleozoic shallow-water sedimentary strata that unconformably overlie exhumed metamorphic and igneous basement rocks of the middle Proterozoic Grenville Province, a division of the Precambrian shield.

Review of published bedrock geology mapping indicates that the Paleozoic bedrock in the northern Lake Ontario region generally belongs to the Middle Ordovician Simcoe Group and the Upper Ordovician Blue Mountain Formation (OGS 2011)[4]. The Simcoe Group consists of five formations; from oldest to youngest; Shadow Lake Formation, Gull River Formation, Bobcaygeon Formation, Verulam Formation and Lindsay Formation. These primarily consist of limestone apart from the Shadow Lake Formation which is a sandstone. The limestones of the Simcoe Group are fossiliferous throughout with several thin coquina beds in the shaly interbeds. The Lindsay Formation is overlain by shale of the Blue Mountain Formation. Near the site, sandstone, siltstone and shale of the Shadow Lake Formation unconformably overlie the Precambrian basement and mark the base of the Paleozoic section.

4.2 Subsurface Conditions

4.2.1 General

The subsurface soil, bedrock and groundwater conditions encountered at the boreholes and the results of in situ testing from the investigation are given on the Record of Borehole and Drillhole sheets presented in Appendix A and/or the other appendices that follow. The results of the laboratory testing carried out during the investigation are presented on the Record of Borehole and Drillhole sheets as well as on the figures in Appendix A and/or in Appendix D.

Photographs of the soil samples and bedrock core recovered at the boreholes are provided in Appendix B and Appendix C, respectively.

The stratigraphic boundaries shown on the Record of Borehole and Drillhole sheets are inferred from observations of drilling progress and noncontinuous sampling and therefore typically represent transitions between soil and rock types rather than exact planes of geological change. The subsurface conditions will vary between and beyond the borehole locations.

In general, the overburden thickness ranges from approximately 24 m on the north end of the CCW tunnels to 22 m near the bluffs to the south. Offshore the lake bed sediment thicknesses in the boreholes along the tunnels

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[5] Johnston, A.C., Coppersmith, K.J., Kanter, L.R., and Cornell, C.A., 1994, The Earthquakes of Stable Continental Regions, Volume 1; Assessment of Large Earthquake Potential: Final report submitted to Electric Power Research Institute (EPRI), TR-102261-V1.

[4] Ontario Geological Survey 2011. 1:250 000 scale Bedrock Geology of Ontario; Ontario Geological Survey, Miscellaneous Release---Data 126-Revision 1.

south of the bluffs range between about 10 m and about 2 m and almost zero at Borehole BH207. The onshore portion of the tunnel alignments consisted of surficial fill and glacio-lacustrine deposits, and an upper till stratum that overlies sequences of cohesive/non-cohesive glacio-lacustrine strata, underlain by a lower till deposit and bedrock. Offshore, the upper till stratum begins to thin out or disappear such that the offshore stratigraphy along the tunnel alignments consists of alternating layers of cohesive and/or non-cohesive glacio-lacustrine deposits underlain by a lower glacial till and bedrock.

4.2.2 Geological Units

In general, the stratigraphy at the intake and outfall tunnel sites consists of alternating layers of cohesive and non-cohesive soils and tills underlain by bedrock.

The following geologic units (from surface to depth) have been used as the basis for the reporting of subsurface conditions in the sections below:

Table 4-1: Table of Geologic Reporting Units

Unit No.	Description
1	Fill/Topsoil (1)
2a	Surficial Lacustrine Deposits - Sandy Lean Clay to Lean Clay (1)
2b	Surficial Lacustrine Deposits – Silty Sand to Silty Sand with Gravel (1)
3	Upper Till (2)- Silty Sand to Sandy Silt
4a	Intermediate Glacio-Lacustrine Deposits - Silty Sand to Sandy Silt (3)
4b	Intermediate Glacio-Lacustrine Deposits - Sandy Lean Clay to Lean Clay(3)
5	Lower Till(3)- Silty Clay with Sand to Sandy Silty Clay
6a	Blue Mountain Formation Bedrock(3)
6b	Lindsay Formation Bedrock(3)

Notes:

1) Encountered onshore only.
2) Encountered onshore, and offshore in BH202 only.
3) Encountered onshore and offshore.

The stratigraphic units are consistent with those used in the WSP Golder Phase 1 Report. The following is a general summary of the soil and rock conditions encountered within the stratigraphic units identified above, at the various borehole locations advanced for Phase 2. Reference should be made to the corresponding Record of Borehole and Drillhole sheets for the specific soil and bedrock stratigraphy.

4.2.3 Unit 1 – Fill/Topsoil

Fill/topsoil (Unit 1) consisting of predominantly silty sand with gravel was encountered at ground surface at all onshore borehole locations. Unit 1 varied in colour from brown to grey. Local sandy lean clay fill was encountered in Unit 1 in Boreholes BH24 and BH25. Cobbles, boulders, shale bedrock fragments and organic staining were also observed in Soil Unit 1 at some borehole locations. An 80 mm thick buried topsoil fill layer was present in BH24 at 1.75 m depth.

The results of the laboratory testing carried out on the fill materials of Soil Unit 1 during the investigation are presented on the Record of Borehole sheets and on the laboratory test result figures provided in Appendix A.

A summary of the water content test results is also provided below in Table 4-2. The results of the organic content testing are summarized below in Table 4-3. The results of the in situ testing carried out within Soil Unit 1 are provided on the respective Record of Boreholes provided in Appendix A.

Table 4-2: Summary of Water Content Tests - Unit 1

BH ID	SA No.	Depth (m)	Water Content (%)	Soil Symbol
BH23	2	0.76-1.22	4.6	(SM)
BH24	2	0.61-1.22	7.2	(SM)
BH24	3A	1.22-1.75	4.9	(SM)
BH25	2	0.76-1.37	5.6	(SM)
BH25	3A	1.52-1.83	16	(CL)
BH26	2	0.61-1.22	3.1	(SM)
BH82	2	0.76-1.22	7.8	(SM)

Table 4-3: Summary of Organic Content Tests - Unit 1

BH ID	SA No.	Depth (m)	Organic Content (%)	Soil Symbol
BH24	3A	1.22-1.77	1.0	(SM)
BH25	3A	1.52-1.83	2.0	(CL)
BH26	2A	0.61-1.16	0.3	(SM)
BH82	2	0.76-1.22	0.8	(SM)

4.2.4 Unit 2a – Surficial Lacustrine Deposits – Sandy Lean Clay to Lean Clay

Deposits of sandy lean clay to lean clay (Unit 2a) were encountered below the fill layer in Boreholes BH24, BH25 and BH82. Unit 2a was brown to grey in colour and consisted of sandy lean clay to lean clay with sand and trace subangular gravel. The results of the in situ testing carried out within Soil Unit 2a are provided on the respective Record of Borehole sheets provided in Appendix A.

The results of index testing carried out on samples from Soil Unit 2a are presented on the Record of Borehole sheets in Appendix A and Table 4-4.

Table 4-4: Summary of Water Content, Grain Size Distribution and Atterberg Limits Tests - Unit 2a

BH ID	SA No.	Depth (m)	Water Content (%)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL(1)	PL(2)	PI(3)	Soil Symbol
BH24	5A	2.44-2.84	20.8	-	-	-	-	-	-	-	(CL)
BH24	5B	2.84-3.05	19.2	-	-	-	-	-	-	-	(CL)
BH24	6	3.05-3.66	21.6	0	6	48	46	34	16	18	(CL)
BH24	7	3.66-4.27	25.1	-	-	-	-	-	-	-	(CL)
BH24	8A	4.27-4.60	23.8	-	-	-	-	-	-	-	(CL)
BH25	4	2.29-2.74	17.5	-	-	-	-	-	-	-	(CL)
BH25	5	3.05-3.50	20.9	-	-	-	-	-	-	-	(CL)
BH25	6	3.81-4.27	11.4	4	28	46	22	17	11	6	(CL-ML)
BH82	3B	1.78-1.98	20.3	-	-	-	-	-	-	-	(CL)
BH82	4	2.29-2.74	18.4	-	-	-	-	-	-	-	(CL)
BH82	5	3.05-3.50	21.0	-	-	-	-	-	-	-	(CL)
BH82	6	3.81-4.27	36.1	2	25	39	34	22	12	10	(CL)

Notes:
1) LL = Liquid Limit
2) PL = Plastic Limit
3) PI = Plasticity Index

4.2.5 Unit 2b – Surficial Lacustrine Deposits – Silty Sand to Silty Sand with Gravel

Deposits of silty sand to silty sand with gravel (Unit 2b) were encountered below Unit 2a in Boreholes BH24, BH25 and BH82. Unit 2b was grey in colour containing non-cohesive fines, fine to coarse sand and subangular to angular, fine to coarse gravel. The results of the in situ testing carried out within Soil Unit 2b are provided on the respective Record of Borehole sheets provided in Appendix A.

The results of index testing carried out on samples from Soil Unit 2b are presented on the Record of Borehole sheets in Appendix A. A summary of the test results is also provided below in Table 4-5. A total of one soil sample from Soil Unit 2b was submitted for resistivity testing and the result is in Table 4-6.

Table 4-5: Summary of Water Content, Grain Size Distribution and Atterberg Limits Tests - Unit 2b

BH ID	SA No.	Depth (m)	Water Content (%)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL[1]	PL[2]	PI[3]	Soil Symbol
BH24	8B	4.60-4.88	9.1	-	-	-	-	-	-	-	(SM)
BH24	9	4.88-5.50	9.2	-	-	-	-	-	-	-	(SM)
BH24	10	5.50-6.10	9.5	18	40	31	11	Non- Plastic			(SM)
BH25	7A	4.70-5.03	8.6	14	41	32	13	Non- Plastic			(SM)
BH25	7B	5.03-5.18	8.2	-	-	-	-	-	-	-	(SM)
BH25	8A	5.33-5.60	8.5	-	-	-	-	-	-	-	(SM)
BH82	7	5.18-5.60	8.6	-	-	-	-	-	-	-	(SM)
BH82	8	6.10-6.55	7.8	15	41	32	12	Non- Plastic			(SM)

Notes:
1) LL = Liquid Limit
2) PL = Plastic Limit
3) PI = Plasticity Index

Table 4-6: Summary of Soil Resistivity Tests - Unit 2b

BH ID	SA No.	Depth (m)	Temperature Corrected Resistivity (Ω cm)	Soil Symbol
BH25	7B	5.03-5.18	4130(1)	(SM)

Notes:
1) As tested using ASTM G57-20 The Wenner Four Electrode method

4.2.6 Unit 3 – Upper Till – Silty Sand to Sandy Silt

Deposits of silty sand with gravel to sandy silt with gravel (Unit 3) were encountered either below the surficial glaciolacustrine deposits (Units 2a/2b) in Boreholes BH24, BH25 and BH82 or below the fill (Unit 1) in Borehole BH23 and BH26. Unit 3 was also encountered in Borehole BH202 offshore. Unit 3 is described as a till layer generally consisting of a heterogeneous mixture of gravel, boulders, and cobbles in a matrix of silty sand. This deposit was brown to grey in colour and consisted of silt, clay, fine to coarse sand and subrounded to subangular to angular, fine to coarse gravel. Occasionally, the upper till contains low plasticity fines.

The results of the in situ testing carried out within Soil Unit 3 are provided on the respective Record of Boreholes provided in Appendix A.

The results of index testing carried out on samples from Soil Unit 3 are presented on the Record of Borehole sheets in Appendix A. A summary of the test results is also provided below in Table 4-7. The results of the organic content tests are summarized in Table 4-8. The result of a unit weight test is shown in Table 4-9.

Ten consolidated drained triaxial tests were carried out on Soil Unit 3 retrieved from Boreholes BH24 and BH26. The results of these tests are provided on the figures in Appendix A and are summarized in Table 4-10.

A total of two soil samples from Soil Unit 3 from onshore boreholes were submitted for chemical analysis related to the potential corrosion of exposed buried steel and potential sulphate attack on buried concrete elements (corrosion and sulphate attack). The test results are provided in Appendix A and are summarized in Table 4-11. Test result for the soil resistivity test on one sample using the Wenner Four Electrode method is also included in the same appendix and table.

Six soil samples from Soil Unit 3 from Boreholes BH24 and BH26 were reconstituted by the laboratory prior to hydraulic conductivity testing. The laboratory hydraulic conductivity test reports are provided in Appendix A and the test result is summarized below in Table 4-12.

The results of the relative density tests carried out on Unit 3 specimens are provided in Appendix A. The minimum densities from Unit 3 from BH24 and BH26 ranged from 15.34 to 16.44 kN/m^3, and the maximum densities ranged from 20.34 to 20.78 kN/m^3.

Table 4-7: Summary of Water Content, Grain Size Distribution, Atterberg Limits and Specific Gravity Tests - Unit 3

BH ID	SA No.	Depth (m)	Water Content (%)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL(1)	PL(2)	PI(3)	Specific Gravity	Soil Symbol
BH23	3	1.52-1.98	6.5	-	-	-	-	-	-	-	-	(SM/ML)
BH23	4	2.29-2.74	5.4	13	41	35	12	Non-Plastic			-	(SM/ML)
BH23	5	3.05-3.50	3.7	-	-	-	-	-	-	-	-	(SM/ML)
BH23	6	3.81-4.24	10.5	-	-	-	-	-	-	-	-	(SM/ML)
BH23	7	4.57-5.03	6.6	7	34	42	17	14	10	4	-	(SM/ML)
BH23	8	5.33-5.78	6.6	-	-	-	-	-	-	-	-	(SM/ML)
BH23	9	6.10-6.43	5.9	6	44	37	13	Non-Plastic			-	(SM/ML)
BH23	10	7.62-8.08	7.1	-	-	-	-	-	-	-	-	(SM/ML)
BH23	11	9.14-9.60	7.0	3	50	37	11	Non-Plastic			-	(SM/ML)
BH23	12	10.67-10.92	5.6	-	-	-	-	-	-	-	-	(SM/ML)
BH23	13	12.19-12.32	5.6	-	-	-	-	-	-	-	-	(SM/ML)
BH23	14	13.72-13.94	6.3	-	-	-	-	-	-	-	-	(SM/ML)
BH23	16	16.76-17.2	8.5	-	-	-	-	-	-	-	-	(ML)
BH24	11	6.10-6.71	7.8	-	-	-	-	-	-	-	-	(SM)
BH24	16	9.14-9.75	-	-	-	-	-	-	-	-	2.68	(SM)
BH24	17	9.75-10.36	7.9	-	-	-	-	-	-	-	-	(SM)
BH24	18	10.36-10.97	6.0	-	-	-	-	-	-	-	-	(SM)
BH24	20	11.58-12.19	7.1	23	37	29	10	13	10	3	-	(SM)
BH24	22	12.80-13.41	10.7	-	-	-	-	-	-	-	-	(SM)
BH24	23	13.41-14.02	12.7	-	-	-	-	-	-	-	-	(SM)
BH24	24	14.02-14.63	14.7	-	-	-	-	-	-	-	-	(SM)
BH25	8B	5.60-5.78	7.8	-	-	-	-	-	-	-	-	(GM)

BH ID	SA No.	Depth (m)	Water Content (%)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL[1]	PL[2]	PI[3]	Specific Gravity	Soil Symbol
BH25	9	6.14-6.55	6.5	44	30	20	6	-	-	-	-	(GM)
BH25	10	7.62-7.75	7.9	-	-	-	-	-	-	-	-	(GM)
BH25	11	9.14-9.40	6.8	-	-	-	-	-	-	-	-	(GM)
BH25	12	10.67-10.95	8.1	39	36	21	5	13	10	3	2.70	(GM)
BH26	4	1.83-2.44	5.7	-	-	-	-	-	-	-	-	(SM)
BH26	6	3.05-3.66	8.6	-	-	-	-	-	-	-	-	(SM)
BH26	8	4.27-4.88	9.6	26	27	40	7	13	11	2	-	(SM)
BH26	10	5.50-5.71	-	-	-	-	-	-	-	-	2.68	(SM)
BH26	11	6.10-6.35	8.0	-	-	-	-	-	-	-	-	(SM)
BH26	15	8.53-9.14	10.3	-	-	-	-	-	-	-	-	(SM)
BH26	17	9.75-9.85	10.7	-	-	-	-	-	-	-	-	(SM)
BH26	19	10.97-11.35	11.2	-	-	-	-	-	-	-	-	(SM)
BH82	9	7.62-8.08	7.4	-	-	-	-	-	-	-	-	(SM)
BH82	10	9.14-9.33	7.4	8	44	37	12	Non-Plastic			-	(SM)
BH202	1	6.15-6.76	9.5	-	-	-	-	-	-	-	-	(CL-ML)
BH202	2	6.91-7.37	10.3	1	22	55	22	17	12	5	-	(CL-ML)
BH202	3	7.37-7.82	5.0	-	-	-	-	-	-	-	-	(CL-ML)
BH202	4	7.82-8.28	8.8	9	26	49	16	15	11	4	-	(CL-ML)

Notes:
1) LL = Liquid Limit
2) PL = Plastic Limit
3) PI = Plasticity Index

Table 4-8: Summary of Organic Content Tests - Unit 3

BH ID	SA No.	Depth (m)	Organic Content (%)	Soil Symbol
BH202	1	6.15-6.76	0.5	(CL-ML)

Table 4-9: Summary of Unit Weights – Unit 3

BH ID	SA No.	Depth (m)	Water Content (%)	Laboratory Measured Unit Weight[1] (kN/m^3)	Soil Symbol
BH202	1	6.15-6.76	9.5	24.60	(CL-ML)

Notes:
1) The value presented in Table 4-9 may not be representative of the actual unit weight of the material encountered in Soil Unit 3. Potential causes for the discrepancy may be due to even a small amount of gravel size particles within the test sample and/or the relatively small sample size for testing.

Table 4-10: Summary of Consolidated Drained Triaxial-Anisotropic Consolidation Tests – Unit 3

BH ID	SA No.	Sample Depth (m)	Vertical Effective Consolidation Stress (kPa)	Horizontal Effective Consolidation Stress (kPa)	Shear Strength (kPa)	Strain at Failure (%)	Strain Rate (%min)	Deviator Stress at Failure (kPa)	Effective Minor Principal Stress at Failure (kPa)	Effective Major principal Stress at Failure (kPa)	B-value	Soil Symbol
BH24	12	6.71-7.32	140.2	96.6	111.1	11.70	0.01	222.2	96.1	318.3	0.95	(SM)
BH24	14	7.92-8.53	421.2	289.8	335.6	10.50	0.01	671.3	289.8	961.1	0.97	(SM)
BH24	17	9.75-10.36	861.2	579.0	726.4	13.00	0.01	1453.0	579.1	2032.0	0.95	(SM)
BH24	20	11.58-12.19	140.4	96.7	125.3	11.20	0.01	250.7	96.5	347.2	0.98	(SM)
BH24	23	13.41-14.02	839.5	579.0	1077.0	4.65	0.01	2154.0	578.9	2733.0	0.95	(SM)
BH26	4	1.83-2.44	93.6	64.8	86.0	11.30	0.01	172.0	64.8	236.8	0.93	(SM)
BH26	7	3.66-4.27	280.1	193.8	424.8	2.58	0.01	849.6	194.2	1044.0	0.98	(SM)
BH26	11	6.10-6.71	564.9	388.8	635.5	5.28	0.01	1271.0	388.8	1660.0	0.97	(SM)
BH26	15	8.53-9.14	93.9	64.9	148.5	2.13	0.01	297.0	64.9	361.9	0.99	(SM)
BH26	17	9.75-10.16	562.2	388.3	688.9	3.65	0.01	1378.0	388.3	1766.0	0.96	(SM)

Table4-11: Summary of Steel Corrosion and Sulphate Attack, Chemical Analysis – Unit 3

BH ID	SA No.	Sample Depth (m)	Sulfates (µg/g)	Chlorides (µg/g)	Sulfide (%)	Resistivity (Ω-cm)	pH	Redox Potential Trials Trials (mV)			Soil Symbol
BH23	6	3.81-4.24	-	-	-	4879(1)	-	-	-	-	(SM/ML)
BH25	11	9.14-9.40	124	7	<0.01	4100	8.17	311	316	318	(GM)
BH26	14	7.92-8.38	106	6	0.01	4350	8.53	261	270	276	(SM)

Notes:

1) As tested using ASTM G57-20 The Wenner Four Electrode method.

Table 4-12: Summary of Estimated Laboratory Hydraulic Conductivity - Unit 3

BH ID	SA No.	Sample Depth (m)	Reconstituted Hydraulic Conductivity (m/s)	Soil Symbol
BH24	13	7.32 - 7.92	1×10^{-9}	(SM)
BH24	17	9.75 - 10.36	5×10^{-10}	(SM)
BH24	22	12.80 - 13.41	5×10^{-10}	(SM)
BH26	6	3.05 - 3.66	7×10^{-10}	(SM)
BH26	8	4.27 - 4.88	6×10^{-9}	(SM)
BH26	15	8.53 - 9.14	1×10^{-7}	(SM)

4.2.7 Unit 4a – Intermediate Glaciolacustrine Deposits – Silty Sand to Sandy Silt

Deposits of mainly silty sand to sandy silt (Unit 4a) were encountered below the upper till layer (Unit 3) onshore and in BH202 (offshore), while offshore Unit 4a was generally encountered at the lakebed or locally below Unit 4b. Unit 4a offshore thins out southerly and was not encountered in BH205 to BH207 and BH309. Unit 4a was brown to grey in colour and consisted of various amounts of silt, clay, fine to coarse sand and occasionally subrounded to subangular/angular, fine to coarse gravel. Occasionally Soil Unit 4a consisted of silt to silt with sand. The results of the in situ testing carried out within Soil Unit 4a are provided on the respective Record of Boreholes provided in Appendix A.

The results of index testing carried out on samples from Soil Unit 4a are presented on the Record of Borehole sheets in Appendix A. A summary of the test results is also provided below in Table 4-13. The results of unit weight testing are summarized in Table 4-14. The results of the organic content tests are summarized in Table 4-15.

Eight consolidated drained triaxial tests were carried out on Soil Unit 4a retrieved from Boreholes BH24 and BH26. The results of these tests are provided on the figures in Appendix A and are summarized in Table 4-16.

A total of eight soil samples from Soil Unit 4a from onshore boreholes were submitted for chemical analysis related to the potential corrosion of exposed buried steel and potential sulphate attack on buried concrete elements (corrosion and sulphate attack). The test results are provided in Appendix A and are summarized in Table 4-17. Test result for the soil resistivity test on one sample using the Wenner Four Electrode method is also included in the same appendix and table.

One soil sample from Soil Unit 4a from Borehole BH24 was reconstituted by the laboratory prior to hydraulic conductivity testing. The laboratory hydraulic conductivity test report is provided in Appendix A and the test result is summarized below in Table 4-18.

The results of the relative density tests carried out on Unit 4a specimens are provided in Appendix A. The minimum densities from Unit 4a specimens from BH24 and BH26 ranged from 14.59 and 14.79 kN/m^3, and the maximum densities ranged from 19.20 and 18.74 kN/m^3.

Table 4-13: Summary of Water Content, Grain Size Distribution, Atterberg Limits and Specific Gravity Tests - Unit 4a

BH ID	SA No.	Depth (m)	Water Content (%)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL(1)	PL(2)	PI(3)	Specific Gravity	Soil Symbol
BH23	15	15.24-15.53	11.3	-	-	-	-	-	-	-	-	(SM)
BH23	17	18.29-18.57	17.8	1	3	84	12	-	-	-	-	(ML)
BH23	18A	19.81-20.12	20.1	-	-	-	-	-	-	-	-	(ML)
BH24	25	14.63-15.24	16.9	1	16	75	9	Non-Plastic				(ML)
BH24	26	15.24-15.85	17.3	-	-	-	-	-	-	-	-	(ML)
BH24	28	16.46-17.07	-	-	-	-	-	-	-	-	2.77	(ML)
BH24	29A	17.07-17.40	-	-	-	-	-	-	-	-	2.67	(ML)
BH24	37	21.95-22.56	21.6	-	-	-	-	-	-	-	-	(ML)
BH24	38A	22.56-23.01	7.7	-	-	-	-	-	-	-	-	(ML)
BH24	38B	23.01-23.16	15.6	-	-	-	-	-	-	-	-	(ML)
BH25	13A	12.19-12.40	17.8	-	-	-	-	-	-	-	-	(ML)
BH25	13B	12.40-12.65	13.8	-	-	-	-	-	-	-	-	(ML)
BH25	14	13.72-14.17	18.8	-	-	-	-	-	-	-	-	(ML)
BH25	15	15.24-15.70	16.4	0	30	67	3	-	-	-	-	(ML)
BH25	16A	16.76-17.02	15.6	-	-	-	-	-	-	-	-	(ML)
BH25	16B	17.02-17.17	17.9	-	-	-	-	-	-	-	-	(ML)
BH25	16C	17.17-17.22	17.9	-	-	-	-	-	-	-	-	(ML)
BH26	20	11.58-12.14	10.9	-	-	-	-	-	-	-	-	(SM/ML)
BH26	21	12.19-12.60	13.1	-	-	-	-	-	-	-	-	(SM/ML)
BH26	22A	12.80-13.11	14.4	0	49	47	4	Non-Plastic			-	(SM/ML)
BH26	31	18.29-18.72	2.8	5	57	33	5	Non-Plastic			2.68	(SM)
BH26	32	18.90-19.35	14.8	-	-	-	-	-	-	-	-	(SM)
BH26	34A	20.12-20.35	20.4	-	-	-	-	-	-	-	-	(SM)
BH82	12	12.19-12.65	20.0	-	-	-	-	-	-	-	-	(ML/SM)
BH82	13	13.72-14.16	13.1	-	-	-	-	-	-	-	2.71	(ML/SM)
BH82	14	15.24-15.66	12.6	0	62	33	5	-	-	-	-	(ML/SM)
BH82	18	21.34-21.79	16.2	0	61	32	7	-	-	-	-	(ML)
BH82	15A	16.76-16.97	18.9	-	-	-	-	-	-	-	-	(ML/SM)
BH202	9	10.87-11.33	12.5	-	-	-	-	-	-	-	-	(ML)
BH202	10	11.48-11.94	18.6	-	-	-	-	-	-	-	-	(ML)
BH202	11	12.09-12.55	18.9	3	38	57	3	Non-Plastic			-	(ML)
BH202	12	12.70-13.16	20.1	-	-	-	-	-	-	-	-	(ML)
BH203	2	8.53-8.99	16.2	-	-	-	-	-	-	-	-	(ML/SM)
BH203	3	9.14-9.60	-	-	-	-	-	-	-	-	2.70	(ML/SM)
BH203	4	9.75-10.21	16.5	-	-	-	-	-	-	-	-	(ML/SM)
BH203	8	12.19-12.65	16.3	0	13	80	7	Non-Plastic			-	(ML)

BH ID	SA No.	Depth (m)	Water Content (%)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL[1]	PL[2]	PI[3]	Specific Gravity	Soil Symbol
BH203	9	12.80-13.26	17.5	-	-	-	-	-	-	-	-	(ML)
BH204	2	11.51-11.96	14.2	1	17	69	13	Non-Plastic			-	(ML)
BH204	3	12.12-12.57	20.4	-	-	-	-	-	-	-	-	(ML)
BH204	8A	15.16-15.47	14.9	-	-	-	-	-	-	-	-	(SM)
BH301	1	5.74-6.35	19.8	-	-	-	-	-	-	-	-	(SM)
BH301	2	6.35-6.81	17.7	1	71	25	3	Non-Plastic			-	(SM)
BH301	3	6.96-7.34	18.4	-	-	-	-	-	-	-	-	(SM)
BH301	6	8.79-9.24	-	-	-	-	-	-	-	-	2.71	(SM)
BH301	12	12.44-12.90	15.7	2	47	38	13	Non-Plastic			-	(ML)
BH302	1B	7.92-8.08	16.1	-	-	-	-	-	-	-	-	(ML)
BH302	2	8.08-8.53	16.5	-	-	-	-	-	-	-	-	(ML)
BH302	3	8.69-9.14	19.8	0	29	68	3	Non-Plastic			-	(ML)
BH302	4A	9.30-9.60	-	-	-	-	-	-	-	-	2.69	(SM)
BH303	2A	9.14-9.24	21.0	-	-	-	-	-	-	-	-	(ML)
BH303	3	9.75-10.21	22.8	-	-	-	-	-	-	-	-	(ML)
BH303	9	13.41-13.87	13.9	1	60	34	5	Non-Plastic			-	(SM)
BH304	1A	9.45-9.72	23.2	-	-	-	-	-	-	-	-	(ML)
BH304	1B	9.72-10.06	20.3	-	-	-	-	-	-	-	-	(ML)
BH304	2	10.06-10.62	6.1	-	-	-	-	-	-	-	-	(ML)
BH305	1A	9.50-9.60	7.8	-	-	-	-	-	-	-	-	(SM/ML)
BH305	1B	9.60-10.11	17.9	-	-	-	-	-	-	-	-	(SM/ML)
BH305	9A	14.38-14.68	16.8	-	-	-	-	-	-	-	-	(SM)
BH306	7A	15.77-16.00	15.0	0	2	87	11	Non-Plastic			-	(ML)
BH306	7B	16.00-16.18	17.0	-	-	-	-	-	-	-	2.71	(ML)
BH306	8B	16.54-16.66	18.6	-	-	-	-	-	-	-	-	(ML)
BH307	2	13.41-13.87	13.0	13	8	65	14	Non-Plastic			-	(ML)
BH308	1A	14.17-14.38	16.1	-	-	-	-	-	-	-	-	(ML)
BH308	1B	14.38-14.55	12.1	5	39	51	5	Non-Plastic			-	(ML)
BH308	1C	14.55-14.78	15.1	-	-	-	-	-	-	-	2.72	(ML)

Notes:
1) LL = Liquid Limit
2) PL = Plastic Limit
3) PI = Plasticity Index

Table 4-14: Summary of Laboratory Measured Unit Weights – Unit 4a

BH ID	SA No.	Depth (m)	Water Content (%)	Laboratory Measured Unit Weight(1) (kN/m^3)	Soil Symbol
BH202	10	11.48-11.94	18.6	23.14	(ML)
BH203	2	8.53-8.99	16.2	23.14	(ML/SM)
BH302	3	8.69-9.14	19.8	21.73	(ML)

Notes:

1) Some of the values presented in Table 4-14 may not be representative of the actual unit weight of the material encountered in Soil Unit 4a. Potential causes for the discrepancy may be due to even a small amount of gravel size particles within the test sample and/or the relatively small sample size for testing.

Table 4-15: Summary of Organic Content Tests - Unit 4a

BH ID	SA No.	Depth (m)	Organic Content (%)	Soil Symbol
BH204	2	11.51-11.96	0.3	(ML)
BH301	1	5.74-6.35	0.2	(SM)
BH302	2	8.08-8.53	0.4	(ML)
BH304	1A	9.45-9.72	0.2	(ML)

Table 4-16: Summary of Consolidated Drained Triaxial-Anisotropic Consolidation Tests – Unit 4a

BH ID	SA No.	Sample Depth (m)	Vertical Effective Consolidation Stress (kPa)	Horizontal Effective Consolidation Stress (kPa)	Shear Strength (kPa)	Strain at Failure (%)	Strain Rate (%/min)	Deviator Stress at Failure (kPa)	Effective Minor Principal Stress at Failure (kPa)	Effective Major principal Stress at Failure (kPa)	B-value	Soil Symbol
BH24	25	14.63-15.24	237.6	135.1	240.6	2.80	0.01	481.2	135.0	616.1	0.99	(ML)
BH24	27	19.20-19.81	1420.0	808.9	1477.0	4.08	0.01	2954.0	808.9	3763.0	0.97	(ML)
BH24	37	21.95-22.26	240.7	135.1	209.3	6.13	0.01	418.7	135.1	553.8	1.00	(ML)
BH26	20	11.58-12.14	206.7	117.9	193.2	3.40	0.01	386.3	117.9	504.3	0.95	(SM/ML)
BH26	21	12.19-12.60	1242.0	708.5	1262.0	4.75	0.01	2523.0	707.8	3231.0	0.99	(SM/ML)
BH26	32	18.90-19.33	206.6	118.0	226.9	2.88	0.01	453.8	118.0	571.8	0.98	(SM)
BH26	34A	20.12-20.35	1246.0	708.8	1201.0	5.38	0.01	2402.0	708.3	3111.0	0.95	(SM)

Table 4-17: Summary of Steel Corrosion and Sulphate Attack, Chemical Analysis – Unit 4a

BH ID	SA No.	Sample Depth (m)	Sulfates (µg/g)	Chlorides (µg/g)	Sulfide (%)	Resistivity (Ω-cm)	pH	Redox Potential Trials (mV)			Soil Symbol
BH23	15	15.24-15.53	89	5	<0.01	5180	7.13	344	374	352	(SM)
BH25	15	15.24-15.70	100	5	0.01	5030	8.55	292	294	298	(ML)
BH82	12	12.19-12.65	202	5	<0.01	3150	8.34	235	247	256	(ML/SM)
BH202	12	12.7-13.16	78	7	<0.01	5560	8.76	241	252	259	(ML)
BH301	5	8.18-8.64	107	7	0.38	3880	8.39	246	249	250	(SM)
BH303	2B	9.24-9.60	-	-	-	5706(1)	-	-	-	-	(ML)
BH303	3	9.75-10.21	194	13	<0.01	3030	8.27	225	236	239	(ML)
BH305	9A	14.38-14.68	56	221	<0.01	1960	8.37	182	197	200	(SM)
BH306	8B	16.54-16.66	67	464	<0.01	1100	7.62	254	257	259	(ML)

Notes:

1) As tested using ASTM G57-20 The Wenner Four Electrode method

Table 4-18: Summary of Estimated Laboratory Hydraulic Conductivity - Unit 4a

BH ID	SA No.	Sample Depth (m)	Reconstituted Hydraulic Conductivity (m/s)	Soil Symbol
BH24	26	15.24 - 15.85	6×10^{-8}	(ML)
BH24	38A	22.56 – 23.01	7×10^{-8}	(ML)
BH26	31	18.29 – 18.72	2×10^{-7}	(SM)

4.2.8 Unit 4b – Intermediate Glaciolacustrine Deposits – Sandy Lean Clay to Lean Clay

Deposits of sandy lean clay to lean clay (Unit 4b) were encountered between the upper and lower till onshore and between the lakebed and lower till offshore. Unit 4b was not encountered in BH206, BH207 and BH308. In some boreholes, Units 4a and 4b were observed to be interlayered. Unit 4b was grey in colour and consisted of clay, silt, fine to coarse sand and trace to some subrounded to angular gravel. Occasionally, Soil Unit 4b was classified as silty clay, which has lower plasticity than lean clay. The results of the in situ testing carried out within Soil Unit 4b are provided on the respective Record of Borehole sheets in Appendix A.

The results of index testing carried out on samples from Soil Unit 4b are presented on the Record of Borehole sheets in Appendix A. A summary of the test results is also provided below in Table 4-19. The results of unit weight testing are summarized in Table 4-20. The results of the organic content tests are summarized in Table 4-21.

Complex laboratory testing was carried out on samples of the clay from Soil Unit 4b including eight one-dimensional consolidation testing and eight undrained consolidated triaxial tests (CK_0U). The results of these complex tests are provided in Appendix A and are summarized in Tables 4-22 and Table 4-23, respectively.

A total of six soil samples from Soil Unit 4b were submitted for chemical analysis related to the potential corrosion of exposed buried steel and potential sulphate attack on buried concrete elements (corrosion and sulphate attack). The test results are provided in Appendix A and are summarized in Table 4-24. Test results for the soil resistivity test on three samples using the Wenner Four Electrode method are also included in the same appendix and table.

Three soil samples from Soil Unit 4b from Boreholes BH24 and BH26 were reconstituted by the laboratory prior to hydraulic conductivity testing. The laboratory hydraulic conductivity test reports are provided in Appendix A and the test results are summarized below in Table 4-25.

Table 4-19: Summary of Water Content, Grain Size Distribution, Atterberg Limits and Specific Gravity Tests - Unit 4b

BH ID	SA No.	Depth (m)	Water Content (%)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL(1)	PL(2)	PI(3)	Specific Gravity	Soil Symbol
BH23	18B	20.12-20.27	11.9	-	-	-	-	-	-	-	-	(CL)
BH24	29B	17.40-17.68	19.5	0	16	73	11	18	14	4	2.67	(CL-ML)
BH24	30	17.68-18.29	19.5	-	-	-	-	35	17	18	-	(CL)
BH24	31	18.29-18.90	24.9	-	-	-	-	35	20	15	-	(CL)
BH24	32S	19.47-19.51	20.0	-	-	-	-	-	-	-	-	(CL)
BH25	17	18.29-18.75	19.0	0	6	45	49	30	15	15	-	(CL)
BH26	23S	13.98-14.02	19.8	-	-	-	-	-	-	-	-	(CL)
BH26	24S	14.59-14.63	14.1	-	-	-	-	-	-	-	-	(CL)
BH26	26	15.24-15.85	15.4	0	7	58	34	24	14	10	2.69	(CL)
BH26	27S	16.42-16.46	17.0	-	-	-	-	-	-	-	-	(CL)
BH26	28S	17.03-17.07	14.4	-	-	-	-	-	-	-	-	(CL)
BH26	29S	17.64-17.68	12.2	-	-	-	-	-	-	-	-	(CL)
BH82	11	10.67-11.13	14.8	0	16	55	29	24	13	11	2.70	(CL)
BH82	15B	16.97-17.22	22.0	0	5	58	37	22	13	9	-	(CL)
BH82	16	18.29-18.75	22.8	-	-	-	-	-	-	-	-	(CL)
BH202	5	8.43-8.89	12.9	-	-	-	-	-	-	-	-	(CL)
BH202	6B	9.42-9.50	16.1	-	-	-	-	-	-	-	-	(CL)
BH202	7	9.65-10.11	21.4	1	6	44	50	32	16	16	-	(CL)
BH202	14	13.92-14.38	18.4	-	-	-	-	-	-	-	2.72	(CL)
BH203	5B	10.49-10.82	19.2	-	-	-	-	-	-	-	-	(CL)
BH203	6	10.97-11.43	14.5	-	-	-	-	-	-	-	-	(CL)
BH204	4	12.73-13.18	21.8	-	-	-	-	-	-	-	-	(CL)
BH204	5	13.34-13.79	22.9	0	4	48	49	33	16	17	-	(CL)

BH ID	SA No.	Depth (m)	Water Content (%)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL(1)	PL(2)	PI(3)	Specific Gravity	Soil Symbol
BH204	6	13.94-14.40	16.1	-	-	-	-	-	-	-	-	(CL)
BH204	7	14.55-15.01	13.5	-	-	-	-	-	-	-	-	(CL)
BH205	1A	11.63-11.68	18.4	-	-	-	-	-	-	-	-	(CL)
BH205	1B	11.68-12.24	21.6	-	-	-	-	-	-	-	-	(CL)
BH205	2	12.24-12.70	28.2	0	2	43	55	34	17	17	-	(CL)
BH205	3A	12.85-13.05	13.7	-	-	-	-	-	-	-	-	(CL)
BH301	7	9.40-9.85	21.9	-	-	-	-	-	-	-	2.73	(CL)
BH301	8	10.01-10.46	22.2	-	-	-	-	-	-	-	-	(CL)
BH301	15	14.27-14.73	12.1	-	-	-	-	-	-	-	-	(CL)
BH302	5	9.91-10.36	22.0	0	5	52	43	29	14	15	-	(CL)
BH302	6	10.52-10.97	33.7	-	-	-	-	-	-	-	-	(CL)
BH302	8A	11.73-11.86	23.6	-	-	-	-	-	-	-	-	(CL)
BH303	1	8.38-8.99	19.1	0	3	56	41	29	16	13	-	(CL)
BH303	4	10.36-10.82	23.5	-	-	-	-	-	-	-	-	(CL)
BH303	6	11.58-12.04	20.0	-	-	-	-	-	-	-	-	(CL)
BH304	3A	10.67-10.82	19.7	-	-	-	-	-	-	-	-	(CL)
BH304	3B	10.82-11.13	22.8	-	-	-	-	-	-	-	-	(CL)
BH304	4	11.28-11.73	27.6	0	2	42	56	38	17	21	-	(CL)
BH304	5	11.89-12.34	22.3	-	-	-	-	-	-	-	2.73	(CL)
BH304	7	13.11-13.56	23.6	-	-	-	-	-	-	-	-	(CL)
BH305	3	10.72-11.18	17.0	-	-	-	-	-	-	-	-	(CL)
BH305	4	11.33-11.79	22.3	0	4	45	51	36	16	20	-	(CL)
BH305	5	11.94-12.40	27.6	-	-	-	-	-	-	-	-	(CL)
BH305	6	12.55-13.01	18.5	-	-	-	-	-	-	-	-	(CL)
BH306	1	12.04-12.65	24.3	-	-	-	-	-	-	-	-	(CL)
BH306	2	12.80-13.26	23.2	0	8	45	47	33	15	18	2.73	(CL)
BH306	3	13.49-13.94	19.6	-	-	-	-	-	-	-	-	(CL)
BH306	8A	16.15-16.54	15.8	-	-	-	-	-	-	-	-	(CL-ML)
BH307	1	12.74-13.16	21.5	-	-	-	-	-	-	-	-	(CL)

BH ID	SA No.	Depth (m)	Water Content (%)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL(1)	PL(2)	PI(3)	Specific Gravity	Soil Symbol
BH309	1	16.74-17.35	24.4	-	-	-	-	-	-	-	-	(CL)
BH309	2	17.50-17.96	28.4	18	2	30	50	41	19	22	-	(CL)
BH309	3B	18.16-18.57	27.1	-	-	-	-	-	-	-	-	(CL)

Notes:
1) LL = Liquid Limit
2) PL = Plastic Limit
3) PI = Plasticity Index

Table 4-20: Summary of Unit Weights – Unit 4b

BH ID	SA No.	Depth (m)	Water Content (%)	Laboratory Measured Unit Weight (kN/m^3)	Soil Symbol
BH302	5	9.91-10.36	22.0	21.17	(CL)
BH305	3	10.72-11.18	17.0	21.61	(CL)

Table 4-21: Summary of Organic Content Tests - Unit 4b

BH ID	SA No.	Depth (m)	Organic Content (%)	Soil Symbol
BH306	1	12.04-12.65	1.0	(CL)
BH307	1	12.74-13.17	0.5	(CL)

Table 4-22: Summary of One-Dimensional Consolidation Test(2) – Unit 4b

BH ID	SA No.	Depth (m)	Initial Void Ratio(1)	Maximum Applied Stress (kPa)	Final Void Ratio(1)	Estimated Specific Gravity(1)	Soil Symbol
BH24	32-1	19.08-19.13	0.686	6400	0.501	2.74	(CL)
BH24	33-1	19.91-19.96	0.308	6400	0.242	2.74	(CL)
BH26	24-1	14.05-14.10	0.726	6400	0.502	2.72	(CL)
BH26	24-2	14.55-14.61	0.663	6400	0.564	2.78	(CL)
BH26	27-1	16.38-16.43	0.848	6400	0.647	2.72	(CL)
BH26	28-1	16.92-16.97	0.592	6400	0.433	2.67	(CL)
BH26	28-2	16.97-17.02	0.531	6400	0.455	2.67	(CL)

Notes:
1) The specific gravity and void ratio values presented in Table 4-22 may not be representative of the actual values. Potential causes for the discrepancy may be because the specific gravity and void ratios are calculated assuming the degree of saturation equals 100% at the end of the test.
2) Each test consists of both loading and unloading stages.

Table 4-23: Summary of Consolidated Undrained Triaxial-K_0 Compression Tests – Unit 4b

BH ID	SA No.	Sample Depth (m)	Vertical Effective Consolidation Stress (kPa)	Horizontal Effective Consolidation Stress (kPa)	Shear Strength (kPa)	Strain at Failure (%)	Strain Rate (%min)	Deviator Stress at Failure (kPa)	Effective Minor Principal Stress at Failure (kPa)	Effective Major principal Stress at Failure (kPa)	B-value	Soil Symbol
BH24	32-2	19.35-19.47	948.3	1121.0	411.2	7.85	0.016	822.3	437.9	1260.0	0.94	(CL)
BH24	33-3	19.56-19.71	249.3	204.1	157.7	1.83	0.016	315.4	91.7	407.0	0.92	(CL)
BH26	24-4	14.07-14.22	179.8	174.3	80.1	7.03	0.016	160.2	64.5	224.7	0.95	(CL)
BH26	24-3	14.35-14.50	1283.0	766.3	860.9	6.74	0.016	1722.0	559.2	2281.0	0.99	(CL)
BH26	28-3	16.54-16.69	790.1	480.9	240.9	5.83	0.016	481.9	251.9	733.8	0.95	(CL)

Table 4-24: Summary of Steel Corrosion and Sulphate Attack, Chemical Analysis – Unit 4b

BH ID	SA No.	Sample Depth (m)	Sulfates (µg/g)	Chlorides (µg/g)	Sulfide (%)	Resistivity (Ω-cm)	pH	Redox Potential Trials (mV)			Soil Symbol
BH24	30S	17.68-18.29	172	9	0.01	2770	7.92	318	333	342	(CL)
BH82	16	18.29-18.75	-	-	-	5296(1)	-	-	-	-	(CL)
BH202	7	9.65-10.11	-	-	-	1464(1)	-	-	-	-	(CL)
BH203	6	10.97-11.43	145	5	0.03	3570	8.53	199	216	220	(CL)
BH204	4	12.73-13.18	255	5	0.01	2220	8.31	232	236	237	(CL)
BH302	6	10.52-10.97	193	4	0.01	2680	8.27	235	239	245	(CL)
BH304	7	13.11-13.56	272	9	0.01	2040	8.20	227	229	231	(CL)
BH306	3	13.50-13.96	-	-	-	1487(1)	-	-	-	-	(CL)
BH309	1	16.74-17.35	74	9	<0.01	3570	7.97	230	233	235	(CL)

Notes:

1) Tested using ASTM G57-20 The Wenner Four Electrode method.

Table 4-25: Summary of Estimated Laboratory Hydraulic Conductivity - Unit 4b

BH ID	SA No.	Sample Depth (m)	Reconstituted Hydraulic Conductivity (m/s)	Soil Symbol
BH24	32	18.90 - 19.51	5 x 10^{-10}	(CL)
BH26	27	15.85 - 16.46	8 x 10^{-10}	(CL)
BH26	29	17.07 - 17.68	1 x 10^{-9}	(CL)

4.2.9 Unit 5 – Lower Till – Silty Clay with Sand to Sandy Silty Clay

A deposit of sandy lean clay to lean clay till (Unit 5) was encountered below the intermediate glaciolacustrine deposits (Units 4a and 4b) in all boreholes advanced onshore and offshore. Unit 5 is described as a lower till layer generally consisting of a heterogeneous mixture of gravel, boulders, and cobbles. Unit 5 is predominantly silty clay with sand to sandy silty clay of low plasticity with occasional non-cohesive sandy silt to silty sand matrix.

The results of the in situ testing carried out within Soil Unit 5 are provided on the respective Record of Boreholes provided in Appendix A.

The results of index testing carried out on samples from Soil Unit 5 are presented on the Record of Borehole sheets in Appendix A. A summary of the test results is also provided below in Table 4-26. The results of unit weight are summarized in Table 4-27.

Eight consolidated drained triaxial tests were carried out on Soil Unit 5 retrieved from Boreholes BH24 and BH26. The results of these tests are provided on the figures in Appendix A and are summarized in Table 4-28.

A total of six soil samples from Soil Unit 5 were submitted for chemical analysis related to the potential corrosion of exposed buried steel and potential sulphate attack on buried concrete elements (corrosion and sulphate attack). The test results are provided in Appendix A and are summarized in Table 4-29. Test results for the soil resistivity test on three samples using the Wenner Four Electrode method are also included in the same appendix and table.

Three soil samples from Soil Unit 5 from Boreholes BH24 and BH26 were reconstituted by the laboratory prior to hydraulic conductivity testing. The laboratory hydraulic conductivity test reports are provided in Appendix A and the test results are summarized below in Table 4-30.

The results of the relative density tests carried out on Unit 5 specimens are provided in Appendix A. The minimum densities from Unit 5 specimens from BH24 and BH26 ranged from 15.45 and 13.99 kN/m^3, and the maximum densities ranged from 19.82 and 18.14 kN/m^3.

Table 4-26: Summary of Water Content, Grain Size Distribution, Atterberg Limits and Specific Gravity Tests - Unit 5

BH ID	SA No.	Depth (m)	Water Content (%)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL(1)	PL(2)	PI(3)	Specific Gravity	Soil Symbol
BH23	19	21.37-21.79	8.7	5	37	40	18	16	11	5	-	(CL-ML)
BH24	34	20.12-20.73	10.3	-	-	-	-	-	-	-	-	(CL-ML)
BH24	39A	23.16-23.42	9.9	-	-	-	-	-	-	-	-	(CL-ML)
BH24	39B	23.42-23.77	6.1	17	31	39	14	15	10	5	-	(CL-ML)
BH24	40	23.77-24.00	7.8	-	-	-	-	-	-	-	-	(CL-ML)
BH24	41	24.37-24.61	6.5	-	-	-	-	15	10	5	-	(CL-ML)
BH25	18	19.81-20.27	11.4	-	-	-	-	-	-	-	-	(CL-ML)
BH25	19	21.34-21.79	8.6	3	27	46	23	16	11	5	-	(CL-ML)
BH25	20	22.86-22.99	7.4	-	-	-	-	-	-	-	-	(CL-ML)
BH26	34B	20.35-20.73	17.8	-	-	-	-	24	14	10	-	(CL)

BH ID	SA No.	Depth (m)	Water Content (%)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL(1)	PL(2)	PI(3)	Specific Gravity	Soil Symbol
BH26	35	20.73-21.34	16.4	9	9	63	19	17	14	3	2.68	(ML)
BH26	36	21.34-21.95	10.9	-	-	-	-	-	-	-	-	(ML)
BH26	37A	22.05-22.25	8.5	-	-	-	-	-	-	-	-	(ML)
BH82	17	19.81-20.27	7.8	3	33	42	22	16	11	5	-	(CL-ML)
BH82	19	22.86-23.32	8.6	-	-	-	-	-	-	-	-	(ML)
BH82	20	24.38-24.64	7.4	6	39	42	14	Non-Plastic			-	(ML)
BH202	16	15.14-15.60	8.3	20	31	34	15	14	10	4	-	(CL-ML)
BH203	11	14.02-14.48	9.0	-	-	-	-	-	-	-	-	(CL-ML)
BH203	12	14.63-15.09	7.9	5	27	49	20	16	11	5	-	(CL-ML)
BH203	13	15.24-15.70	8.7	-	-	-	-	-	-	-	-	(CL-ML)
BH204	8B	15.47-15.62	10.1	-	-	-	-	-	-	-	-	(CL-ML)
BH204	9	15.77-16.23	7.4	7	29	44	20	16	11	5	-	(CL-ML)
BH204	10	16.38-16.82	6.0	-	-	-	-	-	-	-	-	(CL-ML)
BH204	11A	16.99-17.32	5.5	-	-	-	-	-	-	-	-	(CL-ML)
BH205	3B	13.05-13.31	10.7	-	-	-	-	-	-	-	-	(CL-ML)
BH205	4	13.46-13.92	12.3	3	27	50	20	15	11	4	-	(CL-ML)
BH205	5	14.07-14.53	9.3	-	-	-	-	-	-	-	-	(CL-ML)
BH205	6A	14.68-14.88	20.0	-	-	-	-	-	-	-	-	(CL-ML)
BH205	6B	14.88-15.14	9.8	-	-	-	-	-	-	-	-	(ML)
BH206	1	15.39-16.00	13.4	-	-	-	-	-	-	-	-	(SM)
BH206	2	16.15-16.57	8.3	12	41	37	11	Non-Plastic			-	(SM)
BH206	3	16.76-16.85	8.6	-	-	-	-	-	-	-	-	(SM)
BH301	14	13.66-14.12	10.7	3	21	51	26	18	12	6	-	(CL)
BH301	17	15.49-15.95	19.4	-	-	-	-	-	-	-	-	(CL-ML)
BH302	9	12.34-12.80	11.8	-	-	-	-	-	-	-	-	(CL-ML)
BH302	10	12.95-13.41	14.4	3	27	54	16	15	11	4	2.70	(CL-ML)
BH302	12	14.17-14.63	7.9	-	-	-	-	-	-	-	-	(CL-ML)
BH302	14	15.39-15.85	6.8	-	-	-	-	-	-	-	-	(CL-ML)
BH303	7	12.19-12.65	9.7	3	24	54	19	17	12	5	-	(CL-ML)
BH303	8	12.80-13.26	10.1	-	-	-	-	-	-	-	-	(CL-ML)
BH303	10B	14.23-14.48	7.5	-	-	-	-	-	-	-	-	(CL-ML)
BH303	11	14.63-15.09	8.2	-	-	-	-	-	-	-	-	(CL-ML)
BH303	12	15.24-15.58	7.0	-	-	-	-	-	-	-	-	(CL-ML)
BH304	8	13.72-14.17	9.2	-	-	-	-	-	-	-	-	(CL-ML)
BH304	9	14.33-14.76	13.0	-	-	-	-	-	-	-	-	(CL-ML)
BH304	10	14.94-15.49	7.7	-	-	-	-	-	-	-	-	(CL-ML)

BH ID	SA No.	Depth (m)	Water Content (%)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL(1)	PL(2)	PI(3)	Specific Gravity	Soil Symbol
BH305	7	13.16-13.62	10.9	-	-	-	-	-	-	-	-	(CL-ML)
BH305	8	13.77-14.17	11.5	-	-	-	-	-	-	-	-	(CL-ML)
BH305	9B	14.68-14.83	12.2	-	-	-	-	-	-	-	-	(CL-ML)
BH305	10	14.99-15.44	10.5	3	25	49	23	17	12	5	-	(CL-ML)
BH305	11	15.60-15.85	5.6	-	-	-	-	-	-	-	-	(CL-ML)
BH306	4	14.02-14.25	10.0	-	-	-	-	-	-	-	-	(CL-ML)
BH306	5	14.63-14.92	11.9	-	-	-	-	-	-	-	-	(CL-ML)
BH306	8C	16.66-16.84	12.9	-	-	-	-	-	-	-	-	(CL-ML)
BH306	9	17.07-17.53	8.8	3	26	49	22	16	12	4	-	(CL-ML)
BH306	10	17.65-18.10	7.9	-	-	-	-	-	-	-	-	(CL-ML)
BH306	11	18.29-18.44	7.8	-	-	-	-	-	-	-	-	(CL-ML)
BH307	3	14.02-14.57	15.0	-	-	-	-	-	-	-	-	(ML)
BH307	4	14.63-14.88	9.4	11	22	54	12	Non-Plastic			-	(ML)
BH307	5	15.24-15.37	9.8	-	-	-	-	-	-	-	-	(ML)
BH307	7	16.41-16.84	13.2	-	-	-	-	-	-	-	-	(ML)
BH307	8A	16.97-17.07	13.3	-	-	-	-	-	-	-	-	(ML)
BH307	8B	17.07-17.25	13.9	-	-	-	-	-	-	-	-	(ML)
BH307	9	17.37-17.83	14.1	-	-	-	-	-	-	-	-	(CL-ML)
BH307	10	17.98-18.44	12.2	6	26	49	19	17	10	7	2.72	(CL-ML)
BH308	3	15.32-15.79	6.3	24	40	29	7	Non-Plastic			-	(SM)
BH308	4	16.15-16.42	11.9	-	-	-	-	-	-	-	-	(SM)
BH308	6	17.37-17.65	10.6	7	39	42	12	14	10	4	2.70	(SM)
BH308	7	17.98-18.01	10.5	-	-	-	-	-	-	-	-	(SM)
BH308	8	18.59-18.85	9.5	-	-	-	-	-	-	-	-	(SM)
BH308	9	19.20-19.37	6.4	-	-	-	-	-	-	-	-	(SM)
BH308	10	19.81-19.85	14.4	-	-	-	-	-	-	-	-	(SM)
BH309	4	18.72-18.95	16.8	-	-	-	-	-	-	-	-	(CL-ML)
BH309	5	19.03-19.13	24.5	-	-	-	-	-	-	-	-	(CL-ML)

Notes:
1) LL = Liquid Limit
2) PL = Plastic Limit
3) PI = Plasticity Index

Table 4-27: Summary of Unit Weights – Unit 5

BH ID	SA No.	Depth (m)	Water Content (%)	Laboratory Measured Unit Weight(1) (kN/m^3)	Soil Symbol
BH203	11	14.02-14.48	9.0	24.20	(CL-ML)
BH205	4	13.46-13.92	12.3	24.34	(CL-ML)

Notes:

1) Some of the values presented in Table 4-27 may not be representative of the actual unit weight of the material encountered in Soil Unit 5. Potential causes for the discrepancy may be due to even a small amount of gravel size particles within the test sample and/or the relatively small sample size for testing.

Table 4-28: Summary of Consolidated Drained Triaxial-Anisotropic Consolidation Tests – Unit 5

BH ID	SA No.	Sample Depth (m)	Vertical Effective Consolidation Stress (kPa)	Horizontal Effective Consolidation Stress (kPa)		Shear Strength (kPa)	Strain at Failure (%)	Strain Rate (%min)	Deviator Stress at Failure (kPa)	Effective Minor Principal Stress at Failure (kPa)	Effective Major principal Stress at Failure (kPa)	B-value	Soil Symbol
BH24	34	20.12-20.73	269.1	140.6		173.9	4.45	0.01	347.8	140.9	488.7	0.96	(CL-ML)
BH24	35	20.73-21.34	860.2	422.9		641	4.35	0.01	1282.0	422.7	1705.0	1.00	(CL-ML)
BH24	36	21.34-21.95	1711	844.8		1209	5.78	0.01	2417.0	844.9	3262.0	0.97	(CL-ML)
BH24	39A	23.16-23.42	281.3	140.8		183.9	6.73	0.01	367.9	140.7	508.6	0.95	(CL-ML)
BH24	40	23.77-24.00	1637.0	844.6		1074.0	7.65	0.01	2147.0	844.6	2992.0	0.97	(CL-ML)
BH26	35	20.73-21.34	785.5	383.5		555.5	4.50	0.01	1111.0	383.5	1495.0	0.97	(ML)
BH26	36	21.34-21.95	1470.0	766.7		908.1	3.95	0.01	1816.0	766.7	2583.0	0.96	(ML)

Table 4-29: Summary of Steel Corrosion and Sulphate Attack, Chemical Analysis – Unit 5

BH ID	SA No.	Sample Depth (m)	Sulfates (µg/g)	Chlorides (µg/g)	Sulfide (%)	Resistivity (Ω-cm)	pH	Redox Potential Trials (mV)			Soil Symbol
BH25	19	21.34-21.79	162	4	0.03	3460	8.34	254	273	280	(CL-ML)
BH82	19	22.86-23.32	-	-	-	3656(1)	-	-	-	-	(ML)
BH204	10	16.38-16.82	-	-	-	2981(1)	-	-	-	-	(CL-ML)
BH205	5	14.07-14.53	122	2	<0.01	4120	8.47	179	189	196	(CL-ML)
BH206	1	15.39-16.00	134	9	<0.01	3620	8.36	230	239	241	(SM)
BH305	7	13.16-13.61	92	79	0.02	2890	8.41	166	175	180	(CL-ML)
BH307	3	14.02-14.41	136	141	<0.01	1870	6.80	268	264	267	(CL)
BH308	2	14.78-15.04	41	8	<0.01	6760	8.20	245	249	251	(SM)
BH308	8	18.59-18.84	-	-	-	2777[1]	-	-	-	-	(SM)

Notes:

1) As tested using ASTM G57-20 The Wenner Four Electrode method.

Table 4-30: Summary of Estimated Laboratory Hydraulic Conductivity - Unit 5

BH ID	SA No.	Sample Depth (m)	Reconstituted Hydraulic Conductivity (m/s)	Soil Symbol
BH24	35	20.73 - 21.34	2×10^{-9}	(CL-ML)
BH24	40	23.84 - 23.99	6×10^{-9}	(CL-ML)
BH26	36	21.34 - 21.95	1×10^{-9}	(ML)

4.2.10 Unit 6a – Blue Mountain Formation Bedrock

The Blue Mountain Formation consists of a slightly weathered to fresh, very thinly to thickly bedded, dark brownish grey, very fine to fine grained, faintly porous, slightly to moderately reactive to HCl, weak to strong SHALE with laminated to medium, grey, limestone interbeds. The Blue Mountain Formation has a thickness that ranges from 0.89 m to 3.66 m at the DNNP site. The TCR of the Blue Mountain Formation ranges from 54% to 100% and the RQD ranges from 0% to 100%.

For most of the site, the Blue Mountain Formation bedding is anticipated to be subhorizontally dipping, although zones of local variations in the bedding dip may be encountered. In general, the hard layers interbedded within the shale (typically limestone) are up to 0.48 m thick.

The discontinuity descriptions identified from the rock core are summarized on the Records of Drillhole sheets in Appendix A. The shape, roughness, and surface conditions of the bedding joints and joints of the Blue Mountain Formation are outlined in Table 4-31.

Table 4-31: Blue Mountain Formation Discontinuities Description

Shape(1)					Roughness(2)					Infill(3)					Primary Mineral(4)				
Type	Bedding		Joint		Type	Bedding		Joint		Type	Bedding		Joint		Type	Bedding		Joint	
	#	%	#	%		#	%	#	%		#	%	#	%		#	%	#	%
PL	55	65	1	33	**Ro**	37	44	2	67	**CC**	0	0	1	33	**Cl**	1	1	0	0
UN	20	24	2	67	**Sm**	47	56	1	33	**IN**	0	0	0	0	**Br**	0	0	0	0
ST	1	1	0		**Vr**	0	0	0	0	**PC**	3	4	0	0	**M**	0	0	0	0
IR	6	7	0							**SA**	16	19	0	0	**Sa**	1	1	0	0
CU	2	2	0							**SO**	6	7	0	0	**Go**	0	0	0	0
										Clean	59	70	2	67	**None**	82	98	3	100
Total	**84**	**100**	**3**	**100**	**Total**	**84**	**100**	**3**	**100**	**Total**	**84**	**100**	**3**	**100**	**Total**	**84**	**100**	**3**	**100**

Notes:

1) Shape: PL – Planar, UN – Uneven, ST – Stepped, IR – Irregular, CU – Curved.
2) Roughness: Ro – Rough, Sm – Smooth, Vr – Very Rough
3) Infill: CC – Completely Coated, IN – Infilling, PC – Partially Coated, SA – Slightly Altered, SO – Staining Only, Clean – No Infilling
4) Primary Material: SA – Sand, M- Silt, Cl - Clay, Br – Broken Rock, Go - Gouge

Intact Rock Properties

Testing has been carried out on selected bedrock core samples from the Blue Mountain Formation including Unconfined Compressive Strength (UCS), Brazilian testing, Point Load Testing (PLT) and swell testing. Table 4-32, below, summarizes the samples selected from the Blue Mountain Formation for laboratory testing. The laboratory testing results are presented in Appendix D.

Table 4-32: Blue Mountain Formation Laboratory Rock Testing

BH ID	SA ID	Depth		Elevation		Test type
		From (m)	To (m)	From (m)	To (m)	
BH22	BH22-RS-SA1	24.91	25.09	61.63	61.45	Brazilian
BH22	BH22-RS-SA2	25.95	26.15	60.59	60.39	Brazilian
BH24	BH24-RS-SA8	25.74	25.88	63.26	63.12	Brazilian
BH26	BH26-RS-SA6	23.49	23.61	61.61	61.49	Brazilian
BH26	BH26-RS-SA7	22.85	23.01	62.25	62.09	Brazilian
BH207	BH207-RS-SA18	17.22	17.35	61.63	61.50	Brazilian
BH24	BH24-RS-SA7	25.53	25.71	63.47	63.29	UCS
BH26	BH26-RS-SA5	23.21	23.40	61.89	61.70	UCS
BH207	BH207-RS-SA19	17.76	17.83	61.09	61.02	PLT
BH207	BH207-RS-SA20	17.83	17.87	61.02	60.98	PLT
BH207	BH207-RS-SA21	17.87	17.95	60.98	60.90	PLT
BH207	BH207-RS-SA22	17.95	18.00	60.90	60.85	PLT
BH207	BH207-RS-SA23	18.00	18.07	60.85	60.78	PLT
BH207	BH207-RS-SA1	16.84	17.03	62.01	61.82	Swell
BH207	BH207-RS-SA2	17.03	17.22	61.82	61.63	Swell
BH203	BH203-RS-SA1	17.17	17.39	61.45	61.23	Swell
BH203	BH203-RS-SA2	17.77	18.03	60.85	60.59	Swell
BH203	BH203-RS-SA3	18.03	18.37	60.59	60.25	Swell
BH308	BH308-RS-SA1	21.23	21.49	57.37	57.11	Swell
BH205	BH205-RS-SA1	17.69	17.91	60.47	60.25	Swell
BH205	BH205-RS-SA2	18.09	18.29	60.07	59.87	Swell

Unconfined Compressive Strength, Bulk Density, Young's Modulus and Poisson's Ratio Test Results

Two samples were selected from the Blue Mountain Formation for UCS testing. Results of the UCS testing are listed in Appendix D. The unit weight was determined during the UCS testing while Young's modulus and Poisson's Ratio were determined for selected tests using strain gauges. The ranges of results of the UCS testing are listed below in Table 4-33.

Table 4-33: Unconfined Compressive Strength, Bulk Density, Young's Modulus and Poisson's Ratio Test Results for the Blue Mountain Formation

Stratigraphic Unit - Formation	UCS (MPa)		Bulk Density (g/cm^3)		Young's Modulus (GPa)		Poisson's Ratio	
	Min	Max	Min	Max	Min	Max	Min	Max
6a – Blue Mountain	120.9	134.1	2.661	2.665	31	32	0.29	0.31

Brazilian Tensile Test Results

Six samples of the Blue Mountain Formation were selected for Brazilian tensile testing. The results of the tensile testing are summarized below in Table 4-34.

Table 4-34: Tensile Strength Test Results for the Blue Mountain Formation

Stratigraphic Unit	Formation	Tensile Strength (MPa)	
		Min	Max
Unit 6a	Blue Mountain	4.9	7.6

Point Load Test (PLT) Results

Five Blue Mountain Formation samples were selected for point load testing. Axial and diametral tests were done at each test interval. The results of the Point Load Strength Index values $Is_{(50)}$ are listed below in Table 4-35.

Table 4-35: Point Load Test Results for the Blue Mountain Formation

Stratigraphic Unit	Formation	Axial $Is_{(50)}$ (MPa)		Diametric $Is_{(50)}$ (MPa)	
		Min	Max	Min	Max
Unit 6a	Blue Mountain	2.5	4.43	0.18	1.57

Swell Test Results

The results of the swell tests on rock core samples of the Blue Mountain Formation are summarized below in Table 4-36.

Table 4-36: Summary of Swell Test Results

BH ID	Calcite Content (%)	FST(1) – V (% Strain/log cycle)	FST(1)-H (% Strain/log cycle)	SCST(1)-V (% Strain/log cycle)	SCST(1)-H (% Strain/log cycle)	NST(1)-V (MPa)	NST(1)-H (MPa)
BH203	<1 - 43.8	0.0	0.0	0.0	0.0	0.1	0.11
BH205	<1	-	-	-	-	0.1	0.12
BH207	7.6 – 16.7	-	-	0.004	0.0	-	-
BH308	44.7	0.0	0.0	-	-	-	-

Notes:

1) FST – Free Swell Test; SCST – Semi-confined Swell Test; NST – Null Swell Test; V – Vertical; H- Horizontal
Negative strain for Free Swell Tests taken as 0% Strain/Log Cycle Time
Seating pressure of 0.1 MPa applied to all samples for Null Tests

The factual laboratory results of swell tests are contained in Appendix D. The results of water content, pore water salinity and calcite content tests done on the same rock samples are also included in the appendix.

4.2.11 Unit 6b – Lindsay Formation Bedrock

Underlying the Blue Mountain Formation is the Lindsay Formation which consists of a slightly weathered to fresh, laminated to very thickly bedded, grey, fine to medium grained, faintly porous, slightly to moderately reactive to HCl, weak to medium strong to very strong limestone with dark grey shale interbeds. The TCR of the Lindsay Formation ranges from 8% to 100% and the RQD ranges from 8% to 100%.

For most of the site, the Lindsay Formation bedding is anticipated to be subhorizontally dipping, although zones of local variations in the bedding dip may be encountered.

The discontinuity descriptions identified from the rock core are summarized on the Records of Drillholes sheets in Appendix A. The shape, roughness, and surface conditions of the bedding joints and joints are outlined in Table 4-37.

Table 4-37: Lindsay Formation Discontinuities Description

Shape(1)					Roughness(2)					Infill(3)					Primary Mineral(4)				
Type	Bedding		Joint		Type	Bedding		Joint		Type	Bedding		Joint		Type	Bedding		Joint	
	#	%	#	%		#	%	#	%		#	%	#	%		#	%	#	%
PL	354	42	5	83	**Ro**	514	60	6	100	**CC**	4	0	0	0	**Cl**	20	2	0	0
UN	439	52	1	17	**Sm**	337	40	0	0	**IN**	22	3	0	0	**Br**	3	0	0	0
ST	9	1	0	0	**Vr**	0	0	0	0	**PC**	37	4	0	0	**M**	4	0	0	0
IR	33	4	0	0						**SA**	123	14	1	17	**Sa**	4	0	0	0
CU	16	2	0	0						**SO**	42	5	0	0	**Gr**	4	0	0	0
										Clean	623	73	5	83	**None**	816	96	6	100
Total	851	100	6	100	**Total**	851	100	6	100	**Total**	851	100	6	100	**Total**	851	100	6	100

Notes:
1) Shape: PL – Planar, UN – Uneven, ST – Stepped, IR – Irregular, CU – Curved.
2) Roughness: Ro – Rough, Sm – Smooth, Vr – Very Rough
3) Infill: CC – Completely Coated, IN – Infilling, PC – Partially Coated, SA – Slightly Altered, SO – Staining Only, Clean – No Infilling
4) Primary Material: SA – Sand, M- Silt, Cl - Clay, Br – Broken Rock, Go – Gouge, Gr-Gravel

Intact Rock Properties

Testing has been carried out on selected bedrock core samples from the Lindsay Formation including Unconfined Compressive Strength (UCS), triaxial testing, direct shear, Brazilian tensile strength, Point Load Testing (PLT), slake durability, Cerchar abrasion, punch penetration, specific gravity and petrographic analysis. Table 4-38 below summarizes the samples selected in the Lindsay formation for laboratory testing. The laboratory testing reports are presented in Appendix D.

Table 4-38: Lindsay Formation Laboratory Rock Testing

BH ID	SA ID	Depth		Elevation		Test type
		From (m)	To (m)	From (m)	To (m)	
BH207	BH207-RS-SA6	33.66	33.96	45.19	44.89	UCS
BH207	BH207-RS-SA12	40.39	40.63	38.46	38.22	UCS
BH304	BH304-RS-SA4	41.46	41.71	37.94	37.69	UCS
BH204	BH204-RS-SA4	37.25	37.52	42.14	41.87	UCS
BH204	BH204-RS-SA8	44.55	44.74	34.84	34.65	UCS
BH306	BH306-RS-SA10	40.33	40.55	38.84	38.62	UCS
BH302	BH302-RS-SA3	38.31	38.51	40.51	40.31	UCS
BH203	BH203-RS-SA4	40.56	40.77	38.06	37.85	UCS
BH303	BH303-RS-SA2	35.24	35.44	43.60	43.40	UCS
BH303	BH303-RS-SA4	39.75	39.97	39.09	38.87	UCS
BH206	BH206-RS-SA3	38.03	38.27	40.43	40.19	UCS
BH26	BH26-RS-SA1	37.60	37.81	47.50	47.29	UCS
BH26	BH26-RS-SA2	39.94	40.26	45.16	44.84	UCS
BH23	BH23-RS-SA1	39.18	39.35	46.13	45.96	UCS
BH23	BH23-RS-SA3	46.35	46.61	38.96	38.70	UCS
BH24	BH24-RS-SA1	42.52	42.79	46.48	46.21	UCS
BH24	BH24-RS-SA2	45.55	45.76	43.45	43.24	UCS
BH24	BH24-RS-SA6	58.87	59.05	30.13	29.95	UCS
BH202	BH202-RS-SA1	29.49	29.68	48.81	48.62	UCS
BH202	BH202-RS-SA7	37.48	37.66	40.82	40.64	UCS
BH21	BH21-RS-SA1	37.57	37.73	51.18	51.02	UCS
BH21	BH21-RS-SA7	49.73	49.93	39.02	38.82	UCS
BH22	BH22-RS-SA6	39.10	39.34	47.44	47.20	UCS
BH22	BH22-RS-SA9	44.67	44.94	41.87	41.60	UCS
BH22	BH22-RS-SA14	53.25	53.47	33.29	33.07	UCS
BH205	BH205-RS-SA12	40.14	40.39	38.02	37.77	UCS
BH307	BH307-RS-SA11	36.81	37.09	42.09	41.81	UCS
BH307	BH307-RS-SA15	42.37	42.69	36.53	36.21	UCS
BH309	BH309-RS-SA8	44.95	45.18	33.57	33.34	UCS
BH308	BH308-RS-SA7	30.27	30.46	48.33	48.14	UCS
BH308	BH308-RS-SA21	46.67	46.86	31.93	31.74	UCS

BH ID	SA ID	Depth		Elevation		Test type
		From (m)	To (m)	From (m)	To (m)	
BH305	BH305-RS-SA3	35.36	35.61	43.01	42.76	UCS
BH301	BH301-RS-SA3	37.43	37.69	40.66	40.40	UCS
BH17	BH17-RS-04	44.55	44.81	42.27	42.01	UCS
BH17	BH17-RS-06	36.42	36.67	50.40	50.15	UCS
BH7	BH7-RS-04	40.11	40.37	47.99	47.73	UCS
BH7	BH7-RS-05	51.08	51.33	37.02	36.77	UCS
BH75	BH75-RS-04	51.58	51.86	34.95	34.67	UCS
BH75	BH75-RS-08	44.77	45.02	41.76	41.51	UCS
BH205	BH205-RS-SA1	28.24	28.51	49.92	49.65	Triaxial
BH205	BH205-RS-SA2	28.51	28.73	49.65	49.43	Triaxial
BH205	BH205-RS-SA3	29.45	29.74	48.71	48.42	Triaxial
BH205	BH205-RS-SA4	30.32	30.59	47.84	47.57	Triaxial
BH205	BH205-RS-SA6	31.55	31.82	46.61	46.34	Triaxial
BH205	BH205-RS-SA7	32.32	32.59	45.84	45.57	Triaxial
BH205	BH205-RS-SA9	34.26	34.47	43.90	43.69	Triaxial
BH205	BH205-RS-SA10	34.76	35.00	43.40	43.16	Triaxial
BH205	BH205-RS-SA14	43.18	43.46	34.98	34.70	Triaxial
BH205	BH205-RS-SA16	46.41	46.71	31.75	31.45	Triaxial
BH205	BH205-RS-SA17	48.40	48.65	29.76	29.51	Triaxial
BH205	BH205-RS-SA18	49.73	49.96	28.43	28.20	Triaxial
BH307	BH307-RS-SA1	23.75	24.02	55.15	54.88	Triaxial
BH307	BH307-RS-SA4	27.39	27.68	51.51	51.22	Triaxial
BH307	BH307-RS-SA6	31.42	31.68	47.48	47.22	Triaxial
BH307	BH307-RS-SA7	32.02	32.35	46.88	46.55	Triaxial
BH307	BH307-RS-SA9	35.09	35.37	43.81	43.53	Triaxial
BH307	BH307-RS-SA10	36.01	36.33	42.89	42.57	Triaxial
BH307	BH307-RS-SA16	43.45	43.73	35.45	35.17	Triaxial
BH307	BH307-RS-SA18	45.47	45.79	33.43	33.11	Triaxial
BH307	BH307-RS-SA19	47.29	47.54	31.61	31.36	Triaxial
BH307	BH307-RS-SA20	47.54	47.79	31.36	31.11	Triaxial
BH307	BH307-RS-SA24	50.70	51.01	28.20	27.89	Triaxial
BH307	BH307-RS-SA26	53.40	53.68	25.50	25.22	Triaxial

BH ID	SA ID	Depth		Elevation		Test type
		From (m)	To (m)	From (m)	To (m)	
BH207	BH207-RS-SA15	42.87	43.08	35.98	35.77	Direct Shear
BH204	BH204-RS-SA7	42.63	42.85	36.76	36.54	Direct Shear
BH306	BH306-RS-SA13	45.33	45.63	33.84	33.54	Direct Shear
BH302	BH302-RS-SA4	44.14	44.49	34.68	34.33	Direct Shear
BH203	BH203-RS-SA2	36.10	36.41	42.52	42.21	Direct Shear
BH206	BH206-RS-SA4	41.57	41.93	36.89	36.53	Direct Shear
BH26	BH26-RS-SA3	42.01	42.35	43.09	42.75	Direct Shear
BH23	BH23-RS-SA5	51.73	51.98	33.58	33.33	Direct Shear
BH24	BH24-RS-SA5	57.28	57.54	31.72	31.46	Direct Shear
BH202	BH202-RS-SA11	44.59	44.78	33.71	33.52	Direct Shear
BH21	BH21-RS-SA4	42.17	42.39	46.58	46.36	Direct Shear
BH22	BH22-RS-SA12	49.42	49.57	37.12	36.97	Direct Shear
BH205	BH205-RS-SA13	42.39	42.88	35.77	35.28	Direct Shear
BH307	BH307-RS-SA12	38.29	38.73	40.61	40.17	Direct Shear
BH309	BH309-RS-SA1	31.94	32.27	46.58	46.25	Direct Shear
BH309	BH309-RS-SA12	54.91	55.31	23.61	23.21	Direct Shear
BH305	BH305-RS-SA5	43.93	44.28	34.44	34.09	Direct Shear
BH17	BH17-RS-03	43.90	44.25	42.92	42.57	Direct Shear
BH7	BH7-RS-02	42.23	42.46	45.87	45.64	Direct Shear
BH75	BH75-RS-03	53.03	53.33	33.50	33.20	Direct Shear
BH207	BH207-RS-SA7	34.27	34.55	44.58	44.30	Brazilian
BH304	BH304-RS-SA5	43.49	43.68	35.91	35.72	Brazilian
BH204	BH204-RS-SA5	38.90	39.08	40.49	40.31	Brazilian
BH306	BH306-RS-SA6	37.46	37.67	41.71	41.50	Brazilian
BH306	BH306-RS-SA11	43.31	43.51	35.86	35.66	Brazilian
BH302	BH302-RS-SA5	45.74	45.94	33.08	32.88	Brazilian
BH203	BH203-RS-SA5	44.36	44.59	34.26	34.03	Brazilian
BH303	BH303-RS-SA7	46.31	46.52	32.53	32.32	Brazilian
BH206	BH206-RS-SA2	33.96	34.22	44.50	44.24	Brazilian
BH202	BH202-RS-SA2	31.09	31.31	47.21	46.99	Brazilian
BH202	BH202-RS-SA8	40.32	40.52	37.98	37.78	Brazilian
BH205	BH205-RS-SA15	44.86	45.15	33.30	33.01	Brazilian

BH ID	SA ID	Depth		Elevation		Test type
		From (m)	To (m)	From (m)	To (m)	
BH307	BH307-RS-SA14	40.93	41.19	37.97	37.71	Brazilian
BH307	BH307-RS-SA21	48.62	48.85	30.28	30.05	Brazilian
BH309	BH309-RS-SA5	38.47	38.65	40.05	39.87	Brazilian
BH308	BH308-RS-SA3	26.29	26.45	52.31	52.15	Brazilian
BH308	BH308-RS-SA8	31.19	31.36	47.41	47.24	Brazilian
BH308	BH308-RS-SA13	37.25	37.42	41.35	41.18	Brazilian
BH308	BH308-RS-SA23	49.82	49.98	28.78	28.62	Brazilian
BH305	BH305-RS-SA2	32.92	33.20	45.45	45.17	Brazilian
BH301	BH301-RS-SA5	43.37	43.60	34.72	34.49	Brazilian
BH23	BH23-RS-SA6	44.37	44.63	40.94	40.68	Brazilian
BH24	BH24-RS-SA9	41.26	41.48	47.74	47.52	Brazilian
BH17	BH17-RS-07	48.18	48.39	38.64	38.43	Brazilian
BH207	BH207-RS-SA5	32.27	32.49	46.58	46.36	Point Load Testing
BH207	BH207-RS-SA9	37.11	37.34	41.74	41.51	Point Load Testing
BH207	BH207-RS-SA11	39.60	39.86	39.25	38.99	Point Load Testing
BH207	BH207-RS-SA14	42.35	42.60	36.50	36.25	Point Load Testing
BH207	BH207-RS-SA17	45.43	45.63	33.42	33.22	Point Load Testing
BH306	BH306-RS-SA2	32.47	32.67	46.70	46.50	Point Load Testing
BH306	BH306-RS-SA5	35.33	35.56	43.84	43.61	Point Load Testing
BH306	BH306-RS-SA9	39.37	39.57	39.80	39.60	Point Load Testing
BH306	BH306-RS-SA12	44.53	44.76	34.64	34.41	Point Load Testing
BH306	BH306-RS-SA16	49.29	49.50	29.88	29.67	Point Load Testing
BH307	BH307-RS-SA2	24.59	24.82	54.31	54.08	Point Load Testing
BH307	BH307-RS-SA5	30.31	30.55	48.59	48.35	Point Load Testing
BH307	BH307-RS-SA8	32.90	33.12	46.00	45.78	Point Load Testing
BH307	BH307-RS-SA17	43.96	44.14	34.94	34.76	Point Load Testing
BH307	BH307-RS-SA22	49.13	49.36	29.77	29.54	Point Load Testing
BH308	BH308-RS-SA2	25.74	25.94	52.86	52.66	Point Load Testing
BH308	BH308-RS-SA6	30.12	30.27	48.48	48.33	Point Load Testing
BH308	BH308-RS-SA14	37.42	37.63	41.18	40.97	Point Load Testing
BH308	BH308-RS-SA20	45.14	45.36	33.46	33.24	Point Load Testing
BH308	BH308-RS-SA24	51.86	52.04	26.74	26.56	Point Load Testing

BH ID	SA ID	Depth		Elevation		Test type
		From (m)	To (m)	From (m)	To (m)	
BH207	BH207-RS-SA13	41.81	42.03	37.04	36.82	Slake Durability
BH204	BH204-RS-SA6	39.41	39.59	39.98	39.80	Slake Durability
BH303	BH303-RS-SA6	44.15	44.36	34.69	34.48	Slake Durability
BH25	BH25-RS-SA1	25.94	26.06	62.36	62.24	Slake Durability
BH82	BH82-RS-SA1	26.21	26.31	63.05	62.95	Slake Durability
BH23	BH23-RS-SA4	50.20	50.36	35.11	34.95	Slake Durability
BH24	BH24-RS-SA3	49.67	49.78	39.33	39.22	Slake Durability
BH202	BH202-RS-SA6	36.19	36.33	42.11	41.97	Slake Durability
BH202	BH202-RS-SA10	43.63	43.75	34.67	34.55	Slake Durability
BH21	BH21-RS-SA8	52.30	52.46	36.45	36.29	Slake Durability
BH22	BH22-RS-SA11	48.49	48.74	38.05	37.80	Slake Durability
BH308	BH308-RS-SA10	33.66	33.83	44.94	44.77	Slake Durability
BH17	BH17-RS-05	46.86	47.07	39.96	39.75	Slake Durability
BH7	BH7-RS-06	49.57	49.79	38.53	38.31	Slake Durability
BH75	BH75-RS-05	47.40	47.62	39.13	38.91	Slake Durability
BH207	BH207-RS-SA13	41.81	42.03	37.04	36.82	Slake Durability
BH207	BH207-RS-SA3	28.90	29.12	49.95	49.73	Cerchar
BH304	BH304-RS-SA6	46.13	46.33	33.27	33.07	Cerchar
BH204	BH204-RS-SA2	34.58	34.78	44.81	44.61	Cerchar
BH306	BH306-RS-SA3	33.52	33.72	45.65	45.45	Cerchar
BH306	BH306-RS-SA8	38.70	38.88	40.47	40.29	Cerchar
BH302	BH302-RS-SA2	36.90	37.09	41.92	41.73	Cerchar
BH203	BH203-RS-SA3	38.74	38.93	39.88	39.69	Cerchar
BH303	BH303-RS-SA3	37.10	37.33	41.74	41.51	Cerchar
BH206	BH206-RS-SA5	43.58	43.79	34.88	34.67	Cerchar
BH202	BH202-RS-SA3	33.25	33.37	45.05	44.93	Cerchar
BH202	BH202-RS-SA9	41.89	42.03	36.41	36.27	Cerchar
BH21	BH21-RS-SA6	46.86	47.03	41.89	41.72	Cerchar
BH21	BH21-RS-SA10	56.66	56.75	32.09	32.00	Cerchar
BH22	BH22-RS-SA13	49.57	49.92	36.97	36.62	Cerchar
BH22	BH22-RS-SA15	56.07	56.27	30.47	30.27	Cerchar
BH205	BH205-RS-SA11	36.35	36.58	41.81	41.58	Cerchar

BH ID	SA ID	Depth		Elevation		Test type
		From (m)	To (m)	From (m)	To (m)	
BH205	BH205-RS-SA19	52.98	53.23	25.18	24.93	Cerchar
BH307	BH307-RS-SA13	39.42	39.66	39.48	39.24	Cerchar
BH308	BH308-RS-SA5	27.75	27.93	50.85	50.67	Cerchar
BH308	BH308-RS-SA12	35.77	35.91	42.83	42.69	Cerchar
BH308	BH308-RS-SA16	39.08	39.20	39.52	39.40	Cerchar
BH308	BH308-RS-SA22	48.54	48.68	30.06	29.92	Cerchar
BH305	BH305-RS-SA4	39.47	39.75	38.90	38.62	Cerchar
BH305	BH305-RS-SA6	45.95	46.26	32.42	32.11	Cerchar
BH301	BH301-RS-SA4	39.95	40.30	38.14	37.79	Cerchar
BH207	BH207-RS-SA10	38.21	38.43	40.64	40.42	Punch
BH304	BH304-RS-SA1	32.85	33.06	46.55	46.34	Punch
BH204	BH204-RS-SA3	36.32	36.51	43.07	42.88	Punch
BH306	BH306-RS-SA4	34.04	34.27	45.13	44.90	Punch
BH306	BH306-RS-SA14	47.98	48.24	31.19	30.93	Punch
BH302	BH302-RS-SA1	32.71	32.94	46.11	45.88	Punch
BH203	BH203-RS-SA1	32.98	33.15	45.64	45.47	Punch
BH303	BH303-RS-SA1	31.50	31.72	47.34	47.12	Punch
BH206	BH206-RS-SA1	31.10	31.30	47.36	47.16	Punch
BH202	BH202-RS-SA4	33.48	33.62	44.82	44.68	Punch
BH202	BH202-RS-SA13	48.07	48.21	30.23	30.09	Punch
BH21	BH21-RS-SA3	43.91	44.10	44.84	44.65	Punch
BH21	BH21-RS-SA5	43.79	43.93	44.96	44.82	Punch
BH21	BH21-RS-SA9	55.06	55.23	33.69	33.52	Punch
BH22	BH22-RS-SA5	35.28	35.46	51.26	51.08	Punch
BH22	BH22-RS-SA10	47.32	47.46	39.22	39.08	Punch
BH22	BH22-RS-SA16	62.27	62.58	24.27	23.96	Punch
BH205	BH205-RS-SA8	33.65	33.84	44.51	44.32	Punch
BH307	BH307-RS-SA3	26.21	26.45	52.69	52.45	Punch
BH307	BH307-RS-SA23	49.36	49.58	29.54	29.32	Punch
BH309	BH309-RS-SA2	33.37	33.60	45.15	44.92	Punch
BH308	BH308-RS-SA4	27.40	27.59	51.20	51.01	Punch
BH308	BH308-RS-SA11	35.11	35.28	43.49	43.32	Punch

BH ID	SA ID	Depth		Elevation		Test type
		From (m)	To (m)	From (m)	To (m)	
BH308	BH308-RS-SA17	39.93	40.10	38.67	38.50	Punch
BH308	BH308-RS-SA19	43.52	43.72	35.08	34.88	Punch
BH305	BH305-RS-SA1	30.16	30.40	48.21	47.97	Punch
BH301	BH301-RS-SA2	32.91	33.13	45.18	44.96	Punch
BH207	BH207-RS-SA4	31.47	31.73	47.38	47.12	Specific Gravity
BH304	BH304-RS-SA2	36.67	36.89	42.73	42.51	Specific Gravity
BH306	BH306-RS-SA7	37.88	38.08	41.29	41.09	Specific Gravity
BH303	BH303-RS-SA5	42.06	42.26	36.78	36.58	Specific Gravity
BH26	BH26-RS-SA4	46.13	46.45	38.97	38.65	Specific Gravity
BH23	BH23-RS-SA2	44.02	44.24	41.29	41.07	Specific Gravity
BH24	BH24-RS-SA4	51.29	51.51	37.71	37.49	Specific Gravity
BH202	BH202-RS-SA5	35.25	35.42	43.05	42.88	Specific Gravity
BH202	BH202-RS-SA12	47.90	48.07	30.40	30.23	Specific Gravity
BH21	BH21-RS-SA2	39.04	39.22	49.71	49.53	Specific Gravity
BH22	BH22-RS-SA8	43.48	43.68	43.06	42.86	Specific Gravity
BH205	BH205-RS-SA5	31.31	31.51	46.85	46.65	Specific Gravity
BH309	BH309-RS-SA3	34.89	35.08	43.63	43.44	Specific Gravity
BH308	BH308-RS-SA9	32.31	32.50	46.29	46.10	Specific Gravity
BH308	BH308-RS-SA18	40.13	40.31	38.47	38.29	Specific Gravity
BH301	BH301-RS-SA6	45.37	45.66	32.72	32.43	Specific Gravity
BH207	BH207-RS-SA8	36.70	36.95	42.15	41.90	Petrographic Analysis
BH207	BH207-RS-SA16	44.50	44.75	34.35	34.10	Petrographic Analysis
BH304	BH304-RS-SA3	38.60	38.83	40.80	40.57	Petrographic Analysis
BH304	BH304-RS-SA7	47.66	47.90	31.74	31.50	Petrographic Analysis
BH204	BH204-RS-SA1	31.27	31.48	48.12	47.91	Petrographic Analysis
BH204	BH204-RS-SA9	48.81	48.99	30.58	30.40	Petrographic Analysis
BH306	BH306-RS-SA1	29.48	29.65	49.69	49.52	Petrographic Analysis
BH306	BH306-RS-SA15	48.79	49.02	30.38	30.15	Petrographic Analysis

Unconfined Compressive Strength, Bulk Density, Young’s Modulus and Poisson’s Ratio Test Results

Thirty-nine samples were selected for UCS testing. Results of the UCS testing are listed in Appendix D. The unit weight was determined during the UCS testing while Young’s modulus and Poisson’s Ratio were determined for selected tests using strain gauges. The ranges of results of the UCS testing are listed below in Table 4-39**.**

Table 4-39: UCS, Bulk Density, Young’s Modulus and Poisson’s Ratio Testing Results in the Lindsay Formation

Stratigraphic Unit - Formation	UCS (MPa)		Bulk Density (g/cm^3)		Young’s Modulus (GPa)		Poisson’s Ratio	
	Min	Max	Min	Max	Min	Max	Min	Max
6b – Lindsay	50	112	2.621	2.750	20	54	0.22	0.56

Triaxial Testing

Twenty-four samples of the Lindsay Formation were selected for triaxial testing. These samples were selected from Borehole BH205 and BH307. The results of the triaxial testing summarized in Table 4-40 and listed in Appendix D.

Table 4-40: Triaxial Testing Results for the Lindsay Formation

BH ID	SA ID.	Sample Depth (m)	Sample Elev. (m)	Sigma 3 (1) (MPa)	Sigma 1 (1) (MPa)	Young's modulus E (GPa)
BH205	BH205-RS-SA1	28.24	49.92	3.70	111.1	31.4
BH205	BH205-RS-SA2	28.51	49.65	7.60	149.0	47.7
BH205	BH205-RS-SA3	29.45	48.71	15.1	166.5	39.3
BH205	BH205-RS-SA4	30.32	47.84	22.6	195.0	34.9
BH205	BH205-RS-SA6	31.55	46.61	7.60	168.9	49.0
BH205	BH205-RS-SA7	32.32	45.84	15.1	170.3	36.4
BH205	BH205-RS-SA9	34.26	43.9	3.80	134.5	36.3
BH205	BH205-RS-SA10	34.76	43.40	22.6	195.5	36.8
BH205	BH205-RS-SA14	43.18	34.98	15.1	144.8	37.6
BH205	BH205-RS-SA16	46.41	31.75	7.60	120.9	33.9
BH205	BH205-RS-SA17	48.40	29.76	3.70	94.90	23.4
BH205	BH205-RS-SA18	49.73	28.43	22.6	156.2	24.4

BH ID	SA ID.	Sample Depth (m)	Sample Elev. (m)	Sigma 3 (1) (MPa)	Sigma 1 (1) (MPa)	Young's modulus E (GPa)
BH307	BH307-RS-SA1	23.75	55.15	22.6	193.1	31.4
BH307	BH307-RS-SA4	27.39	51.51	15.1	178.3	42.1
BH307	BH307-RS-SA6	31.42	47.48	7.60	132.3	36.3
BH307	BH307-RS-SA7	32.02	46.88	3.80	134.1	40.0
BH307	BH307-RS-SA9	35.09	43.81	7.60	144.8	38.4
BH307	BH307-RS-SA10	36.01	42.89	15.1	146.3	26.4
BH307	BH307-RS-SA16	43.45	35.45	22.6	185.7	38.4
BH307	BH307-RS-SA18	45.47	33.43	3.80	119.0	34.9
BH307	BH307-RS-SA19	47.29	31.61	3.80	83.40	24.1
BH307	BH307-RS-SA20	47.54	31.36	7.60	118.1	28.1
BH307	BH307-RS-SA24	50.70	28.20	15.1	138.4	30.7
BH307	BH307-RS-SA26	53.40	25.50	22.6	189.4	30.0

Note:
1) Sigma 1 = maximum principal stress at failure; Sigma 3 = minimum principal stress at failure

Direct Shear (Constant Displacement)

Twenty direct shear tests were carried out on representative bedding features in the rock core samples from the Lindsay Formation, ranging from planar, irregular to uneven and smooth to rough. The samples were tested under 4 normal stresses (approximately 0.25 MPa, 0.5 MPa, 1 MPa and 2 MPa). The results of the direct shear testing are summarized below in Table 4-41 and in Appendix D.

Table 4-41: Direct Shear Test Results for the Lindsay Formation

Stratigraphic Unit – Formation	SA ID	Normal Stress (MPa)	Peak Shear Stress (MPa)	Joint Condition
Unit 6b - Lindsay Formation	BH207-RS-SA15	0.25	0.25	Bedding, Irregular, Smooth
	BH204-RS-SA7	0.50	0.29	Bedding, Planar, Smooth
	BH306-RS-SA13	1.00	0.57	Bedding, Planar, Rough
	BH302-RS-SA4	2.00	1.25	Bedding, Undulating, Rough
	BH203-RS-SA2	0.25	0.19	Bedding, Undulating, Smooth
	BH206-RS-SA4	0.51	0.69	Bedding, Undulating, Rough
	BH26-RS-SA3	1.00	0.62	Bedding, Planar, Rough
	BH23-RS-SA5	2.00	1.21	Bedding, Undulating, Smooth
	BH24-RS-SA5	0.25	0.41	Bedding, Undulating, Smooth
	BH202-RS-SA11	0.50	0.36	Bedding, Undulating, Smooth
	BH21-RS-SA4	1.00	0.57	Bedding, Undulating, Smooth
	BH22-RS-SA12	2.00	2.36	Bedding, Planar, Rough
	BH205-RS-SA13	0.25	0.14	Bedding, Planar, Smooth
	BH307-RS-SA12	0.49	0.29	Bedding, Planar, Smooth
	BH309-RS-SA1	1.00	0.72	Bedding, Undulating, Rough
	BH309-RS-SA12	2.00	1.19	Bedding, Undulating, Smooth
	BH305-RS-SA5	2.00	1.23	Bedding, Planar, Smooth
	BH17-RS-03	0.25	0.33	Bedding, Planar, Rough
	BH7-RS-02	0.50	0.59	Bedding, Undulating, Rough
	BH75-RS-03	1.00	0.77	Bedding, Undulating, Smooth

Brazilian Tensile Test

Twenty-four samples of the Lindsay Formation were selected for Brazilian tensile testing. The results of the tensile testing are summarized below in Table 4-42.

Table 4-42: Tensile Strength Test Results for the Lindsay Formation

Stratigraphic Unit	Formation	Tensile Strength (MPa)	
		Min	Max
Unit 6b	Lindsay	4.7	7.9

Point Load Test (PLT) Results

Twenty samples from the Lindsay Formation were selected for point load testing. Axial and diametral tests were completed at each test interval. The results of the Point Load Strength Index values $I_{s(50)}$ are listed below in Table 4-43.

Table 4-43: Point Load Test Results for the Lindsay Formation

Stratigraphic Unit	Formation	Axial $Is_{(50)}$ (MPa)		Diametric $Is_{(50)}$ (MPa)	
		Min	Max	Min	Max
Unit 6b	Lindsay	2.28	5.45	0.63	3.77

Slake Durability Test Results

Fifteen samples from the Lindsay Formation were selected for slake durability testing. The results which show the percent retained (slake durability index) after two wetting/drying cycles are listed below in Table 4-44.

Table 4-44: Slake Durability Test Results for the Lindsay Formation

Stratigraphic Unit	Formation	Moisture Content (%)		I_{d1l}		I_{d2}	
		Min	Max	Min	Max	Min	Max
Unit 6b	Lindsay	0.45	1.33	98.65	99.62	97.83	99.43

Cerchar Abrasion Test Results

Twenty-five samples from the Lindsay Formation were selected for Cerchar abrasion testing. The results of the Cerchar abrasion testing are listed below in Table 4-45.

Table 4-45: Cerchar Abrasion Test Results for the Lindsay Formation

Stratigraphic Unit	Formation	Cerchar Abrasion Index, CAI		Classification
		Min	Max	
Unit 6b	Lindsay	0.41	1.01	Very Low to Low

Punch Penetration Test Results

Twenty-seven samples from the Lindsay Formation were selected for punch penetration testing. The results of the Indentation Hardness Index IHI are listed below in Table 4-46.

Table 4-46: Punch Penetration Test Results for the Lindsay Formation

Stratigraphic Unit	Formation	Indentation Hardness Index, IHI (kN/mm)	
		Min	Max
Unit 6b	Lindsay	10.95	56.21

Specific Gravity Test Results

Sixteen samples from the Lindsay Formation were selected for specific gravity testing. The results of the specific gravity testing are listed below in Table 4-47.

Table 4-47: Specific Gravity Test Results for the Lindsay Formation

Stratigraphic Unit	Formation	Bulk Specific Gravity	
		Min	Max
Unit 6b	Lindsay	2.65	2.70

Stress Measurements Results

The borehole information and the in situ testing depths/elevations in each borehole are listed below in Table 4-48. The dates of testing in the boreholes, and the number of interpretable tests achieved with the test attempts are also summarized in the table. The results of the stress measurements are presented and discussed in Section 5.6.3.5.

Table 4-48: In situ Stress Testing Summary Information

BH ID	Ground/Barge deck Elevation⁽²⁾ (m.a.s.l.) ⁽¹⁾	Top of Bedrock Depth (Elevation⁽²⁾) (m.a.s.l.) ⁽¹⁾	Test Depths (m.a.h.) ⁽¹⁾ (Elevations⁽²⁾)	Testing Dates (No. of Interpretable Tests/Test Attempts)
BH23 (onshore)	85.31	22.78 (62.53)	45.88 – 53.50 (39.43 – 31.81)	July 11 – July 18, 2022 (4/6)
BH202 (offshore)	78.30	16.38 (61.92)	29.98 – 46.80 (48.32 – 31.50)	Aug. 13 – Aug. 16, 2022 (3/3)
BH205 (offshore)	78.16	16.28 (61.88)	30.70 -44.86 (47.46 – 33.30)	Sept. 1 – Sept. 9, 2022 (3/6)
BH304 (offshore)	79.40	15.49 (63.91)	28.70 – 44.60 (50.70 – 34.80)	June 9 – June 12, 2022 (3/4)
BH307 (offshore)	78.90	19.10 (59.80)	28.99 – 44.30 (49.91 – 34.60)	July 1 – July 4, 2022 (3/4)

Notes:

1) m.a.s.l. = metres above sea level; m.a.h. = metres along hole, relative to ground surface
2) Elevations are geodetic and are referred to GSC Benchmark No. 0011910U178, having an elevation of 90.025m (CGVD-1928:1978 adjustment).

All the in situ stress measurements were carried out within the Lindsay Formation which is a slightly weathered to fresh and weak to medium strong to very strong limestone with thin wavy shaly interbeds throughout as described in Section 4.2.11. In general, due to the relatively competent nature of the limestone in this formation, a high average success rate of 75% was achieved in the overcoring tests in the offshore boreholes as shown above in Table 4-48 Lower success rates in the onshore borehole BH23 and offshore borehole BH205 were due to some equipment related issues during testing. Unsuccessful tests generally resulted from occasional breakages of the rock along the shaly interbeds during overcoring. The depths of the overcoring tests ranged from 28.70 m to 53.50 m from ground surface or the barge deck level (elevation from 50.70 m to 31.50 m). The deepest test (at 53.50 m depth or 31.81 m elevation) was achieved in the onshore Borehole BH23. All the tests were conducted at elevations within a zone which is 1.5 times the tunnel diameter above and below the springline locations of the proposed discharge and intake tunnels. In the onshore Borehole BH23, some equipment related issue occurred during testing resulting in only 4 interpretable tests. However, results of the completed tests in this borehole showed that the stresses and orientations measured are very consistent with only minor variations. For the offshore boreholes, 3 interpretable tests were achieved in each test hole.

Table G-2, in Appendix G, summarizes results of the interpretable tests achieved in each of the boreholes. It includes the borehole and test numbers, deformations measured in the EX pilot holes during overcoring as interpreted from the overcoring stress relief plots, the measured horizontal elastic modulus (E) values, and the maximum (P) and the minimum (Q) horizontal stresses interpreted from the test data. The horizontal elastic modulus (E) used for the interpretations were measured from biaxial tests on the overcore samples recovered from the boreholes after overcoring. Where overcore samples could not be recovered due to core breakages during overcoring or core retrieval, E values from other close-by tests were used as indicated. Where overcoring tests were not successful but overcore samples were recovered for biaxial tests, the E values measured from the biaxial tests were also listed with the overcoring test number indicated.

The results obtained in each borehole are presented and discussed below in chronological order of the testing programs conducted in the boreholes:

BH23 – Onshore borehole in the vicinity of proposed intake structure (Tests between Elevation 39.43 m and 31.81 m; springline Elevation 39.50 m)

The maximum horizontal stresses (P) in this hole range from 11.92 MPa to 13.24 MPa and the minimum horizontal stresses (Q) range from 8.21 MPa and 9.48 MPa, showing a fairly uniform stress distribution with depth. Figure G-4 shows a plot of the in situ horizontal stresses (P and Q) with elevation in this borehole.

The biaxial modulus (E) values of the rock range from 40.95 GPa to 54.79 GPa. All the overcore samples recovered from the test locations were intact. The range of the E values is consistent with the natural variations of the rock. Figure G-5 shows a plot of the biaxial modulus values with elevation in this borehole.

The orientations of the maximum horizontal stresses (P) are all within the first quadrant and the ratio of the maximum to minimum horizontal stresses (P/Q) ranges from 1.28 to 1.45.

BH202 – Offshore borehole in the vicinity of proposed intake tunnel (Tests between Elevation 48.32 m and 31.5 m; springline Elevation 39.84 m)

The maximum horizontal stresses (P) in this hole range from 9.20 MPa to 11.87 MPa and the minimum horizontal stresses (Q) range from 6.31 MPa to 7.91 MPa, showing a fairly uniform stress distribution with depth. Figure G-6 shows a plot of the in situ horizontal stresses (P and Q) with elevation in this borehole.

The biaxial modulus (E) values of the rock range from 32.36 GPa to 54.86 GPa. All the overcore samples recovered from this hole for biaxial tests were intact. The range of the E values at lower elevations shows fairly uniform modulus values whereas the test at a higher elevation is higher due probably to a stiffer layer where the test was carried out. Nevertheless, the range of E values is consistent with the natural variations of the rock. Figure G-7 shows a plot of the biaxial modulus values with elevation in this borehole.

The orientations of the maximum horizontal stresses (P) are all within the second quadrant and the ratio of the maximum to minimum horizontal stresses (P/Q) ranges from 1.40 to 1.81.

BH205 – Offshore borehole in the vicinity of proposed intake tunnel (Tests between Elevation 47.46 m and 33.30 m; springline Elevation 40.19 m)

The maximum horizontal stresses (P) in this hole range from 10.10 MPa to 22.41 MPa and the minimum horizontal stresses (Q) range from 4.42 MPa to 14.31 MPa, showing quite a large variation but there is no apparent trend of stress increase with depth. The location (elevation 37.76 m) where the higher stresses were measured is likely a stiffer layer where a high biaxial modulus was also measured. Figure G-8 shows a plot of the in situ horizontal stresses (P and Q) with elevation in this borehole.

The biaxial modulus (E) values of the rock range from 39.88 GPa to 57.27 GPa. All the overcore samples recovered from the test locations were intact. The higher modulus (E of 57.27 GPa) occurred at the location where the higher stresses were measured as discussed above. Figure G-9 shows a plot of the biaxial modulus values with elevation in this borehole.

The orientations of the maximum horizontal stresses (P) generally vary between due north and due east and the ratio of the maximum to minimum horizontal stresses (P/Q) ranges from 1.23 to 2.28.

BH304 – Offshore borehole in the vicinity of proposed discharge tunnel (Tests between Elevation 50.7 m and 34.80 m; springline Elevation 40.19 m)

The maximum horizontal stresses (P) in this hole range from 14.04 MPa to 19.07 MPa and the minimum horizontal stresses (Q) range from 5.29 MPa to 11.78 MPa, showing a fairly uniform stress distribution with depth. Figure G-10 shows a plot of the in situ horizontal stresses (P and Q) with elevation in this borehole.

The biaxial modulus (E) values of the rock range from 42.39 GPa to 47.05 GPa. All the overcore samples recovered from the test locations were intact. The range of the E values shows a fairly uniform modulus values with depth. Figure G-11 shows a plot of the biaxial modulus values with elevation in this borehole.

The orientations of the maximum horizontal stresses (P) are generally within the second quadrant and the ratio of the maximum to minimum horizontal stresses (P/Q) ranges from 1.62 to 2.65.

BH307 – offshore borehole in the vicinity of discharge tunnel (Tests between Elevation 49.91 m and 34.6 m; springline Elevation 40.62 m)

The maximum horizontal stresses (P) in this hole range from 10.06 MPa to 11.79 MPa and the minimum horizontal stresses (Q) range from 5.91 MPa to 6.54 MPa, showing a fairly uniform stress distribution with depth. Figure G-12 shows a plot of the in situ horizontal stresses (P and Q) with elevation in this borehole.

The biaxial modulus (E) values of the rock range from 40.74 GPa to 50.32 GPa. All the overcore samples recovered from the test locations were intact. The range of the E values shows a fairly uniform distribution of modulus values with depth. Figure G-13 shows a plot of the biaxial modulus values with elevation in this borehole.

The orientations of the maximum horizontal stresses (P) are within the first quadrant and the ratio of the maximum to minimum horizontal stresses (P/Q) ranges from 1.70 to 1.63.

Petrographic Analysis

Eight (8) samples of the Lindsay Formation were selected for petrographic examination; the results can be found in Appendix D. Table 4-49 describes the composition of the samples selected for petrographic examination.

Table 4-49: Composition of the Petrographic Samples

Mineral	BH204-RS-Sa01	BH204-RS-Sa09	BH207-RS-Sa08	BH207-RS-Sa16	BH304-RS-Sa03	BH304-RS-Sa07	BH306-RS-Sa01	BH306-RS-Sa15	BH204-RS-Sa01	BH204-RS-Sa09
Calcite	83.6	83.1	77.6	78.6	85.4	83.6	80.2	65.7	83.6	83.1
Quartz	6.2	5.9	8.8	6.9	5.5	6.2	6.7	11.4	6.2	5.9
Dolomite	5.2	5.8	6.3	5.3	5.4	5.2	6.1	7.4	5.2	5.8
Illite/muscovite	1.1	1.3	2.5	5.2	0.5	1.1	2.1	9.7	1.1	1.3
Kaolinite	1.9	1.8	0.8	1.7	1.6	1.9	2.0	1.4	1.9	1.8
Orthoclase Feldspar	0.7	0.8	0.9	0.6	0.5	0.7	0.7	2.5	0.7	0.8
Chlorite	0.9	0.9	1.0	0.7	0.8	0.9	1.1	0.6	0.9	0.9
Plagioclase Feldspar	0.4	0.4	1.3	1	0.3	0.4	0.8	1.1	0.4	0.4
Gypsum	-	-	0.8	-	-	-	-	-	-	-
Talc	-	-	-	-	-	-	0.3	-	-	-
Siderite	-	-	-	-	-	-	-	0.2	-	-

4.3 Groundwater

4.3.1 Groundwater Levels

Groundwater depths and estimated elevations were manually measured in the monitoring well installed in BH23 on three events. The manual groundwater depths and elevations are presented in Table 4-50.

Table 4-50: Groundwater Depths and Elevations, BH23

Date	Depth to Groundwater (m bgs(1))	Groundwater Elevation(3) (m CGVD(2))
August 9, 2022	6.71	78.60
September 29, 2022	7.16	78.16
September 30, 2022	6.93	78.38

Notes:
1) m bgs = metres below ground surface.
2) m CGVD = metres relative to CGVD (1928:1978 adjustment).
3) Based on the geodetic pre-drilling staked ground surface elevation and a manually measured stick-up distance.

The groundwater depth and elevation data represent the conditions on the selected dates they were measured, and seasonal and annual fluctuations should be anticipated.

4.3.2 Hydraulic Conductivity Testing

4.3.2.1 Single Well Response Test

Hydraulic conductivity testing was carried out in the monitoring well installed in BH23 with the use of single-well response tests. The estimated hydraulic conductivity results from the tests are summarized below in Table 4-51.

Table 4-51: Summary of Hydraulic Conductivity Testing

BH ID	Hydrostratigraphic Unit		Solution	Estimated Hydraulic Conductivity	
	No.	Description		Test 1 (m/s)	Test 2 (m/s)
BH23	4a	Interglacial	Confined	3×10^{-6}	2×10^{-6}

4.3.2.2 Packer Testing

The hydraulic conductivity values were estimated for the bedrock from 5-step Lugeon and falling head tests. These test results are presented in Appendix F and are summarized below in Table 4-52. The maximum and minimum estimated hydraulic conductivity values are 6.1×10^{-7} m/s and 1.0×10^{-10} m/s, respectively.

Hydraulic conductivities were calculated using the following expression (Hvorslev, 1951)[6]:

$$K = \frac{r^2 \cdot ln\frac{L}{R} \cdot ln\frac{h_1}{h_2}}{2L(t_2 - t_1)}$$

Where:

K	is the hydraulic conductivity (m/s).
r	is the inner radius of the drill rods (m).
L	is the length of the testing interval (m).
R	is the radius of the borehole (m).
h_1/h_2	is the hydraulic head ratio.
$t_2 - t_1$	is the change in time (seconds).

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[6] Hvorslev, M. (1951). *Time Lag and Soil Permeability in Ground-Water Observations.* Corps. of Engineers, U.S Army.

Table 4-52: Packer Tests Results

BH ID	Test Number	Depth		Lithology	Hydraulic conductivity (m/s)
		From (m)	To (m)		
BH23	1	25.43	42.81	Unit 6b – Lindsay Formation	5.8×10^{-8}
BH23	2	42.24	64.16	Unit 6b – Lindsay Formation	2.5×10^{-7}
BH23	3	64.07	77.89	Unit 6b – Lindsay Formation	2.3×10^{-7}
BH203	1	20.82	28.59	Unit 6b – Lindsay Formation	4.9×10^{-8}
BH203	2	27.01	49.92	Unit 6b – Lindsay Formation	7.3×10^{-8}
BH203	3(2)	27.01	49.92	Unit 6b – Lindsay Formation	1.9×10^{-7}
BH203	4	49.63	69.65	Unit 6b – Lindsay Formation	1.5×10^{-8}
BH207	1	25.52	43.90	Unit 6b – Lindsay Formation	1.1×10^{-8}
BH207	2	40.80	60.66	Unit 6b – Lindsay Formation	1.2×10^{-9}
BH207	3	56.05	71.38	Unit 6b – Lindsay Formation	1.0×10^{-10}
BH303	1	25.51	42.41	Unit 6b – Lindsay Formation	3.0×10^{-8}
BH303	2	40.79	61.62	Unit 6b – Lindsay Formation	2.2×10^{-8}
BH305	1	22.43	39.31	Unit 6b – Lindsay Formation	6.1×10^{-7}
BH305	2	37.69	60.62	Unit 6b – Lindsay Formation	8.2×10^{-9}
BH308	1	25.78	44.26	Unit 6b – Lindsay Formation	-(1)
BH308	2	43.95	68.62	Unit 6b – Lindsay Formation	-(1)

Notes:

1) Analysis was not interpretable due to gas infiltration during the tests.
2) Constant head tests.

Two packer analyses, BH308 (test 1) and BH308 (test 2) were not interpretable. This is most likely due to the infiltration of subsurface gas within the testing interval. The infiltration of the subsurface gas increased the water level during the falling head test and resulted in inconclusive hydraulic conductivities.

PART B

Geotechnical Interpretations and Parameters

5.0 DISCUSSION

The information presented herein provides the interpreted subsurface stratigraphy and the geotechnical engineering parameters associated with each stratigraphic unit, including estimates of the parameter variability, for use in the design of the CCW tunnels and the associated shafts and structures.

The interpreted design values provided herein are highly dependent on the stress conditions and structural interactions inherent in the detailed design aspects of the project, which are currently evolving. The designers may need to re-interpret the in situ and laboratory results and parameters based on the subject matter and circumstances being examined such that the parameters correspond to strain/stress levels expected from the permanent and transitory loads being analyzed as the project details evolve. The detailed interpretations are best left to the specialist designers who best understand the intended use of those parameters and the conditions under which they are to be applied. WSP Golder cannot be responsible for the interpretations and soil/rock parameters provided in the report if applied to unanticipated analyses or boundary conditions.

Additional details are contained in the WSP Golder Phase 1 Report which should be referenced in relation to this discussion.

5.1 General

Based on the results of the Phase 2 geotechnical investigation and to align with the stratigraphic units indicated in the OPG Engineering Specifications and to be consistent with WSP Golder Phase 1 Report, Table 4-1 of this report lists the stratigraphic units used as the basis for the reporting of subsurface conditions in this report. Figures 2A, 2B, 3A and 3B (following the text of this report) display subsurface conditions along the intake and outfall tunnel alignments. Some Phase 1 boreholes which were close to the alignment (onshore) were also plotted on the profile for better indication of subsurface data (note that Phase 1 boreholes are not discussed in detail in this report).

5.2 Soil Stratigraphy

5.2.1 General

The stratigraphic soil unit thicknesses encountered in the Phase 2 boreholes are summarized below in Table 5-1 and shown on Figures 2A, 2B, 3A and 3B. Subsurface soil and rock conditions will vary between and beyond the borehole locations. Variations in the stratigraphic boundaries between boreholes/drillholes will exist and are to be expected.

Table 5-1: Summary of Stratigraphic Soil Units Encountered in Phase 2 Onshore and Offshore Boreholes

BH ID	Ground Surface Elevation (m)	Barge Deck Elevation (m)	Lakebed Elevation (m)	Subsurface Unit Thickness (m)					
				Unit 1	Unit 2a	Unit 2b	Unit 3	Units 4a & 4b	Unit 5
BH21	87.26	-	-	-	-		-	-	-
BH22	85.08	-	-	-	-		-	-	-
BH23	85.31	-	-	1.37	-		13.21, 1.64	1.52, 3.06	1.98
BH24	89.00	-	-	2.44	2.16	1.50	8.53	5.49, 1.21	1.83, 1.84
BH25	88.30	-	-	2.13	2.44	1.03	5.97	7.71	4.77
BH26	85.10	-	-	1.83			9.75	8.77	1.90
BH82	89.26	-	-	1.78	3.32	1.99	2.89	9.30, 1.60	1.45, 3.47
BH202	-	78.30	72.15	-	-		2.21	2.10, 3.83	0.34, 1.75
BH203	-	78.62	70.77	-	-		-	3.66, 1.62	0.61, 2.41
BH204	-	79.39	69.03	-	-		-	4.98	2.03
BH205	-	78.16	66.53	-	-		-	1.42	3.23
BH206	-	78.46	63.04	-	-		-	-	1.95
BH207	-	78.85	62.09	-	-		-	-	0.03
BH301	-	78.09	72.35	-	-		-	7.85, 0.61	0.61, 1.45
BH302	-	78.82	71.35	-	-		-	4.80	4.53
BH303	-	78.84	70.46	-	-		-	3.74, 0.89	1.22, 1.46
BH304	-	79.40	71.02	-	-		-	4.17	1.87
BH305	-	78.37	68.87	-	-		-	3.58, 0.41	1.19, 1.52
BH306	-	79.17	67.17	-	-		-	2.95, 0.95	0.72, 2.01
BH307	-	78.90	66.16	-	-		-	1.21, 0.06	3.30, 1.79
BH308	-	78.60	64.43	-	-		-	0.61	6.25
BH309	-	78.52	61.78	-	-		-	1.90	0.50

Notes:

1) Subsurface unit thicknesses are combined for Units 2a and 2b and for Units 4a and 4b. Where multiple unit thicknesses are provided for a given unit in a borehole, the soil unit is interlayered with other unit(s).

2) – under soil unit columns in the table indicates that the soil unit not encountered in listed borehole.

5.2.2 Unit 1 – Fill/Topsoil

This surficial unit extended to depths between about 1.4 m and 2.4 m below the existing ground surface. Cobbles and boulders were encountered within Unit 1 (inferred from auger grinding observations). Rootlets and organic staining as well as shale bedrock fragments were commonly observed within the fill.

The results of SPT carried out within the non-cohesive portions of Unit 1 measured ‘N’ values ranging from 15 to 134 blows per 0.3 m of penetration, indicating medium dense to very dense degree of compactness. The results of SPT carried out within the cohesive portions of Unit 1 measured ‘N’ Values of 14 and 25 in Boreholes BH25 and BH26, indicating stiff to very stiff consistency.

5.2.3 Unit 2a – Surficial Glaciolacustrine Deposits – Sandy Lean Clay to Lean Clay

This unit ranged in thickness between about 2.2 m and 3.3 m and extended to depths between about 4.6 m and 5.1 m below the existing ground surface.

The results of SPT carried out within Unit 2a measured ‘N’ values ranging from 1 to 20 blows per 0.3 m of penetration, indicating a very soft to very stiff consistency. In situ vane testing carried out within Unit 2a measured one undrained shear strength value of 25 kPa, indicating a soft to firm consistency. The results of Atterberg limits testing carried out on selected samples from Unit 2a indicated low to medium plasticity fines.

5.2.4 Unit 2b – Surficial Glaciolacustrine Deposits – Silty Sand to Silty Sand with Gravel

This unit ranged in thickness from about 1 m to 2 m and extended to depths between about 5.6 m and 7.1 m below the existing ground surface.

The results of SPT carried out within Unit 2b measured ‘N’ values ranging from the static weight of the hammer (i.e., 0 blows) to 25 blows per 0.3 m of penetration, indicating a very loose to compact state of compactness. The results of Atterberg limits testing carried out on selected samples from Unit 2b indicate the material is non-plastic.

5.2.5 Unit 3 – Upper Till – Silty Sand to Sandy Silt

This unit ranged in thickness from about 1.6 m to 13.2 m and extended to depths between about 10 m and 17.7 m below the existing ground surface onshore and 2.2 m below lakebed in BH202 offshore. Offshore, Unit 3 was only encountered for 2.2 m thickness in BH202 at the lakebed and this unit was not encountered in any other offshore boreholes.

The results of SPT carried out within Unit 3 measured ‘N’ values ranging from 11 to greater than 100 blows per 0.3 m of penetration, indicating a medium dense to very dense state of compactness, but more typically very dense. The results of Atterberg limits testing carried out on selected samples from Unit 3 indicated non-plastic to low plasticity fines.

Cobbles and boulders are inferred to be present within this deposit as evidenced by auger grinding during drilling and split spoon samples that did not penetrate the full sample length, as reflected in the SPT ‘N’ values. Previous experience in the region indicates that the glacial deposits contain cobbles and boulders that are not identified by conventional drilling, sampling and laboratory testing methods.

5.2.6 Unit 4a – Intermediate Glaciolacustrine Deposits – Silty Sand to Sandy Silt

This unit ranged in thickness between about 0.1 m and 6.2 m and extended to depths ranging from about 0.6 m to 23.1 m below the existing ground surface or lakebed at offshore locations with the shallower depths encountered in the offshore boreholes.

The results of SPT carried out within Unit 4a measured SPT ‘N’ values from 9 to greater than 100 blows per 0.3 m of penetration, indicating a loose to very dense state of compactness although the deposit is typically dense to very dense onshore and more variable in density offshore. The results of Atterberg limits testing carried out on selected samples from Unit 4a indicate the material is non-plastic.

Although not specifically encountered in this deposit, cobbles and boulders may be present as evidenced by hard drilling and split spoon samples that did not penetrate the full sample length, as reflected in the SPT ‘N’ values and previous experience in the region.

5.2.7 Unit 4b – Intermediate Glaciolacustrine Deposits – Sandy Lean Clay to Lean Clay

This unit ranged in thickness from about 0.5 m to 2.5 m and extended to depths ranging between about 0.5 m and 19.3 m below the existing ground surface or lakebed.

The results of SPT carried out within Unit 4b measured ‘N’ values ranging from 5 to greater than 100 blows per 0.3 m of penetration, indicating a medium stiff to hard consistency, with relatively lower ‘N’ values encountered in the offshore boreholes. The higher SPT ‘N’ values are typically as a result of the overlying/underlying very dense till or silty sand deposits containing cobbles and boulders or interlayers; typically the ‘N’ values in this deposit are less than about 50 blows. The results of Atterberg limits testing carried out on selected samples from Unit 4b indicated low to medium plasticity fines.

5.2.8 Unit 5 – Lower Till – Silty Clay with Sand to Sandy Silty Clay

This unit varied in thickness from about 0.5 m to 4.7 m and extended to depths ranging between about 0.5 m and 25.8 m below the existing ground surface or lakebed in offshore boreholes. In BH206 and BH207, Unit 5 was the only soil unit encountered and was only 0.03 m in thickness in BH207.

The results of SPT carried out within Unit 5 measured ‘N’ values ranging from 16 to greater than 100 blows per 0.3 m of penetration, indicating very stiff to hard consistency (where classified as cohesive) or a medium dense to very dense state of compactness (where classified as non-cohesive), but was typically very dense. The results of Atterberg limits testing carried out on selected samples from Unit 5 indicated low to medium plasticity fines and occasionally non-plastic.

Cobbles and boulders are inferred to be present within this deposit as evidenced by auger grinding during drilling and split spoon samples that did not penetrate the full sample length, as reflected in the SPT ‘N’ values. Previous experience in the region indicates that the glacial deposits contain cobbles and boulders that are not identified by conventional drilling, sampling and laboratory testing methods.

5.3 Bedrock Stratigraphy

5.3.1 General

The bedrock stratigraphy underlying the site consisted of the Paleozoic sequence (Blue Mountain Formation and Lindsay Formation). The top of bedrock surface is undulating locally and slopes gently to the south from about elevation 64 m near the northern extent of the site to about elevation 62 m near Lake Ontario. This bedrock surface is consistent with the subhorizontal dip of the Paleozoic sequence observed regionally[7]. The top of bedrock surface registered on offshore boreholes drilled along the tunnel alignments ranges between Elevation 57.50 m to Elevation 64 m. The borehole stratigraphy along the tunnel alignments is shown on the profiles for the tunnels on Figures 2A, 2B, 3A and 3B (following the text of this report). These figures are based on available top of bedrock information from boreholes drilled for the current drilling program and previous investigations of the site.

A summary of the elevations of top of bedrock and bedrock unit thicknesses is presented in Table 5-2 below.

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[7] Chapman, L.J. and Putnam, D.F., 1984. *The Physiography of Southern Ontario*, Ontario Geological Survey. Special Volume 2, Third Edition. Accompanied by Map P.2715, Scale 1:600,000. Ontario Ministry of Natural Resources

Table 5-2: Summary of Stratigraphic Bedrock Units Encountered in Phase 2 Drillholes

Drillhole ID	Ground Surface/Barge Deck Elevation (m)	Depth to Top of Bedrock (m)	Top of Bedrock Elevation (m)	Encountered Subsurface Unit Thickness (m)	
				Blue Mountain Formation	Lindsay Formation
				Unit 6a	Unit 6b
BH21(1)	87.26(4)	24.64	64.11	3.02	41.18(3)
BH22(1)	85.08(4)	24.25	62.29	3.44	39.85(3)
BH23	85.31(4)	22.78	62.53	2.42	52.91(3)
BH24	89.00(4)	25.00	64.00	0.94	53.69(3)
BH25	88.30(4)	24.05	64.25	1.07	3.59(3)
BH26	85.10(4)	22.25	62.85	1.45	51.34(3)
BH82	89.26(4)	25.80	63.46	–(2)	3.01(3)
BH202	78.30(5)	16.38	61.92	–(2)	45.62(3)
BH203	78.62(5)	16.15	62.47	2.48	51.02(3)
BH204	79.39(5)	17.37	62.02	2.08	43.93(3)
BH205	78.16(5)	16.28	61.88	2.12	51.99(3)
BH206	78.46(5)	17.37	61.09	1.01	42.49(3)
BH207	78.85(5)	16.79	62.06	1.38	53.21(3)
BH301	78.09(5)	16.26	61.83	–(2)	44.38(3)
BH302	78.82(5)	16.80	62.02	1.02	53.06(3)
BH303	78.84(5)	15.69	63.15	1.55	44.45(3)
BH304	79.40(5)	15.49	63.91	2.73	53.25(3)
BH305	78.37(5)	16.20	62.17	–(2)	44.42(3)
BH306	79.17(5)	18.67	60.50	–(2)	51.61(3)
BH307	78.90(5)	19.10	59.80	–(2)	41.88(3)
BH308	78.60(5)	21.03	57.57	2.23	45.37(3)
BH309	78.52(5)	19.14	59.38	1.60	40.11(3)

Notes:

1) BH21 and BH22 are angled boreholes. Subsurface units thickness have been converted to be true vertical thickness for these boreholes
2) Blue Mountain Formation was not present in these boreholes.
3) The full thicknesses of the Lindsay Formation were not determined in these boreholes.
4) Elevation reference was taken from ground surface
5) Elevation reference was taken from the barge deck

Subsurface rock conditions may vary between and beyond the borehole/drillhole locations. Variations in the stratigraphic boundaries between boreholes/drillholes will exist and are to be expected.

The Paleozoic sequence at the site is subdivided into 2 units as described below.

5.3.2 Unit 6a – Blue Mountain Formation

Unit 6a is slightly weathered to fresh, very thinly to thickly bedded, dark brownish grey, very fine to fine grained, faintly porous, slightly to moderately reactive to hydrogen chloride (HCl), weak to strong shale with laminated to medium strong to medium, grey, limestone interbeds.

The limestone interbeds referred to as hard layers identified throughout the Blue Mountain Formation typically range from up to 0.48 m and have an average thickness of 0.11 m. It should be noted that layers less than 2 cm were not logged.

5.3.3 Unit 6b – Lindsay Formation

Unit 6b is slightly weathered to fresh, laminated to very thickly bedded, grey, fine to medium grained, faintly porous, slightly to moderately reactive to HCl, weak to medium strong to very strong limestone with grey shale interbeds.

5.4 Groundwater Depths and Elevations

5.4.1 Current Program

Groundwater depths and elevations from the Phase 2 geotechnical investigation are presented in Table 4-47 in Section 4.3. The groundwater depths ranged from 7.16 m below ground surface (mbgs) to 6.71 mbgs and from estimated elevations 78.16 m to 78.60 m relative to CGVD (1928:1978 adjustment). The groundwater depth and elevation data represent the conditions on the selected dates they were measured, and seasonal and annual fluctuations should be anticipated.

5.5 Interpretation of Advanced in Situ and Laboratory Testing

5.5.1 General

The following subsections discuss our interpretations of the advanced in situ and laboratory testing methods used to derive selected soil and rock material parameters.

5.5.2 Overcoring In Situ Stress Testing

General

The following section describe the methods used in the interpretation of the in situ stress measurement data collected at Boreholes BH23, BH202, BH205, BH304, and BH307. Twenty-three overcoring in situ stress tests were attempted during the field program and sixteen valid tests were interpreted.

Evaluation of Stresses

Based on the deformations measured across the three pairs of buttons of the United States Bureau of Mines (USBM) borehole deformation gauge, the stresses on the plane perpendicular to the axis of the borehole are given by the following expressions (Obert and Duval, 1967)[8].

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[8] Obert, L., and Duvall, W.I. 1967. Rock Mechanics and the Design of Structures in Rocks. New York, NY: Wiley.

$$P = \frac{E}{6d(1-\upsilon^2)}\left(U_1 + U_2 + U_3 + \frac{1}{\sqrt{2}}[(U_1-U_2)^2 + (U_2-U_3)^2 + (U_3-U_1)^2]^{1/2}\right)$$

$$Q = \frac{E}{6d(1-\upsilon^2)}\left(U_1 + U_2 + U_3 - \frac{1}{\sqrt{2}}[(U_1-U_2)^2 + (U_2-U_3)^2 + (U_3-U_1)^2]^{1/2}\right)$$

where,

E	is the average deformation modulus
ν	is the Poisson's ratio
d	is the diameter of the pilot hole
U_1, U_2, U_3	are the measured changes in borehole diameter across three diameters at 60° rotation (i.e., the 3 sets of buttons on the USBM deformation gauge)
U	is positive for an increasing diameter
P	is the maximum stress perpendicular to borehole axis
Q	is the minimum stress perpendicular to borehole axis

The direction of P is given by:

$$\theta = \frac{1}{2}\tan^{-1}\left[\frac{\sqrt{3}(U_2 - U_3)}{2U_1 - U_2 - U_3}\right]$$

where,

θ is the angle to P measured counter-clockwise from the direction of the U_1 diameter.

The quadrant of θ may be determined as follows:

If $U_2 > U_3$ and $U_2 + U_3 < 2U_1$ then θ is between 0° and 45°
$U_2 > U_3$ and $U_2 + U_3 > 2U_1$ then θ is between 45° and 90°
$U_2 < U_3$ and $U_2 + U_3 > 2U_1$ then θ is between 90° and 135°
$U_2 < U_3$ and $U_2 + U_3 < 2U_1$ then θ is between 135° and 180°

The above equations are derived for plane strain conditions with zero axial strain ($\varepsilon_2 = 0$) along the borehole. If the effect of axial strain is to be taken into account, an estimate of the axial stress along the borehole is required.

The deformation modulus of the rock is evaluated from the results of the biaxial tests using the following expression and assuming isotropic elasticity:

$$E = \frac{4ab^2P_0}{(b^2 - a^2)U}$$

where,

E	is the deformation modulus
a	is the inner radius of the overcore
b	is the outer radius of the overcore
P_o	is the radial pressure on the outer surface of the overcore
U	is the average diametral deformation of pilot hole in the overcore

5.5.3 Geophysical Testing

Full Waveform Sonic

The Mount Sopris QL40-FWS Full Waveform Sonic probe (FWS) utilizes a sonic transmitter and three receivers to measure the primary (compression) and secondary (shear) wave velocities of rock formations. The transmitter and receiver portions of the probe are isolated from each other with a flexible sonic isolator which prevents the transmitted sonic pulses from travelling through the probe. As the calculations for wave velocity require a consistent separation from the transmitter and receivers relative to the borehole wall, centralizers are required for this probe.

Compression and shear wave velocities from FWS were estimated in WellCAD by computing a semblance plot that evaluates the similarities in the full sonic waveforms across the array of receivers in the probe. Graphically, the FWS Semblance Plot is an image log where individual pixels are assigned a colour based on the amplitude of the semblance between the travel times recorded by each of the FWS receivers. The manually selected slowness curves were adjusted using the WellCAD extremum algorithm, and the logs were inverted to generate compression wave velocity and shear wave velocity logs.

The FWS image logs and curves are displayed in Appendix A after their associated borehole log. The FWS logs include the semblance plot image, the selected compression wave and shear wave slowness curves, the calculated compressive wave velocity and shear wave velocity curves and calculated dynamic engineering properties (as indicated in Engineering Properties section below).

The semblance plot is overlaid with the selected compression wave and shear wave slowness curves, which correspond to the two separate peak values shown in the semblance plot image. The corresponding compression wave velocity and shear wave velocity curves are provided adjacent for comparison. The Poisson's ratio curve is displayed adjacent to the three overlain elastic constants curves: shear modulus, Young's modulus, and bulk modulus.

Engineering Properties

Values for Poisson's ratio (ν), shear modulus (G), Young's modulus (E) and bulk modulus (K) are calculated from compression wave and shear wave velocities as:

Poisson's ratio:

$$v = \frac{0.5\left(\frac{V_P}{V_S}\right)^2 - 1}{\left(\frac{V_P}{V_S}\right)^2 - 1}$$

Young's modulus:

$$E = \frac{V_P^2\rho(1+v)(1-2v)}{(1-v)} = 2G(1+v)$$

Shear modulus:

$$G = \frac{E}{2(1+v)} = V_s^2\rho$$

Bulk modulus:

$$K = \frac{E}{3(1-2v)} = \frac{V_P^2\rho}{\frac{4}{3}G}$$

Where ρ is the bulk density (in Kg/m^3), V_P is the compression wave velocity (m/s) and V_s is the shear wave velocity (m/s).

5.5.4 Advanced Laboratory Testing of Soil

5.5.4.1 One Dimensional Consolidation Testing

Laboratory one-dimensional consolidation testing was carried out on Soil Unit 4b specimens from Boreholes BH24 and BH26 near the proposed tunnel shaft locations. The following subsections describe the methods and assumptions used in the estimation of consolidation properties from the laboratory results.

It should be noted that some test results indicate that specimens may have been disturbed (although sample disturbance was not necessarily evident at the time the sample was prepared for testing), and the tests carried out on disturbed specimens may not be representative of actual in situ conditions. Sample disturbance may be inferred from the characteristic shape of the consolidation curve. For example, in the semi-logarithmic plot of void ratio versus applied stress, a curve with a well-defined break between recompression and virgin compression may indicate a relatively “intact” specimen. A gradually rounded curve or a flattened curve between recompression and virgin compression typically indicates a disturbed specimen. The specimen volumetric strain, as defined below, may be considered as a general index of sample disturbance:

$$\varepsilon_{vo} = \frac{e_0 - e_1}{1 + e_0} \times 100$$

Where ε_{vo} is the volumetric strain at the estimated in situ vertical effective stress (%), e_0 is the initial void ratio determined in the laboratory, and e_1 is the void ratio at the estimated in situ vertical effective stress during consolidation testing. Table 5-3 presents the void ratios and initial volumetric strain estimates for the one-dimensional consolidation specimens.

Table 5-3: Summary of Void Ratios and Initial Volumetric Strain from One-Dimensional Consolidation Testing

BH ID	SA ID	Avg. Sample Depth (m)	Strati-graphic Unit	Soil Description from Borehole Log[1]	Estimated In Situ Vertical Effective Stress[2] (kPa)	Initial Void Ratio	Void Ratio at Est. In Situ Vertical Effective Stress	Volumetric Strain at Est. In Situ Vertical Effective Stress (%)
BH24	32-1	19.11	4b	Lean Clay with Sand (CL)	245	0.686	0.65	2.3
BH24	33-1	19.94	4b	Lean Clay with Sand (CL)	252	0.308	0.26	3.8
BH26	24-1	14.08	4b	Lean Clay with Sand to Sandy Lean Clay (CL)	181	0.726	0.65	4.4
BH26	24-2	14.58	4b	Lean Clay with Sand to Sandy Lean Clay (CL)	181	0.663	0.61	3.1
BH26	27-1	16.41	4b	Lean Clay (CL)	206	0.848	0.78	3.7
BH26	28-1	16.95	4b	Lean Clay (CL)	209	0.592	0.52	4.8
BH26	28-2	17.00	4b	Lean Clay (CL)	209	0.531	0.46	4.9

Notes:
1) Soil description from borehole log at sample depth (See Appendix A for borehole logs).
2) In situ vertical effective stress estimated assuming unit weight of soil of 20 kN/m^3 and groundwater table at 2.5 m below ground surface.

Preconsolidation Pressure

Two graphical methods were used to estimate preconsolidation pressure: the Casagrande method and the “work” method. The Casagrande method for estimating the preconsolidation pressure is described in ASTM D2435. This method relies upon the presence of a well-defined break in the semi-logarithmic plot of void ratio versus applied stress (in the vicinity of the preconsolidation pressure). In practice, however, stress-strain curves from laboratory consolidation testing are often rounded (to some extent) due to sample disturbance. To address this limitation of the Casagrande method, The point of maximum curvature was selected based on the intersection of the compression curve with the extension of the angle bisector of the virgin compression and recompression portions of the plot as per McNulty (1977)[9].

The “work” method for estimating preconsolidation pressure given by Becker et al. (1987)[10] relates the energy used to compress clay samples to the stress applied. Specifically, this method fits two linear segments to the plot of strain energy density versus stress to represent the pre-yield and post-yield behavior of the soil. The “work” method, like the Casagrande method, can be somewhat subjective as it relies on linear interpolations of strain energy density and stress plots that are, in practice, sometimes curved.

For the interpretations presented herein, the pre-yield line was drawn by fitting through at least three data points showing reasonable linearity following initial loading. The post-yield line was similarly drawn by fitting to data that exhibited linearity following a clear break in the work stress curve (the yield zone).

If nonlinearities in post-yield data were observed, the data point with the largest stress was neglected. This method was adopted due to observations that post-yield lines constructed using the largest stress data points overestimated the preconsolidation pressure when compared with ranges obtained from the Casagrande method, and because of similar patterns noted by Becker et al. (1987) at high pressures. From the Casagrande results, it was inferred which samples were normally consolidated or overconsolidated and care was taken in post-yield fits to only include data from beyond the calculated in situ effective stresses in these cases.

Table 5-4, below, summarizes the preconsolidation pressures and overconsolidation ratios estimated using the Casagrande and “work” methods for the one-dimensional consolidation testing in Boreholes BH24 and BH26.

Coefficients of Consolidation, Volume Compressibility, and Hydraulic Conductivity

Coefficients of vertical consolidation, volume compressibility, and vertical hydraulic conductivity at the end of each consolidation loading step are provided in the laboratory reports in Appendix A. These coefficients vary over the testing duration and are dependent on many factors including stress level, overconsolidation ratio, and strain rate.

Table 5-5 summarizes the coefficient of consolidation, volume compressibility, and hydraulic conductivity data determined from the one-dimensional consolidation testing. For reporting purposes, these coefficients are linearly interpolated between end of loading step data and are taken at a stress level of 100 kPa in excess of the estimated in situ vertical effective stress. The use of this parameter in design is dependent on the actual loading conditions applied by the proposed structures and may require additional interpretation.

Compression Index and Compression Ratio

Table 5-4 below, summarizes the compression index and compression ratio data determined from the one-dimensional consolidation testing. The compression index was estimated from the slope of the virgin consolidation

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[9] McNulty, E. G. 1977. Computerized Analysis of Stress-Strain Consolidation Data. Kentucky Department of Transportation.

[10] Becker DE, Crooks JHA, Been K, Jefferies MG. 1987. Work as a criterion for determining in situ and yield stresses in clays. Canadian Geotechnical Journal. 24(4):549-564.

portion (steepest linear portion) of the semi-logarithmic stress-strain curve. The compression ratio was calculated from the compression index and the initial void ratio.

Table 5-4: Summary of Preconsolidation Pressure and Overconsolidation Ratio from One-Dimensional Consolidation Testing (Casagrande and Work Methods)

BH ID	SA ID	Avg. Sample Depth (m)	Stratigraphic Unit	Soil Description from Borehole Log[1]	Estimated In Situ Vertical Effective Stress[2] (kPa)	Initial Void Ratio	Preconsolidation Pressure (kPa)		Overconsolidation Ratio	
							Casagrande Method	Work Method	Casagrande Method	Work Method
BH24	32-1	19.11	4b	Lean Clay with sand (CL)	245	0.686	881	949	3.6	3.9
BH24	33-1	19.94	4b	Lean Clay with sand (CL)	252	0.308	767	1527	3.0	6.1
BH26	24-1	14.08	4b	Lean Clay with Sand to sandy Lean Clay (CL)	181	0.726	1060	1371	5.9	7.6
BH26	24-2	14.58	4b	Lean Clay with Sand to sandy Lean Clay (CL)	181	0.663	772	1531	4.3	8.5
BH26	27-1	16.41	4b	Lean clay (CL)	206	0.848	894	1051	4.3	5.1
BH26	28-1	16.95	4b	Lean clay (CL)	209	0.592	579	1085	2.8	5.2
BH26	28-2	17.00	4b	Lean clay (CL)	209	0.531	234	745	1.1	3.6

Notes:

1) Soil description from borehole log at sample depth (See Appendix A for borehole logs).
2) In situ vertical effective stress estimated assuming unit weight of soil of 20 kN/m^3 and groundwater table at 2.5 m below ground surface.

Table 5-5: Summary of Coefficients of Consolidation, Volume Compressibility, and Hydraulic Conductivity from One-Dimensional Consolidation Testing

BH ID	SA ID	Avg. Sample Depth (m)	Stratigraphic Unit	Soil Description from Borehole Log(1)	Estimated In Situ Vertical Effective Stress(2) (kPa)	Initial Void Ratio	Coefficient of Vertical Consolidation(3) (cm^2/s)	Coefficient of Volume Compressibility(3) (1/kPa)	Vertical Hydraulic Conductivity(3) (m/s)
BH24	32-1	19.11	4b	Lean Clay with sand (CL)	245	0.686	2.2×10^{-3}	6.5×10^{-5}	1.4×10^{-8}
BH24	33-1	19.94	4b	Lean Clay with sand (CL)	252	0.308	1.9×10^{-4}	5.0×10^{-5}	9.5×10^{-10}
BH26	24-1	14.08	4b	Lean Clay with Sand to sandy Lean Clay (CL)	181	0.726	1.8×10^{-3}	8.6×10^{-5}	1.5×10^{-8}
BH26	24-2	14.58	4b	Lean Clay with Sand to sandy Lean Clay (CL)	181	0.663	1.8×10^{-3}	8.6×10^{-5}	1.5×10^{-8}
BH26	27-1	16.41	4b	Lean Clay (CL)	206	0.848	1.9×10^{-3}	7.7×10^{-5}	1.5×10^{-8}
BH26	28-1	16.95	4b	Lean clay (CL)	209	0.592	1.9×10^{-3}	7.7×10^{-5}	1.5×10^{-8}
BH26	28-2	17.00	4b	Lean clay (CL)	209	0.531	1.8×10^{-3}	1.1×10^{-4}	2.1×10^{-8}

Notes:

1) Soil description from borehole log at sample depth (See Appendix A for borehole logs).
2) In situ vertical effective stress estimated assuming unit weight of soil of 20 kN/m^3 and groundwater table at 2.5 m below ground surface.
3) Coefficients of vertical consolidation, volume compressibility, and vertical hydraulic conductivity are taken at a stress level of 100 kPa in excess of the estimated in situ vertical effective stress.

Table 5-6: Summary of Compression Index and Compression Ratio from One-Dimensional Consolidation Testing

BH ID	SA ID	Avg. Sample Depth (m)	Strata Unit	Soil Description from Borehole Log[1]	Estimated In Situ Vertical Effective Stress[2] (kPa)	Initial Void Ratio	Compression Index	Compression Ratio
BH24	32-1	19.11	4b	Lean Clay with sand (CL)	245	0.686	0.21	0.12
BH24	33-2	19.94	4b	Lean Clay with sand (CL)	252	0.308	0.05	0.04
BH26	24-1	14.08	4b	Lean Clay with Sand to sandy Lean Clay (CL)	181	0.726	0.16	0.09
BH26	24-2	14.58	4b	Lean Clay with Sand to sandy Lean Clay (CL)	181	0.663	0.11	0.07
BH26	27-1	16.41	4b	Lean clay (CL)	206	0.848	0.28	0.15
BH26	28-1	16.95	4b	Lean clay (CL)	209	0.592	0.12	0.08
BH26	28-2	17.00	4b	Lean clay (CL)	209	0.531	0.11	0.07

Notes:

1) Soil description from borehole log at sample depth (see Appendix A for borehole logs).
2) In situ vertical effective stress estimated assuming unit weight of soil of 20 kN/m^3 and groundwater table at 2.5 m below ground surface.

5.5.4.2 Consolidated Drained Triaxial Testing

Consolidated anisotropic drained (CAD) triaxial compression testing was completed on reconstituted Soil Units 3, 4a and 5 specimens from Boreholes BH24 and BH26 near the proposed shaft locations. Reconstituted specimens were prepared by moist tamping combined with the undercompaction method, where the initial layer is compacted to lower density than succeeding layers so that the final density of each specimen is approximately uniform. Specimens were anisotropically consolidated prior to the drained shearing stage. The raw data results are provided in Appendix A.

Shear Strength Behaviour

Drained shear strength parameters were determined from CAD triaxial testing by constructing effective stress Mohr-Coulomb failure envelopes based on results from two to three different specimens originating from the same stratigraphic unit in a single borehole. The drained shear strength parameter interpretations are provided in Appendix J. Failure envelopes were interpreted using the 'p' versus 'q' graphical representation of the Mohr-Coulomb failure criteria. The slope of the failure envelope was used to determine the drained friction angle, assuming a drained cohesion intercept of zero for reconstituted granular soil specimens. The 'p' versus 'q' method has advantages over the Mohr circle method when considering multiple specimens, as specimen failures can be represented by a set of points, allowing for a line of best fit to be used as an envelope. Resulting failure envelopes were also plotted with effective Mohr circles to show agreement. For interpretation purposes, it was assumed that specimen failure corresponded to the maximum principal effective stress difference attained.

Deformation Behaviour

The initial tangent modulus of elasticity (i.e., initial/small strain Young's modulus) and secant modulus of elasticity at 50% of the vertical effective stress increase during shearing to failure were determined from the stress-strain results for each tested specimen. Appendix J provides the interpreted elastic moduli parameters from the CAD triaxial testing. Additionally, Poisson’s ratio was estimated by the initial linear portion of the volumetric strain versus vertical strain plot, and the dilation angle was estimated by the linear portion of the volumetric strain versus vertical strain plot following the point of failure. Table 5-7 provides the estimated values of Poisson’s ratio and dilation angle from CAD testing.

Table 5-7: Summary of Poisson's Ratio and Dilation Angle from Drained Shearing of Reconstituted Anisotropically Consolidated Triaxial Specimens

BH ID	Sample ID	Avg. Sample Depth (m)	Strata Unit	Soil Description from Borehole Log[1]	Effective Vertical Consolidation Stress (kPa)	End-of-Consolidation Ratio of Horizontal to Vertical Stress	Void Ratio Before Shear	Deviator Stress at Failure (kPa)	Vertical Strain at Failure (%)	Poisson's Ratio	Dilation Angle (degrees)
BH24	12	7.02	3	Silty Sand with Gravel (SM)	140.2	0.69	0.389	222.2	11.70	0.35	0
BH24	14	8.23	3		421.2	0.69	0.347	671.3	10.50	0.36	1
BH24	17	10.06	3		861.2	0.67	0.190	1453.0	13.00	0.46	0
BH24	20	11.89	3	Silty Sand with Gravel (SM)	140.4	0.69	0.295	250.7	11.20	0.22	1
BH24	23	13.72	3		839.5	0.69	0.468	2154.0	4.65	0.43	3
BH24	25	14.94	4a	Silt with Sand (ML)	237.6	0.57	0.437	481.2	2.80	0.39	4
BH24	27	19.51	4a		1420.0	0.57	0.435	2954.0	4.08	0.47	4
BH24	37	22.26	4a	Sandy Silt (ML)	240.7	0.56	0.397	418.7	6.13	0.41	1
BH24	34	20.43	5	Silty Clay with Sand (CL-ML)	269.1	0.52	0.408	347.8	4.45	0.39	0
BH24	35	21.04	5		860.2	0.49	0.316	1282.0	4.35	0.42	3
BH24	36	21.65	5		1711	0.49	0.304	2417.0	5.78	0.49	1
BH24	39A	23.29	5	Sandy Silt Clay with Gravel (CL-ML)	281.3	0.50	0.252	367.9	6.73	0.37	0
BH24	40	23.89	5		1637.0	0.52	0.344	2147.0	7.65	0.44	0
BH26	4	2.14	3	Silty Sand with Gravel (SM)	93.6	0.69	0.204	172.0	11.30	0.28	0
BH26	7	3.97	3		280.1	0.69	0.224	849.6	2.58	0.34	8
BH26	11	6.41	3		564.9	0.69	0.243	1271.0	5.28	0.36	0
BH26	15	8.84	3	Silty Sand with Gravel (SM)	93.9	0.69	0.318	297.0	2.13	0.44	6
BH26	17	9.96	3		562.2	0.69	0.248	1378.0	3.65	0.39	11
BH26	20	11.86	4a	Silty Sand (SM) to Sandy Silt (ML)	206.7	0.57	0.352	386.3	3.40	0.38	1
BH26	21	12.40	4a		1242.0	0.57	0.405	2523.0	4.75	0.39	6
BH26	32	19.12	4a	Silty Sand (SM)	206.6	0.57	0.435	453.8	2.88	0.35	12
BH26	34A	20.24	4a		1246.0	0.57	0.470	2402.0	5.38	0.38	10
BH26	35	21.04	5	Silt with Sand (ML)	785.5	0.49	0.390	1111.0	4.50	0.42	3
BH26	36	21.65	5		1470.0	0.52	0.386	1816.0	3.95	0.49	1

Notes:

1) Soil description from borehole log at sample depth (see Appendix A for borehole logs).

5.5.4.3 Consolidated Undrained Triaxial Testing

Consolidated undrained triaxial compression testing was completed on intact Soil Unit 4b specimens extruded from Shelby tubes collected from BH24 and BH26 near the proposed shaft locations. Specimens were consolidated under no lateral strain conditions (i.e., K_0-consolidation) prior to the undrained shearing stage. Available raw data results are provided in Appendix A.

Shear Strength Behaviour

Drained and undrained shear strength parameters were determined from K_0-Consolidated Undrained (CK_0U) triaxial testing by constructing Mohr-Coulomb failure envelopes based on results from two to three different specimens originating from the same stratigraphic unit in a single borehole. The Mohr-Coulomb shear strength parameter interpretations are provided in Appendix K. Failure envelopes were interpreted using the ‘p’ versus ‘q’ graphical representation of the Mohr-Coulomb failure criteria and the plotted Mohr circles for both effective and total stress conditions. For interpretation purposes, it was assumed that specimen failure corresponded to the point of maximum obliquity (i.e., maximum effective stress ratio). The failure envelope was derived based on a best-fit line tangent to the Mohr circles produced at different stress intervals.

Additionally, as shown in Table 5-8 for CK_0U tests, the laboratory undrained shear strength value for each tested specimen was determined as the product of half of the deviator stress at failure and the cosine of the drained friction angle (from the Mohr-Coulomb failure envelope).

Where specimens were consolidated under no lateral strain conditions, the coefficient of lateral earth pressure at rest (K_0) was estimated from the consolidation phase of the triaxial testing (see Table 5-9). It should be noted that due to specimen creep during consolidation, the reported stress ratio at the end of the consolidation stage may not be equivalent to the estimated coefficient of lateral earth pressure at rest.

Table 5-8: Summary of Undrained Shear Strength from Undrained Shearing of Intact K_0-Consolidated Triaxial Specimens

BH ID	SA ID	Avg. Sample Depth (m)	Stratigraphic Unit	Soil Description from Borehole Log[1]	Effective Vertical Consolidation Stress (kPa)	End-of-Consolidation Ratio of Horizontal to Vertical Stress[2]	Void Ratio Before Shear	Deviator Stress at Failure (kPa)	Vertical Strain at Failure (%)	Undrained Shear Strength (kPa)	Undrained Shear Strength Ratio[3]
BH24	32-2	19.41	4b	Lean Clay with Sand (CL)	948	1.18	0.67	822	7.85	373	0.39
BH24	33-3	19.64	4b	Lean Clay with Sand (CL)	249	0.82	0.60	315	1.83	143	0.57
BH26	24-3	14.15	4b	Lean Clay with Sand to Sandy Lean Clay (CL)	180	0.97	0.67	160	7.03	66	0.36
BH26	24-4	13.51	4b	Lean Clay with Sand to Sandy Lean Clay (CL)	1283	0.60	0.57	1722	6.74	703	0.55
BH26	28-3	16.62	4b	Lean Clay (CL)	790	0.61	0.68	482	5.83	197	0.25

Notes:

1) Soil description from borehole log at sample depth (See Appendix A for borehole logs).
2) The End-of-Consolidation Ratio of Horizontal to Vertical Stress may be affected by specimen creep and should not necessarily be considered equivalent to K_0.
3) Undrained Shear Strength Ratio taken as the ratio of the Undrained Shear Strength to the Effective Vertical Consolidation Stress.

Table 5-9: Summary of Estimated Coefficient of Lateral Earth Pressure at Rest from Consolidation of Intact K_0-Consolidated Triaxial Specimens

BH ID	SA ID	Avg. Sample Depth (m)	Strata Unit	Soil Description from Borehole Log[1]	Effective Vertical Consolidation Stress (kPa)	End-of-Consolidation Ratio of Horizontal to Vertical Stress[2]	Estimated Coefficient of Lateral Earth Pressure at Rest[3]
BH24	32-2	19.41	4b	Lean Clay with Sand (CL)	948	1.18	See Note Below[4]
BH24	33-3	19.64	4b	Lean Clay with Sand (CL)	249	0.82	0.77
BH26	24-3	14.15	4b	Lean Clay with Sand to Sandy Lean Clay (CL)	180	0.97	See Note Below[4]
BH26	24-4	13.51	4b	Lean Clay with Sand to Sandy Lean Clay (CL)	1283	0.60	See Note Below[4]
BH26	28-3	16.62	4b	Lean Clay (CL)	790	0.61	0.61

Notes:

1) Soil description from borehole log at sample depth (see Appendix A for borehole logs).
2) The End-of-Consolidation Ratio of Horizontal to Vertical Stress may be affected by specimen creep and should not necessarily be considered equivalent to K_0.
3) Coefficient of Lateral Earth Pressure at Rest estimated from K_0-consolidation phase of triaxial testing, excluding effects of specimen creep, where observed at the end of consolidation.
4) Specimen considered disturbed due to irregularities in stress-strain response during consolidation phase; Coefficient of Lateral Earth Pressure at Rest not considered representative. The irregularities in the stress-strain response during the consolidation stage is likely due to specimen quality.

5.5.5 Advanced Laboratory Testing of Rock

Swell Testing

The effects of applied pressure on the swelling potential of the Blue Mountain Formation shale bedrock (Unit 6a) were examined by plotting the swelling strain rate (percent strain per log cycle of time) versus the logarithm (to the base of 10) of the applied pressures on the test samples for the free swell and semi-confined swell tests. For the free swell tests, there is no applied pressure during the test, and for the null test, there is an initial seating pressure of 0.1 MPa after which the strain is kept to a null value by increasing the applied pressure which is then reported as the null pressure. Positive strain rates indicate expansion while negative strain rates indicate compression (note that negative strain rates were taken as zero swelling potential).

The average strain rate over a single log cycle of time in days (typically from 10 to 100 days) was then estimated from the plots as shown in Table 5-10. For the tests, the strain was set to 0 at the beginning of the tests and although some tests showed some initial swell potential at 1 day, in most of these cases there was no further swelling after that time. In these cases, this very short duration swelling was ignored as typically this is less than the time required to construct the structures in the case of the shafts or in the case of the tunnel lining, less than the time required for the annular grout to be injected and for it to reach initial set.

Table 5-10: Rock Swelling Results for the Blue Mountain Formation

Direction	Sample	Test Type(1)	Depth (mbgs)	Calcite Content	Applied Pressure (MPa)	Average Strain Rate (% per log cycle time)
Horizontal	FST-203-RS2-2	FS	17.79	4.9%	0.0	0.00
Horizontal	FST-308-RS-SA1-1	FS	21.27	44.7%	0.0	0.00
Horizontal	SCSTH-203-RS2-1	SC	17.97	<1.0%	0.08	0.00
Horizontal	SCSTH-207-RS-SA2-2	SC	17.18	7.6%	0.04	0.00
Horizontal	NSTH-203-RS3-1	NS	18.30	38.3%	0.11	0.00
Horizontal	NSTH-205-RS-SA2-2	NS	18.24	<1.0%	0.12	0.00
Vertical	FST-203-RS2-2	FS	17.79	4.9%	0.0	0.00
Vertical	FST-308-RS-SA1-1	FS	21.27	44.7%	0.0	0.00
Vertical	SCSTV-203-RS1-1	SC	17.34	1.9%	0.08	0.00
Vertical	SCSTV-207-RS-SA1-2	SC	16.97	16.7%	0.05	0.004
Vertical	NSTV-205-RS-SA2-2	NS	18.24	<1.0%	0.1	0.00
Vertical	NSTV-203-RS3-1	NS	18.15	43.8%	0.1	0.00

Notes:

1) FS – Free Swell; SC – Semiconfined; NS – Null Swell Test

5.6 Geotechnical Design Parameters

5.6.1 Geotechnical Variability and Uncertainty

Geotechnical variability and uncertainty are considerations in reliability-based design. Geotechnical variability is complex and results from several distinct sources of uncertainty, as depicted below on Figure 5-1 (adapted from Phoon and Kukhawy, 1999)[11]

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[11] Phoon, K.-K. and Kulhawy, F.H. (1999). Characterization of geotechnical variability. Can. Geotech. J. 36: 612-724.

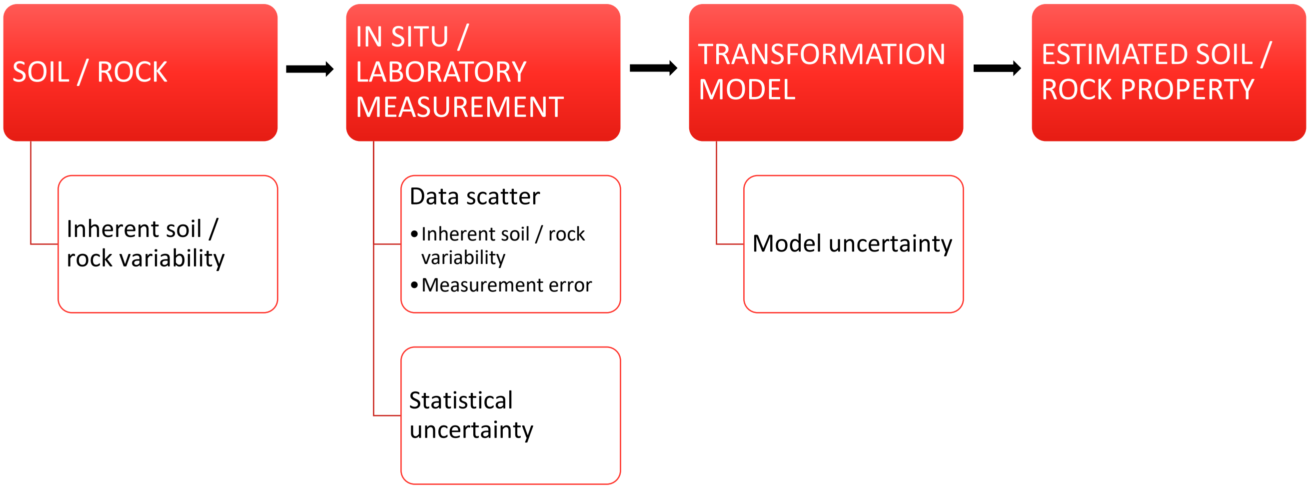

Figure 5-1: Overview of Geotechnical Variability and Uncertainty

Soil and rock are inherently variable materials, derived from, and continually influenced by, natural processes. The subsurface data describe complex inter-layered deposits of glacial origin (both glaciolacustrine deposits and glacial till). The glacial history of the region is recognized as contributing to the geotechnical variability of the site. Similar to the soil units, the bedrock at the site is comprised of sedimentary formations which displayed significant variability due to the changes in the depositional environment.

When sampling the soil and rock there can be sampling bias that is introduced in the sample selection process. In general, for the Phase 2 investigation, soil samples were selected based on predetermined testing requirements for Boreholes BH24 and BH26 and samples were selected from a variety of depths within each borehole. In some cases, such as the shale from the Blue Mountain Formation, it is not often possible to test the weaker rock as samples of this material cannot be properly prepared for testing without breaking apart (typically along weaker bedding planes). In these cases, sensitivity analysis and engineering judgement are required during design to account for the fact that the range in the data may not capture the minimum values.

When in situ and laboratory methods are utilized to measure soil and rock attributes, the inherent variability along with measurement error typically lead to data scatter. Measurement errors may result from equipment errors and procedural or operator errors. Measurement error is minimized through equipment calibration, standardized procedures, laboratory accreditation, etc. The relevant equipment and procedural details for this project are summarized in Table 3-3.

In situ and laboratory methods are also subject to statistical uncertainty, which may be reduced by increasing the sampling frequency. Further, certain in situ and laboratory measurements are transformed for design purposes, through empirical or other correlation methods (another source of uncertainty). In some cases, there may be an insufficient number of data points to derive a representative understanding of the true statistical variability.

In the context of the present geotechnical investigation, geotechnical variability and uncertainty are addressed by a two-pronged approach:

1) Reduction in uncertainty through use of reliable, calibrated equipment, precision in measurement and testing procedures and sufficient quantity of sampling/testing.

2) Consideration of total variability associated with each geotechnical property/parameter, including evaluation of statistical parameters (minimum, maximum, mean, standard deviation) and identification of sources of uncertainty particular to each property/parameter.

The following subsections present the geotechnical design parameters for soil (BH24 and BH26) and rock based on the Phase 2 geotechnical investigation and discuss the main sources of geotechnical uncertainty affecting these parameters.

5.6.2 Soil Parameters

5.6.2.1 Basic Material Characteristics

Based on the results of the Phase 2 geotechnical investigation, summaries of the water content, particle size distribution, Atterberg limits, organic content, specific gravity, and unit weight results from laboratory testing are presented by stratigraphic unit in Tables 5-11 to 5-17, below. Particle size distribution and Atterberg limits results are also presented in Appendix I, grouped by stratigraphic soil unit.

From Tables 5-11 to 5-17 and the plots in Appendix I, the water content, particle size distribution, Atterberg limits, organic content, and specific gravity show reasonable agreement within the respective stratigraphic units. Variation of particle size distribution and organic content are observed in Unit 1 (fill), which is to be expected in fill materials. Unit 3 (upper till) and Unit 4a (intermediate glaciolacustrine deposits) also exhibit variation in the particle size distribution.

With regards to direct measurement of bulk unit weight in the laboratory, it should be noted that this methodology is sensitive to the inclusion of gravel in the specimen soil matrix. Even a small amount of gravel particles within these small specimen may yield greater unit weight values in the laboratory than would be considered representative of in situ conditions, as such judgement should be used in considering these data. Plots of unit weight and energy corrected SPT ‘N’ values are presented in Appendix L.

Table 5-11: Summary of Soils Laboratory Index Testing, Unit 1

Stratigraphic Unit	Statistical Parameter	Water Content (%)	Laboratory Testing Results								
			Particle Size Distribution				Atterberg Limits		Organic Content	Specific Gravity	Bulk Unit Weight (kN/m^3)
			Gravel (%)	Sand (%)	Silt-Sized (%)	Clay-Sized (%)	Liquid Limit	Plasticity Index			
Unit 1 – Topsoil/Fill	Minimum	3.1	-	-	-	-	-	-	0.3	-	-
	Maximum	16.0	-	-	-	-	-	-	2.0	-	-
	Mean	7.0	-	-	-	-	-	-	1.0	-	-
	Std Dev	4.3	-	-	-	-	-	-	0.7	-	-
	No. Tests	7	-				-		4	-	-

Table 5-12: Summary of Soils Laboratory Index Testing, Unit 2a

Stratigraphic Unit	Statistical Parameter	Water Content (%)	Laboratory Testing Results								
			Particle Size Distribution				Atterberg Limits		Organic Content	Specific Gravity	Bulk Unit Weight (kN/m^3)
			Gravel (%)	Sand (%)	Silt-Sized (%)	Clay-Sized (%)	Liquid Limit	Plasticity Index			
Unit 2a – Surficial Glaciolacustrine Deposits – Sandy Lean Clay to Lean Clay	Minimum	11.4	0	6	39	22	17	11	-	-	-
	Maximum	36.1	4	28	48	46	34	16	-	-	-
	Mean	21.3	2	20	44	34	24	13	-	-	-
	Std Dev	5.8	2	12	5	12	9	3	-	-	-
	No. Tests	12	3				3		-	-	-

Table 5-13: Summary of Soils Laboratory Index Testing, Unit 2b

Stratigraphic Unit	Statistical Parameter	Water Content (%)	Laboratory Testing Results								
			Particle Size Distribution				Atterberg Limits(1)		Organic Content	Specific Gravity	Bulk Unit Weight (kN/m^3)
			Gravel (%)	Sand (%)	Silt-Sized (%)	Clay-Sized (%)	Liquid Limit	Plasticity Index			
Unit 2b – Surficial Glaciolacustrine Deposits – Silty Clayey Sand to Silty Sand/ Sandy Silt	Minimum	7.8	14	40	31	11	-	-	-	-	-
	Maximum	9.5	18	41	32	13	-	-	-	-	-
	Mean	8.7	16	41	32	12	-	-	-	-	-
	Std Dev	0.6	2	1	1	1	-	-	-	-	-
	No. Tests	8	3				-		-	-	-

Notes:

1) For Unit 2b, three (3) tested samples were reported by the laboratory as non-plastic.

Table 5-14: Summary of Soils Laboratory Index Testing, Unit 3

Stratigraphic Unit	Statistical Parameter	Water Content (%)	Laboratory Testing Results								
			Particle Size Distribution				Atterberg Limits(1)		Organic Content	Specific Gravity	Bulk Unit Weight (kN/m^3)
			Gravel (%)	Sand (%)	Silt-Sized (%)	Clay-Sized (%)	Liquid Limit	Plasticity Index			
Unit 3 – Upper Till	Minimum	3.7	1	22	20	5	13	10	0.5	2.68	24.6
	Maximum	14.7	44	50	55	22	17	12	0.5	2.70	24.6
	Mean	7.9	16	36	37	12	14	11	0.5	2.69	24.6
	Std Dev	2.3	15	9	11	5	2	1	-	0.01	-
	No. Tests	38	11				6		1	3	1

Notes:

1) For Unit 3, four (4) out of 10 tested samples were reported by the laboratory as non-plastic.

Table 5-15: Summary of Soils Laboratory Index Testing, Unit 4a

Stratigraphic Unit	Statistical Parameter	Water Content (%)	Laboratory Testing Results								
			Particle Size Distribution				Atterberg Limits(1)		Organic Content	Specific Gravity	Bulk Unit Weight (kN/m^3)
			Gravel (%)	Sand (%)	Silt-Sized (%)	Clay-Sized (%)	Liquid Limit	Plasticity Index			
Unit 4a – Intermediate Glaciolacustrine Deposits – Silty Sand to Sandy Silt	Minimum	2.8	0	2	25	3	-	-	0.2	2.67	21.7
	Maximum	23.2	13	71	87	14	-	-	0.4	2.77	23.1
	Mean	16.1	2	35	56	7	-	-	0.3	2.71	22.7
	Std Dev	3.9	3	23	20	4	-	-	0.1	0.03	0.8
	No. Tests	59	17				-		4	9	3

Notes:

1) For Unit 4a, thirteen (13) tested samples were reported by the laboratory as non-plastic.

Table 5-16: Summary of Soils Laboratory Index Testing, Unit 4b

Stratigraphic Unit	Statistical Parameter	Water Content (%)	Laboratory Testing Results								
			Particle Size Distribution				Atterberg Limits		Organic Content	Specific Gravity	Bulk Unit Weight (kN/m^3)
			Gravel (%)	Sand (%)	Silt-Sized (%)	Clay-Sized (%)	Liquid Limit	Plasticity Index			
Unit 4a – Intermediate Glaciolacustrine Deposits – Silty Sand to Sandy Silt	Minimum	11.9	0	2	30	11	18	13	0.5	2.67	20.7
	Maximum	33.7	18	16	73	56	41	20	1.0	2.73	21.6
	Mean	20.2	1	6	50	43	31	16	0.8	2.71	21.2
	Std Dev	4.7	5	5	10	12	6	2	0.4	0.02	0.4
	No. Tests	56	14				16		2	7	4

Table 5-17: Summary of Soils Laboratory Index Testing, Unit 5

Stratigraphic Unit	Statistical Parameter	Water Content (%)	Laboratory Testing Results								
			Particle Size Distribution				Atterberg Limits(1)		Organic Content	Specific Gravity	Bulk Unit Weight (kN/m³)
			Gravel (%)	Sand (%)	Silt-Sized (%)	Clay-Sized (%)	Liquid Limit	Plasticity Index			
Unit 5 – Lower Till	Minimum	5.5	3	9	29	7	14	10	-	2.68	24.2
	Maximum	25.0	24	41	63	26	24	14	-	2.72	24.3
	Mean	10.0	8	29	46	18	16	11	-	2.70	24.3
	Std Dev	3.6	6	8	8	5	2	1	-	0.02	0.1
	No. Tests	74	20				18		-	4	2

Notes:

1) For Unit 5, four (4) out of 22 tested samples were reported by the laboratory as non-plastic.

5.6.2.2 Hydraulic and Volume Change Behaviour

Hydraulic Parameters

The hydraulic parameters of the soils encountered in the Phase 2 geotechnical investigation were characterized using the following methodologies:

- Laboratory determination of vertical hydraulic conductivity by one-dimensional consolidation testing on intact Shelby tube samples from Boreholes BH24 and BH26;
- Laboratory determination of vertical hydraulic conductivity by flexible wall permeameter testing on intact Shelby tube samples from Boreholes BH24 and BH26;
- In situ determination of bulk hydraulic conductivity by single well response testing (rising head tests) at BH23; and,
- Laboratory determination of reconstituted/remoulded hydraulic conductivity by flexible wall permeameter testing on reconstituted/remoulded samples.

Based on the results of the Phase 2 geotechnical investigation, summaries of the hydraulic conductivity values (vertical, reconstituted/remoulded, and bulk, where applicable) estimated from laboratory and in situ testing are presented for Units 3, 4a, 4b and 5 in Table 5-18 through Table 5-21. Appendix L includes plots of hydraulic conductivity (determined by laboratory testing methods on intact samples) with depth for Unit 4b.

Note that no direct measurements of hydraulic behaviour were obtained in soil units except for Soil Unit 4a, which was measured in the monitoring well in Borehole BH23.

Table 5-18: Summary of Hydraulic Conductivity from Laboratory and In Situ Testing, Unit 3

Stratigraphic Unit	Statistical Parameter	Hydraulic Conductivity (m/s)			
		Vertical, from one-dimensional consolidation testing	Vertical, from permeameter testing	Bulk, from single-well response testing	Reconstituted/ Remoulded(2), from permeameter testing
Unit 3 – Upper Till	Minimum	–(1)	–	–	5.0 x 10^{-10}
	Maximum	–	–	–	9.8 x 10^{-8}
	Geometric Mean	–	–	–	2.2 x 10^{-9}
	Std Dev(1)	–	–	–	4.2 x 10^{-8}
	No. Tests	-	-	0	6

Notes:

1) Std Dev = standard deviation (from geometric mean); – = no data.

3) Laboratory specimens reconstituted/remoulded to approximate average dry density of 20.1 kN/m^3 and approximate average water content of 9%.

Table 5-19: Summary of Hydraulic Conductivity from Laboratory and In Situ Testing, Unit 4a

Stratigraphic Unit	Statistical Parameter	Hydraulic Conductivity (m/s)			
		Vertical, from one-dimensional consolidation testing	Vertical, from permeameter testing	Bulk, from single-well response testing	Reconstituted/ Remoulded(2) from permeameter testing
Unit 4a – Intermediate Glaciolacustrine Deposits – Silty Sand to Sandy Silt	Minimum	–(1)	–	1.7×10^{-6}	6.1×10^{-8}
	Maximum	–	–	3.1×10^{-6}	1.7×10^{-7}
	Geometric Mean	–	–	2.4×10^{-6}	8.9×10^{-8}
	Std Dev(1)	–	–	7.0×10^{-7}	6.2×10^{-8}
	No. Tests	-	-	2	3

Notes:

1) Std Dev = standard deviation (from geometric mean); – = no data.
2) See the hydraulic conductivity test reports for reconstitution parameters.

Table 5-20: Summary of Hydraulic Conductivity from Laboratory and In Situ Testing, Unit 4b

Stratigraphic Unit	Statistical Parameter	Hydraulic Conductivity (m/s)			
		Vertical(1), from one-dimensional consolidation testing	Vertical, from permeameter testing	Bulk, from single-well response testing	Reconstituted/ Remoulded, from permeameter testing
Unit 4b – Intermediate Glaciolacustrine Deposits – Sandy Lean Clay to Lean Clay	Minimum	9.5×10^{-10}	4.8×10^{-10}	–	-
	Maximum	2.1×10^{-8}	9.8×10^{-10}	–	-
	Geometric Mean	1.03×10^{-8}	7.3×10^{-10}	–	-
	Std Dev	6.17×10^{-9}	2.6×10^{-10}	–	-
	No. Tests	7	3	0	-

Notes:

1) Vertical hydraulic conductivity from one-dimensional consolidation testing taken at a stress level of 100 kPa in excess of the estimated in situ vertical effective stress for each test specimen.

Table 5-21: Summary of Hydraulic Conductivity from Laboratory and In Situ Testing, Unit 5

Stratigraphic Unit	Statistical Parameter	Hydraulic Conductivity (m/s)			
		Vertical, from one-dimensional consolidation testing	Vertical, from permeameter testing	Bulk, from single-well response testing	Reconstituted/ Remoulded[1] from permeameter testing
Unit 5 – Lower Till	Minimum		-	–	1.1 x 10^{-9}
	Maximum	-		–	6.4 x 10^{-9}
	Geometric Mean	-		–	2.6 x 10^{-9}
	Std Dev	-	–	–	2.9 x 10^{-9}
	No. Tests	-	-	0	3

Notes:
1) See the hydraulic conductivity test reports for reconstitution parameters.

The following provides a discussion of the hydraulic conductivity results from the various test methods utilized for the subsurface investigation. The hydraulic conductivity results relate to the specific soil sample and borehole depth or screened interval that was tested, and results will vary between and beyond the tested depths and locations. The following general discussion is provided:

- Differences between vertical and horizontal hydraulic conductivity are expected in glaciolacustrine units which are generally deposited in thin horizontal or sub-horizontal layers of varying grain size distribution (e.g., layers of sand, silt, and clay). This typically results in vertical hydraulic conductivity that is usually one or more orders of magnitude lower than horizontal hydraulic conductivity. Variability is also expected in the matrix of glacial till deposits which can contain zones of differing grain size distribution (e.g., zones with relatively fewer fines), and also lenses or pockets of coarser- or finer-grained soils.
- Within the same unit, hydraulic conductivity can vary laterally and vertically in response to the variability of grain size distribution within the unit, especially the fines content. Hydraulic conductivity also typically decreases with depth in the near-surface environment due to soil structure and secondary permeability caused by frost action, fractures, joints, roots and root holes and other near-surface processes.
- Differences in laboratory test results are expected to vary depending on the method used for the permeability test. Laboratory tests of Shelby tubes samples oriented in the permeameter as they were oriented in situ will estimate vertical hydraulic conductivity, while the remoulding or reconstituting of soil samples in the lab deteriorates or removes the native soil fabric and its orientation, soil structure, and secondary permeability, which typically decreases hydraulic conductivity. Laboratory test results are highly dependent on the remoulded/reconstituted density that is achieved (i.e., hydraulic conductivity decreases with the amount of compaction/compression that is achieved). Fine-grained soils tend to be more affected by remoulding than coarse-grained soils, particularly coarse-grained soils that are free-draining (i.e., contain 4% or less fines). Also, the re-saturation of remoulded/reconstituted soil samples can result in entrapped air in the void spaces between soil grains, blocking the flow of the permeant water, and resulting in a reduction in hydraulic conductivity on the order of half an order of magnitude.

The following discussion is provided for the results presented in the tables above for each stratigraphic unit:

Unit 3 – Upper Till

The reconstituted/remoulded hydraulic conductivity results from the laboratory range by about two and a half orders of magnitude, which is likely due to the variability in grain size distribution and the reconstituting/ remoulding process for a fine-grained soil material.

Unit 4a – Intermediate Glaciolacustrine

The two estimated bulk hydraulic conductivity values for the Intermediate Glaciolacustrine silty sand to sandy silt deposits (Unit 4a) show good correlation. The reconstituted hydraulic conductivity values are approximately two to three orders of magnitude lower than estimated from the single-well response tests which is reasonably attributed to sandier zones within the screened interval at Borehole BH23 having fewer fines than the samples.

Unit 4b – Intermediate Glaciolacustrine

The reconstituted hydraulic conductivity values for the Intermediate Glaciolacustrine clay deposits (Unit 4b) ranged by half an order of magnitude and show good correlation.

Unit 5 – Lower Till

The reconstituted hydraulic conductivity values for the Lower Till (Unit 5) ranged by about half an order of magnitude and show good correlation.

Consolidation Parameters

Summaries of the consolidation parameters from laboratory testing are presented for Unit 4b in Table 5-22.

Table 5-22: Summary of Consolidation Parameters from Laboratory Testing, Unit 4b

Stratigraphic Unit	Statistical Parameter	Overconsolidation Ratio(1)		Coefficient of Vertical Consolidation(2) (cm^2/s)	Compression Ratio	Compression Index
		Casagrande Method	Work Method			
Unit 4b – Intermediate Glaciolacustrine Deposits – Sandy Lean Clay to Lean Clay	Minimum	1.1	3.6	1.94 x 10^{-4}	0.03	0.04
	Maximum	5.9	8.5	2.15 x 10^{-3}	0.15	0.28
	Mean(3)	3.6	5.7	1.37 x 10^{-3}	0.09	0.15
	Std Dev(4)	1.5	1.8	7.36 x 10^{-4}	0.04	0.08
	No. Tests	7				

Notes:

1) Summary considers overconsolidation ratio value determined by a given method for each interpreted test specimen.
2) Coefficient of vertical consolidation taken at a stress level of 100 kPa in excess of the estimated in situ vertical effective stress for each interpreted test specimen
3) Geometric mean provided for coefficient of vertical consolidation; arithmetic mean provided for all other parameters.
4) Std Dev = standard deviation (from arithmetic or geometric mean).

Coefficient of Lateral Earth Pressure at Rest

Based on the results of the Phase 2 geotechnical investigation, the coefficient of lateral earth pressure at rest (K_0) as determined by laboratory and in situ testing is presented by stratigraphic unit in Table 5-23 for Unit 4b.

Table 5-23: Summary of Coefficient of Lateral Earth Pressure at Rest from Laboratory and In Situ Testing, Unit 4b

Stratigraphic Unit	Statistical Parameter	Coefficient of Lateral Earth Pressure at Rest
		From Triaxial Compression Testing(1)
Unit 4b – Intermediate Glaciolacustrine Deposits – Sandy Lean Clay to Lean Clay	Minimum	0.77
	Maximum	0.77
	Mean	0.77
	Std Dev	-
	No. Tests	1

Notes:

1) Coefficient of lateral earth pressure at rest interpreted from consolidated undrained triaxial testing, where specimen consolidated to approximate in situ vertical effective stress under no lateral strain conditions (i.e., K_0-consolidation). Effects of specimen creep, if observed at the end of consolidation, were excluded from determination of K_0.

Effective Friction Angle

Based on the results of the Phase 2 geotechnical investigation, the effective friction angle (Φ’), as determined by laboratory, is presented by stratigraphic unit in Table 5-24 through Table 5-27. Plots of effective friction angle with depth are also presented in Appendix K, by stratigraphic soil unit (excluding Units 1, 2a and 2b).

Table 5-24: Summary of Effective Friction Angle from Laboratory and In Situ Testing, Unit 3

Stratigraphic Unit	Statistical Parameter	Effective Friction Angle(1) From Triaxial Compression Testing
Unit 3 – Upper Till	Minimum	34
	Maximum	41
	Mean	38.5
	Std Dev	3.3
	No. Tests	4

Notes:

1) Effective Friction Angle interpreted from a set of two to three consolidated drained triaxial testing where the specimen consolidated anisotropically to the approximate in situ vertical effective stress.

Table 5-25: Summary of Effective Friction Angle from Laboratory and In Situ Testing, Unit 4a

, Stratigraphic Unit	Statistical Parameter	Effective Friction Angle From Triaxial Compression Testing(1)
Unit 4a – Intermediate Glaciolacustrine Deposits – Silty Sand to Sandy Silt	Minimum	39
	Maximum	40
	Mean	39.7
	Std Dev	0.58
	No. Tests	3

Notes:

1) Effective Friction Angle interpreted from a set of two to three consolidated drained triaxial testing where the specimen consolidated anisotropically to the approximate in situ vertical effective stress.

Table 5-26: Summary of Effective Friction Angle from Laboratory and In Situ Testing, Unit 4b

Stratigraphic Unit	Statistical Parameter	Effective Friction Angle From Triaxial Compression Testing(1)
Unit 4b – Intermediate Glaciolacustrine Deposits – Sandy Lean Clay to Lean Clay	Minimum	25
	Maximum	30
	Mean	27
	Std Dev	3.53
	No. Tests	2

Notes:

1) Effective Friction Angle interpreted from a set of two to three consolidated undrained triaxial tests on Unit 4b, where specimen consolidated to approximate in situ vertical effective stress under no lateral strain conditions (i.e., K0-consolidation).

Table 5-27: Summary of Coefficient of Effective Friction Angle from Laboratory and In Situ Testing, Unit 5

Stratigraphic Unit	Statistical Parameter	Effective Friction Angle(a) From Triaxial Compression Testing
Unit 5 – Lower Till	Minimum	32
	Maximum	36
	Mean	34
	Std Dev	2
	No. Tests	3

Notes:

1) Effective Friction Angle interpreted from a set of two to three consolidated drained triaxial testing where the specimen consolidated anisotropically to the approximate in situ vertical effective stress.

5.6.2.3 *Shear Strength and Deformation Behaviour*

Based on the results of the Phase 2 geotechnical investigation, shear strength and deformation parameters are summarized from Boreholes BH24 and BH26 located near the proposed shafts, as follows:

- Undrained shear strength as determined by triaxial compression testing are provided in Appendix K for Unit 4b;
- Undrained shear strength ratio as determined from triaxial compression testing is provided in Table 5-28 for Unit 4b;
- The overconsolidation ratio, coefficient of consolidation and K_0 from the oedometer and triaxial tests is presented on figures in Appendix L for Unit 4b;
- Effective friction angle and effective cohesion intercept from triaxial compression testing are provided in Appendix K for Unit 4b;
- Effective friction angle (assuming cohesion intercept of zero) from triaxial compression testing are provided Appendix J for Unit 3, Unit 4a and Unit 5;
- Elastic moduli as determined by triaxial compression testing are provided in Appendix J for Units 3, 4a, and 5; and,
- Initial tangent elastic modulus from triaxial compression testing is provided in Table 5-29 to Table 5-32 and in Appendix J for Units 3, 4a and 5.

Plots of the parameters for each stratigraphic unit are presented in Appendix L. The following should be considered when selecting strength and deformation material parameters for use in design:

- The glacially derived subsurface materials at site (particularly the tills and lower glaciolacustrine materials) are highly variable, ranging from fine-grained to coarse-grained material, and ranging from non-cohesive to cohesive behaviour. While geotechnical strength and deformation parameters are commonly understood within the framework of either undrained or drained conditions, it should be recognized that the in situ materials at the site may not be expected to behave conformably as either undrained or drained.
- Consolidated anisotropic drained triaxial laboratory specimens were reconstituted and consolidated to the approximate in situ density and vertical effective stress. However, these reconstituted specimens do not replicate the soil particle fabric and stress history present in situ. Testing results on reconstituted specimens may not be representative of in situ material behaviour.
- Intact laboratory specimens were selected to obtain a reasonable representation of the range of subsurface conditions encountered. However, there remains a potential for sample bias to occur. Intact laboratory specimens selected for testing may be inherently biased towards samples exhibiting greater cohesion and samples excluding larger particles present in situ (e.g., oversized gravels) (i.e., It is more likely that finer-grained, more cohesive materials would provide intact specimens suitable for testing.) Similarly, reconstituted laboratory specimens may be biased towards excluding larger particles.

- Stress-strain modulus values correlated from undrained shear strength and/or SPT N values (from Bowles, 1997[12]) are provided on the plots in Appendix L. These correlated values may be considered as an indicator of material behaviour, but they are not intended to be used directly in design.

Table 5-28: Summary of Undrained Shear Strength Ratio from Laboratory Testing, Unit 4b

Stratigraphic Unit	Statistical Parameter	Undrained Shear Strength Ratio (kPa) From Triaxial Compression Testing(1)
Unit 4b –Glaciolacustrine Deposits – Sandy Lean Clay to Lean Clay	Minimum	0.25
	Maximum	0.57
	Mean	0.43
	Std Dev	0.13
	No. Tests	5

Notes:
1) Undrained shear strength ratio interpreted from consolidated undrained triaxial testing representative of in situ conditions (i.e., where specimen consolidated to approximate in situ vertical effective stress, typically under K_0-conditions).

Table 5-29: Summary of Elastic Modulus from Laboratory and In Situ Testing, Unit 3

Stratigraphic Unit	Statistical Parameter	Elastic Modulus (E), (MPa)
		Initial Tangent E, from Triaxial Compression Testing(1)
Unit 3 – Upper Till	Minimum	40
	Maximum	279
	Mean	173
	Std Dev	94.03
	No. Tests	10

Notes:
1) Initial tangent elastic modulus interpreted from consolidated anisotropic drained triaxial testing of reconstituted specimen, representative of in situ conditions (i.e., where specimen consolidated to approximate in situ vertical effective stress).

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[12] Bowles, J.E. 1997. Foundation Analysis and Design. Fifth ed. McGraw-Hill.

Table 5-30: Summary of Elastic Modulus from Laboratory and In Situ Testing, Unit 4a

Stratigraphic Unit	Statistical Parameter	Elastic Modulus (E), (MPa)
		Initial Tangent E, from Triaxial Compression Testing⁽¹⁾
Unit 4a – Intermediate Glaciolacustrine Deposits – Silty Sand to Sandy Silt	Minimum	78
	Maximum	483
	Mean	230
	Std Dev	159.7
	No. Tests	7

Notes:

1) Initial tangent elastic modulus interpreted from consolidated anisotropic drained triaxial testing of reconstituted specimen, representative of in situ conditions (i.e., where specimen consolidated to approximate in situ vertical effective stress).

Table 5-31: Summary of Elastic Modulus from Laboratory and In Situ Testing, Unit 4b

Stratigraphic Unit	Statistical Parameter	Elastic Modulus (E),
		Initial Tangent E, from Triaxial Compression Testing⁽¹⁾
Unit 4b – Intermediate Glaciolacustrine Deposits – Sandy Lean Clay to Lean Clay	Minimum	-⁽²⁾
	Maximum	-
	Mean	-
	Std Dev	-
	No. Tests	5

Notes:

1) – = no data
2) Initial tangent elastic modulus was not interpreted from consolidated undrained triaxial testing.

Table 5-32: Summary of Elastic Modulus from Laboratory and In Situ Testing, Unit 5

Stratigraphic Unit	Statistical Parameter	Elastic Modulus (E), (MPa)
		Initial Tangent E, from Triaxial Compression Testing⁽¹⁾
Unit 5 – Lower Till	Minimum	125
	Maximum	500
	Mean	316
	Std Dev	144.3
	No. Tests	7

Notes:

1) Initial tangent elastic modulus interpreted from consolidated anisotropic drained triaxial testing of reconstituted specimen, representative of in situ conditions (i.e., where specimen consolidated to approximate in situ vertical effective stress).

5.6.3 Bedrock Parameters

5.6.3.1 Basic Material Characteristics

Bulk Density

Summaries of the bulk density results from laboratory testing (UCS and triaxial testing) from the Phase 2 geotechnical investigation are presented by stratigraphic unit in Table 5-33. A histogram of the laboratory data is presented in Figure 5-2. Results of the laboratory testing can be found in Appendix D.

Table 5-33: Summary of Bulk Density Test Results by Stratigraphic Rock Unit

Stratigraphic Unit	No. of Samples	Bulk Density (g/cm^3)			
		Min	Max	Mean(1)	Std Dev(1)
Unit 6a – Blue Mountain Formation	2	2.661	2.665	2.663	N/A
Unit 6b – Lindsay Formation	38	2.621	2.750	2.675	0.0156

Notes:
1) Std Dev = Standard Deviation; Mean values are arithmetic.

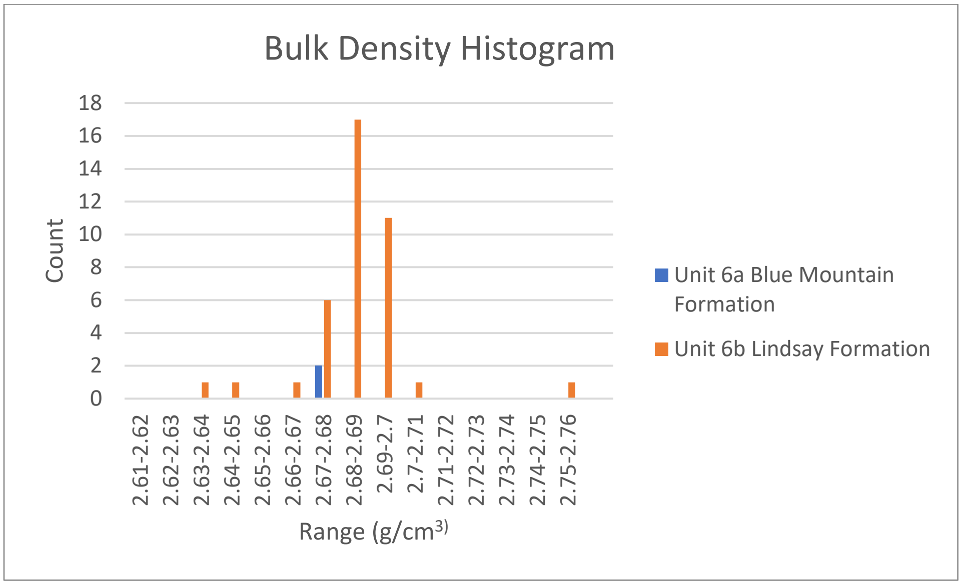

Figure 5-2: Summary of Bulk Density Test Results by Stratigraphic Rock Unit

Rock Quality Designation:

The average rock quality designation (RQD) values of the bedrock units at the DNNP site are generally good to excellent. The Blue Mountain Formation is more weathered and has lower average RQD values compared to Lindsay Formation. Table 5-34 summarizes the range and average RQD values based on the borehole logging conducted during the Phase 2 investigation. A histogram of the RQD measured during the drilling program is presented in Figure 5-3.

Table 5-34: Summary of Rock Quality Designation Summary by Stratigraphic Rock Unit

Stratigraphic Unit	No. of Samples	Minimum (%)	Maximum (%)	Mean[(1)] (%)
Unit 6a – Blue Mountain	24	0	100	82
Unit 6b – Lindsay	542	8	100	98

Note:

1) Mean values are arithmetic.

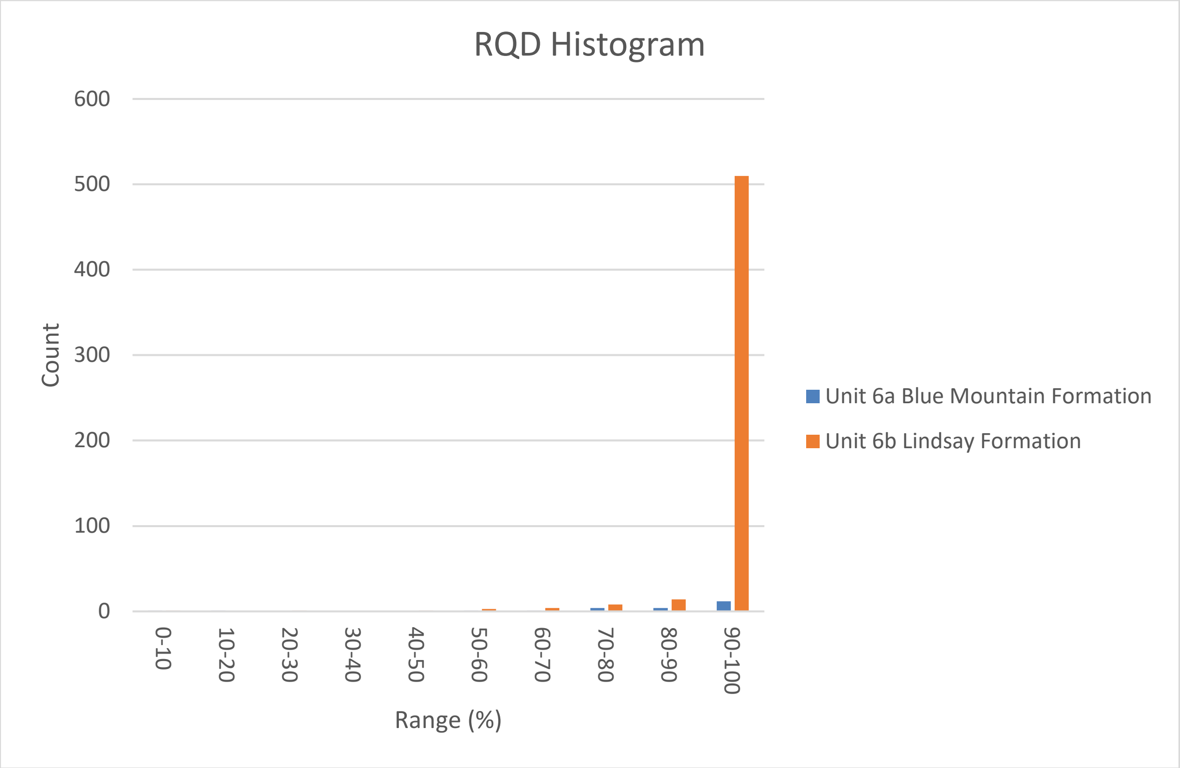

Figure 5-3: Summary of RQD Results by Stratigraphic Rock Unit

Slake Durability

Slake durability testing was conducted on the Lindsay Formation shale and the results are summarized in Table 5-35. The percent retained (slake durability index) after two wetting/drying cycles are shown in the table. Results of the laboratory testing can be found in Appendix D.

Table 5-35: Summary of Slake Durability Results for Lindsay Formation

Moisture Content (%)			Slake Durability Index, I_{d1}			Slake Durability Index, I_{d2}			No. Tests
Min	Max	Mean	Min	Max	Mean	Min	Max	Mean(1)	
0.45	1.33	0.80	98.65	99.62	99.37	97.83	99.43	98.92	15

Notes:
1) Mean values are arithmetic.

Bedrock Discontinuity

Structural data was collected in the boreholes using the acoustic televiewer surveys in each borehole. Optical televiewer was used occasionally only when acoustic televiewer data was not clear. A total of twenty (20) boreholes were surveyed, resulting in 2,324 measured features. The televiewer data provide information on the dip and dip direction of borehole features within the surveyed hole, as well as the type of feature encountered. Types of features logged included bedding, broken zones, contacts, induced fractures, filled joints, major open joints, minor open joints, and partially open joints. The structural data from the borehole televiewer surveys have been plotted as a stereographic projection (stereoplots) as shown in Appendix H. Based on the contoured stereoplots, the rock mass structure encountered in the boreholes for the Blue Mountain and Lindsay formations is dominated by near horizontal discontinuities (bedding joints and low angle joints). Approximately 98% of all measured features dip less than 20º. In order for the less prominent inclined joints to be more visible on the stereoplots, all bedding features and discontinuities dipping less than 35º were filtered from the data set and the remaining discontinuities plotted on stereoplots. As seen on the contoured stereoplots, a total of eleven features (filled joints and partially open joints) dipping more than 35º were isolated from all the measured data. The limited amount of data for the inclined joints (i.e., joints with dip greater than 35º) is considered insufficient for proper contour plots which are intended to show all of the major joint sets present at the site and as such the results should be considered preliminary until more structural data on the inclined joints can be obtained. From the limited data obtained to date, one major sub-vertical joint set dipping north with the dip directions between approximately 354º and 7º can be noted. Note that joint set dipping south with the orientations between approximately 180º and 194º appears to be a subset of the north dipping set. Other joint sets identified on the contoured stereoplots have inclinations between approximately 35º and 53º and are dipping south, southwest, north and northwest respectively. One sub-vertical joint set dipping west with orientation 284º can also be noted.

The bedding planes were determined to have a discontinuity spacing ranging between 0.02 m and 20.3 m with a typical spacing of 1.2 m. Due to the limited data for the inclined joints, the discontinuity spacing could not be determined for these inclined sets.

Refer to Appendix H for more detailed presentation of stereographic projections of the televiewer data measured for each formation.

5.6.3.2 Hydraulic Behaviour

Packer Testing

Packer testing was carried out during the Phase 2 field investigation to estimate the hydraulic conductivities of the bedrock. Individual test results are summarized above in Section 4.3.1.2. The data for packer testing conducted in Lindsay Formation is summarized in Table 5-36.

Table 5-36: Summary of Packer Testing in Lindsay Formation

Stratigraphic Unit	No. of Tests	Estimated Hydraulic Conductivity from Packer Testing (m/s)		
		Minimum	Maximum	Mean
Unit 6b – Lindsay	16	1.0×10^{-10}	6.1×10^{-7}	1.1×11^{-7}

Variability of Hydraulic Conductivity

The hydraulic conductivity estimates for the bedrock varied by four orders of magnitude. For these test results, the majority of the flow is associated with discontinuities in the rock mass and therefore the degree to which the primary (e.g., bedding planes) and secondary (e.g., joints and fractures) discontinuities intersect the tested interval and the aperture or opening width of those discontinuities, is expected to be the most significant influence on the hydraulic conductivity estimated at each borehole location.

5.6.3.3 Strength and Deformation Behaviour – Intact Rock

Uniaxial Compressive Strength

Rock samples from the formations observed during the drilling program were tested in the laboratory to determine the Uniaxial Compressive Strength (UCS). Two (2) samples from Blue Mountain and thirty-nine (39) samples from Lindsay Formation were selected for UCS testing.

Table 5-37 presents the range, mean and standard deviation of the evaluated rock parameters from UCS laboratory testing. A histogram of the laboratory data is presented in Figure 5-4. Results of the laboratory testing can be found in Appendix D.

Table 5-37: Uniaxial Compressive Strength from Laboratory Testing by Stratigraphic Rock Unit

Stratigraphic Unit	Lithology	No. of Samples	Uniaxial Compressive Strength (MPa)			
			Min	Max	Mean(1)	Std Dev
Unit 6a – Blue Mountain Formation	Shale	2	120.9	134.1	127.5	N/A
	Shale/Limestone	0	-	-	-	-
	Limestone	0	-	-	-	-
Unit 6b – Lindsay Formation	Shale	0	-	-	-	-
	Shale/Limestone	32	52.1	106.9	84.2	15.6
	Limestone	7	50.3	111.8	80.5	18.70

Notes:
1) Std Dev = Standard Deviation; Mean values are arithmetic.

The shale samples from the Blue Mountain Formation had higher strengths compared to the interbedded shale/limestone and limestone samples from the Lindsay Formation. It should be noted that the shale strengths for the Blue Mountain Formation from Phase 2 are considerably higher than those from the Phase 1 investigation. Interpretation of the UCS results for the Blue Mountain shale for design should consider the Phase 1 results as well given the limited number of samples tested in Phase 2 which likely means that the Phase 2 results do not fully capture the actual range and average for the shale layers.

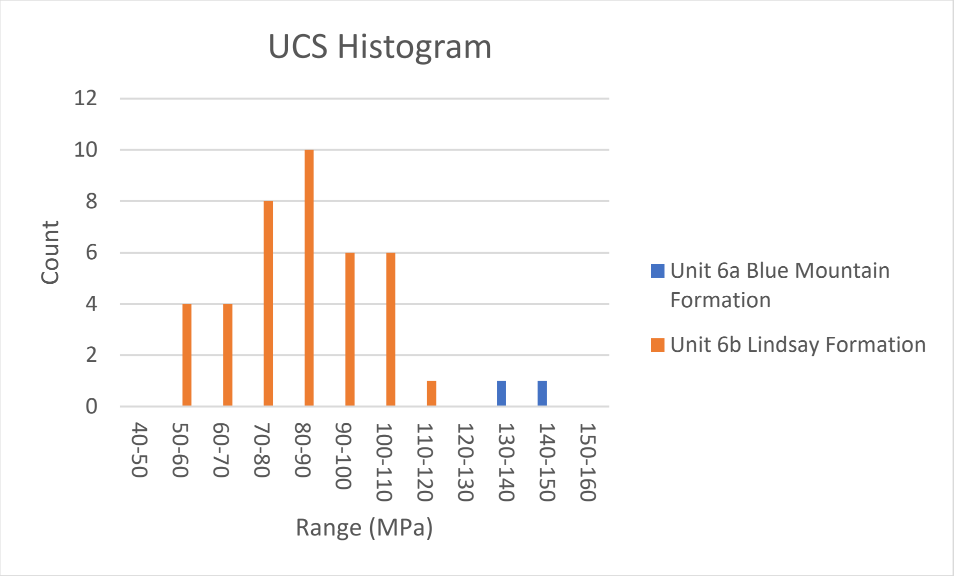

Figure 5-4: Summary of UCS Test Results by Stratigraphic Rock Unit

Young's Modulus and Poisson's Ratio

Young's modulus and Poisson's ratio were evaluated from UCS testing. Table 5-38 summarizes the deformation properties (Young's modulus and Poisson's ratio) by stratigraphic unit. Histograms of the laboratory data are presented in Figure 5-5 and Figure 5-6. Results of the laboratory testing can be found in Appendix D.

Table 5-38: Deformation Properties from Laboratory Testing by Stratigraphic Rock Unit

Stratigraphic Unit	Lithology	No. of Samples	Young's Modulus (GPa)				Poisson's Ratio			
			Min	Max	Mean (2)	Std Dev	Min	Max	Mean(2)	Std Dev
Unit 6a – Blue Mountain Formation	Shale	2	31.0	32.0	31.5	N/A	0.29	0.31	0.30	N/A
	Shale/Limestone	0								
	Limestone	0	-(1)	-	-	-	-	-	-	-
Unit 6b – Lindsay Formation	Shale	0	-	-	-	-	-	-	-	-
	Shale/Limestone	26	19.5	53.9	34.2	6.72	0.22	0.56	0.36	0.09
	Limestone	4	23.6	46.8	34.0	9.82	0.23	0.42	0.31	0.08

Notes:
1) (-) Minimum and Maximum values not applicable, only one sample available.
2) Mean values are arithmetic.

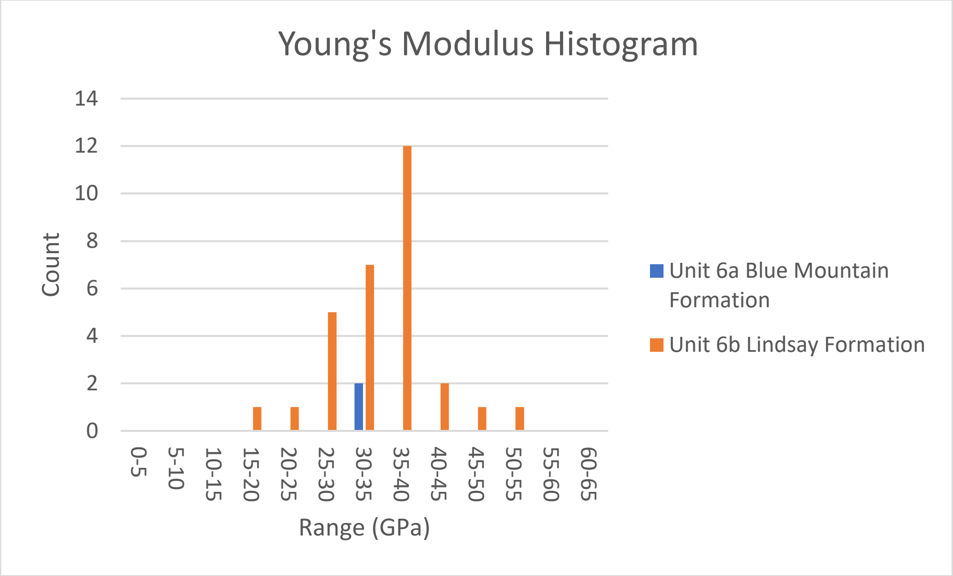

Figure 5-5: Summary of Young's Modulus Test Results by Stratigraphic Rock Unit

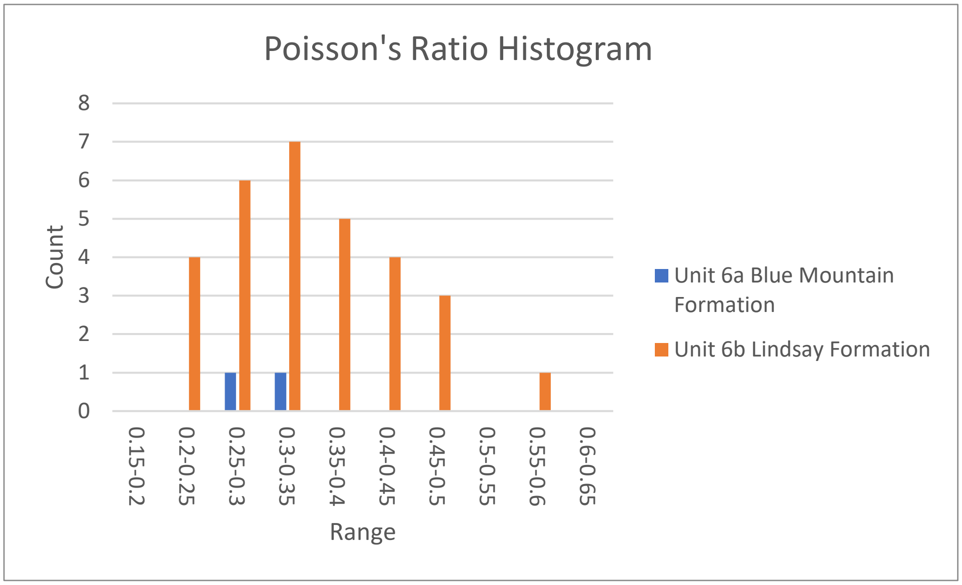

Figure 5-6: Summary of Poisson's Ratio from Test Results by Stratigraphic Rock Unit

5.6.3.4 Strength and Deformation Behaviour – Rock Mass

Rock Dilatometer Results

Dilatometer testing (i.e., RPMT) was carried out in the bedrock of offshore boreholes BH203, BH302 and BH307. The testing was carried out onsite and analyzed by In-Depth Geotechnical Inc.

The purpose of this testing was to determine the deformation properties of the rock at specific intervals. The mean Young's modulus by borehole is summarized in Table 5-39 and the test results for the RPMT are provided in a report prepared by In-Depth Geotechnical Inc. in Appendix E.

Table 5-39: Offshore Rock Dilatometer Young's Modulus Results by Borehole

Borehole ID	Mean Young's Modulus (MPa) (1)
BH203	12605
BH302	15131
BH307	13943
Mean	13992

Notes:
1) Mean values are arithmetic.

Shear Strength

The results for the direct shear tests on bedding are presented in Table 5-40 below which summarizes the interpreted friction angle for the Lindsay formation from the tests assuming no cohesion along the open joints and using a best fit trendline on a plot of normal stress in Figure 5-7. Results of the laboratory testing can be found in Appendix D.

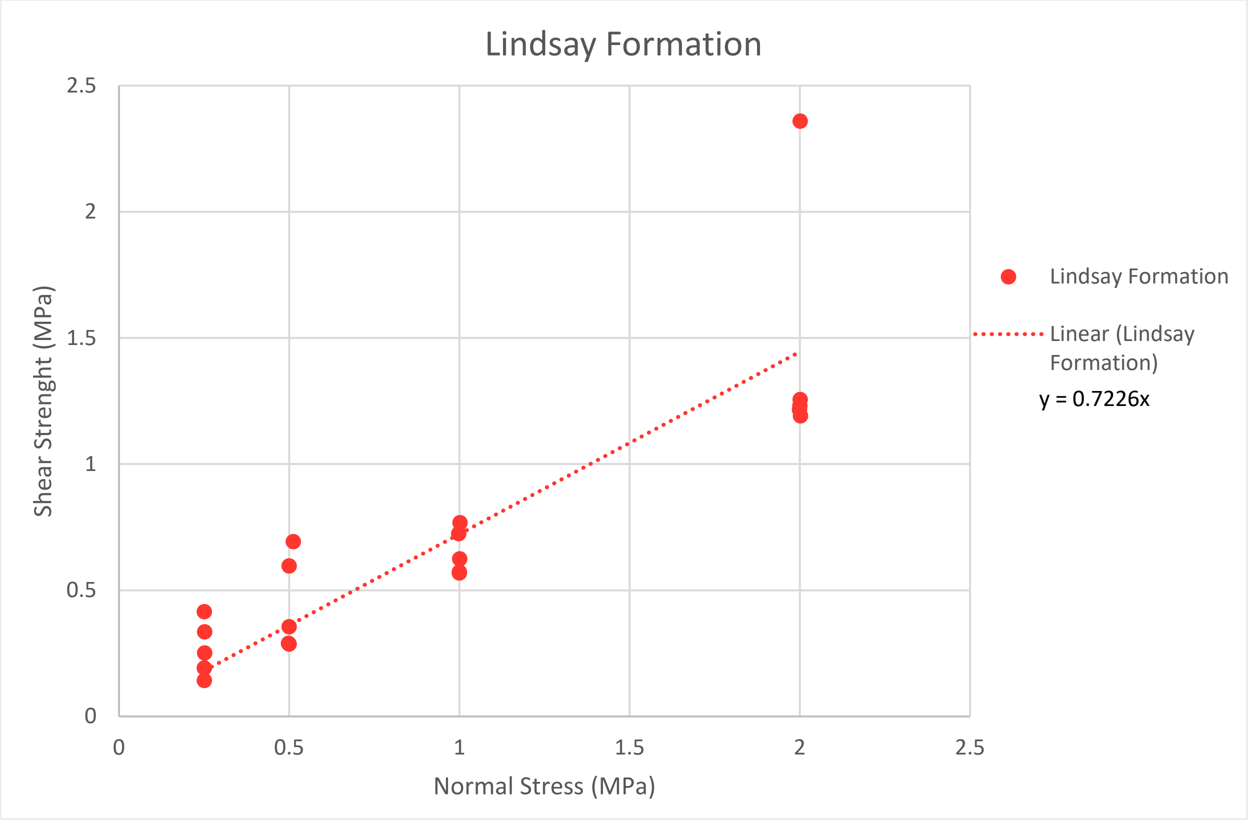

Figure 5-7: Best Fit Trendline on Direct Shear Test Results.

Table 5-40: Interpreted Friction Angle for Bedding in Lindsay Formation

Stratigraphic Unit	Formation	Joint Type	Friction Angle[1] (degrees)
Unit 6b	Lindsay	Bedding	35

Notes:
1) Friction angle is calculated assuming no cohesion across the rock discontinuities.

Shear Joint Stiffness

The shear stiffness was calculated from the direct shear tests using the shear load versus shear displacement plots. Table 5-41 presents the shear stiffness values for Lindsay Formation obtained from the direct shear testing. Results of the laboratory testing can be found in Appendix D.

Table 5-41: Summary of Joint Shear Stiffness for Lindsay Formation

Stratigraphic Unit	Joint Type	Shear Stiffness[1] (MPa/mm)			No. of Tests
		Minimum	Maximum	Mean [2]	
Unit 6b – Lindsay[3]	Bedding	0.21	2.78	1.12	20

Notes:
1) Where slope of stress/displacement curve changed within a test, multiple slopes (i.e. stiffness values) were determined.
2) Overall mean values were obtained by determining the best overall slope fit for each test.
3) No tests were completed on inclined joints in the Lindsay Formation.

Punch Penetration

Rock samples from the Lindsay Formation obtained during the Phase 2 drilling program were tested in the laboratory to determine the punch penetration index. Twenty-seven (27) samples from Lindsay Formation were selected for punch penetration testing.

Table 5-42 presents the range, mean and standard deviation of the evaluated rock parameters from punch penetration laboratory testing. A histogram of the laboratory data is presented in Figure 5-8. Results of the laboratory testing can be found in Appendix D.

Table 5-42: Punch Penetration from Laboratory Testing for Lindsay Formation

Stratigraphic Unit	Indentation Hardness Index, IHI (kN/mm)				No. of Tests
	Minimum	Maximum	Mean[1]	Standard Deviation [1]	
Unit 6b – Lindsay	10.95	56.21	35.29	9.90	27

Notes:
1) Std Dev = Standard Deviation; Mean values are arithmetic.

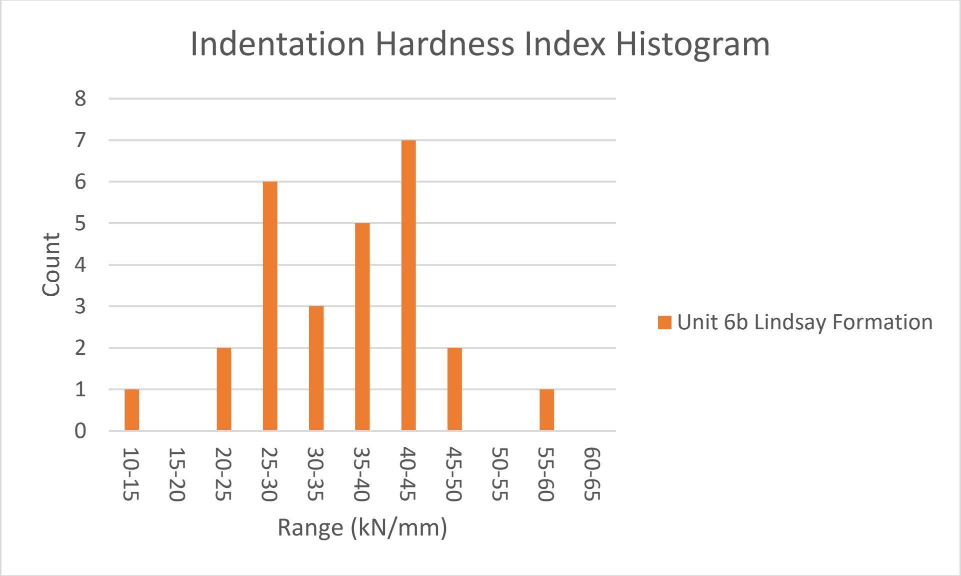

Figure 5-8: Summary of Punch Penetration Test Results

Brazilian Tensile Strength

Rock samples from the bedrock obtained during the drilling program were tested in the laboratory to determine the Brazilian tensile strength. Twenty-four (24) samples from Lindsay Formation and six (6) samples from the Blue Mountain Formation were selected for Brazilian testing.

Table 5-43 presents the range, mean and standard deviation of the evaluated tensile strength test results. A histogram of the laboratory data is presented in Figure 5-9. Results of the laboratory testing can be found in Appendix D.

Table 5-43: Brazilian Tensile Strength from Laboratory Testing by Stratigraphic Rock Unit

Stratigraphic Unit	Tensile strength (MPa)				No. of Tests
	Min	Max	Mean(1)	Standard Deviation (1)	
Unit 6a – Blue Mountain	4.9	7.6	6.0	1.06	6
Unit 6b – Lindsay	4.7	7.9	6.3	0.71	24

Notes:
1) Std Dev = Standard Deviation; Mean values are arithmetic.

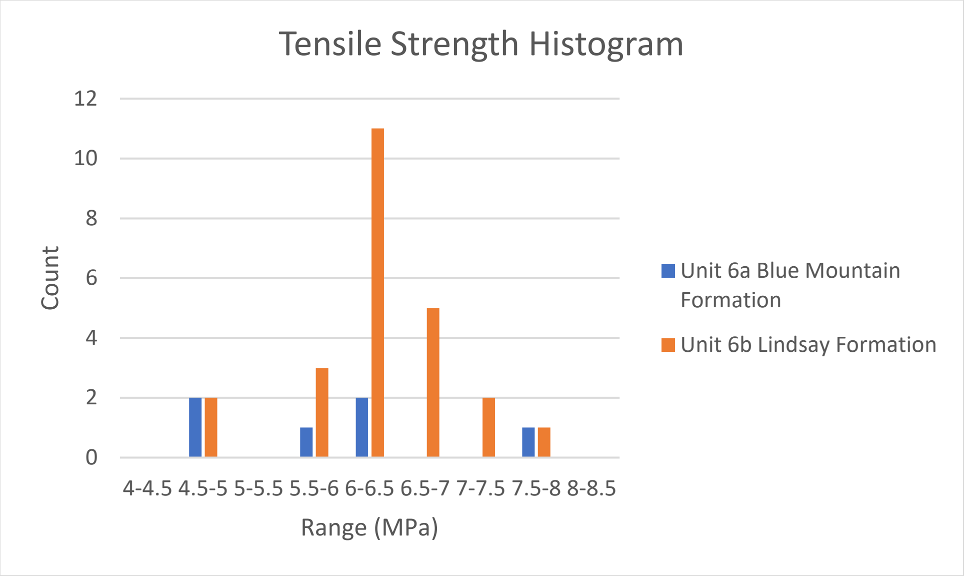

Figure 5-9: Summary of Brazilian Test Results by Stratigraphic Rock Unit

Point load Testing

Point load rock samples from the bedrock obtained during the Phase 2 drilling program were tested in the laboratory. Twenty-four (24) samples from Lindsay Formation and six (6) samples from the Blue Mountain Formation were selected for point load testing.

Table 5-44 presents the range, mean and standard deviation of the evaluated point load testing. Histograms of the laboratory data is presented in Figure 5-10 and Figure 5-11. Results of the laboratory testing can be found in Appendix D.

Table 5-44: Point Load Test Results from Laboratory Testing by Stratigraphic Rock Unit

Stratigraphic Unit	Axial $I_{s(50)}$ (MPa)					Diametric $I_{s(50)}$ (MPa)				
	Min	Max	Mean⁽¹⁾	Standard Deviation (1)	No. of Tests	Min	Max	Mean (1)	Standard Deviation (1)	No. of Tests
Unit 6a – Blue Mountain	2.5	4.4	3.7	0.7	9	0.2	1.6	0.8	0.6	4
Unit 6b – Lindsay	2.3	5.5	4.0	0.8	97	0.6	3.8	1.9	0.9	97

Notes:
2) Std Dev = Standard Deviation; Mean values are arithmetic.

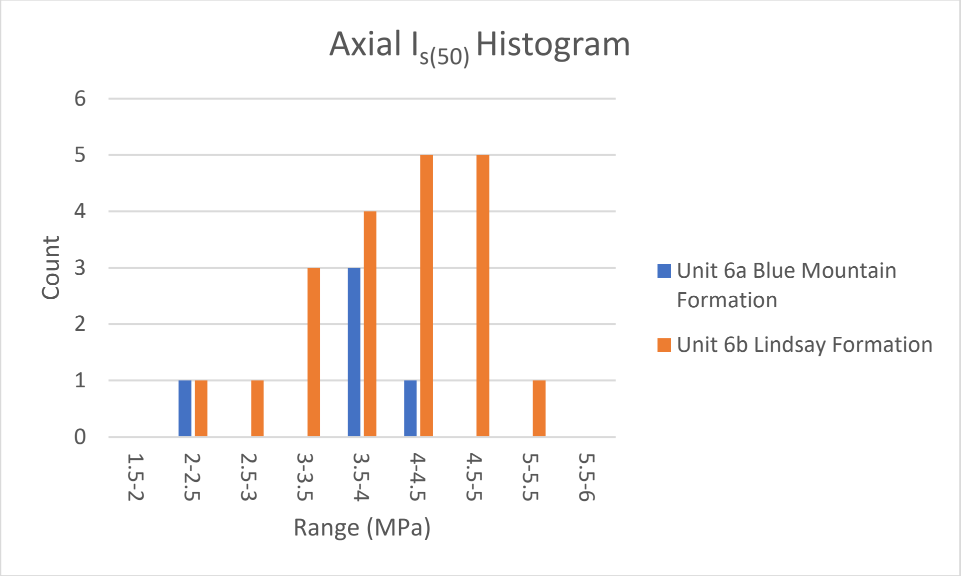

Figure 5-10: Distribution of Axial $I_{s(50)}$ values by Stratigraphic Rock Unit

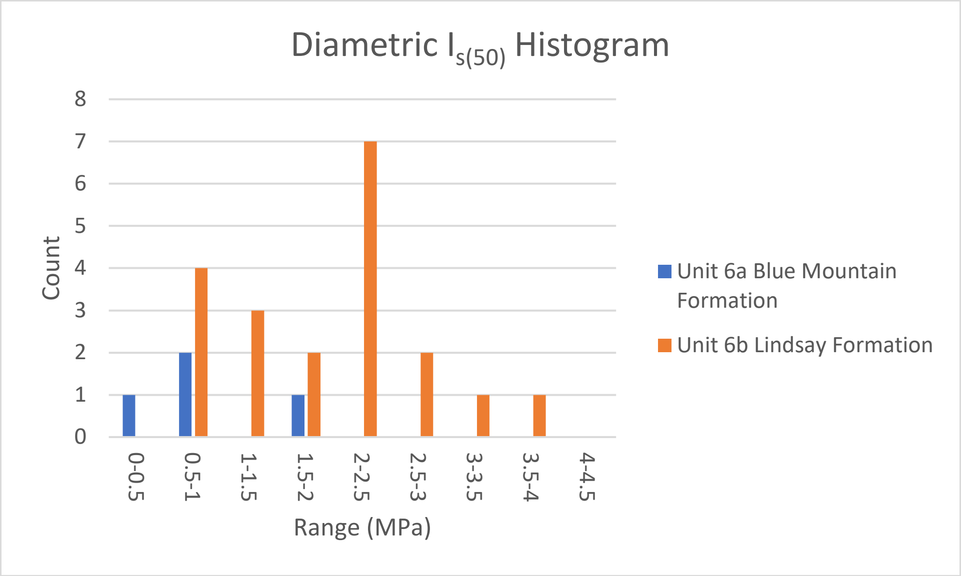

Figure 5-11: Distribution of Diametric $I_{s(50)}$ values by Stratigraphic Rock Unit

Specific gravity

Specific gravity samples from the bedrock obtained during the Phase 2 drilling program were tested in the laboratory. Sixteen (16) samples from Lindsay Formation were selected for specific gravity testing.

Table 5-45 presents the range, mean and standard deviation of the evaluated specific gravity testing. A histogram of the laboratory data is presented in Figure 5-12. Results of the laboratory testing can be found in Appendix D.

Table 5-45: Specific Gravity Results from Laboratory Testing for Lindsay Formation

Stratigraphic Unit	Specific Gravity				No. of Tests
	Minimum	Maximum	Mean[(1)]	Standard Deviation [(1)]	
Unit 6b – Lindsay	2.648	2.691	2.670	0.01	16

Notes:
1) Std Dev = Standard Deviation; Mean values are arithmetic.

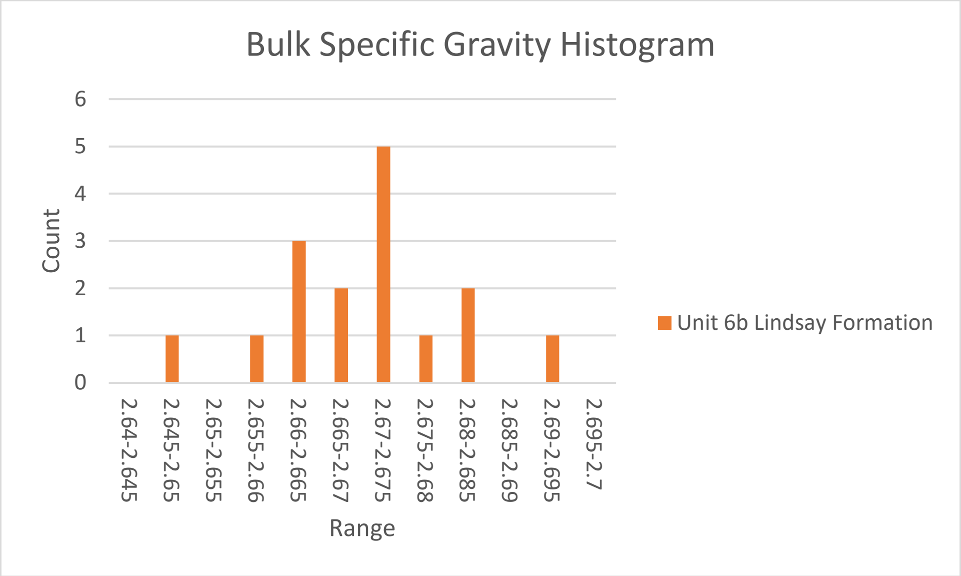

Figure 5-12: Distribution of Specific Gravity Results

Cerchar

Rock samples from the bedrock obtained during the Phase 2 drilling program were tested in the laboratory to determine the Cerchar abrasion index. Twenty-five (25) samples from Lindsay Formation were selected for Cerchar testing.

Table 5-46 presents the range, mean and standard deviation of the evaluated Cerchar abrasion testing. A histogram of the laboratory data is presented in Figure 5-13. Results of the laboratory testing can be found in Appendix D.

Table 5-46: Cerchar Abrasion Index from Laboratory Testing for Lindsay Formation

Stratigraphic Unit	Cerchar Abrasion Index				No. of Tests
	Minimum	Maximum	Mean[(1)]	Standard Deviation [(1)]	
Unit 6b – Lindsay	0.41	1.01	0.59	0.15	25

Notes:
1) Std Dev = Standard Deviation; Mean values are arithmetic.

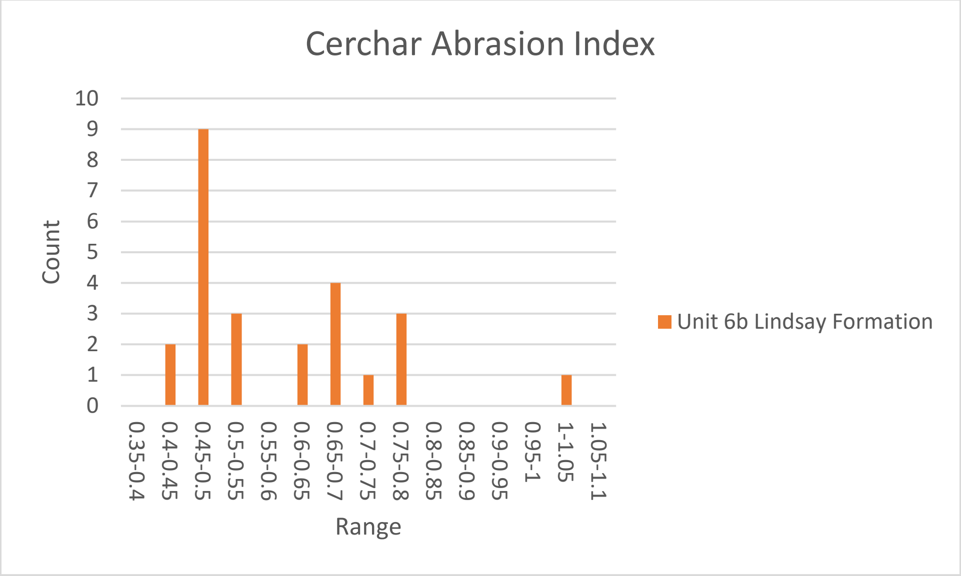

Figure 5-13: Distribution of Cerchar Abrasion Index Results

Geological Strength Index

An assessment of the overall rock mass quality was completed for the boreholes using the Geological Strength Index (GSI). Initially GSI was assessed for each of the borehole runs using RMR (Bieniawski, 1976) [13] assuming it is analogous to GSI over the range of values encountered when the groundwater term is set to dry conditions. The following presents the results of the assessment of GSI per drill run interval. Note that a typical drill run interval was 1.5 m.

The GSI values were determined for each drillhole run using the RMR76 (Bieniawski, 1976)[13] classification system as follows:

RMR76 = P1 + P2 + P3 + P4 + P5

Where: P1 is the strength of intact rock material (rating = 0 to 15);
P2 is the drill core quality, Rock Quality Designation, RQD (rating = 3 to 20);
P3 is the spacing of discontinuities (rating = 5 to 30);
P4 is the condition of discontinuities (rating = 0 to 25); and,
P5 is the groundwater (rating = 0 to 10).

An average rating for each RMR76 parameter are shown in Table 5-47.

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[13] Bieniawski, Z.T. 1976. Rock mass Classification in Rock Engineering. In *Exploration for Rock Engineering, proc. of the symp.*, (ed. Z.T. Bieniawski) **1**, 97-106. Cape Town: Balkema.

Table 5-47: Parameter Values Used in the Average GSI Calculations by Formation

Stratigraphic Unit	Average P1 Rating	Average P2 Rating	Average P3 Rating	Average P4 Rating	Average P5 Rating (1)
Unit 6a – Blue Mountain	11	16	14	19	10
Unit 6b – Lindsay	8	16	14	19	10

Notes:

1) The groundwater rating for dry conditions has been used to determine GSI.

The GSI values were grouped into five rock mass classifications, and these are presented in Table 5-48, below.

Table 5-48: Geological Strength Index Classification

GSI Class	Description	GSI
Class I	Very Good	>80
Class II	Good	60<GSI<80
Class III	Fair	40<GSI<60
Class IV	Poor	20<GSI<40
Class V	Very Poor	<20

Table 5-49, below, presents a summary of the GSI values for each rock unit. Most of the bedrock at the DNNP site is considered good to very good rock.

Table 5-49: Geological Strength Index Summary Based on RMR76 Directly, by Stratigraphic Rock Unit

Stratigraphic Unit	No. of Samples	Lower Bound GSI	Upper Bound GSI	Mean GSI	Std Dev(1)
Unit 6a – Blue Mountain Formation	24	45	96	70	10
Unit 6b – Lindsay Formation	542	55	93	80	6

Notes:

1) Std Dev = Standard Deviation; Mean values are arithmetic.

The GSI was also assessed using the following equation from Hoek et al., 2013[14]:

$$GSI = 2xJcon_{76} + RQD/2$$

where:
$Jcon_{76}$ is the Joint Condition rating from the RMR 1976
RQD is the Rock Quality Designation

The results, which are presented below in Table 5-50, are somewhat similar to the results in Table 5-51 with the average values typically lower for the GSI values determined directly from RMR_{76}.

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[14] Hoek, E.; Carter, T.G.; Diederichs, M.S. Quantification of the Geological Strength Index Chart. In Proceedings of the 47th US Rock Mechanics/Geomechanics Symposium ARMA, San Francisco, CA, USA, 23-26 June 2013; pp.13-672

Table 5-50: Geological Strength Index Summary Based on Jcon and RQD, by Stratigraphic Rock Unit

Stratigraphic Unit	No. of Samples	Lower Bound GSI	Upper Bound GSI	Mean GSI (1)	Std Dev(1)
Unit 6a – Blue Mountain Formation	24	32	100	79	15
Unit 6b – Lindsay Formation	542	49	100	93	8

Notes:
1) Std Dev = Standard Deviation; Mean values are arithmetic.

Rock Mass Strength and Rock Mass Elastic Modulus

The Hoek-Brown mb, s and a parameters were calculated using the RSData (Rocscience, 2021) [15] software using the triaxial and unconfined compressive strength test results from the Phase 2 investigation. Curve fitting of the laboratory data was completed using selected triaxial samples and the unconfined compressive strengths. Some of the outliers were removed from the data set used for curve fitting to derive the Hoek-Brown parameters in order to obtain reasonable results.

The intact rock strength and elastic modulus values can be adjusted to rock mass values using the Geological Strength Index (GSI) values shown in Table 5-51 and the following equations (Hoek, Carranza-Torres and Corkum, 2002) [16]:

Rock Mass Uniaxial Compressive Strength:

$$\sigma_c = \sigma_{ci} \cdot s^a$$

Where:

$$s = exp\left(\frac{GSI - 100}{9 - 3D}\right)$$

and

$$a = \frac{1}{2} + \frac{1}{6}\left(e^{-GSI/15} - e^{-20/3}\right)$$

D is a disturbance factor ranging from 0 for TBM tunnels to 1.0 for very poor blasting. Note the disturbed zone around the excavation should be modelled separately using the appropriate disturbance factor.

Rock Mass Tensile Strength:

$$\sigma_t = \frac{s\sigma_{ci}}{m_b}$$

Where:

$$m_b = m_i \cdot exp\left(\frac{GSI - 100}{28 - 14D}\right)$$

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[15] RSData Manual (2021). Manual for the RSData program – version 1, prepared by Rocscience Inc.

[16] Hoek, E., Carranza-Torres, C. and Corkum, B. 2002. Hoek-Brown Failure Criterion – 2002 Edition. 5th North American Rock Mechanics Symposium and 17th Tunneling Association of Canada Conference: NARMS-TAC, 2002, pp. 267-271.

Rock Mass Modulus (after Hoek and Diederichs, 2005):

$$E_{rm} = E_i\left(0.02 + \frac{1 - D/2}{1 + e^{((60+15D-GSI)/11)}}\right)$$

The rock mass strength and rock mass modulus design values for each GSI rock class are summarized below in Table 5-51. The rock mass modulus used for design should depend on the scale of the application (i.e. the rock mass modulus values will very from the intact values to the rock mass modulus values derived from GSI which is more suitable for large-scale applications). Engineering judgement should be used when selecting a suitable rock mass modulus for design. The mean value minus one standard deviation has been used as a lower bound for the intact UCS and modulus. The results are summarized Table 5-51.

Table 5-51: Rock Mass Properties Summary by Stratigraphic Rock Unit

Stratigraphic Unit	Intact Rock Properties				Rock Mass Properties							
	Mean Intact Strength (MPa)	Mean Intact Modulus (GPa)	σ_{ci} (1) (MPa)	m_i	Geological Strength Index (GSI) Range	Mean GSI	mb	s	a	Rock Mass Strength from GSI (MPa)	Rock Mass Modulus from GSI (GPa)	Rock Mass Modulus from Rock Dilatometer Tests (GPa)
Unit 6a – Blue Mountain Formation	128	31.5	123.4	-	45-96	70	-	-	-	-	-	-
Unit 6b – Lindsay Formation	84	34.6	84.7	10.8	55-93	80	5.287	0.108	0.501	27.8	30.5	13.99

Note:

1) σ_{ci} is the unconfined compressive strength intercept for the generalized Hoek Brown failure envelope.

5.6.3.5 In Situ Stresses

The in situ horizontal stresses were measured in five (5) boreholes as part of the Phase 2 geotechnical investigation for the purposes of characterizing the stress regime within the test site. With the exception of BH23 which is located onshore (in the vicinity of the proposed intake structure), the rest of the boreholes are located offshore. Boreholes BH202 and BH205 are located in the vicinity of the proposed intake tunnel alignment, whereas boreholes BH304 and BH307 are located in the vicinity of the proposed discharge tunnel alignment.

Test area in the vicinity of proposed intake structure and tunnel (boreholes BH23, BH202 and BH205)

- With the exception of the tests at the relatively stiffer zone in borehole BH205 (elevation 37.76 m), the maximum horizontal stresses (P) and minimum horizontal stresses (Q) are fairly uniform with depth with P values ranging from 9.20 to 14.21 MPa and Q values ranging from 4.42 to 11.47 MPa.
- The biaxial modulus (E) values range from 39.88 to 57.27 GPa, which are within the natural variations of the rock. The relatively higher modulus value at elevation 37.76 m as discussed above, results in localized higher P and Q values (P = 22.40 MPa and Q = 14.31 MPa)
- The orientations of the maximum stresses (P) vary between the first and second quadrant and the ratio of the maximum and minimum stresses (P/Q) ranges from 1.23 to 2.28 with an average value of 1.53.
- Figure G-11 shows a combined plot of all the measured maximum horizontal stresses (P) and minimum horizontal stresses (Q) with elevation for the test area in the vicinity of the proposed intake tunnel.
- Figure G-12 shows a combined plot of all the measured biaxial modulus with elevation for the test area in the vicinity of the proposed intake tunnel.

Test area in the vicinity of proposed discharge tunnel (boreholes BH304 and BH307)

- The maximum horizontal stresses (P) and the minimum horizontal stresses (Q) are fairly uniform with depth with P values ranging from 10.66 to 19.07 MPa and Q values ranging from 5.29 to 11.78 MPa.
- The biaxial modulus (E) values range from 40.74 to 50.32 GPa which are within the natural variations of the rock.
- The orientations of the maximum stresses (P) are generally within the first quadrant and the ratio of the maximum and minimum stresses (P/Q) ranges from 1.62 to 2.65 with and average value of 1.87.
- Figure G-13 shows a combined plot of all the measured maximum horizontal stresses (P) and minimum horizontal stresses (Q) with elevation for the test area in the vicinity of the proposed discharge tunnel.
- Figure G-14 shows a combined plot of all the measured biaxial modulus with elevation for the test area in the vicinity of the proposed discharge tunnel.

A summary of the in situ stress measurements is presented below in Table 5-52.

Table 5-52: Summary of In Situ Stress Measurement Test Results

Depth (mbgs)	No. of Tests	P			Q			E			Azimuth of P (2)		
		(MPa)			(MPa)			(GPa)			(°)		
Elev. (m)		Min	Max	Mean(1)	Min	Max	Mean(1)	Min	Max	Mean(1)	Min	Max	Mean(1)
28.70 − 53.50	21	9.20	22.41	13.18	4.42	14.31	8.23	32.36	52.27	45.17	7.10	167.5	83.8
50.70 − 31.50													

Note:
1) Mean values are arithmetic.
2) Azimuth of P and Q are referenced to magnetic north, a declination of 10.7° W must be added to convert to true north.

For the sake of comparison, the in situ horizontal stresses (P and Q) and biaxial modulus (E) values measured at the site of the intake tunnel located in the existing Darlington Nuclear Power Station (Lo and Lukajic,1984)[17] are summarized below:

- Between 80 m and 40 m in elevation in the Lindsay Formation, the maximum horizontal stresses (P) range from 10 MPa to 14 MPa whereas the minimum horizontal stresses (Q) range from 5 MPa to 8 MPa.
- Below 40 m in elevation (from 40 m to -100 m), the in situ stresses are fairly uniform with an average P value of 14 MPa and an average Q value of 8 MPa.
- Between 85 and 20 m in elevation, the biaxial modulus (E) values range from 32 GPa to 63 GPa.

It may be noted that the in situ horizontal stresses and biaxial modulus values obtained from the current overcoring test program carried out at the site are consistent with the set of historical stress data obtained in the same rock formation at comparable depths at the site of the existing Darlington Power Station.

A comparison of the test data from the Phase 1 and Phase 2 stress measurement programs at the Darlington New Nuclear project site are as follows:

<u>Phase 1 stress measurements (test elevations: 57.98 m to 25.78 m)</u>

Maximum horizontal stress (P): 8.03 MPa to 23.36 MPa

Minimum horizontal stress (Q): 5.02 MPa to 12.30 MPa

Biaxial modulus (E): 34.95 GPa to 58.75 GPa

<u>Phase 2 stress measurements (test elevations: 49.91 m to 31.5 m)</u>

Maximum horizontal stress (P): 9.20 MPa to 22.41 MPa

Minimum horizontal stress (Q): 4.42 MPa to 11.78 MPa

Biaxial modulus (E): 39.88 GPa to 57.27 GPa

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[17] Lo, K.Y., Lukajic, B., 1984. Predicted and Measured Stresses and Displacements Around the Darlington Intake Tunnel. Can. Geotech. J. 21, 147-165.

It may be noted that the test data from the Phase 1 and 2 stress measurements are consistent in terms of the horizontal stresses (P and Q) and the biaxial modulus (E) values.

For design purposes, the in situ stress values presented below in Table 5-53 are recommended for the bedrock. The in situ stress in the rock is defined by the constant locked-in stress at the bedrock surface plus the stress gradient value calculated based on the depth from ground surface (i.e., σ_h = *Locked-in Constant* + 2 x σ_v , where σ_v is the vertical lithostatic stress). The locked-in horizontal stress at the bedrock surface was set to a value near the lower end of the range of measured values.

Table 5-53: Summary of Recommended Design In Situ Stress Values

Vertical Stress	Locked-in Near Surface Major Horizontal Stress (P)$^{(1)}$	Locked-in Near Surface Minor Horizontal Stress (Q)$^{(1)}$	Horizontal to Vertical Ratio
Lithostatic	8.5 MPa	6.5 MPa	2

Note:

1) Locked in stress is was determined at assumed bedrock elevation of 62 masl.

5.6.3.6 Rock Swelling Pressures

The results of the swell testing on the Blue Mountain Formation shale are presented in Appendix D and are summarized above in Section 5.5.6.

The swelling characteristics of the Blue Mountain shale, as determined from the laboratory swell tests, will need to be taken into consideration in the design of the underground structures located within this rock formation including any concrete structures and any tunnel linings that are in contact with the shale bedrock. For any structures which are directly in contact with the rock, the time dependent deformation (swelling) of the rock will cause pressure to build up with time at the rock structure interface. The magnitude of the pressure will depend on the rigidity of the structure, the timing of the construction, the swelling characteristics of the rock and the initial in situ stresses in the rock formation and will vary over the design life of the structure. The design of the final structures will need to be based on a rock/structure interaction analysis over the design life of the structure, taking into consideration the structure type (thickness, stiffness etc.) and the rock characteristics (swell rates). Depending on the results, it may be necessary to incorporate a compressible material between the structure and the rock. The structures should be checked for all loading cases including cases with the maximum swelling in one direction and the minimum swelling in the orthogonal direction.

The interpreted swell test results are shown below on Figure 5-14 and Figure 5-15 for vertical and horizontal samples, respectively. In generating these plots, the applied pressure for the free swell tests was taken as 0.001MPa. the swelling potentials and the applied pressures typically approximate a linear relationship in a semi-log plot. The results indicate that the shale samples for Phase 2 did not show any measurable swelling potential under the free swell, semi-confined and null test conditions except for one semi-confined test in the vertical direction and two null tests which showed some swelling potential in the horizontal direction. The results for the Blue Mountain Shale (Unit 6a) do not show the linear relationship on the semi-log plot that is typical for other Southern Ontario shales; however, if the free swell results are ignored, and only the semi-confined and null swell test results from Phase 1 and 2 which showed minor swelling potential are considered - a linear relationship on the semi-log plot can be assumed for design as shown below as a dashed line on the plots. It should be noted the calcite content, which tends to inhibit the swelling potential of the shale, is considered very high for some test samples (i.e., 38.3% to 43.8% for BH203 and 44.7% for BH308) and this could in part explain the atypical results.

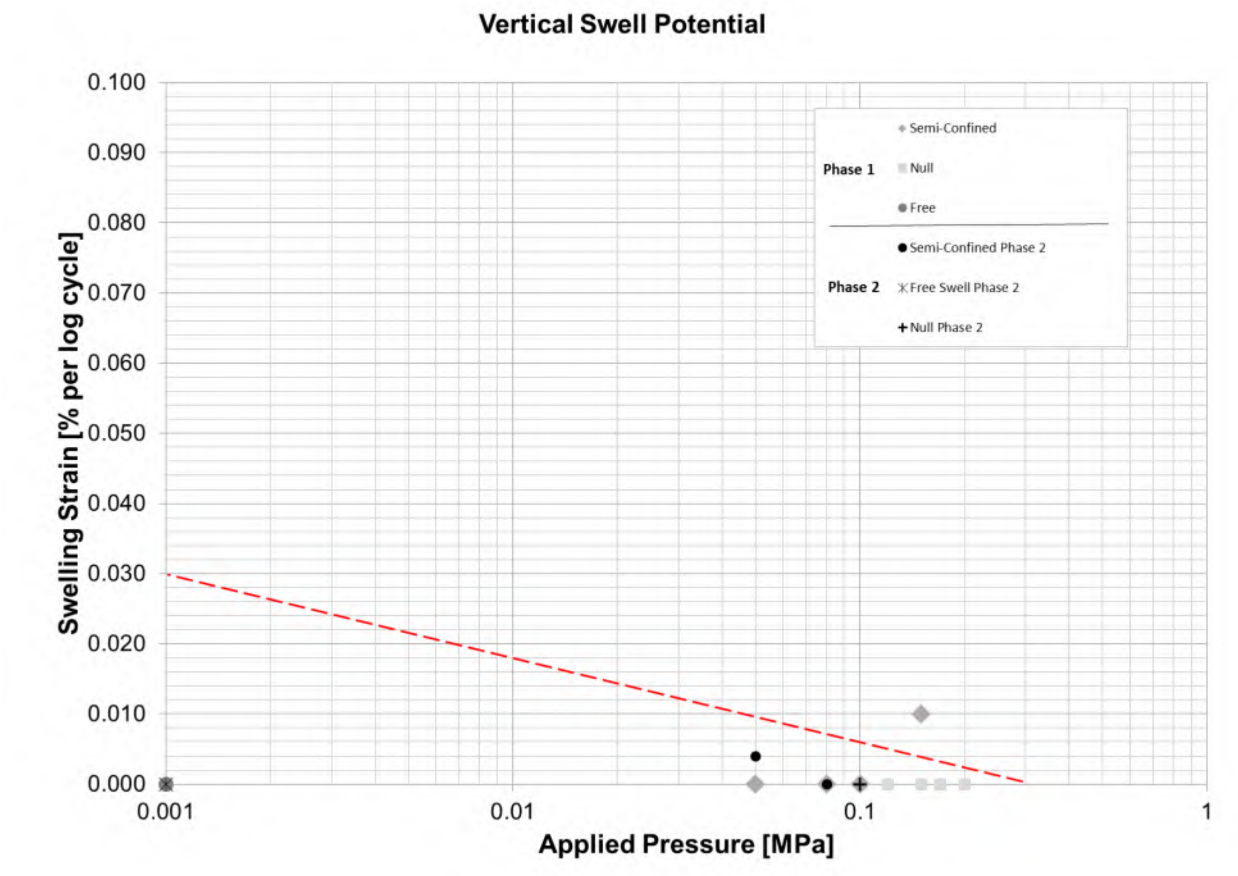

Figure 5-14: Vertical Swell Testing Results for Blue Mountain Shale (Unit 6a)

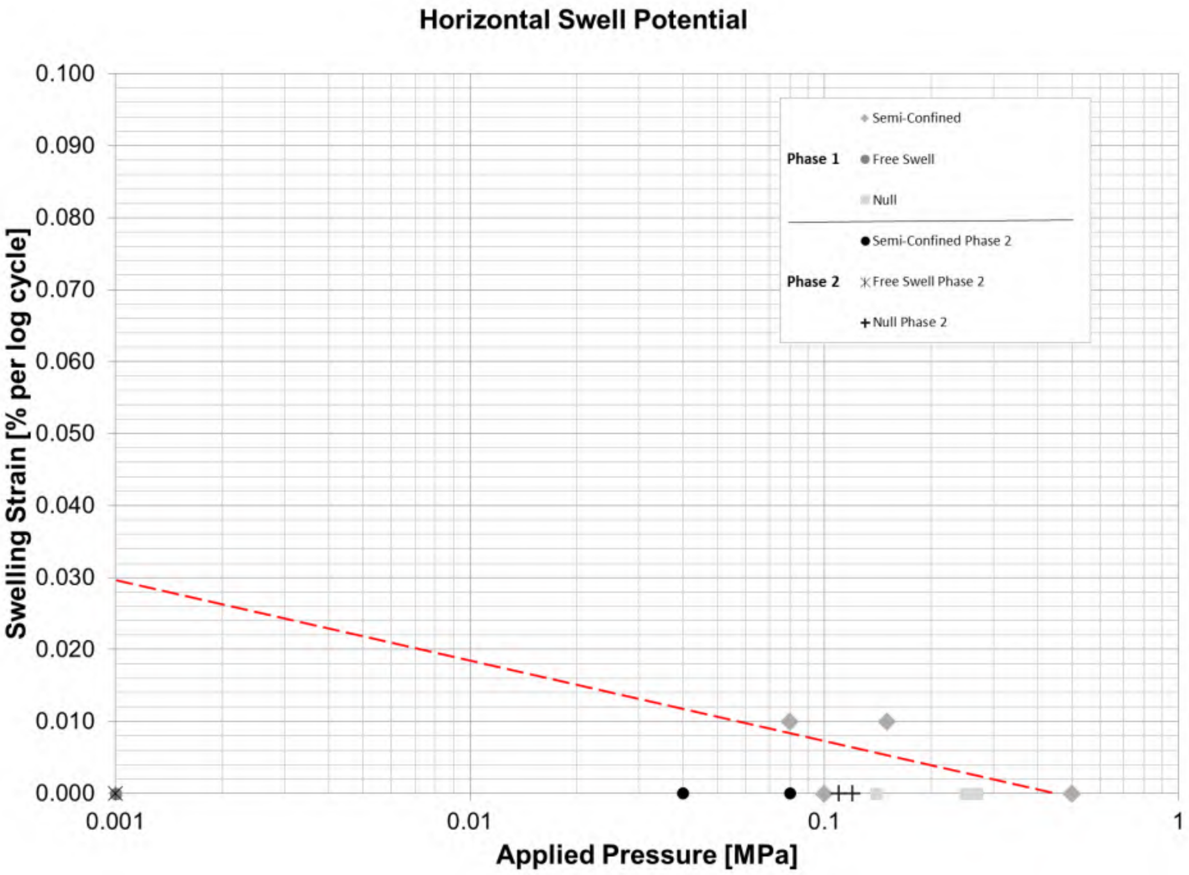

Figure 5-15: Horizontal Swell Testing Results for Blue Mountain Shale (Unit 6a)

5.6.3.7 Dynamic Behaviour

The results of the dynamic parameters in bedrock from geophysical testing are summarized below in Tables 5-60 to 5-64, which are based on the full waveform sonic probe measurements and the average bulk density measurements of each formation, as summarized above. The velocities remain consistent throughout the rock. The velocities are seen in Figure 5-16 and Figure 5-17.

The uncertainty reported in the seismic velocities measured with the FWS probe is considered to be ±5% of the reported velocity values presented in the tables below. The average Poisson’s ratio, dynamic shear modulus, dynamic Young’s modulus, and dynamic bulk modulus were calculated for each bedrock formation in each of the 5 boreholes. The minimum, maximum, and mean values displayed in Tables 5-54 to Table 5-58 are the average of those values.

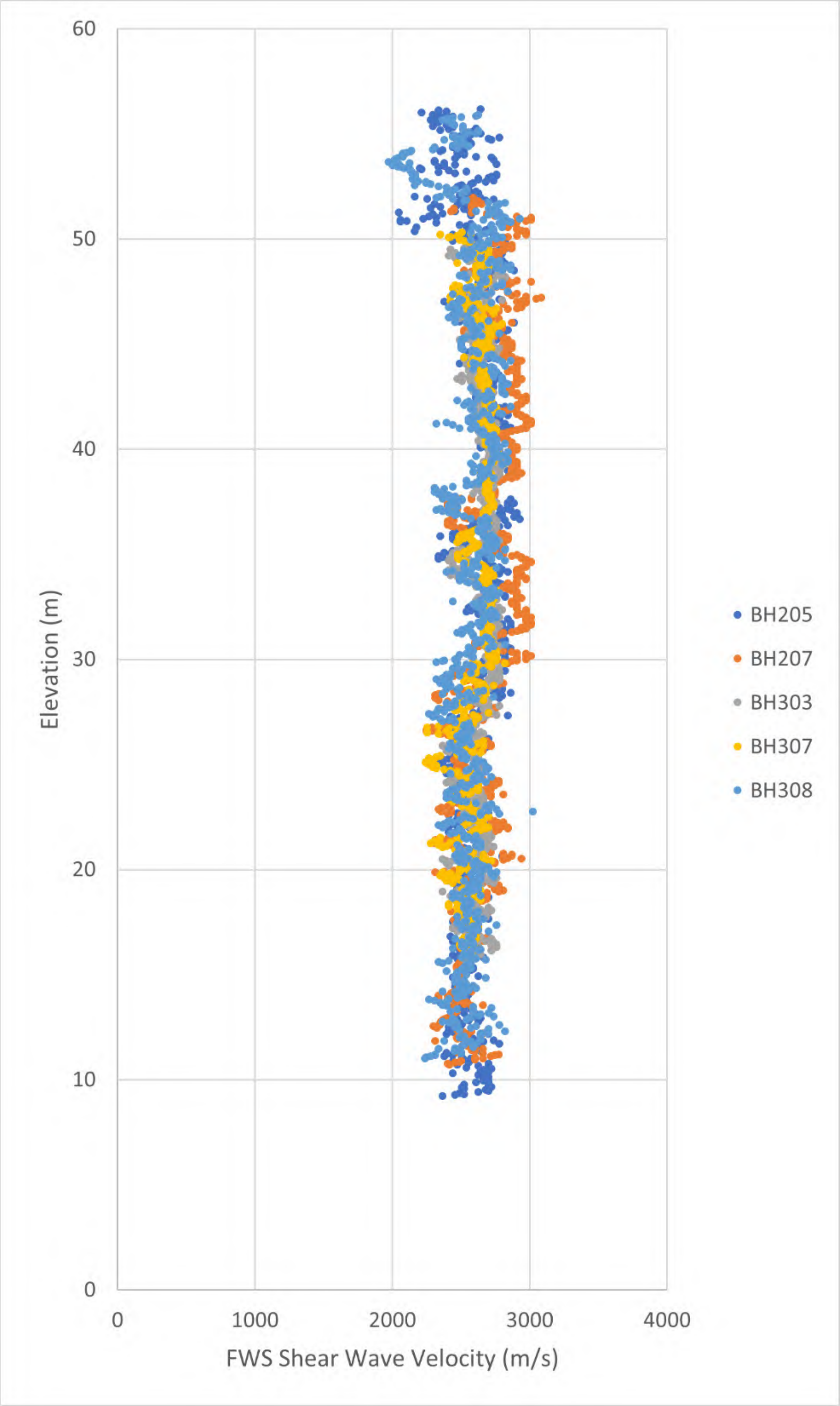

Figure 5-16: Shear Wave Velocity Measured with FWS

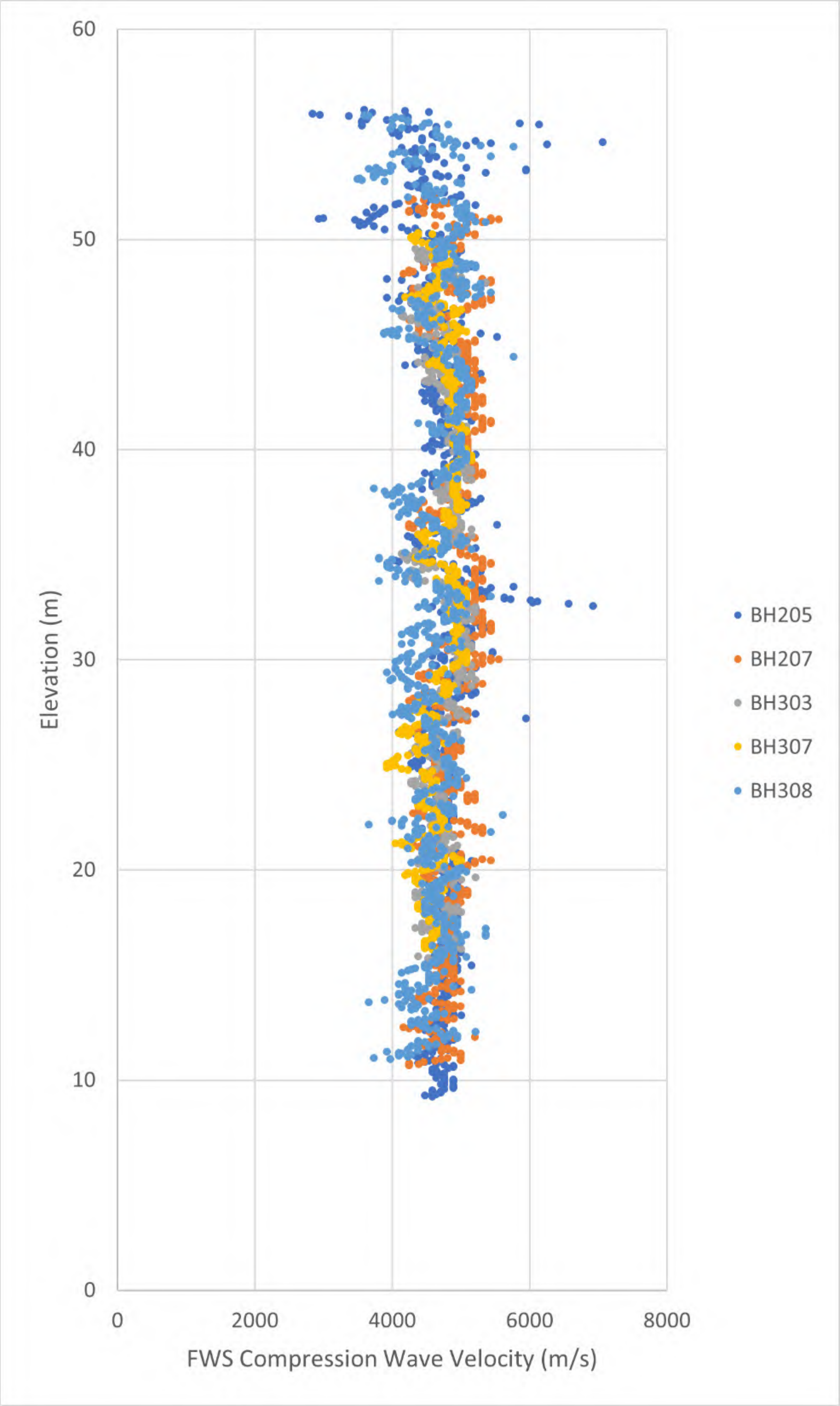

Figure 5-17: Compression Wave Velocity Measured with FWS

Table 5-54: Summary of Poisson's Ratio from Geophysical Testing by Stratigraphic Rock Unit

Stratigraphic Unit	Shear Wave Velocity (m/s)					Compression Wave Velocity (m/s)				
	Min	Max	Mean	Std Dev	Sample Size	Min	Max	Mean	Std Dev	Sample Size
Unit 6a – Blue Mountain Formation	2,369	2,628	2,496	82	14	3,594	4,823	4,251	347	14
Unit 6b – Lindsay Formation	2,564	2,694	2,623	43	5	4,628	4,878	4,739	91	5

Table 5-55: Summary of Poisson's Ratio from Geophysical Testing by Stratigraphic Rock Unit

Stratigraphic Unit	Poisson's Ratio				
	Min	Max	Mean	Std Dev	Sample Size
Unit 6a – Blue Mountain Formation	0.16	0.33	0.24	0.04	14
Unit 6b – Lindsay Formation	0.17	0.38	0.28	0.03	5

Table 5-56: Summary of Dynamic Shear Modulus from Geophysical Testing by Stratigraphic Rock Unit

Stratigraphic Unit	Dynamic Shear Modulus (MPa)				
	Minimum	Maximum	Mean	Std Dev	Sample Size
Unit 6a – Blue Mountain Formation	14,821	18,234	16,453	972	14
Unit 6b – Lindsay Formation	17,625	19,458	18,448	677	5

Table 5-57: Summary of Dynamic Young's Modulus from Geophysical Testing by Stratigraphic Rock Unit

Stratigraphic Unit	Dynamic Young's Modulus (MPa)				
	Minimum	Maximum	Mean	Std Dev	Sample Size
Unit 6a – Blue Mountain Formation	33,772	46,136	40,704	2,690	14
Unit 6b – Lindsay Formation	45,070	49,834	47,195	1,751	5

Table 5-58: Summary of Dynamic Bulk Modulus from Geophysical Testing by Stratigraphic Rock Unit

Stratigraphic Unit	Dynamic Bulk Modulus (MPa)				
	Minimum	Maximum	Mean	Std Dev	Sample Size
Unit 6a – Blue Mountain Formation	19,317	40,463	25,788	5,984	14
Unit 6b – Lindsay Formation	33,922	37,850	35,621	1,444	5

5.6.3.8 Petrographic Analysis

Eight (8) samples of the Lindsay Formation were analyzed for petrographic examination, the results can be found in Appendix D. The samples were characterized as Micritic Limestone, fine-grained, finely bedded/interbedded with evidence of bioturbation including shell fragments. Grain sizes from 0.02 to 0.18mm. Color is medium to dark grey/brown. The elemental composition of the samples primarily consists of Calcite, Quartz and Dolomite as shown in Table 5-59. Trace amounts of Gypsum, Siderite and Talc were found in some of the samples.

Table 5-59: Mineral Composition of the Petrographic Samples of the Lindsay Formation

Interpreted Mineral	Min (%)	Max (%)	Mean (%)
Calcite	65.7	85.4	79.7
Quartz	5.5	11.4	7.2
Dolomite	5.2	7.4	5.8
Illite/muscovite	0.5	9.7	2.9
Kaolinite	0.8	2	1.6
Orthoclase Feldspar	0.5	2.5	0.9
Chlorite	0.6	1.1	0.9
Plagioclase Feldspar	0.3	1.3	0.7

5.7 Geohazard Considerations

5.7.1 Natural Gas

Methane and hydrogen sulphide gas are known to be present in the bedrock and in the soils of Southern Ontario, typically in granular layers or rock capped by cohesive tills. Methane gas was encountered in some of the boreholes advanced at the site. Table 5-60 provides details of the gas readings detected by the multi-gas meter mounted on drill rig equipment adjacent to the collar of the borehole; these details are also presented on the borehole logs.

Table 5-60: Natural Gas Occurrences Details

Borehole	Gas Type Encountered	Approximate Elevation Range Encountered (m)	Remarks
BH21	CO	73.8 – 65.3	Gas encountered within overburden.
BH22	Methane, VOCs, H_2S	80.1 – 14.8	Gas encountered within overburden and bedrock. H_2S concentrations of about 3 ppm encountered within bedrock at approximate Elevation 21 m. Gas took relatively longer to dissipate to safe working levels.
BH23	Methane, CO, VOC	35.3 – 20.3	Gas encountered within bedrock. Gas impacted successfulness of overcoring test attempts.
BH24	Methane, CO, VOCs	49.0 – 17.0	Gas encountered within bedrock. At approximate Elevation 29 m gas took longer to dissipate to safe working levels. Drill fluid bubbling at surface observed between approximate Elevations 19 m and 17 m.
BH301	Methane	61.8 – 58.4	Gas encountered within bedrock.

It should be noted that gas monitoring and controls implemented during the subsurface exploration program were carried out for the health and safety of the drilling crews and specific measurements of concentration were not necessarily recorded (due to the need to remove the crews promptly from the area for safety). Further, gas readings measured above the borehole collar are not considered representative of the actual concentrations at specific elevations and soil/rock stratum at the borehole locations.

Methane forms an explosive mixture with air and is a potential hazard for excavation and construction work and it should be assumed that it will be encountered in the bedrock and soil at this site. Changes in groundwater pressure which may be caused by dewatering or seepage into excavations/underground spaces can lead to migration/release of gaseous or dissolved methane. Therefore, the absence of methane detection in a particular area should not be interpreted as an indication that there is no risk of the presence of natural gases including methane in the future or in other site areas. Tunnels and shafts should generally be considered as “potentially gassy” according to the OHSA Underground Construction (Tunnelling) Regulations (29 CFR Part 1926.800, "Tunnels and Shafts.")

5.7.2 Karst Cavities

No evidence of significant karst cavities was encountered in the onshore or offshore CCW geotechnical boreholes. Some zones of lost core were encountered in the boreholes and have been presented on the drillhole logs in Appendix A. These zones range between 3 cm to 31 cm in height, but no noticeable drop in the drilling rods was noted and therefore these are thought to be associated with zones of weaker material that had been washed out by the core drilling.

No evidence of significant karst cavities was encountered in the interpretation of the marine geophysical survey conducted at the site. There is a laterally continuous character to the bedrock stratigraphy based on the results of the marine geophysical testing and there does not appear to be any geophysical anomalies in the data that would be indicative of large karst features. It should be noted that the surveys selected for the offshore marine geophysics were not designed specifically for the interpretation for karst cavities and would not detect small cavities.

5.7.3 Weak Zones in the Bedrock

A significant number of weak (R1) zones with a field estimate of strength less than approximately 5 MPa were encountered in BH-23 between Elevation 51 m and Elevation 7.2 (i.e. end of the borehole). These zones were classified as R1 based on the ISRM Intact Rock Material Strength Classifications and were up to 43 cm thick.

5.7.4 Cobbles and Boulders

The presence of cobbles/boulders within the overburden onshore and within the lakebed sediments offshore was inferred from drilling resistance, SPT sampler refusal, spoon bouncing, drill bit chattering, auger/casing grinding observations and rock fragments recovered in split spoon samples. Cobbles and/or boulders on the lakebed were also detected as part of the offshore geophysical works (refer to the WSP Offshore Geophysics Report), as well as at the borehole and drill spud locations as observed using underwater camera and diver observations at select locations. The barge crew's utilization of underwater camera was used occasionally as part of the procedure of setting up the barge. Boulders on the lakebed surface at BH205, BH301, BH306 borehole locations were moved by divers to clear the conflict with barge spuds or borehole casing. The fact that the divers were not deployed at other borehole locations or their deployment was not deemed necessary by McKeil should not be construed that lakebed is clear of boulders/obstructions at other borehole locations.

Although not occurring in the limited number of Phase 2 onshore boreholes, it should be noted that some boreholes from the Phase 1 power block investigation needed coring to advance the boreholes through cobbles and boulders (refer to WSP Golder Phase 1 Report). In addition, some boreholes also had poor spoon recovery, and difficulty advancing the dilatometer probe, due to a large percentage of coarse gravel/cobbles/boulders and these holes were generally on the portion of the power block site closer to the tunnel alignment.

Based on our extensive experience and observations during the subsurface investigation programs at the DNNP project, cobbles and boulders should be anticipated mainly in Soil Units 3 and Unit 5 (the upper and lower till) and occasionally within the interglacial deposits (Soil Unit 4a). Cobbles/boulders should also be anticipated on the lakebed surface and within fill materials.

The presence of cobbles and boulders can significantly affect the selection of equipment and progress of construction works in shaft construction and for the diffuser pipes in the lake. Encountering cobbles and/or boulders within the till or non-cohesive deposits or at the lakebed could result in difficulties in advancing the shafts or other excavations. Further, cobbles/boulders can originate from the igneous and metamorphic rocks of the Canadian Shield, and these can have unconfined compressive strengths on the order of 250 MPa. Therefore, suitable equipment will be required to remove/penetrate through any cobbles/boulders encountered, as may be necessary. It is noted that the borehole drilling method used in this Phase 2 investigation, without coring of cobbles (and/or boulders), and the random distribution of these materials, permit neither measurement of the size of the cobbles (and/or boulders), nor an estimate of the quantity (overall volume) and frequency of these materials.

Given the nominal 35 mm inside diameter of the split-spoon sampler and 63 mm in Boreholes BH24 and BH26, which are smaller than the upper limit of gravel size of about 75 mm, the actual gravel percentages that are expected to be encountered at this site are greater than the values measured during the laboratory testing and presented in this report.

5.7.5 Seismicity

Eastern Canada lacks evidence for major historical earthquakes because it is located within the stable continental region (SCR) of the North American tectonic plate. Nevertheless, a number of seismic source regions have been defined from the historical and instrumental record of earthquake epicentres and magnitudes. These source zones are used to define areas where earthquakes might be expected in the future, particularly when undertaking probabilistic seismic hazard analysis (PSHA) for the development of national seismic hazard maps and site-specific earthquake hazard assessments for critical structures.

The DNNP site falls within the regional Southern Great Lakes Seismic Zone (SGLSZ) as defined by the Geological Survey of Canada. The SGLSZ is one of a number of seismic zones within the SCR of the North American tectonic plate. The SGLSZ is defined over a large area that extends from Windsor to east of Kingston and into the United States to the south. The SGLSZ is characterized by relatively low to moderate rates of instrumental seismicity, with only 2 to 3 magnitude (M) 2.5 or larger earthquakes recorded in the last 30 years. Historical records for earthquakes with epicentres located within the SGLSZ includes three moderate (i.e., about M 5) events: 1929 in Attica, New York, 1986 near Cleveland, Ohio, and 1998 near the Pennsylvania/Ohio border.

Wallach et. al. (1998)[18] identified three linear zones of earthquakes in this part of southeast Canada and within the wider SGLSZ. These zones are based on underlying geophysical anomalies with the basement rocks of this part of the North American plate. Mohajer (1993)[19] also argued for a linear seismic zone and Jacobi and Fountain (1993)[20] identified a basement fault system as potential earthquake sources in the region surrounding the Darlington site. These sources are the Niagara-Pickering linear zone, the Georgian Bay linear zone, the Hamilton-Lake Erie lineament, the Hamilton-Presqu'ile Fault, and the Clarendon-Linden Fault System.

The Niagara-Pickering linear zone trends north-northeasterly, extending from Balsam Lake to the north and Pickering to the west of the Darlington site. Wallach et. al. (1998) defines the Niagara-Pickering linear zone by north-northeast trending topographical lineaments, linear magnetic anomalies, mesoscopic-scale faults, and some macroscopic-scale faults.

Wallach et. al (1998) identifies the Georgian Bay linear zone from Bouguer gravity anomalies and normal faults observed in the rocks within the Rouge River valley. The Georgian Bay zone has a north-northwest trending lineament, crossing just north of Lake Ontario to the west of Pickering and north into Georgian Bay.

Wallach et al. (1998) argues for the existence of the Hamilton-Lake Erie lineament based on mapping a range of mapped small-scale faults. The lineament has a north-northeasterly trend that is subparallel and west of the Niagara-Pickering linear zone. These two zones diverge south of Lake Ontario.

Mohajer (1993) identified the Hamilton-Presqu'ile Fault as another potential earthquake source within the SGLSZ. The Hamilton-Presqu'ile Fault is sub-parallel to the long axis of Lake Ontario. Mohajer (1993) cites a 40 m offset of Paleozoic-age strata as evidence of the fault. He argues that several microearthquakes could have been located on or close to the Hamilton-Presqu'ile Fault at the western end of Lake Ontario.

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[18] Wallach, J.L., Mohajer, A.A., and Thomas, R.L. 1998. *Linear zones, seismicity, and the possibility of a major earthquake in the intraplate western Lake Ontario area of eastern North America.* Canadian Journal of Earth Sciences 35: 762-786.

[19] Mohajer, A.A. 1993. *Seismicity and Seismotectonics of the Western Lake Ontario Region*. Géographie physique et Quaternaire 47 (3): 353-362.

[20] Jacobi, R. and Fountain, J. 1993. *The Southern Extension and Reactivations of the Clarendon-Linden Fault System*. Géographie physique et Quaternaire 47 (3): 285-302.

To the south of the SGLSZ, Jacobi and Fountain (1993) have argued that the Clarendon-Linden Fault System could be a potential source of future large earthquakes. The Clarendon-Linden Fault System strikes north-northeast and crosses Lake Ontario to the east of the Darlington site from Clarendon, New York to Prince Edward County, Ontario. Jacobi and Fountain (1993) consider that stress release on the Clarendon-Linden Fault System as the likely source of instrumentally recorded earthquakes with body-wave (m_b)magnitudes ranging from m_b 2.8 to m_b 4.8 between 1955 and 1971, and the 1928 m_b 5.2 Attica earthquake.

5.7.5.1 Paleoseismicity

The definition of the source zones described above is based on alignments of geophysical anomalies, limited numbers of instrumental and historical earthquakes, and structural geological observations in near surface rocks. At present, there is no known evidence of larger, pre-historic earthquakes that have resulted in surface fault rupture because such earthquakes have not occurred, or the evidence for surface rupture or coseismic damage is not preserved, or the studies needed to identify past large earthquakes is insufficient to recognize these events. Given the relatively stable geological setting of the region surrounding the Darlington site, the recency of the post-glacial landscape that might preserve past large earthquake effects, it is expected that evidence for large earthquakes, if they have occurred, would be difficult to identify.

WSP Golder's review of available paleoseismic information confirms the lack of historical evidence for surface rupture within the Darlington site, including and absence of faults within the boreholes as logged during the current investigation.

5.7.5.2 Seismic Site Class Determination

It is understood that the seismic design of the structures will be carried out per nuclear standards (e.g., CSA N289). The average shear wave velocities for the upper 30 m of soil and bedrock beneath the structure foundations (i.e., Vs_{30}) and corresponding design Site Class are summarized below in Table 7-2.

Table 5-61: Summary Average Shear Wave Velocities for the Upper 30 m Beneath Foundations for Structures

Structure	Vs_{30} (m/s)
Intake Shaft	2625
Outfall Shaft	2611
Forebay Structure	2493
Discharge Structure	1052

We would note that the Vs_{30} values presented above are based on the materials extending beneath the founding elevations of the indicated facilities as currently understood. The ultimate designer should carefully evaluate and apply the values as applicable to the actual embedment depths as the design progresses.

The site classification for seismic site response for structures being designed under the 2020 National Building Code of Canada (NBCC) can be determined based on Section 4.4.8.1 of the Code and the results of the geotechnical investigation, including shear wave velocity measurements from geophysical testing. For preliminary design, structures founded at or below about Elevation 79 masl may be designed using a Site Class C designation. Structures founded on or within 3 m of the underlying bedrock may be designed using a Site Class A designation. These should be confirmed for detailed design of any such structures. These seismic Site Class designations also assume that structures founded on or within 3 m of bedrock will be seismically isolated from any adjacent structures founded on overburden.

5.8 Shaft and Tunnelling Considerations

5.8.1 Open Cut Excavations

All temporary excavations onshore should be carried out in accordance with current Ontario Occupational Health and Safety Act and Regulations for Construction Projects (OHSA). Soil types encountered in the boreholes can be classified according to the OHSA soil types summarized in Table 5-62.

Table 5-62: Open Cut Excavation Side Slopes

Soil Unit	Fully Dewatered Excavations	Wet or Partially Unwatered Excavations	Excavation Side Slope to Comply with OSHA
Unit 1	Type 3	Type 4	Type 2 soils should be sloped at angles not steeper than 1H:1V (Horizontal:Vertical) with the bottom 1.2 m of the excavation depth permitted to be cut vertical. Type 3 soils should be sloped at angles not steeper than 1H:1V. Type 4 soils should be sloped at angles no steeper than 3H:1V.
Unit 2a and Unit 4b	Type 3	Type 3	
Unit 2b	Type 3	Type 4	
Unit 3 and Unit 5	Type 2	Type 3	
Unit 4a	Type 3	Type 4	

Where the face of the slope consists of variable soil types, the lower soil type should govern the required slope. However, depending upon the construction procedures adopted by the contractor, actual groundwater seepage conditions, the success of the contractor's groundwater control methods and weather conditions at the time of construction, some flattening and/or blanketing of the slopes may be required.

Care should be taken to direct surface runoff away from the open excavations and all excavations. Any boulders or large cobbles should be removed from the side slopes for worker safety.

To maintain temporary excavation stability, excavated materials should be placed away from the edge of the excavation a distance equal to the depth of the excavation or greater. In addition, stockpiling of the material should be prohibited adjacent to the excavation to minimize surcharge loading near the excavation crest. Where sufficient space is not available to stockpile the excavated material at the site, off-site disposal of the excavated material intended for reuse would need to be arranged.

Any existing utilities or structures which are located in the zone of influence of excavations will require adequate support to limit unacceptable movements or deformations. The zone of excavation influence is defined by a line drawn from the base of the excavation upward at an inclination of 1V:1H. If sufficient space is not available to develop the excavations or if such excavations would encroach into the zone of influence of other adjacent structures, properly designed temporary support systems should be used to limit the extent of the excavations and reduce potential effects on adjacent structures services.

Depending on the construction methodology, a temporary support system may be required. Temporary protection systems should be designed and installed by a specialist contractor to resist lateral earth pressures of the soils, lateral pressures from any surcharges in proximity to the excavation including construction equipment, and groundwater pressures. It is common practice for a specialist contractor to design and install the excavation support system. If shoring is implemented at the site, the requirements of Ontario Provincial Standard Specification (OPSS) PROV 539 should be followed as discussed below.

5.8.2 Onshore Shafts

The excavation for the tunnel boring machine (TBM) launching shafts onshore for the intake and discharge/outfall tunnels will extend through overburden into bedrock of the Blue Mountain Formation and Lindsay Formation and will require the use of temporary protection systems. Depending on the selected method of shaft construction, dewatering will be required at the shaft locations. Dewatering requirements can be minimized if watertight shaft construction is used.

The temporary protection system should be designed and constructed in accordance with OPSS.PROV 539 (*Temporary Protection Systems*). The selection and design of the temporary protection system will be the responsibility of the contractor.

The system must be designed to accommodate the loads applied from earth pressures, water pressures and surcharge pressures from area, line or point loads, as well as the effects of sloping ground behind the system. The loading from construction equipment as well as any material stockpiles within a distance defined by a 1 horizontal to 1 vertical line drawn from the bottom of the excavation to the existing ground surface should be included as a surcharge in the design of the temporary protection system.

The portion of the shafts excavated in the shale bedrock should be designed to accommodate the swelling pressures as discussed for the tunnel below in Section 5.8.4.

Shaft excavations in the bedrock should consider temporary rock support measures such as rock bolts and mesh or shotcrete to prevent blocks or wedges of rock from ravelling and falling from the walls. Ice formation in the winter months must also be considered since blocks of ice can fall from the shaft walls if not properly managed.

5.8.3 Offshore Intake Shaft

Based on the intake tunnel alignment shown on Figure 2B, the offshore intake shaft location is expected to be located at approximately Station 1+150 m, about 350 from the shore. Considering the information from Borehole BH207, which is located close to the intake shaft, the lakebed thickness at the borehole was 3 cm consisting of hard sandy silty clay. Borehole BH207 encountered shale bedrock of the Blue Mountain Formation between Elevations 62.06 m and 60.68 m which can be described as slightly weathered to fresh, very thinly to thinly bedded, dark brownish grey medium strong with very thin to thin limestone interbeds.

The rock quality designation (RQD) ranges from 73% to 93%, indicating a rock mass of fair to excellent quality. Below the Blue Mountain Shale, between Elevations 60.68 m and 7.47 m (end of drillhole), the Lindsay Formation was encountered which can be described as slightly weathered to fresh, very thinly to very thickly bedded, strong to very strong limestone with shale interbeds. The rock quality designation (RQD) ranges from 30% to 100% with lower RQD values ranging from 30% to 56% recorded in only two runs drilled through the upper part of the borehole, while the remainder of the RQD in the borehole generally ranges from 90% to 100% indicating the rock of an excellent quality.

The portion of the shafts excavated in the shale bedrock should be designed to accommodate the swelling pressures as discussed for the onshore shafts and the tunnels. It is assumed that the intake shaft would be lined as the excavation progresses.

5.8.4 Offshore Diffuser Risers

It is our understanding that the proposed diffuser riser locations will be distributed approximately along the last 300 m of the outfall tunnel, between Stations 0+810 m and 1+120 m. Based on the information obtained from five boreholes (BH305, BH306, BH307, BH308 and BH309) drilled in the vicinity of the proposed diffuser locations, the lakebed sediment thickness ranges between 2.4 m and 6.9 m and would be encountered between Elevations 68.87 m and 57.57 m. The sediments are generally underlain by limestone of the Lindsay Formation, except for the Boreholes BH308 and BH309 in which Blue Mountain Shale Formation was encountered between Elevations 59.38 m and 55.34 m. Shale can be described as slightly weathered to fresh, thin to medium bedded, brownish grey, medium strong with thin limestone interbeds. Rock Quality Designation (RQD) in the shale ranges 73% to 97% indicating a rock of fair to excellent quality.

Lindsay Formation was encountered between Elevations 62.17 m and 8.89 m and generally consists of slightly weathered to fresh, very thinly to very thickly bedded, grey, medium strong to very strong limestone with dark grey laminated shale interbeds. The rock quality designation (RQD) ranges from 69% to 100% indicating the rock of fair to excellent quality. Lower RQD values indicating rock of a very poor to poor quality with RQD ranging from 8% to 45% were recorded locally in two runs drilled through the upper parts of the Borehole BH307. It should be recognized and expected that rock conditions may vary between and beyond borehole locations.

The portion of the diffuser risers excavated in the shale bedrock should be designed to accommodate the swelling pressures as discussed for the other shafts and the tunnels. The risers should be lined as the excavation progresses.

5.8.5 Tunneling Considerations

Tunnels in the bedrock should have sufficient rock support near the cutterhead to prevent rockfalls from the crown which may occur due to the high horizontal stresses and the presence of near horizontal bedding planes above the tunnel crown.

Although the tunnel will be excavated in the Lindsay Formation, the swelling characteristics of any significant shale layers, estimated from laboratory swell tests (refer to Section 5), will need to be taken into consideration for the design of underground structures located within the shale layers. For any permanent structures, such as the tunnel lining, diffuser pipes or the intake structure that may be in direct contact with the shale layers in the bedrock, the swelling of the shale will cause pressure to build up with time along the rock/structure interface. The magnitude of the pressure will depend on the rigidity of the structure, the time of construction after excavation of the rock, the (asymmetrical) swelling characteristics of the rock and the initial in-situ stresses in the rock formation. The swelling potential could vary along the extent of the tunnel due to natural variations of the rock such as the salinity of the rock pore fluid and the calcite content, the in-situ stresses and the groundwater conditions.

Assuming a sufficient delay between excavation and lining installation is not possible, the final lining system may need to be designed for the relevant loads imparted by the swelling of the shale, or a compressible material (e.g., cellular grout) would need to be incorporated into the lining design (i.e., between the rock and the lining) to further reduce the pressures on the final lining due to subsequent swelling. The design of the final lining will need to be based on a rock-structure interaction analysis considering the time and stress dependent behaviour of the rock taking into consideration the final excavation size, the lining type (liner material, thickness, stiffness, etc.) and the rock characteristics (in-situ stress, rock mass parameters, swell rates, etc.).

5.8.6 Corrosion Potential

Twenty-two selected soil samples from all boreholes (except for BH21, BH22 onshore and BH207 offshore which had little/no overburden) were submitted to AGAT Laboratories (AGAT) for basic chemical analysis related to potential sulphate attack on buried concrete elements. The concentration of sulphate provides an indication of the degree of sulphate attack that is expected for concrete in contact with soil and groundwater at the site. The sulphate results were compared with Table 3 of Canadian Standards Association Standard A23.1-19 (CSA A23.1) and generally indicate a low degree of sulphate attack potential on concrete structures at of the locations of all tested samples.

The selected soil samples were also submitted to AGAT for basic chemical analysis related to potential corrosion of buried ferrous elements. The pH, resistivity and chloride concentrations provide an indication of the degree of corrosiveness of the subsurface environment. Generally, the results indicate a high potential for corrosion of exposed ferrous metal within the study area, which should be taken into consideration in the design of substructures.

5.8.7 Inspections and Monitoring

During construction, full time inspections and in situ materials testing should be carried out by a qualified geotechnical engineer to confirm that the conditions exposed are consistent with those encountered in the boreholes and to monitor conformance to the pertinent project specifications. Materials testing should be carried out in CCIL and CSA certified laboratories, respectively.

6.0 REFERENCES

Becker DE, Crooks JHA, Been K, Jefferies MG. 1987. Work as a criterion for determining in situ and yield stresses in clays. Canadian Geotechnical Journal. 24(4):549-564.

Bieniawski, Z.T. 1976. Rock mass Classification in Rock Engineering. In Exploration for Rock Engineering, proc. of the symp., (ed. Z.T. Bieniawski) 1, 97-106. Cape Town: Balkema.

Bouwer, H. and R.C. Rice, 1976. A slug test method for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells, Water Resources Research, vol. 12, no. 3, pp. 423-428.

Bowles, J.E. 1997. Foundation Analysis and Design. Fifth ed. McGraw-Hill.

Butler, J.J., Jr., 1998. The Design, Performance, and Analysis of Slug Tests (1st ed.), Lewis Publishers, New York, 252p

Brown, E.T. (ed.) 1981. Suggested Methods for Rock Characterization Testing and Monitoring, International Society for Rock Mechanics. Oxford: Pergamon.

Chapman, L.J. and Putnam, D.F., 1984. *The Physiography of Southern Ontario*, Ontario Geological Survey. Special Volume 2, Third Edition. Accompanied by Map P.2715, Scale 1:600,000. Ontario Ministry of Natural Resources

Hoek, E., Carranza-Torres, C. and Corkum, B. 2002. Hoek-Brown Failure Criterion – 2002 Edition. 5th North American Rock Mechanics Symposium and 17th Tunneling Association of Canada Conference: NARMS-TAC, 2002, pp. 267-271.

Hoek, E.; Carter, T.G.; Diederichs, M.S. Quantification of the Geological Strength Index Chart. In Proceedings of the 47th US Rock Mechanics/Geomechanics Symposium ARMA, San Francisco, CA, USA, 23-26 June 2013; pp.13-672

Hvorslev, M. (1951). *Time Lag and Soil Permeability in Ground-Water Observations.* Corps. of Engineers, U.S Army

Jacobi, R. and Fountain, J. 1993. The Southern Extension and Reactivations of the Clarendon-Linden Fault System. Géographie physique et Quaternaire 47 (3): 285-302.

Johnston, A.C., Coppersmith, K.J., Kanter, L.R., and Cornell, C.A., 1994, The Earthquakes of Stable Continental Regions, Volume 1; Assessment of Large Earthquake Potential: Final report submitted to Electric Power Research Institute (EPRI), TR-102261-V1.

Lo, K.Y., Lukajic, B., 1984. Predicted and Measured Stresses and Displacements Around the Darlington Intake Tunnel. Can. Geotech. J. 21, 147-165

Mohajer, A.A. 1993. Seismicity and Seismotectonics of the Western Lake Ontario Region. Géographie physique et Quaternaire 47 (3): 353-362.

McNulty, E. G. 1977. Computerized Analysis of Stress-Strain Consolidation Data. Kentucky Department of Transportation.

Obert, L., and Duvall, W.I. 1967. Rock Mechanics and the Design of Structures in Rocks. New York, NY: Wiley.

Ontario Geological Survey 2011. 1:250 000 scale Bedrock Geology of Ontario; Ontario Geological Survey, Miscellaneous Release---Data 126-Revision 1.

Phoon, K.-K. and Kulhawy, F.H. (1999). Characterization of geotechnical variability. Can. Geotech. J. 36: 612-724.

RSData Manual (2021). Manual for the RSData program – Version 1, prepared by Rocscience Inc.

Wallach, J.L., Mohajer, A.A., and Thomas, R.L. 1998. Linear zones, seismicity, and the possibility of a major earthquake in the intraplate western Lake Ontario area of eastern North America. Canadian Journal of Earth Sciences 35: 762-786.

7.0 CLOSURE

At the time of preparation of the report, the details of the CCW intake and outfall tunnels and associated structures were not known in enough detail to provide specific geotechnical engineering design recommendations. As such, additional specific geotechnical engineering recommendations for the currently proposed onshore structures will be provided under separate cover. If you have any questions regarding the contents of this report or require additional information, please do not hesitate to contact this office.

Signature Page

WSP Canada Inc.

Reza Vahdani, P.Eng.
Geotechnical Engineer

Alex Champigny, P.Eng.
Rock Mechanics Engineer

LICENSED PROFESSIONAL ENGINEER
S. E. M. POOT
90471921
June 9, 2023
PROVINCE OF ONTARIO

Sarah E. M. Poot, P.Eng.
Principal Geotechnical Engineer

LICENSED PROFESSIONAL ENGINEER
Mark Telesnicki
M. J. TELESNICKI
PROVINCE OF ONTARIO

Mark Telesnicki, P.Eng.
Principal, Senior Rock Mechanics Engineer

https://golderassociates.sharepoint.com/sites/140261/project files/7 reporting/1. report/phase 2/2.geotech/4. rev1/21451329-002 rpt rev1 2023'06'09 dnnp phase 2 report.docx

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: WSP Canada Inc. (WSP) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to WSP by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. WSP cannot be responsible for use of this report, or portions thereof, unless WSP is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, WSP may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to WSP. The report, all plans, data, drawings and other documents as well as all electronic media prepared by WSP are considered its professional work product and shall remain the copyright property of WSP, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of WSP. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to WSP by the Client, communications between WSP and the Client, and to any other reports prepared by WSP for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. WSP can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Ground Water Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, WSP does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that WSP interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: WSP will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

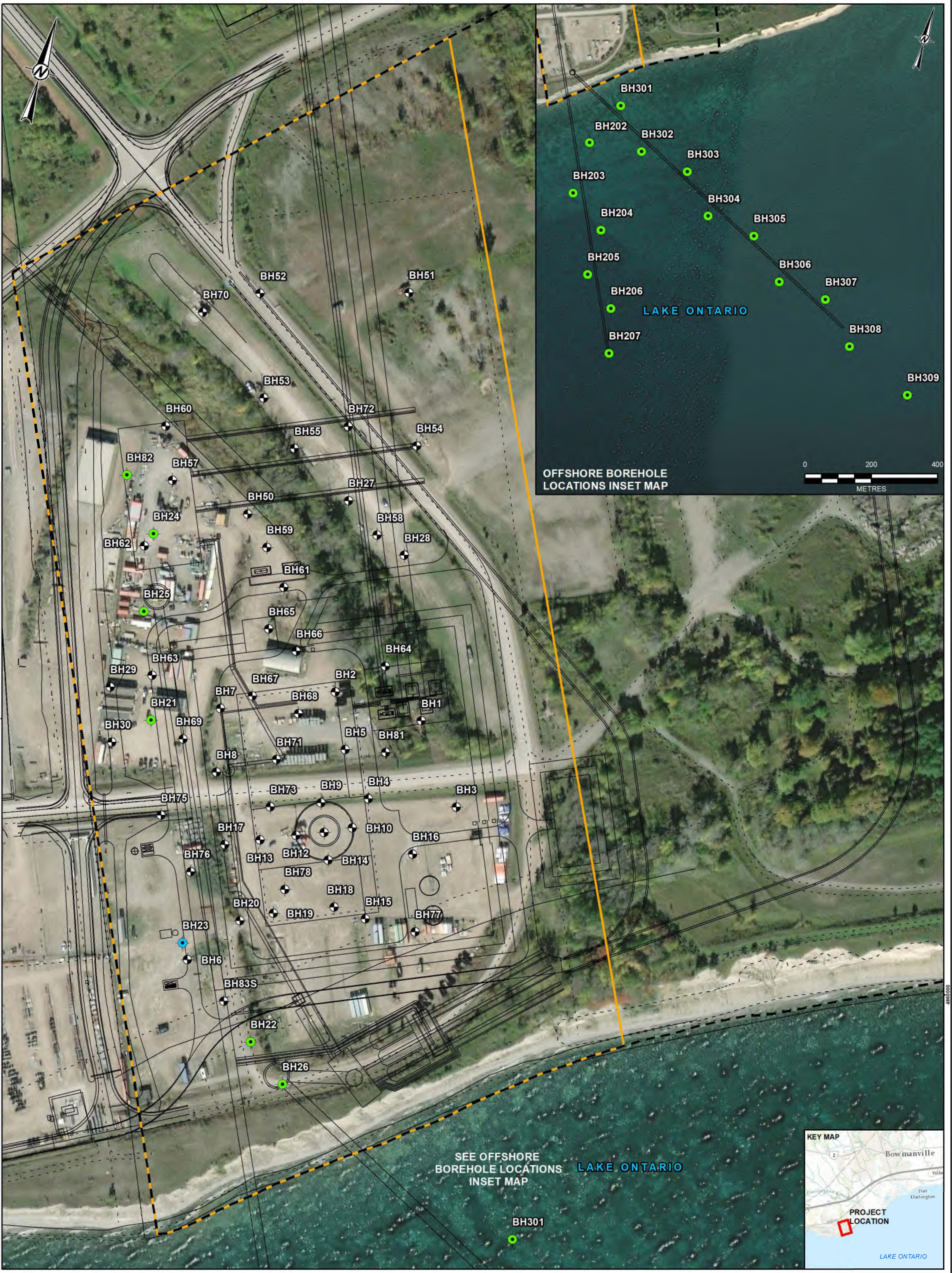
Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder's report. WSP should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, WSP should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction are necessary for WSP to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that WSP be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that WSP be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. WSP takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

PATH: S:\Clients\OPG\Darlington_Generating_Station\99_PROJ\21451329_ES_Fox_DNNP_Geotech_Invest\40_PROD\0003_Boreholes\21451329-0003-BG-0011.mxd PRINTED ON: 2023-02-10 AT: 9:22:40 AM



LEGEND

⊕	BOREHOLE LOCATION (PHASE 1)
●	BOREHOLE LOCATION (PHASE 2)
●	BOREHOLE LOCATION WITH WELL (PHASE 2)
▭	PROPOSED NEW SITE
▭	PROPOSED NUCLEAR PLANT AND ANCILLARY BUILDINGS

0 50 100
1:2,250 METRES

NOTE(S)

1. LOCATIONS ARE APPROXIMATE.

REFERENCE(S)

1. BASE IMAGE - SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
2. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 CSRS COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
E.S. FOX LIMITED NUCLEAR SERVICES

PROJECT
OPG DARLINGTON NEW NUCLEAR PROJECT – PHASE 2 GEOTECHNICAL INVESTIGATION (CONDENSER COOLING WATER SYSTEM)

TITLE
BOREHOLE LOCATION PLAN

CONSULTANT

YYYY-MM-DD	2023-02-10
DESIGNED	CGE
PREPARED	CGE
REVIEWED	SP
APPROVED	SP

PROJECT NO.	CONTROL	REV.	FIGURE
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
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LEGEND

BOREHOLE - PHASE II

BOREHOLE - PHASE I

BH ← BOREHOLE ID

O/S -5.4 m ← OFFSET FROM ALIGNMENT
+ EAST
- WEST

PIEZOMETER
WATER LEVEL
WATER LEVEL MEASUREMENT DATE
SCREEN
June 12, 2022
N Value
32
40
21 ← N VALUE
16
16
117
57
100/0.10
73% ← RQD
SOIL UNIT

🟦	WATER
⬜	UNIT 1 TOPSOIL / FILL
▨	UNIT 2a SURFICIAL GLACIOLACUSTRINE DEPOSITS SANDY LEAN CLAY TO LEAN CLAY
▨	UNIT 2b SURFICIAL GLACIOLACUSTRINE DEPOSITS SILTY CLAYEY SAND TO SILTY SAND/SANDY SILT
▨	UNIT 3 UPPER TILL
▨	UNIT 4a INTERMEDIATE GLACIOLACUSTRINE DEPOSITS SILTY SAND TO SANDY SILT
▨	UNIT 4b INTERMEDIATE GLACIOLACUSTRINE DEPOSITS SANDY LEAN CLAY TO LEAN CLAY
▨	UNIT 5 LOWER TILL
▨	UNIT 6a BLUE MOUNTAIN FORMATION BEDROCK
▨	UNIT 6b LINDSAY FORMATION BEDROCK

NOTE(S)

1. THE ACTUAL LAKE BED MEASURED IN THE BOREHOLES COULD DIFFER FROM LAKE BED PROVIDED BY BLACK & VEATCH.

REFERENCE(S)

1. INTAKE TUNNEL ALIGNMENT PROVIDED BY BLACK & VEATCH, FILE NO. 412250-CCW-TN001.dgn, RECEIVED JANUARY 31, 2023.
2. BASE IMAGERY - © 2022 MICROSOFT CORPORATION © 2022 MAXAR ©CNES (2022) DISTRIBUTION AIRBUS DS.

0 10 20
1:500 VERTICAL METRES

0 25 50
1:1,000 HORIZONTAL METRES

CLIENT
E.S. FOX LIMITED NUCLEAR SERVICES

PROJECT
OPG DARLINGTON NEW NUCLEAR PROJECT
PHASE 2 GEOTECHNICAL INVESTIGATION
(CONDENSER COLLING WATER SYTEM)

TITLE
BOREHOLE LOCATION PLAN AND SUBSURFACE STRATIGRAPHY - INTAKE TUNNEL PROFILE - SHEET 1 OF 2

CONSULTANT
wsp

YYYY-MM-DD	2023-05-30
DESIGNED	
PREPARED	DD
REVIEWED	RV
APPROVED	

PROJECT NO.	PHASE/TASK	REV.	FIGURE
21451329	(21700)/(710)	A	2A

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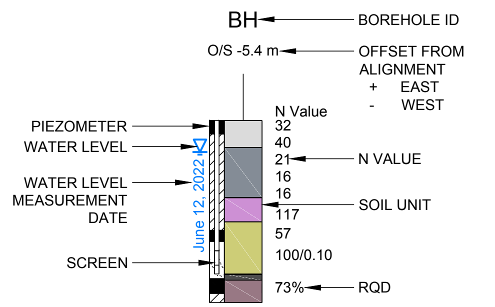
LEGEND

BOREHOLE - PHASE II

BOREHOLE - PHASE I



🟦 WATER

UNIT 1
TOPSOIL / FILL

UNIT 2a
SURFICIAL GLACIOLACUSTRINE DEPOSITS
SANDY LEAN CLAY TO LEAN CLAY

UNIT 2b
SURFICIAL GLACIOLACUSTRINE DEPOSITS
SILTY CLAYEY SAND TO SILTY SAND/SANDY SILT

UNIT 3
UPPER TILL

UNIT 4a
INTERMEDIATE GLACIOLACUSTRINE DEPOSITS
SILTY SAND TO SANDY SILT

UNIT 4b
INTERMEDIATE GLACIOLACUSTRINE DEPOSITS
SANDY LEAN CLAY TO LEAN CLAY

UNIT 5
LOWER TILL

UNIT 6a
BLUE MOUNTAIN FORMATION
BEDROCK

UNIT 6b
LINDSAY FORMATION
BEDROCK

NOTE(S)

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1:1,000 HORIZONTAL METRES

CLIENT
E.S. FOX LIMITED NUCLEAR SERVICES

PROJECT
OPG DARLINGTON NEW NUCLEAR PROJECT
PHASE 2 GEOTECHNICAL INVESTIGATION
(CONDENSER COLLING WATER SYTEM)

TITLE
BOREHOLE LOCATION PLAN AND SUBSURFACE
STRATIGRAPHY - INTAKE TUNNEL PROFILE - SHEET 2 OF 2

CONSULTANT

YYYY-MM-DD	2023-05-30
DESIGNED	
PREPARED	DD
REVIEWED	RV
APPROVED	

PROJECT NO.	PHASE/TASK	REV.	FIGURE
21451329	(21700)/(710)	A	2B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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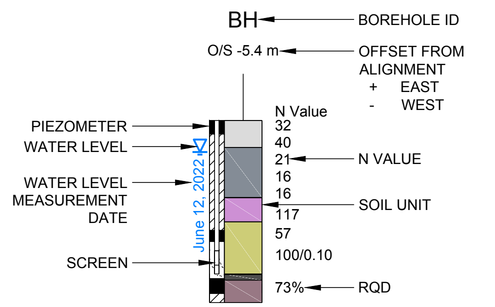
LEGEND

BOREHOLE - PHASE II

BOREHOLE - PHASE I



🟦	WATER
⬜	UNIT 1 TOPSOIL / FILL
⬛	UNIT 2a SURFICIAL GLACIOLACUSTRINE DEPOSITS SANDY LEAN CLAY TO LEAN CLAY
🟪	UNIT 2b SURFICIAL GLACIOLACUSTRINE DEPOSITS SILTY CLAYEY SAND TO SILTY SAND/SANDY SILT
🟨	UNIT 3 UPPER TILL
🟧	UNIT 4a INTERMEDIATE GLACIOLACUSTRINE DEPOSITS SILTY SAND TO SANDY SILT
🟦	UNIT 4b INTERMEDIATE GLACIOLACUSTRINE DEPOSITS SANDY LEAN CLAY TO LEAN CLAY
🟩	UNIT 5 LOWER TILL
⬛	UNIT 6a BLUE MOUNTAIN FORMATION BEDROCK
🟫	UNIT 6b LINDSAY FORMATION BEDROCK

NOTE(S)

1. THE ACTUAL LAKE BED MEASURED IN THE BOREHOLES COULD DIFFER FROM LAKE BED PROVIDED BY BLACK & VEATCH.

REFERENCE(S)

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0 10 20
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1:1,000 HORIZONTAL METRES

CLIENT
E.S. FOX LIMITED NUCLEAR SERVICES

PROJECT
OPG DARLINGTON NEW NUCLEAR PROJECT
PHASE 2 GEOTECHNICAL INVESTIGATION
(CONDENSER COLLING WATER SYTEM)

TITLE
BOREHOLE LOCATION PLAN AND SUBSURFACE STRATIGRAPHY - OUTFALL TUNNEL PROFILE - SHEET 1 OF 2

CONSULTANT

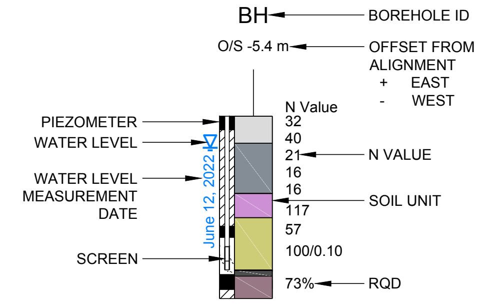
YYYY-MM-DD	2023-05-30
DESIGNED	
PREPARED	DD
REVIEWED	RV
APPROVED	

PROJECT NO.	PHASE/TASK	REV.	FIGURE
21451329	(21700)/(710)	A	3A

LEGEND

BOREHOLE - PHASE II

BOREHOLE - PHASE I



🟦	WATER
⬜	UNIT 1 TOPSOIL / FILL
⬛	UNIT 2a SURFICIAL GLACIOLACUSTRINE DEPOSITS SANDY LEAN CLAY TO LEAN CLAY
🟪	UNIT 2b SURFICIAL GLACIOLACUSTRINE DEPOSITS SILTY CLAYEY SAND TO SILTY SAND/SANDY SILT
🟨	UNIT 3 UPPER TILL
🟧	UNIT 4a INTERMEDIATE GLACIOLACUSTRINE DEPOSITS SILTY SAND TO SANDY SILT
🟦	UNIT 4b INTERMEDIATE GLACIOLACUSTRINE DEPOSITS SANDY LEAN CLAY TO LEAN CLAY
🟩	UNIT 5 LOWER TILL
⬛	UNIT 6a BLUE MOUNTAIN FORMATION BEDROCK
🟫	UNIT 6b LINDSAY FORMATION BEDROCK

NOTE(S)

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CLIENT
E.S. FOX LIMITED NUCLEAR SERVICES

PROJECT
OPG DARLINGTON NEW NUCLEAR PROJECT
PHASE 2 GEOTECHNICAL INVESTIGATION
(CONDENSER COLLING WATER SYTEM)

TITLE
BOREHOLE LOCATION PLAN AND SUBSURFACE STRATIGRAPHY-OUTFALL TUNNEL PROFILE - SHEET 2 OF 2

CONSULTANT
wsp

YYYY-MM-DD	2023-02-15
DESIGNED	
PREPARED	DD
REVIEWED	RV
APPROVED	

PROJECT NO.	PHASE/TASK	REV.	FIGURE
21451329	(21700)/(710)	A	3B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
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APPENDIX A

Borehole and Drillhole Logs
Soil Laboratory Results
And Geophysical Test Results

SPT Hammer Energy Calibration Report

GRL engineers, inc.
Dynamic Measurements and Analyses

May 12, 2022

Glenn Whyte
Odyssey Fluid Power
138 Progress Rd
North Bay, ON P1A 0B9, Canada

Re: <u>SPT Energy Calibration</u>
Diedrich D120 (Serial # D120-104)

GRL Job No. 225045-1

Dear Mr. Whyte:

This report summarizes the results of Standard Penetration Test (SPT) energy measurements taken from a SPT drilling rigs. The rig tested was a Diedrich D120 (Serial #104). The field work associated with the energy measurements summarized in this report was performed on May 5, 2022.

The purpose for collecting the SPT energy measurements was to compute the energy transfer efficiencies for the SPT hammers. To meet this objective, a model 8G Pile Driving Analyzer (PDA) was used to acquire and process the dynamic test data. Additional information regarding the testing equipment and analytical procedures is provided in Appendix A.

Test Sequence

An instrumented AWJ rod was used to take energy measurements for each of the rigs. Dynamic measurements were obtained at sampling intervals of 10 feet to 11.5 feet, 13 feet to 14.5 feet, 15 feet to 16.5 feet, 20 feet to 21.5 feet and 25 feet to 26.5 feet. At each sampling interval, energy measurements were taken during 18 inches of driving of a split-spoon sampler.

Energy Transfer Measurements

An 8G model Pile Driving Analyzer was used to take measurements of strain and acceleration during driving of the sampler. The strain and acceleration signals were conditioned and converted to force and velocities by the PDA. The PDA interprets the measured dynamic data according to the Case Method equations. Force and velocity records from the PDA were also

viewed graphically on an LCD screen to evaluate data quality. All force and velocity records were digitally stored for subsequent analysis.

The maximum energy transferred to the drill rod (EFV) is calculated by integrating both the force and velocity records over time as follows:

$$EFV = \int F(t)V(t)dt$$

Where: $F(t)$ = the force at time t
$V(t)$ = the velocity at time t

The energy transfer ratio (ETR) or efficiency is computed by dividing EFV by the theoretical SPT hammer energy of 350 lb-ft (computed from the product of the hammer weight, assumed to be 140 lbs, and the fall height, assumed to be 2.5 ft). The SPT N-values can then be corrected for a nominal 60% transfer efficiency, $N_{60,}$ as follows:

$$N_{60} = (e_m / 60)\ N_m$$

Where: e_m = the measured transfer ratio (ETR)
N_m = the measured SPT “N” value

Conclusions

Tables in Appendix B summarize the average transferred energies and the energy transfer ratios for each drill rig at each sample depth calculated using the *EFV* equation. Also included are average values of the hammer operating rate, maximum impact force and maximum velocity of the rod. In addition, the overall performance, which represents the average of data from all sample depths, is shown. Complete information, including the maximum, minimum and standard deviation for each sampling depth, is included in Appendix B.

The overall transfer ratios (for all sampling depths weighted by N-values for each sample) were as follows:

SPT Rig (*Serial Number*)	**Overall Transfer Efficiency**
Diedrich D120 (Serial # D120-104)	**75.2%**

We appreciate the opportunity to be of assistance to you. Please do not hesitate to contact us if you have any questions regarding this report, or if we may be of further service.

Sincerely,
GRL Engineers, Inc.

Matthew Perrella

Matthew Perrella

C. Michael Morgano

C. Michael Morgano

Calibration Appendix A

An Introduction To SPT Dynamic Pile Testing

APPENDIX A
AN INTRODUCTION INTO SPT DYNAMIC PILE TESTING

1. BACKGROUND

The Standard Penetration Test is frequently conducted as an in-situ assessment of soil strength. This test requires that a 140 lb weight is dropped 30 inches onto a drive rod at whose bottom a sampler is usually installed. The sampler is driven for 18 inches; the number of blows required for the last 12 inches of driving is the so-called N-value. The N-value may be used as a strength indicator for foundation design or as a means of assessing the liquefaction potential of soils.

Obviously, the SPT hammer efficiency is an important consideration when using the N-values for design purposes. Measurements have indicated that the energy in the drive rod is sometimes only 30% and and may reach 90% of the potential or rated energy of the SPT hammer (E-rated = 0.35 kip-ft or 0.475 kJ). The type of hammer used to drive the rod is the main reason for these variations. On the average, the energy in the drive rod is 60% of the standard rated energy.

Because of the variability of energy, methods based on N-values are considered unreliable. However, measurements during SPT testing using the Case Method can be done on a routine basis and these measurements yield the transferred energy values. With measured energy, EMX, known, an adjustment of the measured N-value, N_m, can be made as follows.

$$N_{60} = N_m \left[E_m / (0.6E_r)\right] \qquad (1)$$

Thus, if the measured energy value is equal to the normally expected transferred energy of 60% of E-rated then the adjusted and measured N-values are identical. On the other hand, if the measured energy is only 30% then the adjusted blow count will be reduced by 50%.

2. DYNAMIC TESTING AND ANALYSIS METHODS APPLIED TO SPT

The Case Method of dynamic pile testing, named after the Case Institute of Technology where it was developed between 1964 and 1975, requires that a substantial ram mass (e.g. a pile driving hammer) impacts the pile top such that the pile undergoes at least a small permanent set. Thus, the method is also referred to as a “High Strain Method”. The Case Method requires dynamic measurements on the pile or shaft under the ram impact and then a calculation of various quantities. Conveniently, for SPT applications, the measurements and analyses are done by a single piece of equipment: the SPT Analyzer. The Pile Driving Analyzer® (PDA) is also suitable to perform these measurements and data processing.

A related analysis method is the “Wave Equation Analysis” which calculates a relationship between bearing capacity, pile stresses, transferred energy and field blow count. The GRLWEAP™ program performs this analysis and provides a complete set of helpful information and input data. This program can be used very effectively to simulate the SPT driving process.

3. MEASUREMENTS

GRL uses equipment manufactured by Pile Dynamics, Inc. The system includes either an SPT-Analyzer™ (SPTA) or a Pile Driving Analyzer® (PDA), an instrumented rod section and two accelerometers. SPT energy testing is very closely related to and borrows procedures from dynamic pile testing. Those interested in the basis of the SPT energy testing method may obtain extensive literature on dynamic pile testing from GRL Engineers, Inc.

3.1 SPT Analyzer or Pile Driving Analyzer

The basis for the results calculated by the SPTA or PDA are strain and acceleration measured in an instrumented rod section. These signals are converted to rod top force, F(t), and rod top velocity, v(t). The SPTA or PDA conditions, calibrates and displays these signals and immediately computes average pile force and velocity thereby eliminating bending effects. The product of these two

measurements is then integrated over time which yields the energy transferred to the instrumented section as a function of time (see Section 4.1).

For convenience and accuracy, strain measurements are usually taken on an instrumented section of SPT drive rod. Ideally, the section properties of the instrumented rod and those of the drive rod are the same, however, using subs, other sections can also be utilized.

For the instrumented section, PDI provides a force calibration in such a way that the output of the instrumented rod is directly calculated without the need for an accurate elastic modulus or cross sectional area of the rod section.

The acceleration measurements are often demanding in the SPT environment, because of high frequency and high acceleration motion components. An experienced measurement engineer, therefore, has to evaluate the quality of this data before final conclusions are drawn from the numerical results calculated by SPTA or PDA.

SPTA or PDA records are taken while the standard N-value is acquired in the conventional manner. This then allows a direct correlation between N-value and average transferred energy.

3.2 HPA

The SPT hammer's ram velocity may be directly obtained using radar technology in the Hammer Performance Analyzer™. The impact velocity results can be automatically processed with a PC or recorded on a strip chart. HPA measurements yield a hammer kinetic energy, but not the energy transferred to the drive rod.

4 RECORD EVALUATION BY SPTA OR PDA

4.1 HAMMER PERFORMANCE

The PDA calculates the energy transferred to the pile top from:

$$E(t) = \int_0^t F(\tau)v(\tau)\, d\tau \qquad (2)$$

The maximum of the E(t) curve is often called **ENTHRU or EMX;** it is the most important quantity for an overall evaluation of the performance of a hammer and driving system. **EMX** allows for a classification of the hammer's performance when presented as, e_T, the rated transfer efficiency, also called energy transfer ratio (**ETR**) or global efficiency.

$$e_T = EMX/E_R \qquad (3)$$

where E_R is the hammer manufacturer's rated energy value or 0.35 kip-ft (0.475 kJ) in the case of the SPT hammer.

Often in the SPT literature one finds also reference to the EF2 energy. This evaluation is based on assumed proportionality between force and velocity (see also Section 5):

$$v(t) = F(t) / Z \qquad (4)$$

where Z = EA/c is the pile impedance, E is the elastic modulus, A is the cross sectional area and c is the speed of the stress wave in the pile material..

Combining equations 2 and 4 leads to

$$EF(t) = \int_0^t F(\tau)^2 / Z\, d\tau \qquad (5)$$

The EF2 transferred energy value is the EF-value at the time t = 2L/c, where L is the drive rod length and c is the stress wave speed in steel (16,800 ft/s or 5,124 m/s). Since the force is easier to measure than both force and velocity, Equation 5 is preferred by some test engineers. However, the EF method is fraught with errors and certain correction factors have to be applied to make it approximately correct. Among the error sources are the following:

- Proportionality is often violated prior to time 2L/c. The proportionality between force and velocity in a downward traveling wave only holds if the wave does not encounter a disturbance prior to reflecting off the pile toe. Such disturbances include a change in cross sectional area, an open or loose splice or joint, or resistance along the shaft.

- Using only one force measurement precludes a data quality check based on the proportionality between force and velocity. Thus, a force measurement that is for some reason in error may not be detectable, which will lead to errors in the EF2 value. Data quality checks will be discussed further in Section 5.

The use if EF2 is therefore not recommended but it is often included in result presentations for the sake of completeness.

4.2 STRESSES

During SPT monitoring, it is also of interest to monitor compressive stresses at both the top of the drive rod and at its bottom.

At the pile top (location of sensors) the maximum compression stress averaged over the rod's cross section, **CSX**, is directly obtained from the measurements. Note that this stress value refers to the instrumented section. If the rod has a different cross sectional area then the stress in the rod will be different from CSX.

The SPTA or PDA can also calculate, in an approximate manner, the force at the rod bottom, **CFB**. To obtain the corresponding stress, this force value should be divided by the appropriate cross sectional area, e.g. by the rod area just above the sampler or by the sampler area itself. Of course, non-uniform stress components as they might occur at the sampler tip due to a sloping rock are not considered in this calculation.

5. DATA QUALITY CHECKS

Quality data is the first and foremost requirement for accurate dynamic testing results. It is therefore important that the measurement engineer performing SPTA or PDA tests has the experience necessary to recognize measurement problems and take appropriate corrective action should problems develop. Fortunately, dynamic pile testing allows for certain data quality checks because two independent measurements are taken that have to conform to the so-called proportionality relationship.

As long as there is only a wave traveling in one direction, as is the case during impact when only a downward traveling wave exists in the rod, force and velocity measured at its top are proportional

$$F = v\,Z \qquad (5)$$

where Z is again the pile impedance, Z = EA/c. This relationship can also be expressed in terms of stress

$$\sigma = F/A = v\,(E/c) \qquad (6)$$

or strain

$$\epsilon = \sigma/E = v / c \qquad (7)$$

This means that the early portion of strain times wave speed must be equal to the velocity unless the proportionality is affected by high friction near the pile top or by a pile cross sectional change not far below the sensors. Checking the proportionality is an excellent means of assuring meaningful measurements but is only truly meaningful for perfectly uniform rods. Open or loose splices, for example, will lead to a non-proportionality. For SPT rods it is fortunate that usually no soil resistance acts along the shaft and for that reason, proportionality can exist until the stress wave returns from sampler top or rod bottom unless connectors are not sufficiently tightened or have a significant mass.

Velocity data quality can also be checked by looking at the final displacement, DFN, which is calculated from the acceleration by double integration. If the calculated final displacement is much higher or lower than indicated by the N-value, the accelerometer attachment may be loose or the sensor may be faulty. If major drift in the velocity is observed, the EMX value may be in error, even though proportionality from impact to time 2L/c exists. In this case, it may be useful to evaluate the energy transferred to the drill rod at time 2L/c, which is calculated by the PDA or SPTA as the E2E quantity.

Calibration Appendix B

Results of SPT Rig Calibrations

DIEDRICH D-120 (SN 104)

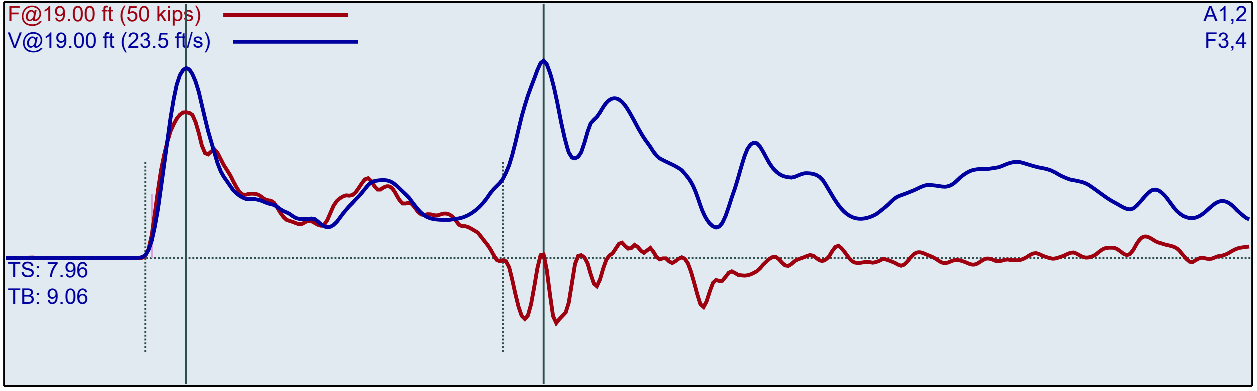
Diedrich D-120 - 104
MDP
SN 104

10_11.5
Interval start: 5/5/2022

AR: 1.19 in^2
LE: 19.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (10.00 - 11.50 ft], displaying BN: 14



F3 : [363AW1] 210.09 PDICAL (1) FF3
F4 : [363AWJ2] 210.62 PDICAL (1) FF3

A1 (PR): [K2607] 322.279 mv/6.4v/5000g (1) VF3
A2 (PR): [K11477] 415.534 mv/6.4v/5000g (1) VF3

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR %
1	4	10.13	27	16.2	1.9	214	61.0
2	4	10.25	30	18.1	26.6	242	69.1
3	4	10.38	30	18.0	26.9	259	74.0
4	4	10.50	31	18.6	27.1	263	75.1
5	5	10.60	30	19.1	27.0	263	75.0
6	5	10.70	30	19.1	27.1	264	75.3
7	5	10.80	30	18.8	27.1	265	75.8
8	5	10.90	30	18.5	27.1	265	75.8
9	5	11.00	30	18.8	27.1	262	74.9
10	7	11.07	31	19.2	27.2	255	72.8
11	7	11.14	30	18.6	27.1	241	68.7
12	7	11.21	30	18.3	27.1	242	69.1
13	7	11.29	30	18.4	27.1	239	68.4
14	7	11.36	28	18.2	27.1	228	65.1
15	7	11.43	28	18.3	27.1	227	64.8
16	7	11.50	27	18.2	27.1	223	63.8
		Average	30	18.6	27.1	248	70.8
		Std Dev	1	0.3	0.0	16	4.5
		Maximum	31	19.2	27.2	265	75.8
		Minimum	27	18.2	27.0	223	63.8

N-value: 12

Sample Interval Time: 33.34 seconds.

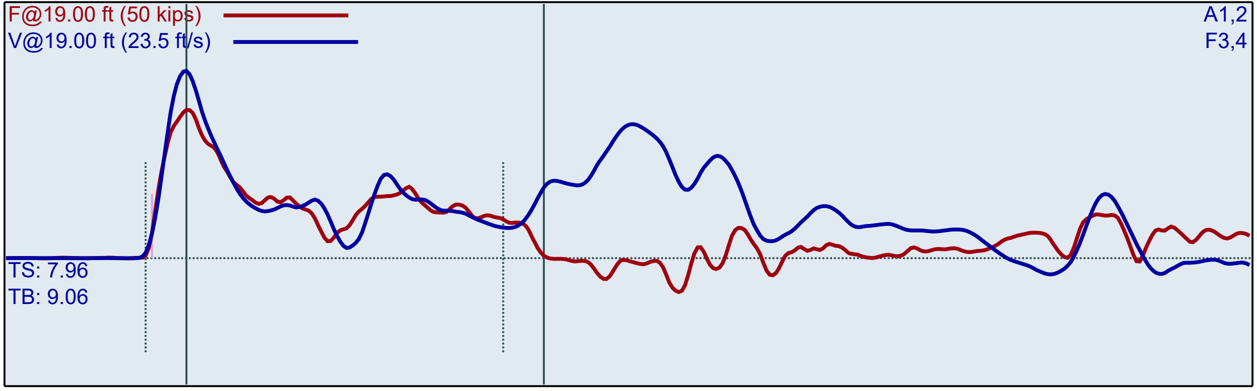
Diedrich D-120 - 104
MDP
SN 104

10_11.5
Interval start: 5/5/2022

AR: 1.19 in^2
LE: 19.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (13.00 - 14.50 ft], displaying BN: 63



F3 : [363AW1] 210.09 PDICAL (1) FF3
F4 : [363AWJ2] 210.62 PDICAL (1) FF3

A1 (PR): [K2607] 322.279 mv/6.4v/5000g (1) VF3
A2 (PR): [K11477] 415.534 mv/6.4v/5000g (1) VF3

BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR %
17	14	13.04	22	15.5	1.9	155	44.2
18	14	13.07	29	18.0	26.0	248	70.9
19	14	13.11	29	18.5	27.2	239	68.2
20	14	13.14	31	18.3	27.3	244	69.7
21	14	13.18	31	18.8	27.3	244	69.8
22	14	13.21	31	18.7	27.3	252	71.9
23	14	13.25	31	18.9	27.3	252	72.1
24	14	13.29	32	19.2	27.2	257	73.3
25	14	13.32	31	19.2	27.4	261	74.4
26	14	13.36	31	19.2	27.3	259	73.9
27	14	13.39	32	19.0	27.4	256	73.1
28	14	13.43	31	18.9	27.3	252	71.9
29	14	13.46	32	19.3	27.3	261	74.4
30	14	13.50	32	19.2	27.4	258	73.8
31	17	13.53	32	19.4	27.3	263	75.0
32	17	13.56	32	18.9	27.3	266	75.9
33	17	13.59	33	19.5	27.3	275	78.6
34	17	13.62	31	18.6	27.5	253	72.3
35	17	13.65	32	19.6	27.3	272	77.7
36	17	13.68	33	19.2	27.3	271	77.4
37	17	13.71	33	19.5	27.3	277	79.1
38	17	13.74	33	19.4	27.4	275	78.5
39	17	13.76	33	19.3	27.3	274	78.4
40	17	13.79	33	19.2	27.4	271	77.6
41	17	13.82	32	19.3	27.3	274	78.2
42	17	13.85	33	18.9	27.3	272	77.6
43	17	13.88	33	19.6	27.3	275	78.7
44	17	13.91	33	19.6	27.4	275	78.6
45	17	13.94	32	19.6	27.3	274	78.2
46	17	13.97	32	19.4	27.2	277	79.2
47	17	14.00	33	19.5	27.4	282	80.5

48	18	14.03	32	18.4	27.4	273	78.1
49	18	14.06	29	16.9	27.3	264	75.3
50	18	14.08	29	17.1	27.4	262	74.8
51	18	14.11	29	17.2	27.4	261	74.7
52	18	14.14	29	17.2	27.3	256	73.2
53	18	14.17	28	17.1	27.3	253	72.4
54	18	14.19	29	17.2	27.3	254	72.6
55	18	14.22	30	17.8	27.4	256	73.1
56	18	14.25	30	17.7	27.4	260	74.4
57	18	14.28	29	17.7	27.4	259	74.1
58	18	14.31	29	17.3	27.4	254	72.7
59	18	14.33	29	17.2	27.4	254	72.7
60	18	14.36	29	17.2	27.4	254	72.7
61	18	14.39	29	17.2	27.4	250	71.6
62	18	14.42	29	17.1	27.4	252	72.0
63	18	14.44	29	17.2	27.5	253	72.3
64	18	14.47	29	17.2	27.4	245	70.1
65	18	14.50	29	17.1	27.4	249	71.2
		Average	31	18.3	27.4	264	75.4
		Std Dev	2	1.0	0.1	10	2.9
		Maximum	33	19.6	27.5	282	80.5
		Minimum	28	16.9	27.2	245	70.1

N-value: 35

Sample Interval Time: 105.42 seconds.

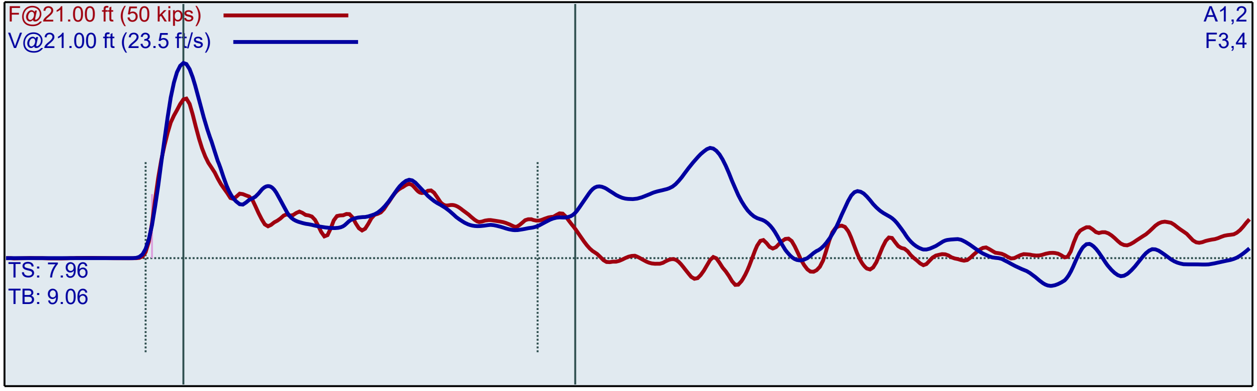
Diedrich D-120 - 104
MDP
SN 104

10_11.5
Interval start: 5/5/2022

AR: 1.19 in^2
LE: 21.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (15.00 - 16.50 ft], displaying BN: 118



F3 : [363AW1] 210.09 PDICAL (1) FF3
F4 : [363AWJ2] 210.62 PDICAL (1) FF3

A1 (PR): [K2607] 322.279 mv/6.4v/5000g (1) VF3
A2 (PR): [K11477] 415.534 mv/6.4v/5000g (1) VF3

BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR %
66	20	15.03	22	13.9	1.9	142	40.5
67	20	15.05	29	17.6	26.2	228	65.1
68	20	15.08	29	17.6	27.4	236	67.4
69	20	15.10	29	17.5	27.2	239	68.2
70	20	15.13	29	17.4	27.3	238	68.0
71	20	15.15	29	17.5	27.4	241	68.8
72	20	15.18	29	17.8	27.4	240	68.7
73	20	15.20	29	18.0	27.4	245	70.1
74	20	15.23	30	18.2	27.4	250	71.4
75	20	15.25	30	18.5	27.4	253	72.4
76	20	15.28	30	18.5	27.4	250	71.5
77	20	15.30	31	18.8	27.4	256	73.2
78	20	15.33	30	18.7	27.4	261	74.5
79	20	15.35	31	18.6	27.4	263	75.3
80	20	15.38	31	18.8	27.3	270	77.3
81	20	15.40	31	18.9	27.4	270	77.2
82	20	15.43	31	18.6	27.4	264	75.3
83	20	15.45	31	18.6	27.4	259	74.1
84	20	15.48	31	18.9	27.4	263	75.0
85	20	15.50	31	18.6	27.4	260	74.2
86	16	15.53	31	18.9	27.4	267	76.4
87	16	15.56	31	18.6	27.5	267	76.2
88	16	15.59	31	18.2	27.4	262	74.8
89	16	15.63	31	18.9	27.4	268	76.4
90	16	15.66	31	18.8	27.5	268	76.6
91	16	15.69	31	18.7	27.5	266	76.0
92	16	15.72	31	18.6	27.5	263	75.0
93	16	15.75	31	18.7	27.4	265	75.7
94	16	15.78	32	19.3	27.4	277	79.1
95	16	15.81	31	18.3	27.5	267	76.3
96	16	15.84	31	18.7	27.5	269	76.9

97	16	15.88	31	18.7	27.5	264	75.3
98	16	15.91	31	19.1	27.4	265	75.7
99	16	15.94	31	18.8	27.5	262	74.9
100	16	15.97	31	18.9	27.5	260	74.2
101	16	16.00	32	18.9	27.5	266	75.9
102	19	16.03	32	18.8	27.5	259	74.1
103	19	16.05	31	18.1	27.5	246	70.3
104	19	16.08	32	18.8	27.5	253	72.3
105	19	16.11	32	18.5	27.5	250	71.6
106	19	16.13	31	18.5	27.5	247	70.6
107	19	16.16	31	18.7	27.5	253	72.2
108	19	16.18	31	18.4	27.5	246	70.2
109	19	16.21	31	18.3	27.5	247	70.5
110	19	16.24	31	18.3	27.5	249	71.1
111	19	16.26	31	18.1	27.6	247	70.6
112	19	16.29	31	18.0	27.5	248	71.0
113	19	16.32	31	18.3	27.6	240	68.6
114	19	16.34	31	18.2	27.5	242	69.0
115	19	16.37	31	18.2	27.6	242	69.3
116	19	16.39	31	18.1	27.5	243	69.3
117	19	16.42	31	18.0	27.6	238	67.9
118	19	16.45	31	18.0	27.5	240	68.7
119	19	16.47	31	17.7	27.6	234	66.9
120	19	16.50	31	17.8	27.6	236	67.3
		Average	31	18.5	27.5	255	72.8
		Std Dev	0	0.4	0.1	12	3.3
		Maximum	32	19.3	27.6	277	79.1
		Minimum	31	17.7	27.4	234	66.9

N-value: 35

Sample Interval Time: 118.16 seconds.

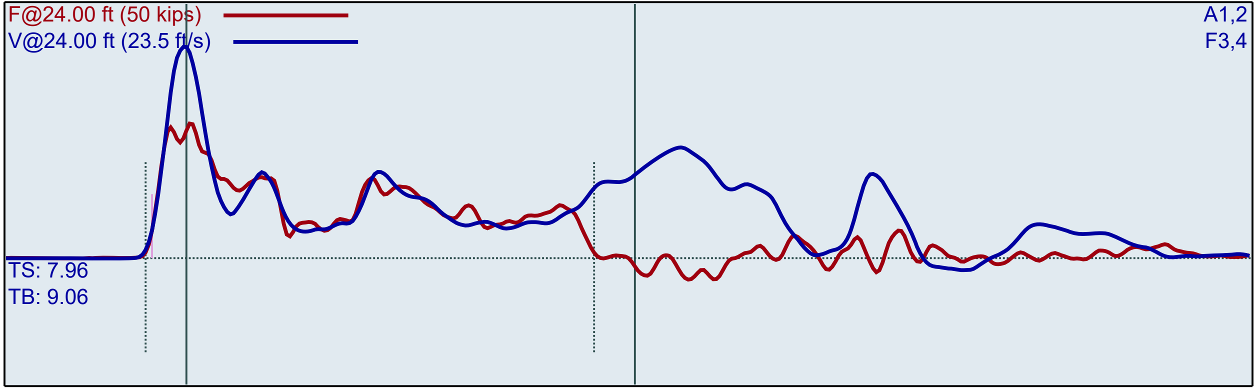
Diedrich D-120 - 104
MDP
SN 104

10_11.5
Interval start: 5/5/2022

AR: 1.19 in^2
LE: 24.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (20.00 - 21.50 ft], displaying BN: 173



F3 : [363AW1] 210.09 PDICAL (1) FF3
F4 : [363AWJ2] 210.62 PDICAL (1) FF3

A1 (PR): [K2607] 322.279 mv/6.4v/5000g (1) VF3
A2 (PR): [K11477] 415.534 mv/6.4v/5000g (1) VF3

BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR %
121	19	20.03	30	17.7	1.9	247	70.5
122	19	20.05	30	18.1	27.3	252	72.0
123	19	20.08	31	18.5	27.5	257	73.4
124	19	20.11	32	18.5	27.6	261	74.5
125	19	20.13	32	18.6	27.5	266	76.1
126	19	20.16	32	18.5	27.6	264	75.3
127	19	20.18	32	18.5	27.5	266	75.9
128	19	20.21	32	18.4	27.6	258	73.8
129	19	20.24	32	18.7	27.6	265	75.7
130	19	20.26	32	18.8	27.5	271	77.3
131	19	20.29	32	18.7	27.6	266	75.9
132	19	20.32	32	18.7	27.5	266	76.1
133	19	20.34	33	19.0	27.5	270	77.1
134	19	20.37	33	18.9	27.6	271	77.3
135	19	20.39	32	18.8	27.5	267	76.3
136	19	20.42	33	19.1	27.5	273	78.1
137	19	20.45	33	19.1	27.6	269	76.7
138	19	20.47	33	19.1	27.6	270	77.3
139	19	20.50	33	19.4	27.5	274	78.2
140	17	20.53	33	19.3	27.7	275	78.5
141	17	20.56	32	19.2	27.6	269	76.8
142	17	20.59	32	19.3	27.5	273	78.1
143	17	20.62	32	19.4	27.5	273	78.0
144	17	20.65	32	19.4	27.6	275	78.6
145	17	20.68	32	19.3	27.5	271	77.4
146	17	20.71	32	19.2	27.5	276	78.8
147	17	20.74	32	19.7	27.6	277	79.1
148	17	20.76	32	19.1	27.6	274	78.2
149	17	20.79	32	19.6	27.5	273	77.9
150	17	20.82	32	19.5	27.6	276	78.8
151	17	20.85	31	19.4	27.6	269	76.9

152	17	20.88	31	19.3	27.6	271	77.5
153	17	20.91	31	19.0	27.5	259	73.9
154	17	20.94	30	19.0	27.5	259	74.1
155	17	20.97	31	19.2	27.6	262	74.8
156	17	21.00	30	19.0	27.5	259	73.9
157	19	21.03	31	18.9	27.5	253	72.3
158	19	21.05	29	18.8	27.5	247	70.6
159	19	21.08	30	18.6	27.6	247	70.6
160	19	21.11	28	19.0	27.6	245	70.1
161	19	21.13	28	19.0	27.5	247	70.6
162	19	21.16	27	19.7	27.6	256	73.1
163	19	21.18	27	19.4	27.6	252	72.0
164	19	21.21	27	19.4	27.6	257	73.3
165	19	21.24	27	19.7	27.7	259	74.0
166	19	21.26	27	19.4	27.6	252	72.1
167	19	21.29	27	19.8	27.6	260	74.3
168	19	21.32	27	19.7	27.7	254	72.4
169	19	21.34	26	19.2	27.6	246	70.2
170	19	21.37	27	19.4	27.6	250	71.5
171	19	21.39	26	19.5	27.7	248	70.7
172	19	21.42	26	19.2	27.6	243	69.5
173	19	21.45	26	19.4	27.6	242	69.3
174	19	21.47	26	19.1	27.6	238	67.9
175	19	21.50	26	19.1	27.6	235	67.0
		Average	29	19.3	27.6	259	74.0
		Std Dev	2	0.3	0.1	12	3.5
		Maximum	33	19.8	27.7	277	79.1
		Minimum	26	18.6	27.5	235	67.0

N-value: 36

Sample Interval Time: 117.58 seconds.

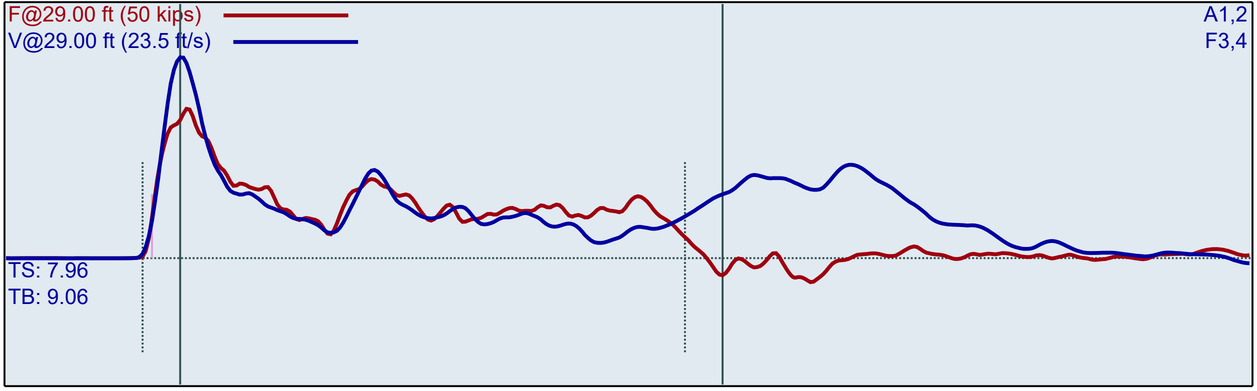
Diedrich D-120 - 104
MDP
SN 104

10_11.5
Interval start: 5/5/2022

AR: 1.19 in^2
LE: 29.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (25.00 - 26.50 ft], displaying BN: 234



F3 : [363AW1] 210.09 PDICAL (1) FF3
F4 : [363AWJ2] 210.62 PDICAL (1) FF3

A1 (PR): [K2607] 322.279 mv/6.4v/5000g (1) VF3
A2 (PR): [K11477] 415.534 mv/6.4v/5000g (1) VF3

BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR %
176	22	25.02	20	12.0	1.9	130	37.3
177	22	25.05	30	18.1	26.0	275	78.7
178	22	25.07	31	18.5	27.8	277	79.2
179	22	25.09	30	18.5	27.8	281	80.3
180	22	25.11	30	18.4	28.0	274	78.4
181	22	25.14	30	18.8	27.9	278	79.4
182	22	25.16	30	18.2	28.0	271	77.3
183	22	25.18	30	18.2	27.8	269	76.7
184	22	25.20	28	17.7	27.9	260	74.3
185	22	25.23	30	18.5	27.9	274	78.2
186	22	25.25	29	18.1	28.0	266	76.1
187	22	25.27	29	18.3	27.9	267	76.2
188	22	25.30	30	18.6	28.0	276	78.7
189	22	25.32	30	19.4	27.9	286	81.6
190	22	25.34	30	19.1	28.0	277	79.2
191	22	25.36	31	19.8	27.8	285	81.3
192	22	25.39	30	19.5	27.9	285	81.5
193	22	25.41	30	19.3	27.9	279	79.7
194	22	25.43	30	19.5	27.9	286	81.6
195	22	25.45	30	19.2	28.0	278	79.6
196	22	25.48	30	19.4	27.9	284	81.1
197	22	25.50	31	19.5	27.9	287	82.0
198	20	25.53	31	19.3	27.9	287	82.1
199	20	25.55	31	19.3	28.0	283	80.9
200	20	25.58	30	19.6	27.9	287	81.9
201	20	25.60	31	19.7	27.9	292	83.4
202	20	25.63	30	19.6	27.9	286	81.8
203	20	25.65	31	19.8	27.9	291	83.3
204	20	25.68	30	19.7	27.9	290	82.8
205	20	25.70	31	18.7	27.9	282	80.7
206	20	25.73	31	19.9	27.9	293	83.7

207	20	25.75	31	19.8	28.0	290	82.9
208	20	25.78	30	19.1	27.9	283	80.9
209	20	25.80	31	19.9	28.0	294	83.9
210	20	25.83	30	19.4	27.9	287	81.9
211	20	25.85	31	20.0	27.9	301	85.9
212	20	25.88	30	19.9	28.0	294	83.9
213	20	25.90	30	20.0	27.9	290	83.0
214	20	25.93	31	19.7	27.9	292	83.4
215	20	25.95	30	19.8	27.9	287	82.0
216	20	25.98	30	19.4	27.8	286	81.7
217	20	26.00	30	19.6	27.9	288	82.2
218	19	26.03	29	18.8	27.9	276	78.9
219	19	26.05	29	17.9	27.9	272	77.7
220	19	26.08	29	18.5	28.0	274	78.2
221	19	26.11	28	17.0	28.0	266	76.1
222	19	26.13	28	17.7	27.9	274	78.3
223	19	26.16	27	17.1	28.0	271	77.5
224	19	26.18	27	17.2	28.0	268	76.5
225	19	26.21	27	17.3	27.9	274	78.1
226	19	26.24	27	16.9	28.0	271	77.4
227	19	26.26	27	16.9	28.0	267	76.1
228	19	26.29	27	17.5	27.9	268	76.5
229	19	26.32	27	17.2	28.1	265	75.8
230	19	26.34	30	18.8	28.0	272	77.8
231	19	26.37	29	17.8	27.9	270	77.0
232	19	26.39	29	18.2	28.0	267	76.2
233	19	26.42	29	18.2	28.0	264	75.3
234	19	26.45	29	18.5	27.9	269	76.8
235	19	26.47	29	18.2	28.0	262	74.9
236	19	26.50	29	18.2	28.0	260	74.3
		Average	29	18.7	27.9	279	79.8
		Std Dev	1	1.0	0.1	11	3.1
		Maximum	31	20.0	28.1	301	85.9
		Minimum	27	16.9	27.8	260	74.3

N-value: 39

Sample Interval Time: 129.15 seconds.

Summary of SPT Test Results

Project: Diedrich D-120 - 104, Test Date: 5/5/2022

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Blows Applied /6"	Start Depth ft	Final Depth ft	**N Value**	**N60 Value**	Average FMX kips	Average VMX ft/s	Average BPM bpm	Average EFV ft-lb	Average ETR %
19.00	**4-5-7**	10.00	11.50	**12**	**15**	30	18.6	27.1	248	70.8
19.00	**14-17-18**	13.00	14.50	**35**	**43**	31	18.3	27.4	264	75.4
21.00	**20-16-19**	15.00	16.50	**35**	**43**	31	18.5	27.5	255	72.8
24.00	**19-17-19**	20.00	21.50	**36**	**45**	29	19.3	27.6	259	74.0
29.00	**22-20-19**	25.00	26.50	**39**	**48**	29	18.7	27.9	279	79.8
					Overall Average Values:	30	18.7	27.6	263	75.2
					Standard Deviation:	2	0.8	0.3	15	4.4
					Overall Maximum Value:	33	20.0	28.1	301	85.9
					Overall Minimum Value:	26	16.9	27.0	223	63.8

GRL engineers, inc.
Dynamic Measurements and Analyses

May 12, 2022

Glenn Whyte
Odyssey Fluid Power
138 Progress Rd
North Bay, ON P1A 0B9, Canada

Re: SPT Energy Calibration
Diedrich D120 (Serial # D120-121)

GRL Job No. 225045-1

Dear Mr. Whyte:

This report summarizes the results of Standard Penetration Test (SPT) energy measurements taken from a SPT drilling rigs. The rig tested was a Diedrich D120 (Serial #121). The field work associated with the energy measurements summarized in this report was performed on May 5, 2022.

The purpose for collecting the SPT energy measurements was to compute the energy transfer efficiencies for the SPT hammers. To meet this objective, a model 8G Pile Driving Analyzer (PDA) was used to acquire and process the dynamic test data. Additional information regarding the testing equipment and analytical procedures is provided in Appendix A.

Test Sequence

An instrumented AWJ rod was used to take energy measurements for each of the rigs. Dynamic measurements were obtained at sampling intervals of 10 feet to 11.5 feet, 15 feet to 16.5 feet and 20 feet to 21.5 feet. At each sampling interval, energy measurements were taken during 18 inches of driving of a split-spoon sampler.

Energy Transfer Measurements

An 8G model Pile Driving Analyzer was used to take measurements of strain and acceleration during driving of the sampler. The strain and acceleration signals were conditioned and converted to force and velocities by the PDA. The PDA interprets the measured dynamic data according to the Case Method equations. Force and velocity records from the PDA were also

viewed graphically on an LCD screen to evaluate data quality. All force and velocity records were digitally stored for subsequent analysis.

The maximum energy transferred to the drill rod (EFV) is calculated by integrating both the force and velocity records over time as follows:

$$EFV = \int F(t)V(t)dt$$

Where: $F(t)$ = the force at time t
$V(t)$ = the velocity at time t

The energy transfer ratio (ETR) or efficiency is computed by dividing EFV by the theoretical SPT hammer energy of 350 lb-ft (computed from the product of the hammer weight, assumed to be 140 lbs, and the fall height, assumed to be 2.5 ft). The SPT N-values can then be corrected for a nominal 60% transfer efficiency, $N_{60,}$ as follows:

$$N_{60} = (e_m / 60)\ N_m$$

Where: e_m = the measured transfer ratio (ETR)
N_m = the measured SPT “N” value

Conclusions

Tables in Appendix B summarize the average transferred energies and the energy transfer ratios for each drill rig at each sample depth calculated using the *EFV* equation. Also included are average values of the hammer operating rate, maximum impact force and maximum velocity of the rod. In addition, the overall performance, which represents the average of data from all sample depths, is shown. Complete information, including the maximum, minimum and standard deviation for each sampling depth, is included in Appendix B.

The overall transfer ratios (for all sampling depths weighted by N-values for each sample) were as follows:

SPT Rig (*Serial Number*)	**Overall Transfer Efficiency**
Diedrich D120 (Serial # D120-121)	**77.9%**

We appreciate the opportunity to be of assistance to you. Please do not hesitate to contact us if you have any questions regarding this report, or if we may be of further service.

Sincerely,
GRL Engineers, Inc.

Matthew Perrella

Matthew Perrella

C. Michael Morgano

C. Michael Morgano

Calibration Appendix A

An Introduction To SPT Dynamic Pile Testing

APPENDIX A
AN INTRODUCTION INTO SPT DYNAMIC PILE TESTING

1. BACKGROUND

The Standard Penetration Test is frequently conducted as an in-situ assessment of soil strength. This test requires that a 140 lb weight is dropped 30 inches onto a drive rod at whose bottom a sampler is usually installed. The sampler is driven for 18 inches; the number of blows required for the last 12 inches of driving is the so-called N-value. The N-value may be used as a strength indicator for foundation design or as a means of assessing the liquefaction potential of soils.

Obviously, the SPT hammer efficiency is an important consideration when using the N-values for design purposes. Measurements have indicated that the energy in the drive rod is sometimes only 30% and and may reach 90% of the potential or rated energy of the SPT hammer (E-rated = 0.35 kip-ft or 0.475 kJ). The type of hammer used to drive the rod is the main reason for these variations. On the average, the energy in the drive rod is 60% of the standard rated energy.

Because of the variability of energy, methods based on N-values are considered unreliable. However, measurements during SPT testing using the Case Method can be done on a routine basis and these measurements yield the transferred energy values. With measured energy, EMX, known, an adjustment of the measured N-value, N_m, can be made as follows.

$$N_{60} = N_m \left[E_m / (0.6E_r)\right] \qquad (1)$$

Thus, if the measured energy value is equal to the normally expected transferred energy of 60% of E-rated then the adjusted and measured N-values are identical. On the other hand, if the measured energy is only 30% then the adjusted blow count will be reduced by 50%.

2. DYNAMIC TESTING AND ANALYSIS METHODS APPLIED TO SPT

The Case Method of dynamic pile testing, named after the Case Institute of Technology where it was developed between 1964 and 1975, requires that a substantial ram mass (e.g. a pile driving hammer) impacts the pile top such that the pile undergoes at least a small permanent set. Thus, the method is also referred to as a “High Strain Method”. The Case Method requires dynamic measurements on the pile or shaft under the ram impact and then a calculation of various quantities. Conveniently, for SPT applications, the measurements and analyses are done by a single piece of equipment: the SPT Analyzer. The Pile Driving Analyzer® (PDA) is also suitable to perform these measurements and data processing.

A related analysis method is the “Wave Equation Analysis” which calculates a relationship between bearing capacity, pile stresses, transferred energy and field blow count. The GRLWEAP™ program performs this analysis and provides a complete set of helpful information and input data. This program can be used very effectively to simulate the SPT driving process.

3. MEASUREMENTS

GRL uses equipment manufactured by Pile Dynamics, Inc. The system includes either an SPT-Analyzer™ (SPTA) or a Pile Driving Analyzer® (PDA), an instrumented rod section and two accelerometers. SPT energy testing is very closely related to and borrows procedures from dynamic pile testing. Those interested in the basis of the SPT energy testing method may obtain extensive literature on dynamic pile testing from GRL Engineers, Inc.

3.1 SPT Analyzer or Pile Driving Analyzer

The basis for the results calculated by the SPTA or PDA are strain and acceleration measured in an instrumented rod section. These signals are converted to rod top force, F(t), and rod top velocity, v(t). The SPTA or PDA conditions, calibrates and displays these signals and immediately computes average pile force and velocity thereby eliminating bending effects. The product of these two

measurements is then integrated over time which yields the energy transferred to the instrumented section as a function of time (see Section 4.1).

For convenience and accuracy, strain measurements are usually taken on an instrumented section of SPT drive rod. Ideally, the section properties of the instrumented rod and those of the drive rod are the same, however, using subs, other sections can also be utilized.

For the instrumented section, PDI provides a force calibration in such a way that the output of the instrumented rod is directly calculated without the need for an accurate elastic modulus or cross sectional area of the rod section.

The acceleration measurements are often demanding in the SPT environment, because of high frequency and high acceleration motion components. An experienced measurement engineer, therefore, has to evaluate the quality of this data before final conclusions are drawn from the numerical results calculated by SPTA or PDA.

SPTA or PDA records are taken while the standard N-value is acquired in the conventional manner. This then allows a direct correlation between N-value and average transferred energy.

3.2 HPA

The SPT hammer's ram velocity may be directly obtained using radar technology in the Hammer Performance Analyzer™. The impact velocity results can be automatically processed with a PC or recorded on a strip chart. HPA measurements yield a hammer kinetic energy, but not the energy transferred to the drive rod.

4 RECORD EVALUATION BY SPTA OR PDA

4.1 HAMMER PERFORMANCE

The PDA calculates the energy transferred to the pile top from:

$$E(t) = \int_{o}^{t} F(\tau)v(\tau)\,d\tau \qquad (2)$$

The maximum of the E(t) curve is often called **ENTHRU or EMX;** it is the most important quantity for an overall evaluation of the performance of a hammer and driving system. **EMX** allows for a classification of the hammer's performance when presented as, e_T, the rated transfer efficiency, also called energy transfer ratio (**ETR**) or global efficiency.

$$e_T = EMX/E_R \qquad (3)$$

where E_R is the hammer manufacturer's rated energy value or 0.35 kip-ft (0.475 kJ) in the case of the SPT hammer.

Often in the SPT literature one finds also reference to the EF2 energy. This evaluation is based on assumed proportionality between force and velocity (see also Section 5):

$$v(t) = F(t) / Z \qquad (4)$$

where Z = EA/c is the pile impedance, E is the elastic modulus, A is the cross sectional area and c is the speed of the stress wave in the pile material..

Combining equations 2 and 4 leads to

$$EF(t) = \int_{o}^{t} F(\tau)^2 / Z\,d\tau \qquad (5)$$

The EF2 transferred energy value is the EF-value at the time t = 2L/c, where L is the drive rod length and c is the stress wave speed in steel (16,800 ft/s or 5,124 m/s). Since the force is easier to measure than both force and velocity, Equation 5 is preferred by some test engineers. However, the EF method is fraught with errors and certain correction factors have to be applied to make it approximately correct. Among the error sources are the following:

- Proportionality is often violated prior to time 2L/c. The proportionality between force and velocity in a downward traveling wave only holds if the wave does not encounter a disturbance prior to reflecting off the pile toe. Such disturbances include a change in cross sectional area, an open or loose splice or joint, or resistance along the shaft.

- Using only one force measurement precludes a data quality check based on the proportionality between force and velocity. Thus, a force measurement that is for some reason in error may not be detectable, which will lead to errors in the EF2 value. Data quality checks will be discussed further in Section 5.

The use if EF2 is therefore not recommended but it is often included in result presentations for the sake of completeness.

4.2 STRESSES

During SPT monitoring, it is also of interest to monitor compressive stresses at both the top of the drive rod and at its bottom.

At the pile top (location of sensors) the maximum compression stress averaged over the rod's cross section, **CSX**, is directly obtained from the measurements. Note that this stress value refers to the instrumented section. If the rod has a different cross sectional area then the stress in the rod will be different from CSX.

The SPTA or PDA can also calculate, in an approximate manner, the force at the rod bottom, **CFB**. To obtain the corresponding stress, this force value should be divided by the appropriate cross sectional area, e.g. by the rod area just above the sampler or by the sampler area itself. Of course, non-uniform stress components as they might occur at the sampler tip due to a sloping rock are not considered in this calculation.

5. DATA QUALITY CHECKS

Quality data is the first and foremost requirement for accurate dynamic testing results. It is therefore important that the measurement engineer performing SPTA or PDA tests has the experience necessary to recognize measurement problems and take appropriate corrective action should problems develop. Fortunately, dynamic pile testing allows for certain data quality checks because two independent measurements are taken that have to conform to the so-called proportionality relationship.

As long as there is only a wave traveling in one direction, as is the case during impact when only a downward traveling wave exists in the rod, force and velocity measured at its top are proportional

$$F = v\,Z \qquad (5)$$

where Z is again the pile impedance, Z = EA/c. This relationship can also be expressed in terms of stress

$$\sigma = F/A = v\,(E/c) \qquad (6)$$

or strain

$$\epsilon = \sigma/E = v / c \qquad (7)$$

This means that the early portion of strain times wave speed must be equal to the velocity unless the proportionality is affected by high friction near the pile top or by a pile cross sectional change not far below the sensors. Checking the proportionality is an excellent means of assuring meaningful measurements but is only truly meaningful for perfectly uniform rods. Open or loose splices, for example, will lead to a non-proportionality. For SPT rods it is fortunate that usually no soil resistance acts along the shaft and for that reason, proportionality can exist until the stress wave returns from sampler top or rod bottom unless connectors are not sufficiently tightened or have a significant mass.

Velocity data quality can also be checked by looking at the final displacement, DFN, which is calculated from the acceleration by double integration. If the calculated final displacement is much higher or lower than indicated by the N-value, the accelerometer attachment may be loose or the sensor may be faulty. If major drift in the velocity is observed, the EMX value may be in error, even though proportionality from impact to time 2L/c exists. In this case, it may be useful to evaluate the energy transferred to the drill rod at time 2L/c, which is calculated by the PDA or SPTA as the E2E quantity.

Calibration Appendix B

Results of SPT Rig Calibrations

DIEDRICH D-120 (SN 121)

SPT Analyzer Results
PDA-S Ver. 2021.34 - Printed: 5/5/2022

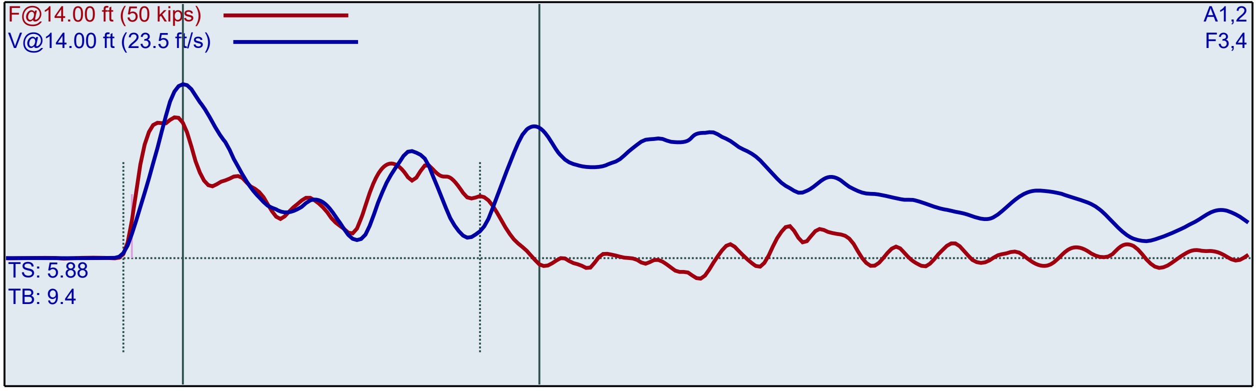
Diedrich D-120 - D121
MDP
D121

10_11.5
Interval start: 5/5/2022

AR: 1.19 in^2
LE: 14.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (10.00 - 11.50 ft], displaying BN: 31



F3 : [363AW1] 210.09 PDICAL (1) FF3
F4 : [363AWJ2] 210.62 PDICAL (1) FF3

A1 (PR): [K2607] 322.279 mv/6.4v/5000g (1) VF3
A2 (PR): [K11477] 415.534 mv/6.4v/5000g (1) VF3

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR %
1	6	10.08	28	16.3	1.9	244	69.8
2	6	10.17	29	17.2	44.0	256	73.1
3	6	10.25	29	16.5	43.9	260	74.3
4	6	10.33	30	17.6	43.6	292	83.4
5	6	10.42	30	16.8	43.3	286	81.8
6	6	10.50	30	17.6	43.7	292	83.3
7	15	10.53	31	17.7	43.5	278	79.5
8	15	10.57	30	17.5	43.5	269	76.7
9	15	10.60	29	17.4	43.6	275	78.5
10	15	10.63	31	17.4	43.0	278	79.3
11	15	10.67	30	17.3	43.6	286	81.8
12	15	10.70	30	16.9	43.5	271	77.4
13	15	10.73	31	17.9	43.2	286	81.8
14	15	10.77	31	17.4	43.4	281	80.3
15	15	10.80	30	17.1	43.4	268	76.6
16	15	10.83	30	17.2	43.4	269	76.9
17	15	10.87	29	16.9	43.3	260	74.3
18	15	10.90	30	17.1	43.5	265	75.6
19	15	10.93	30	16.9	43.1	264	75.3
20	15	10.97	30	17.0	43.3	270	77.1
21	15	11.00	29	16.6	43.2	268	76.7
22	12	11.04	29	16.7	43.3	268	76.5
23	12	11.08	29	16.6	43.2	265	75.8
24	12	11.13	29	16.7	43.5	272	77.7
25	12	11.17	28	16.5	43.2	263	75.3
26	12	11.21	27	16.5	43.4	265	75.8
27	12	11.25	29	16.5	43.2	262	74.9
28	12	11.29	29	17.0	43.5	266	76.1

29	12	11.33	27	16.0	43.3	259	73.9
30	12	11.38	28	16.5	43.4	257	73.6
31	12	11.42	27	16.0	43.4	263	75.1
32	12	11.46	28	16.2	43.3	260	74.2
33	12	11.50	27	16.0	43.3	261	74.6
		Average	29	16.9	43.4	268	76.7
		Std Dev	1	0.5	0.1	8	2.2
		Maximum	31	17.9	43.6	286	81.8
		Minimum	27	16.0	43.0	257	73.6

N-value: 27

Sample Interval Time: 44.20 seconds.

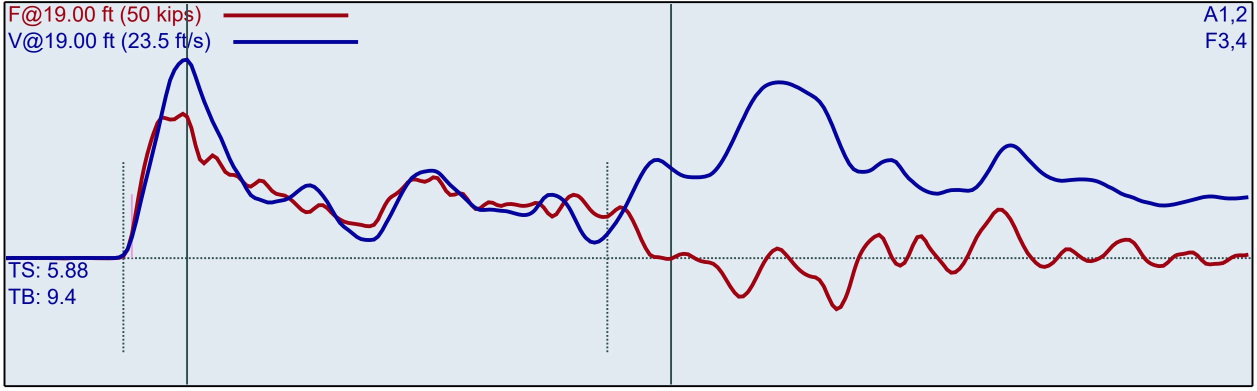
Diedrich D-120 - D121
MDP
D121

10_11.5
Interval start: 5/5/2022

AR: 1.19 in^2
LE: 19.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (15.00 - 16.50 ft], displaying BN: 52



F3 : [363AW1] 210.09 PDICAL (1) FF3
F4 : [363AWJ2] 210.62 PDICAL (1) FF3

A1 (PR): [K2607] 322.279 mv/6.4v/5000g (1) VF3
A2 (PR): [K11477] 415.534 mv/6.4v/5000g (1) VF3

BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR %
34	6	15.08	27	18.9	1.9	237	67.8
35	6	15.17	26	17.6	43.8	246	70.2
36	6	15.25	27	18.1	43.0	248	70.8
37	6	15.33	30	18.6	43.4	275	78.6
38	6	15.42	29	18.1	43.1	275	78.4
39	6	15.50	31	19.2	43.1	298	85.2
40	7	15.57	31	18.9	43.2	276	78.8
41	7	15.64	31	18.9	43.1	280	80.1
42	7	15.71	31	19.1	43.0	274	78.3
43	7	15.79	31	19.0	43.1	276	78.9
44	7	15.86	31	18.8	43.0	278	79.4
45	7	15.93	31	18.8	43.1	272	77.8
46	7	16.00	31	19.0	43.2	271	77.4
47	8	16.06	30	18.8	43.2	275	78.6
48	8	16.13	29	18.5	42.8	261	74.5
49	8	16.19	31	19.1	43.2	278	79.3
50	8	16.25	29	18.5	42.9	265	75.8
51	8	16.31	30	18.9	43.1	267	76.2
52	8	16.38	28	18.2	43.0	265	75.7
53	8	16.44	28	18.3	43.0	267	76.3
54	8	16.50	28	18.5	43.2	269	76.9
		Average	30	18.8	43.1	272	77.6
		Std Dev	1	0.3	0.1	6	1.6
		Maximum	31	19.1	43.2	280	80.1
		Minimum	28	18.2	42.8	261	74.5

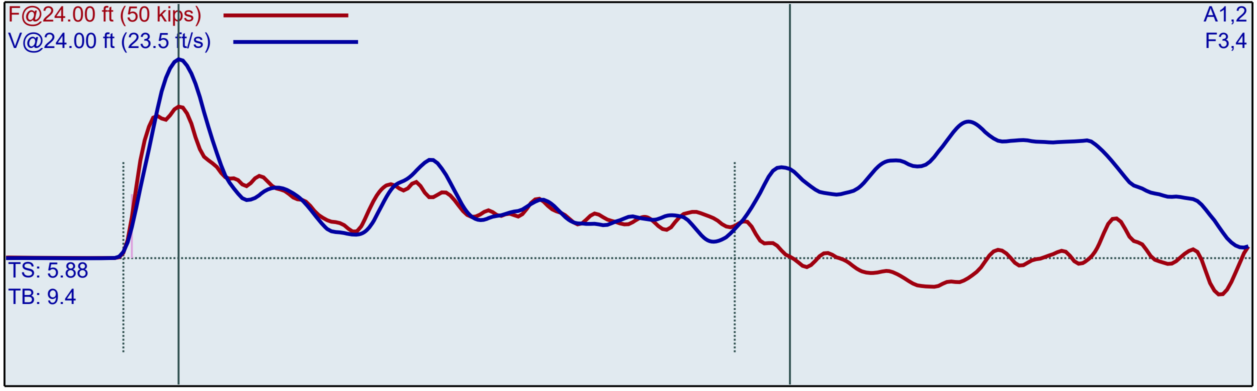
N-value: 15

Sample Interval Time: 27.92 seconds.

Diedrich D-120 - D121 10_11.5
MDP Interval start: 5/5/2022
D121

AR: 1.19 in^2 SP: 0.492 k/ft3
LE: 24.00 ft EM: 30000 ksi
WS: 16807.9 ft/s

Depth: (20.00 - 21.50 ft], displaying BN: 84



F3 : [363AW1] 210.09 PDICAL (1) FF3
F4 : [363AWJ2] 210.62 PDICAL (1) FF3

A1 (PR): [K2607] 322.279 mv/6.4v/5000g (1) VF3
A2 (PR): [K11477] 415.534 mv/6.4v/5000g (1) VF3

BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR %
55	11	20.05	33	19.6	1.9	266	76.0
56	11	20.09	33	19.7	44.0	280	79.9
57	11	20.14	33	19.4	43.6	275	78.4
58	11	20.18	33	19.9	43.2	281	80.3
59	11	20.23	33	19.8	43.4	280	80.0
60	11	20.27	32	19.5	43.0	277	79.2
61	11	20.32	32	19.1	43.2	287	82.1
62	11	20.36	32	19.4	43.1	287	82.0
63	11	20.41	31	18.9	43.3	287	81.9
64	11	20.45	32	18.9	43.1	288	82.2
65	11	20.50	32	19.4	42.8	297	84.9
66	11	20.55	32	19.0	43.4	293	83.8
67	11	20.59	32	19.5	43.1	299	85.6
68	11	20.64	32	19.1	43.0	287	81.9
69	11	20.68	32	19.4	43.1	292	83.3
70	11	20.73	32	19.4	43.1	288	82.4
71	11	20.77	32	18.9	43.2	284	81.1
72	11	20.82	32	18.9	43.1	282	80.5
73	11	20.86	32	19.2	43.0	285	81.5
74	11	20.91	31	18.4	43.1	279	79.8
75	11	20.95	30	18.0	43.1	272	77.7
76	11	21.00	31	18.8	42.9	277	79.2
77	10	21.05	31	18.3	43.4	271	77.5
78	10	21.10	30	18.3	43.0	268	76.7
79	10	21.15	31	18.5	43.0	270	77.3
80	10	21.20	30	18.2	43.1	274	78.2
81	10	21.25	31	18.8	43.1	276	79.0
82	10	21.30	30	18.5	43.0	278	79.4
83	10	21.35	30	18.2	43.2	272	77.6
84	10	21.40	30	18.3	43.2	272	77.6
85	10	21.45	30	18.3	43.2	273	78.1

86	10	21.50	29	18.1	43.1	270	77.0
		Average	31	18.7	43.1	279	79.8
		Std Dev	1	0.5	0.1	9	2.5
		Maximum	32	19.5	43.4	299	85.6
		Minimum	29	18.0	42.9	268	76.7

N-value: 21

Sample Interval Time: 43.14 seconds.

Summary of SPT Test Results

Project: Diedrich D-120 - D121, Test Date: 5/5/2022

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Blows Applied /6"	Start Depth ft	Final Depth ft	**N Value**	**N60 Value**	Average FMX kips	Average VMX ft/s	Average BPM bpm	Average EFV ft-lb	Average ETR %
14.00	**6-15-12**	10.00	11.50	**27**	**35**	29	16.9	43.4	268	76.7
19.00	**6-7-8**	15.00	16.50	**15**	**19**	30	18.8	43.1	272	77.6
24.00	**11-11-10**	20.00	21.50	**21**	**27**	31	18.7	43.1	279	79.8
					Overall Average Values:	30	17.9	43.2	273	77.9
					Standard Deviation:	1	1.0	0.2	9	2.6
					Overall Maximum Value:	32	19.5	43.6	299	85.6
					Overall Minimum Value:	27	16.0	42.8	257	73.6

GRL engineers, inc.
Dynamic Measurements and Analyses

June 20, 2022

Glenn Whyte
Odyssey Fluid Power
138 Progress Rd
North Bay, ON P1A 0B9, Canada

Re: <u>SPT Energy Calibration</u>
Diedrich D120 (Serial # D120-122)

GRL Job No. 225045-2

Dear Mr. Whyte:

This report summarizes the results of Standard Penetration Test (SPT) energy measurements taken from a SPT drilling rigs. The rig tested was a Diedrich D120 (Serial #122). The field work associated with the energy measurements summarized in this report was performed on May 18, 2022.

The purpose for collecting the SPT energy measurements was to compute the energy transfer efficiencies for the SPT hammers. To meet this objective, a model 8G Pile Driving Analyzer (PDA) was used to acquire and process the dynamic test data. Additional information regarding the testing equipment and analytical procedures is provided in Appendix A.

Test Sequence

An instrumented AWJ rod was used to take energy measurements for each of the rigs. Dynamic measurements were obtained at sampling intervals of 10 feet to 11.5 feet, 13 feet to 14.5 feet, 15 feet to 16.5 feet, and 25 feet to 26.5 feet. At each sampling interval, energy measurements were taken during 18 inches of driving of a split-spoon sampler.

Energy Transfer Measurements

An 8G model Pile Driving Analyzer was used to take measurements of strain and acceleration during driving of the sampler. The strain and acceleration signals were conditioned and converted to force and velocities by the PDA. The PDA interprets the measured dynamic data according to the Case Method equations. Force and velocity records from the PDA were also

viewed graphically on an LCD screen to evaluate data quality. All force and velocity records were digitally stored for subsequent analysis.

The maximum energy transferred to the drill rod (EFV) is calculated by integrating both the force and velocity records over time as follows:

$$EFV = \int F(t)V(t)dt$$

Where: $F(t)$ = the force at time t
$V(t)$ = the velocity at time t

The energy transfer ratio (ETR) or efficiency is computed by dividing EFV by the theoretical SPT hammer energy of 350 lb-ft (computed from the product of the hammer weight, assumed to be 140 lbs, and the fall height, assumed to be 2.5 ft). The SPT N-values can then be corrected for a nominal 60% transfer efficiency, $N_{60,}$ as follows:

$$N_{60} = (e_m / 60)\ N_m$$

Where: e_m = the measured transfer ratio (ETR)
N_m = the measured SPT "N" value

Conclusions

Tables in Appendix B summarize the average transferred energies and the energy transfer ratios for each drill rig at each sample depth calculated using the *EFV* equation. Also included are average values of the hammer operating rate, maximum impact force and maximum velocity of the rod. In addition, the overall performance, which represents the average of data from all sample depths, is shown. Complete information, including the maximum, minimum and standard deviation for each sampling depth, is included in Appendix B.

The overall transfer ratios (for all sampling depths weighted by N-values for each sample) were as follows:

SPT Rig (*Serial Number*)	**Overall Transfer Efficiency**
Diedrich D120 (Serial # D120-122)	**76.5%**

We appreciate the opportunity to be of assistance to you. Please do not hesitate to contact us if you have any questions regarding this report, or if we may be of further service.

Sincerely,
GRL Engineers, Inc.

Matthew Perrella

Matthew Perrella

C. Michael Morgano

C. Michael Morgano, P.E.

Calibration Appendix A

An Introduction To SPT Dynamic Pile Testing

APPENDIX A
AN INTRODUCTION INTO SPT DYNAMIC PILE TESTING

1. BACKGROUND

The Standard Penetration Test is frequently conducted as an in-situ assessment of soil strength. This test requires that a 140 lb weight is dropped 30 inches onto a drive rod at whose bottom a sampler is usually installed. The sampler is driven for 18 inches; the number of blows required for the last 12 inches of driving is the so-called N-value. The N-value may be used as a strength indicator for foundation design or as a means of assessing the liquefaction potential of soils.

Obviously, the SPT hammer efficiency is an important consideration when using the N-values for design purposes. Measurements have indicated that the energy in the drive rod is sometimes only 30% and and may reach 90% of the potential or rated energy of the SPT hammer (E-rated = 0.35 kip-ft or 0.475 kJ). The type of hammer used to drive the rod is the main reason for these variations. On the average, the energy in the drive rod is 60% of the standard rated energy.

Because of the variability of energy, methods based on N-values are considered unreliable. However, measurements during SPT testing using the Case Method can be done on a routine basis and these measurements yield the transferred energy values. With measured energy, EMX, known, an adjustment of the measured N-value, N_m, can be made as follows.

$$N_{60} = N_m [E_m / (0.6E_r)] \qquad (1)$$

Thus, if the measured energy value is equal to the normally expected transferred energy of 60% of E-rated then the adjusted and measured N-values are identical. On the other hand, if the measured energy is only 30% then the adjusted blow count will be reduced by 50%.

2. DYNAMIC TESTING AND ANALYSIS METHODS APPLIED TO SPT

The Case Method of dynamic pile testing, named after the Case Institute of Technology where it was developed between 1964 and 1975, requires that a substantial ram mass (e.g. a pile driving hammer) impacts the pile top such that the pile undergoes at least a small permanent set. Thus, the method is also referred to as a “High Strain Method”. The Case Method requires dynamic measurements on the pile or shaft under the ram impact and then a calculation of various quantities. Conveniently, for SPT applications, the measurements and analyses are done by a single piece of equipment: the SPT Analyzer. The Pile Driving Analyzer® (PDA) is also suitable to perform these measurements and data processing.

A related analysis method is the “Wave Equation Analysis” which calculates a relationship between bearing capacity, pile stresses, transferred energy and field blow count. The GRLWEAP™ program performs this analysis and provides a complete set of helpful information and input data. This program can be used very effectively to simulate the SPT driving process.

3. MEASUREMENTS

GRL uses equipment manufactured by Pile Dynamics, Inc. The system includes either an SPT-Analyzer™ (SPTA) or a Pile Driving Analyzer® (PDA), an instrumented rod section and two accelerometers. SPT energy testing is very closely related to and borrows procedures from dynamic pile testing. Those interested in the basis of the SPT energy testing method may obtain extensive literature on dynamic pile testing from GRL Engineers, Inc.

3.1 SPT Analyzer or Pile Driving Analyzer

The basis for the results calculated by the SPTA or PDA are strain and acceleration measured in an instrumented rod section. These signals are converted to rod top force, F(t), and rod top velocity, v(t). The SPTA or PDA conditions, calibrates and displays these signals and immediately computes average pile force and velocity thereby eliminating bending effects. The product of these two

measurements is then integrated over time which yields the energy transferred to the instrumented section as a function of time (see Section 4.1).

For convenience and accuracy, strain measurements are usually taken on an instrumented section of SPT drive rod. Ideally, the section properties of the instrumented rod and those of the drive rod are the same, however, using subs, other sections can also be utilized.

For the instrumented section, PDI provides a force calibration in such a way that the output of the instrumented rod is directly calculated without the need for an accurate elastic modulus or cross sectional area of the rod section.

The acceleration measurements are often demanding in the SPT environment, because of high frequency and high acceleration motion components. An experienced measurement engineer, therefore, has to evaluate the quality of this data before final conclusions are drawn from the numerical results calculated by SPTA or PDA.

SPTA or PDA records are taken while the standard N-value is acquired in the conventional manner. This then allows a direct correlation between N-value and average transferred energy.

3.2 HPA

The SPT hammer’s ram velocity may be directly obtained using radar technology in the Hammer Performance Analyzer™. The impact velocity results can be automatically processed with a PC or recorded on a strip chart. HPA measurements yield a hammer kinetic energy, but not the energy transferred to the drive rod.

4 RECORD EVALUATION BY SPTA OR PDA

4.1 HAMMER PERFORMANCE

The PDA calculates the energy transferred to the pile top from:

$$E(t) = \int_{0}^{t} F(\tau)v(\tau)\, d\tau \qquad (2)$$

The maximum of the E(t) curve is often called **ENTHRU or EMX;** it is the most important quantity for an overall evaluation of the performance of a hammer and driving system. **EMX** allows for a classification of the hammer's performance when presented as, e_T, the rated transfer efficiency, also called energy transfer ratio (**ETR**) or global efficiency.

$$e_T = EMX/E_R \qquad (3)$$

where E_R is the hammer manufacturer’s rated energy value or 0.35 kip-ft (0.475 kJ) in the case of the SPT hammer.

Often in the SPT literature one finds also reference to the EF2 energy. This evaluation is based on assumed proportionality between force and velocity (see also Section 5):

$$v(t) = F(t) / Z \qquad (4)$$

where Z = EA/c is the pile impedance, E is the elastic modulus, A is the cross sectional area and c is the speed of the stress wave in the pile material..

Combining equations 2 and 4 leads to

$$EF(t) = \int_{0}^{t} F(\tau)^2 / Z\, d\tau \qquad (5)$$

The EF2 transferred energy value is the EF-value at the time t = 2L/c, where L is the drive rod length and c is the stress wave speed in steel (16,800 ft/s or 5,124 m/s). Since the force is easier to measure than both force and velocity, Equation 5 is preferred by some test engineers. However, the EF method is fraught with errors and certain correction factors have to be applied to make it approximately correct. Among the error sources are the following:

- Proportionality is often violated prior to time 2L/c. The proportionality between force and velocity in a downward traveling wave only holds if the wave does not encounter a disturbance prior to reflecting off the pile toe. Such disturbances include a change in cross sectional area, an open or loose splice or joint, or resistance along the shaft.

- Using only one force measurement precludes a data quality check based on the proportionality between force and velocity. Thus, a force measurement that is for some reason in error may not be detectable, which will lead to errors in the EF2 value. Data quality checks will be discussed further in Section 5.

The use if EF2 is therefore not recommended but it is often included in result presentations for the sake of completeness.

4.2 STRESSES

During SPT monitoring, it is also of interest to monitor compressive stresses at both the top of the drive rod and at its bottom.

At the pile top (location of sensors) the maximum compression stress averaged over the rod's cross section, **CSX**, is directly obtained from the measurements. Note that this stress value refers to the instrumented section. If the rod has a different cross sectional area then the stress in the rod will be different from CSX.

The SPTA or PDA can also calculate, in an approximate manner, the force at the rod bottom, **CFB**. To obtain the corresponding stress, this force value should be divided by the appropriate cross sectional area, e.g. by the rod area just above the sampler or by the sampler area itself. Of course, non-uniform stress components as they might occur at the sampler tip due to a sloping rock are not considered in this calculation.

5. DATA QUALITY CHECKS

Quality data is the first and foremost requirement for accurate dynamic testing results. It is therefore important that the measurement engineer performing SPTA or PDA tests has the experience necessary to recognize measurement problems and take appropriate corrective action should problems develop. Fortunately, dynamic pile testing allows for certain data quality checks because two independent measurements are taken that have to conform to the so-called proportionality relationship.

As long as there is only a wave traveling in one direction, as is the case during impact when only a downward traveling wave exists in the rod, force and velocity measured at its top are proportional

$$F = v\,Z \qquad (5)$$

where Z is again the pile impedance, Z = EA/c. This relationship can also be expressed in terms of stress

$$\sigma = F/A = v\,(E/c) \qquad (6)$$

or strain

$$\epsilon = \sigma/E = v\,/\,c \qquad (7)$$

This means that the early portion of strain times wave speed must be equal to the velocity unless the proportionality is affected by high friction near the pile top or by a pile cross sectional change not far below the sensors. Checking the proportionality is an excellent means of assuring meaningful measurements but is only truly meaningful for perfectly uniform rods. Open or loose splices, for example, will lead to a non-proportionality. For SPT rods it is fortunate that usually no soil resistance acts along the shaft and for that reason, proportionality can exist until the stress wave returns from sampler top or rod bottom unless connectors are not sufficiently tightened or have a significant mass.

Velocity data quality can also be checked by looking at the final displacement, DFN, which is calculated from the acceleration by double integration. If the calculated final displacement is much higher or lower than indicated by the N-value, the accelerometer attachment may be loose or the sensor may be faulty. If major drift in the velocity is observed, the EMX value may be in error, even though proportionality from impact to time 2L/c exists. In this case, it may be useful to evaluate the energy transferred to the drill rod at time 2L/c, which is calculated by the PDA or SPTA as the E2E quantity.

Calibration Appendix B

Results of SPT Rig Calibrations

DIEDRICH D-120 (SN 122)

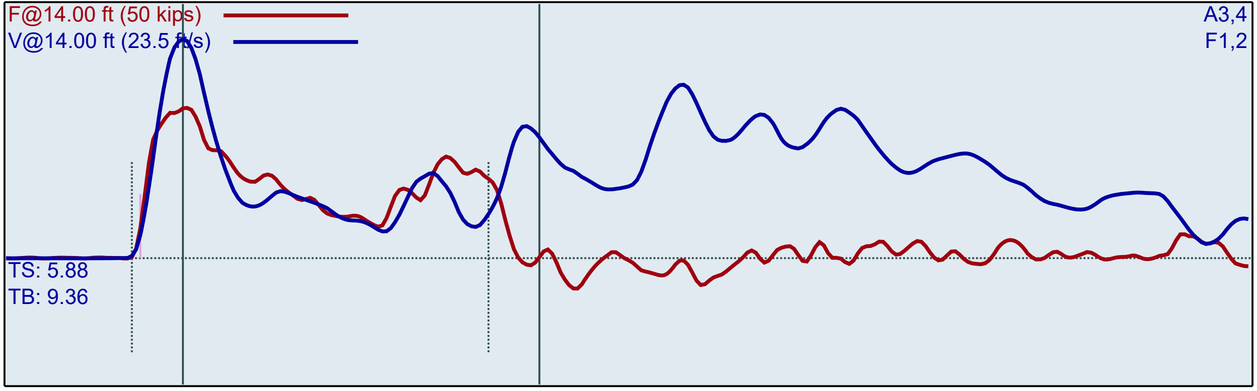
Diedrich D-120 - 122
MDP
SN 122

10_11.5
Interval start: 5/18/2022

AR: 1.19 in^2
LE: 14.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (10.00 - 11.50 ft], displaying BN: 23



F1 : [363AW1] 210.09 PDICAL (1) FF3
F2 : [363AWJ2] 210.62 PDICAL (1) FF3

A3 (PR): [K11477] 415.534 mv/6.4v/5000g (1) VF3
A4 (PR): [K2607] 322.279 mv/6.4v/5000g (1) VF3

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

BL#	BC	LP	FMX	VMX	BPM	EFV	ETR
	/6"	ft	kips	ft/s	bpm	ft-lb	%
1	6	10.08	27	18.9	1.9	256	73.1
2	6	10.17	30	18.0	39.1	270	77.2
3	6	10.25	31	18.8	39.0	275	78.5
4	6	10.33	31	19.2	39.0	281	80.3
5	6	10.42	32	19.3	39.0	282	80.6
6	6	10.50	30	18.4	38.9	294	84.1
7	9	10.56	31	19.3	38.9	274	78.3
8	9	10.61	30	18.8	39.1	266	76.1
9	9	10.67	30	18.8	39.0	270	77.1
10	9	10.72	30	18.8	39.0	270	77.1
11	9	10.78	30	19.1	39.0	264	75.3
12	9	10.83	29	19.0	38.9	267	76.3
13	9	10.89	29	19.2	38.9	270	77.2
14	9	10.94	29	18.5	39.1	259	73.9
15	9	11.00	29	19.1	39.0	260	74.3
16	10	11.05	30	19.7	39.0	271	77.4
17	10	11.10	29	19.1	39.1	260	74.3
18	10	11.15	29	19.5	39.0	264	75.3
19	10	11.20	29	19.3	38.9	258	73.8
20	10	11.25	29	19.4	39.0	271	77.3
21	10	11.30	30	20.6	39.1	268	76.5
22	10	11.35	29	19.8	39.0	262	74.9
23	10	11.40	29	20.1	39.0	268	76.6
24	10	11.45	30	20.6	39.0	263	75.1
25	10	11.50	29	20.6	39.1	256	73.2

Average	30	19.5	39.0	265	75.8
Std Dev	0	0.6	0.1	5	1.4
Maximum	31	20.6	39.1	274	78.3
Minimum	29	18.5	38.9	256	73.2

N-value: 19

Sample Interval Time: 36.93 seconds.

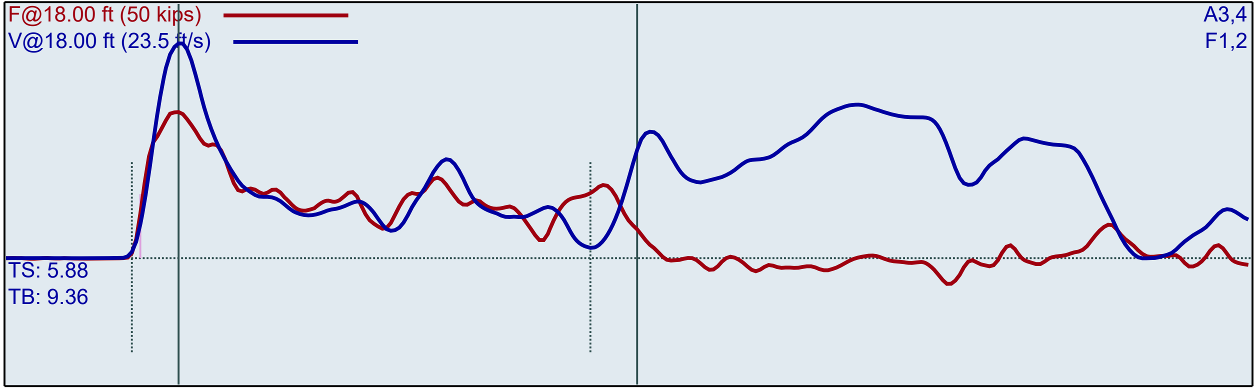
Diedrich D-120 - 122
MDP
SN 122

10_11.5
Interval start: 5/18/2022

AR: 1.19 in^2
LE: 18.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (13.00 - 14.50 ft], displaying BN: 42



F1 : [363AW1] 210.09 PDICAL (1) FF3
F2 : [363AWJ2] 210.62 PDICAL (1) FF3

A3 (PR): [K11477] 415.534 mv/6.4v/5000g (1) VF3
A4 (PR): [K2607] 322.279 mv/6.4v/5000g (1) VF3

BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR %
26	2	13.25	28	20.8	1.9	302	86.4
27	2	13.50	29	19.5	38.9	262	75.0
28	7	13.57	30	19.6	39.0	251	71.6
29	7	13.64	29	19.6	39.0	278	79.5
30	7	13.71	29	19.6	38.9	278	79.3
31	7	13.79	29	20.2	39.0	269	77.0
32	7	13.86	28	19.6	38.8	276	78.9
33	7	13.93	28	19.9	39.0	280	80.0
34	7	14.00	28	19.9	38.9	277	79.2
35	10	14.05	28	19.6	38.8	263	75.1
36	10	14.10	29	19.9	38.9	267	76.3
37	10	14.15	29	19.9	39.0	266	75.9
38	10	14.20	28	19.6	38.9	261	74.7
39	10	14.25	28	19.5	38.9	257	73.5
40	10	14.30	28	19.5	38.9	260	74.3
41	10	14.35	28	19.7	38.9	259	74.0
42	10	14.40	29	19.8	38.8	259	73.9
43	10	14.45	28	19.4	39.0	253	72.3
44	10	14.50	28	19.0	38.9	252	72.1
		Average	28	19.7	38.9	265	75.8
		Std Dev	0	0.3	0.1	10	2.7
		Maximum	30	20.2	39.0	280	80.0
		Minimum	28	19.0	38.8	251	71.6

N-value: 17

Sample Interval Time: 27.72 seconds.

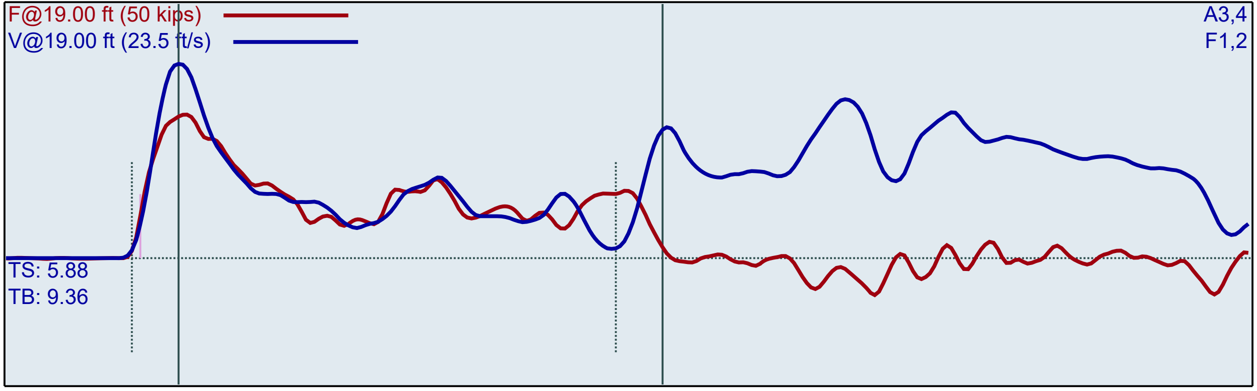
Diedrich D-120 - 122
MDP
SN 122

10_11.5
Interval start: 5/18/2022

AR: 1.19 in^2
LE: 19.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (15.00 - 16.50 ft], displaying BN: 62



F1 : [363AW1] 210.09 PDICAL (1) FF3
F2 : [363AWJ2] 210.62 PDICAL (1) FF3

A3 (PR): [K11477] 415.534 mv/6.4v/5000g (1) VF3
A4 (PR): [K2607] 322.279 mv/6.4v/5000g (1) VF3

BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR %
45	6	15.08	30	20.8	1.9	258	73.7
46	6	15.17	31	19.7	38.0	267	76.4
47	6	15.25	31	19.5	37.9	278	79.5
48	6	15.33	31	19.3	38.0	289	82.6
49	6	15.42	31	19.4	37.8	290	82.8
50	6	15.50	31	20.0	37.9	299	85.5
51	7	15.57	30	19.3	38.0	281	80.3
52	7	15.64	31	19.7	37.9	284	81.2
53	7	15.71	31	19.0	37.8	274	78.3
54	7	15.79	31	19.4	38.0	272	77.7
55	7	15.86	31	19.0	37.9	254	72.4
56	7	15.93	31	19.3	37.9	261	74.5
57	7	16.00	30	18.4	37.9	261	74.6
58	7	16.07	31	18.8	38.0	267	76.3
59	7	16.14	30	18.9	37.8	272	77.8
60	7	16.21	29	18.5	38.0	267	76.4
61	7	16.29	28	17.4	38.0	259	74.0
62	7	16.36	28	17.9	37.9	251	71.8
63	7	16.43	29	18.2	37.9	260	74.3
64	7	16.50	28	17.4	37.9	244	69.7
		Average	30	18.6	37.9	265	75.7
		Std Dev	1	0.7	0.1	11	3.1
		Maximum	31	19.7	38.0	284	81.2
		Minimum	28	17.4	37.8	244	69.7

N-value: 14

Sample Interval Time: 30.06 seconds.

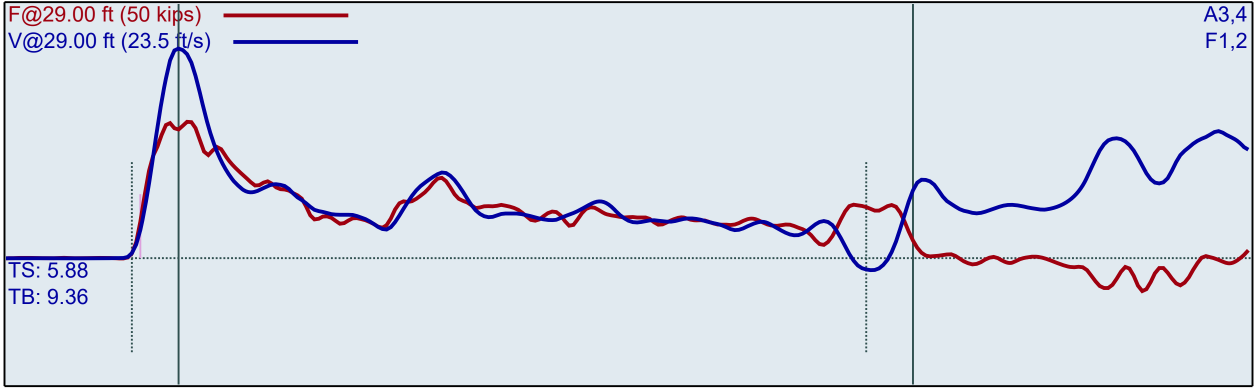
Diedrich D-120 - 122
MDP
SN 122

10_11.5
Interval start: 5/18/2022

AR: 1.19 in^2
LE: 29.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (25.00 - 26.50 ft], displaying BN: 98



F1 : [363AW1] 210.09 PDICAL (1) FF3
F2 : [363AWJ2] 210.62 PDICAL (1) FF3

A3 (PR): [K11477] 415.534 mv/6.4v/5000g (1) VF3
A4 (PR): [K2607] 322.279 mv/6.4v/5000g (1) VF3

BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR %
65	12	25.04	30	19.2	1.9	295	84.3
66	12	25.08	32	20.9	37.5	305	87.1
67	12	25.13	30	20.2	37.8	290	82.8
68	12	25.17	30	20.2	37.7	290	82.9
69	12	25.21	29	20.1	37.6	288	82.4
70	12	25.25	28	20.2	37.6	286	81.7
71	12	25.29	29	20.5	37.6	279	79.8
72	12	25.33	29	20.1	37.8	287	82.0
73	12	25.38	30	21.3	37.6	294	83.9
74	12	25.42	29	20.0	37.7	286	81.8
75	12	25.46	28	21.0	37.6	284	81.2
76	12	25.50	28	20.5	37.7	282	80.7
77	11	25.55	28	20.7	37.6	289	82.6
78	11	25.59	29	21.2	37.6	297	85.0
79	11	25.64	28	20.0	37.7	282	80.6
80	11	25.68	28	20.1	37.5	285	81.5
81	11	25.73	29	20.2	37.8	280	80.1
82	11	25.77	29	19.9	37.7	283	80.9
83	11	25.82	31	20.5	37.6	283	80.9
84	11	25.86	29	20.3	37.7	284	81.3
85	11	25.91	26	19.2	37.7	271	77.5
86	11	25.95	29	20.4	37.7	285	81.4
87	11	26.00	28	19.1	37.7	276	78.8
88	13	26.04	28	20.1	37.6	275	78.6
89	13	26.08	27	19.0	37.7	267	76.2
90	13	26.12	29	20.3	37.8	278	79.3
91	13	26.15	29	20.4	37.6	279	79.8
92	13	26.19	27	19.3	37.7	265	75.6
93	13	26.23	28	19.9	37.7	264	75.5
94	13	26.27	27	19.7	37.7	266	76.0
95	13	26.31	27	19.5	37.7	262	74.8

96	13	26.35	28	19.9	37.7	265	75.6
97	13	26.38	27	19.8	37.6	264	75.5
98	13	26.42	27	19.3	37.8	255	72.9
99	13	26.46	26	18.8	37.6	253	72.4
100	13	26.50	27	19.7	37.7	260	74.2
		Average	28	19.9	37.7	274	78.2
		Std Dev	1	0.6	0.1	11	3.2
		Maximum	31	21.2	37.8	297	85.0
		Minimum	26	18.8	37.5	253	72.4

N-value: 24

Sample Interval Time: 55.82 seconds.

Summary of SPT Test Results

Project: Diedrich D-120 - 122, Test Date: 5/18/2022

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Blows Applied /6"	Start Depth ft	Final Depth ft	**N Value**	**N60 Value**	Average FMX kips	Average VMX ft/s	Average BPM bpm	Average EFV ft-lb	Average ETR %
14.00	**6-9-10**	10.00	11.50	**19**	**24**	30	19.5	39.0	265	75.8
18.00	**2-7-10**	13.00	14.50	**17**	**21**	28	19.7	38.9	265	75.8
19.00	**6-7-7**	15.00	16.50	**14**	**17**	30	18.6	37.9	265	75.7
29.00	**12-11-13**	25.00	26.50	**24**	**30**	28	19.9	37.7	274	78.2
					Overall Average Values:	29	19.5	38.4	268	76.5
					Standard Deviation:	1	0.7	0.6	10	3.0
					Overall Maximum Value:	31	21.2	39.1	297	85.0
					Overall Minimum Value:	26	17.4	37.5	244	69.7

GRL Dynamic Measurements and Analyses
engineers, inc.

June 20, 2022

Glenn Whyte
Odyssey Fluid Power
138 Progress Rd
North Bay, ON P1A 0B9, Canada

Re: SPT Energy Calibration
Diedrich D50 (Serial # D57)

GRL Job No. 225045-2

Dear Mr. Whyte:

This report summarizes the results of Standard Penetration Test (SPT) energy measurements taken from a SPT drilling rigs. The rig tested was a Diedrich D50 (Serial #D57). The field work associated with the energy measurements summarized in this report was performed on June 2, 2022.

The purpose for collecting the SPT energy measurements was to compute the energy transfer efficiencies for the SPT hammers. To meet this objective, a model 8G Pile Driving Analyzer (PDA) was used to acquire and process the dynamic test data. Additional information regarding the testing equipment and analytical procedures is provided in Appendix A.

Test Sequence

An instrumented AWJ rod was used to take energy measurements for each of the rigs. Dynamic measurements were obtained at sampling intervals of 10 feet to 11.5 feet, 13 feet to 14.5 feet, 15 feet to 16.5 feet, 18 feet to 19.5 feet, and 20 feet to 21.5 feet. At each sampling interval, energy measurements were taken during 18 inches of driving of a split-spoon sampler.

Energy Transfer Measurements

An 8G model Pile Driving Analyzer was used to take measurements of strain and acceleration during driving of the sampler. The strain and acceleration signals were conditioned and converted to force and velocities by the PDA. The PDA interprets the measured dynamic data according to the Case Method equations. Force and velocity records from the PDA were also

viewed graphically on an LCD screen to evaluate data quality. All force and velocity records were digitally stored for subsequent analysis.

The maximum energy transferred to the drill rod (EFV) is calculated by integrating both the force and velocity records over time as follows:

$$EFV = \int F(t)V(t)dt$$

Where: $F(t)$ = the force at time t
$V(t)$ = the velocity at time t

The energy transfer ratio (ETR) or efficiency is computed by dividing EFV by the theoretical SPT hammer energy of 350 lb-ft (computed from the product of the hammer weight, assumed to be 140 lbs, and the fall height, assumed to be 2.5 ft). The SPT N-values can then be corrected for a nominal 60% transfer efficiency, $N_{60,}$ as follows:

$$N_{60} = (e_m / 60)\ N_m$$

Where: e_m = the measured transfer ratio (ETR)
N_m = the measured SPT “N” value

Conclusions

Tables in Appendix B summarize the average transferred energies and the energy transfer ratios for each drill rig at each sample depth calculated using the *EFV* equation. Also included are average values of the hammer operating rate, maximum impact force and maximum velocity of the rod. In addition, the overall performance, which represents the average of data from all sample depths, is shown. Complete information, including the maximum, minimum and standard deviation for each sampling depth, is included in Appendix B.

The overall transfer ratios (for all sampling depths weighted by N-values for each sample) were as follows:

SPT Rig (*Serial Number*)	**Overall Transfer Efficiency**
Diedrich D50(Serial # D57)	**68.2%**

We appreciate the opportunity to be of assistance to you. Please do not hesitate to contact us if you have any questions regarding this report, or if we may be of further service.

Sincerely,
GRL Engineers, Inc.

Matthew Perrella

Matthew Perrella

C. Michel Morgano

C. Michael Morgano, P.E.

Calibration Appendix A

An Introduction To SPT Dynamic Pile Testing

APPENDIX A
AN INTRODUCTION INTO SPT DYNAMIC PILE TESTING

The following has been written by GRL Engineers, Inc. and may only be copied with its written permission.

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1. BACKGROUND

The Standard Penetration Test is frequently conducted as an in-situ assessment of soil strength. This test requires that a 140 lb weight is dropped 30 inches onto a drive rod at whose bottom a sampler is usually installed. The sampler is driven for 18 inches; the number of blows required for the last 12 inches of driving is the so-called N-value. The N-value may be used as a strength indicator for foundation design or as a means of assessing the liquefaction potential of soils.

Obviously, the SPT hammer efficiency is an important consideration when using the N-values for design purposes. Measurements have indicated that the energy in the drive rod is sometimes only 30% and and may reach 90% of the potential or rated energy of the SPT hammer (E-rated = 0.35 kip-ft or 0.475 kJ). The type of hammer used to drive the rod is the main reason for these variations. On the average, the energy in the drive rod is 60% of the standard rated energy.

Because of the variability of energy, methods based on N-values are considered unreliable. However, measurements during SPT testing using the Case Method can be done on a routine basis and these measurements yield the transferred energy values. With measured energy, EMX, known, an adjustment of the measured N-value, N_m, can be made as follows.

$$N_{60} = N_m [E_m / (0.6E_r)] \qquad (1)$$

Thus, if the measured energy value is equal to the normally expected transferred energy of 60% of E-rated then the adjusted and measured N-values are identical. On the other hand, if the measured energy is only 30% then the adjusted blow count will be reduced by 50%.

2. DYNAMIC TESTING AND ANALYSIS METHODS APPLIED TO SPT

The Case Method of dynamic pile testing, named after the Case Institute of Technology where it was developed between 1964 and 1975, requires that a substantial ram mass (e.g. a pile driving hammer) impacts the pile top such that the pile undergoes at least a small permanent set. Thus, the method is also referred to as a “High Strain Method”. The Case Method requires dynamic measurements on the pile or shaft under the ram impact and then a calculation of various quantities. Conveniently, for SPT applications, the measurements and analyses are done by a single piece of equipment: the SPT Analyzer. The Pile Driving Analyzer® (PDA) is also suitable to perform these measurements and data processing.

A related analysis method is the “Wave Equation Analysis” which calculates a relationship between bearing capacity, pile stresses, transferred energy and field blow count. The GRLWEAP™ program performs this analysis and provides a complete set of helpful information and input data. This program can be used very effectively to simulate the SPT driving process.

3. MEASUREMENTS

GRL uses equipment manufactured by Pile Dynamics, Inc. The system includes either an SPT-Analyzer™ (SPTA) or a Pile Driving Analyzer® (PDA), an instrumented rod section and two accelerometers. SPT energy testing is very closely related to and borrows procedures from dynamic pile testing. Those interested in the basis of the SPT energy testing method may obtain extensive literature on dynamic pile testing from GRL Engineers, Inc.

3.1 SPT Analyzer or Pile Driving Analyzer

The basis for the results calculated by the SPTA or PDA are strain and acceleration measured in an instrumented rod section. These signals are converted to rod top force, F(t), and rod top velocity, v(t). The SPTA or PDA conditions, calibrates and displays these signals and immediately computes average pile force and velocity thereby eliminating bending effects. The product of these two

measurements is then integrated over time which yields the energy transferred to the instrumented section as a function of time (see Section 4.1).

For convenience and accuracy, strain measurements are usually taken on an instrumented section of SPT drive rod. Ideally, the section properties of the instrumented rod and those of the drive rod are the same, however, using subs, other sections can also be utilized.

For the instrumented section, PDI provides a force calibration in such a way that the output of the instrumented rod is directly calculated without the need for an accurate elastic modulus or cross sectional area of the rod section.

The acceleration measurements are often demanding in the SPT environment, because of high frequency and high acceleration motion components. An experienced measurement engineer, therefore, has to evaluate the quality of this data before final conclusions are drawn from the numerical results calculated by SPTA or PDA.

SPTA or PDA records are taken while the standard N-value is acquired in the conventional manner. This then allows a direct correlation between N-value and average transferred energy.

3.2 HPA

The SPT hammer's ram velocity may be directly obtained using radar technology in the Hammer Performance Analyzer™. The impact velocity results can be automatically processed with a PC or recorded on a strip chart. HPA measurements yield a hammer kinetic energy, but not the energy transferred to the drive rod.

4 RECORD EVALUATION BY SPTA OR PDA

4.1 HAMMER PERFORMANCE

The PDA calculates the energy transferred to the pile top from:

$$E(t) = \int_{o}^{t} F(\tau)v(\tau)\, d\tau \qquad (2)$$

The maximum of the E(t) curve is often called **ENTHRU or EMX;** it is the most important quantity for an overall evaluation of the performance of a hammer and driving system. **EMX** allows for a classification of the hammer's performance when presented as, e_T, the rated transfer efficiency, also called energy transfer ratio (**ETR**) or global efficiency.

$$e_T = EMX/E_R \qquad (3)$$

where E_R is the hammer manufacturer's rated energy value or 0.35 kip-ft (0.475 kJ) in the case of the SPT hammer.

Often in the SPT literature one finds also reference to the EF2 energy. This evaluation is based on assumed proportionality between force and velocity (see also Section 5):

$$v(t) = F(t) / Z \qquad (4)$$

where Z = EA/c is the pile impedance, E is the elastic modulus, A is the cross sectional area and c is the speed of the stress wave in the pile material..

Combining equations 2 and 4 leads to

$$EF(t) = \int_{o}^{t} F(\tau)^2 / Z\, d\tau \qquad (5)$$

The EF2 transferred energy value is the EF-value at the time t = 2L/c, where L is the drive rod length and c is the stress wave speed in steel (16,800 ft/s or 5,124 m/s). Since the force is easier to measure than both force and velocity, Equation 5 is preferred by some test engineers. However, the EF method is fraught with errors and certain correction factors have to be applied to make it approximately correct. Among the error sources are the following:

- Proportionality is often violated prior to time 2L/c. The proportionality between force and velocity in a downward traveling wave only holds if the wave does not encounter a disturbance prior to reflecting off the pile toe. Such disturbances include a change in cross sectional area, an open or loose splice or joint, or resistance along the shaft.

- Using only one force measurement precludes a data quality check based on the proportionality between force and velocity. Thus, a force measurement that is for some reason in error may not be detectable, which will lead to errors in the EF2 value. Data quality checks will be discussed further in Section 5.

The use if EF2 is therefore not recommended but it is often included in result presentations for the sake of completeness.

4.2 STRESSES

During SPT monitoring, it is also of interest to monitor compressive stresses at both the top of the drive rod and at its bottom.

At the pile top (location of sensors) the maximum compression stress averaged over the rod's cross section, **CSX**, is directly obtained from the measurements. Note that this stress value refers to the instrumented section. If the rod has a different cross sectional area then the stress in the rod will be different from CSX.

The SPTA or PDA can also calculate, in an approximate manner, the force at the rod bottom, **CFB**. To obtain the corresponding stress, this force value should be divided by the appropriate cross sectional area, e.g. by the rod area just above the sampler or by the sampler area itself. Of course, non-uniform stress components as they might occur at the sampler tip due to a sloping rock are not considered in this calculation.

5. DATA QUALITY CHECKS

Quality data is the first and foremost requirement for accurate dynamic testing results. It is therefore important that the measurement engineer performing SPTA or PDA tests has the experience necessary to recognize measurement problems and take appropriate corrective action should problems develop. Fortunately, dynamic pile testing allows for certain data quality checks because two independent measurements are taken that have to conform to the so-called proportionality relationship.

As long as there is only a wave traveling in one direction, as is the case during impact when only a downward traveling wave exists in the rod, force and velocity measured at its top are proportional

$$F = v\,Z \qquad (5)$$

where Z is again the pile impedance, Z = EA/c. This relationship can also be expressed in terms of stress

$$\sigma = F/A = v\,(E/c) \qquad (6)$$

or strain

$$\epsilon = \sigma/E = v / c \qquad (7)$$

This means that the early portion of strain times wave speed must be equal to the velocity unless the proportionality is affected by high friction near the pile top or by a pile cross sectional change not far below the sensors. Checking the proportionality is an excellent means of assuring meaningful measurements but is only truly meaningful for perfectly uniform rods. Open or loose splices, for example, will lead to a non-proportionality. For SPT rods it is fortunate that usually no soil resistance acts along the shaft and for that reason, proportionality can exist until the stress wave returns from sampler top or rod bottom unless connectors are not sufficiently tightened or have a significant mass.

Velocity data quality can also be checked by looking at the final displacement, DFN, which is calculated from the acceleration by double integration. If the calculated final displacement is much higher or lower than indicated by the N-value, the accelerometer attachment may be loose or the sensor may be faulty. If major drift in the velocity is observed, the EMX value may be in error, even though proportionality from impact to time 2L/c exists. In this case, it may be useful to evaluate the energy transferred to the drill rod at time 2L/c, which is calculated by the PDA or SPTA as the E2E quantity.

Calibration Appendix B

Results of SPT Rig Calibrations

DIEDRICH D-50 (SN D57)

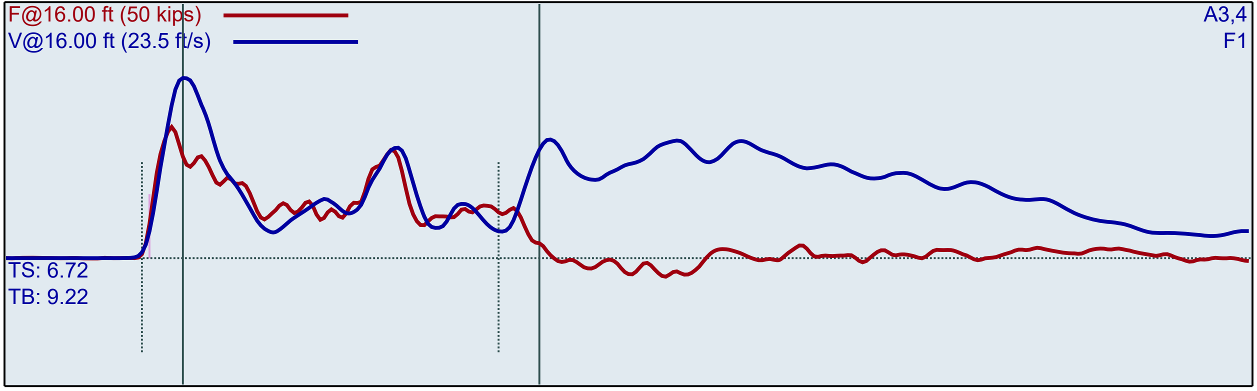
Diedrich D50 - D57
MDP
SN D57

10-11.5
Interval start: 6/2/2022

AR: 1.19 in^2
LE: 16.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (10.00 - 11.50 ft], displaying BN: 25



F1 : [363AW1] 210.09 PDICAL (1) FF3

A3 (PR): [K11477] 415.534 mv/6.4v/5000g (1) VF3
A4 (PR): [K2607] 322.279 mv/6.4v/5000g (1) VF3

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR %
1	8	10.06	24	20.0	1.9	235	67.2
2	8	10.13	27	20.2	38.8	254	72.7
3	8	10.19	27	19.7	39.5	250	71.3
4	8	10.25	32	19.8	38.9	265	75.7
5	8	10.31	31	20.2	39.2	254	72.5
6	8	10.38	30	19.0	39.1	248	70.9
7	8	10.44	29	19.8	39.2	245	69.9
8	8	10.50	26	18.1	39.1	236	67.3
9	8	10.56	31	19.2	39.1	245	70.1
10	8	10.63	30	19.0	39.2	247	70.5
11	8	10.69	27	17.4	39.2	239	68.2
12	8	10.75	27	18.5	39.1	243	69.5
13	8	10.81	27	17.8	39.2	252	71.9
14	8	10.88	27	17.0	39.2	246	70.2
15	8	10.94	27	17.9	39.0	250	71.5
16	8	11.00	25	17.0	39.2	240	68.4
17	11	11.05	24	16.6	39.1	228	65.0
18	11	11.09	25	17.0	39.1	228	65.2
19	11	11.14	26	16.8	39.1	237	67.7
20	11	11.18	25	16.8	39.2	230	65.7
21	11	11.23	25	16.8	39.3	233	66.5
22	11	11.27	25	16.7	39.1	233	66.6
23	11	11.32	26	16.9	39.3	233	66.4
24	11	11.36	25	16.7	39.2	231	66.1
25	11	11.41	26	16.6	39.1	236	67.3
26	11	11.45	24	16.5	39.2	230	65.8
27	11	11.50	25	16.3	39.1	240	68.5

Average	26	17.2	39.2	238	68.0
Std Dev	2	0.8	0.1	7	2.1
Maximum	31	19.2	39.3	252	71.9
Minimum	24	16.3	39.0	228	65.0
	N-value: 19				

Sample Interval Time: 39.84 seconds.

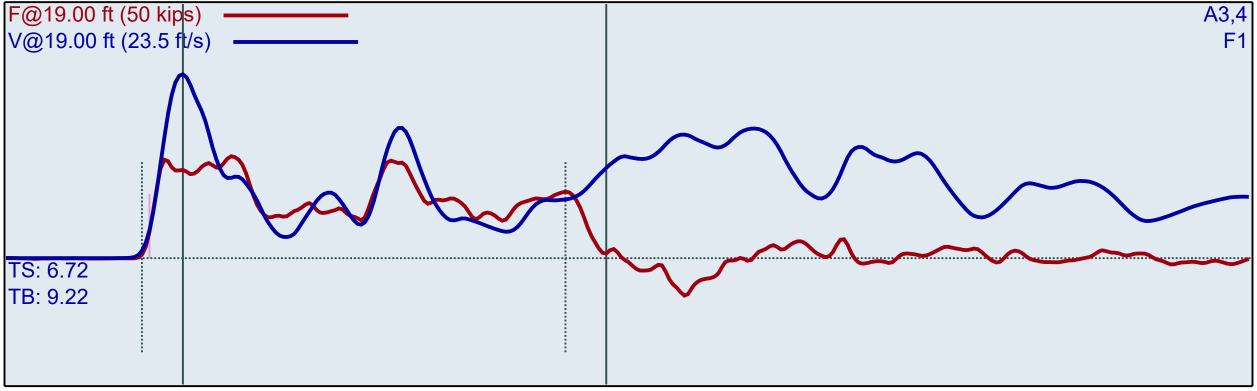
Diedrich D50 - D57
MDP
SN D57

10-11.5
Interval start: 6/2/2022

AR: 1.19 in^2
LE: 19.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (13.00 - 14.50 ft], displaying BN: 49



F1 : [363AW1] 210.09 PDICAL (1) FF3

A3 (PR): [K11477] 415.534 mv/6.4v/5000g (1) VF3
A4 (PR): [K2607] 322.279 mv/6.4v/5000g (1) VF3

BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR %
29	6	13.08	24	17.2	38.4	243	69.5
30	6	13.17	23	16.8	38.7	234	66.8
31	6	13.25	22	16.8	38.5	235	67.1
32	6	13.33	22	16.7	38.7	241	68.9
33	6	13.42	21	16.6	38.7	245	69.9
34	6	13.50	21	16.8	38.6	251	71.8
35	7	13.57	21	16.6	38.6	242	69.0
36	7	13.64	20	16.6	38.7	236	67.3
37	7	13.71	20	16.7	38.4	234	66.7
38	7	13.79	20	16.6	38.6	226	64.6
39	7	13.86	20	16.7	38.4	233	66.6
40	7	13.93	20	16.6	38.7	228	65.0
41	7	14.00	20	17.0	38.5	232	66.2
42	10	14.05	21	16.9	38.5	229	65.4
43	10	14.10	19	16.7	38.6	227	64.9
44	10	14.15	20	16.9	38.5	226	64.6
45	10	14.20	20	16.4	38.6	225	64.3
46	10	14.25	20	16.9	38.7	226	64.5
47	10	14.30	20	17.1	38.6	225	64.2
48	10	14.35	20	16.9	38.6	235	67.0
49	10	14.40	20	16.9	38.5	236	67.5
50	10	14.45	20	16.6	38.8	233	66.6
51	10	14.50	20	16.3	38.7	232	66.2
		Average	20	16.7	38.6	231	65.9
		Std Dev	0	0.2	0.1	5	1.3
		Maximum	21	17.1	38.8	242	69.0
		Minimum	19	16.3	38.4	225	64.2

N-value: 17

Sample Interval Time: 34.19 seconds.

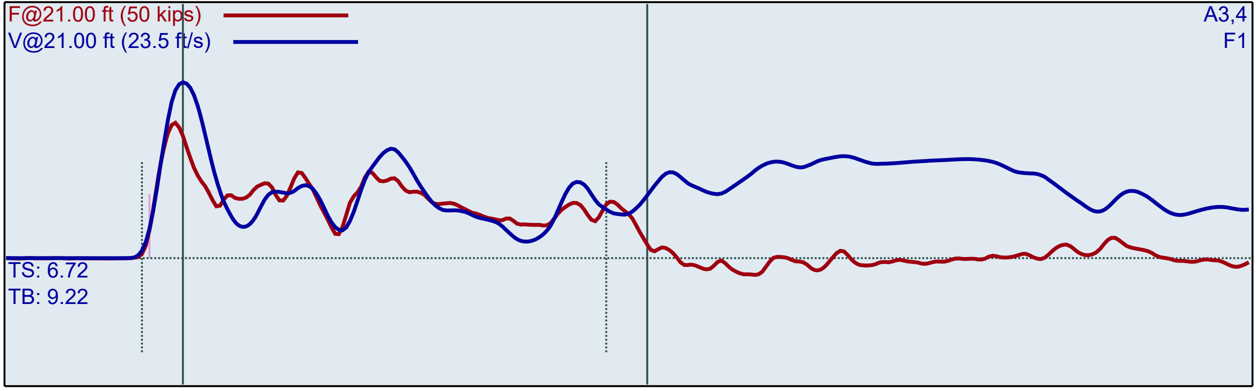
Diedrich D50 - D57
MDP
SN D57

10-11.5
Interval start: 6/2/2022

AR: 1.19 in^2
LE: 21.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (15.00 - 16.50 ft], displaying BN: 65



F1 : [363AW1] 210.09 PDICAL (1) FF3

A3 (PR): [K11477] 415.534 mv/6.4v/5000g (1) VF3
A4 (PR): [K2607] 322.279 mv/6.4v/5000g (1) VF3

BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR %
52	3	15.17	28	17.5	1.9	227	64.9
53	3	15.33	28	17.2	38.5	235	67.2
54	3	15.50	28	17.2	38.5	251	71.7
55	4	15.63	28	17.2	38.5	243	69.4
56	4	15.75	28	16.7	38.6	242	69.1
57	4	15.88	27	16.8	38.5	253	72.3
58	4	16.00	27	16.4	38.4	246	70.4
59	9	16.06	26	16.1	38.5	221	63.0
60	9	16.11	27	16.5	38.5	228	65.3
61	9	16.17	26	16.1	38.7	231	65.9
62	9	16.22	26	16.0	38.6	233	66.6
63	9	16.28	27	16.4	38.6	235	67.0
64	9	16.33	27	16.2	38.5	234	66.9
65	9	16.39	26	16.2	38.5	235	67.3
66	9	16.44	26	15.9	38.6	237	67.8
67	9	16.50	26	16.2	38.6	243	69.4
		Average	27	16.4	38.5	237	67.7
		Std Dev	1	0.3	0.1	8	2.3
		Maximum	28	17.2	38.7	253	72.3
		Minimum	26	15.9	38.4	221	63.0

N-value: 13

Sample Interval Time: 23.33 seconds.

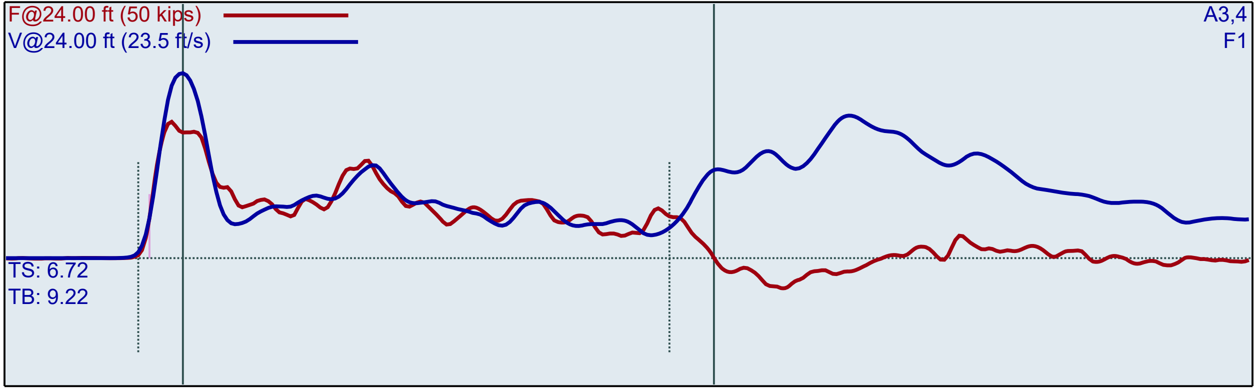
Diedrich D50 - D57
MDP
SN D57

10-11.5
Interval start: 6/2/2022

AR: 1.19 in^2
LE: 24.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (18.00 - 19.50 ft], displaying BN: 81



F1 : [363AW1] 210.09 PDICAL (1) FF3

A3 (PR): [K11477] 415.534 mv/6.4v/5000g (1) VF3
A4 (PR): [K2607] 322.279 mv/6.4v/5000g (1) VF3

BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR %
68	4	18.13	29	18.1	1.9	247	70.5
69	4	18.25	29	18.1	38.3	255	72.8
70	4	18.38	30	18.8	38.4	265	75.8
71	4	18.50	29	18.5	38.6	249	71.1
72	5	18.60	28	18.1	38.5	250	71.3
73	5	18.70	29	17.9	38.5	252	71.9
74	5	18.80	29	18.1	38.4	252	72.1
75	5	18.90	28	17.9	38.5	249	71.1
76	5	19.00	28	17.6	38.4	257	73.5
77	7	19.07	28	17.5	38.4	245	70.0
78	7	19.14	26	17.1	38.4	242	69.2
79	7	19.21	27	17.0	38.5	242	69.0
80	7	19.29	26	16.7	38.6	241	68.9
81	7	19.36	27	17.0	38.4	242	69.2
82	7	19.43	28	17.5	38.5	243	69.4
83	7	19.50	25	16.6	38.5	236	67.3
		Average	27	17.4	38.5	246	70.2
		Std Dev	1	0.5	0.1	6	1.7
		Maximum	29	18.1	38.6	257	73.5
		Minimum	25	16.6	38.4	236	67.3

N-value: 12

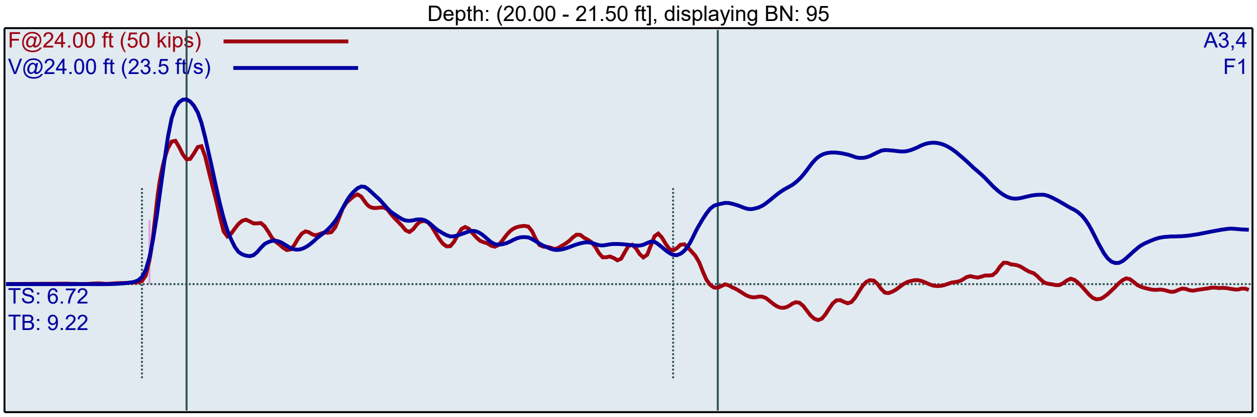
Sample Interval Time: 23.40 seconds.

Diedrich D50 - D57
MDP
SN D57

10-11.5
Interval start: 6/2/2022

AR: 1.19 in^2
LE: 24.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi


Depth: (20.00 - 21.50 ft], displaying BN: 95

F1 : [363AW1] 210.09 PDICAL (1) FF3

A3 (PR): [K11477] 415.534 mv/6.4v/5000g (1) VF3
A4 (PR): [K2607] 322.279 mv/6.4v/5000g (1) VF3

BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR %
84	4	20.13	32	19.0	1.9	262	74.9
85	4	20.25	29	17.9	38.3	249	71.1
86	4	20.38	29	17.2	38.4	265	75.6
87	4	20.50	29	16.2	38.5	242	69.2
88	5	20.60	28	16.9	38.4	248	70.9
89	5	20.70	26	16.5	38.5	239	68.3
90	5	20.80	26	16.2	38.3	236	67.5
91	5	20.90	29	17.7	38.5	248	70.7
92	5	21.00	30	17.7	38.4	253	72.3
93	5	21.10	28	17.0	38.4	252	72.0
94	5	21.20	28	17.1	38.4	247	70.5
95	5	21.30	28	17.0	38.4	257	73.3
96	5	21.40	28	17.0	38.3	242	69.2
97	5	21.50	28	17.1	38.4	245	70.0
		Average	28	17.0	38.4	247	70.5
		Std Dev	1	0.4	0.1	6	1.7
		Maximum	30	17.7	38.5	257	73.3
		Minimum	26	16.2	38.3	236	67.5

N-value: 10

Sample Interval Time: 20.29 seconds.

Summary of SPT Test Results

Project: Diedrich D50 - D57, Test Date: 6/2/2022

FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute

EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Blows Applied /6"	Start Depth ft	Final Depth ft	**N Value**	**N60 Value**	Average FMX kips	Average VMX ft/s	Average BPM bpm	Average EFV ft-lb	Average ETR %
16.00	**8-8-11**	10.00	11.50	**19**	**21**	26	17.2	39.2	238	68.0
19.00	**6-7-10**	13.00	14.50	**17**	**19**	20	16.7	38.6	231	65.9
21.00	**3-4-9**	15.00	16.50	**13**	**14**	27	16.4	38.5	237	67.7
24.00	**4-5-7**	18.00	19.50	**12**	**13**	27	17.4	38.5	246	70.2
24.00	**4-5-5**	20.00	21.50	**10**	**11**	28	17.0	38.4	247	70.5
					Overall Average Values:	25	17.0	38.7	239	68.2
					Standard Deviation:	3	0.7	0.3	9	2.5
					Overall Maximum Value:	31	19.2	39.3	257	73.5
					Overall Minimum Value:	19	15.9	38.3	221	63.0

List of Symbols
Lithological and Geotechnical Rock Description Terminology
Field Estimation of Rock Strength
Field Estimation of Rock Weathering

METHOD OF SOIL CLASSIFICATION

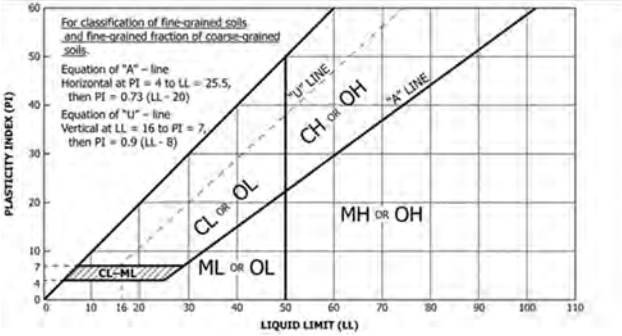
The WSP Canada Soil Classification[1] System is based on the Unified Soil Classification System (USCS) (after ASTM D2487)

Organic or Inorganic	Soil Group	Type of Soil		Gradation or Plasticity	$Cu = \frac{D_{60}}{D_{10}}$	$Cc = \frac{(D_{30})^2}{D_{10} x D_{60}}$	Organic Content [6,9]	USCS Group Symbol[3,5,7]	Primary Group Name[2]
INORGANIC (Organic Content <30% by mass)	**COARSE-GRAINED SOILS** (>50% by mass is larger than 0.075 mm)	GRAVELS (>50% by mass of coarse fraction is larger than 4.75 mm)	Clean Gravels with <5% fines [3] (by mass)	Well Graded	≥4 (and)	≥1 to ≤3	≤30%	GW	Well-graded GRAVEL [4,6]
				Poorly Graded	<4 (and/or)	<1 or >3		GP	Poorly graded GRAVEL [4,6]
			Gravels with >12% fines [3] (by mass)	Below A Line	n/a			GM	SILTY GRAVEL [4,6]
				Above A Line	n/a			GC	CLAYEY GRAVEL [4,5,6]
		SANDS (≥50% by mass of coarse fraction is smaller than 4.75 mm)	Clean Sands with <5% fines [7] (by mass)	Well Graded	≥6 (and)	≥1 to ≤3		SW	Well-graded SAND [6,8]
				Poorly Graded	<6 (and/or)	<1 or >3		SP	Poorly graded SAND [6,8]
			Sands with >12% fines [7] (by mass)	Below A Line	n/a			SM	SILTY SAND [6,8]
				Above A Line	n/a			SC	CLAYEY SAND [5,6,8]

Organic or Inorganic	Soil Group	Type of Soil	Laboratory Tests	Field Indicators					Organic Content [B,H]	USCS Group Symbol [A]	Primary Group Name [A]
				Dilatancy	Dry Strength	Shine Test	Thread Diameter (mm)	Toughness (of 3 mm thread)			
INORGANIC (Organic Content <30% by mass)	**FINE-GRAINED SOILS** (≥50% by mass is smaller than 0.075 mm)	SILTS (Nonplastic or PI and LL plot **below A-Line** on Plasticity Chart below) [C]	Liquid Limit <50 [D]	Rapid	None to Low	Dull to None	3 to >6	Low/can't roll 3 mm	<15%	ML	SILT [H]
				None to Slow	Low to Medium	Dull to Slight	3 to 6	Low	15% to 30%	OL	ORGANIC SILT
			Liquid Limit ≥50 [D]	None to V.Slow	Low to Medium	Slight	3 to 6	Low to Medium	<15%	MH	ELASTIC SILT[H]
				None	Medium to High	Dull to Slight	1 to 3	Low to Medium	15% to <30%	OH	ORGANIC SILT
		CLAYS (PI and LL plot **above A-Line** on Plasticity Chart below) [A]	Liquid Limit <50 [D]	None to Medium Slow	Medium to High	Slight to Shiny	1 to 3	Medium	<15%	CL	LEAN CLAY [A,E,F,G,H]
				None to V.Slow	Medium to High	Slight to Shiny	1 to 3	Medium	15% to <30%	OL	ORGANIC CLAY [E,F,G]
			Liquid Limit ≥50 [D]	None	High to V.High	Shiny	<1	High	<15%	CH	FAT CLAY [E,F,G,H]
				None	High	Shiny	<1 to 1	High	15% to <30%	OH	ORGANIC CLAY [E,F,G]
HIGHLY ORGANIC SOILS (Organic Content >30% by mass)		Peat and mineral soil mixtures	Relatively lightweight, possibly spongy. Some water may squeeze from sample. Some shrinkage may occur on air drying. Sand fraction may be visible. Low to high dilatancy. Thread weak near plastic limit. Low to medium dry strength.						30% to <75%	PT	SILTY PEAT, SANDY PEAT
		Predominantly peat, may contain some mineral soil, fibrous or amorphous peat	Lightweight, spongy. Much water squeezes from sample. Shrinks considerably on air drying (i.e., very high water content). Plant structure identiable to altered.						75% to 100%		PEAT

Coarse-Grained Soil Note(s):

1. Based on the material passing the 75 mm sieve.
2. If field sample contains or drilling observations indicate cobbles or boulders or both, add, "with cobbles" or "with cobbles and boulders". Include notes on the depth(s) encountered, and sizes if possible.
3. Gravels with 5% to 12% fines require dual symbols:
   (GW-GM) Well-graded GRAVEL with silt,
   (GW-GC) Well-graded GRAVEL with clay,
   (GP-GM) Poorly graded GRAVEL with silt,
   (GP-GC) Poorly graded GRAVEL with clay.
4. If soil contains ≥15% sand, add "with sand" to Group Name.
5. If fines classify as CL-ML, use dual symbol (GC-GM) or (SC-SM) for Group Symbol.
6. If the soil has an organic content (OC) 15%≤OC<30% the prefix "Organic" should be added before the Group Name. If the soil has an organic content 3%≤OC<15% add "with organic fines" to Group Name. If the soil contains >0% to ≤3% organics, the descriptor "trace organics" may be added.
7. Sands with 5% to 12% fines require dual symbols:
   (SW-SM) Well-graded SAND with silt,
   (SW-SC) Well-graded SAND with clay,
   (SP-SM) Poorly graded SAND with silt,
   (SP-SC) Poorly graded SAND with clay.
8. If soil contains ≥15% gravel, add "with gravel" to Group Name.



Fine-Grained Soil Note(s):

A. If Atterberg limits plot above the A-line but in the 'hatched' area on the plasticity chart, soil is a (CL-ML) SILTY CLAY.
B. If the soil contains >0% to ≤3% organics, the descriptor "trace organics" may be added.
C. If fine-grained materials are nonplastic (i.e., a plastic limit (PL) cannot be measured), soil is a (ML) SILT.
D. If soil has a liquid limit (LL) >30% to <50%, the term 'medium plasticity' may be included in the description, but the Group Name/Symbol is not changed.
E. If soil contains 15% to <30% +No.200, add "with sand" or "with gravel".
F. If soil contains ≥30% +No.200 mainly sand, add "Sandy" to Group Name.
G. If soil contains ≥30% +No.200 mainly gravel, add "Gravelly" to Group Name.
H. If the soil has an organic content (OC) 3%≤OC<15% add "with organic fines" to Group Name.

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>300	>12
COBBLES	Not Applicable	75 to 300	3 to 12
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
SILT/CLAY	Classified by plasticity	<0.075	< (200)

GRADATIONAL COMPONENT TERMS

% (by mass)	Term
≤ 5	Use “trace”
> 5 to ≤ 12	Use “few”
> 12 to <30	Use “little”
≥ 30 to <50	Use “some”
≥ 50	Use “mostly”

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split-spoon sampler for a distance of 300 mm (12 in.). Values reported are as recorded in the field and are uncorrected.

Cone Penetration Test (CPT)

An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (q_t), porewater pressure (u) and sleeve frictions are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); Nd:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH:	Sampler advanced by hydraulic pressure
PM:	Sampler advanced by manual pressure
WH:	Sampler advanced by static weight of hammer
WR:	Sampler advanced by weight of sampler and rod

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
DD	Diamond Drilling
DO or DP	Seamless open ended, driven, pushed tube sampler, or geoprobe macro-core – note size
DS	Denison type sample
FS	Foil Sample
GS	Grab Sample
MC	Modified California Samples – note sample diameter and hammer weight
MS	Modified Shelby (for frozen soil)
RC	Rock core
SC	Soil core
SS	Split-spoon sampler (50 mm OD); larger sizes use MC
ST	Slotted tube
TO	Thin-walled, open – note size (Shelby tube)
TP	Thin-walled, piston – note size (Shelby tube)
WS	Wash sample

SOIL TESTS

w	water content
PL , w_p	plastic limit
LL , w_L	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, Gs)
DS	direct shear test
GS	specific gravity
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
γ	unit weight

1. Tests anisotropically consolidated prior to shear are shown as CAD, CAU.

NON-COHESIVE (COHESIONLESS) SOILS

Compactness[2]

Term	SPT ‘N’ (blows/0.3m)[1]
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	>50

1. SPT ‘N’ in general accordance with ASTM D1586, uncorrected for the effects of overburden pressure.
2. Definition of compactness terms are based on SPT ‘N’ ranges as provided in Terzaghi, Peck and Mesri (1996). Many factors affect the recorded SPT ‘N’ value, including hammer efficiency (which may be greater than 60% in automatic trip hammers), overburden pressure, groundwater conditions, and grainsize. As such, the recorded SPT ‘N’ value(s) should be considered only an approximate guide to the soil compactness. These factors need to be considered when evaluating the results, and the stated compactness terms should not be relied upon for design or construction.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

COHESIVE SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT ‘N’[1,2] (blows/0.3m)
Very Soft	<12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	>200	>30

1. SPT ‘N’ in general accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.
2. SPT ‘N’ values should be considered ONLY an approximate guide to consistency; for sensitive clays (e.g., Champlain Sea clays), the N-value approximation for consistency terms does NOT apply. Rely on direct measurement of undrained shear strength or other manual observations.

Water Content

Term	Description
w < PL	Material is estimated to be drier than the Plastic Limit.
w ~ PL	Material is estimated to be close to the Plastic Limit.
w > PL	Material is estimated to be wetter than the Plastic Limit.

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
ln x	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\,\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
υ	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
σ_1, σ_2, σ_3	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

(a) Index Properties (continued)

w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity index = $(w_l - w_p)$
NP	nonplastic
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p) / I_p$
I_C	consistency index = $(w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_α	secondary compression index
m_v	coefficient of volume change
c_v	coefficient of consolidation (vertical direction)
c_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = $\tan\delta$
c′	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p′	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

Notes: 1 $\tau = c' + \sigma' \tan \phi'$

2 shear strength = (compressive strength)/2

* Density symbol is ρ. Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

CORE CONDITION

Total Core Recovery

The percentage of drill core recovered regardless of quality, measured relative to the total length of the core run.

Solid Core Recovery (SCR)

The percentage of solid drill core of any length recovered at full diameter, measured relative to the length of the total core run.

Rock Quality Designation (RQD)

The percentage of solid drill core, greater than 100mm length, recovered at full diameter, measured relative to the length of the total core run. RQD varies from 0% for completely broken core to 100% for core in solid sticks.

DISCONTINUITY DATA

Fracture Index

A count of the number of discontinuities (physical separations) in the rock core, including naturally occurring fractures but not including mechanically induced breaks caused by drilling.

Dip with Respect to (W.R.T) Core Axis

The angle of the discontinuity relative to the axis (length) of the core. In a vertical borehole a discontinuity with a 90° angle is horizontal.

CORE FEATURES

■	Lost Core
▨	Broken Core
▦	Hard Limestone Layers (greater than 2 cm)
▩	Soft (Clay) Layers

WEAK ZONES

▨	R0
■	R1

DISCONTINUITY DESCRIPTION

Type

JN	Joint
BD	Bedding
CO	Contact

Shape

UN	Undulated
CU	Curved
IR	Irregular
PL	Planar
ST	Stepped

Roughness

SM	Smooth
RO	Rough
VR	Very Rough

Infilling/Coating Character

-	Clean
CC	Completely Coated
PC	Partially Coated
SA	Slightly Altered
SO	Staining Only
IN	Infilling > 1mm

Infilling Type

Sa	Sand
M	Silt
Br	Broken
Go	Gouge
Cl	Clay
Ca	Calcite
Gr	Gravel

Rock Condition

Jr – Q System Joint Roughness (Barton et al. (1974))
Ja - Q System Joint Alteration (Barton et al. (1974))
Jcon – Rock Mass Rating (Bieniaski 1976) Joint Condition

Barton N.R. et al. (1974) “Engineering Classification of Rock Masses for the Design of Rock Support”. Rock Mechanics Vol. 6, 189-236, New York

Bieniawski, Z. (1976). Rock Mass Classifications in Rock Engineering. *Proceedings of the Symposium on Exploration for Rock Engineering.* Johannesburg..

BEDDING THICKNESS

Description	*Bedding Plane Spacing*
Very thicky bedded	Greater than 2 m
Thickly bedded	0.6 m to 2 m
Medium bedded	0.2 m to 0.6 m
Thinly bedded	60 mm to 0.2 m
Very thinly bedded	20 mm to 60 mm
Laminated	6 mm to 20 mm
Thinly laminated	Less than 6 mm

JOINT OR FOLIATION SPACING

Description	*Spacing*
Very wide	Greater than 3 m
Wide	1 m to 3 m
Moderately close	0.3 m to 1 m
Close	50 mm to 0.3 m
Very close	Less than 50 mm

GRAIN SIZE

Term	*Size**
Very Coarse Grained	Greater than 60 mm
Coarse Grained	2 mm to 60 mm
Medium Grained	60 microns to 2 mm
Fine Grained	2 microns to 60 microns
Very Fine Grained	Less than 2 microns

Note*: Grains greater than 60 microns diameter are visible to the naked eye.

FIELD ESTIMATION OF ROCK STRENGTH

(Representation of Intact Rock Strength)

Grade	Description	Field Identification	Approx. Range of Uniaxial Compressive Strength (MPa)
R0	Extremely Weak Rock	Intended by thumbnail.	0.25 – 1
R1	Very Weak Rock	Material can be shaped with a pocket knife or can be peeled by a pocket knife. Crumbles under firm blows of pick (or point) of geological hammer.	1.0 – 5.0
R2	Weak Rock	Knife cuts material but too hard to shape into triaxial specimens or material can be peeled by a pocket knife with difficulty. Shallow indentations (<5 mm) made by firm blow with pick (or point) of a geological hammer.	5.0 – 25
R3	Medium Strong Rock	Cannot be scraped or peeled with a pocket knife. Handheld specimen can be fractured with single firm blow of geological hammer.	25 – 50
R4	Strong Rock	Handheld specimen requires more than one blow of geological hammer to break intact rock specimen (or to fracture it).	50 – 100
R5	Very Strong Rock	Specimen requires many blows of geological hammer to break intact rock specimens (or to fracture it).	100 – 250
R6	Extremely Strong Rock	Specimen can only be chipped under repeated hammer blows, rings when hit.	>250

REFERENCE

Brown, 1981, “Suggested Methods for Rock Characterization Testing and Monitoring”, International Society For Rock Mechanics.

WEATHERING CLASSIFICATION

Symbol	Term	Description	Discoloration Extent	Fracture Condition	Surface Characteristics
W1	Fresh	No visible sign of rock material weathering.	None	Closed or discoloured	Unchanged
W2	Slightly Weathered	Discoloration indicates weathering of rock material on discontinuity surfaces (usually oxidized). Less than 5% of rock mass altered.	<20% of fracture spacing on both sides of fracture	Discoloured, may contain thin filling	Partial discoloration
W3	Moderately Weathered	Less than 50% of the rock material is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as corestones. Visible texture of the host rock still preserved. Surface planes are weathered (oxidized or carbonate filling) even when breaking the “intact rock”.	>20% of fracture spacing on both sides of fracture	Discoloured, may contain thick filling	Partial to complete discoloration, not friable except poorly cemented rocks
W4	Highly Weathered	More than 50% of the rock material is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as corestones.	Throughout	Filled with alteration minerals	Friable and possibly pitted
W5	Completely Weathered	100% of rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.	Throughout	Filled with alteration minerals	Resembles soil
W6	Residual Soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.	Throughout	N/A	Resembles soil

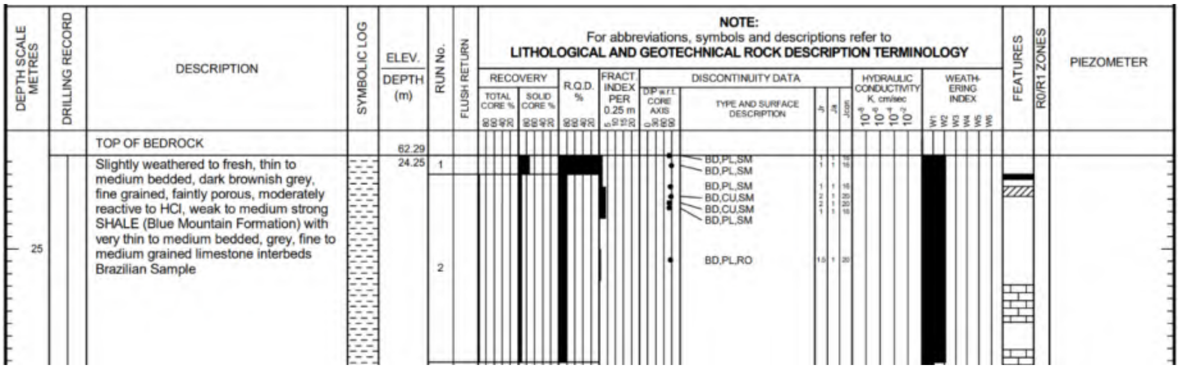
REFERENCE

Brown, 1981, “Suggested Methods for Rock Characterization Testing and Monitoring”, International Society For Rock Mechanics.

DRILL LOG INTERPRETATION

All drill logs are read from left to right and top to bottom.

The total core, solid core, and RQD columns are presented as percentages with the absence of a black bar representing 100% and a black bar filling the entire column representing 0%.



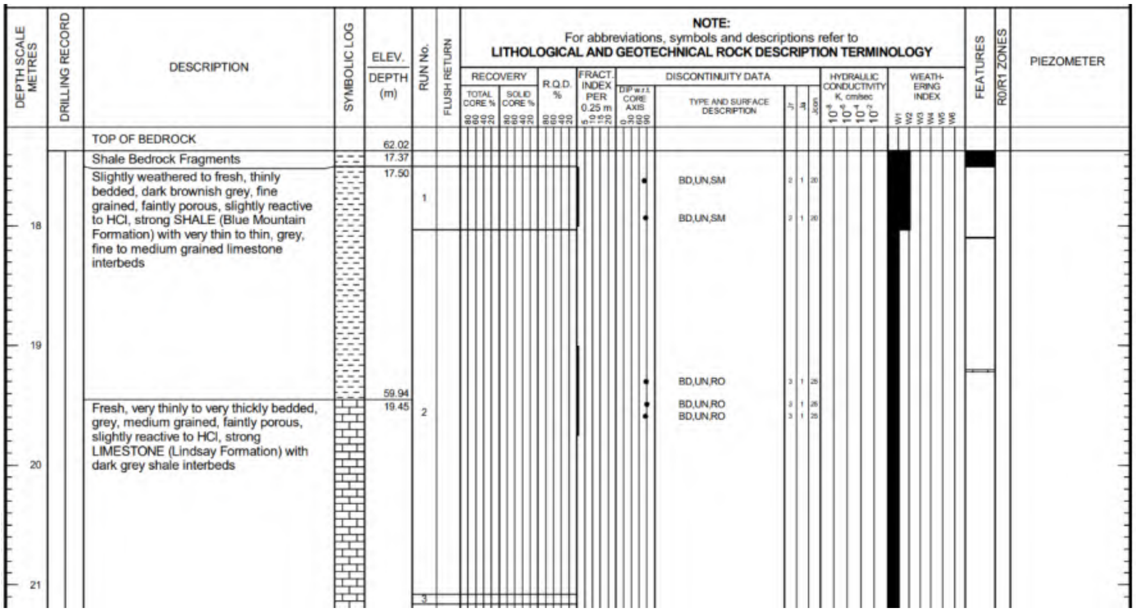
TOP OF BEDROCK

Slightly weathered to fresh, thin to medium bedded, dark brownish grey, fine grained, faintly porous, moderately reactive to HCl, weak to medium strong SHALE (Blue Mountain Formation) with very thin to medium bedded, grey, fine to medium grained limestone interbeds
Brazilian Sample

In the example above, run 1 is indicated to have a total core recovery of 100%, a solid core recovery of 75% and an RQD of 0%. Run 2 has a total core recovery of 95%, a solid core recovery of 90% and an RQD of 80%.

Fracture index indicates the number of discontinuities logged over 0.25 m intervals, with a wider black bar indicating a higher number of fractures over the 0.25 m interval. Broken core is counted towards the fracture index and is an estimate of how many fractures created the broken core zone. In the same example above, the interval 24.25 mbgs (meters below ground surface) to 24.50 mbgs has two fractures, the interval 24.50 mbgs to 24.75 mbgs has four fractures, and the interval 24.75 mbgs to 25.00 mbgs has zero fractures.

Weathering index indicates the weathering classification given along an interval of core. One bar presented indicates a weathering classification of W1 or fresh rock. A black bar filling the entire column represents a weathering classification of W6 or residual soil. The weathering classification can increase or decrease within a single run.



TOP OF BEDROCK

Shale Bedrock Fragments

Slightly weathered to fresh, thinly bedded, dark brownish grey, fine grained, faintly porous, slightly reactive to HCl, strong SHALE (Blue Mountain Formation) with very thin to thin, grey, fine to medium grained limestone interbeds

Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong LIMESTONE (Lindsay Formation) with dark grey shale interbeds

In the example above, run 1 has a weathering classification of W2 over the entire run and runs 2 and 3 both have a weathering classification of W1.

A01-BH21

PROJECT: 21451329

LOCATION: N 4860024.76; E 683775.82

RECORD OF BOREHOLE: BH21

SHEET 1 OF 8

BORING DATE: August 9 and 10, 2022

DATUM: Geodetic

DRILL RIG: Acker Renegrade I Track Mounted

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-10} 10^{-8} 10^{-6} 10^{-4}); WATER CONTENT PERCENT Wp ⊢ W ○ ⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION; GRAIN SIZE DISTRIBUTION (%)
		GROUND SURFACE		87.26							GR SA SI CL
0	Mud Rotary Wash Boring HW Casing	BH21 had an inclination of -70° advanced at an azimuth of 140°. No soil sampling/testing completed in the overburden.		0.00							
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

LOGGED: BD

CHECKED: SEMP

PROJECT: 21451329

RECORD OF BOREHOLE: BH21

SHEET 2 OF 8

LOCATION: N 4860024.76; E 683775.82

BORING DATE: August 9 and 10, 2022

DATUM: Geodetic

DRILL RIG: Acker Renegrade I Track Mounted

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-10} 10^{-8} 10^{-6} 10^{-4} WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	Mud Rotary Wash Boring HW Casing	BH21 had an inclination of -70° advanced at an azimuth of 140°. No soil sampling/testing completed in the overburden.									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

LOGGED: BD

CHECKED: SEMP

PROJECT: 21451329

LOCATION: N 4860024.76; E 683775.82

RECORD OF BOREHOLE: BH21

SHEET 3 OF 8

BORING DATE: August 9 and 10, 2022

DATUM: Geodetic

DRILL RIG: Acker Renegrade I Track Mounted

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-10} 10^{-8} 10^{-6} 10^{-4}); WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION; GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		--- CONTINUED FROM PREVIOUS PAGE ---									
20	Mud Rotary Wash Boring HW Casing	BH21 had an inclination of -70° advanced at an azimuth of 140°. No soil sampling/testing completed in the overburden.									
21											
22											
23											
24											
		Shale Bedrock Notes: 1. Bedrock cored from 24.64 m to 71.67 m depth 2. Refer to Record of Inclined Drillhole BH21. 3. Water level in open borehole could not be measured upon completion of soil drilling due to use of mud-rotary technique. 4. Carbon Monoxide (CO) gas was detected at surface by a portable gas monitor(GX-6000) during drilling of BH21 between depths of approximately 13.5 m and 22 m.		64.11 24.64							
25											
26											
27											
28											
29											
30											

DEPTH SCALE

1 : 50

LOGGED: BD

CHECKED: SEMP

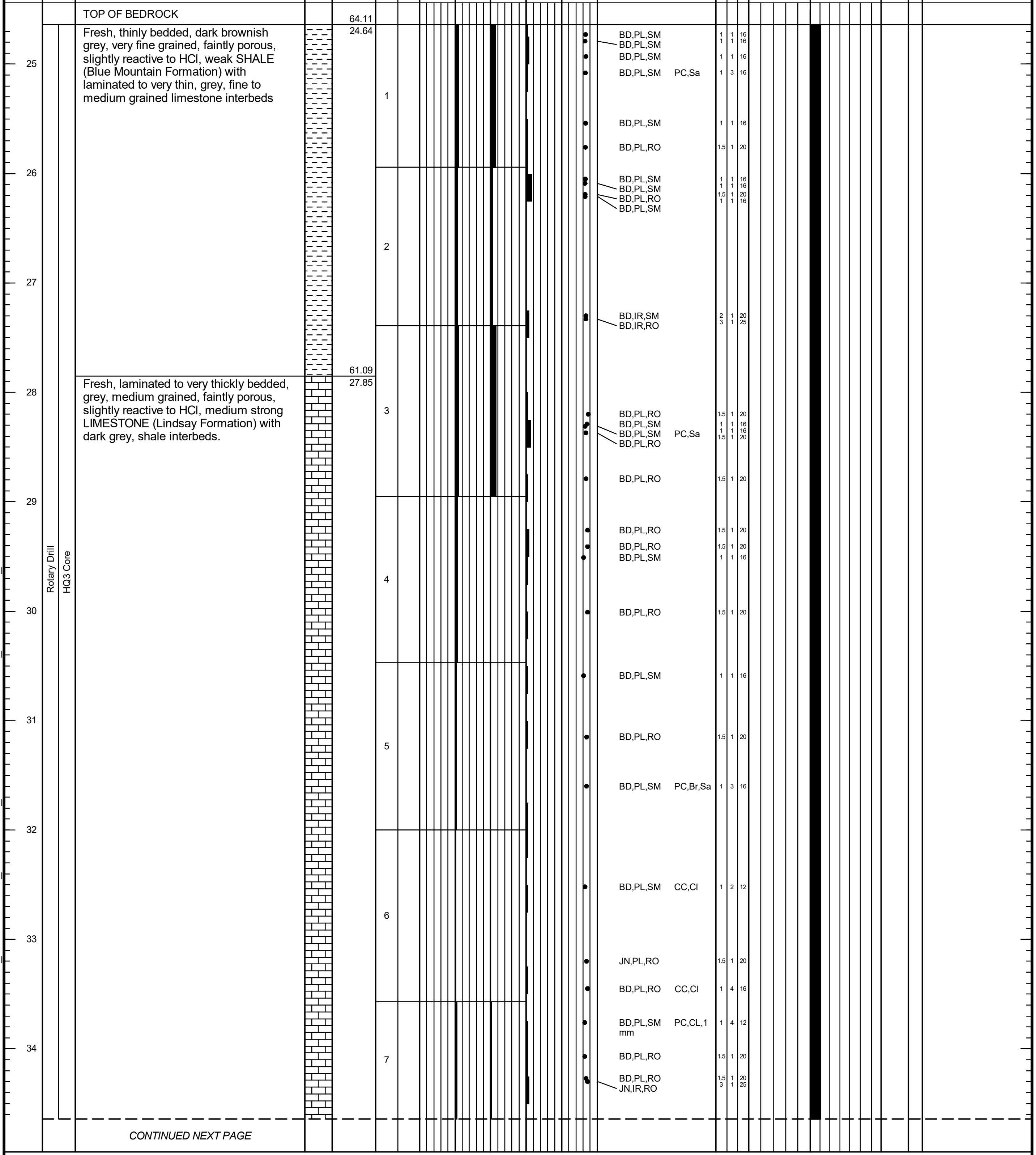
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4860024.76; E 683775.82
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -70° AZIMUTH: 140°

RECORD OF DRILLHOLE: BH21

DRILLING DATE: August 10 to 16, 2022
DRILL RIG: Acker Renegrade I Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 4 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



DESCRIPTION	ELEV. DEPTH (m)
TOP OF BEDROCK	64.11
Fresh, thinly bedded, dark brownish grey, very fine grained, faintly porous, slightly reactive to HCl, weak SHALE (Blue Mountain Formation) with laminated to very thin, grey, fine to medium grained limestone interbeds	24.64
Fresh, laminated to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong LIMESTONE (Lindsay Formation) with dark grey, shale interbeds.	61.09 27.85

DISCONTINUITY DATA

TYPE AND SURFACE DESCRIPTION		Jr	Ja	Jcon
BD,PL,SM		1	1	16
BD,PL,SM		1	1	16
BD,PL,SM		1	1	16
BD,PL,SM	PC,Sa	1	3	16
BD,PL,SM		1	1	16
BD,PL,RO		1.5	1	20
BD,PL,SM		1	1	16
BD,PL,SM		1	1	16
BD,PL,RO		1.5	1	20
BD,PL,SM		1	1	16
BD,IR,SM		2	1	20
BD,IR,RO		3	1	25
BD,PL,RO		1.5	1	20
BD,PL,SM		1	1	16
BD,PL,SM	PC,Sa	1	1	16
BD,PL,RO		1.5	1	20
BD,PL,RO		1.5	1	20
BD,PL,RO		1.5	1	20
BD,PL,RO		1.5	1	20
BD,PL,SM		1	1	16
BD,PL,RO		1.5	1	20
BD,PL,SM		1	1	16
BD,PL,RO		1.5	1	20
BD,PL,SM	PC,Br,Sa	1	3	16
BD,PL,SM	CC,Cl	1	2	12
JN,PL,RO		1.5	1	20
BD,PL,RO	CC,Cl	1	4	16
BD,PL,SM mm	PC,CL,1	1	4	12
BD,PL,RO		1.5	1	20
BD,PL,RO		1.5	1	20
JN,IR,RO		3	1	25

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: BD
CHECKED: AKV

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4860024.76; E 683775.82
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -70° AZIMUTH: 140°

RECORD OF DRILLHOLE: BH21

DRILLING DATE: August 10 to 16, 2022
DRILL RIG: Acker Renegrade I Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 5 OF 8
DATUM: Geodetic

NOTE: For abbreviations, symbols and descriptions refer to **LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY**

DEPTH SCALE METRES | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (m) | RUN No. | FLUSH RETURN | RECOVERY (TOTAL CORE %, SOLID CORE %) | R.Q.D. % | FRACT. INDEX PER 0.25 m | DISCONTINUITY DATA (DIP w.r.t. CORE AXIS, TYPE AND SURFACE DESCRIPTION, Jr, Ja, Jcon) | HYDRAULIC CONDUCTIVITY K, cm/sec | WEATHERING INDEX (W1 W2 W3 W4 W5 W6) | FEATURES | R0/R1 ZONES | PIEZOMETER

--- CONTINUED FROM PREVIOUS PAGE ---

Drilling record: Rotary Drill, HQ3 Core

Depth scale: 35, 36, 37, 38, 39, 40, 41, 42, 43, 44

Fresh, laminated to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong LIMESTONE (Lindsay Formation) with dark grey, shale interbeds.

UCS with Modulus Sample

Specific Gravity Sample

Direct Shear Sample

Punch Penetration Sample
Punch Penetration Sample

Run No.: 7, 8, 9, 10, 11, 12, 13, 14

TYPE AND SURFACE DESCRIPTION		Jr	Ja	Jcon
BD,UN,SM		2	1	20
BD,UN,SM		2	1	20
BD,PL,RO		1.5	1	20
BD,PL,RO		1.5	1	20
BD,PL,RO		1.5	1	20
BD,PL,RO		1.5	1	20
BD,PL,RO		1.5	1	20
BD,PL,RO		1.5	1	20
BD,UN,SM		2	1	20
BD,IR,RO	PC,CI	3	4	20
BD,PL,RO mm	IN,Gr,4	1.5	3	6
BD,UN,RO		3	1	25
BD,PL,RO		1.5	1	20
BD,PL,RO		1.5	1	20
BD,PL,SM		1	1	16
BD,UN,RO		3	1	25
BD,UN,RO		3	1	25
BD,PL,SM		1	1	16
BD,UN,SM		2	1	20
JN,PL,RO mm	IN,CL, 20	1.5	1	20
BD,PL,RO		1.5	1	20
BD,PL,SM		1	1	16

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: BD
CHECKED: AKV

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4860024.76; E 683775.82
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -70° AZIMUTH: 140°

RECORD OF DRILLHOLE: BH21

DRILLING DATE: August 10 to 16, 2022
DRILL RIG: Acker Renegrade I Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 6 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

Columns: DEPTH SCALE METRES | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (m) | RUN No. | FLUSH RETURN | RECOVERY: TOTAL CORE % (80 60 40 20), SOLID CORE % (80 60 40 20) | R.Q.D. % (80 60 40 20) | FRACT. INDEX PER 0.25 m (5 10 15 20) | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (0 30 60 90), TYPE AND SURFACE DESCRIPTION, Jr, Ja, Jcon | HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-8} 10^{-6} 10^{-4} 10^{-2}) | WEATH-ERING INDEX (W1 W2 W3 W4 W5 W6) | FEATURES | R0/R1 ZONES | PIEZOMETER

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	RUN No.	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
	Rotary Drill HQ3 Core	Fresh, laminated to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong LIMESTONE (Lindsay Formation) with dark grey, shale interbeds.					
45				BD,UN,SM PC,M JN,PL,RO	2 1.5	4 1	16 20
			14				
				JN,PL,RO	1.5	1	20
46							
			15				
47		Cerchar Sample					
48			16				
49							
			17				
		UCS Sample					
50							
				JN,PL,RO	1.5	1	20
51			18				
				BD,PL,SM	1	1	16
52							
		Slake Durability Sample		BD,UN,SM	2	1	20
			19				
53							
54			20				

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: BD
CHECKED: AKV

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4860024.76; E 683775.82
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -70° AZIMUTH: 140°

RECORD OF DRILLHOLE: BH21

DRILLING DATE: August 10 to 16, 2022
DRILL RIG: Acker Renegrade I Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 7 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE % 80 60 40 20	RECOVERY SOLID CORE % 80 60 40 20	R.Q.D. % 80 60 40 20	FRACT. INDEX PER 0.25 m 5 10 15 20	DIP w.r.t. CORE AXIS 0 30 60 90	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2}	WEATHERING INDEX W1 W2 W3 W4 W5 W6	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
	Rotary Drill HQ3 Core	Fresh, laminated to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong LIMESTONE (Lindsay Formation) with dark grey, shale interbeds. Punch Penetration Sample			20															
55																				
					21															
56												BD,UN,RO	3	1	25					
		Cerchar Sample										JN,PL,SM	1	1	12					
57					22							BD,UN,SM	2	1	20					
												BD,UN,SM	2	1	20					
												BD,UN,RO	3	1	25					
												BD,UN,RO	3	1	25					
58					23							BD,PL,SM PC,M	1	4	12					
												BD,UN,SM	2	1	20					
59												BD,UN,SM	2	1	20					
60					24							BD,PL,SM	1	1	16					
												BD,UN,SM	2	1	20					
												BD,PL,RO	1.5	1	20					
61												BD,PL,SM	1	1	16					
					25															
62																				
63					26							BD,PL,SM	1	1	16					
												BD,PL,RO PC,M	1.5	4	16					
												BD,PL,SM	1	1	16					
												BD,PL,RO	1.5	1	20					
64					27															
		CONTINUED NEXT PAGE																		

DEPTH SCALE
1 : 50

LOGGED: BD
CHECKED: AKV

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4860024.76; E 683775.82
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -70° AZIMUTH: 140°

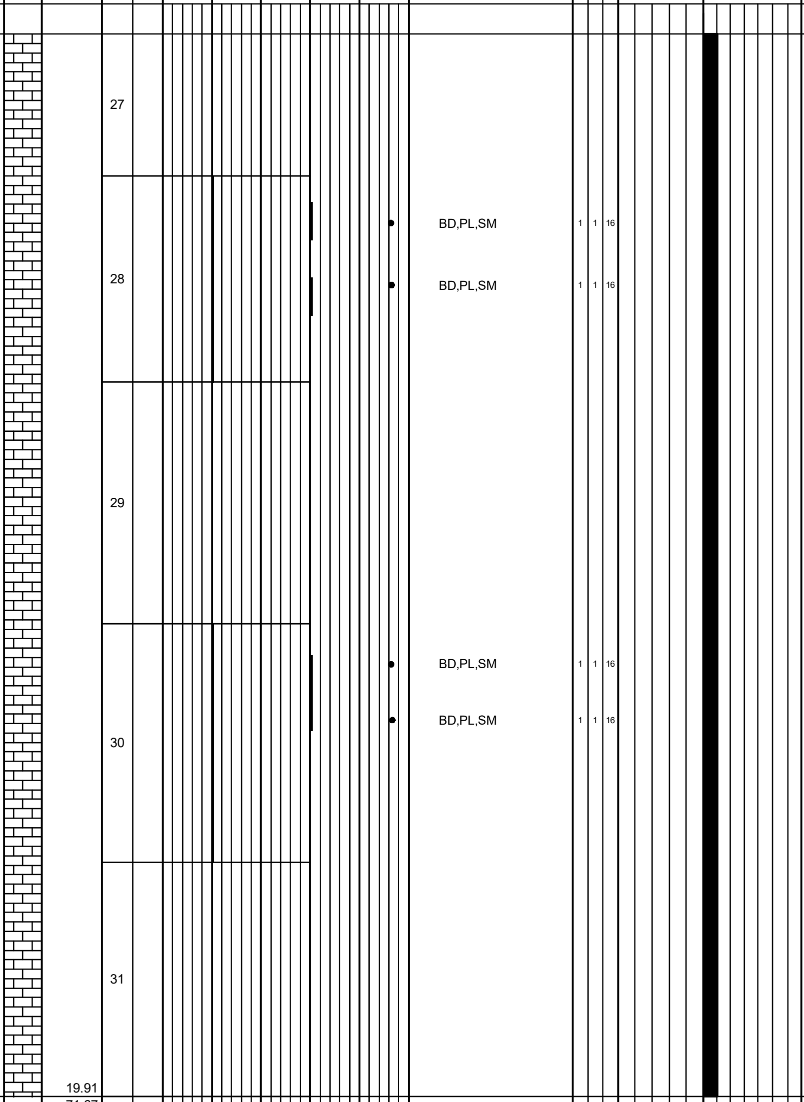
RECORD OF DRILLHOLE: BH21

DRILLING DATE: August 10 to 16, 2022
DRILL RIG: Acker Renegrade I Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 8 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (m)	RUN No.	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
		--- CONTINUED FROM PREVIOUS PAGE ---						
65	Rotary Drill HQ3 Core	Fresh, laminated to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong LIMESTONE (Lindsay Formation) with dark grey, shale interbeds.		27				
66				28	BD,PL,SM	1	1	16
					BD,PL,SM	1	1	16
67								
68				29				
69				30	BD,PL,SM	1	1	16
					BD,PL,SM	1	1	16
70								
71				31				
			19.91 71.67					
		END OF DRILLHOLE						
72								
73								
74								



FEATURES | R0/R1 ZONES | PIEZOMETER

DEPTH SCALE
1 : 50

LOGGED: BD
CHECKED: AKV

Geophysical Record of Borehole: BH21

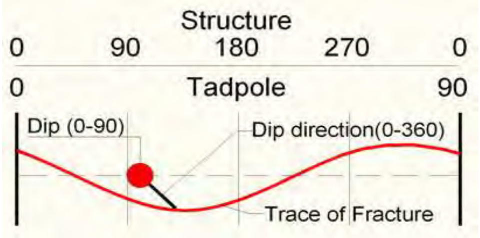
Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

Datum: NAD83, UTM Zone 17N
Easting: 683775.82 m
Northing: 4860024.76 m
Elevation: 87.26 m

Depth Reference: "0" at ground
Drilled Depth: 71 m bgs
Borehole Diameter: 96 mm
Casing Diameter: HQ

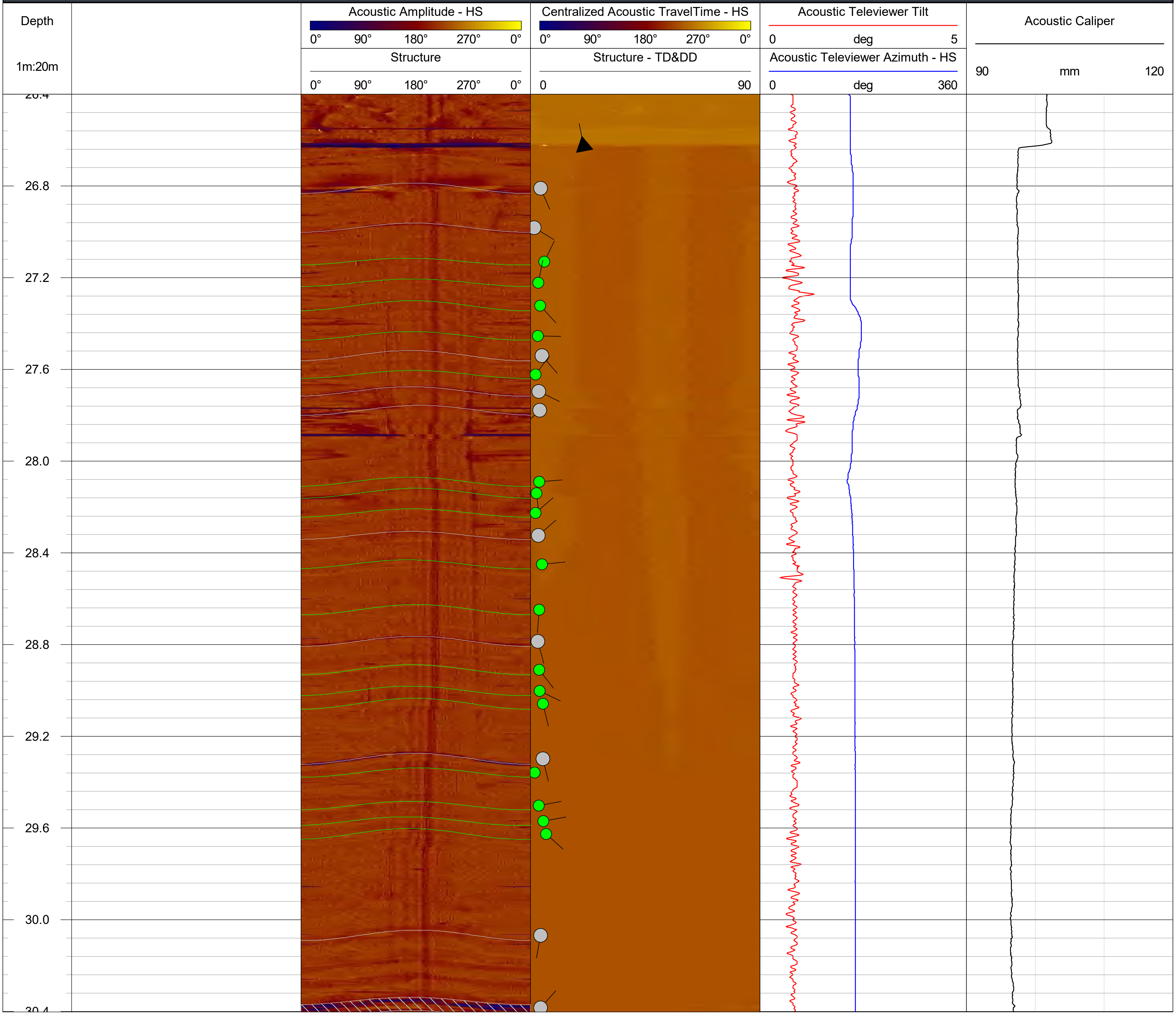
Casing Depth: ~24.64 m bgs
Water Level: 8.4 m bgs
Borehole Inclination: 20 degs
Borehole Azimuth: N/A

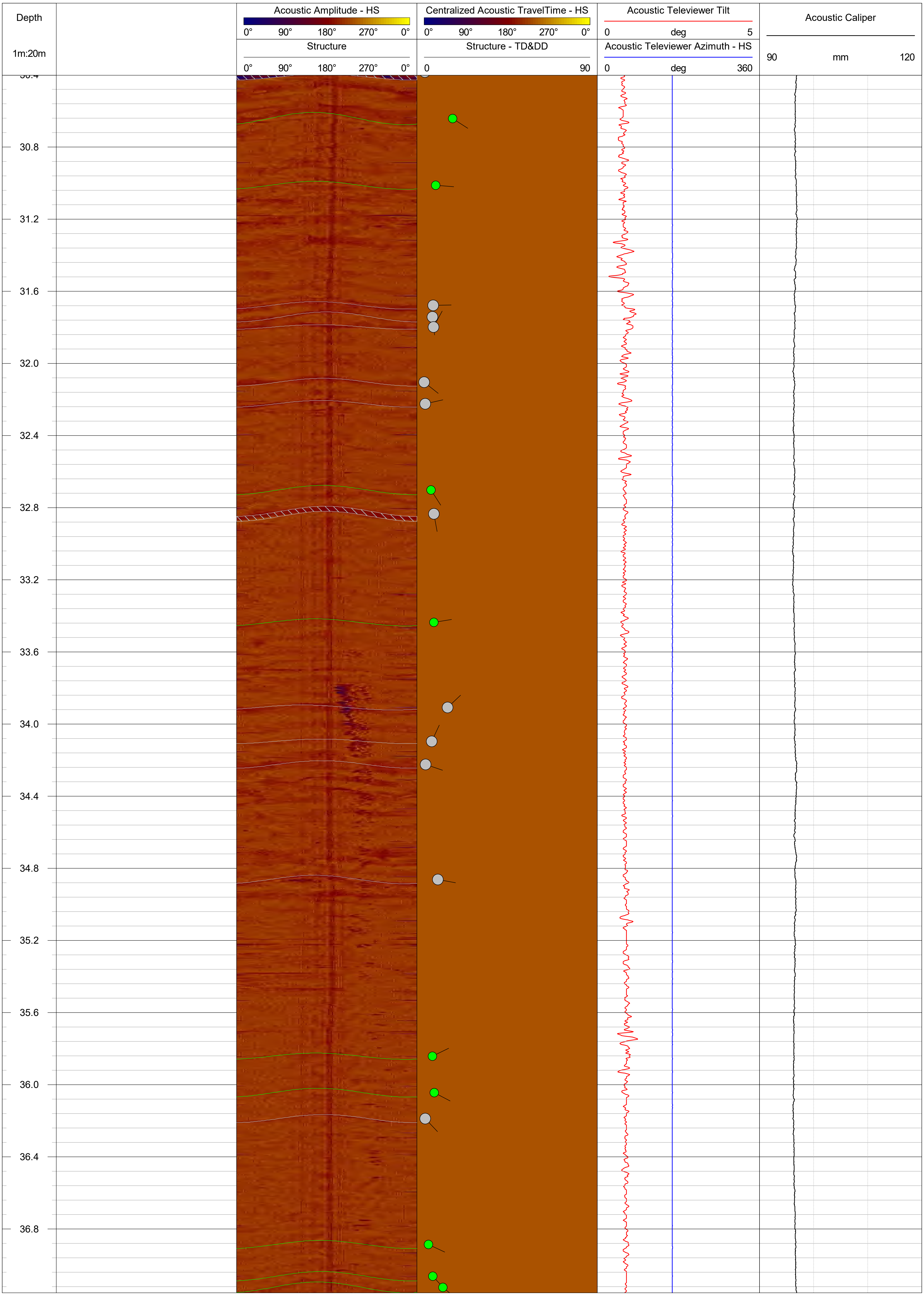
Location: Darlington, Ontario
Log Date: Aug-16-2022
Logged By: P. Giamou



- 🟠 Partially Open Joint / Fracture
- ⚪ Filled Fracture / Joint
- 🟢 Bedding / Banding / Foliation
- ◀ Casing

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)

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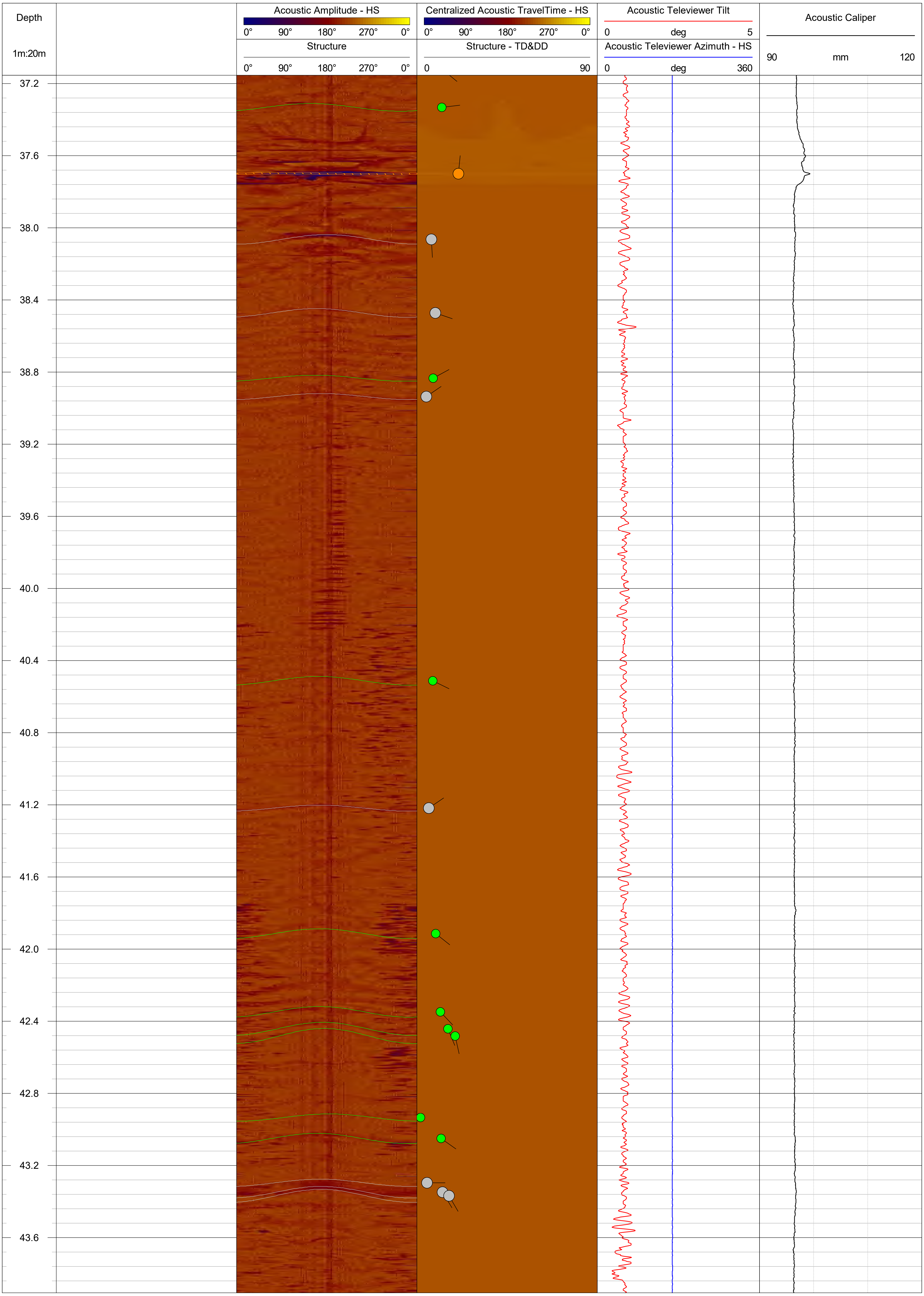
1m:20m
Acoustic Amplitude - HS
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - HS
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - HS
0 deg 360
Acoustic Caliper
90 mm 120
30.8
31.2
31.6
32.0
32.4
32.8
33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8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Acoustic Amplitude - HS
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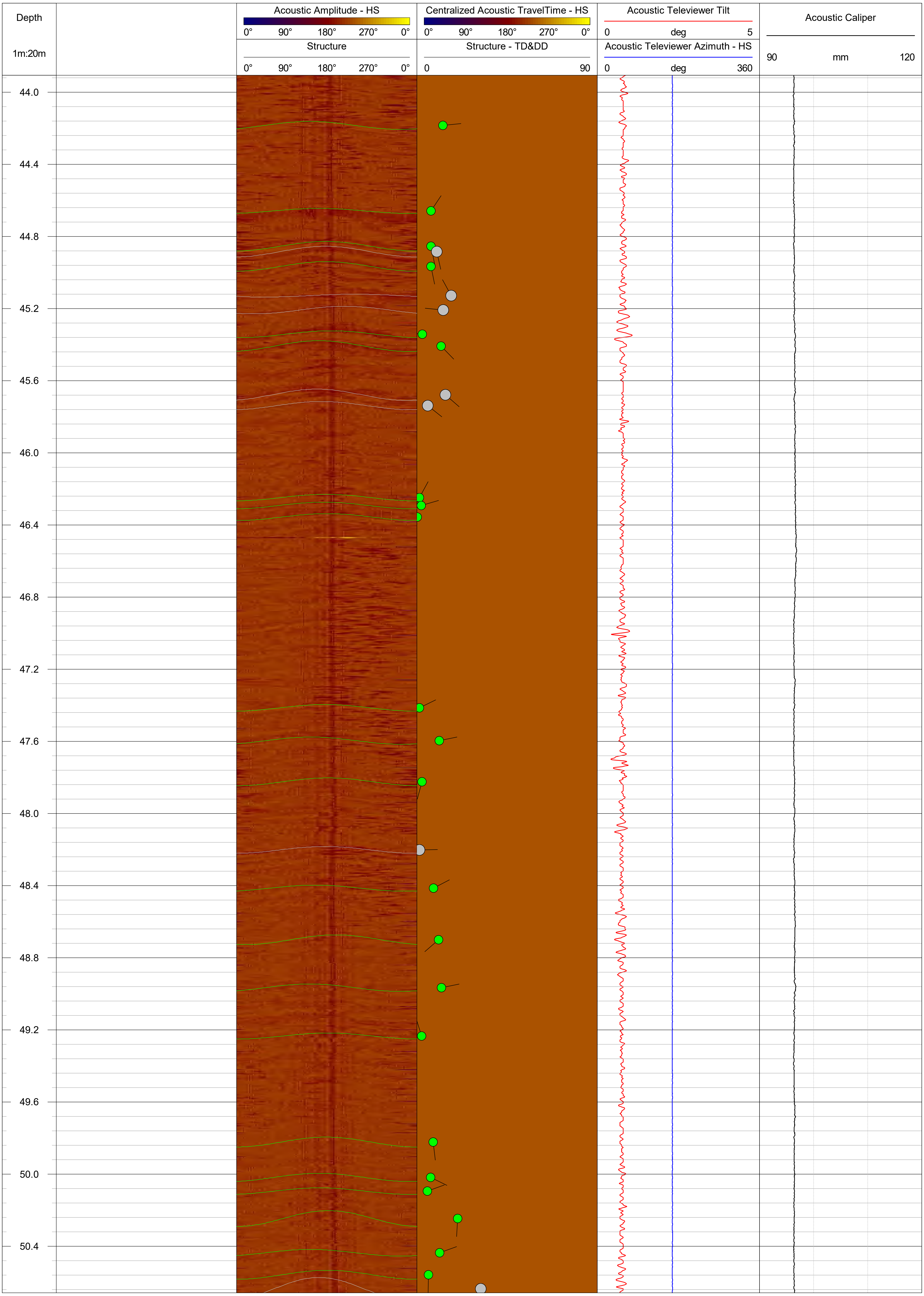
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - HS
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - HS
0 deg 360
Acoustic Caliper
90 mm 120
37.2
37.6
38.0
38.4
38.8
39.2
39.6
40.0
40.4
40.8
41.2
41.6
42.0
42.4
42.8
43.2
43.6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Acoustic Amplitude - HS
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - HS
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - HS
0 deg 360
Acoustic Caliper
90 mm 120
44.0
44.4
44.8
45.2
45.6
46.0
46.4
46.8
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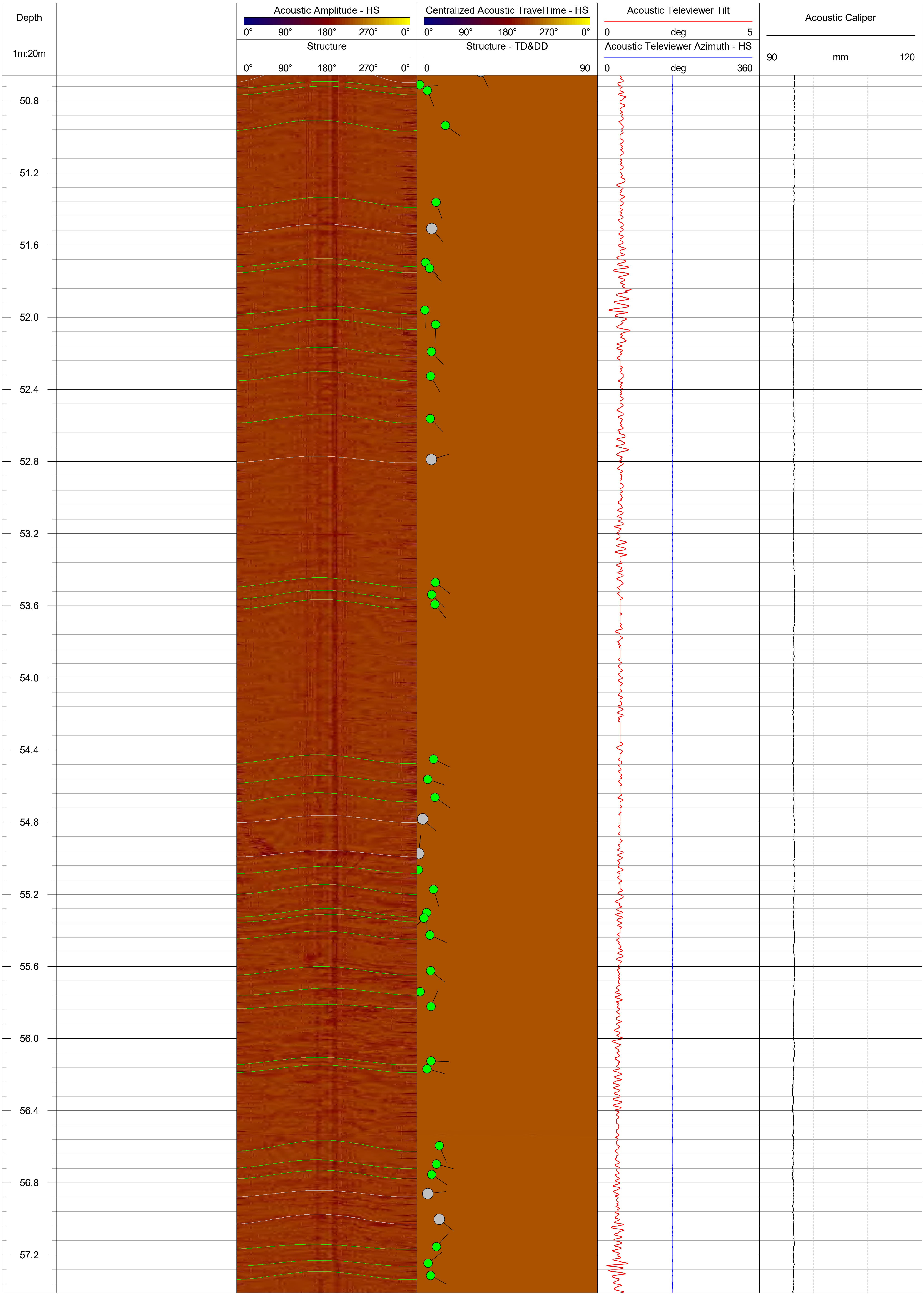
49.2
49.6
50.0
50.4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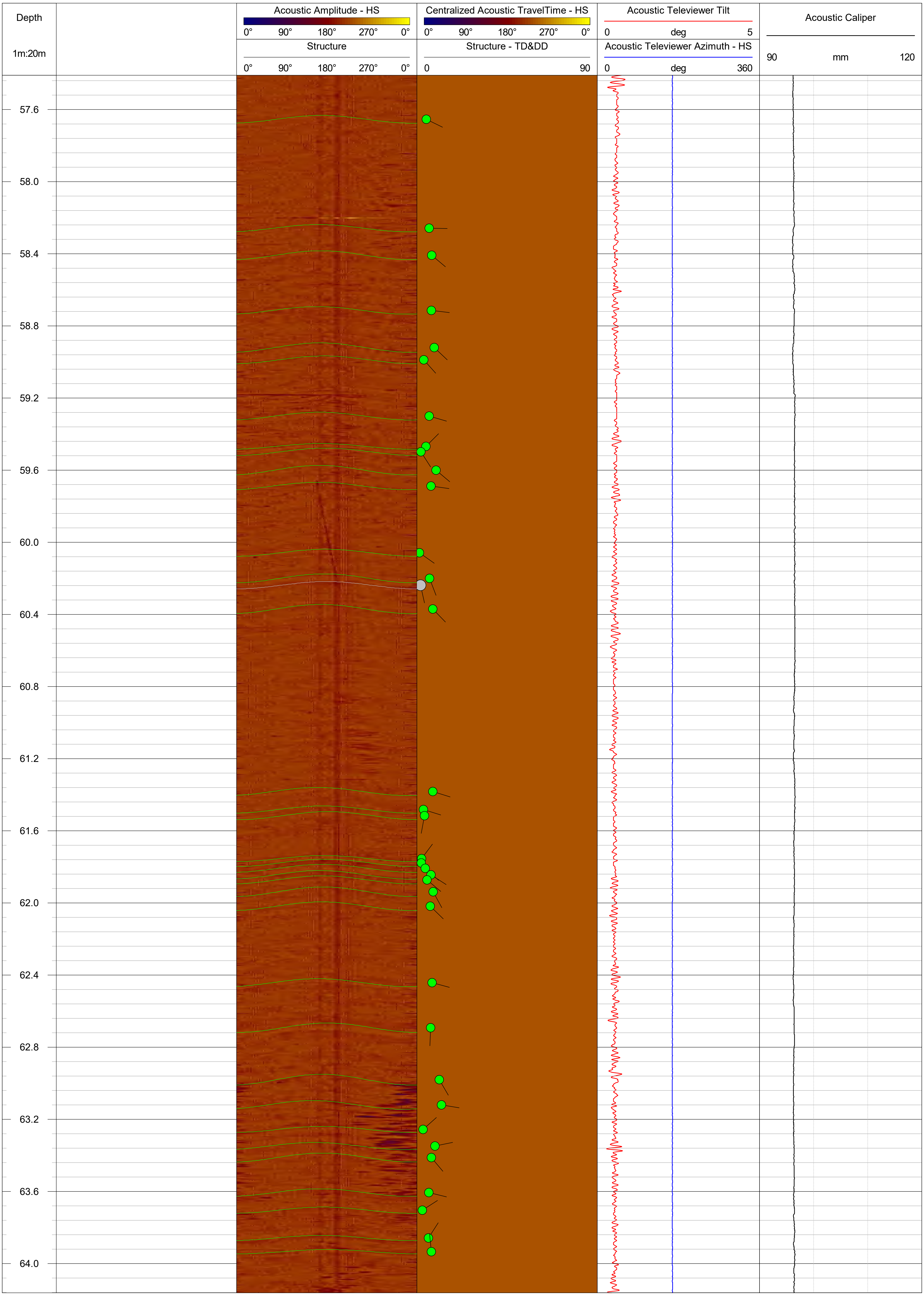
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - HS
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - HS
0 deg 360
Acoustic Caliper
90 mm 120
50.8
51.2
51.6
52.0
52.4
52.8
53.2
53.6
54.0
54.4
54.8
55.2
55.6
56.0
56.4
56.8
57.2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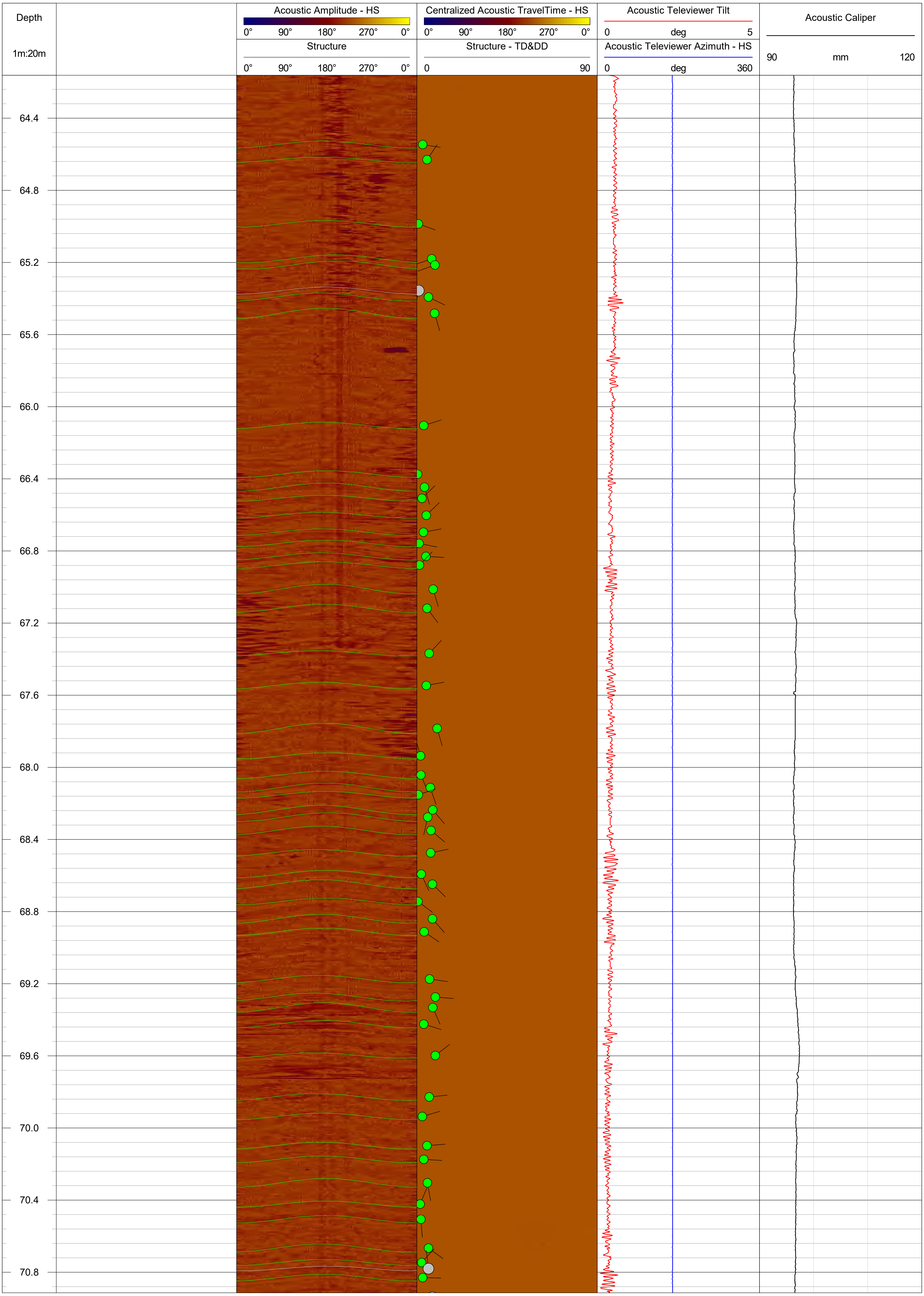
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - HS
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - HS
0 deg 360
Acoustic Caliper
90 mm 120
57.6
58.0
58.4
58.8
59.2
59.6
60.0
60.4
60.8
61.2
61.6
62.0
62.4
62.8
63.2
63.6
64.0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Acoustic Amplitude - HS
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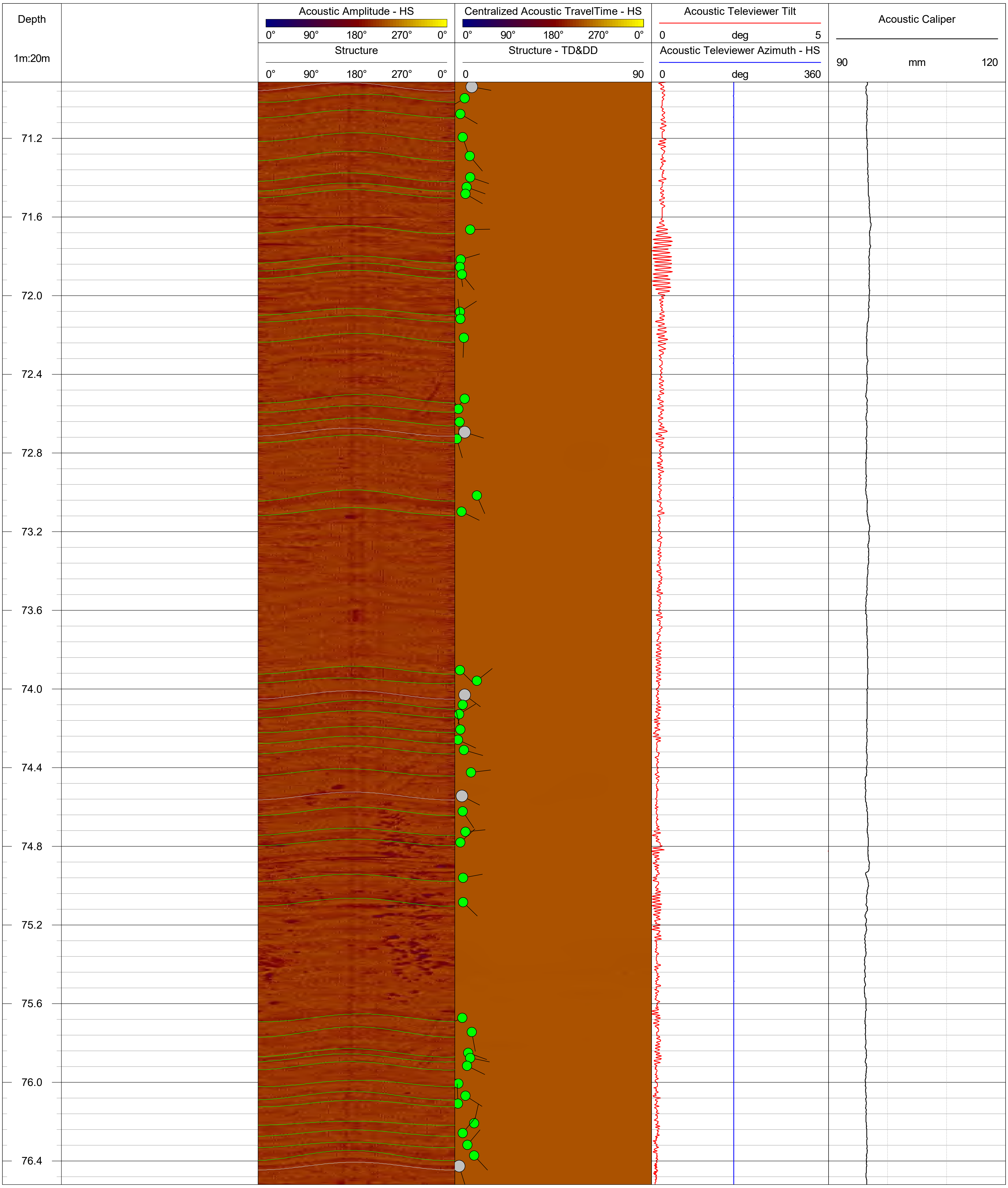
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - HS
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - HS
0 deg 360
Acoustic Caliper
90 mm 120
64.4
64.8
65.2
65.6
66.0
66.4
66.8
67.2
67.6
68.0
68.4
68.8
69.2
69.6
70.0
70.4
70.8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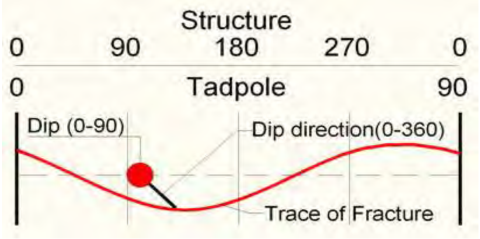
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - HS
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - HS
0 deg 360
Acoustic Caliper
90 mm 120
71.2
71.6
72.0
72.4
72.8
73.2
73.6
74.0
74.4
74.8
75.2
75.6
76.0
76.4

Geophysical Record of Borehole: BH21

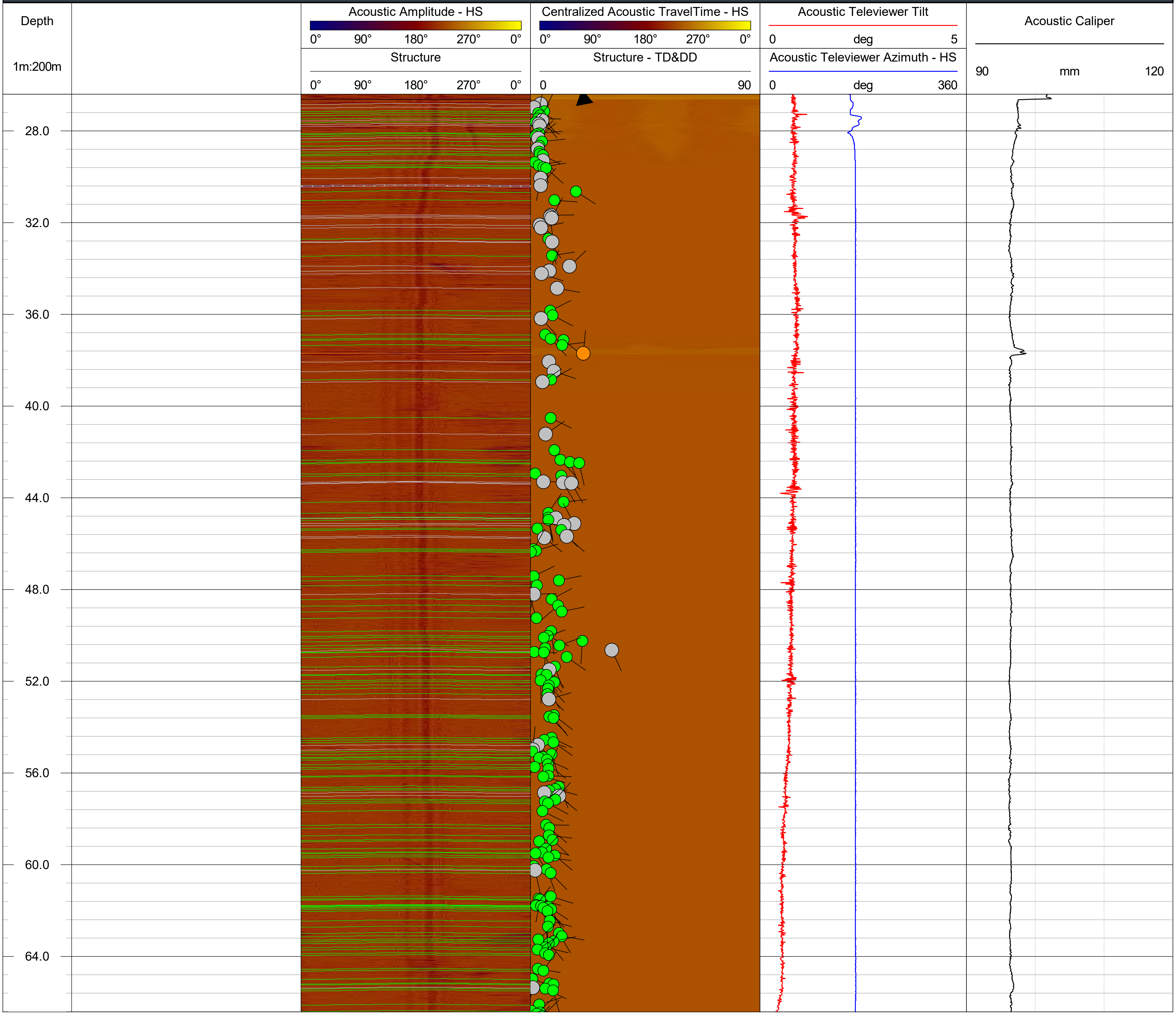
Log Title:	Darlington DNNP Geophysical Log
Project Number:	21451329
Client:	Ontario Power Generation
Date:	January 2023

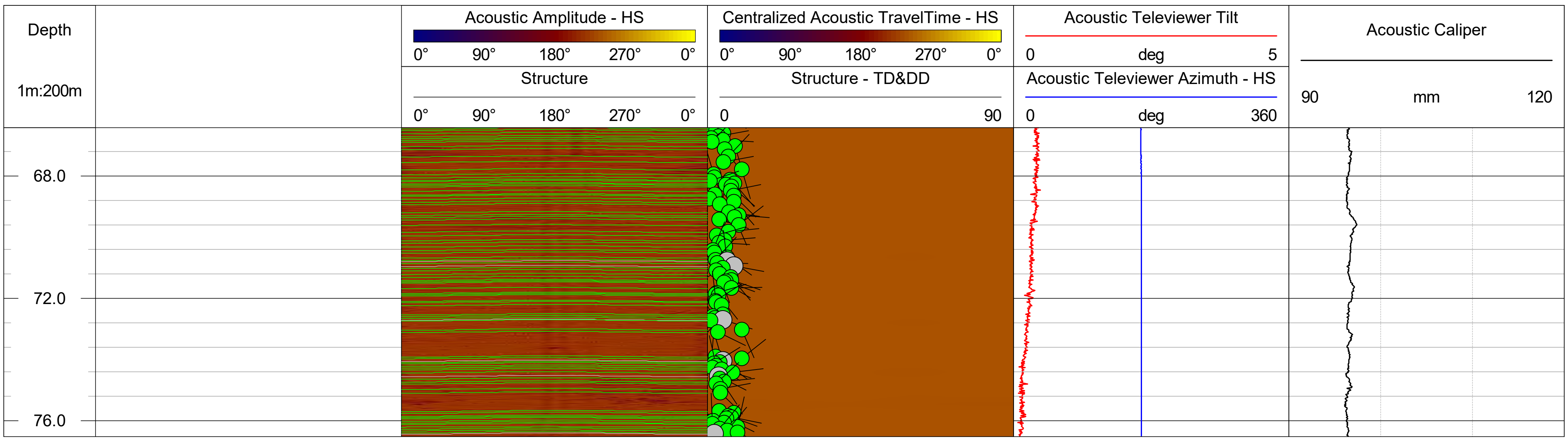
Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at ground	**Casing Depth:**	~24.64 m bgs	**Location:**	Darlington, Ontario
Easting:	683775.82 m	**Drilled Depth:**	71 m bgs	**Water Level:**	8.4 m bgs	**Log Date:**	Aug-16-2022
Northing:	4860024.76 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	20 degs		
Elevation:	87.26 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	P. Giamou



● Partially Open Joint / Fracture	● Filled Fracture / Joint	● Bedding / Banding / Foliation
◀ Casing		

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)




Depth
1m:200m
Acoustic Amplitude - HS
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - HS
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - HS
0 deg 360
Acoustic Caliper
90 mm 120
68.0
72.0
76.0

A02-BH22

PROJECT: 21451329

LOCATION: N 4859852.05; E 683890.35

RECORD OF BOREHOLE: BH22

SHEET 1 OF 8

BORING DATE: August 31 to September 15, 2022

DATUM: Geodetic

DRILL RIG: Acker Renegade I Track Mounted

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-10} 10^{-8} 10^{-6} 10^{-4}); WATER CONTENT PERCENT Wp ⊢○W⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION (GRAIN SIZE DISTRIBUTION (%))
		GROUND SURFACE		85.08							GR SA SI CL
0	Mud Rotary Wash Boring HW Casing	BH22 had an inclination of -70° advanced at an azimuth of 340°. No soil sampling/testing completed in the overburden.		0.00							
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

LOGGED: DR

CHECKED: SEMP

PROJECT: 21451329

LOCATION: N 4859852.05; E 683890.35

RECORD OF BOREHOLE: BH22

SHEET 2 OF 8

BORING DATE: August 31 to September 15, 2022

DATUM: Geodetic

DRILL RIG: Acker Renegade I Track Mounted

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80) SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20, 40, 60, 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-10}, 10^{-8}, 10^{-6}, 10^{-4}) WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10, 20, 30, 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	Mud Rotary Wash Boring HW Casing	BH22 had an inclination of -70° advanced at an azimuth of 340°. No soil sampling/testing completed in the overburden.									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
		CONTINUED NEXT PAGE									

DEPTH SCALE

1 : 50

LOGGED: DR

CHECKED: SEMP

PROJECT: 21451329

LOCATION: N 4859852.05; E 683890.35

RECORD OF BOREHOLE: BH22

SHEET 3 OF 8

BORING DATE: August 31 to September 15, 2022

DATUM: Geodetic

DRILL RIG: Acker Renegade I Track Mounted

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 / SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-10} 10^{-8} 10^{-6} 10^{-4} / WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION / GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		--- CONTINUED FROM PREVIOUS PAGE ---									
20	Mud Rotary Wash Boring HW Casing	BH22 had an inclination of -70° advanced at an azimuth of 340°. No soil sampling/testing completed in the overburden.									
21											
22											
23											
24				62.29 24.25							
		Shale Bedrock									RQD = 0%
25											RQD = 82%
26											
											RQD = 100%
27											
28											RQD = 100%
29											
											RQD = 100%
30											

Notes:

1. Bedrock cored from 24.25 m to 70.32 m depth

2. Refer to Record of Inclined Drillhole BH22

3. Water level in open borehole could not be measured upon completion of soil drilling due to use of mud-rotary technique.

4. Methane (CH4), Carbon Monoxide (CO), Volatile Organic Compound (VOCs) and on one occasion Hydrogen Suilfide (H2S) gases were detected at surface by a portable gas monitor(GX-6000) during drilling of BH22 starting from a depth of approximately 5 m to the bottom of the borehole at 70.32 m depth.
H2S (about 3 ppm) was encountered at a depth of approximately 64.1 m.
Delays were relatively minor until depth of 33.5 m reached. Between 33.5 m and 41.3 m delays became significant later in the day and gases vented overnight into around midday the following day.
Between depths of 56.5 and 64.1 m, gases vented overnight as well as the following day.
Between depths of 64.1 and 67.1 m, about 3 hours of delay occurred and gases vented overnight and continued in the morning of the following day.
The borehole was grouted after reaching 70.32 m depth.

GTA-BHS 005 S:\CLIENTS\OPG\DARLINGTON_GENERATING_STATION\02_DATA\GINT\DARLINGTON_GENERATING_STATION.GPJ GAL-MIS.GDT 3/14/23

DEPTH SCALE

1 : 50

LOGGED: DR

CHECKED: SEMP

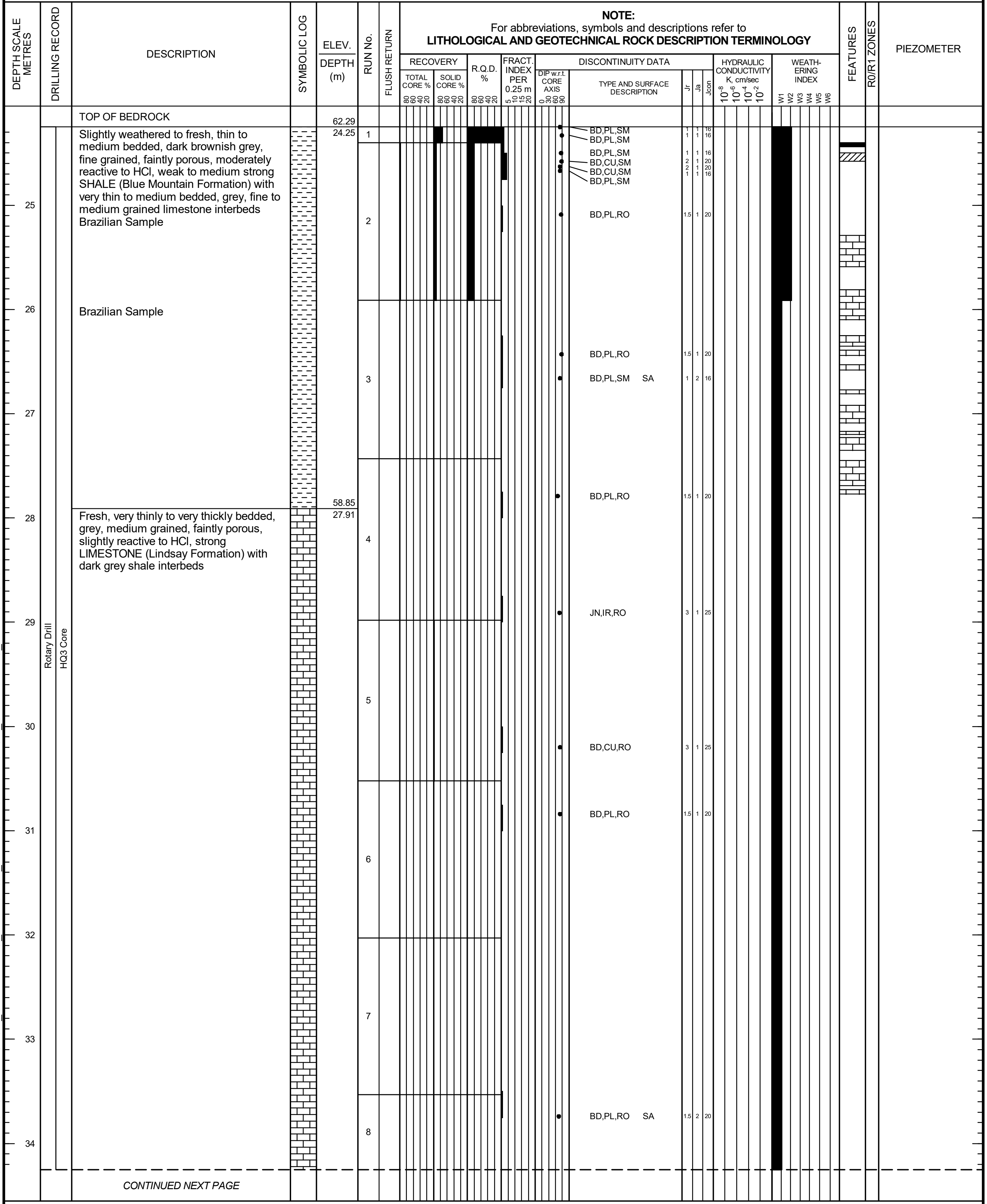
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859852.05; E 683890.35
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -70° AZIMUTH: 340°

RECORD OF DRILLHOLE: BH22

DRILLING DATE: August 31 to September 15, 2022
DRILL RIG: Acker Renegade I Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 4 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



DESCRIPTION	ELEV. DEPTH (m)
TOP OF BEDROCK	62.29 24.25
Slightly weathered to fresh, thin to medium bedded, dark brownish grey, fine grained, faintly porous, moderately reactive to HCl, weak to medium strong SHALE (Blue Mountain Formation) with very thin to medium bedded, grey, fine to medium grained limestone interbeds Brazilian Sample Brazilian Sample	
Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong LIMESTONE (Lindsay Formation) with dark grey shale interbeds	58.85 27.91

TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,CU,SM	2	1	20
BD,CU,SM	2	1	20
BD,PL,SM	1	1	16
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,PL,SM SA	1	2	16
BD,PL,RO	1.5	1	20
JN,IR,RO	3	1	25
BD,CU,RO	3	1	25
BD,PL,RO	1.5	1	20
BD,PL,RO SA	1.5	2	20

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: DR
CHECKED: CM

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859852.05; E 683890.35
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -70° AZIMUTH: 340°

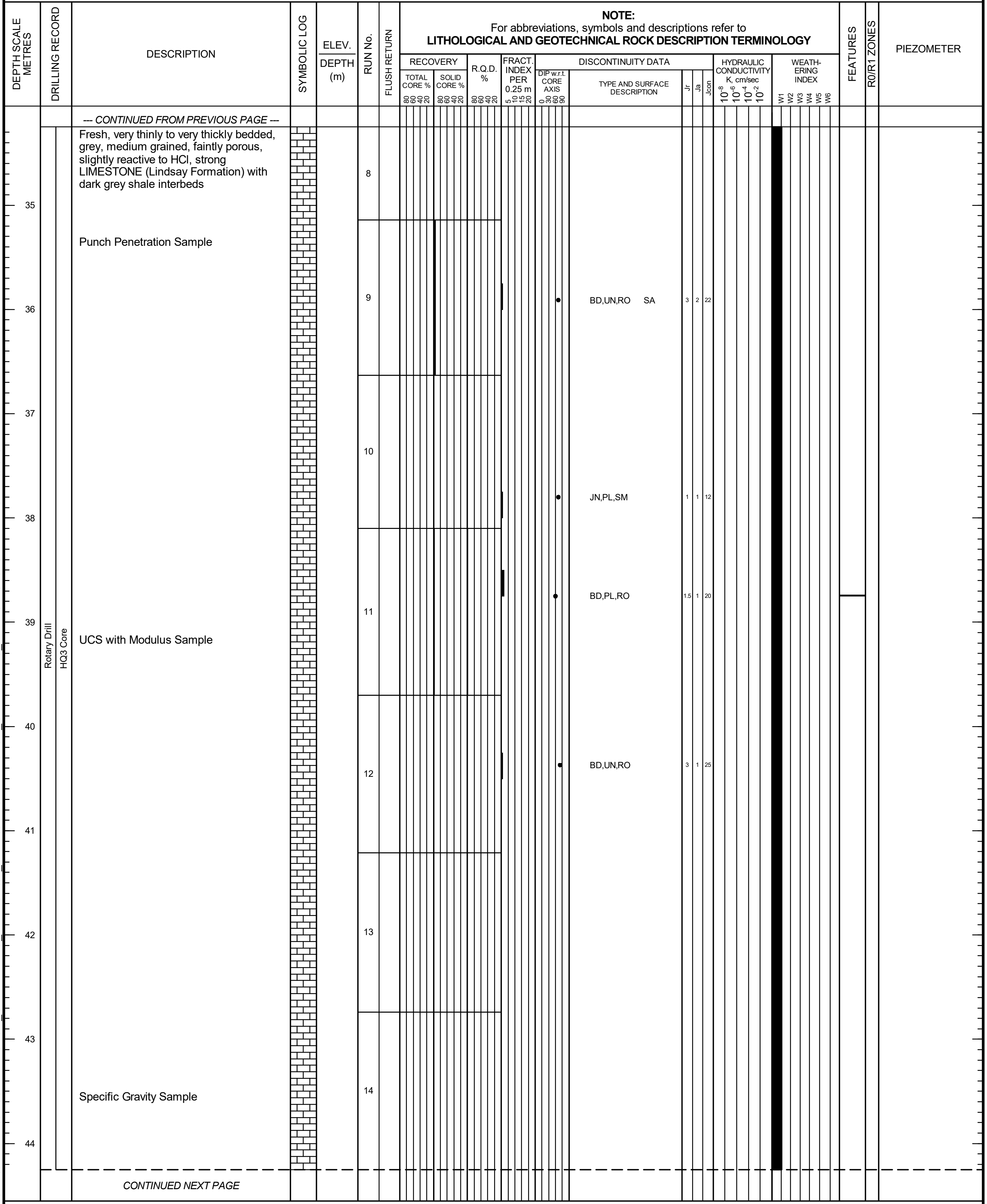
RECORD OF DRILLHOLE: BH22

SHEET 5 OF 8

DRILLING DATE: August 31 to September 15, 2022
DRILL RIG: Acker Renegade I Track Mounted
DRILLING CONTRACTOR: Walker Drilling

DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



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Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong LIMESTONE (Lindsay Formation) with dark grey shale interbeds

Punch Penetration Sample

UCS with Modulus Sample

Specific Gravity Sample

TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,UN,RO SA	3	2	22
JN,PL,SM	1	1	12
BD,PL,RO	1.5	1	20
BD,UN,RO	3	1	25

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: DR
CHECKED: CM

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859852.05; E 683890.35
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -70° AZIMUTH: 340°

RECORD OF DRILLHOLE: BH22

DRILLING DATE: August 31 to September 15, 2022
DRILL RIG: Acker Renegade I Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 6 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

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DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	RUN No.
	Rotary Drill HQ3 Core	Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong LIMESTONE (Lindsay Formation) with dark grey shale interbeds UCS Sample	
45			15
46			16
47		Punch Penetration Sample	
48			17
		Slake Durability Sample	
49		Direct Shear Sample Cerchar Sample	18
50			
51			19
52			20
53		UCS with Modulus Sample	
54			21

DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,PL,RO	1.5	1	20
BD,UN,RO	3	1	25
BD,PL,RO	1.5	1	20
BD,UN,RO	3	1	25
BD,UN,SM	2	1	20
BD,UN,RO SA	3	2	22
BD,PL,RO	1.5	1	20

Column headings: DEPTH SCALE METRES; DRILLING RECORD; DESCRIPTION; SYMBOLIC LOG; ELEV. DEPTH (m); RUN No.; FLUSH RETURN; RECOVERY (TOTAL CORE % 80 60 40 20; SOLID CORE % 80 60 40 20); R.Q.D. % 80 60 40 20; FRACT. INDEX PER 0.25 m 5 10 15 20; DISCONTINUITY DATA (DIP w.r.t. CORE AXIS 0 30 60 90; TYPE AND SURFACE DESCRIPTION; Jr; Ja; Jcon); HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2}; WEATHERING INDEX W1 W2 W3 W4 W5 W6; FEATURES; R0/R1 ZONES; PIEZOMETER

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: DR
CHECKED: CM

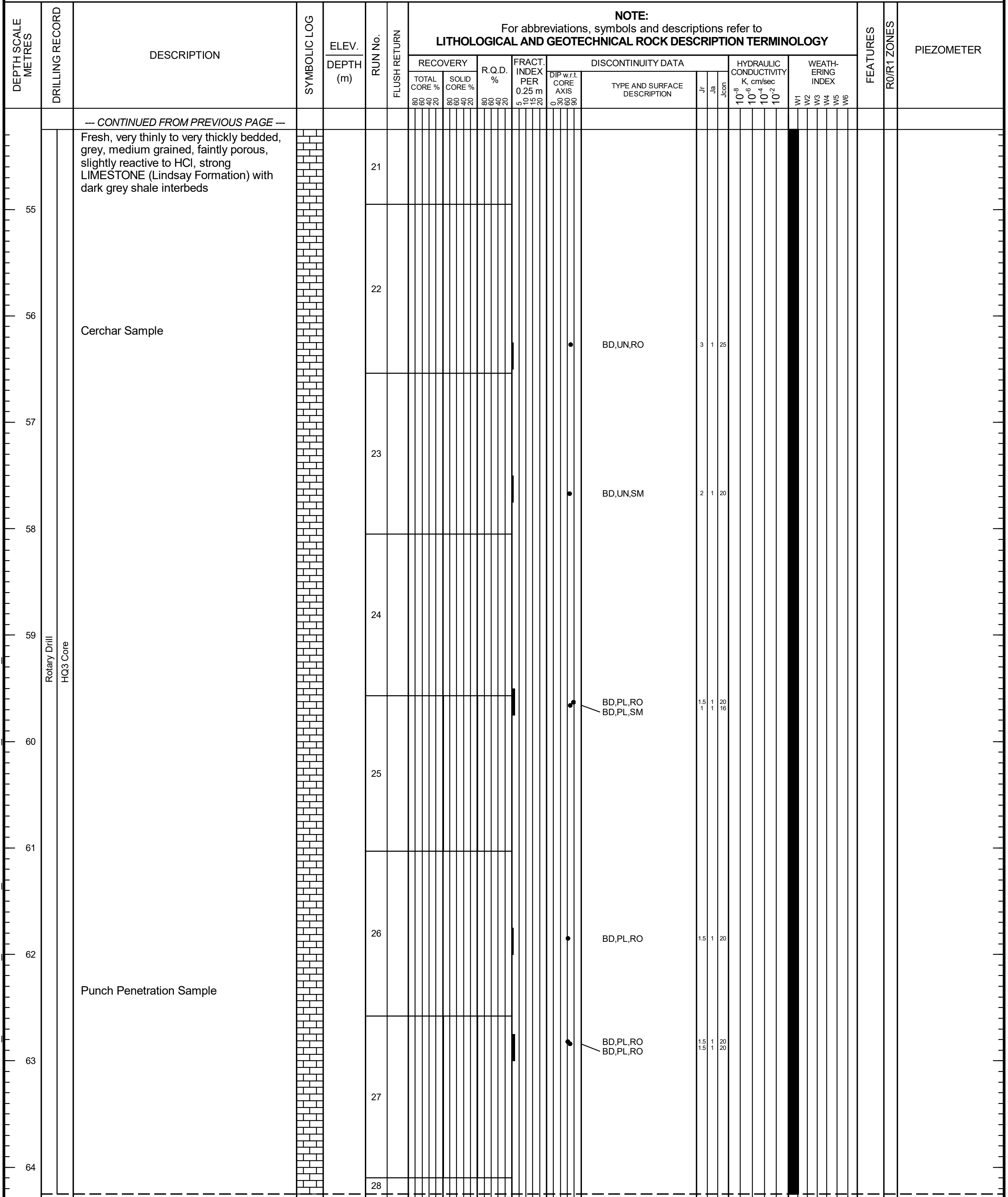
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859852.05; E 683890.35
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -70° AZIMUTH: 340°

RECORD OF DRILLHOLE: BH22

SHEET 7 OF 8
DATUM: Geodetic

DRILLING DATE: August 31 to September 15, 2022
DRILL RIG: Acker Renegade I Track Mounted
DRILLING CONTRACTOR: Walker Drilling

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



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Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong LIMESTONE (Lindsay Formation) with dark grey shale interbeds

Cerchar Sample

Punch Penetration Sample

TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,UN,RO	3	1	25
BD,UN,SM	2	1	20
BD,PL,RO	1.5	1	20
BD,PL,SM	1	1	16
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: DR
CHECKED: CM

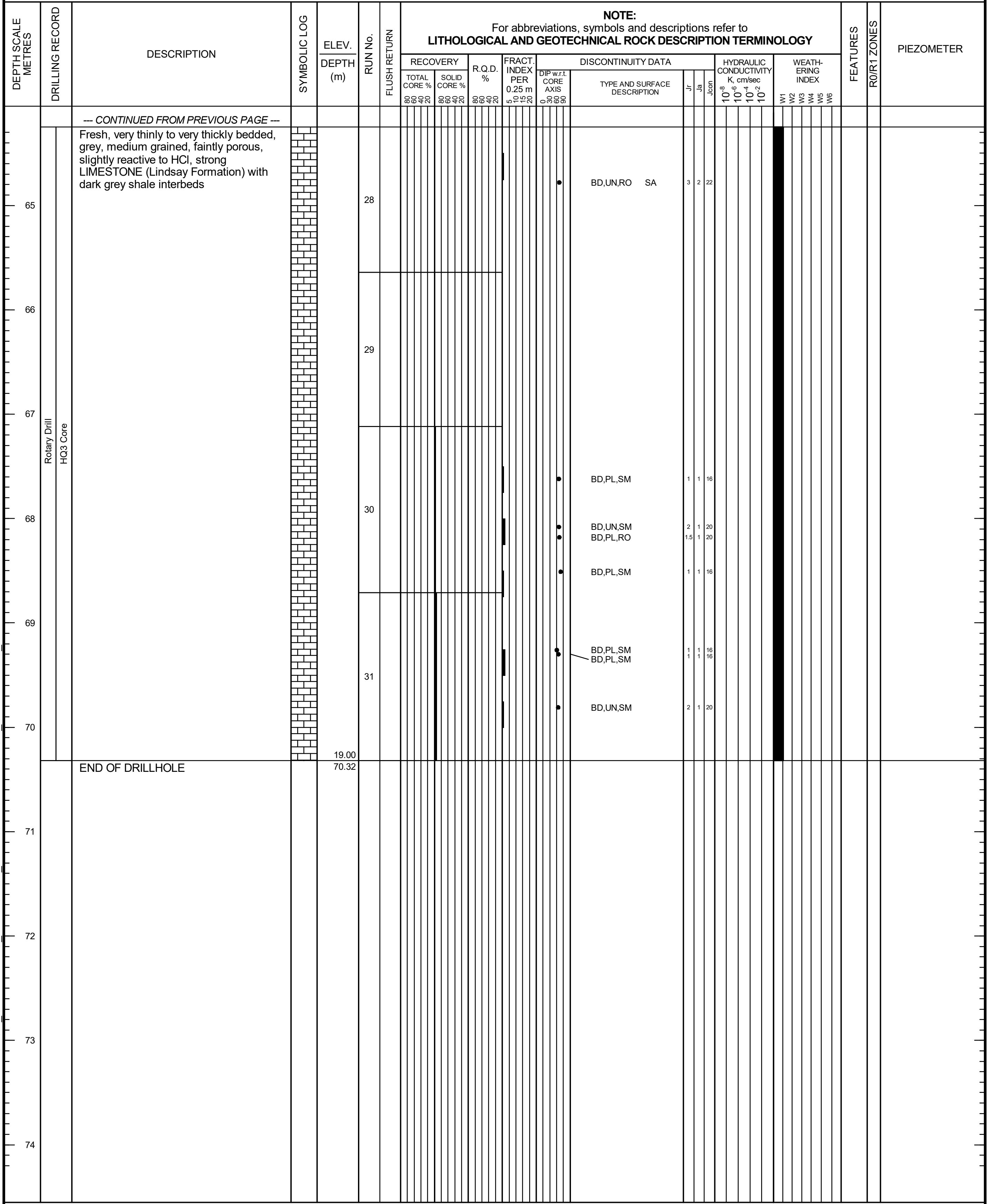
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859852.05; E 683890.35
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -70° AZIMUTH: 340°

RECORD OF DRILLHOLE: BH22

DRILLING DATE: August 31 to September 15, 2022
DRILL RIG: Acker Renegade I Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 8 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



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Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong LIMESTONE (Lindsay Formation) with dark grey shale interbeds

TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,UN,RO SA	3	2	22
BD,PL,SM	1	1	16
BD,UN,SM	2	1	20
BD,PL,RO	1.5	1	20
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,UN,SM	2	1	20

19.00
70.32

END OF DRILLHOLE

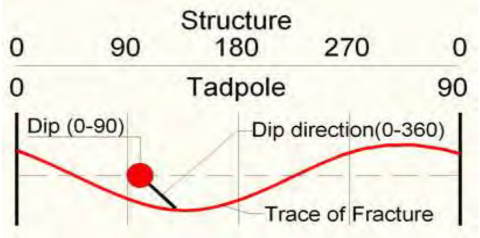
DEPTH SCALE
1 : 50

LOGGED: DR
CHECKED: CM

Geophysical Record of Borehole: BH22

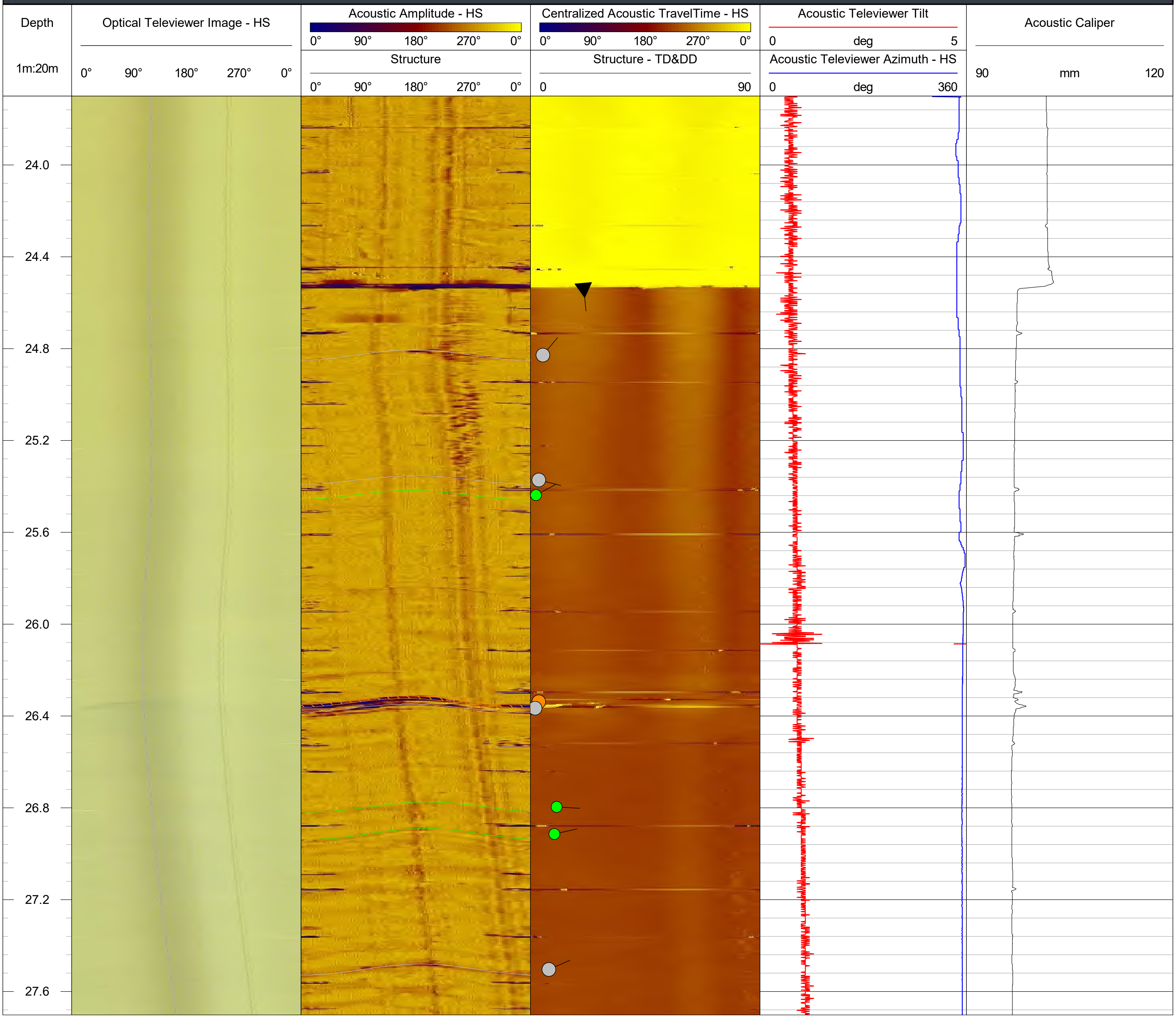
Log Title:	Darlington DNNP Geophysical Log
Project Number:	21451329
Client:	Ontario Power Generation
Date:	January 2023

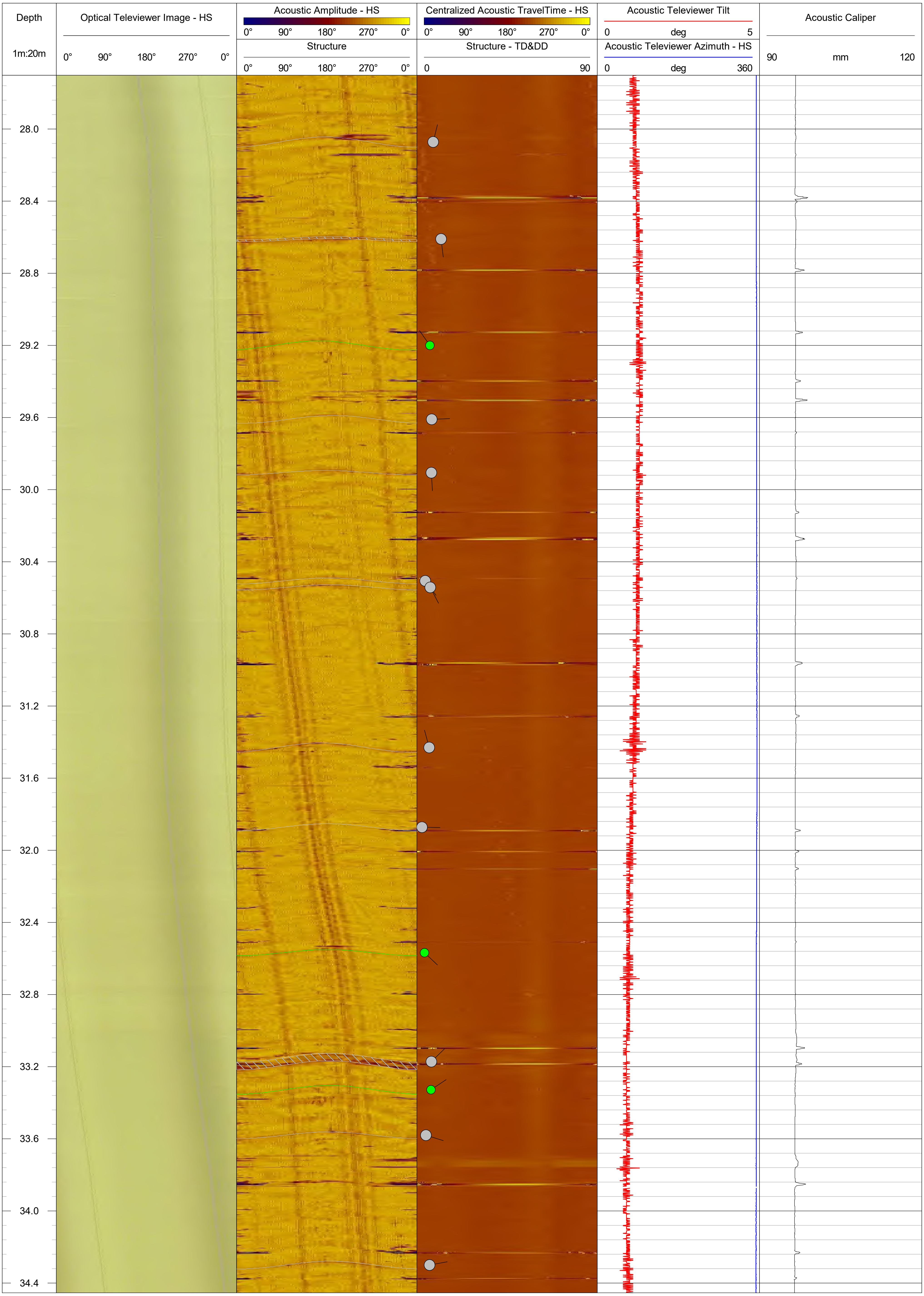
Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at ground	**Casing Depth:**	~23.82 m bgs	**Location:**	Darlington, Ontario
Easting:	683890.35 m	**Drilled Depth:**	70.32 m bgs	**Water Level:**	9.68 m bgs	**Log Date:**	Sept-15-2022
Northing:	4859852.05 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	70 degs		
Elevation:	85.08 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	J. Crawford



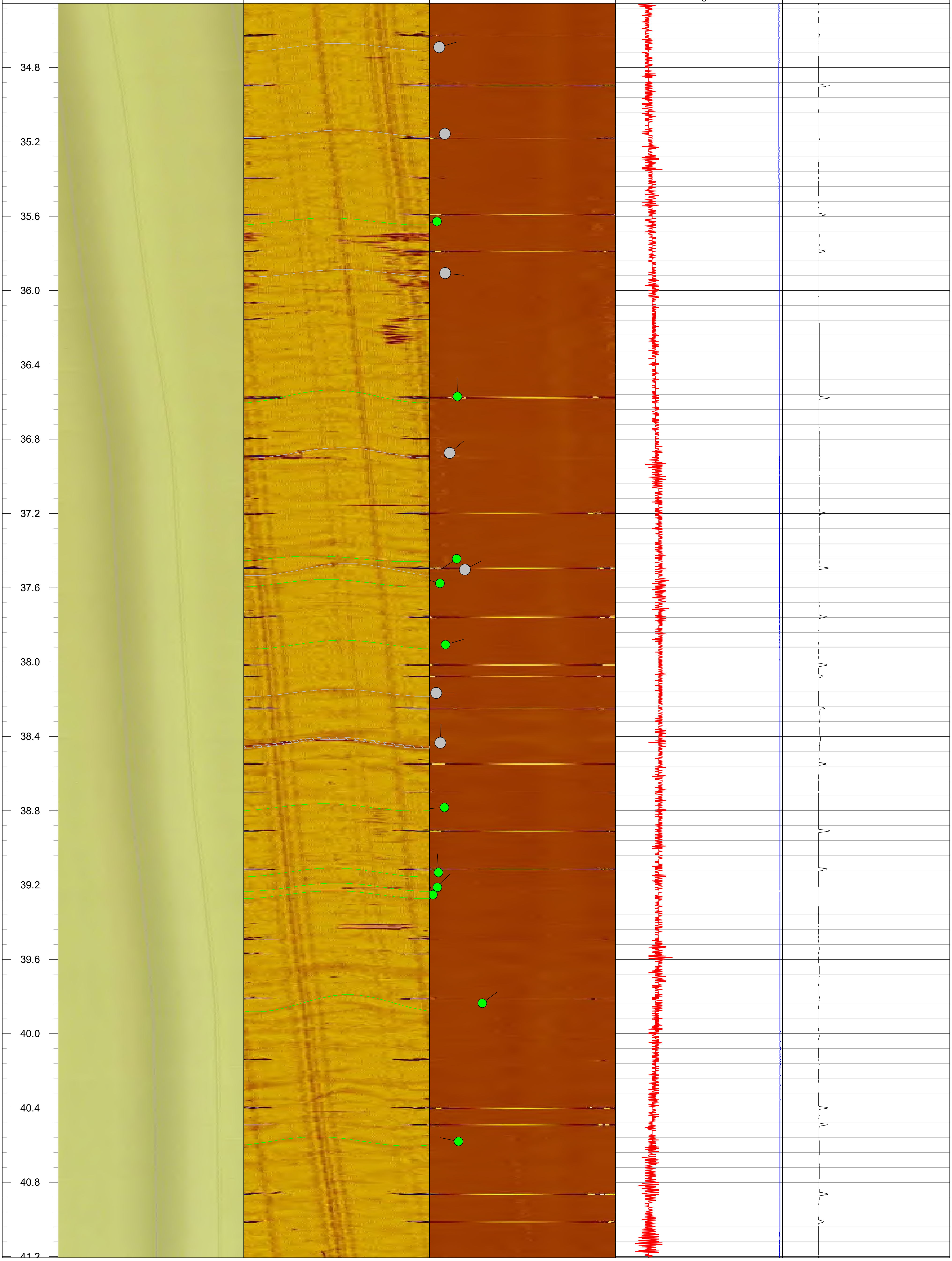
- 🟠 Partially Open Joint / Fracture
- ⚪ Filled Fracture / Joint
- 🟢 Bedding / Banding / Foliation
- ◀ Casing

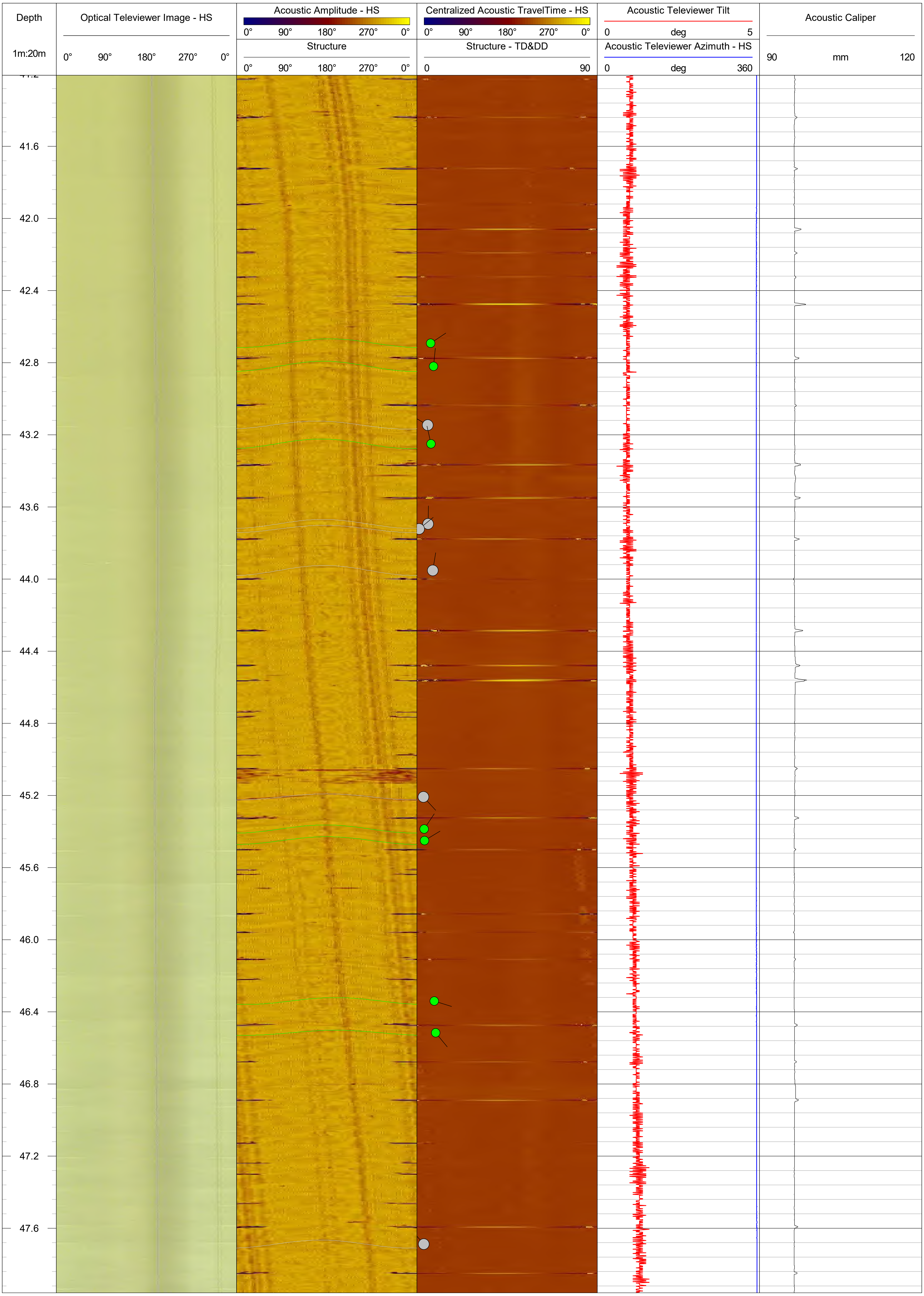
Notes: Magnetic Declination of 10.75 Degress West used to correct structure data to True Dip and Dip Direction (TD&DD)

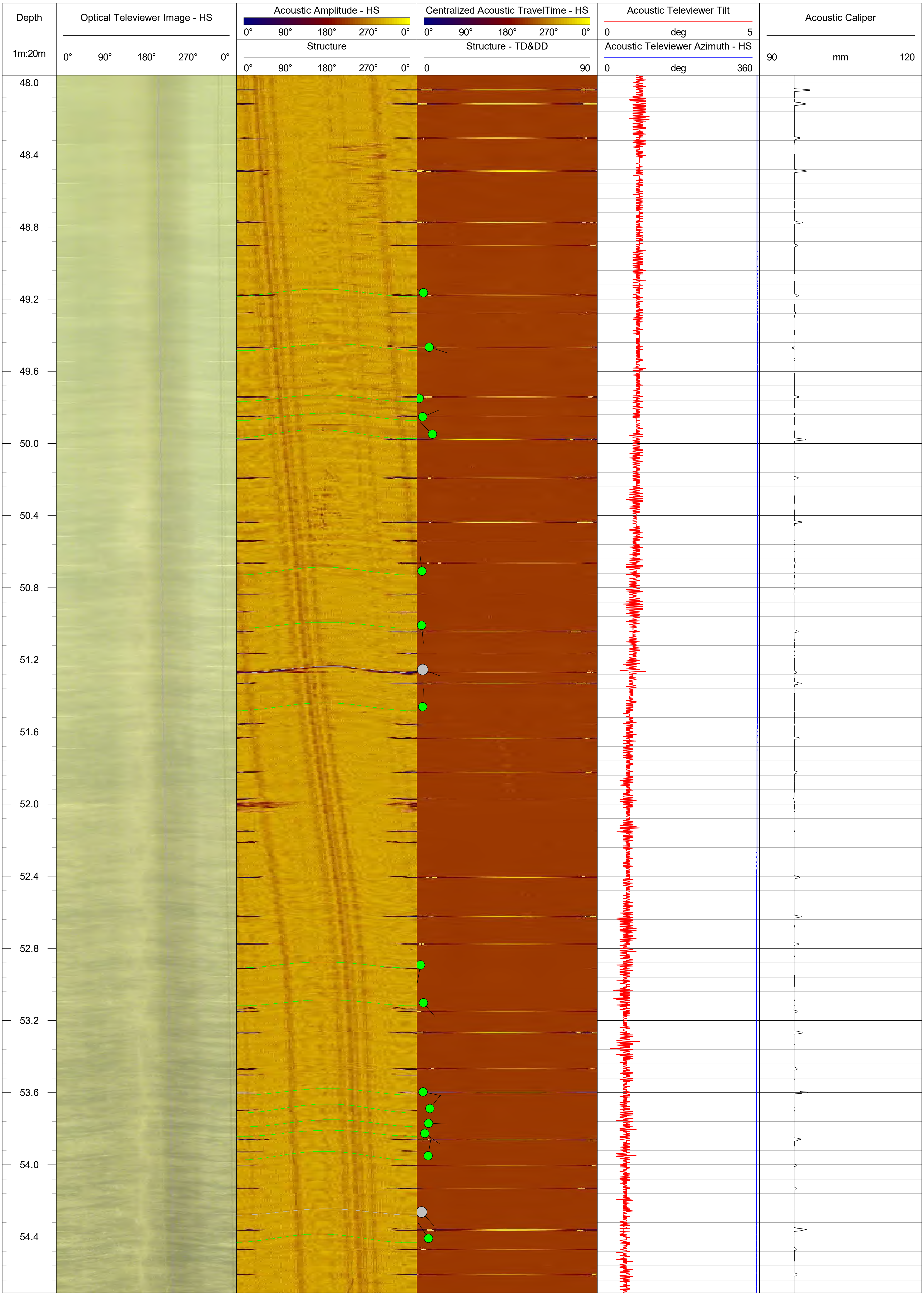


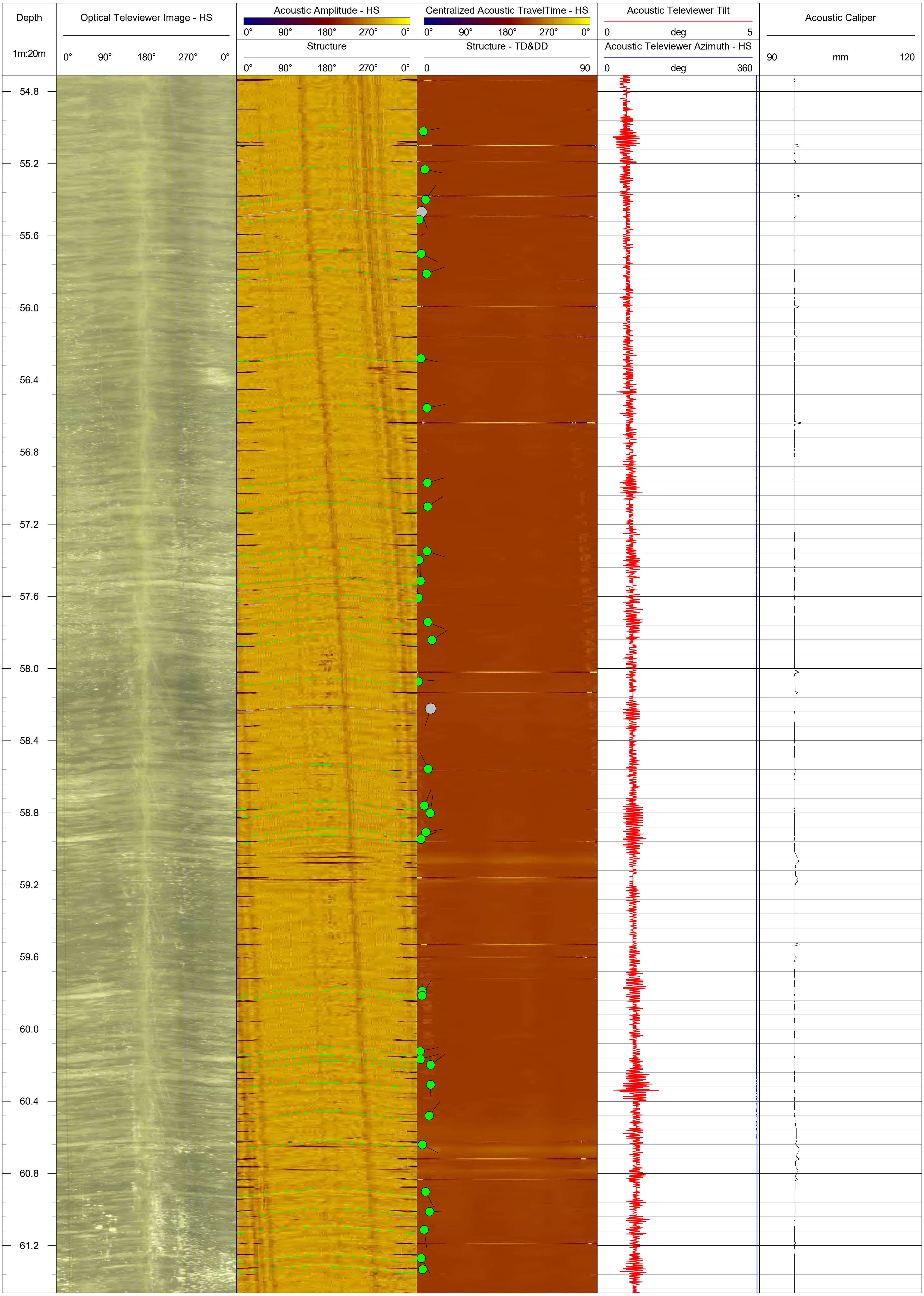

Depth
1m:20m
Optical Televiewer Image - HS
0° 90° 180° 270° 0°
Acoustic Amplitude - HS
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - HS
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - HS
0 deg 360
Acoustic Caliper
90 mm 120
28.0
28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0
32.4
32.8
33.2
33.6
34.0
34.4

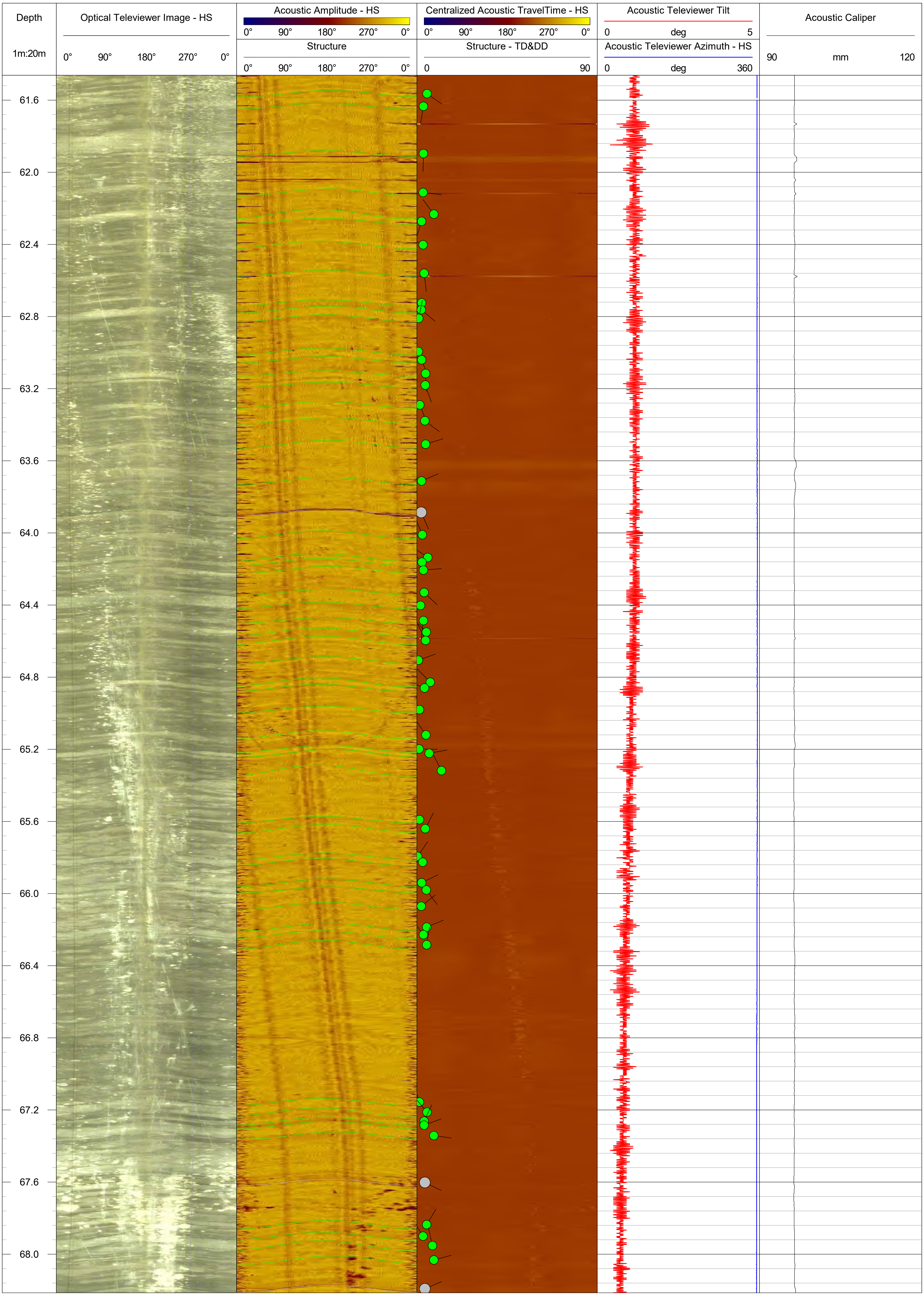
Depth 1m:20m	Optical Televiewer Image - HS 0° 90° 180° 270° 0°	Acoustic Amplitude - HS 0° 90° 180° 270° 0° Structure 0° 90° 180° 270° 0°	Centralized Acoustic TravelTime - HS 0° 90° 180° 270° 0° Structure - TD&DD 0 90	Acoustic Televiewer Tilt 0 deg 5 Acoustic Televiewer Azimuth - HS 0 deg 360	Acoustic Caliper 90 mm 120




Depth
1m:20m
Optical Televiewer Image - HS
0°
90°
180°
270°
0°
Acoustic Amplitude - HS
0°
90°
180°
270°
0°
Structure
0°
90°
180°
270°
0°
Centralized Acoustic TravelTime - HS
0°
90°
180°
270°
0°
Structure - TD&DD
0
90
Acoustic Televiewer Tilt
0
deg
5
Acoustic Televiewer Azimuth - HS
0
deg
360
Acoustic Caliper
90
mm
120
41.6
42.0
42.4
42.8
43.2
43.6
44.0
44.4
44.8
45.2
45.6
46.0
46.4
46.8
47.2
47.6


Depth
1m:20m
Optical Televiewer Image - HS
0° 90° 180° 270° 0°
Acoustic Amplitude - HS
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - HS
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - HS
0 deg 360
Acoustic Caliper
90 mm 120
48.0
48.4
48.8
49.2
49.6
50.0
50.4
50.8
51.2
51.6
52.0
52.4
52.8
53.2
53.6
54.0
54.4


Depth
1m:20m
Optical Televiewer Image - HS
0° 90° 180° 270° 0°
Acoustic Amplitude - HS
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - HS
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - HS
0 deg 360
Acoustic Caliper
90 mm 120
54.8
55.2
55.6
56.0
56.4
56.8
57.2
57.6
58.0
58.4
58.8
59.2
59.6
60.0
60.4
60.8
61.2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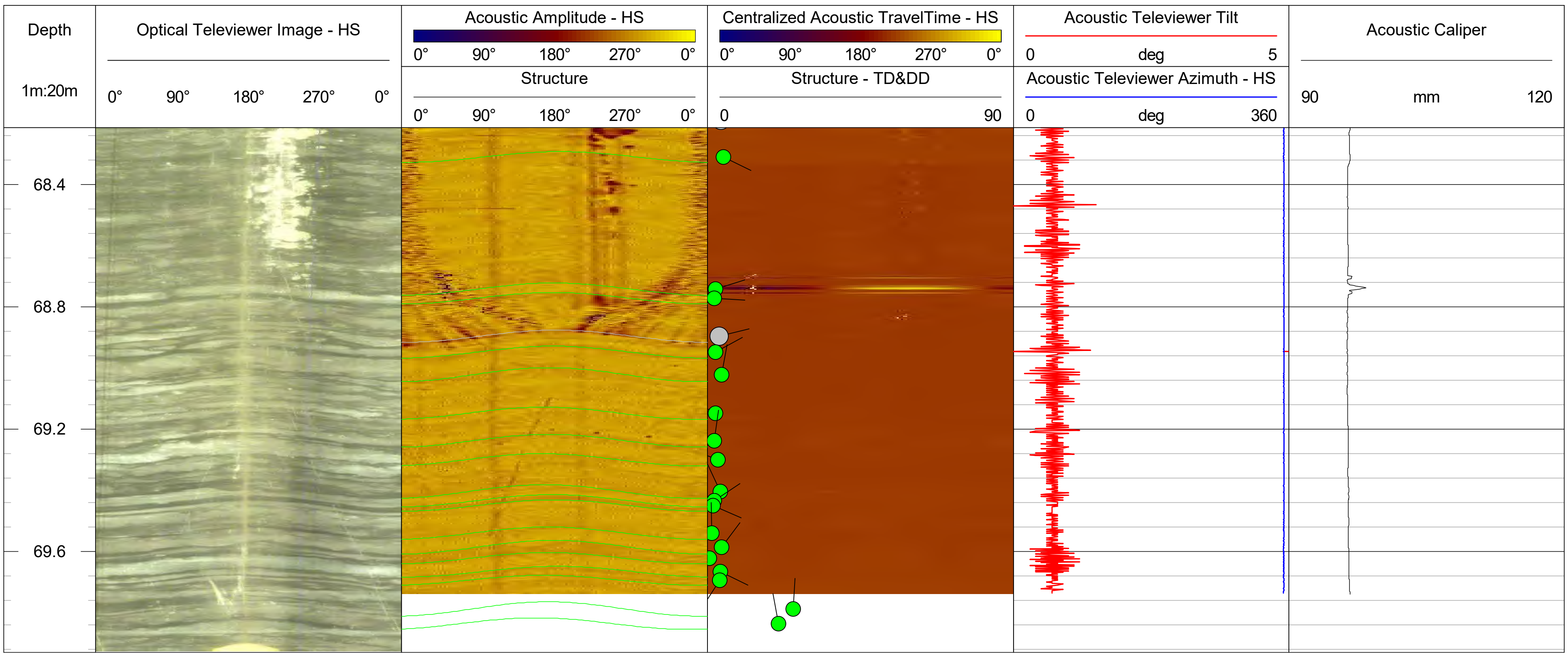
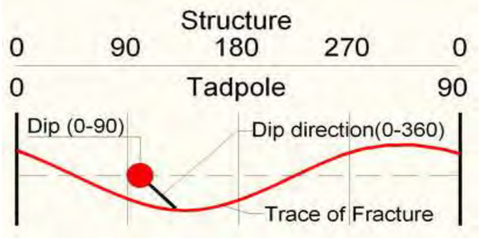
1m:20m
Optical Televiewer Image - HS
0° 90° 180° 270° 0°
Acoustic Amplitude - HS
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - HS
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - HS
0 deg 360
Acoustic Caliper
90 mm 120
61.6
62.0
62.4
62.8
63.2
63.6
64.0
64.4
64.8
65.2
65.6
66.0
66.4
66.8
67.2
67.6
68.0


Depth
1m:20m
Optical Televiewer Image - HS
0° 90° 180° 270° 0°
Acoustic Amplitude - HS
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - HS
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - HS
0 deg 360
Acoustic Caliper
90 mm 120
68.4
68.8
69.2
69.6

Geophysical Record of Borehole: BH22

Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at ground	**Casing Depth:**	~23.82 m bgs	**Location:**	Darlington, Ontario
Easting:	683890.35 m	**Drilled Depth:**	70.32 m bgs	**Water Level:**	9.68 m bgs	**Log Date:**	Sept-15-2022
Northing:	4859852.05 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	70 degs		
Elevation:	85.08 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	J. Crawford



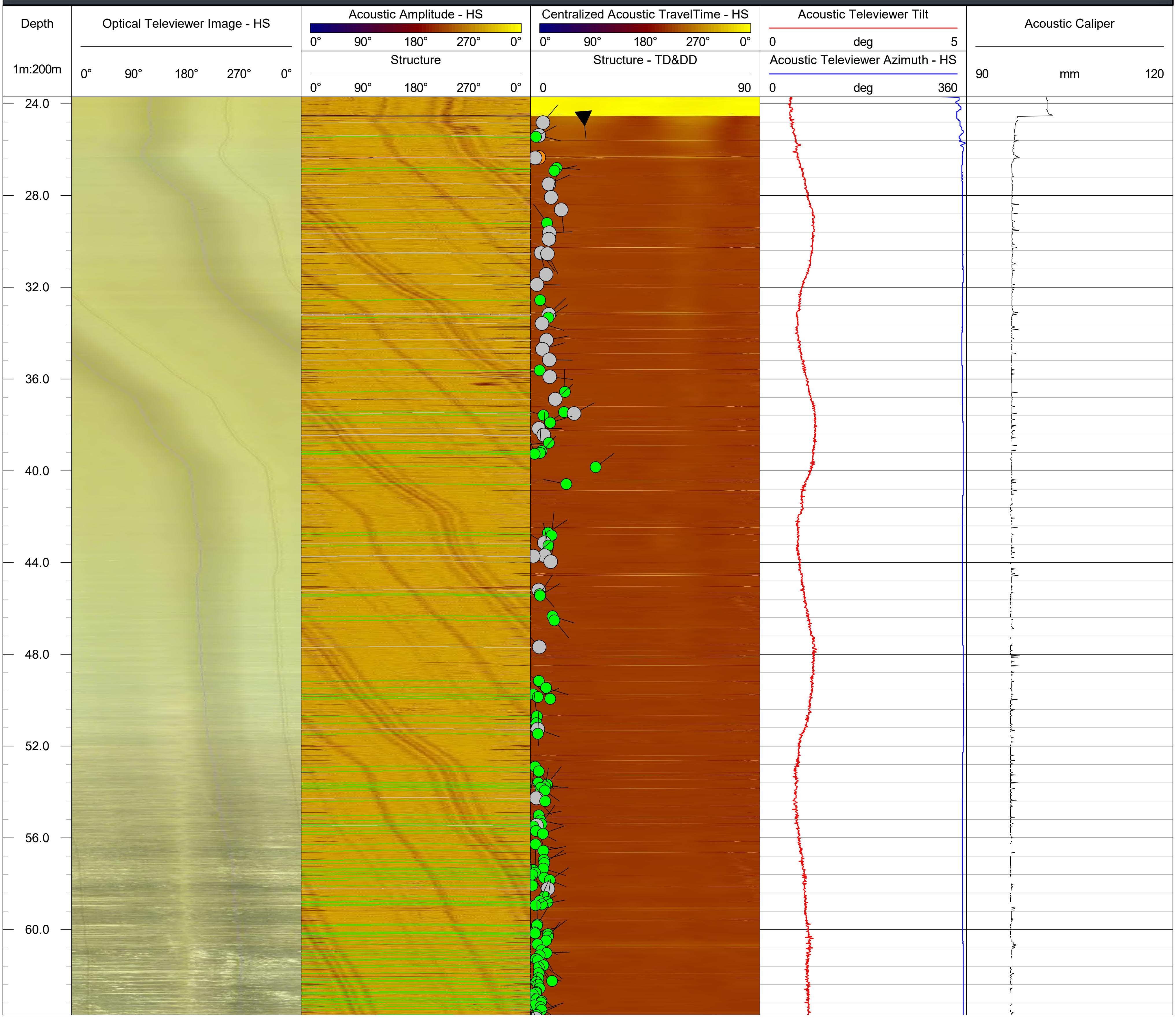
🟠 Partially Open Joint / Fracture

⚪ Filled Fracture / Joint

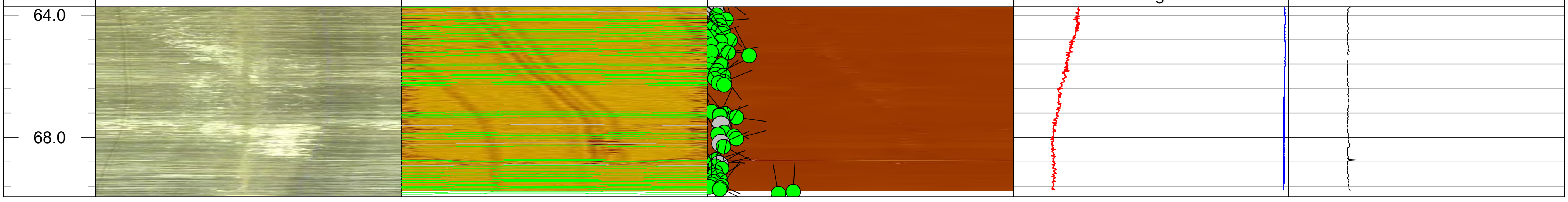
🟢 Bedding / Banding / Foliation

◀ Casing

Notes: Magnetic Declination of 10.75 Degress West used to correct structure data to True Dip and Dip Direction (TD&DD)



Depth	Optical Televiewer Image - HS	Acoustic Amplitude - HS	Centralized Acoustic TravelTime - HS	Acoustic Televiewer Tilt	Acoustic Caliper
		0° 90° 180° 270° 0°	0° 90° 180° 270° 0°	0 deg 5	
1m:200m	0° 90° 180° 270° 0°	Structure 0° 90° 180° 270° 0°	Structure - TD&DD 0 90	Acoustic Televiewer Azimuth - HS 0 deg 360	90 mm 120



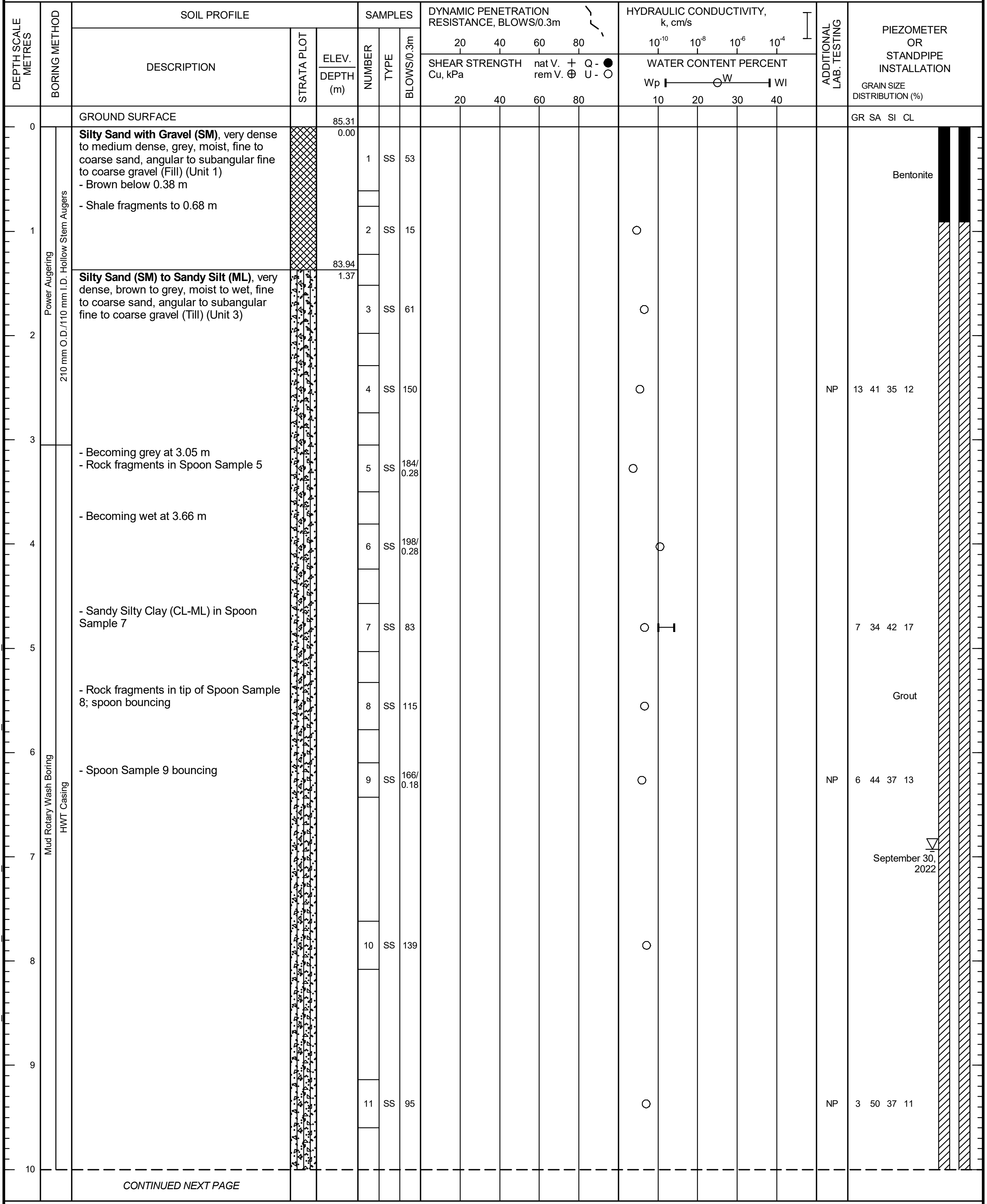
A03-BH23

PROJECT: 21451329
LOCATION: N 4859898.80; E 683833.09

RECORD OF BOREHOLE: BH23

BORING DATE: June 30 to July 5, 2022
DRILL RIG: Diedrich 120 Track Mounted

DATUM: Geodetic



DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	85.31
Silty Sand with Gravel (SM), very dense to medium dense, grey, moist, fine to coarse sand, angular to subangular fine to coarse gravel (Fill) (Unit 1) - Brown below 0.38 m - Shale fragments to 0.68 m	0.00
Silty Sand (SM) to Sandy Silt (ML), very dense, brown to grey, moist to wet, fine to coarse sand, angular to subangular fine to coarse gravel (Till) (Unit 3) - Becoming grey at 3.05 m - Rock fragments in Spoon Sample 5 - Becoming wet at 3.66 m - Sandy Silty Clay (CL-ML) in Spoon Sample 7 - Rock fragments in tip of Spoon Sample 8; spoon bouncing - Spoon Sample 9 bouncing	83.94 1.37

NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	GR	SA	SI	CL
1	SS	53					
2	SS	15					
3	SS	61					
4	SS	150	NP	13	41	35	12
5	SS	184/0.28					
6	SS	198/0.28					
7	SS	83		7	34	42	17
8	SS	115					
9	SS	166/0.18	NP	6	44	37	13
10	SS	139					
11	SS	95	NP	3	50	37	11

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: JS
CHECKED: SEMP

PROJECT: 21451329

LOCATION: N 4859898.80; E 683833.09

RECORD OF BOREHOLE: BH23

BORING DATE: June 30 to July 5, 2022

DRILL RIG: Diedrich 120 Track Mounted

SHEET 2 OF 9

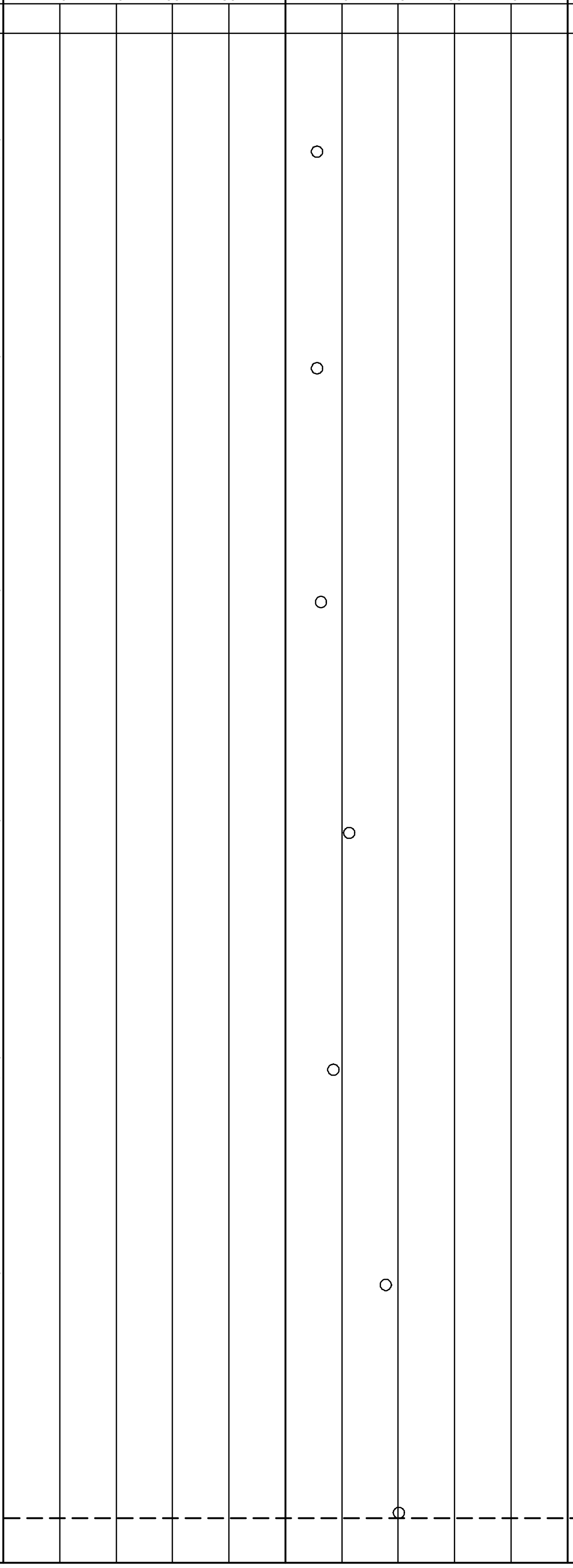
DATUM: Geodetic

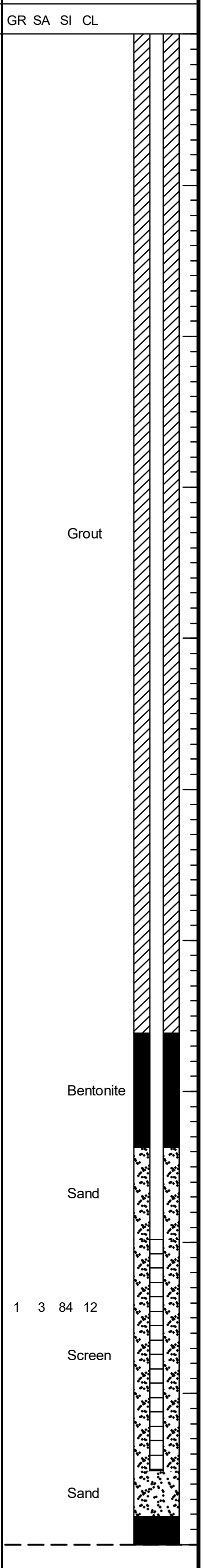
BORING METHOD: Mud Rotary Wash Boring, HWT Casing

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)
10	**Silty Sand (SM) to Sandy Silt (ML)**, very dense, brown to grey, moist to wet, fine to coarse sand, angular to subangular fine to coarse gravel (Till) (Unit 3)	
14.58	**Silty Sand (SM)**, very dense, grey, wet, fine to medium sand (Glaciolacustrine) (Unit 4a)	70.73 14.58
16.10	**Sandy Silt (ML)**, very dense, grey, moist, fine to coarse sand, angular fine gravel (Till) (Unit 3)	69.21 16.10
17.74	**Silt (ML)**, very dense, grey, moist, fine to medium sand (Glaciolacustrine) (Unit 4a)	67.57 17.74

SAMPLES NUMBER	TYPE	BLOWS/0.3m	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
12	SS	100/ 0.10	
13	SS	100/ 0.13	
14	SS	100/ 0.07	
15	SS	100/ 0.13	
16	SS	184/ 0.28	
17	SS	100/ 0.13	1 3 84 12
18A			





CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

LOGGED: JS

CHECKED: SEMP

PROJECT: 21451329

LOCATION: N 4859898.80; E 683833.09

RECORD OF BOREHOLE: BH23

BORING DATE: June 30 to July 5, 2022

DRILL RIG: Diedrich 120 Track Mounted

SHEET 3 OF 9

DATUM: Geodetic

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE – DESCRIPTION	ELEV. / DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	PIEZOMETER OR STANDPIPE INSTALLATION
20	Mud Rotary Wash Boring HWT Casing		65.19 20.12	18A 18B	SS	124		Bentonite
		Lean Clay with Sand (CL), hard, grey, moist, fine to medium sand, low to medium plasticity (Glaciolacustrine) (Unit 4b)	64.51 20.80					
21		**Sandy Silty Clay (CL-ML)**, hard, grey, moist, fine to coarse sand, angular fine to coarse gravel, low plasticity (Till) (Unit 5)		19	SS	93	5 37 40 18	
22			62.53 22.84	20	SS	100/ 0.05		
23		**Shale Bedrock Fragments** (Unit 6a) - Bedrock cored from 22.95 m to 78.11 m depth - Refer to Record of Drillhole BH23						

NOTES:

1. Water level in open borehole could not be measured upon completion of soil drilling due to use of mud-rotary technique.

2. Monitoring well installed on August 2, 2022.

3. Water level measured in the monitoring well at a depth of 6.93 m below ground surface (Elev. 78.38 m) on September 30, 2022.

4. Efficiency of the SPT hammer utilized was 76.5 %.

5. Methane (CH4), Carbon Monoxide (CO) and Volatile Organic Compound (VOCs) gases were detected at surface by a portable gas monitor(GX-6000) during drilling of BH23 between depths of approximately 50 m and 65 m.

6. Overcoring attempts made between approximately depths of 55 m and 60 m were unseccessful due to gas occurrences.

DEPTH SCALE

1 : 50

LOGGED: JS

CHECKED: SEMP

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859898.8; E 683833.09
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

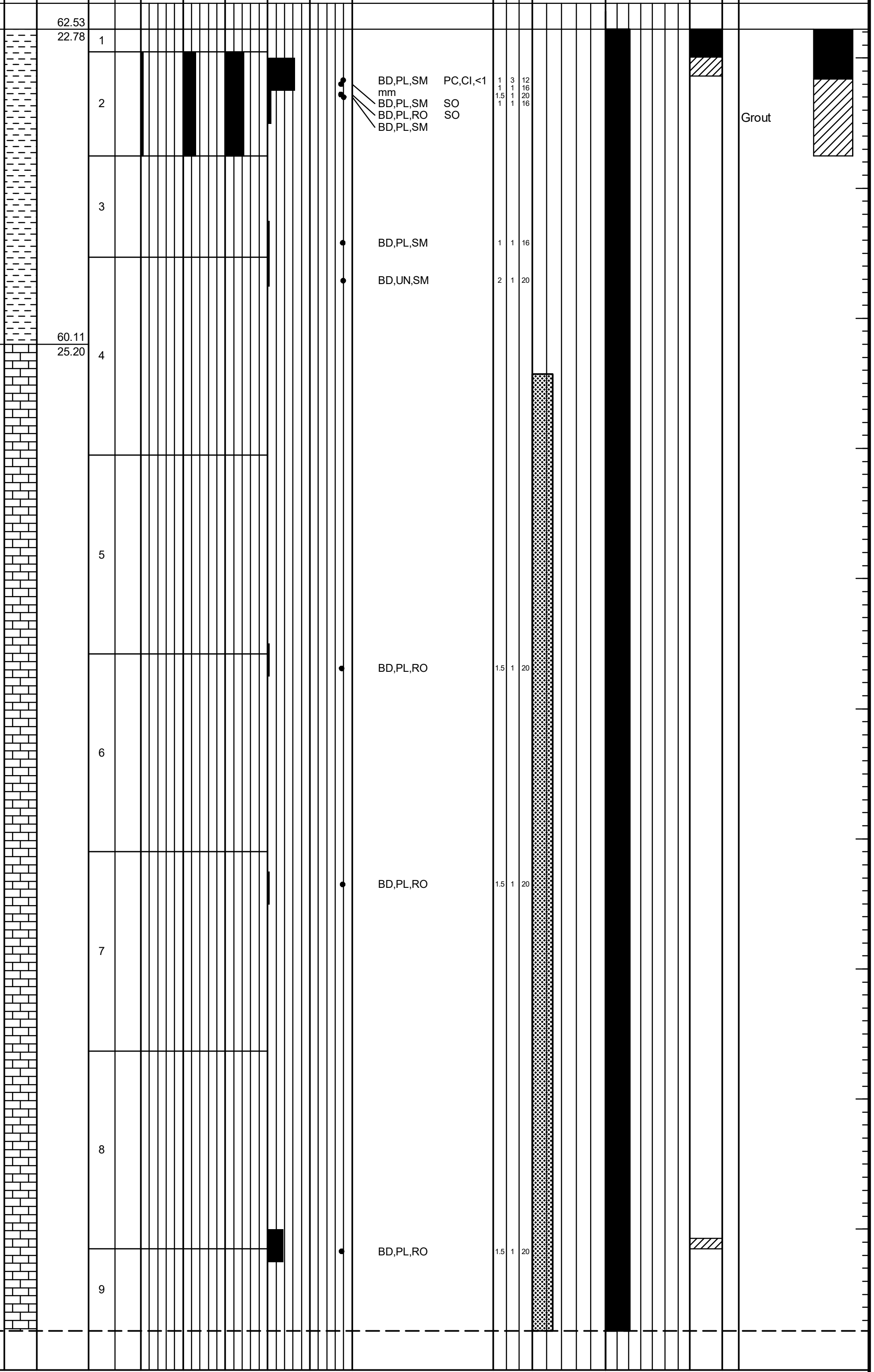
RECORD OF DRILLHOLE: BH23

DRILLING DATE: July 6 to 26, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (m)
		TOP OF BEDROCK	62.53
23–25	Rotary Drill HQ3 Core	Slightly weathered, very thinly to medium bedded, dark brownish grey, fine grained, faintly porous, moderately reactive to HCl, medium strong SHALE (Blue Mountain Formation) with thin, grey, limestone interbeds	22.78
			60.11 25.20
25–32		Slightly weathered to fresh, very thinly to thickly bedded, grey, fine to medium grained, faintly porous, moderately reactive to HCl, weak to strong LIMESTONE (Lindsay Formation) with dark grey, shale interbeds	



DISCONTINUITY DATA

TYPE AND SURFACE DESCRIPTION		Jr	Ja	Jcon
BD,PL,SM	PC,CI,<1 mm	1	3	12
BD,PL,SM	SO	1	1	16
BD,PL,RO	SO	1.5	1	20
BD,PL,SM		1	1	16
BD,PL,SM		1	1	16
BD,UN,SM		2	1	20
BD,PL,RO		1.5	1	20
BD,PL,RO		1.5	1	20
BD,PL,RO		1.5	1	20

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: JS/BD
CHECKED: AC

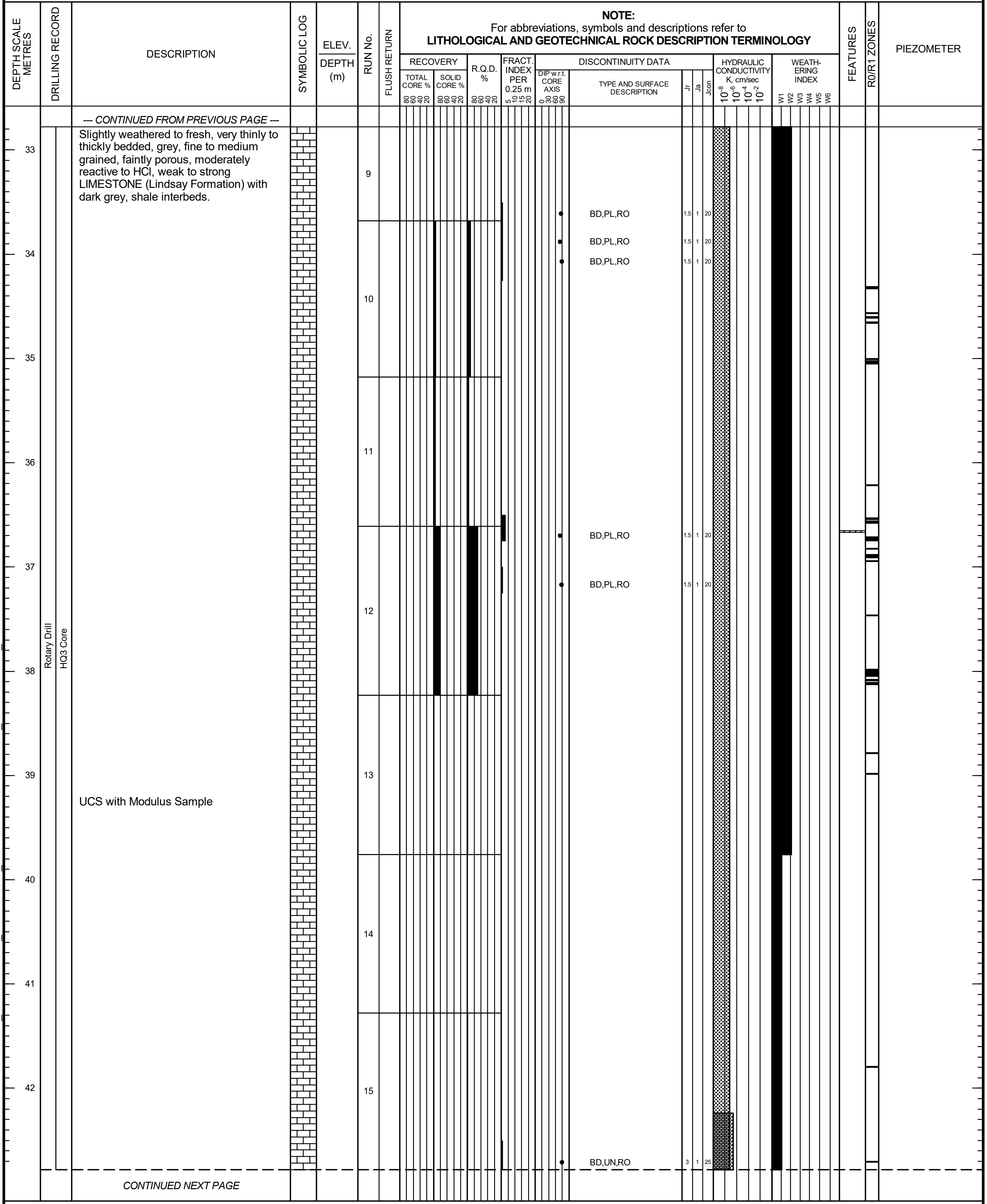
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859898.8; E 683833.09
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH23

DRILLING DATE: July 6 to 26, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 5 OF 9
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



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Slightly weathered to fresh, very thinly to thickly bedded, grey, fine to medium grained, faintly porous, moderately reactive to HCl, weak to strong LIMESTONE (Lindsay Formation) with dark grey, shale interbeds.

UCS with Modulus Sample

TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,UN,RO	3	1	25

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: JS/BD
CHECKED: AC

RECORD OF DRILLHOLE: BH23

DRILLING DATE: July 6 to 26, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec	WEATHERING INDEX	FEATURES	R0/R1 ZONES	PIEZOMETER

--- CONTINUED FROM PREVIOUS PAGE ---

Slightly weathered to fresh, very thinly to thickly bedded, grey, fine to medium grained, faintly porous, moderately reactive to HCl, weak to strong LIMESTONE (Lindsay Formation) with dark grey, shale interbeds.

Specific Gravity Sample

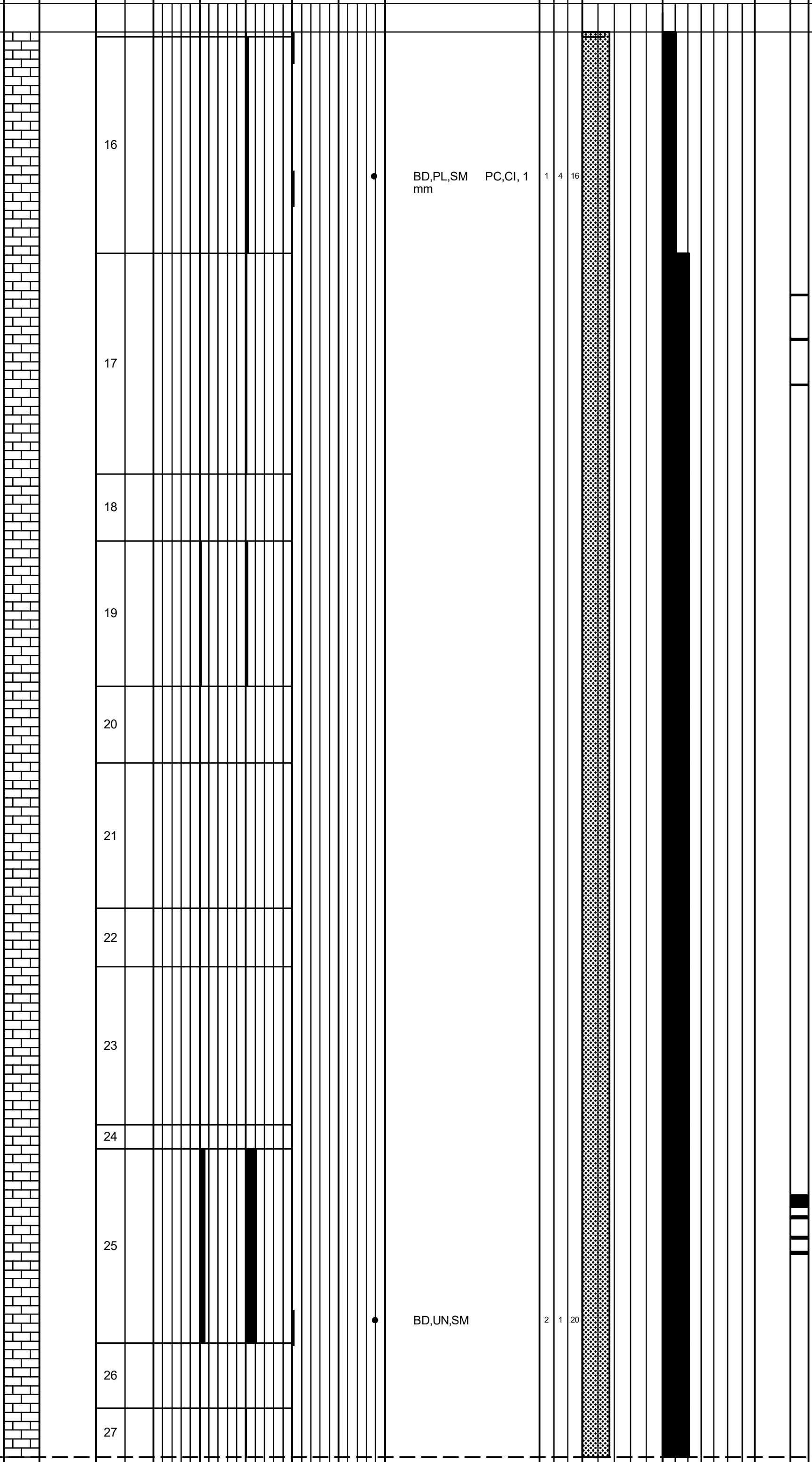
Brazilian Sample

UCS Sample

Slake Durability Sample

Direct Shear Sample

Drilling record: Rotary Drill, HQ3 Core



Depth scale (m): 43, 44, 45, 46, 47, 48, 49, 50, 51, 52

Runs: 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27

Type and surface description	Jr	Ja	Jcon
BD,PL,SM PC,CI, 1 mm	1	4	16
BD,UN,SM	2	1	20

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: JS/BD
CHECKED: AC

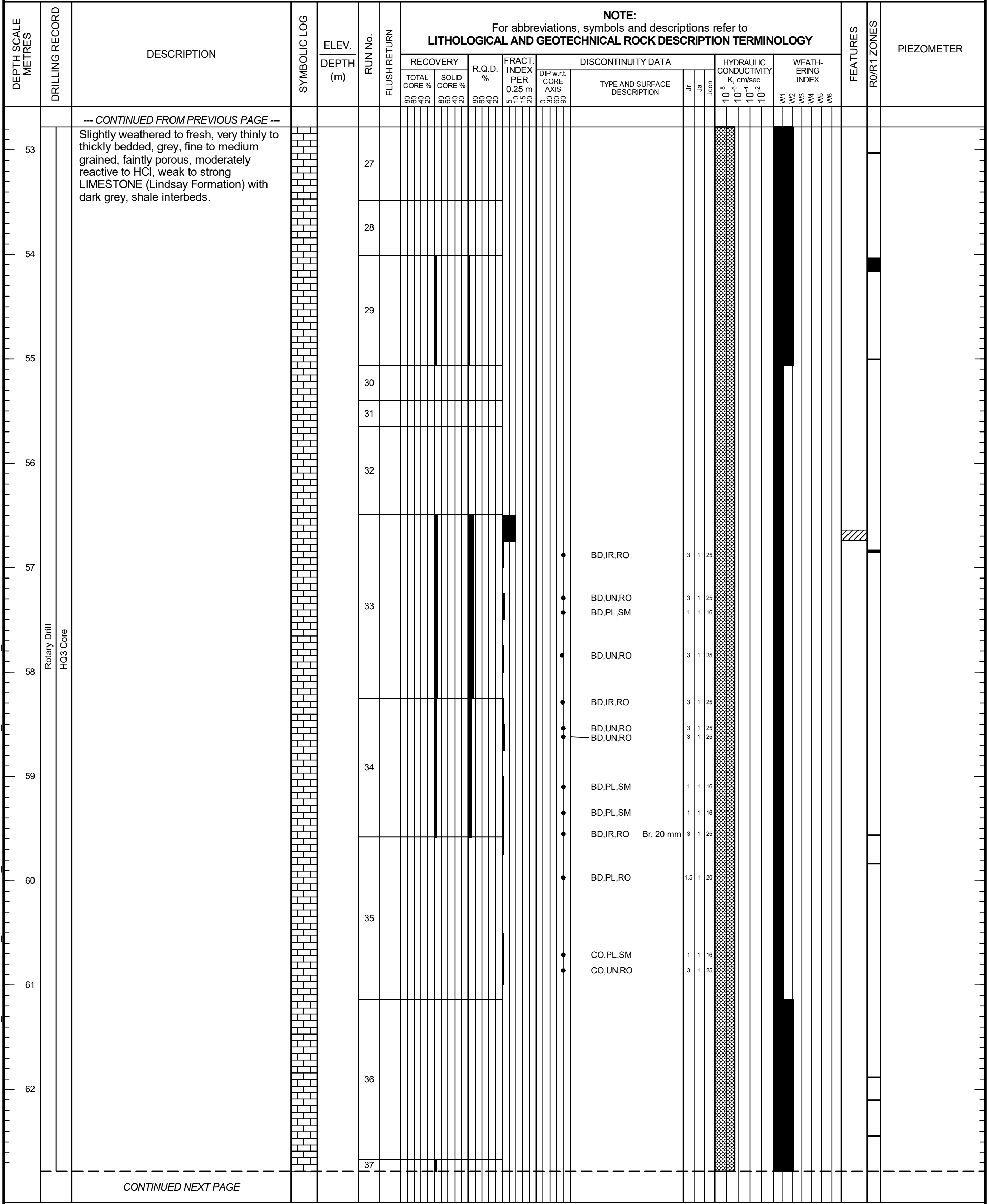
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859898.8; E 683833.09
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH23

DRILLING DATE: July 6 to 26, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 7 OF 9
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



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Slightly weathered to fresh, very thinly to thickly bedded, grey, fine to medium grained, faintly porous, moderately reactive to HCl, weak to strong LIMESTONE (Lindsay Formation) with dark grey, shale interbeds.

TYPE AND SURFACE DESCRIPTION		Jr	Ja	Jcon
BD,IR,RO		3	1	25
BD,UN,RO		3	1	25
BD,PL,SM		1	1	16
BD,UN,RO		3	1	25
BD,IR,RO		3	1	25
BD,UN,RO		3	1	25
BD,UN,RO		3	1	25
BD,PL,SM		1	1	16
BD,PL,SM		1	1	16
BD,IR,RO	Br, 20 mm	3	1	25
BD,PL,RO		1.5	1	20
CO,PL,SM		1	1	16
CO,UN,RO		3	1	25

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: JS/BD
CHECKED: AC

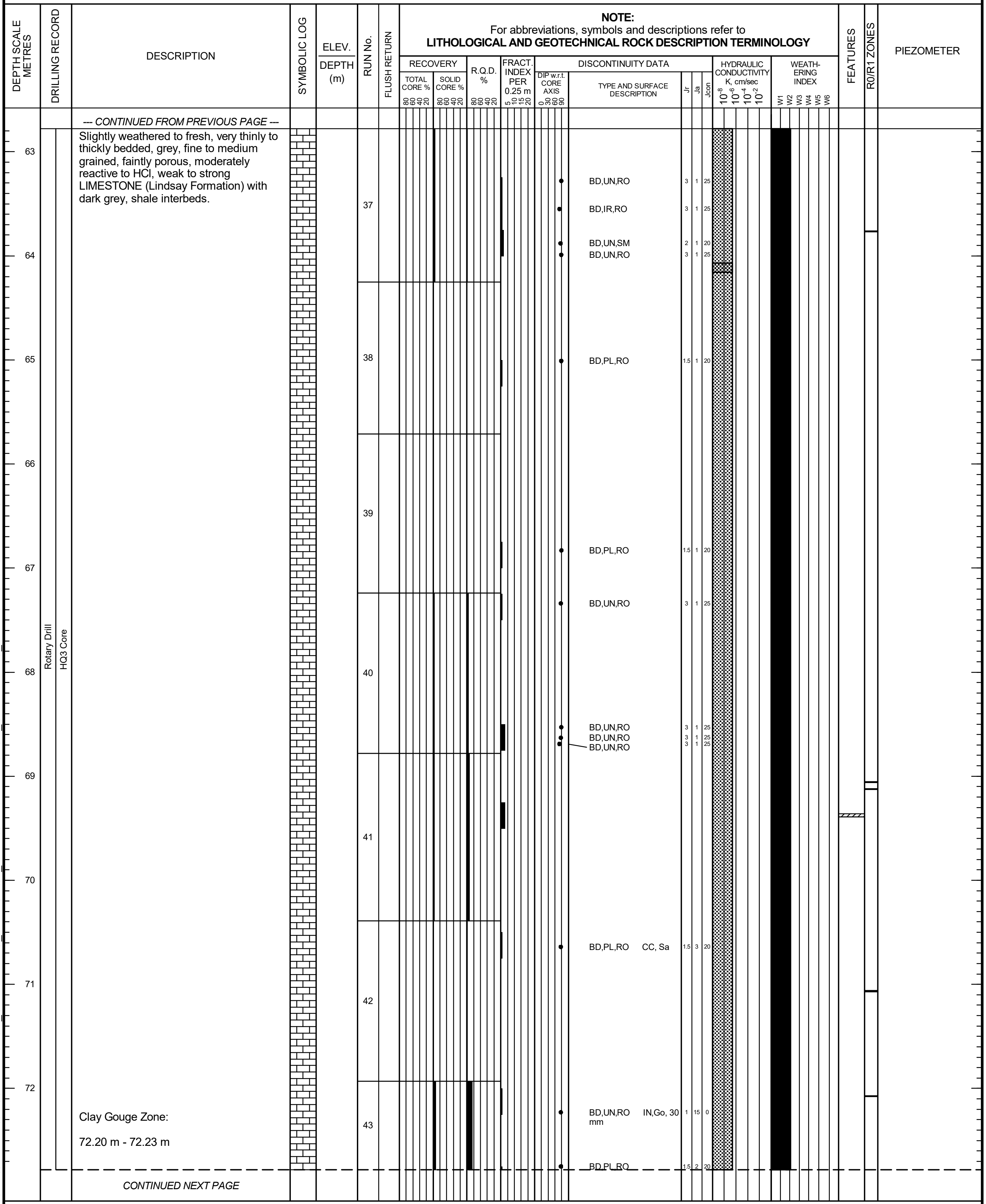
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859898.8; E 683833.09
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH23

DRILLING DATE: July 6 to 26, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 8 OF 9
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



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Slightly weathered to fresh, very thinly to thickly bedded, grey, fine to medium grained, faintly porous, moderately reactive to HCl, weak to strong LIMESTONE (Lindsay Formation) with dark grey, shale interbeds.

Clay Gouge Zone:

72.20 m - 72.23 m

RUN No.	TYPE AND SURFACE DESCRIPTION		Jr	Ja	Jcon
37	BD,UN,RO		3	1	25
37	BD,IR,RO		3	1	25
37	BD,UN,SM		2	1	20
37	BD,UN,RO		3	1	25
38	BD,PL,RO		1.5	1	20
39	BD,PL,RO		1.5	1	20
40	BD,UN,RO		3	1	25
40	BD,UN,RO		3	1	25
40	BD,UN,RO		3	1	25
40	BD,UN,RO		3	1	25
42	BD,PL,RO	CC, Sa	1.5	3	20
43	BD,UN,RO	IN,Go, 30 mm	1	15	0
43	BD,PL,RO		1.5	2	20

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

wsp

LOGGED: JS/BD
CHECKED: AC

GTA-RCK 048 S:\CLIENTS\OPG\DARLINGTON_GENERATING_STATION\02_DATA\GINT\DARLINGTON_GENERATING_STATION.GPJ GAL-MISS.GDT 6/2/23

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859898.8; E 683833.09
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

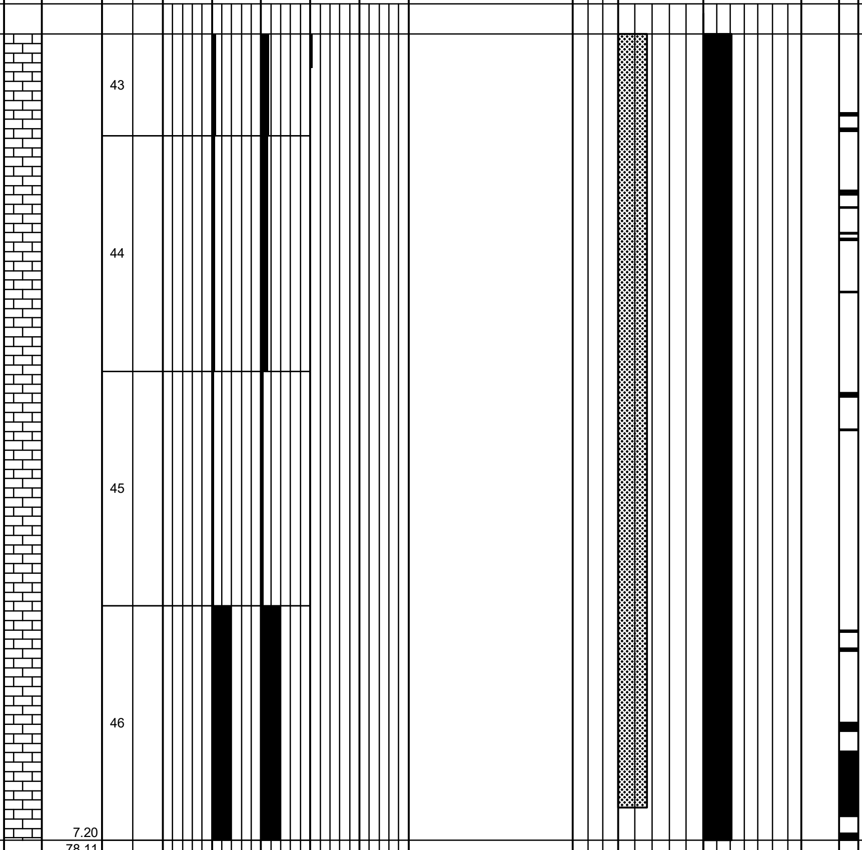
RECORD OF DRILLHOLE: BH23

DRILLING DATE: July 6 to 26, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 9 OF 9
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (m)	RUN No.
		--- CONTINUED FROM PREVIOUS PAGE ---		
73	Rotary Drill HQ3 Core	Slightly weathered to fresh, very thinly to thickly bedded, grey, fine to medium grained, faintly porous, moderately reactive to HCl, weak to strong LIMESTONE (Lindsay Formation) with dark grey, shale interbeds.		43
74				44
75				45
76				
77				46
78			7.20 78.11	
		END OF DRILLHOLE		
79				
80				
81				
82				



DEPTH SCALE
1 : 50

LOGGED: JS/BD
CHECKED: AC

GTA-RCK 048 S:\CLIENTS\OPG\DARLINGTON_GENERATING_STATION\02_DATA\GINT\DARLINGTON_GENERATING_STATION.GPJ GAL-MISS.GDT 6/2/23

Water Content Summary
ASTM D2216

Test Request #	21451329-21600-610 BH23	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville		

Sample Location	Sample				Soil Description	Water Content %	Method	Remarks
	Ref	Top (m)	Base (m)	Type				
BH23	2	0.76	1.22	SS		4.6	B	
BH23	3	1.52	1.98	SS		6.5	B	
BH23	4	2.29	2.74	SS		5.4	B	
BH23	5	3.05	3.48	SS		3.7	B	
BH23	6	3.81	4.24	SS		10.5	B	
BH23	7	4.57	5.03	SS		6.6	B	
BH23	8	5.33	5.79	SS		6.6	B	
BH23	9	6.10	6.43	SS		5.9	B	
BH23	10	7.62	8.08	SS		7.1	B	
BH23	11	9.14	9.60	SS		7.0	B	
BH23	12	10.67	10.92	SS		5.6	B	
BH23	13	12.19	12.32	SS		5.6	B	
BH23	14	13.72	13.94	SS		6.3	B	
BH23	15	15.24	15.53	SS		11.3	B	
BH23	16	16.76	17.20	SS		8.5	B	
BH23	17	18.29	18.57	SS		17.8	B	
BH23	18A	19.81	20.12	SS		20.1	B	
BH23	18B	20.12	20.27	SS		11.9	B	
BH23	19	21.34	21.79	SS		8.7	B	

Notes:

Disclaimer:

Tested by: JTimms **Date:** 12 Oct 2022
Checked by: MRuck **Date:** 27 Oct 2022
Reviewed by: JoNorris **Date:** 04 Nov 2022

PARTICLE SIZE DISTRIBUTION

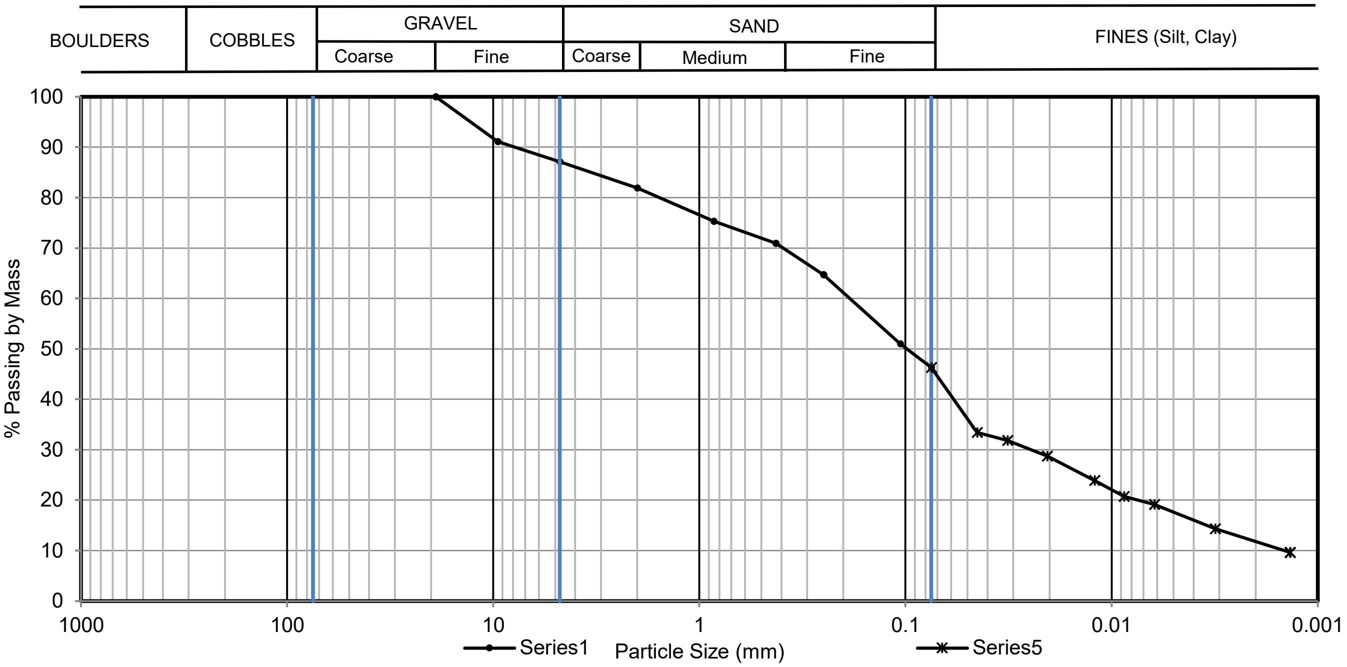
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH23	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH23
Source:		Sample No.:	4
		Type:	SS
Soil Description:		Depth (m):	2.29 - 2.74

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	18 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%) 12.9 40.8 46.3



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0449	33.4
3/8"	9.5	91.1	0.0320	31.8
#4	4.75	87.1	0.0205	28.7
#10	2	81.9	0.0121	23.9
#20	0.85	75.3	0.0087	20.7
#40	0.425	70.9	0.0062	19.1
#60	0.25	64.7	0.0031	14.3
#140	0.106	51.0	0.0014	9.6
#200	0.075	46.3		
			0.005 mm	17.57
			0.002 mm	11.77
			D60	0.19
			D30	0.02
			D10	0.00
			Cu	130.00
			Cc	2.20

Notes:

Disclaimer:

Tested by: JTimms **Date:** 18 Oct 2022 **Checked by:** MRuck **Date:** 27 Oct 2022 **Reviewed by:** JoNorris **Date:** 04 Nov 2022

PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422

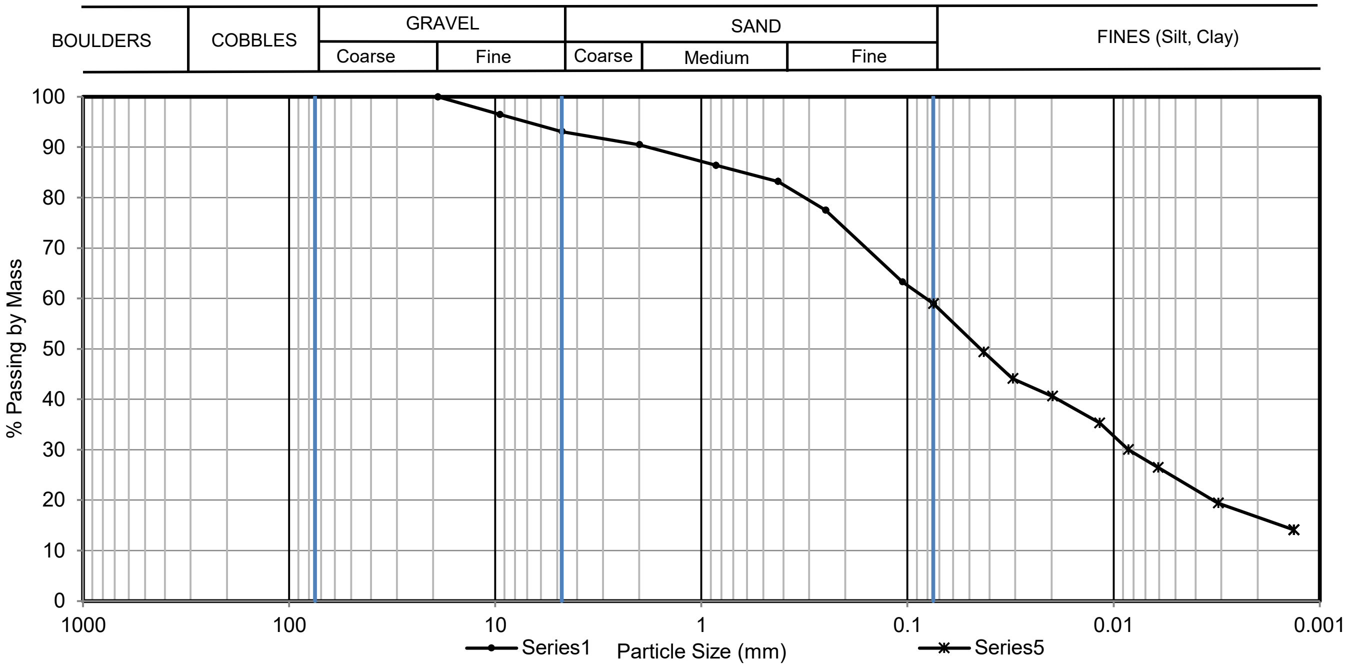
Method B

Test Request #	21451329-21600-610 BH23	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH23
Source:		Sample No.:	7
		Type:	SS
Soil Description:		Depth (m):	4.57 - 5.03

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	18 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)

BOULDERS	COBBLES	GRAVEL	SAND	FINES (Silt, Clay)
		6.9	34.1	59.0



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0427	49.4
3/8"	9.5	96.5	0.0309	44.1
#4	4.75	93.1	0.0198	40.6
#10	2	90.5	0.0117	35.3
#20	0.85	86.4	0.0085	30.0
#40	0.425	83.2	0.0061	26.5
#60	0.25	77.5	0.0031	19.4
#140	0.106	63.3	0.0013	14.1
#200	0.075	59.0		
			0.005 mm	24.40
			0.002 mm	16.62
			D60	0.08
			D30	0.01
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

Tested by: JTimms **Date:** 18 Oct 2022 **Checked by:** MRuck **Date:** 27 Oct 2022 **Reviewed by:** JoNorris **Date:** 04 Nov 2022

GOLDER
MEMBER OF WSP

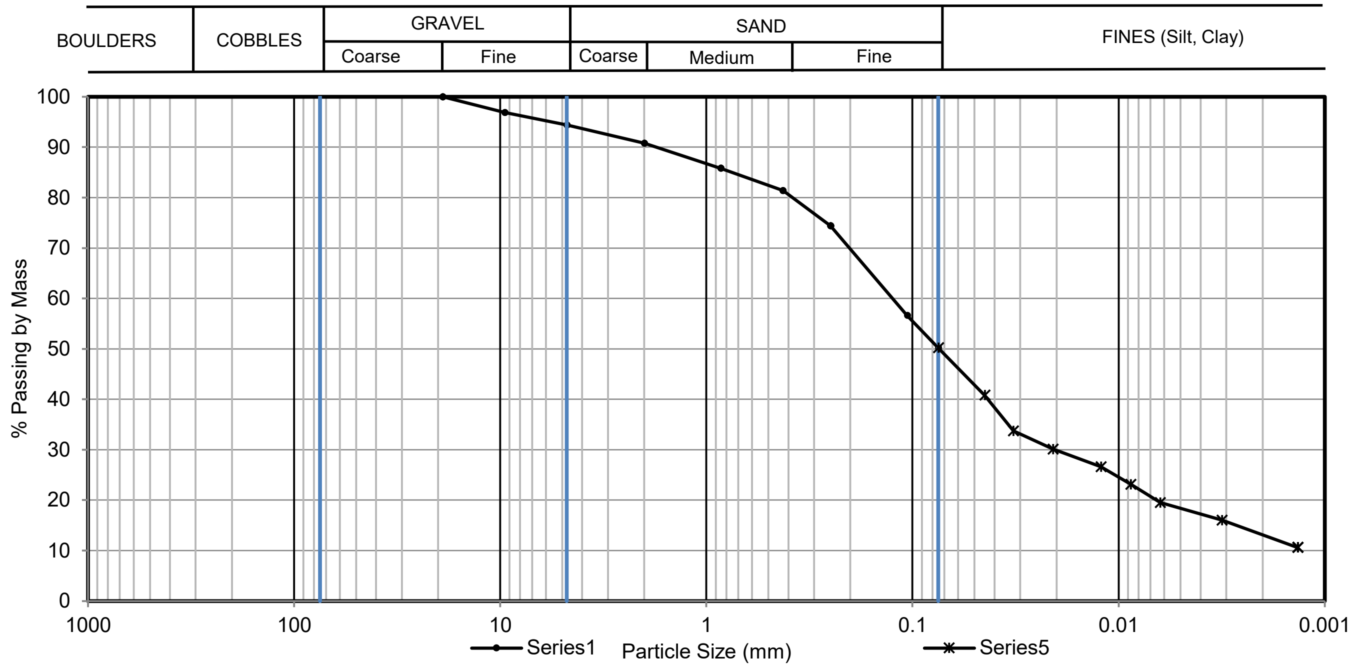
PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422
Method B

Test Request #	21451329-21600-610 BH23	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH23
Source:		Sample No.:	9
Soil Description:		Type:	SS
		Depth (m):	6.10 - 6.43

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	18 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)	Gravel	Sand	Fines
	5.6	44.2	50.2



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0446	40.8
3/8"	9.5	96.9	0.0324	33.7
#4	4.75	94.4	0.0208	30.1
#10	2	90.8	0.0122	26.6
#20	0.85	85.8	0.0087	23.1
#40	0.425	81.4	0.0063	19.5
#60	0.25	74.4	0.0032	16.0
#140	0.106	56.6	0.0014	10.6
#200	0.075	50.2		
			0.005 mm	18.34
			0.002 mm	13.10
			D60	0.13
			D30	0.02
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

Tested by: JTimms **Date:** 18 Oct 2022 **Checked by:** MRuck **Date:** 27 Oct 2022 **Reviewed by:** JoNorris **Date:** 04 Nov 2022

Golder Associates
100 Scotia Court Whitby, ON L1N 8Y6 Canada
[+1] 905-723-2727

PARTICLE SIZE DISTRIBUTION

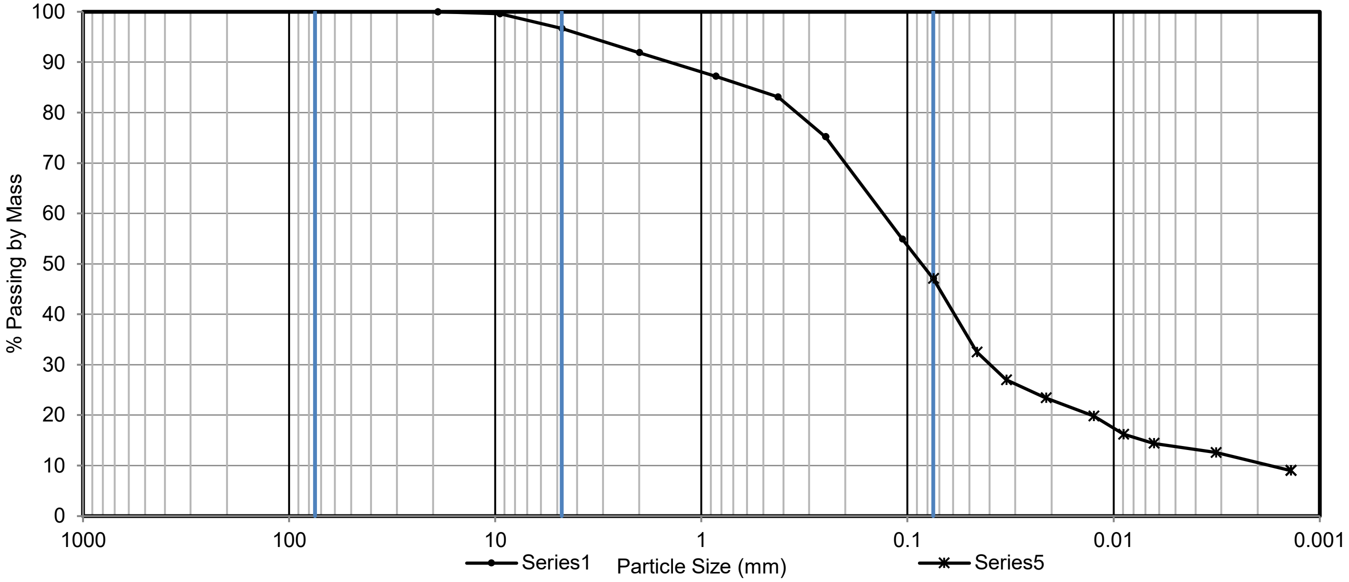
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH23	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH23
Source:		Sample No.:	11
Soil Description:		Type:	SS
		Depth (m):	9.14 - 9.60

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	18 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)			3.3			49.6		47.1
BOULDERS	COBBLES	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0461	32.5
3/8"	9.5	99.6	0.0332	27.0
#4	4.75	96.7	0.0213	23.4
#10	2	91.9	0.0125	19.8
#20	0.85	87.2	0.0090	16.2
#40	0.425	83.1	0.0064	14.4
#60	0.25	75.2	0.0032	12.6
#140	0.106	54.9	0.0014	9.0
#200	0.075	47.1		
			0.005 mm	13.76
			0.002 mm	10.59
			D60	0.13
			D30	0.04
			D10	0.00
			Cu	75.00
			Cc	6.90

Notes:

Disclaimer:

Tested by: JTimms **Date:** 18 Oct 2022 **Checked by:** MRuck **Date:** 27 Oct 2022 **Reviewed by:** JoNorris **Date:** 04 Nov 2022

PARTICLE SIZE DISTRIBUTION

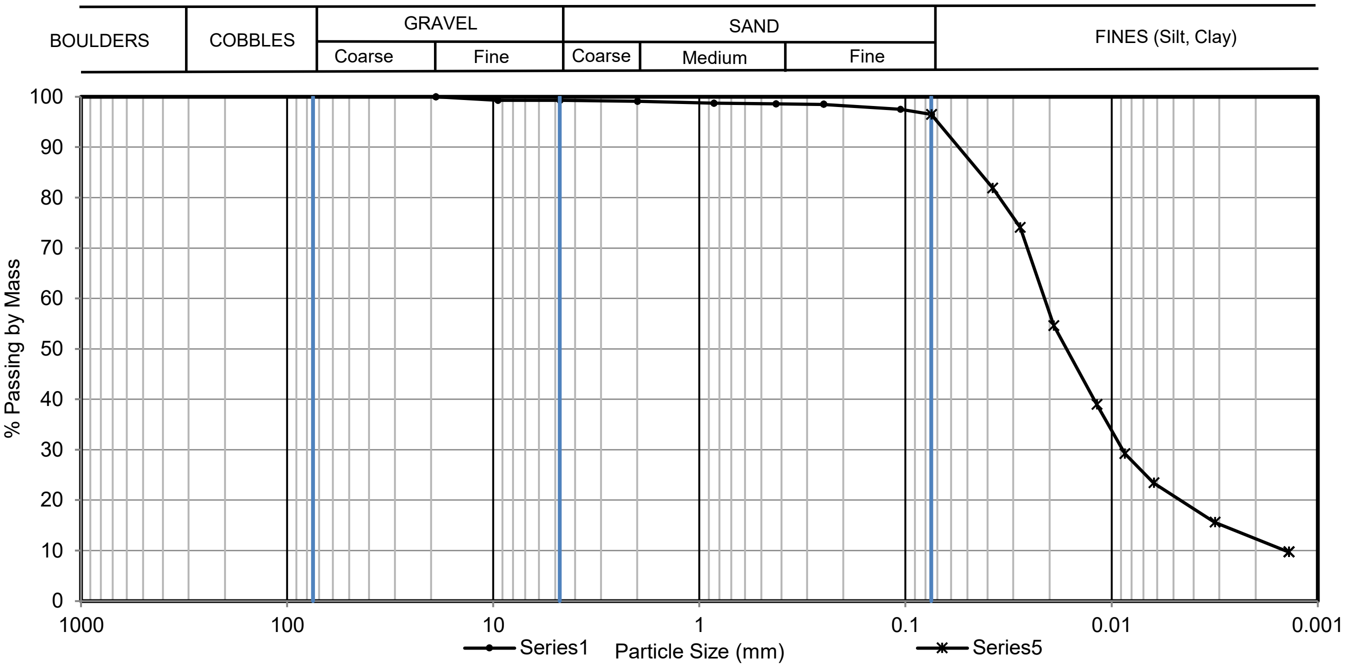
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH23	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH23
Source:		Sample No.:	17
Soil Description:		Type:	SS
		Depth (m):	18.29 - 18.57

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	18 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%) 0.7 2.8 96.5



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0378	81.9
3/8"	9.5	99.3	0.0278	74.1
#4	4.75	99.3	0.0191	54.6
#10	2	99.1	0.0118	39.0
#20	0.85	98.7	0.0086	29.2
#40	0.425	98.6	0.0062	23.4
#60	0.25	98.5	0.0032	15.6
#140	0.106	97.5	0.0014	9.7
#200	0.075	96.5		
			0.005 mm	20.86
			0.002 mm	12.34
			D60	0.02
			D30	0.01
			D10	0.00
			Cu	15.00
			Cc	2.60

Notes:

Disclaimer:

Tested by: JTimms **Date:** 18 Oct 2022 **Checked by:** MRuck **Date:** 27 Oct 2022 **Reviewed by:** JoNorris **Date:** 04 Nov 2022

GOLDER
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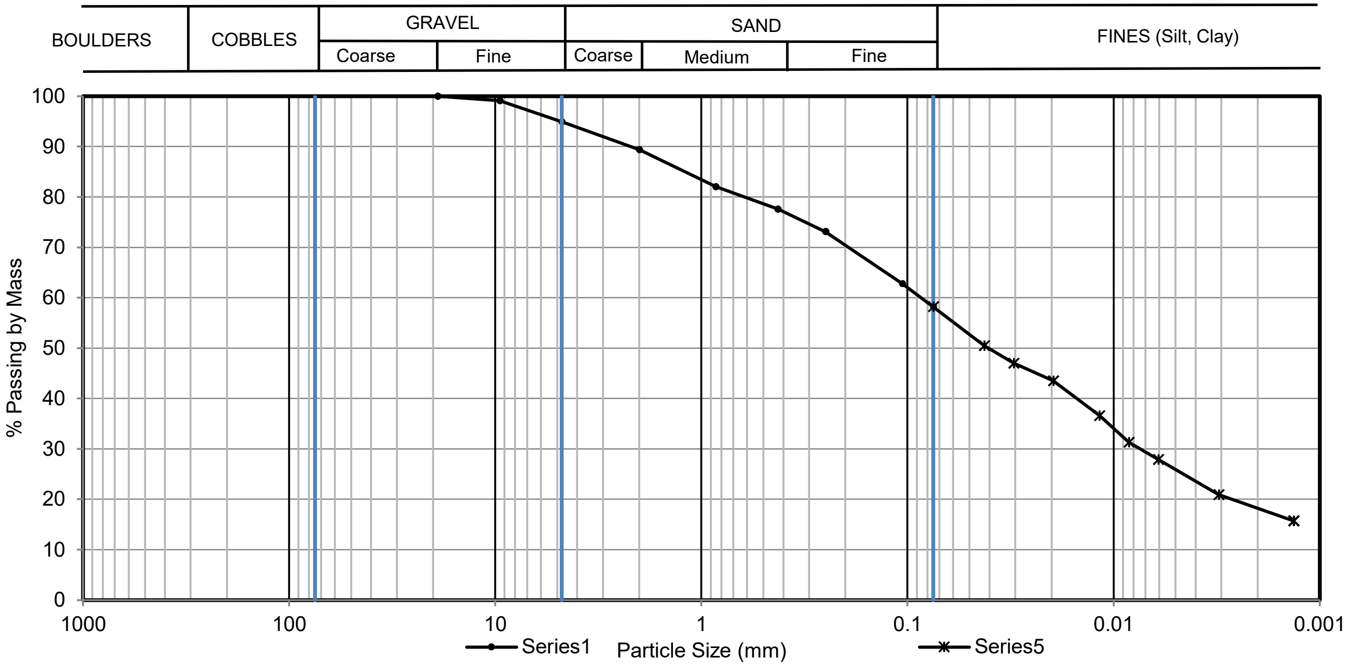
PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422
Method B

Test Request #	21451329-21600-610 BH23	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH23
Source:		Sample No.:	19
		Type:	SS
Soil Description:		Depth (m):	21.34 - 21.79

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	18 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)			
	5.1	36.7	58.2



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0424	50.5
3/8"	9.5	99.1	0.0305	47.0
#4	4.75	94.9	0.0196	43.5
#10	2	89.4	0.0117	36.6
#20	0.85	82.0	0.0084	31.3
#40	0.425	77.6	0.0061	27.9
#60	0.25	73.1	0.0031	20.9
#140	0.106	62.8	0.0013	15.7
#200	0.075	58.2		
			0.005 mm	25.89
			0.002 mm	18.19
			D60	0.09
			D30	0.01
			D10	
			Cu	
			Cc	

Notes:

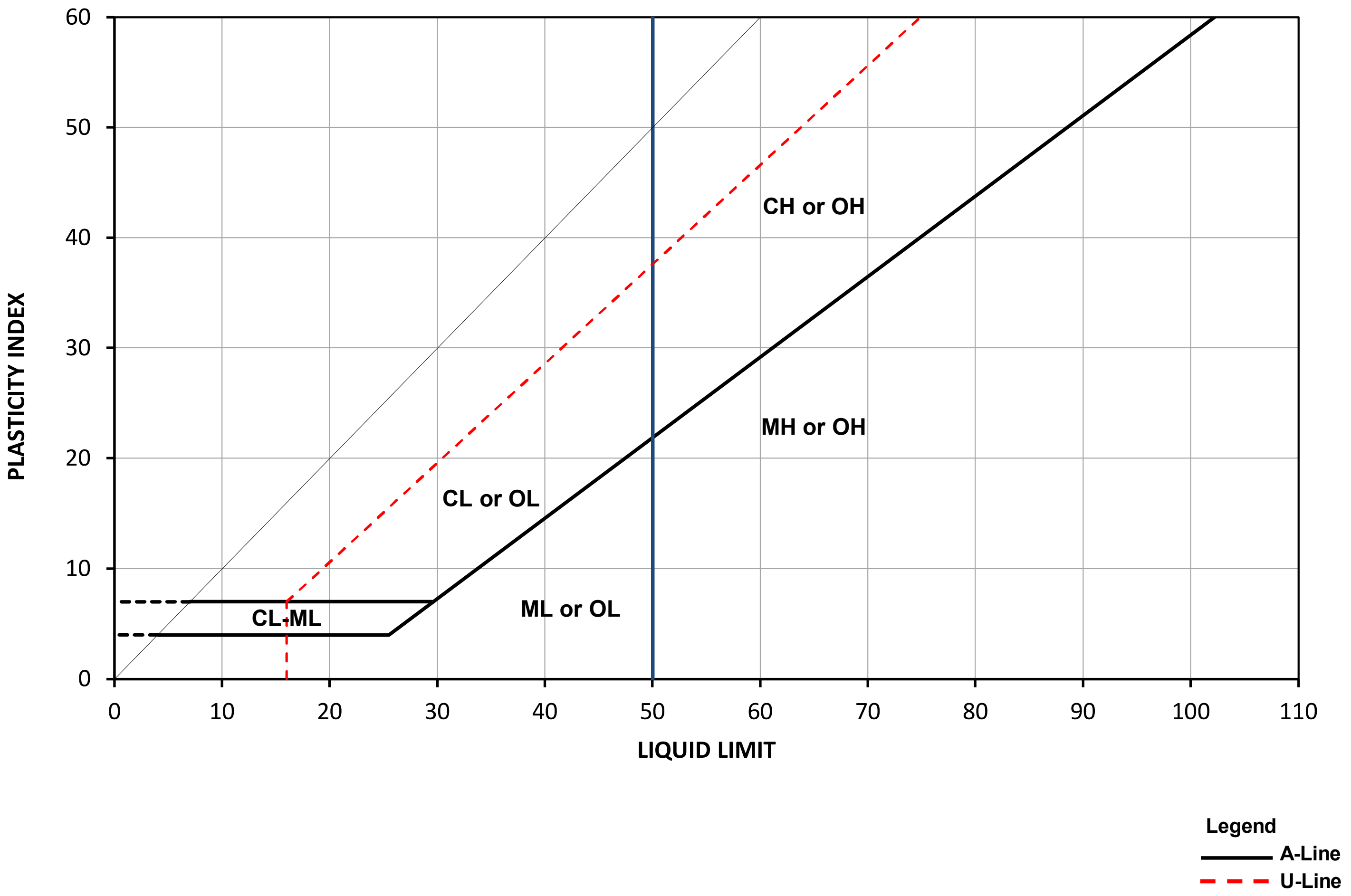
Disclaimer:

Tested by: JTimms **Date:** 18 Oct 2022 **Checked by:** MRuck **Date:** 27 Oct 2022 **Reviewed by:** JoNorris **Date:** 04 Nov 2022

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318

Test Request #	21451329-21600-610 BH23	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH23
Source:		Sample No.:	4
Soil Description:		Type:	SS
		Depth (m):	2.29 - 2.74

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	21 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH23	4	2.29	2.74	83	5.4		NP		

NP = Non-Plastic
ND = Not Determined

Test Preparation
Dry Preparation Tested after >425um removed

Notes:

Tested by: JTimms **Date:** 21 Oct 2022
Checked by: MRuck **Date:** 27 Oct 2022

Disclaimer:
The laboratory testing services reported herein have been performed in accordance with the terms of a contract with Golder's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of Golder's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

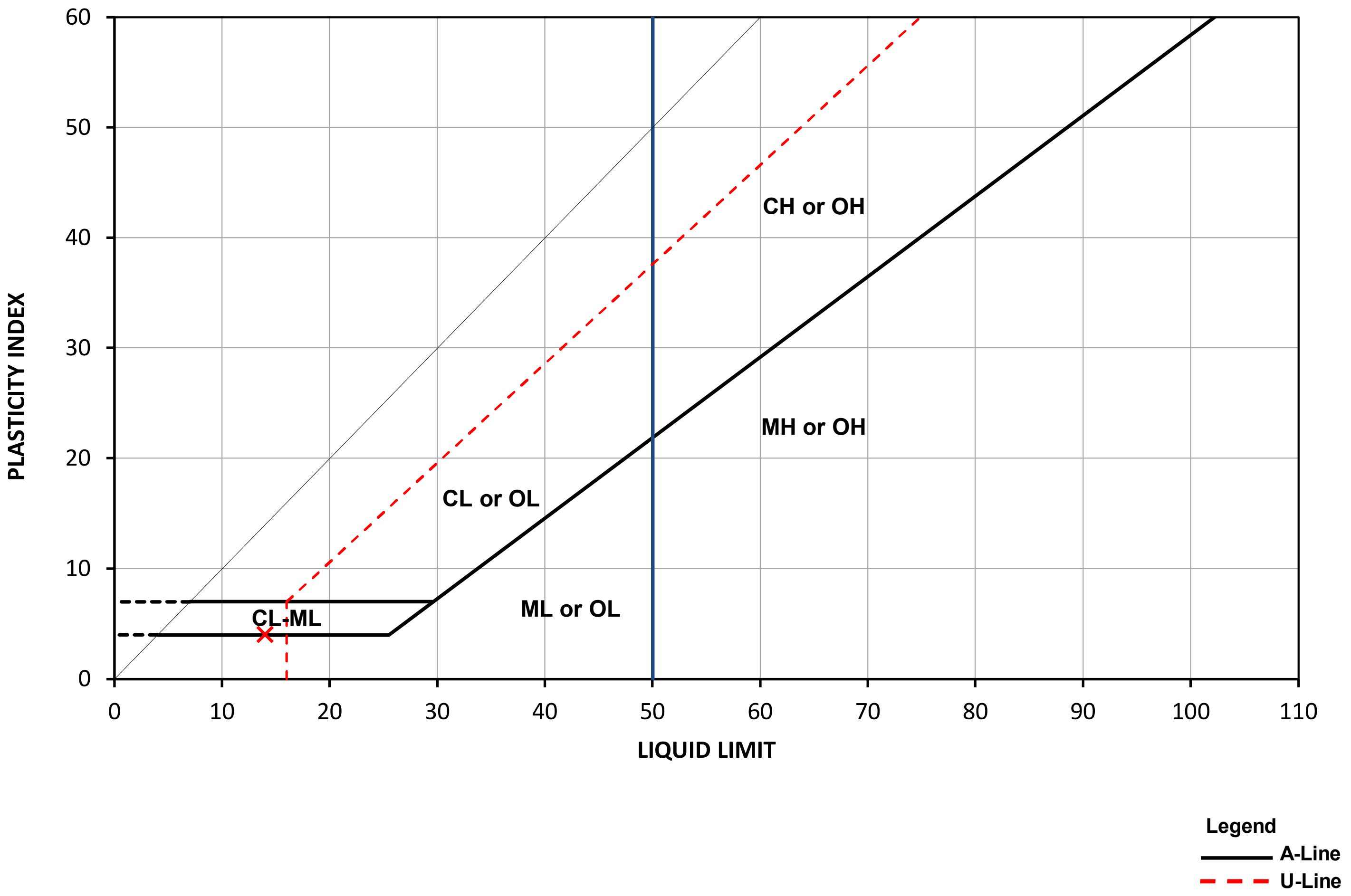
Reviewed by: JoNorris **Date:** 04 Nov 2022

GOLDER
MEMBER OF WSP

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318
Method A - Multipoint Test

Test Request #	21451329-21600-610 BH23	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH23
Source:		Sample No.:	7
Soil Description:		Type:	SS
		Depth (m):	4.57 - 5.03

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	19 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH23	7	4.57	5.03	89	6.6	14	10	4	-0.85

NP = Non-Plastic
ND = Not Determined

Test Preparation

Dry Preparation Tested after >425um removed

Notes:

Tested by: JTimms **Date:** 19 Oct 2022
Checked by: MRuck **Date:** 27 Oct 2022

Disclaimer:

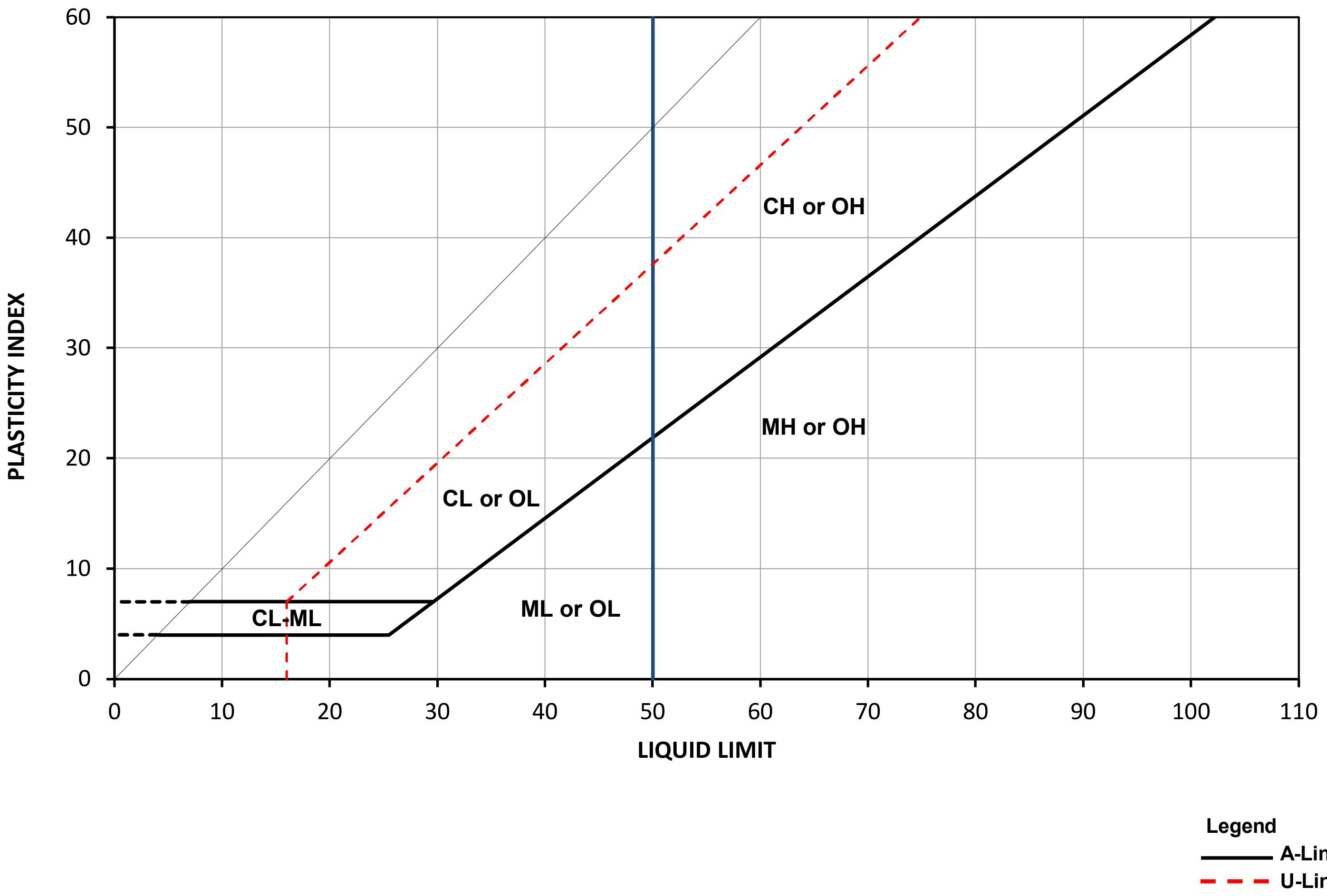
Reviewed by: JoNorris **Date:** 04 Nov 2022

GOLDER
MEMBER OF WSP

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318

Test Request #	21451329-21600-610 BH23	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH23
Source:		Sample No.:	9
Soil Description:		Type:	SS
		Depth (m):	6.10 - 6.43

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	25 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH23	9	6.10	6.43	85	5.9		NP		

NP = Non-Plastic
ND = Not Determined

Test Preparation
Wet Preparation Tested after >425um removed

Notes:

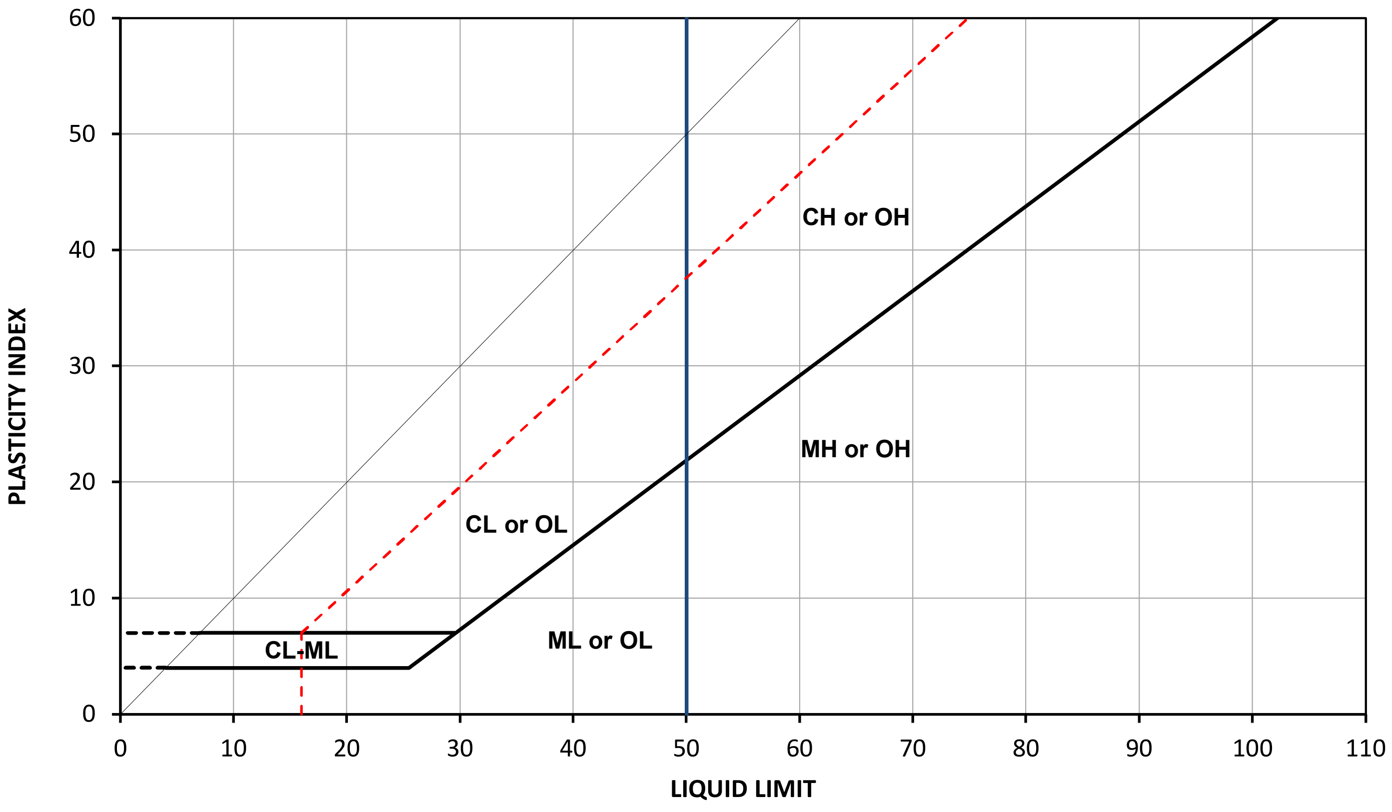
Disclaimer:

Tested by: JTimms **Date:** 25 Oct 2022
Checked by: MRuck **Date:** 27 Oct 2022
Reviewed by: JoNorris **Date:** 04 Nov 2022

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318

Test Request #	21451329-21600-610 BH23	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH23
Source:		Sample No.:	11
Soil Description:		Type:	SS
		Depth (m):	9.14 - 9.60

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	19 Oct 2022
Specimen Description	NA				



Legend

▬ A-Line

🟥 - - U-Line

Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH23	11	9.14	9.60	87	7.0		NP		

NP = Non-Plastic
ND = Not Determined

Test Preparation

Notes:

Disclaimer:

The laboratory testing services reported herein have been performed in accordance with the terms of a contract with Golder's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of Golder's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Tested by: JTimms **Date:** 19 Oct 2022

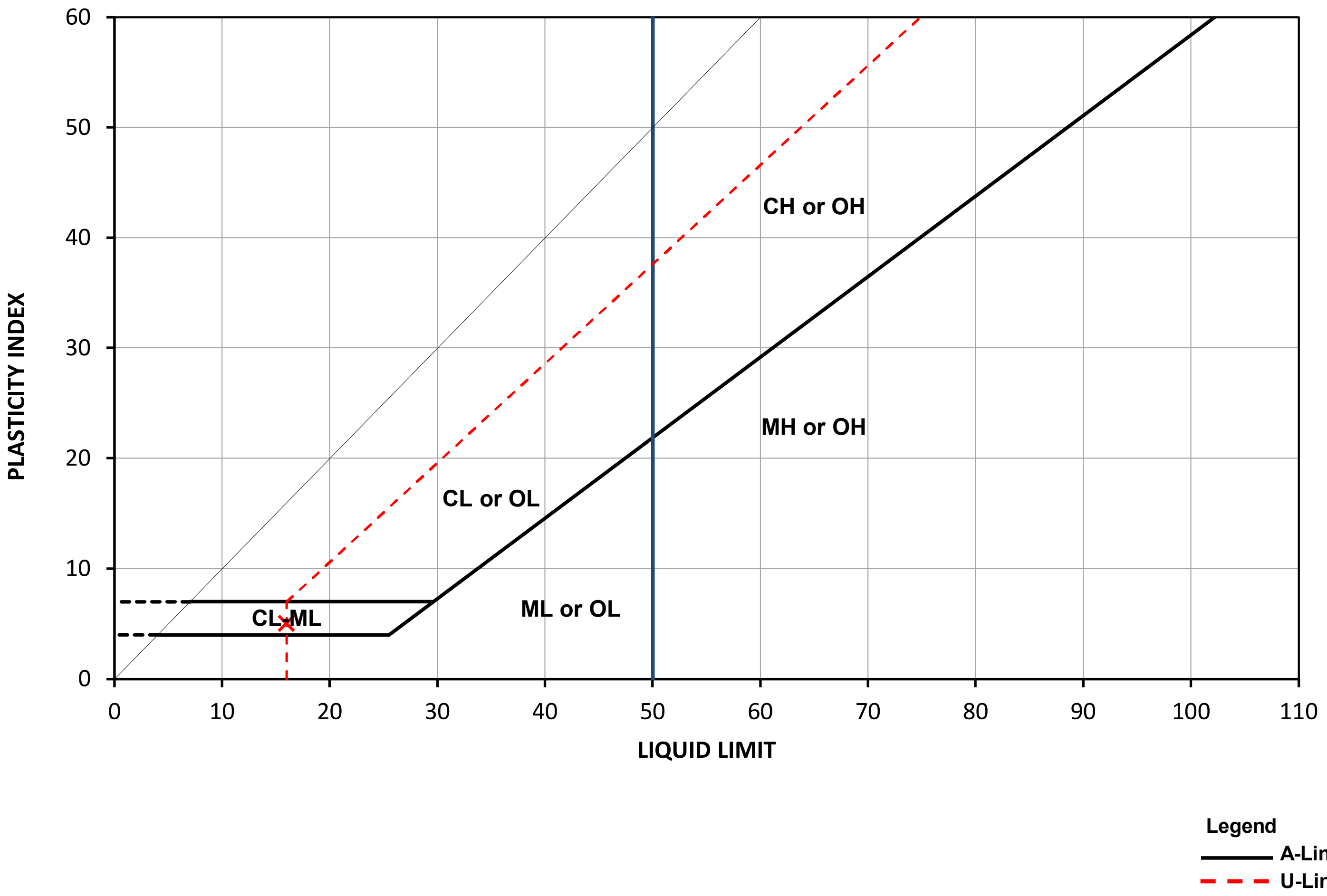
Checked by: MRuck **Date:** 27 Oct 2022

Reviewed by: JoNorris **Date:** 04 Nov 2022

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318
Method A - Multipoint Test

Test Request #	21451329-21600-610 BH23	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH23
Source:		Sample No.:	19
Soil Description:		Type:	SS
		Depth (m):	21.34 - 21.79

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	25 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH23	19	21.34	21.79	86	8.7	16	11	5	-0.46

NP = Non-Plastic
ND = Not Determined

Test Preparation
Wet Preparation Tested after >425um removed

Notes:

Tested by: JTimms **Date:** 25 Oct 2022
Checked by: MRuck **Date:** 27 Oct 2022

Disclaimer:

Reviewed by: JoNorris **Date:** 04 Nov 2022

SOIL RESISTIVITY USING THE WENNER FOUR ELECTRODE METHOD (ASTM G57-20)

November 3, 2022
Golder Project Number: 21451329-21600-610

Attention: Sarah Poot

Sample Description: **BH23, SA6, 3.81-4.24m**

Date Scheduled:	October 3, 2022	Sampled By:	Golder Associates Ltd.
Date Received:	October 12, 2022	Golder Lab No.:	G-22-266
Date Tested:	October 12, 2022	Tested By:	E. Shallhorn

Resistivity Meter Model Number	Miller 400D
Soil Box Factor	0.976377953
Temperature of Sample (°C)	23.2
Measured Resistance (ohm)	4190.0
Resistivity (ohm•cm)	4091.0
Temperature Corrected Resistivity (ohm•cm)	**4878.5**

Data Input By: M. Ruck

Reviewed by:

Jodi Norris, Technical and Quality Coordinator

The Voice Of Independent Canadian Laboratories
La voix des laboratoires indépendants canadiens

Geophysical Record of Borehole: BH23

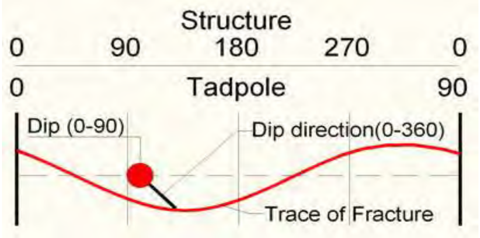
Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

Datum: NAD83, UTM Zone 17N
Easting: 683833.09 m
Northing: 4859898.80 m
Elevation: 85.31 m

Depth Reference: "0" at ground
Drilled Depth: 77.92 m bgs
Borehole Diameter: 96 mm
Casing Diameter: HQ

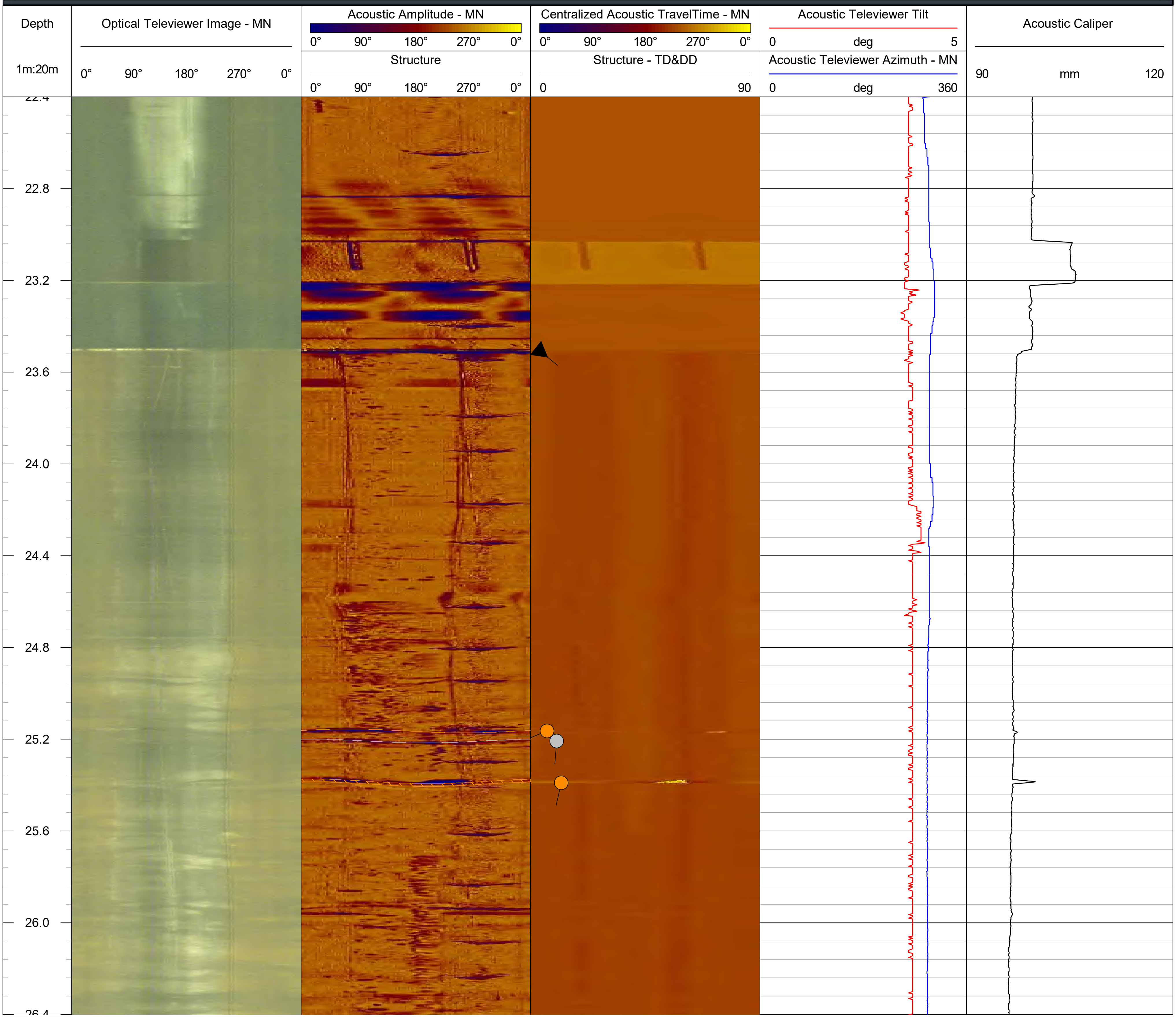
Casing Depth: ~22.70 m bgs
Water Level: 8.11 m bgs
Borehole Inclination: Vertical
Borehole Azimuth: N/A

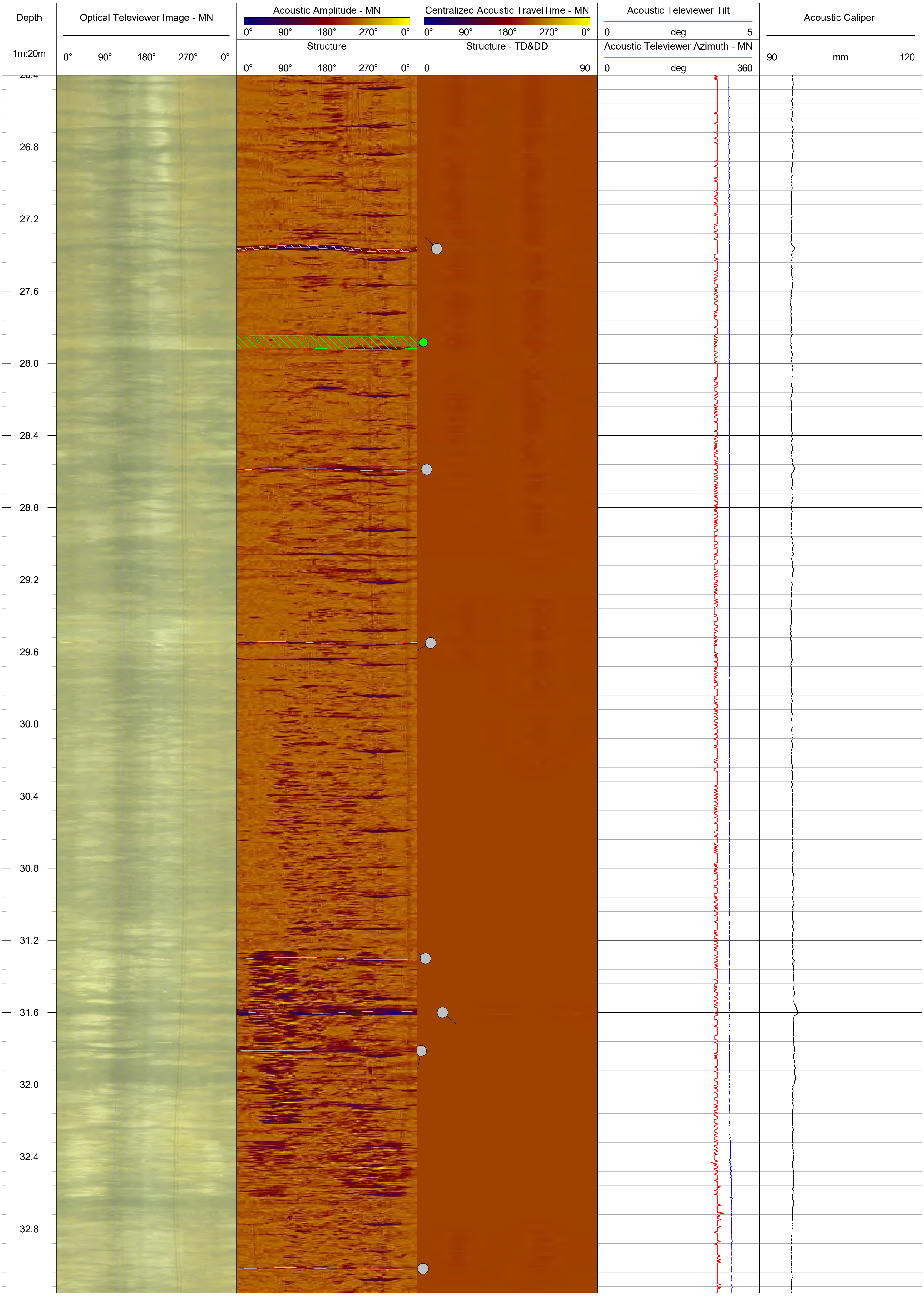
Location: Darlington, Ontario
Log Date: July-27-2022
Logged By: J. Crawford



● Partially Open Joint / Fracture
● Filled Fracture / Joint
● Bedding / Banding / Foliation
◀ Casing

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)

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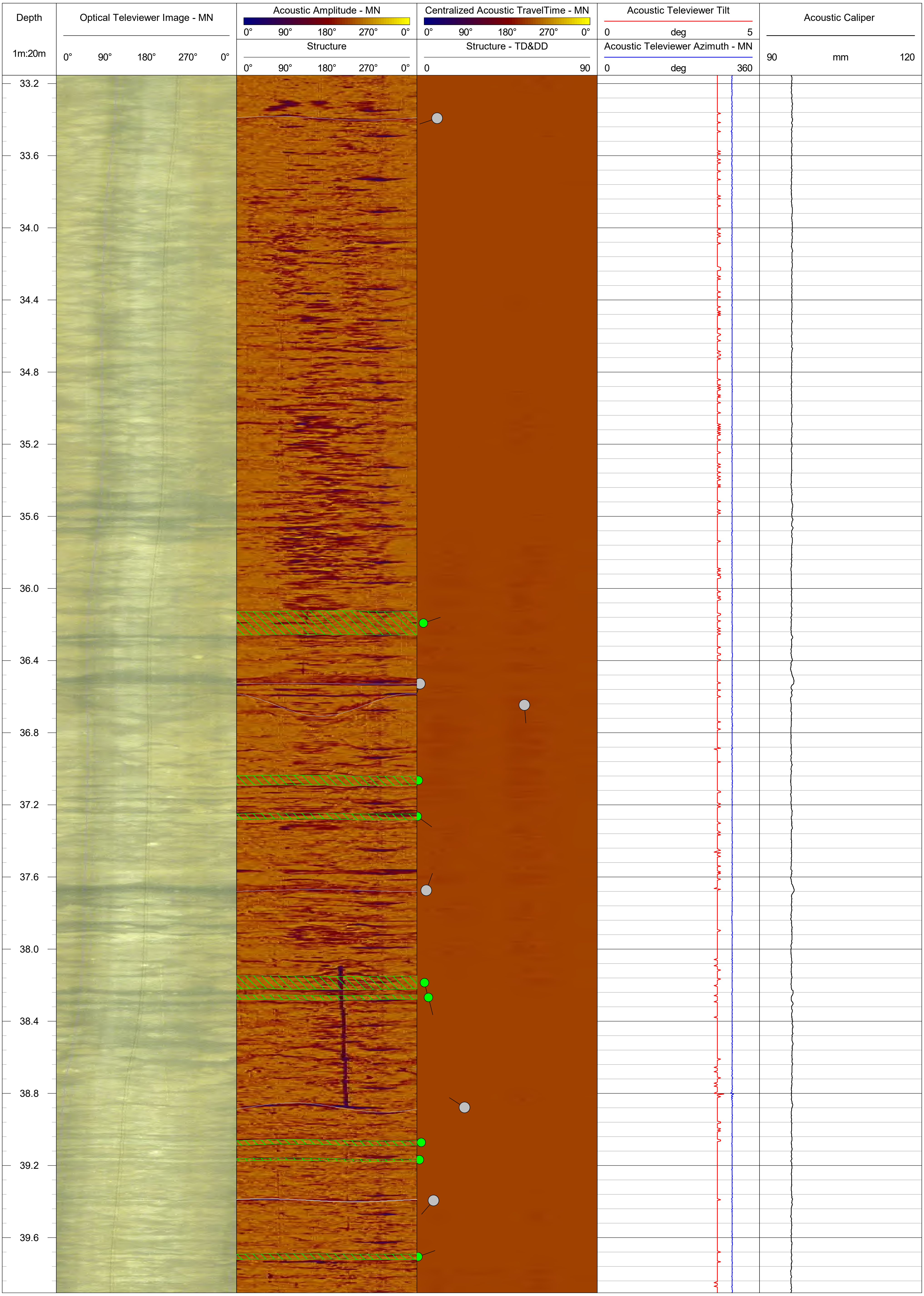
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
26.8
27.2
27.6
28.0
28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0
32.4
32.8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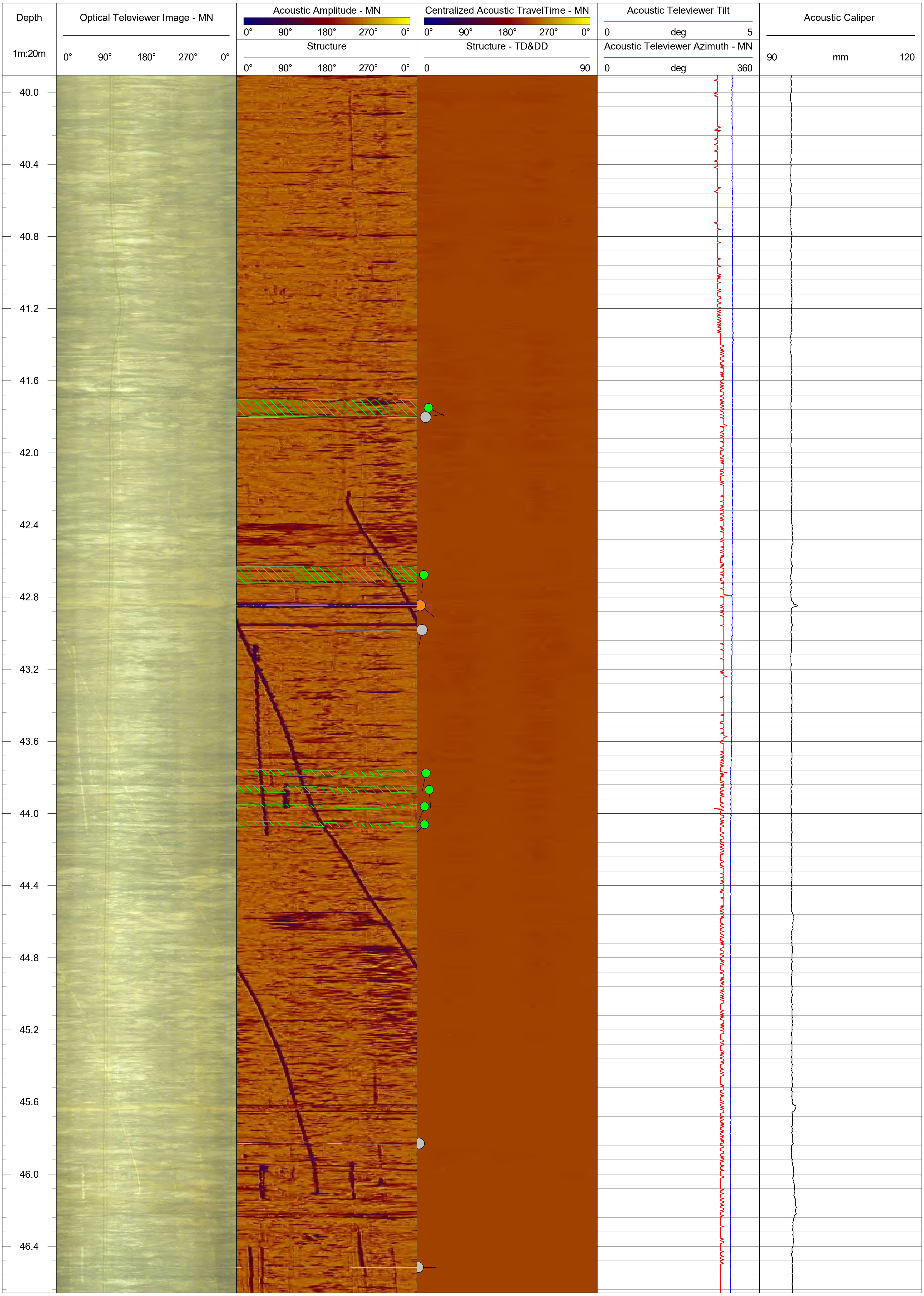
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8
37.2
37.6
38.0
38.4
38.8
39.2
39.6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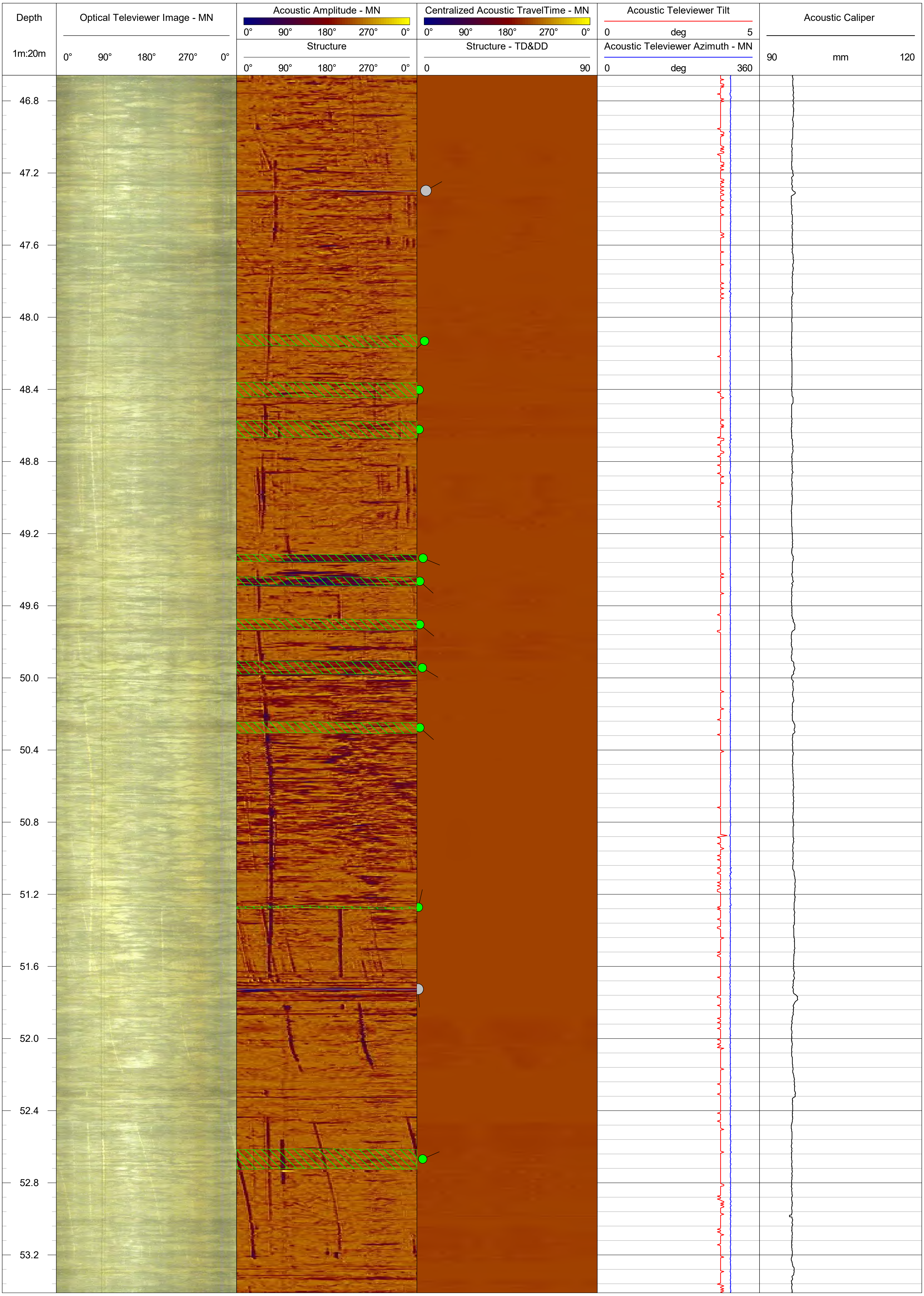
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
40.0
40.4
40.8
41.2
41.6
42.0
42.4
42.8
43.2
43.6
44.0
44.4
44.8
45.2
45.6
46.0
46.4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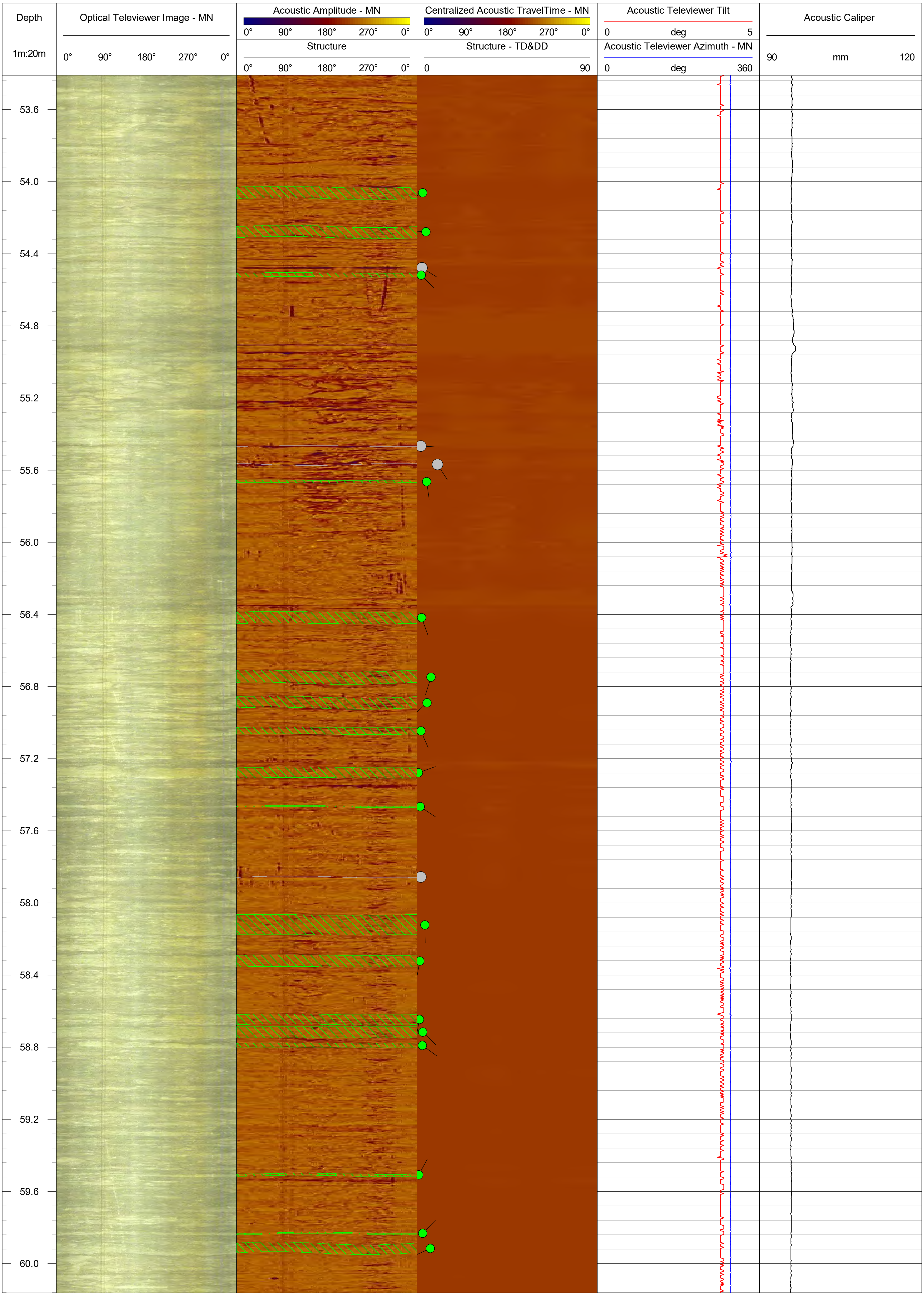
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
46.8
47.2
47.6
48.0
48.4
48.8
49.2
49.6
50.0
50.4
50.8
51.2
51.6
52.0
52.4
52.8
53.2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Optical Televiewer Image - MN
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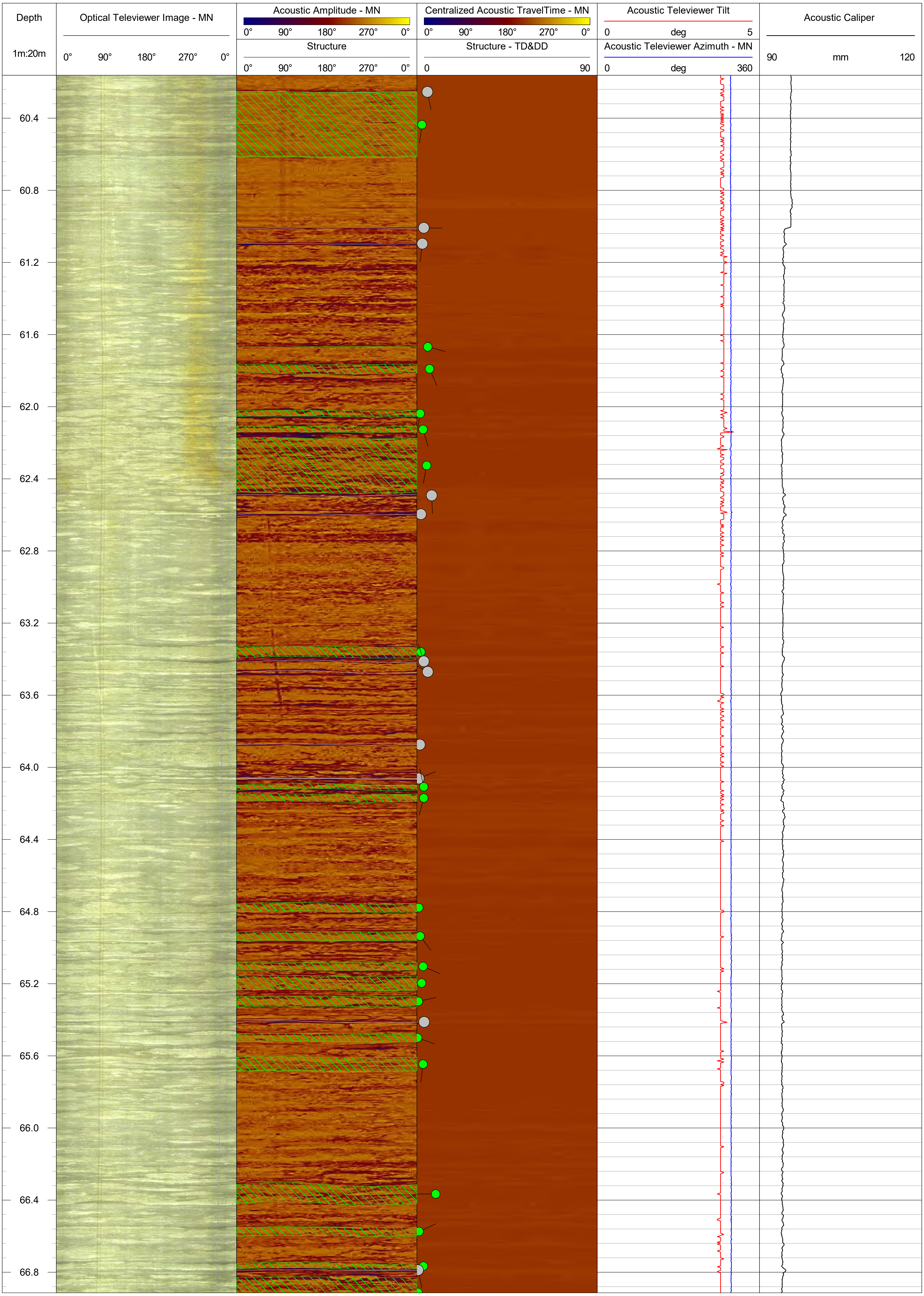
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
53.6
54.0
54.4
54.8
55.2
55.6
56.0
56.4
56.8
57.2
57.6
58.0
58.4
58.8
59.2
59.6
60.0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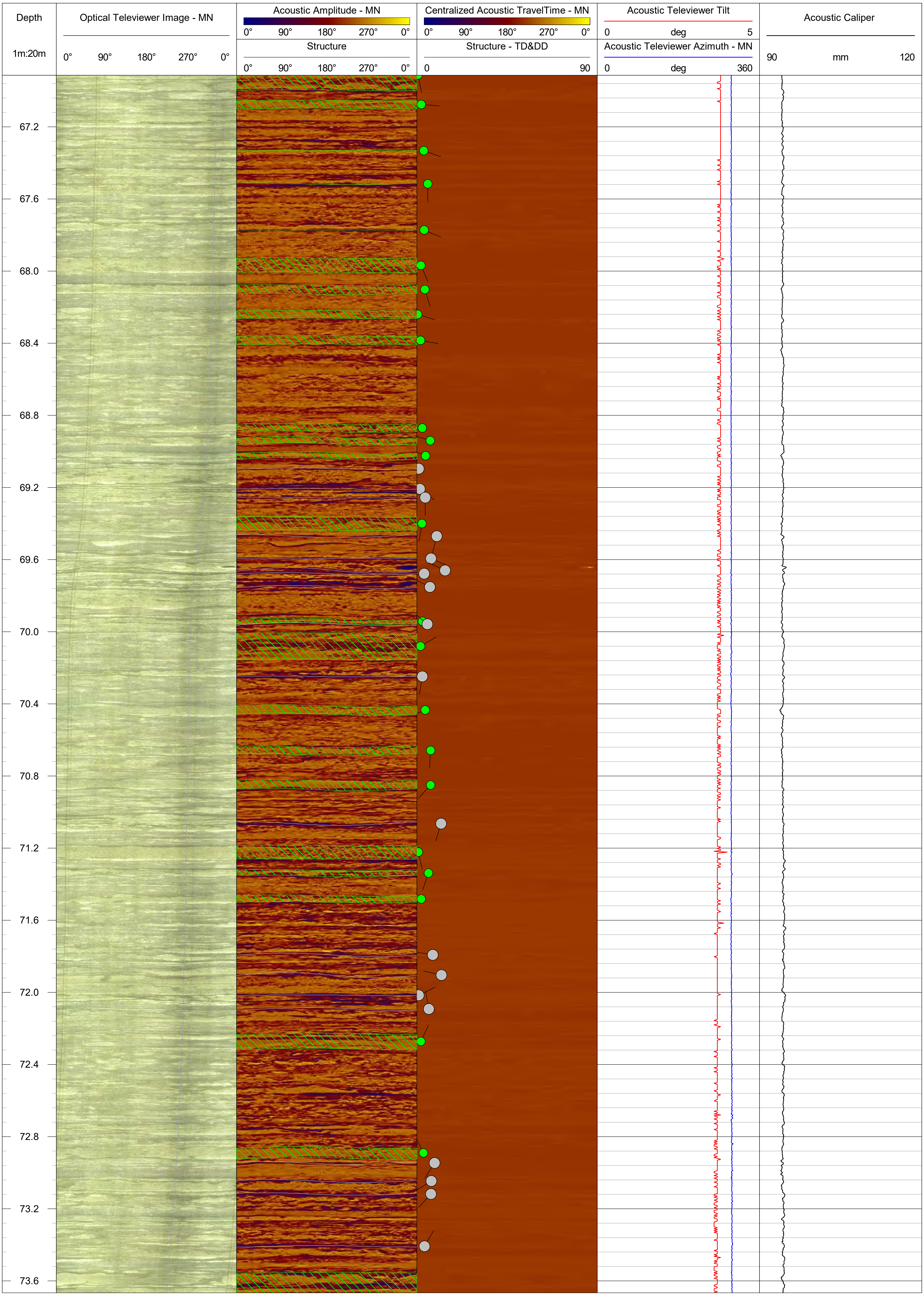
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
60.4
60.8
61.2
61.6
62.0
62.4
62.8
63.2
63.6
64.0
64.4
64.8
65.2
65.6
66.0
66.4
66.8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Optical Televiewer Image - MN
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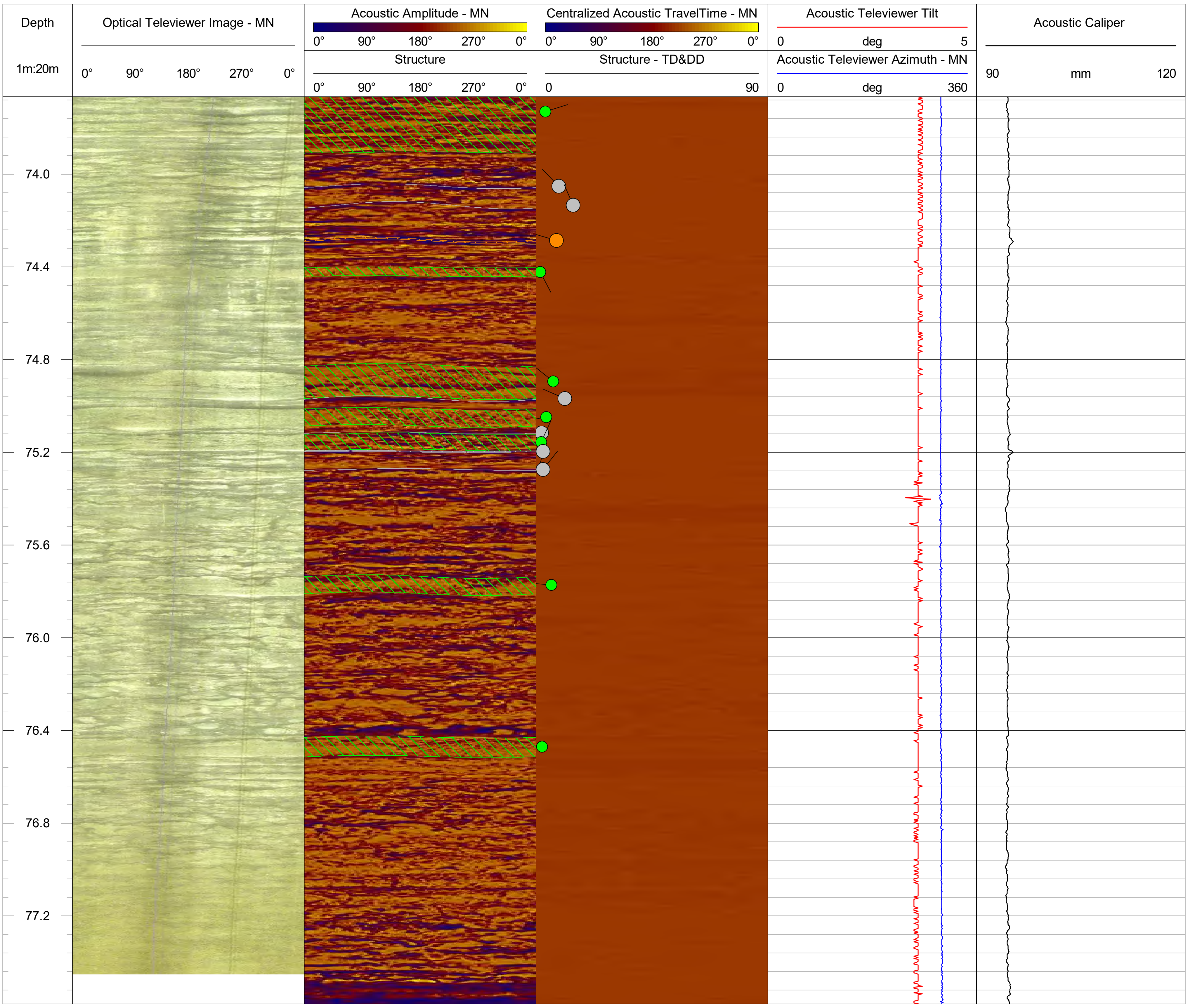
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
67.2
67.6
68.0
68.4
68.8
69.2
69.6
70.0
70.4
70.8
71.2
71.6
72.0
72.4
72.8
73.2
73.6



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Optical Televiewer Image - MN
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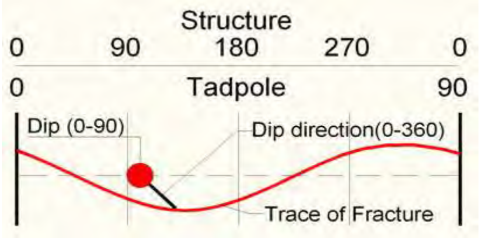
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
74.0
74.4
74.8
75.2
75.6
76.0
76.4
76.8
77.2

Geophysical Record of Borehole: BH23

Log Title:	Darlington DNNP Geophysical Log
Project Number:	21451329
Client:	Ontario Power Generation
Date:	January 2023

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at ground	**Casing Depth:**	~22.70 m bgs	**Location:**	Darlington, Ontario
Easting:	683833.09 m	**Drilled Depth:**	77.92 m bgs	**Water Level:**	8.11 m bgs	**Log Date:**	July-27-2022
Northing:	4859898.80 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	85.31 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	J. Crawford



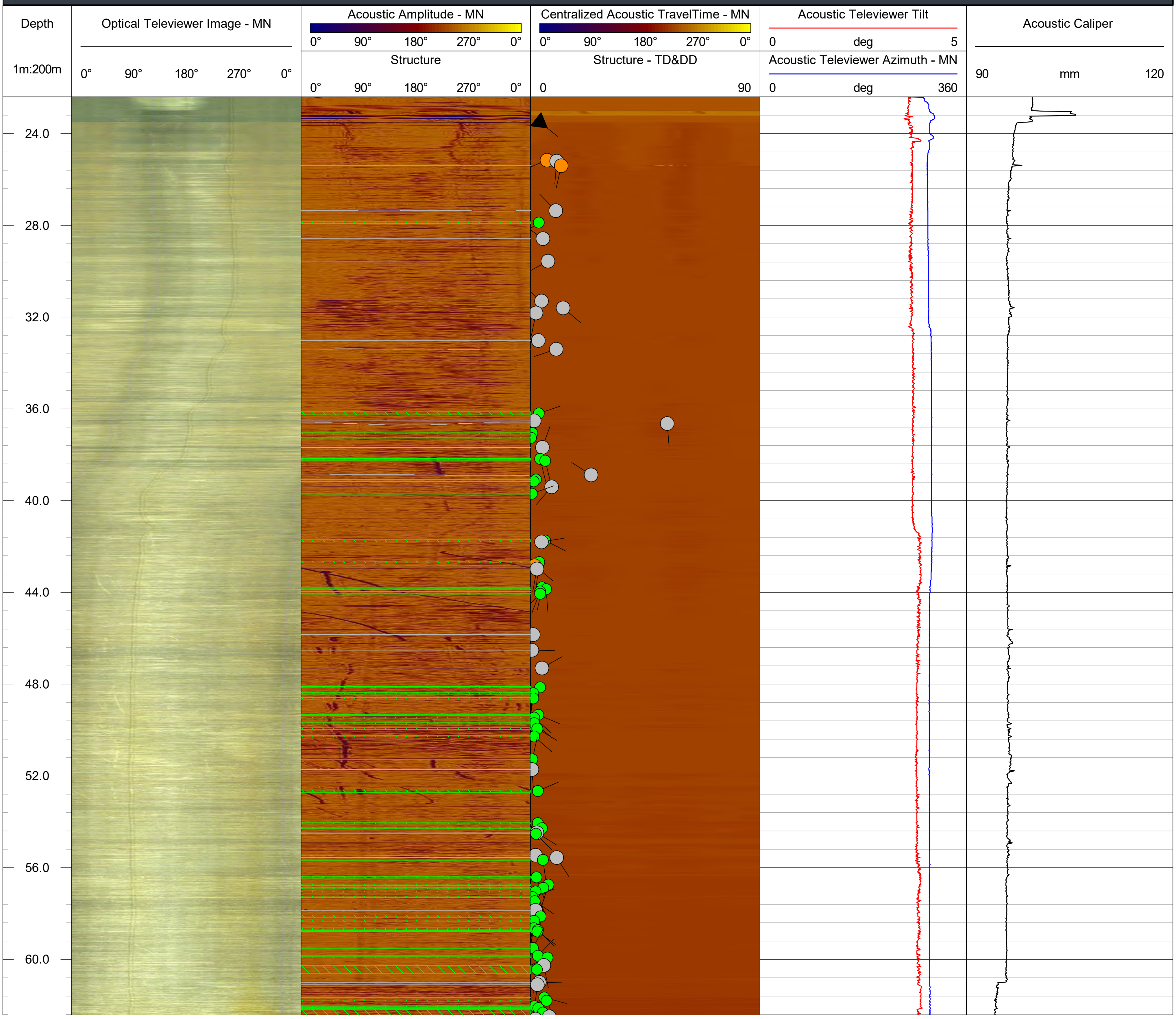
● Partially Open Joint / Fracture

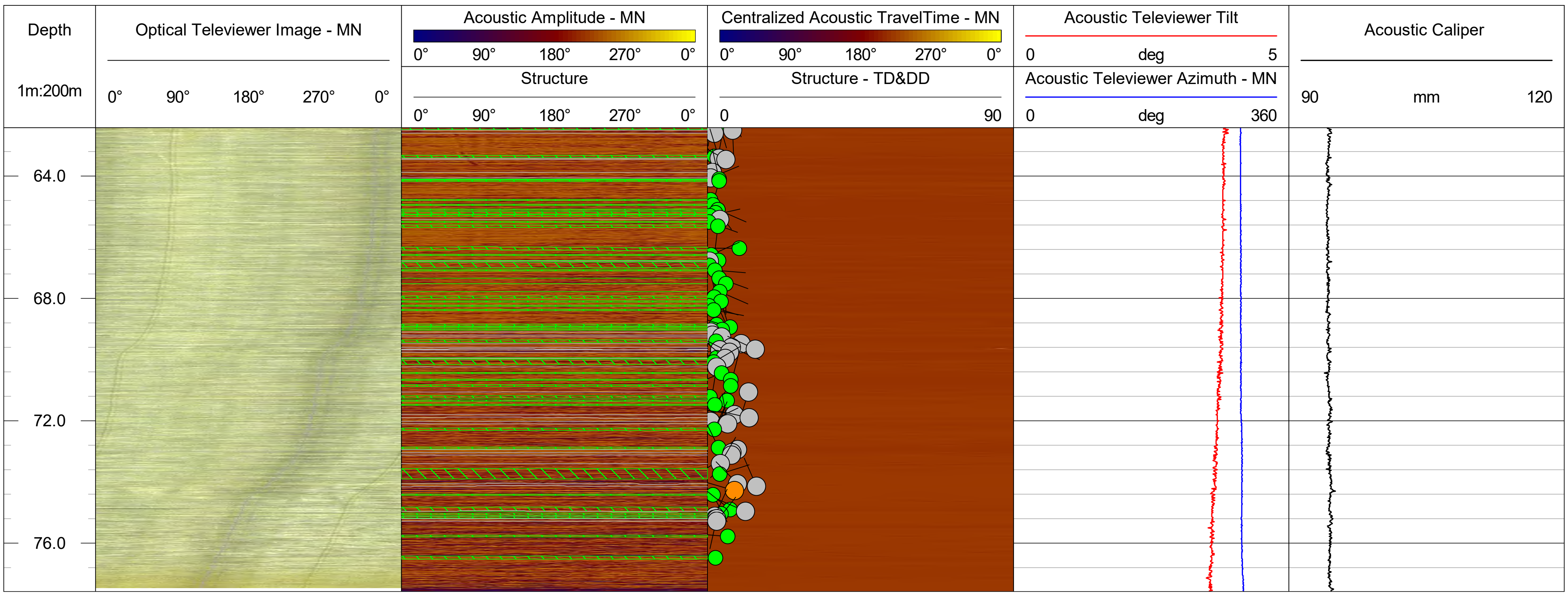
● Filled Fracture / Joint

● Bedding / Banding / Foliation

◀ Casing

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)




Depth
1m:200m
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
64.0
68.0
72.0
76.0

A04-BH24

PROJECT: 21451329
LOCATION: N 4860135.33; E 683745.15

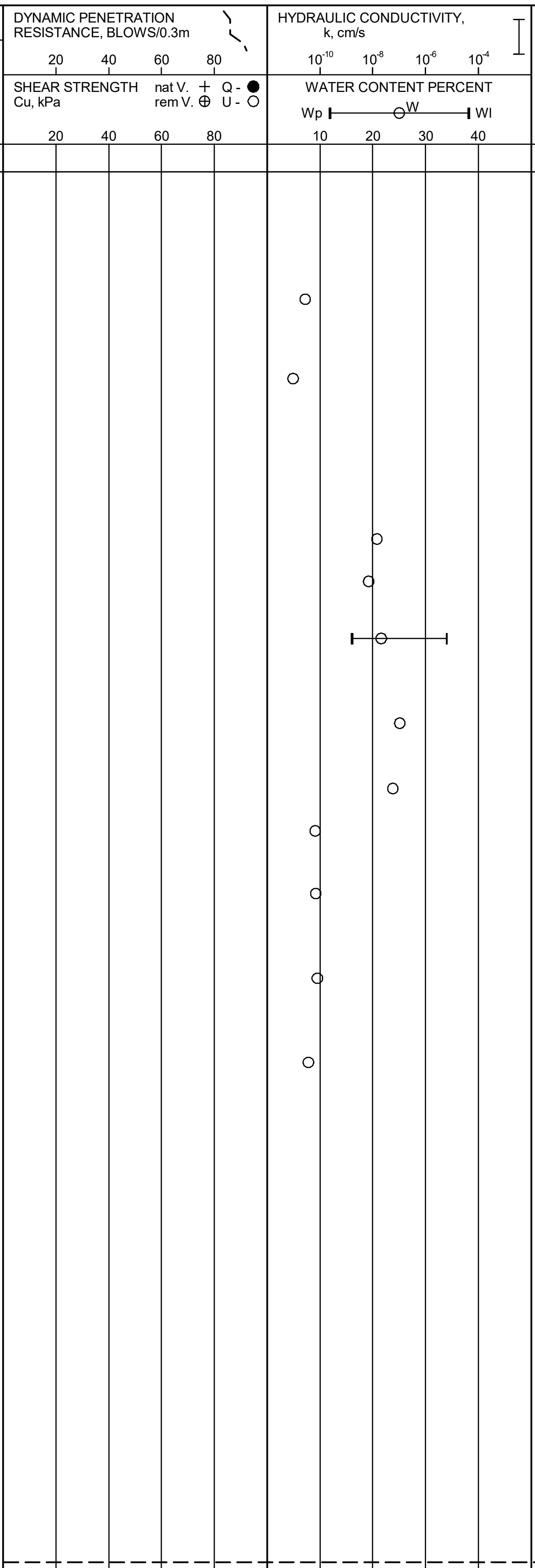
RECORD OF BOREHOLE: BH24

BORING DATE: June 20 to 29, 2022
DRILL RIG: Diedrich 50 Track Mounted

SHEET 1 OF 9
DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	ELEV. / DEPTH (m)
		GROUND SURFACE	89.00
0	Power Augering 250 mm O.D./150 mm I.D. Hollow Stem Auger	**Silty Sand with Gravel (SM)**, medium dense, brown, moist, fine to coarse sand, angular to subangular fine to coarse gravel (Fill) (Unit 1) - Rock fragments in Spoon Sample 2 - Topsoil between 1.75 m and 1.83 m	0.00
		Sandy Lean Clay (CL), stiff, brown, fine to coarse sand, low to medium plasticity (Fill) (Unit 1)	87.17 1.83
	Mud Rotary Wash Boring PWT Casing	**Lean Clay (CL)**, very stiff to very soft, brown, fine to coarse sand, low to medium plasticity (Glaciolacustrine) (Unit 2a)	86.56 2.44
		Silty Sand (SM), very loose, grey, moist to wet, fine to coarse sand, subangular to angular fine to coarse gravel (Glaciolacustrine) (Unit 2b)	84.40 4.60
		Silty Sand with Gravel (SM), medium dense to very dense, grey, moist, fine to coarse sand, angular to subangular fine to coarse gravel (Till) (Unit 3)	82.90 6.10
10		*CONTINUED NEXT PAGE*	

NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1	SS	26		
2	SS	21		
3A	SS	14		
3B				
4A	SS	14		
4B				
5A	SS	12		
5B				
6	SS	16		0 6 48 46
7	SS	1		
8A	SS	WH		
8B				
9	SS	1		
10	SS	3	NP	18 40 31 11
11	SS	11		
12	SS	17		
13	SS	21		
14	SS	113		
15	SS	226		
16	SS	115		
17	SS	128		



PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE
1 : 50

LOGGED: MH
CHECKED: SEMP

PROJECT: 21451329

LOCATION: N 4860135.33; E 683745.15

RECORD OF BOREHOLE: BH24

BORING DATE: June 20 to 29, 2022

DRILL RIG: Diedrich 50 Track Mounted

SHEET 2 OF 9

DATUM: Geodetic

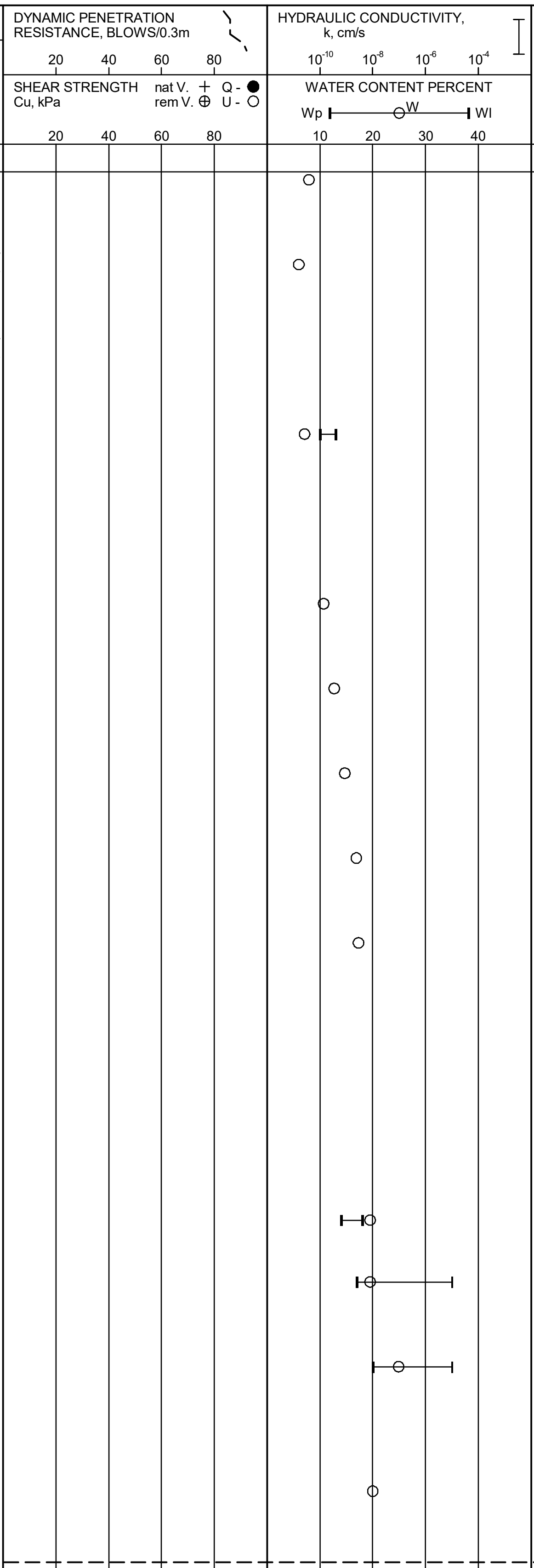
--- CONTINUED FROM PREVIOUS PAGE ---

BORING METHOD: Mud Rotary Wash Boring; PWT Casing

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
10 – 14.63	**Silty Sand with Gravel (SM)**, medium dense to very dense, grey, moist, fine to coarse sand, angular to subangular fine to coarse gravel (Till) (Unit 3) - Low plasticity silt in Spoon Sample 20 - Rock fragments in Spoon Samples 19 to 23	74.37 14.63
14.63 – 17.40	**Silt with Sand (ML)**, very dense, grey, wet, fine to medium sand (Glaciolacustrine) (Unit 4a) - Lean Clay interlayer between 15.24 m and 15.85 m	71.60 17.40
17.40 – 20	**Lean Clay with Sand (CL)**, hard, grey, moist, low plasticity (Glaciolacustrine) (Unit 4b) - Pitcher barrel (PB) tube 30 and 31 attempts not successful; Shelby tube samples 30 and 31 damaged - Soils from damaged Shelby tubes 30 and 31 recovered for further laboratory testings - Pocket penetrometer 4.5 kg/m² at bottom of tubes 32 and 33	

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	GR	SA	SI	CL
17	SS	128					
18	SS	200/0.25					
19	SS	100/0.13					
20	SS	68		23	37	29	10
21	SS	201					
22	SS	158					
23	SS	83					
24	SS	162					
25	SS	105	NP	1	16	75	9
26	SS	61					
27	SS	99					
28	SS	144					
29A	SS	131					
29B				0	16	73	11
30	TO	PB					
31	TO	PB					
32	TO	PB					
32S	TO	PB					
33	TO	PB					

PIEZOMETER OR STANDPIPE INSTALLATION



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DEPTH SCALE

1 : 50

LOGGED: MH

CHECKED: SEMP

PROJECT: 21451329
LOCATION: N 4860135.33; E 683745.15

RECORD OF BOREHOLE: BH24

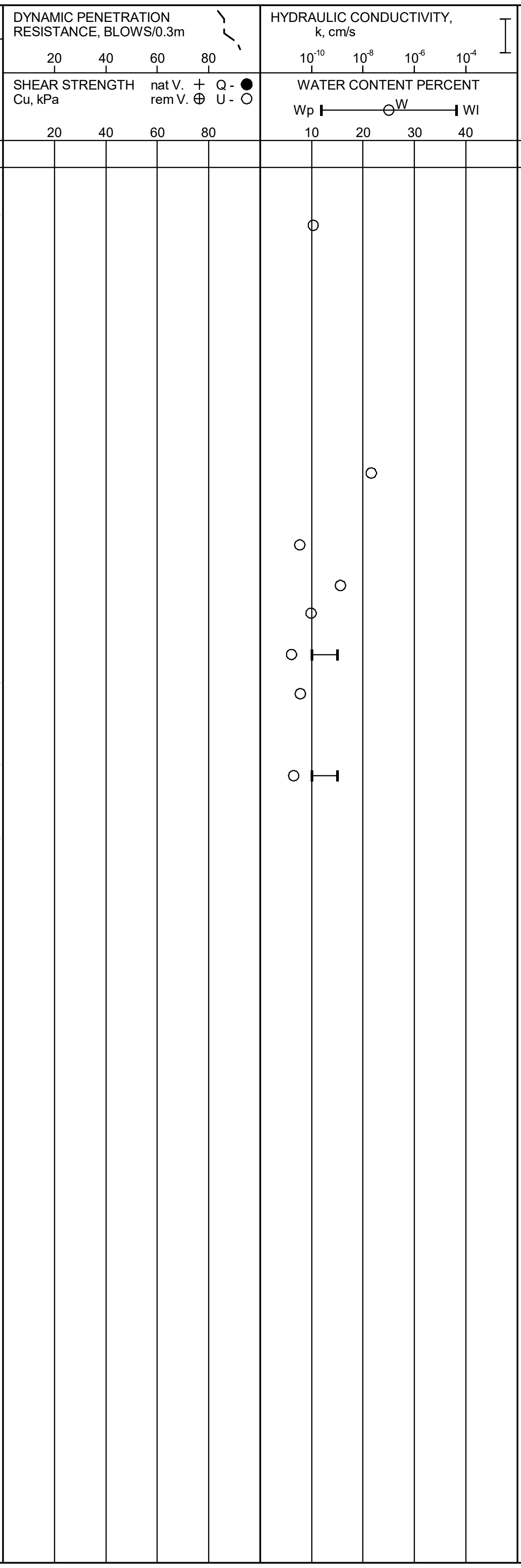
BORING DATE: June 20 to 29, 2022
DRILL RIG: Diedrich 50 Track Mounted

SHEET 3 OF 9
DATUM: Geodetic

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	ELEV. / DEPTH (m)
20	Mud Rotary Wash Boring PWT Casing		68.88
20.12		**Silty Clay with Sand (CL-ML)**, hard, grey, moist, fine to coarse sand, angular to subangular fine to coarse gravel, low plasticity (Till) (Unit 5)	20.12
21.95		**Sandy Silt (ML)**, very dense, grey, moist to wet, fine to medium sand (Glaciolacustrine) (Unit 4a)	67.05 21.95
23.16		**Sandy Silty Clay with Gravel (CL-ML)**, hard, grey, moist, fine to coarse sand, subangular to angular fine to coarse gravel, low plasticity (Till) (Unit 5) - Rock fragments in Spoon Sample 41	65.84 23.16
25.07		**Shale Bedrock Fragments** (Unit 6a) - Bedrock cored from 25.07 m to 79.63 m depth - Refer to Record of Drillhole BH24	64.00 25.07

NUMBER	TYPE	BLOWS/0.3m	GR	SA	SI	CL
33	TO	PB				
34	SS	196/ 0.15				
35	SS	131				
36	SS	103				
37	SS	136				
38A 38B	SS	98				
39A 39B	SS	164	17	31	39	14
40	SS	100/ 0.07				
41	SS	100/ 0.07				
42	SS	100/ 0.07				



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GRAIN SIZE DISTRIBUTION (%)

Notes:

1. Water level in open borehole could not be measured upon completion of soil drilling due to use of mud-rotary technique.

2. Efficiency of the SPT hammer utilized was 68.2 %.

3. Methane (CH4), Carbon Monoxide (CO) and Volatile Organic Compound (VOCs) gases were detected at surface by a portable gas monitor(GX-6000) during drilling of BH24 between depths of approximately 40 m and 72 m. At approximate depth of 60 m, gases vented overnight into the following morning.
Drilling fluid bubbling noticed while drilling between approximate depths of 58 m and 60 m.

4. After standard 2 inch diameter split spoon testing, 3 inch diameter split spoon utilized to obtain more sample volume along the same depth.

DEPTH SCALE
1 : 50

LOGGED: MH
CHECKED: SEMP

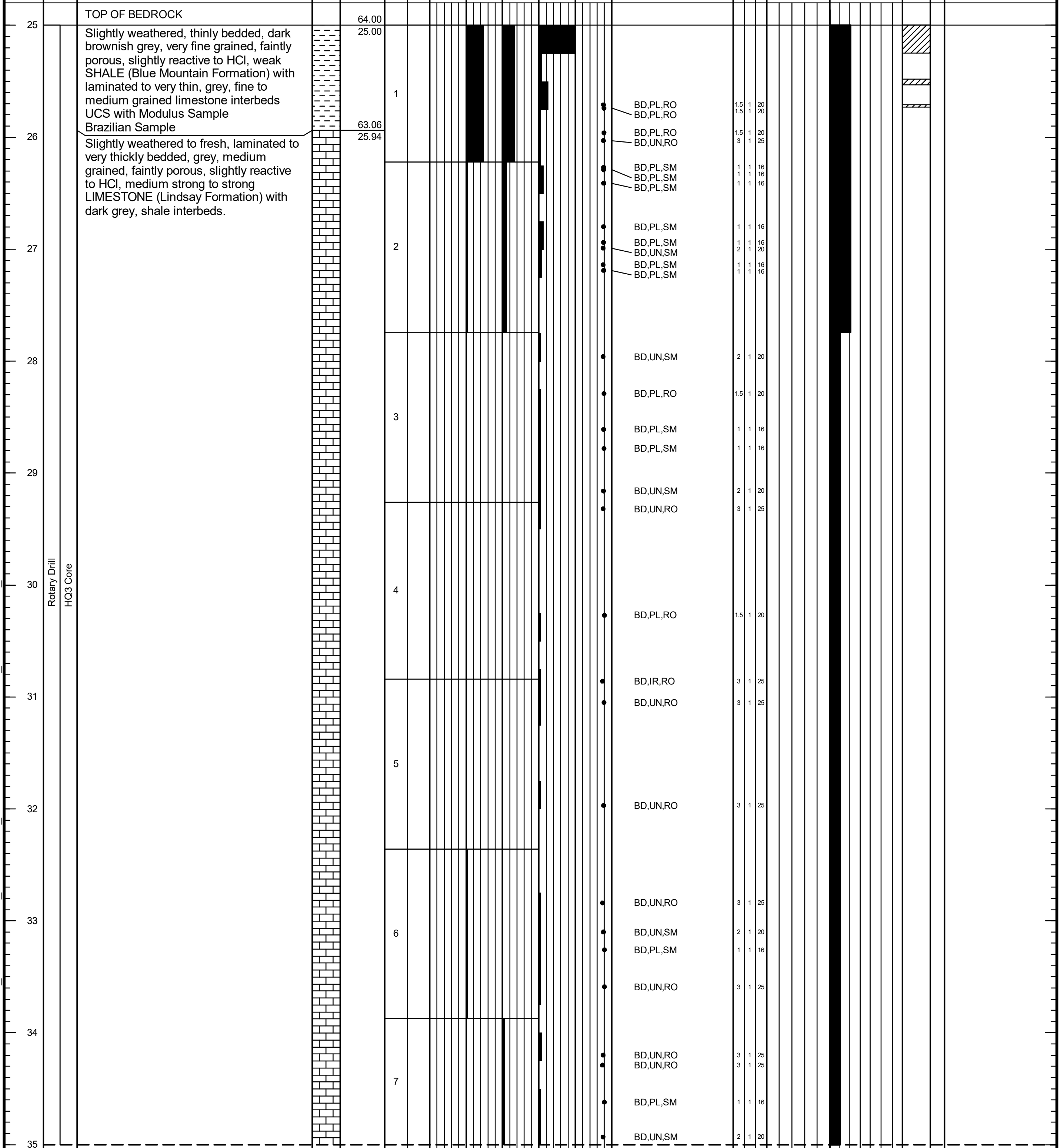
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4860135.33; E 683745.15
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH24

DRILLING DATE: June 30 to July 8, 2022
DRILL RIG: Diedrich 50 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 4 OF 9
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



ELEV. DEPTH (m)	DESCRIPTION
64.00	TOP OF BEDROCK
63.06 25.00	Slightly weathered, thinly bedded, dark brownish grey, very fine grained, faintly porous, slightly reactive to HCl, weak SHALE (Blue Mountain Formation) with laminated to very thin, grey, fine to medium grained limestone interbeds UCS with Modulus Sample Brazilian Sample
25.94	Slightly weathered to fresh, laminated to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with dark grey, shale interbeds.

DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,UN,RO	3	1	25
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,UN,SM	2	1	20
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,UN,SM	2	1	20
BD,PL,RO	1.5	1	20
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,UN,SM	2	1	20
BD,UN,RO	3	1	25
BD,PL,RO	1.5	1	20
BD,IR,RO	3	1	25
BD,UN,RO	3	1	25
BD,UN,RO	3	1	25
BD,UN,RO	3	1	25
BD,UN,SM	2	1	20
BD,PL,SM	1	1	16
BD,UN,RO	3	1	25
BD,UN,RO	3	1	25
BD,UN,RO	3	1	25
BD,PL,SM	1	1	16
BD,UN,SM	2	1	20

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: MH
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4860135.33; E 683745.15
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH24

DRILLING DATE: June 30 to July 8, 2022
DRILL RIG: Diedrich 50 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 5 OF 9
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

Columns: DEPTH SCALE METRES | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (m) | RUN No. | FLUSH RETURN | RECOVERY (TOTAL CORE % 80 60 40 20; SOLID CORE % 80 60 40 20) | R.Q.D. % 80 60 40 20 | FRACT. INDEX PER 0.25 m 5 10 15 20 | DISCONTINUITY DATA (DIP w.r.t. CORE AXIS 0 30 60 90; TYPE AND SURFACE DESCRIPTION; Jr; Ja; Jcon) | HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2} | WEATHERING INDEX W1 W2 W3 W4 W5 W6 | FEATURES | R0/R1 ZONES | PIEZOMETER

--- CONTINUED FROM PREVIOUS PAGE ---

Depth scale: 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45

Drilling record: Rotary Drill; HQ3 Core

Run No.: 7, 8, 9, 10, 11, 12, 13, 14

Slightly weathered to fresh, laminated to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with dark grey, shale interbeds.

Brazilian Sample

UCS with Modulus Sample

TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,UN,SM	2	1	20
BD,UN,RO	3	1	25
BD,UN,SM	2	1	20
BD,UN,SM	2	1	20
BD,UN,RO	3	1	25
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16

CONTINUED NEXT PAGE

GTA-RCK 048 S:\CLIENTS\OPG\DARLINGTON_GENERATING_STATION\02_DATA\GINT\DARLINGTON_GENERATING_STATION.GPJ GAL-MISS.GDT 6/2/23

DEPTH SCALE
1 : 50

LOGGED: MH
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4860135.33; E 683745.15
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH24

DRILLING DATE: June 30 to July 8, 2022
DRILL RIG: Diedrich 50 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 6 OF 9
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE % 80 60 40 20	RECOVERY SOLID CORE % 80 60 40 20	R.Q.D. % 80 60 40 20	FRACT. INDEX PER 0.25 m 5 10 15 20	DIP w.r.t. CORE AXIS 0 30 60 90	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2}	WEATHERING INDEX W1 W2 W3 W4 W5 W6	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
45	Rotary Drill HQ3 Core	Slightly weathered to fresh, laminated to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with dark grey, shale interbeds. UCS Sample			14															
46					15							BD,PL,SM BD,UN,RO	1 3	1 1	16 25					
47																				
48					16															
49					17															
		Slake Durability Sample										BD,PL,SM BD,PL,SM	1 1	1 1	16 16					
50												BD,UN,SM PC,CL BD,UN,SM PC,CL	2 2	4 4	16 16					
51		Specific Gravity Sample			18															
52																				
53					19															
54					20															
55																				

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DEPTH SCALE
1 : 50

LOGGED: MH
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4860135.33; E 683745.15
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

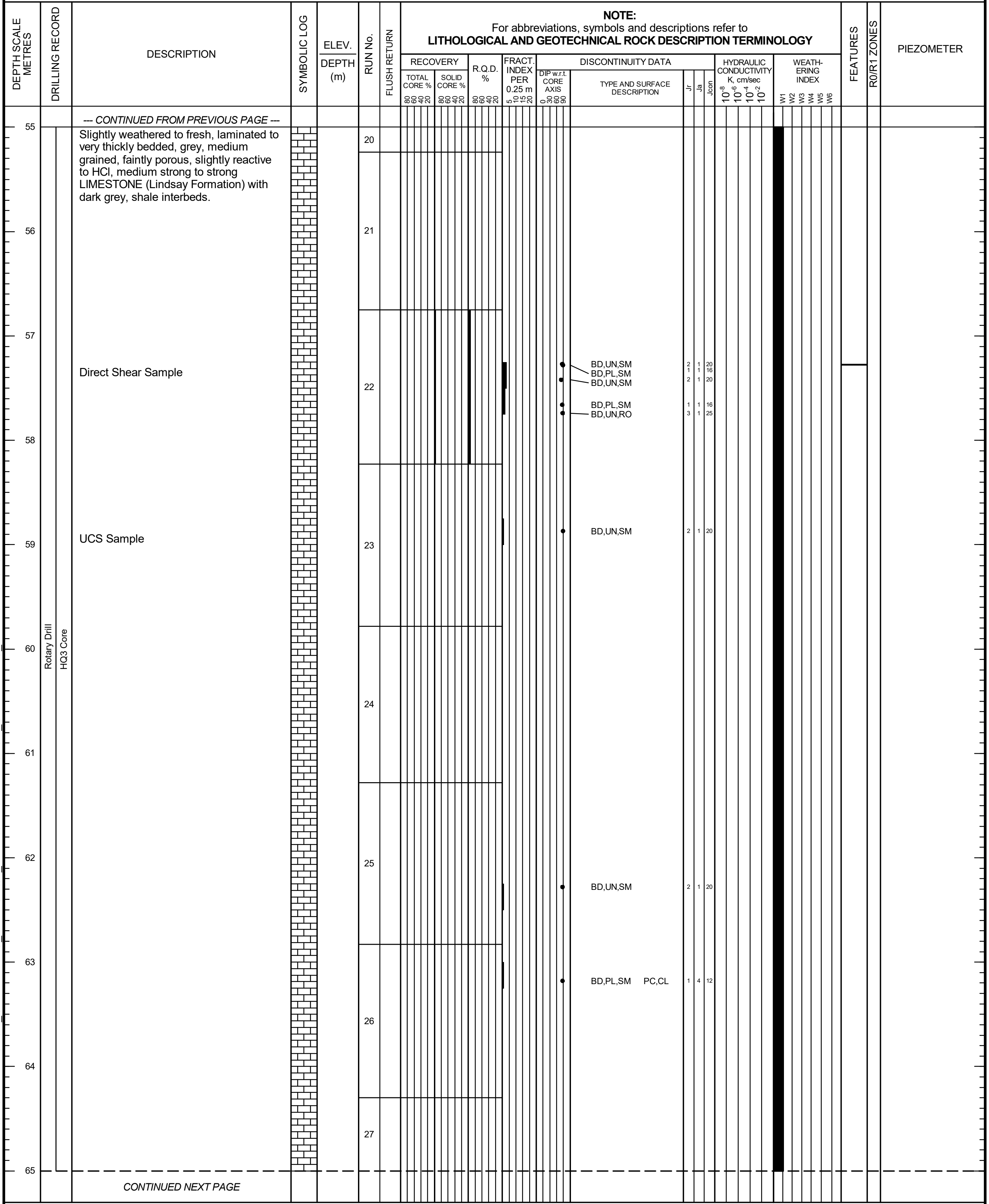
RECORD OF DRILLHOLE: BH24

SHEET 7 OF 9

DRILLING DATE: June 30 to July 8, 2022
DRILL RIG: Diedrich 50 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



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Slightly weathered to fresh, laminated to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with dark grey, shale interbeds.

Direct Shear Sample

UCS Sample

Type and surface description	Jr	Ja	Jcon
BD,UN,SM	2	1	20
BD,PL,SM	1	1	16
BD,UN,SM	2	1	20
BD,PL,SM	1	1	16
BD,UN,RO	3	1	25
BD,UN,SM	2	1	20
BD,UN,SM	2	1	20
BD,PL,SM PC,CL	1	4	12

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: MH
CHECKED: PKS

RECORD OF DRILLHOLE: BH24

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4860135.33; E 683745.15
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

DRILLING DATE: June 30 to July 8, 2022
DRILL RIG: Diedrich 50 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 8 OF 9
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (m) | RUN No. | FLUSH RETURN | RECOVERY (TOTAL CORE %, SOLID CORE %) 80 60 40 20 | R.Q.D. % 80 60 40 20 | FRACT. INDEX PER 0.25 m 5 10 15 20 | DISCONTINUITY DATA (DIP w.r.t. CORE AXIS 0 30 60 90; TYPE AND SURFACE DESCRIPTION; Jr; Ja; Jcon) | HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2} | WEATHERING INDEX W1 W2 W3 W4 W5 W6 | FEATURES | R0/R1 ZONES | PIEZOMETER

--- CONTINUED FROM PREVIOUS PAGE ---

Depth scale: 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75

Drilling record: Rotary Drill, HQ3 Core

Slightly weathered to fresh, laminated to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with dark grey, shale interbeds.

Run No.: 27, 28, 29, 30, 31, 32, 33

TYPE AND SURFACE DESCRIPTION		Jr	Ja	Jcon
BD,PL,SM	PC,CL	1	4	12
BD,PL,SM	PC,CL	1	4	12
BD,PL,SM		1	1	16
BD,PL,SM		1	1	16
BD,PL,SM	PC,CL	1	4	12

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: MH
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4860135.33; E 683745.15
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH24

DRILLING DATE: June 30 to July 8, 2022
DRILL RIG: Diedrich 50 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 9 OF 9
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (m)	RUN No.	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
		--- CONTINUED FROM PREVIOUS PAGE ---						
75	Rotary Drill HQ3 Core	Slightly weathered to fresh, laminated to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with dark grey, shale interbeds.		34				
76				34	BD,PL,SM IN,Go,15 mm	1	15	0
77				35	BD,PL,SM	1	1	16
				35	BD,PL,SM	1	1	16
78				36	BD,UN,RO	3	1	25
				36	BD,UN,RO	3	1	25
				36	BD,UN,RO	3	1	25
				36	BD,IR,SM PC,Br	2	4	20
				36	BD,IR,SM	2	1	20
				36	BD,UN,SM PC,CL	2	4	16
79				36	CO,PL,RO	1.5	1	20
			9.37 79.63					
		END OF DRILLHOLE						
80								
81								
82								
83								
84								
85								

Column headings: DEPTH SCALE METRES; DRILLING RECORD; DESCRIPTION; SYMBOLIC LOG; ELEV. DEPTH (m); RUN No.; FLUSH RETURN; RECOVERY (TOTAL CORE % 80 60 40 20; SOLID CORE % 80 60 40 20); R.Q.D. % 80 60 40 20; FRACT. INDEX PER 0.25 m 5 10 15 20; DIP w.r.t. CORE AXIS 0 30 60 90; DISCONTINUITY DATA (TYPE AND SURFACE DESCRIPTION, Jr, Ja, Jcon); HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2}; WEATHERING INDEX W1 W2 W3 W4 W5 W6; FEATURES; R0/R1 ZONES; PIEZOMETER

DEPTH SCALE
1 : 50

LOGGED: MH
CHECKED: PKS

GOLDER
MEMBER OF WSP

Water Content Summary
ASTM D2216

Test Request #	21451329-21600-610 BH24	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville		

Sample Location	Sample				Soil Description	Water Content %	Method	Remarks
	Ref	Top (m)	Base (m)	Type				
BH24	2	0.61	1.22	SS		7.2	B	
BH24	3A	1.22	1.77	SS		4.9	B	
BH24	5A	2.44	2.83	SS		20.8	B	
BH24	5B	2.83	3.05	SS		19.2	B	
BH24	6	3.05	3.66	SS		21.6	B	
BH24	7	3.66	4.27	SS		25.1	B	
BH24	8A	4.27	4.60	SS		23.8	B	
BH24	8B	4.60	4.88	SS		9.1	B	
BH24	9	4.88	5.49	SS		9.2	B	
BH24	10	5.49	6.10	SS		9.5	B	

Notes:

Disclaimer:

Tested by: JTimms **Date:** 12 Oct 2022
Checked by: MRuck **Date:** 20 Oct 2022
Reviewed by: JoNorris **Date:** 03 Nov 2022

Client:	Golder Associates USA, Inc.		
Project:	Darlington New Nuclear Plant Phase II		
Location:	Ontario, Canada	Project No:	GTX-316444

Boring ID:	---	Sample Type:	---	Tested By:	ckg
Sample ID:	---	Test Date:	12/19/22	Checked By:	ank
Depth :	---	Test Id:	697088		

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content, %
BH24	11	20-22'	Moist, gray sandy clay with gravel	7.8
BH24	17	32-34'	Moist, gray sandy silt with gravel	7.9
BH24	18	34-36'	Moist, gray sandy silt with gravel	6.0
BH24	20	38-40'	Moist, gray silty sand with gravel	7.1
BH24	23	44-46'	Moist, gray silty sand with gravel	12.7
BH24	24	46-48'	Moist, gray sand with silt and gravel	14.7
BH24	25	48-50'	Moist, gray silt with sand	16.9
BH24	26	50-52'	Moist, gray sand with silt	17.3
BH24	37	72-74'	Moist, gray sand with silt	21.6
BH24	38A	74-75.5'	Moist, gray silty sand	7.7

Notes: Temperature of Drying : 110° Celsius

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GeoTesting EXPRESS

Client:	Golder Associates USA, Inc.				
Project:	Darlington New Nuclear Plant Phase II				
Location:	Ontario, Canada			Project No:	GTX-316444
Boring ID:	---	Sample Type:	---	Tested By:	ckg
Sample ID:	---	Test Date:	12/15/22	Checked By:	ank
Depth :	---	Test Id:	697171		

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	**Sample ID**	**Depth**	**Description**	**Moisture Content, %**
BH24	38B	75.5-76'	Moist, gray silty clay	15.6
BH24	29	56-58'	Moist, gray silty clay with sand	19.5
BH24	30	58-60'	Moist, gray clay	19.5
BH24	31	60-62'	Moist, grayish brown clay	24.9
BH24	32S	62-64'	Moist, gray clay	20.0
BH24	34	66-68'	Moist, gray clay	10.3
BH24	39A	76-76.83'	Moist, gray clay	9.9
BH24	39B	76.83-78'	Moist, gray sandy silty clay with gravel	6.1
BH24	40	78-78.75'	Moist, gray silty sand	7.8
BH24	41	80-80.75'	Moist, gray silty clay with gravel	6.5

Notes: Temperature of Drying : 110° Celsius

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Client:	Golder Associates USA, Inc.				
Project:	Darlington New Nuclear Plant Phase II				
Location:	Ontario, Canada			Project No:	GTX-316444
Boring ID:	---	Sample Type:	---	Tested By:	ckg
Sample ID:	---	Test Date:	12/12/22	Checked By:	ank
Depth :	---	Test Id:	697174		

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content,%
BH24	42	82-82.25'	Moist, dark brown silty sand with gravel	10.7
BH26	35	68-70'	Moist, gray silt with sand	16.4

Notes: Temperature of Drying : 110º Celsius

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PARTICLE SIZE DISTRIBUTION

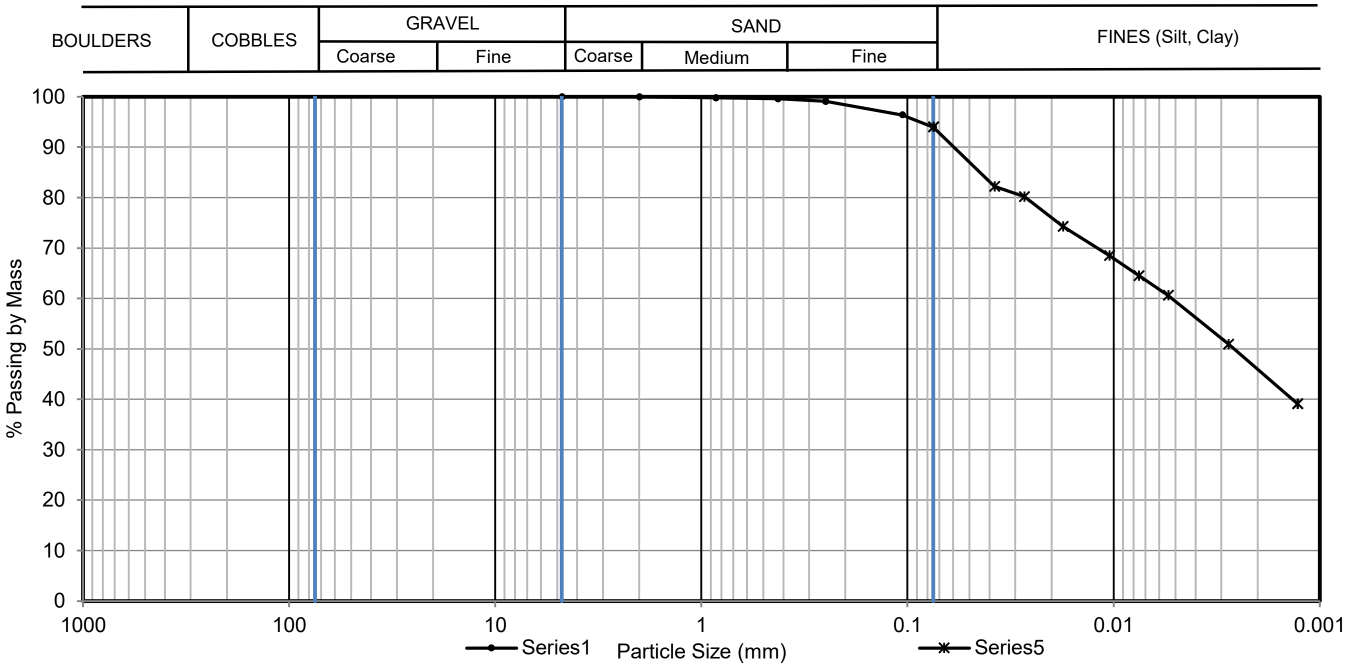
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH24	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH24
Source:		Sample No.:	6
Soil Description:		Type:	SS
		Depth (m):	3.05 - 3.66

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	14 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%) 0.0 6.0 94.0



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
#4	4.75	100.0	0.0379	82.2
#10	2	100.0	0.0271	80.2
#20	0.85	99.8	0.0176	74.3
#40	0.425	99.6	0.0105	68.5
#60	0.25	99.1	0.0075	64.5
#140	0.106	96.4	0.0054	60.6
#200	0.075	94.0	0.0028	50.9
			0.0013	39.1
			0.005 mm	59.41
			0.002 mm	45.92
			D60	0.01
			D30	
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

Tested by: JTimms **Date:** 14 Oct 2022 **Checked by:** MRuck **Date:** 20 Oct 2022 **Reviewed by:** JoNorris **Date:** 03 Nov 2022

PARTICLE SIZE DISTRIBUTION

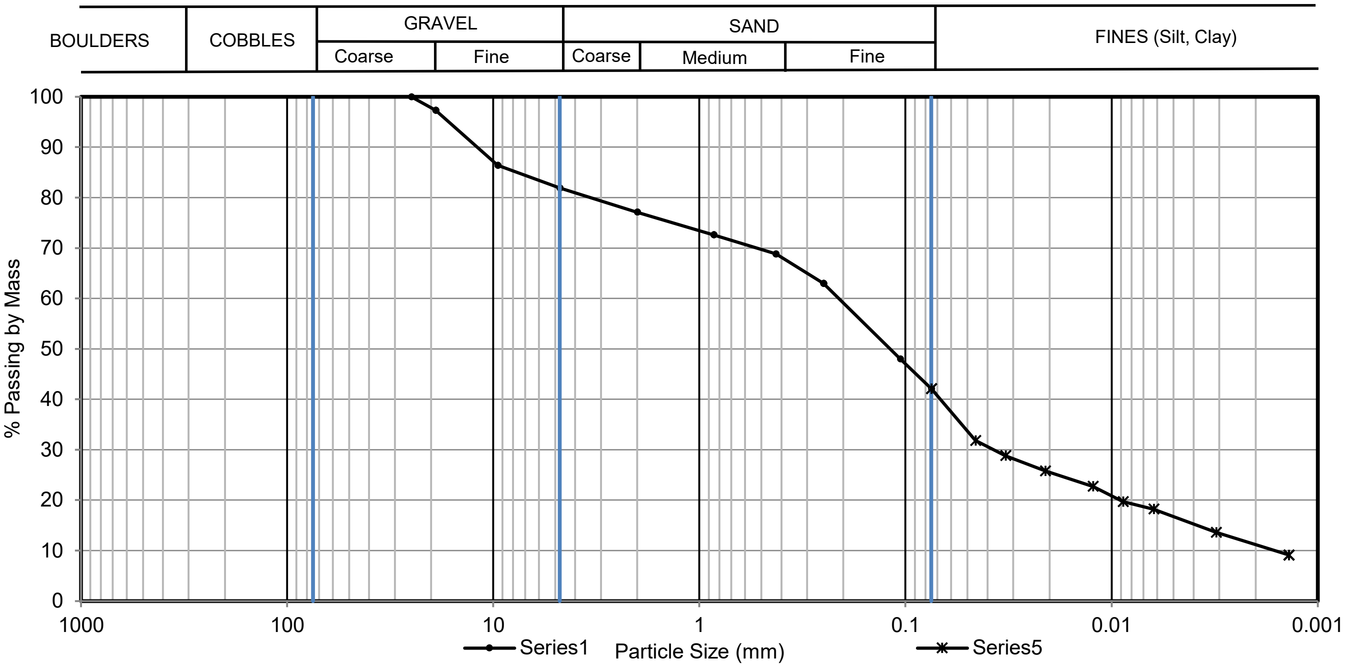
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH24	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH24
Source:		Sample No.:	10
		Type:	SS
Soil Description:		Depth (m):	5.49 - 6.10

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	14 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%) 18.1 39.8 42.1



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1"	25	100.0	0.0457	31.8
3/4"	19	97.3	0.0327	28.8
3/8"	9.5	86.4	0.0210	25.8
#4	4.75	81.9	0.0123	22.7
#10	2	77.1	0.0088	19.7
#20	0.85	72.6	0.0063	18.2
#40	0.425	68.8	0.0031	13.6
#60	0.25	63.0	0.0014	9.1
#140	0.106	48.0		
#200	0.075	42.1		
			0.005 mm	16.73
			0.002 mm	11.16
			D60	0.21
			D30	0.04
			D10	0.00
			Cu	130.00
			Cc	4.10

Notes:

Disclaimer:

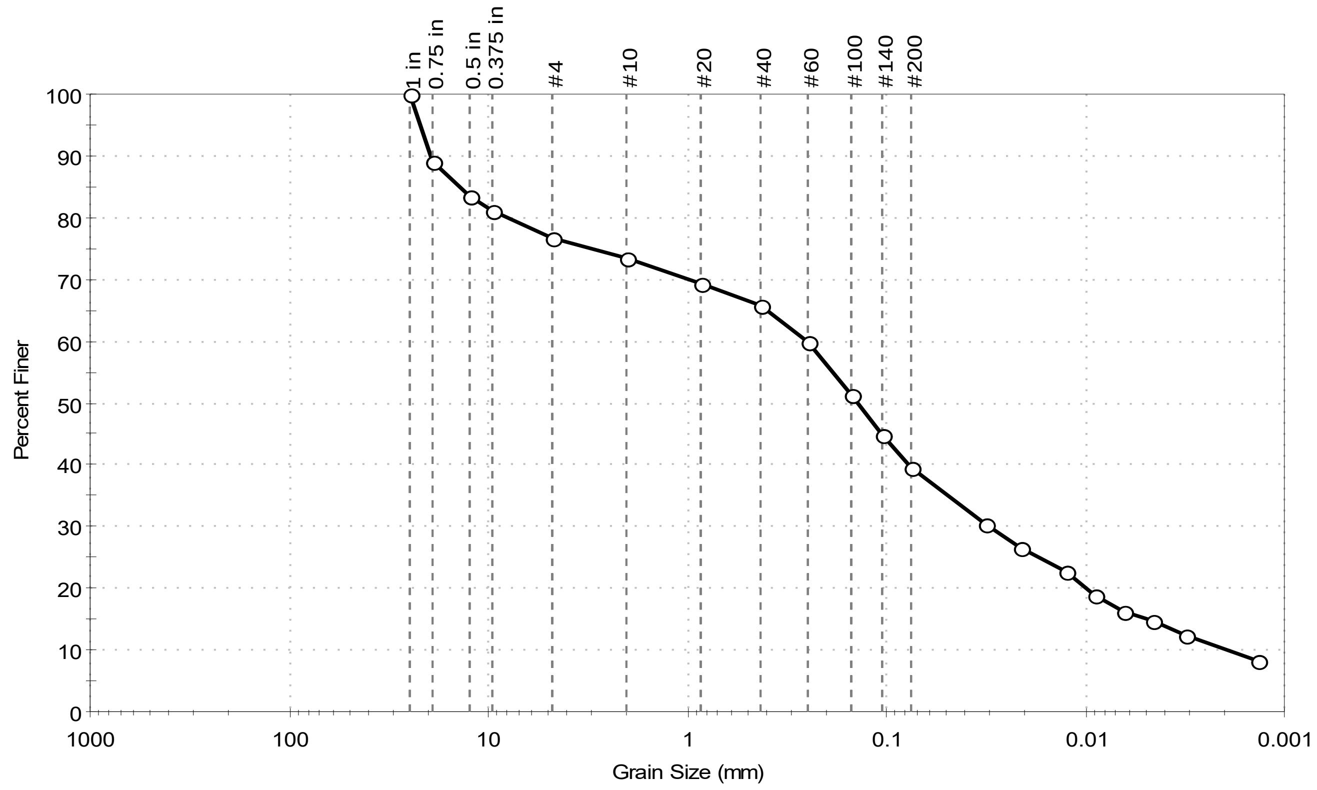
Tested by: JTimms **Date:** 14 Oct 2022 **Checked by:** MRuck **Date:** 20 Oct 2022 **Reviewed by:** JoNorris **Date:** 03 Nov 2022

GeoTesting
EXPRESS

Client:	WSP Canada Inc.				
Project:	Darlington New Nuclear Plant Phase II				
Location:	Ontario, Canada			Project No:	GTX-316444
Boring ID:	BH24	Sample Type:	jar	Tested By:	ckg
Sample ID:	20	Test Date:	12/14/22	Checked By:	ank
Depth :	38-40'	Test Id:	697130		

Test Comment: ---
Visual Description: Moist, gray silty sand with gravel
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	23.4	37.2	39.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	89		
0.5 in	12.50	83		
0.375 in	9.50	81		
#4	4.75	77		
#10	2.00	73		
#20	0.85	69		
#40	0.42	66		
#60	0.25	60		
#100	0.15	51		
#140	0.11	45		
#200	0.075	39		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0317	30		
---	0.0213	27		
---	0.0126	23		
---	0.0091	19		
---	0.0065	16		
---	0.0046	15		
---	0.0031	12		
---	0.0014	8		

Coefficients

D_{85} =14.1165 mm	D_{30} =0.0302 mm
D_{60} =0.2501 mm	D_{15} =0.0048 mm
D_{50} =0.1391 mm	D_{10} =0.0019 mm
C_u =131.632	C_c =1.919

Classification

ASTM	Silty SAND with Gravel (SM)
AASHTO	Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #200 Sieve

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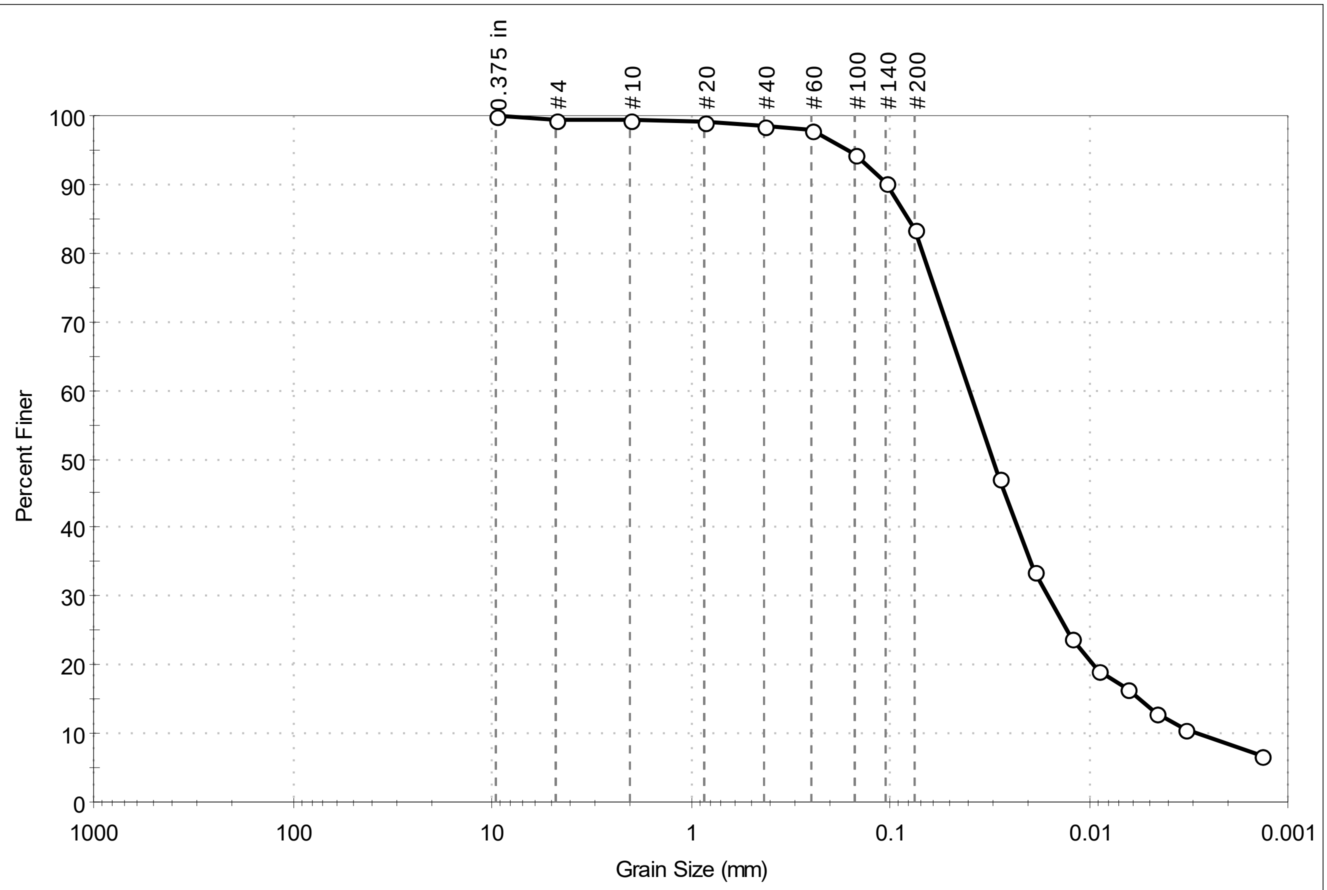
GeoTesting EXPRESS

Client: WSP Canada Inc.
Project: Darlington New Nuclear Plant Phase II
Location: Ontario, Canada
Project No: GTX-316444
Boring ID: BH24
Sample Type: jar
Tested By: ckg
Sample ID: 25
Test Date: 12/12/22
Checked By: ank
Depth : 48-50'
Test Id: 697132
Test Comment: ---
Visual Description: Moist, gray silt with sand
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.5	16.0	83.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	99		
#20	0.85	99		
#40	0.42	99		
#60	0.25	98		
#100	0.15	94		
#140	0.11	90		
#200	0.075	84		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0283	47		
---	0.0189	34		
---	0.0124	24		
---	0.0089	19		
---	0.0064	17		
---	0.0046	13		
---	0.0033	11		
---	0.0014	7		

Coefficients

D_{85} = 0.0810 mm
D_{30} = 0.0161 mm
D_{60} = 0.0399 mm
D_{15} = 0.0055 mm
D_{50} = 0.0305 mm
D_{10} = 0.0029 mm
C_u = 13.759
C_c = 2.240

Classification

ASTM SILT with Sand (ML)

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve

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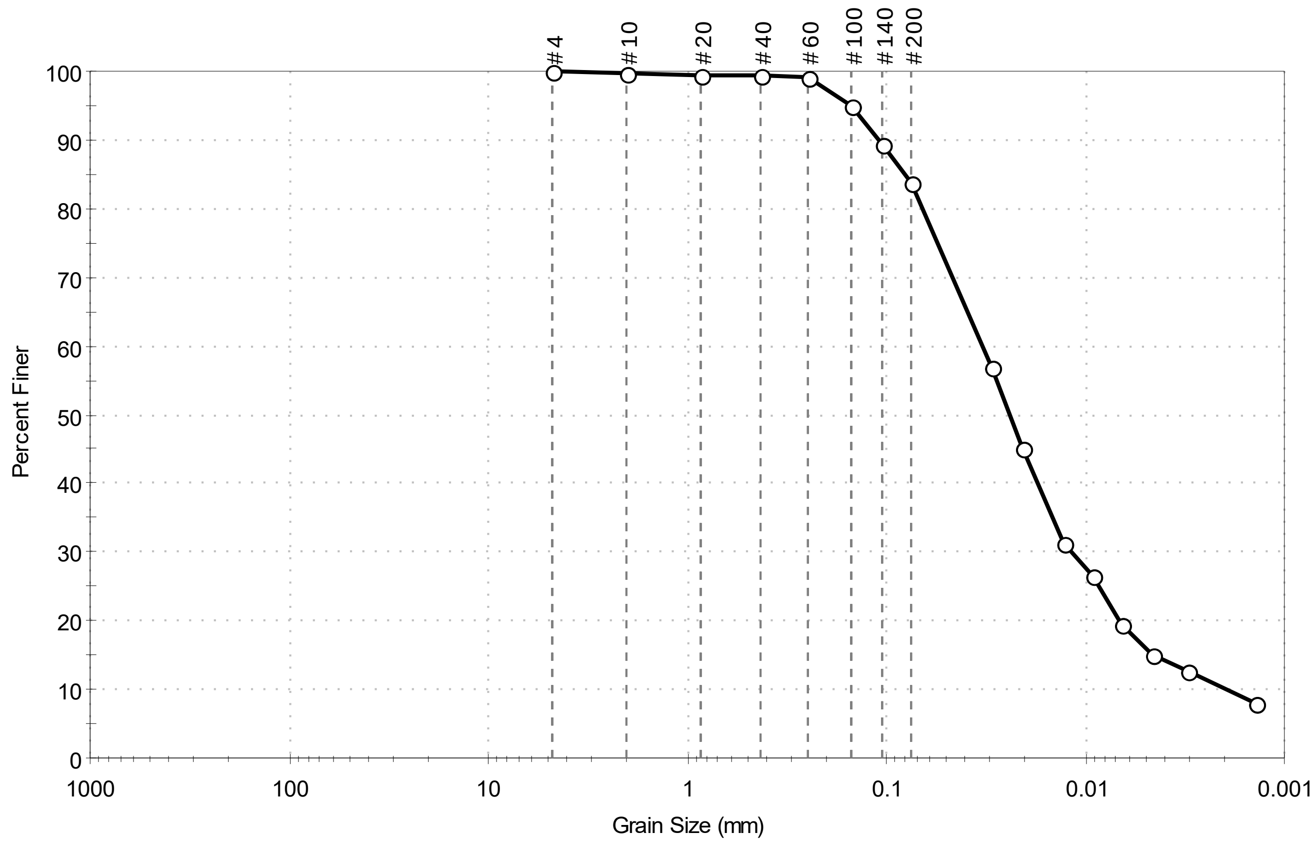
Client:	WSP Canada Inc.		
Project:	Darlington New Nuclear Plant Phase II		
Location:	Ontario, Canada	Project No:	GTX-316444

Boring ID:	BH24	Sample Type:	jar	Tested By:	ckg
Sample ID:	29	Test Date:	12/16/22	Checked By:	ank
Depth :	56-58'	Test Id:	697177		

Test Comment: ---
Visual Description: Moist, gray silty clay with sand
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	16.1	83.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	99		
#60	0.25	99		
#100	0.15	95		
#140	0.11	89		
#200	0.075	84		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0294	57		
---	0.0207	45		
---	0.0128	31		
---	0.0091	27		
---	0.0066	20		
---	0.0046	15		
---	0.0030	13		
---	0.0014	8		

Coefficients

D_{85} = 0.0803 mm	D_{30} = 0.0117 mm
D_{60} = 0.0328 mm	D_{15} = 0.0046 mm
D_{50} = 0.0239 mm	D_{10} = 0.0020 mm
C_u = 16.400	C_c = 2.087

Classification

ASTM	Silty CLAY with Sand (CL-ML)
AASHTO	Silty Soils (A-4 (0))

Sample/Test Description

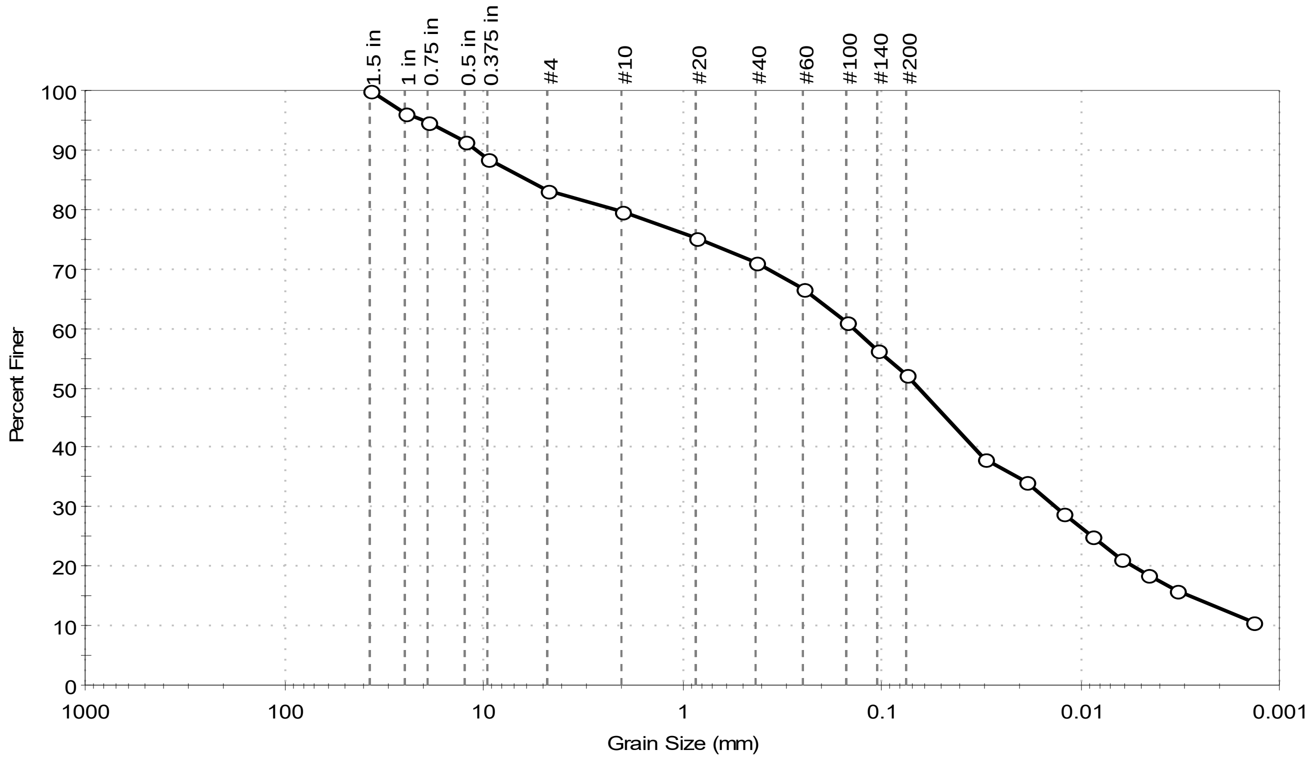
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve

Client: WSP Canada Inc.
Project: Darlington New Nuclear Plant Phase II
Location: Ontario, Canada
Project No: GTX-316444

Boring ID: BH24
Sample Type: jar
Tested By: ckg
Sample ID: 39B
Test Date: 12/14/22
Checked By: ank
Depth : 76.83-78'
Test Id: 697180

Test Comment: ---
Visual Description: Moist, gray sandy silty clay with gravel
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	16.7	31.2	52.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.5 in	37.50	100		
1 in	25.00	96		
0.75 in	19.00	95		
0.5 in	12.50	91		
0.375 in	9.50	88		
#4	4.75	83		
#10	2.00	80		
#20	0.85	75		
#40	0.42	71		
#60	0.25	67		
#100	0.15	61		
#140	0.11	56		
#200	0.075	52		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0302	38		
---	0.0189	34		
---	0.0122	29		
---	0.0087	25		
---	0.0063	21		
---	0.0046	19		
---	0.0033	16		
---	0.0014	11		

Coefficients

D_{85} = 5.9684 mm	D_{30} = 0.0133 mm
D_{60} = 0.1393 mm	D_{15} = 0.0028 mm
D_{50} = 0.0654 mm	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM	Sandy Silty CLAY with Gravel (CL-ML)
AASHTO	Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve

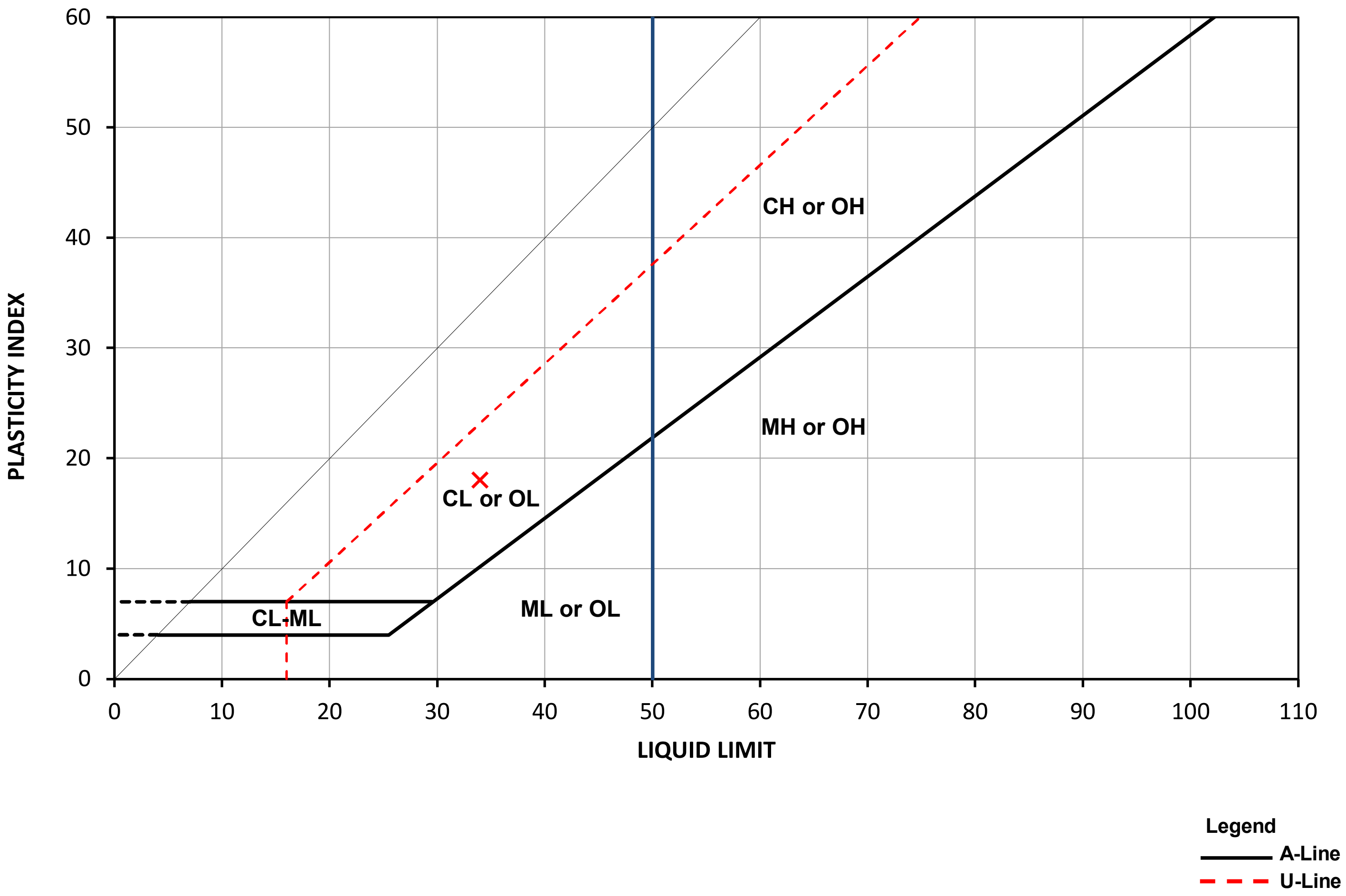
LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

ASTM D4318

Method A - Multipoint Test

Test Request #	21451329-21600-610 BH24	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH24
Source:		Sample No.:	6
Soil Description:		Type:	SS
		Depth (m):	3.05 - 3.66

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	18 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH24	6	3.05	3.66	94	21.6	34	16	18	0.31

NP = Non-Plastic
ND = Not Determined

Test Preparation

Notes:

Tested by: JTimms **Date:** 18 Oct 2022
Checked by: MRuck **Date:** 20 Oct 2022

Disclaimer:

The laboratory testing services reported herein have been performed in accordance with the terms of a contract with Golder's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of Golder's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

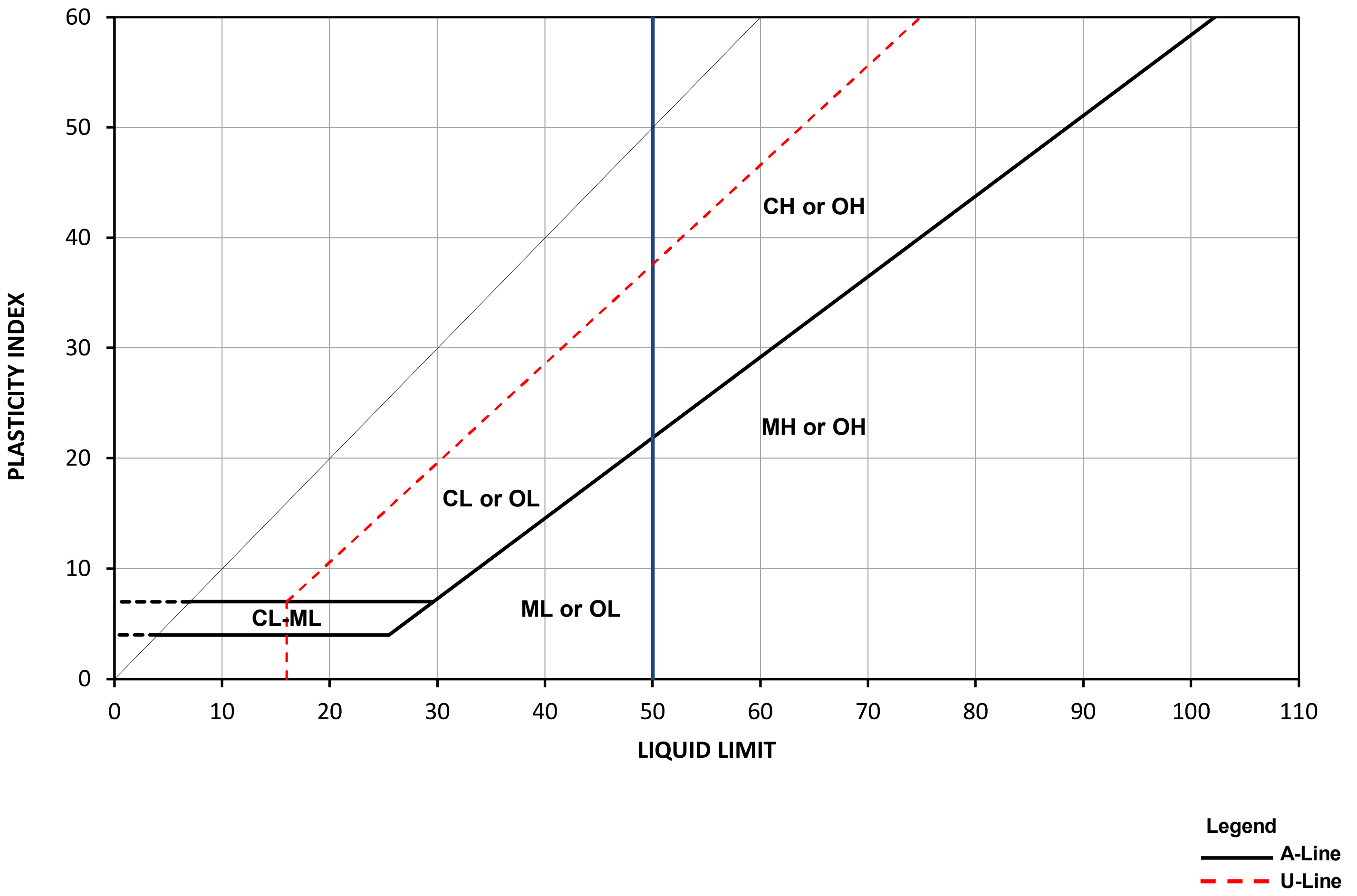
Reviewed by: JoNorris **Date:** 03 Nov 2022

GOLDER
MEMBER OF WSP

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318

Test Request #	21451329-21600-610 BH24	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH24
Source:		Sample No.:	10
Soil Description:		Type:	SS
		Depth (m):	5.49 - 6.10

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	18 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH24	10	5.49	6.10	ND	9.5		NP		

NP = Non-Plastic
ND = Not Determined

Test Preparation

Notes:

Tested by: JTimms **Date:** 18 Oct 2022
Checked by: MRuck **Date:** 20 Oct 2022

Disclaimer:

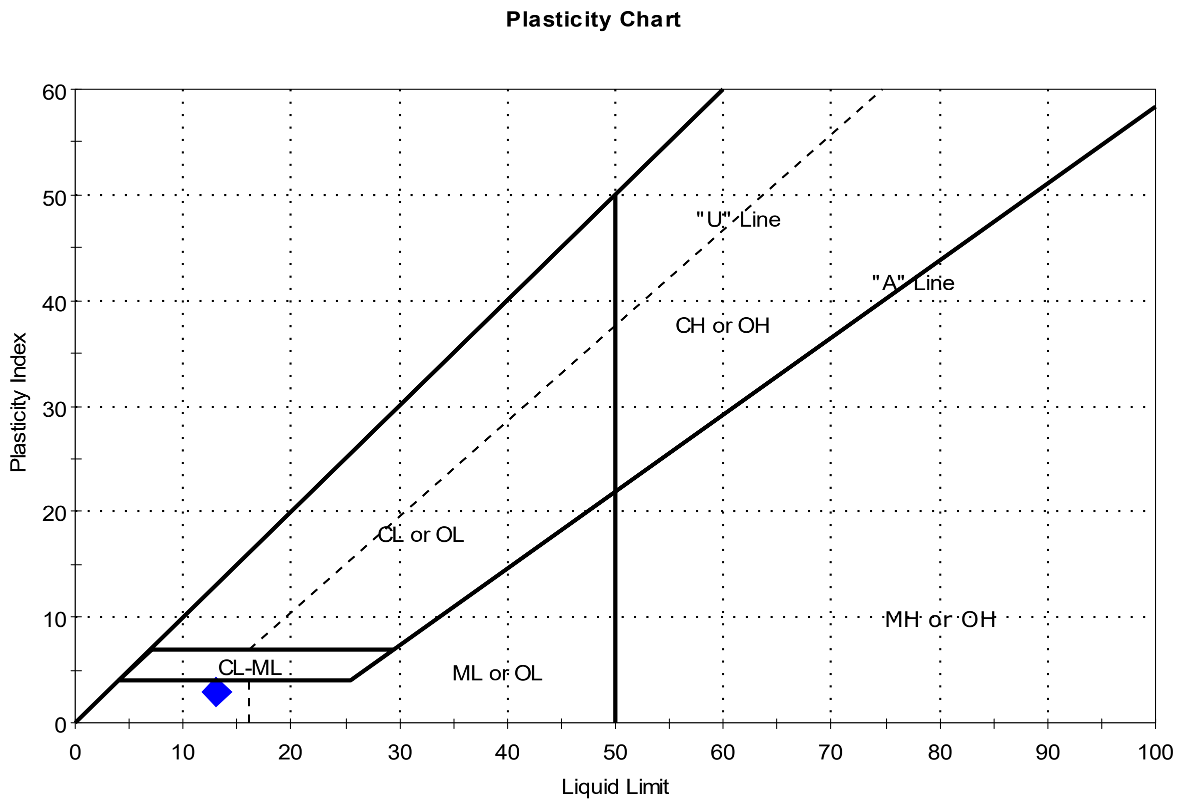
Reviewed by: JoNorris **Date:** 03 Nov 2022

Client: WSP Canada Inc.
Project: Darlington New Nuclear Plant Phase II
Location: Ontario, Canada
Project No: GTX-316444

Boring ID: BH24
Sample ID: 20
Depth : 38-40'
Sample Type: jar
Test Date: 12/15/22
Test Id: 697137
Tested By: cam
Checked By: ank

Test Comment: ---
Visual Description: Moist, gray silty sand with gravel
Sample Comment: ---

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	20	BH24	38-40'	7	13	10	3	-1	Silty SAND with Gravel (SM)

Sample Prepared using the WET method

34% Retained on #40 Sieve

Dry Strength: HIGH

Dilatancy: SLOW

Toughness: LOW

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Client:	WSP Canada Inc.				
Project:	Darlington New Nuclear Plant Phase II				
Location:	Ontario, Canada			Project No:	GTX-316444
Boring ID:	BH24	Sample Type:	jar	Tested By:	cam
Sample ID:	25	Test Date:	12/15/22	Checked By:	ank
Depth :	48-50'	Test Id:	697139		

Test Comment: ---
Visual Description: Moist, gray silt with sand
Sample Comment: ---

Atterberg Limits - ASTM D4318

Sample Determined to be non-plastic

Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	25	BH24	48-50'	17	n/a	n/a	n/a	n/a	SILT with Sand (ML)

1% Retained on #40 Sieve
Dry Strength: LOW
Dilatancy: RAPID
Toughness: n/a
The sample was determined to be Non-Plastic

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GeoTesting EXPRESS

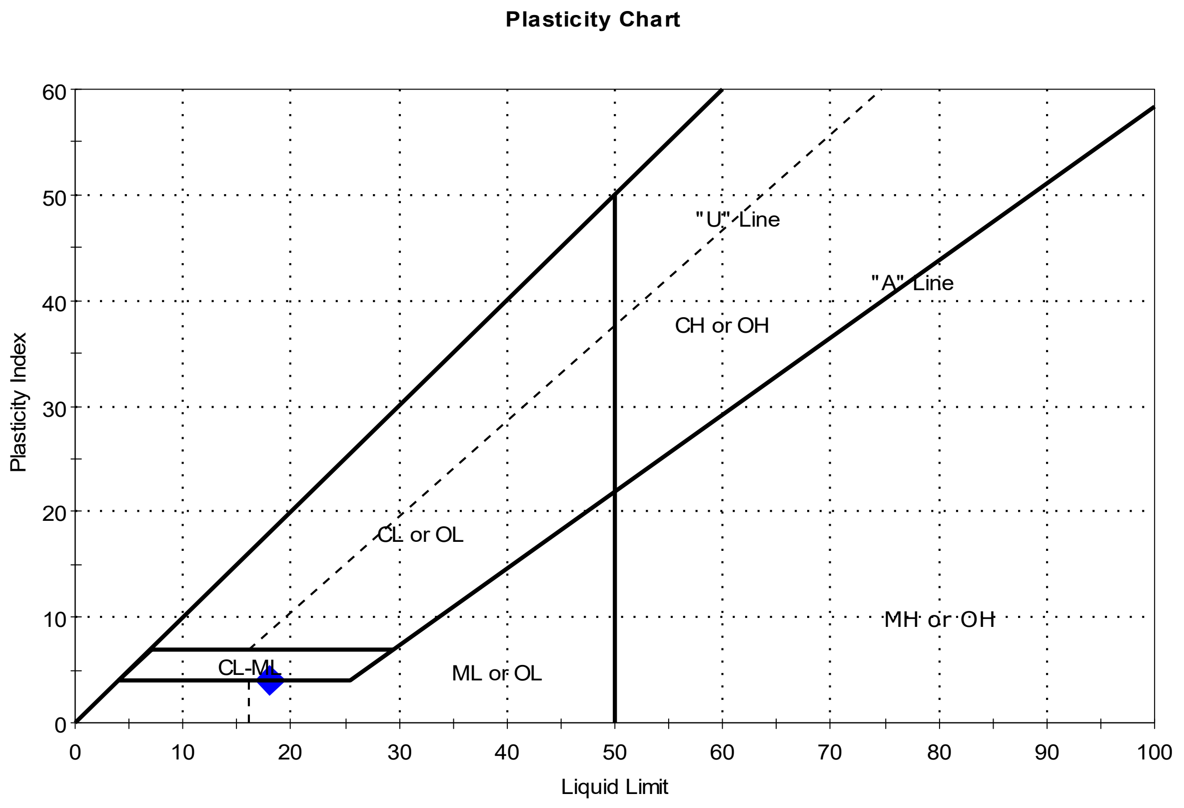
Client:	WSP Canada Inc.				
Project:	Darlington New Nuclear Plant Phase II				
Location:	Ontario, Canada			Project No:	GTX-316444
Boring ID:	BH24	Sample Type:	jar	Tested By:	cam
Sample ID:	29	Test Date:	12/16/22	Checked By:	ank
Depth :	56-58'	Test Id:	697183		

Test Comment: ---

Visual Description: Moist, gray silty clay with sand

Sample Comment: ---

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	29	BH24	56-58'	19	18	14	4	1.4	Silty CLAY with Sand (CL-ML)

Sample Prepared using the WET method

1% Retained on #40 Sieve

Dry Strength: HIGH

Dilatancy: SLOW

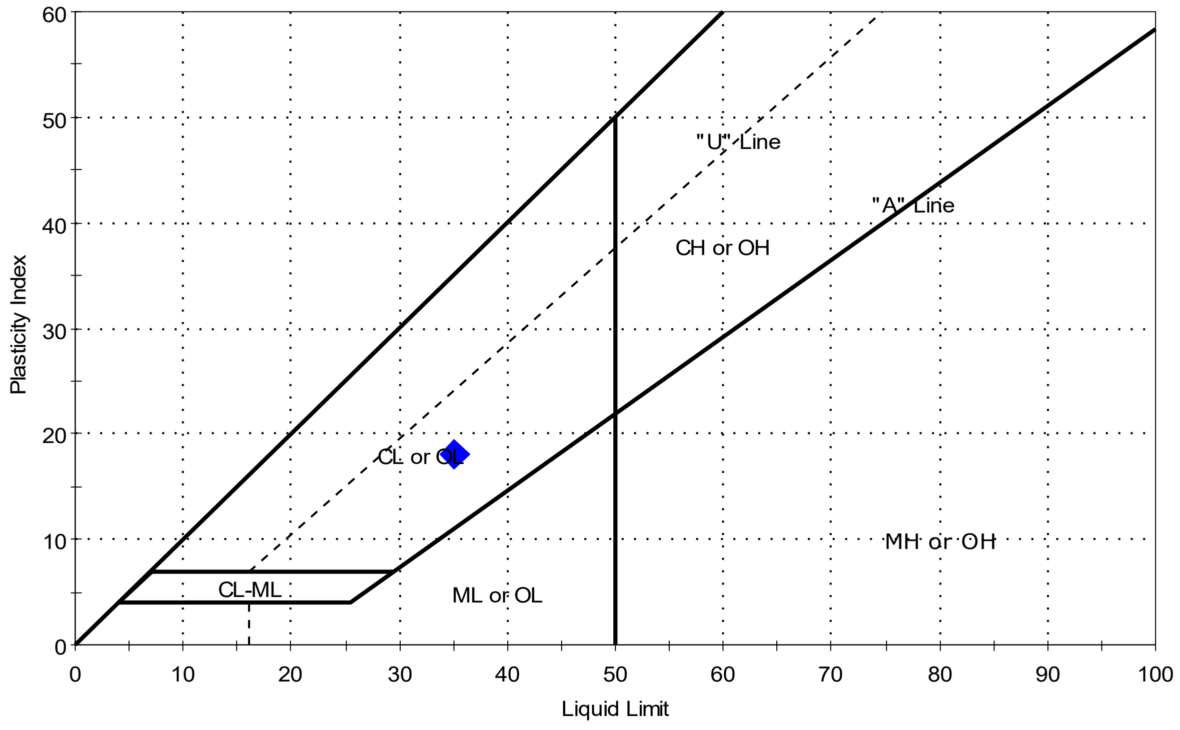
Toughness: LOW

Client:	WSP Canada Inc.				
Project:	Darlington New Nuclear Plant Phase II				
Location:	Ontario, Canada			Project No:	GTX-316444
Boring ID:	BH24	Sample Type:	jar	Tested By:	cam
Sample ID:	30	Test Date:	12/15/22	Checked By:	ank
Depth :	58-60'	Test Id:	697184		

Test Comment: ---
Visual Description: Moist, gray clay
Sample Comment: ---

Atterberg Limits - ASTM D4318

Plasticity Chart



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	30	BH24	58-60'	19	35	17	18	0.1	

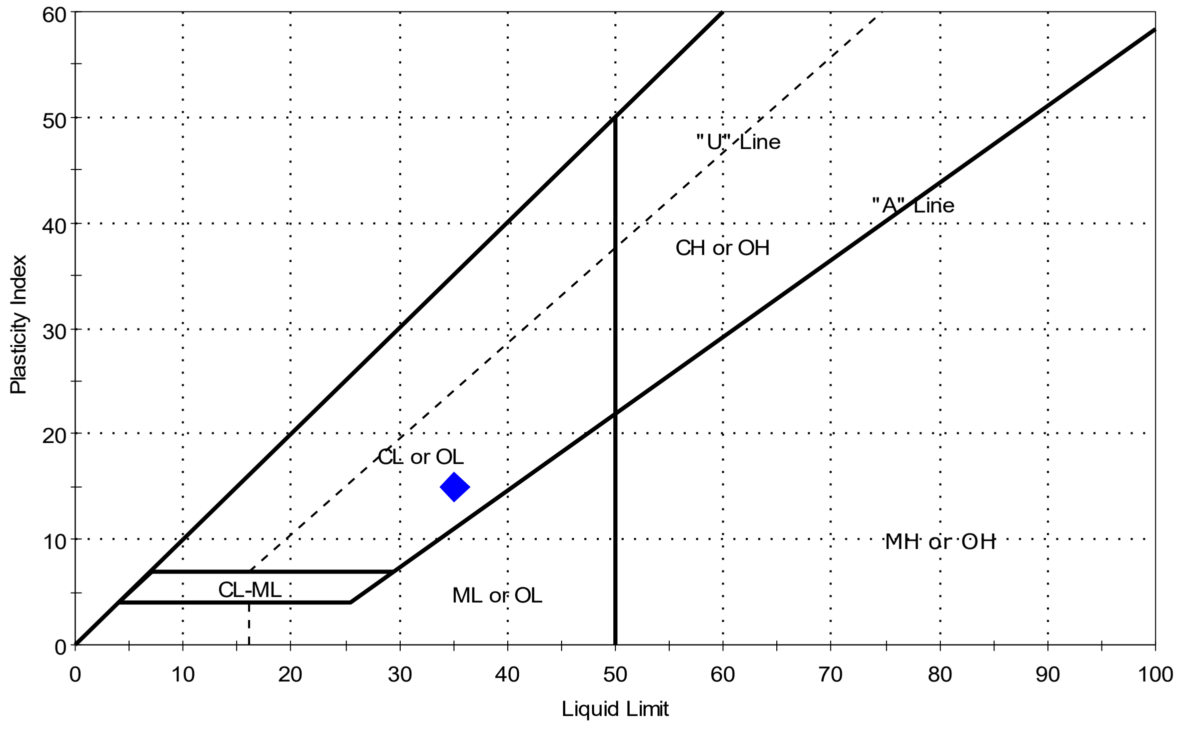
Sample Prepared using the WET method

Dry Strength: VERY HIGH
Dilatancy: SLOW
Toughness: LOW

Client: WSP Canada Inc.
Project: Darlington New Nuclear Plant Phase II
Location: Ontario, Canada
Project No: GTX-316444
Boring ID: BH24
Sample Type: jar
Tested By: cam
Sample ID: 31
Test Date: 12/15/22
Checked By: ank
Depth : 60-62'
Test Id: 697185
Test Comment: ---
Visual Description: Moist, grayish brown clay
Sample Comment: ---

Atterberg Limits - ASTM D4318

Plasticity Chart



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	31	BH24	60-62'	25	35	20	15	0.3	

Sample Prepared using the WET method

Dry Strength: VERY HIGH
Dilatancy: SLOW
Toughness: LOW

Client:	WSP Canada Inc.				
Project:	Darlington New Nuclear Plant Phase II				
Location:	Ontario, Canada			Project No:	GTX-316444
Boring ID:	BH24	Sample Type:	jar	Tested By:	cam
Sample ID:	39B	Test Date:	12/15/22	Checked By:	ank
Depth :	76.83-78'	Test Id:	697188		

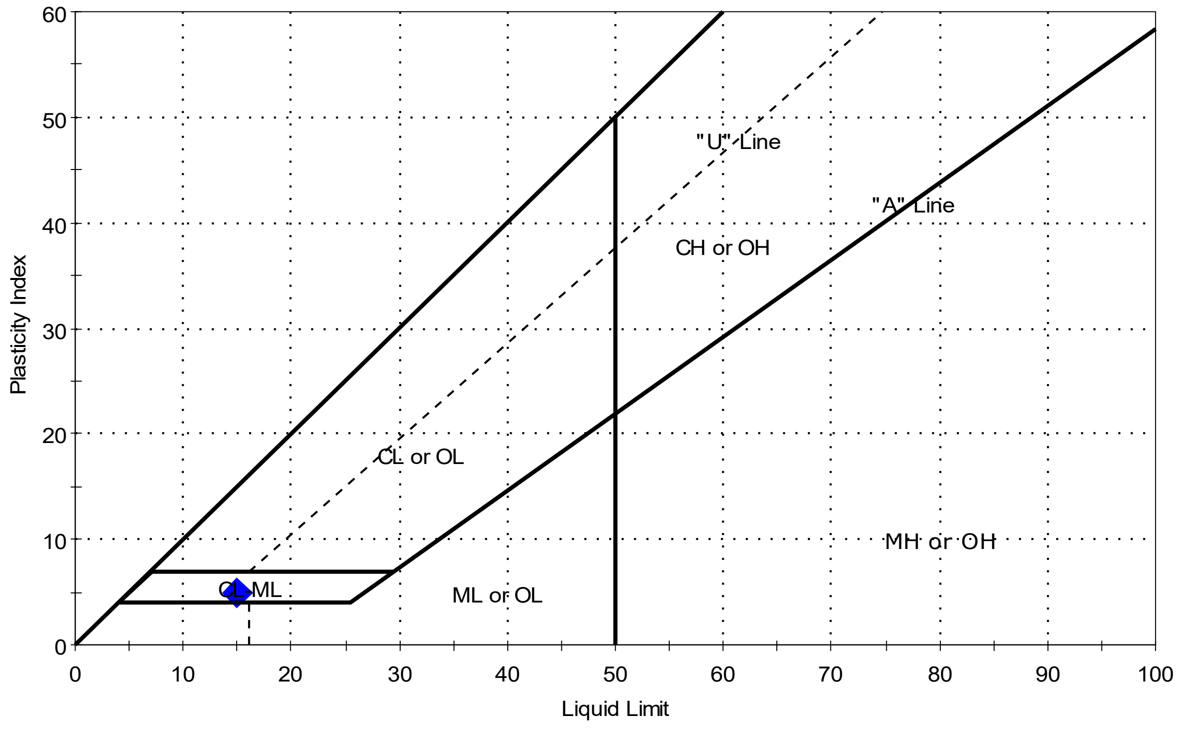
Test Comment: ---

Visual Description: Moist, gray sandy silty clay with gravel

Sample Comment: ---

Atterberg Limits - ASTM D4318

Plasticity Chart



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	39B	BH24	76.83-78'	6	15	10	5	-0.8	Sandy Silty CLAY with Gravel (CL-ML)

Sample Prepared using the WET method

29% Retained on #40 Sieve

Dry Strength: HIGH

Dilatancy: SLOW

Toughness: LOW

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Client:	WSP Canada Inc.				
Project:	Darlington New Nuclear Plant Phase II				
Location:	Ontario, Canada			Project No:	GTX-316444
Boring ID:	BH24	Sample Type:	jar	Tested By:	cam
Sample ID:	41	Test Date:	12/15/22	Checked By:	ank
Depth :	80-80.75'	Test Id:	697189		

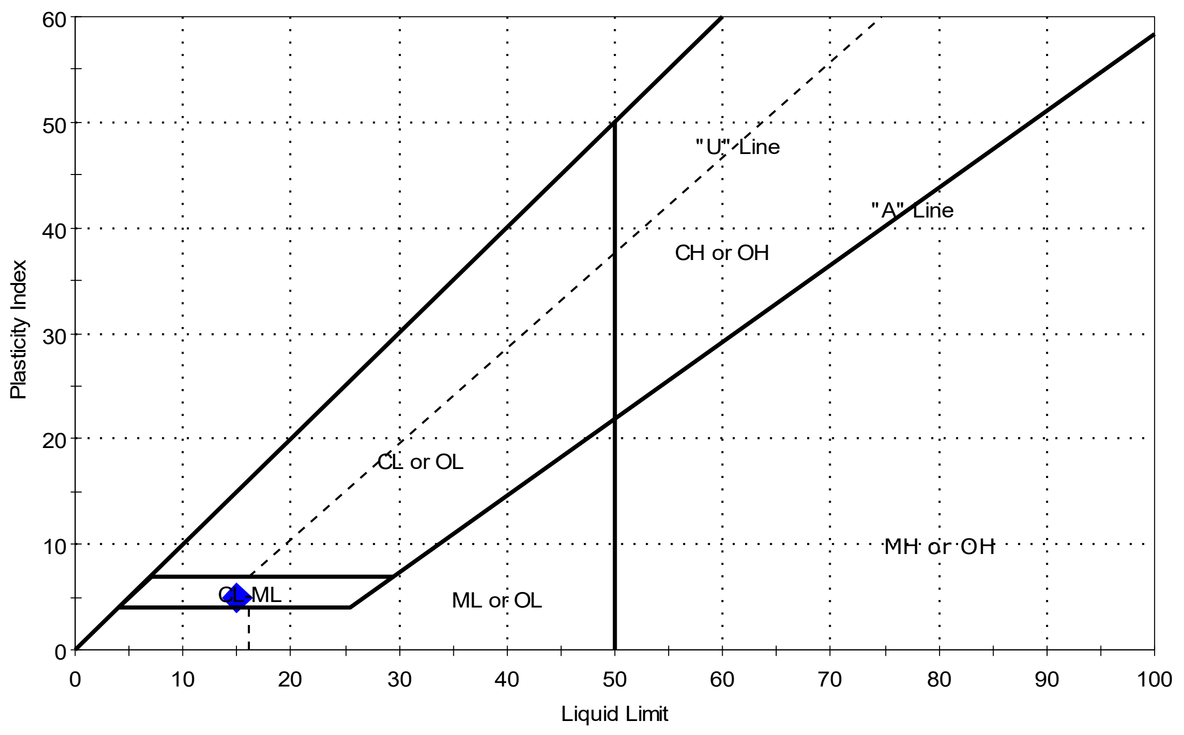
Test Comment: ---

Visual Description: Moist, gray silty clay with gravel

Sample Comment: ---

Atterberg Limits - ASTM D4318

Plasticity Chart



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	41	BH24	80-80.75'	7	15	10	5	-0.7	

Sample Prepared using the WET method

Dry Strength: HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	WSP Canada Inc.				
Project:	Darlington New Nuclear Plant Phase II				
Location:	Ontario, Canada			Project No:	GTX-316444
Boring ID:	---	Sample Type:	---	Tested By:	ckg
Sample ID:	---	Test Date:	12/12/22	Checked By:	ank
Depth :	---	Test Id:	697199		

Specific Gravity of Soils by ASTM D854

Boring ID	Sample ID	Depth	Visual Description	Specific Gravity	Comment
BH24	28	54-56 ft	Moist, light gray sandy silt	2.77	
BH26	31	60-61.42'	Moist, gray silty sand	2.68	
BH24	29	56-58'	Moist, gray silty clay with sand	2.67	
BH26	26	50-52'	Moist, gray clay	2.69	
BH24	16	30-32'	Moist, gray silty sand	2.68	
BH26	10	18-20'	Moist, gray gravel with silt	2.68	
BH26	35	68-70'	Moist, gray silt with sand	2.68	

Notes: Specific Gravity performed by using method B (oven dried specimens) of ASTM D854
Moisture Content determined by ASTM D2216.

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Water (Moisture) Content, Ash Content, and Organic Material of Soils ASTM D2974 Method A

Test Request #	21451329-21600-610 BH24	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH24
Source:		Sample No.:	3A
Soil Description:		Type:	SS
		Depth (m):	1.22 - 1.77

Specimen Reference	NA	Specimen Depth	NA	Date of Test	12 Oct 2022
Specimen Description	NA				

Furnace Temperature During Test (°C)	440
Duration of Test (nearest 15 minutes)	5850
Mass of Crucible With Lid (g)	58.27
Moist Mass of Specimen Plus Crucible With Lid (g)	110.81
Oven Dry Mass of Specimen Plus Crucible With Lid (g)	106.72
Mass of Crucible With Lid Plus Ash (g)	106.23
Water Content (%)	8
Ash Content (%)	99
Organic Material (%)	1

Test Preparation

Notes:

Disclaimer:

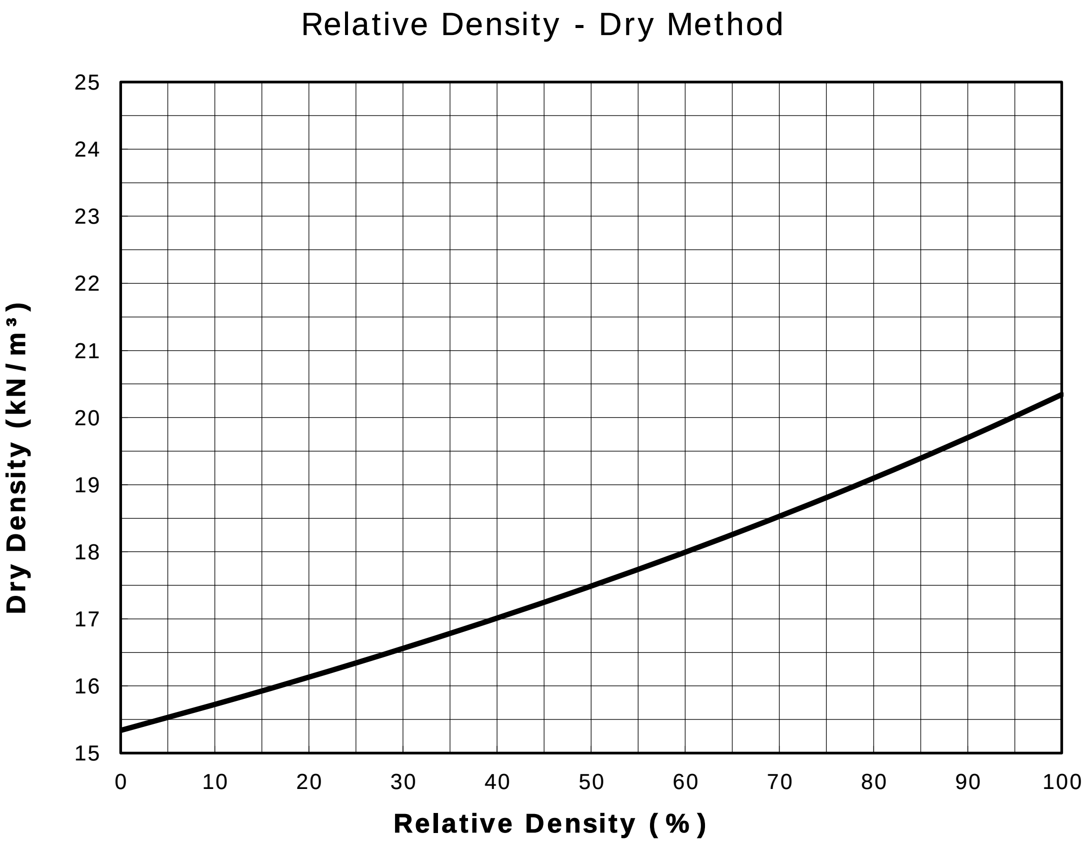
Tested by: JTimms **Date:** 12 Oct 2022

Checked by: MRuck **Date:** 20 Oct 2022

Reviewed by: JoNorris **Date:** 03 Nov 2022

Client:	Golder Associates
Project Name:	Darlington New Nuclear Plant Phase II
Project Location:	Ontario, Canada
GTX #:	316444
Test Date:	12/08/22
Tested By:	lam
Checked By:	as
Boring ID:	BH24
Sample ID:	15, 16 / RD-1
Depth:	---
Description:	Moist, dark gray sandy silt

Relative Density Test by ASTM D4253/D4254

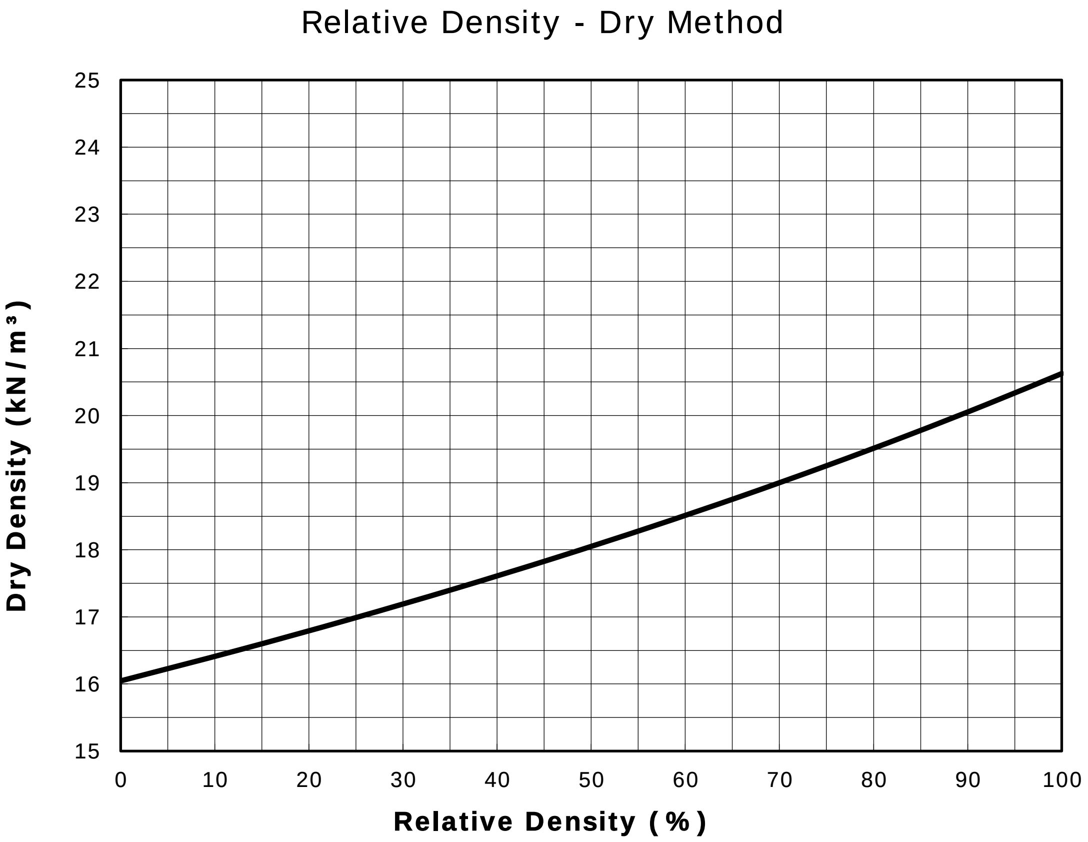


Minimum Density		15.34	kN/m³
Maximum Density	Dry Method	20.34	kN/m³
	Wet Method	---	kN/m³

Notes: Only Dry Method performed.

Client:	Golder Associates
Project Name:	Darlington New Nuclear Plant Phase II
Project Location:	Ontario, Canada
GTX #:	316444
Test Date:	12/09/22
Tested By:	lam
Checked By:	as
Boring ID:	BH24
Sample ID:	21, 22 / RD-2
Depth:	---
Description:	Moist, dark gray sandy silt

Relative Density Test by ASTM D4253/D4254

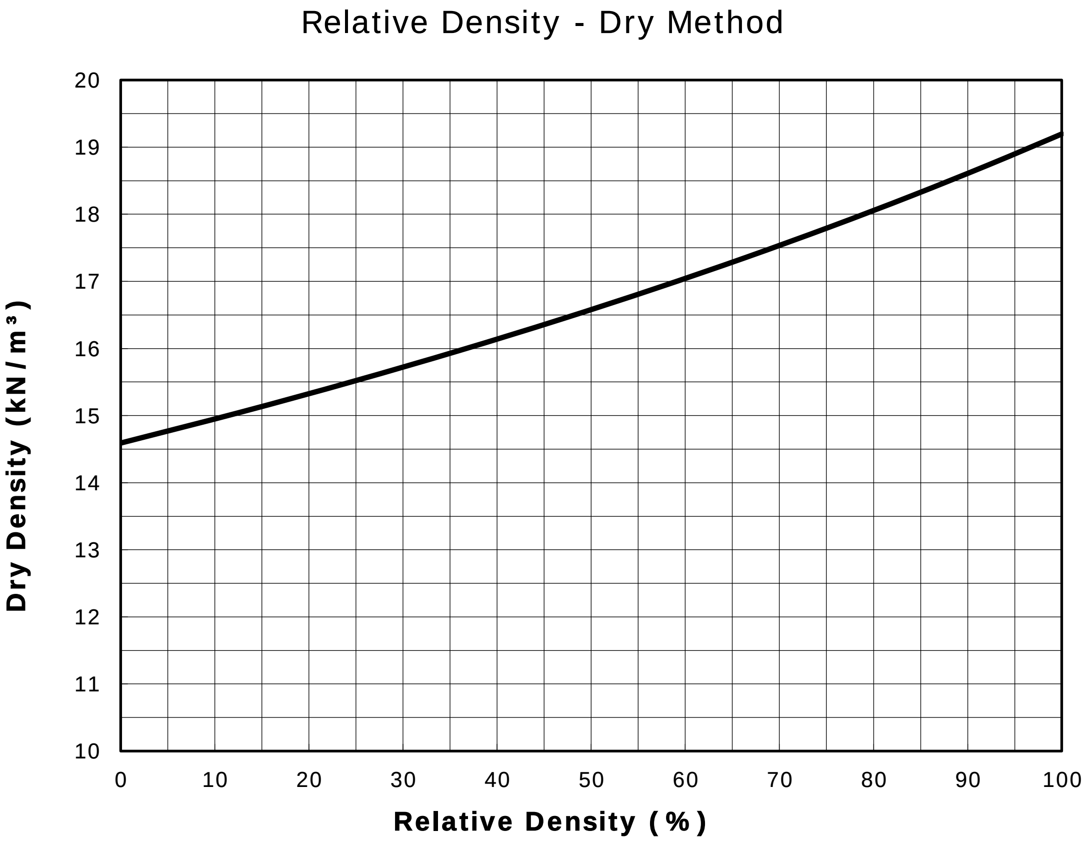


Minimum Density		16.05	kN/m³
Maximum Density	Dry Method	20.63	kN/m³
	Wet Method	---	kN/m³

Notes: Only Dry Method performed.

Client:	Golder Associates
Project Name:	Darlington New Nuclear Plant Phase II
Project Location:	Ontario, Canada
GTX #:	316444
Test Date:	12/09/22
Tested By:	lam
Checked By:	as
Boring ID:	BH24
Sample ID:	27, 28 / RD-5
Depth:	---
Description:	Moist, dark gray sandy silt

Relative Density Test by ASTM D4253/D4254

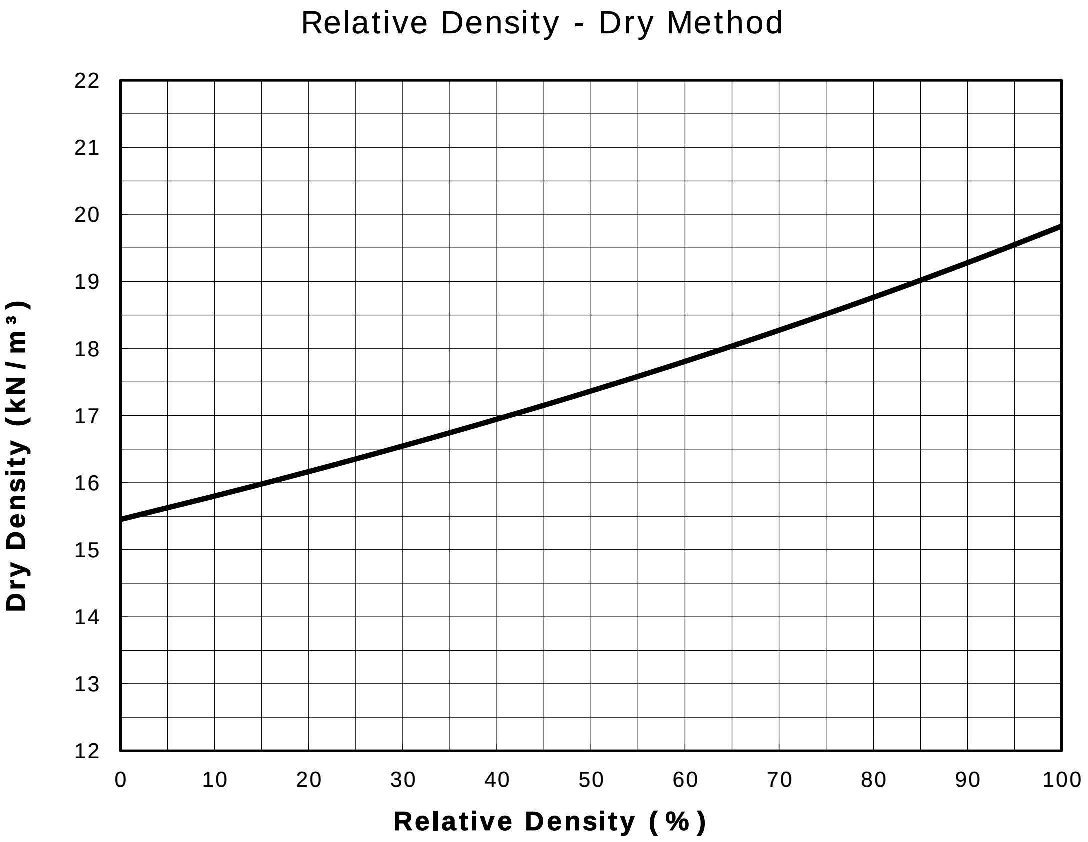


Minimum Density		14.59	kN/m³
Maximum Density	Dry Method	19.20	kN/m³
	Wet Method	---	kN/m³

Notes: Only Dry Method performed.

Client:	Golder Associates
Project Name:	Darlington New Nuclear Plant Phase II
Project Location:	Ontario, Canada
GTX #:	316444
Test Date:	12/13/22
Tested By:	lam
Checked By:	jsc
Boring ID:	BH24
Sample ID:	36
Depth:	70-72 ft
Description:	Moist, dark gray silty clay

Relative Density Test by ASTM D4253/D4254

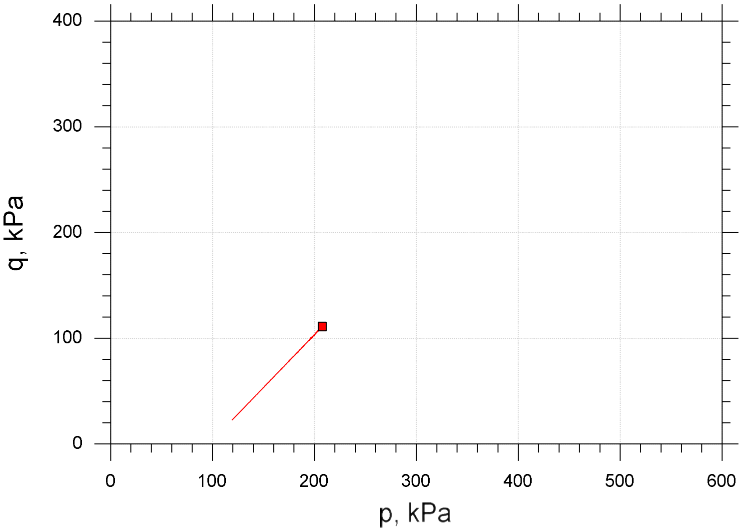


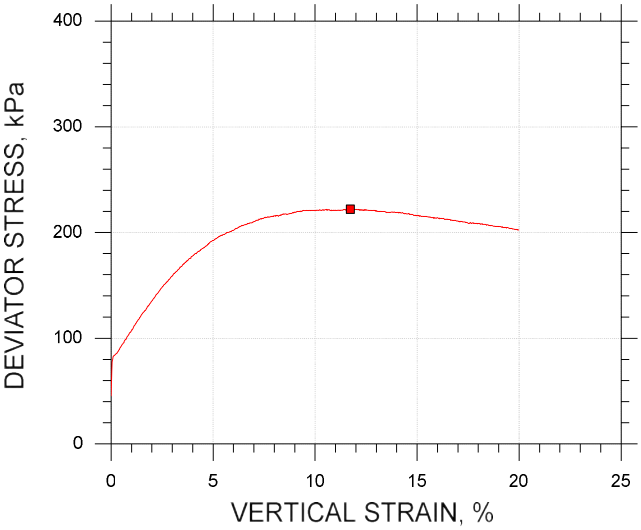
Minimum Density		15.45	kN/m³
Maximum Density	Dry Method	19.82	kN/m³
	Wet Method	---	kN/m³

Notes: Only Dry Method performed.

Client: WSP Canada Inc.	
Project Name: Darlington NNP Phase II	
Project Location: Ontario Canada	
Project Number: GTX-316444	
Tested By: trm	Checked By: njh
Boring ID: BH24	
Preparation: reconstituted	
Description: Moist, gray silty sand with gravel, (Greater than #4 sieve removed)	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.65

CONSOLIDATED DRAINED TRIAXIAL TEST - ANISOTROPIC CONSOLIDATION





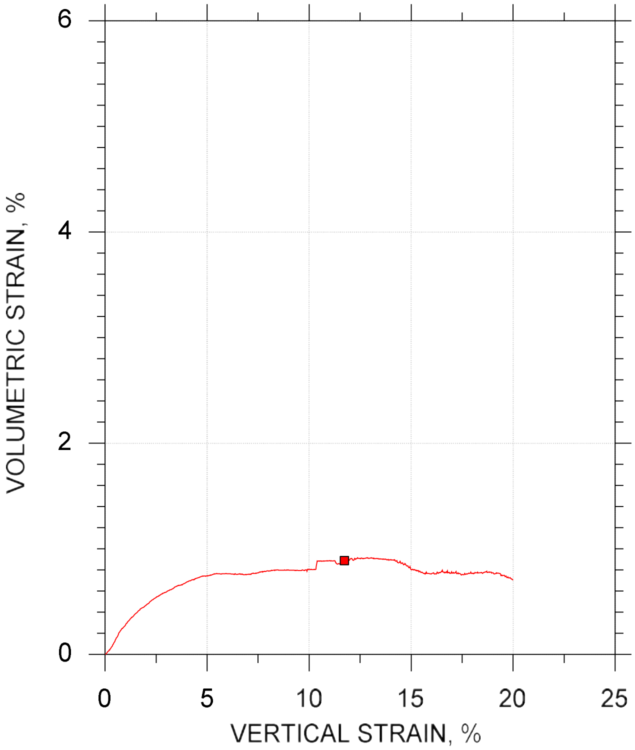
Symbol		🟥			
Sample ID		12			
Depth, ft		22-24'			
Test Number		CAD-1			
Initial	Height, cm	10.16			
	Diameter, cm	5.080			
	Moisture Content (from Cuttings), %	7.7			
	Dry Density, kN/m³	17.5			
	Saturation (Wet Method), %	41.7			
	Void Ratio	0.486			
Before Shear	Moisture Content, %	14.7			
	Dry Density, kN/m³	18.7			
	Cross-sectional Area (Method A), cm²	19.55			
	Saturation, %	100.0			
	Void Ratio	0.389			
	Back Pressure, kPa	1041.			
Vertical Effective Consolidation Stress, kPa		140.2			
Horizontal Effective Consolidation Stress, kPa		96.62			
Vertical Strain after Consolidation, %		2.585			
Volumetric Strain after Consolidation, %		4.935			
Time to 50% Consolidation, min		---			
Shear Strength, kPa		111.1			
Strain at Failure, %		11.7			
Strain Rate, %/min		0.01000			
Deviator Stress at Failure, kPa		222.2			
Effective Minor Principal Stress at Failure, kPa		96.12			
Effective Major Principal Stress at Failure, kPa		318.3			
B-Value		0.95			

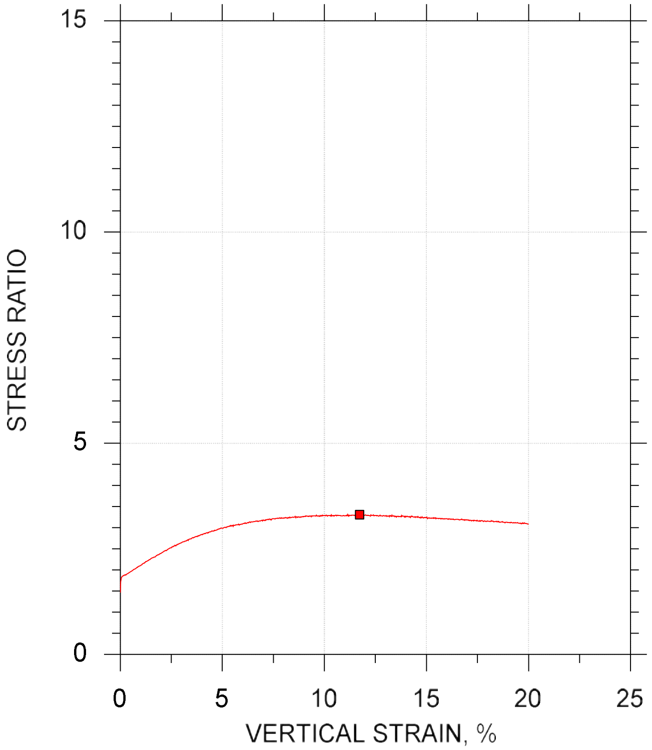
Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

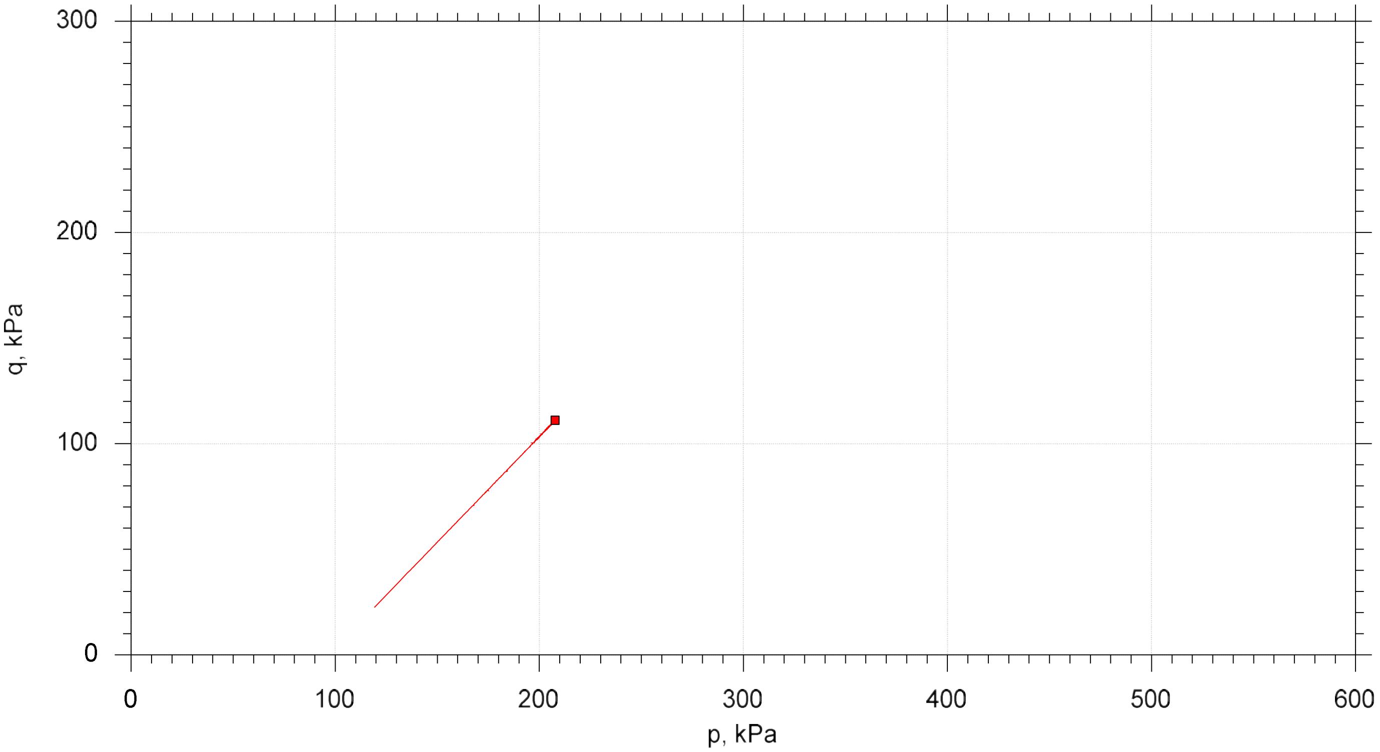
Remarks:

TX-007, Target Comp 17.44 kN/m3 at 8.0% mc. Final Diameters: 5.334 cm, 5.588 cm, 5.715 cm, 5.207 cm and 5.156 cm.

CONSOLIDATED DRAINED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION







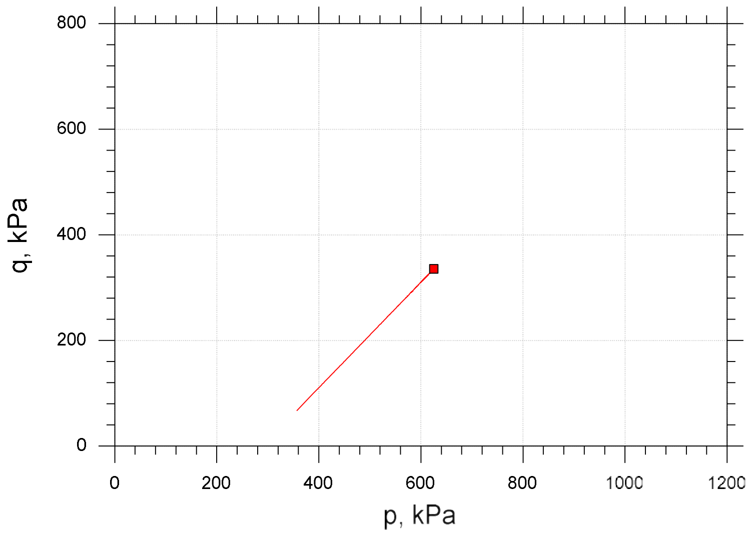
	Sample No	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
🟥	12	CAD-1	22-24'	trm	1/5/23	njh	1/16/23	316444-CAD-1n.dat

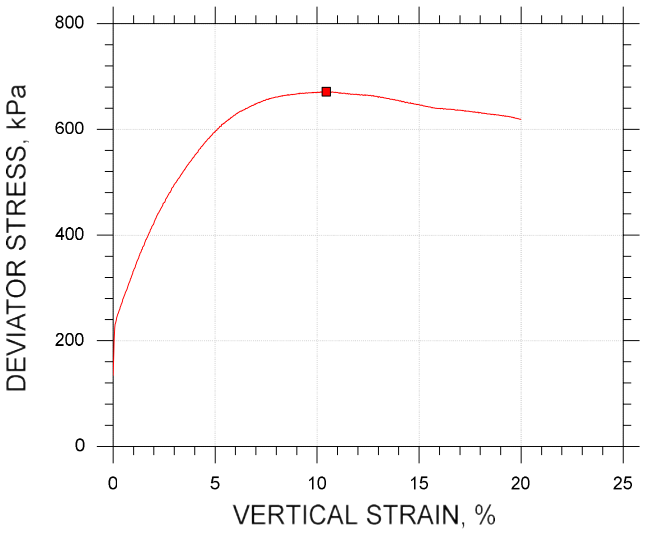
GeoTesting EXPRESS

Project: Darlington NNP Phase II	Location: Ontario Canada	Project No.: GTX-316444
Boring No.: BH24	Sample Type: reconstituted	
Description: Moist, gray silty sand with gravel, (Greater than #4 sieve removed)		
Remarks: TX-007, Target Comp 17.44 kN/m3 at 8.0% mc. Final Diameters: 5.334 cm, 5.588 cm, 5.715 cm, 5.207 cm and 5.156 cm.		

Client: WSP Canada Inc.
Project Name: Darlington NNP Phase II
Project Location: Ontario, Canada
Project Number: GTX-316444
Tested By: trm
Checked By: njh
Boring ID: BH24
Preparation: reconsituted
Description: Moist, gray silty sand with gravel, (Greater than #4 sieve removed)
Classification: ---
Group Symbol: ---
Liquid Limit: ---
Plastic Limit: ---
Plasticity Index: ---
Estimated Specific Gravity: 2.65

CONSOLIDATED DRAINED TRIAXIAL TEST - ANISOTROPIC CONSOLIDATION





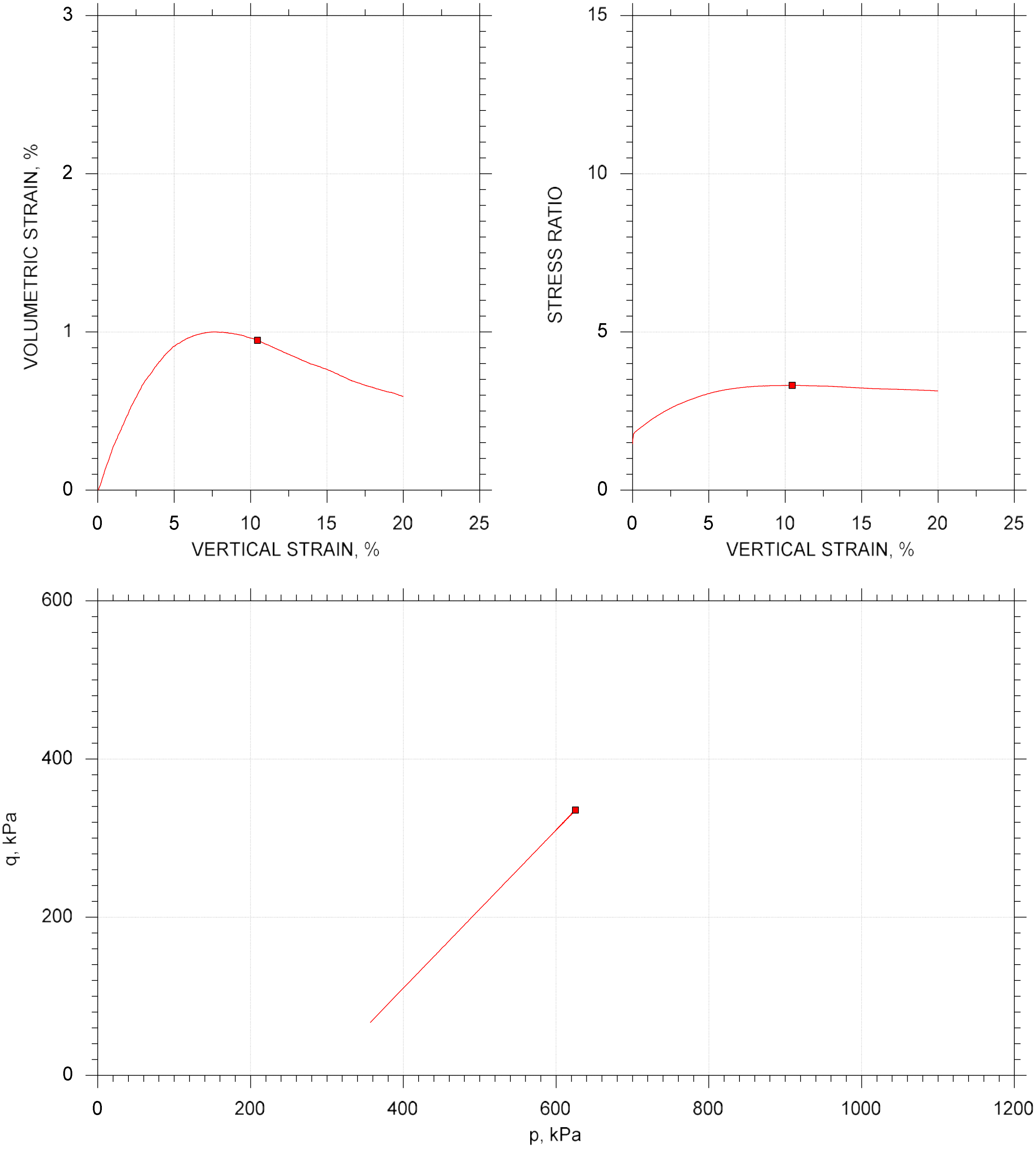
Symbol		🟥			
Sample ID		14			
Depth, ft		26-28'			
Test Number		CAD-2			
Initial	Height, cm	10.16			
	Diameter, cm	5.080			
	Moisture Content (from Cuttings), %	5.9			
	Dry Density, kN/m³	18.0			
	Saturation (Wet Method), %	35.0			
	Void Ratio	0.446			
Before Shear	Moisture Content, %	13.1			
	Dry Density, kN/m³	19.3			
	Cross-sectional Area (Method A), cm²	19.72			
	Saturation, %	100.0			
	Void Ratio	0.347			
	Back Pressure, kPa	406.9			
Vertical Effective Consolidation Stress, kPa		421.2			
Horizontal Effective Consolidation Stress, kPa		289.8			
Vertical Strain after Consolidation, %		4.120			
Volumetric Strain after Consolidation, %		6.521			
Time to 50% Consolidation, min		---			
Shear Strength, kPa		335.6			
Strain at Failure, %		10.5			
Strain Rate, %/min		0.01000			
Deviator Stress at Failure, kPa		671.3			
Effective Minor Principal Stress at Failure, kPa		289.8			
Effective Major Principal Stress at Failure, kPa		961.1			
B-Value		0.97			

Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

Remarks:

TX-019, Target Comp 20.34 kN/m3 at 8.0% mc. Final Diameters: 5.182 cm, 5.436 cm, 5.690 cm, 5.867 cm and 5.182 cm.

CONSOLIDATED DRAINED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION



	Sample No	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
🟥	14	CAD-2	26-28'	trm	1/5/23	njh	1/16/23	316444-CAD-2n.dat

GeoTesting EXPRESS

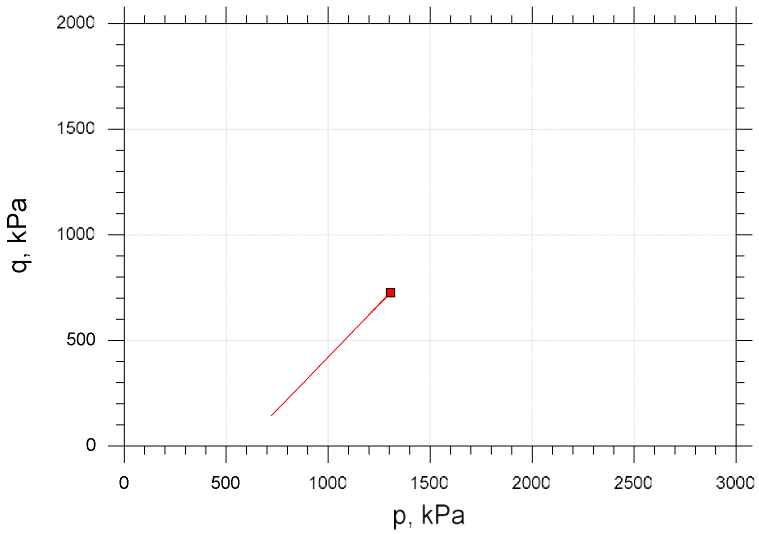
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Sample Type: reconsituted	

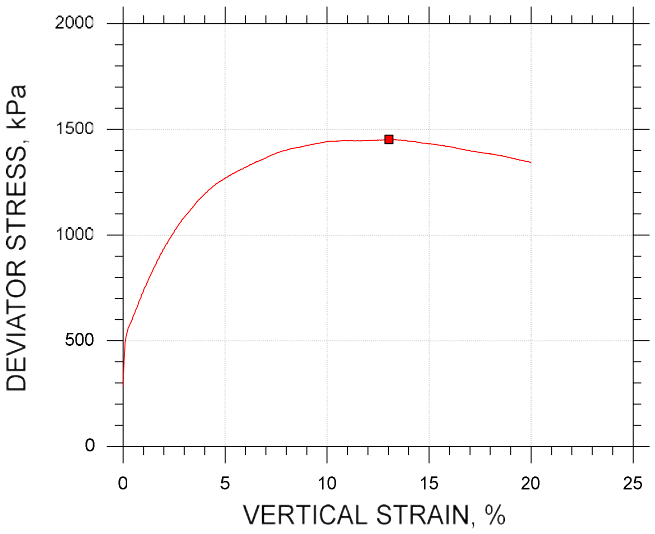
Description: Moist, gray silty sand with gravel, (Greater than #4 sieve removed)

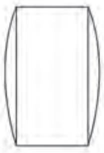
Remarks: TX-019, Target Comp 20.34 kN/m3 at 8.0% mc. Final Diameters: 5.182 cm, 5.436 cm, 5.690 cm, 5.867 cm and 5.182 cm.

Client: WSP Canada Inc.	
Project Name: Darlington NNP Phase II	
Project Location: Ontario Canada	
Project Number: GTX-316444	
Tested By: trm	Checked By: njh
Boring ID: BH24	
Preparation: reconsititued	
Description: Moist, gray silty sand with gravel, (Greater than #4 sieve removed)	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.65

CONSOLIDATED DRAINED TRIAXIAL TEST - ANISOTROPIC CONSOLIDATION

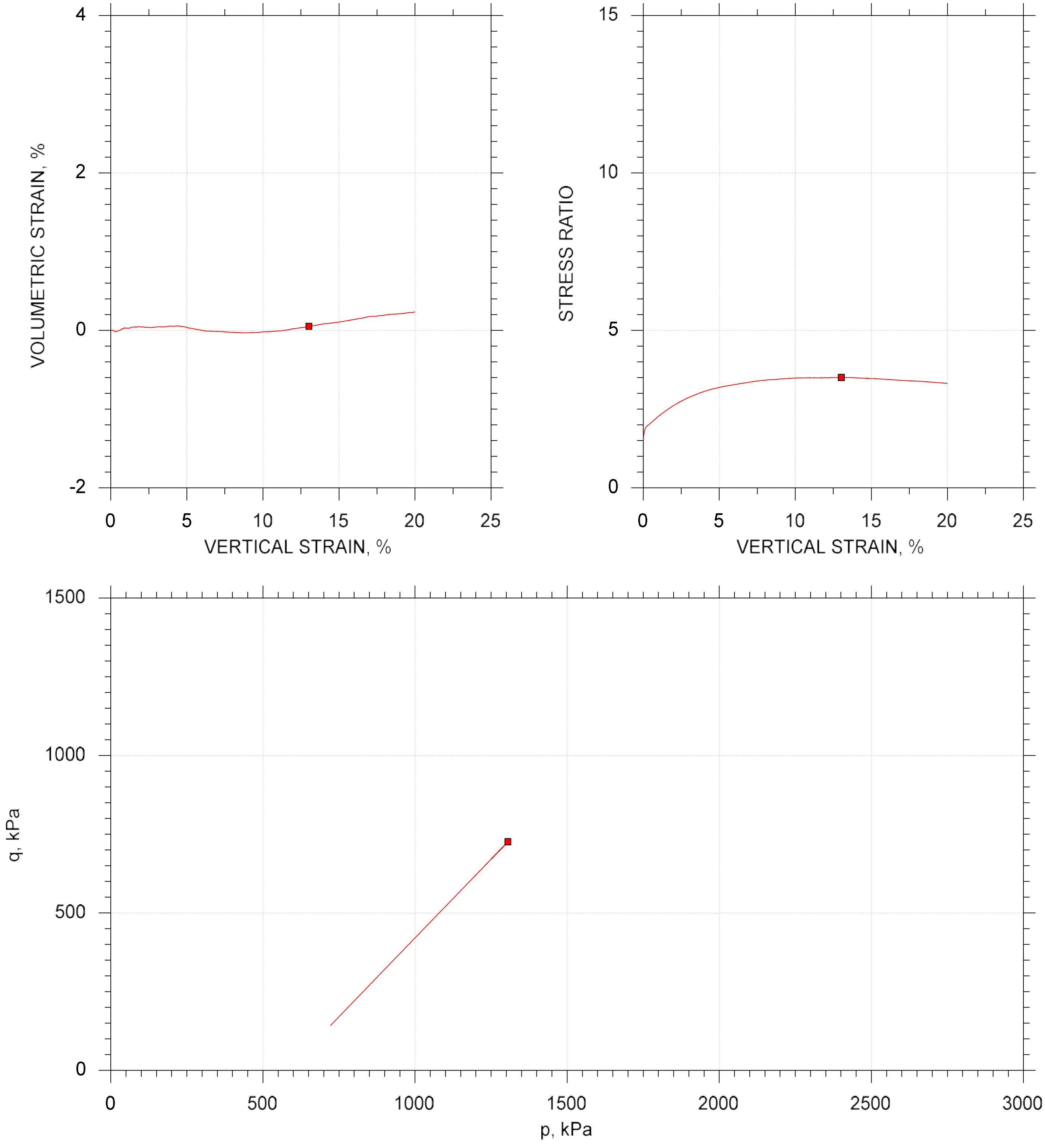




	Symbol	🟥			
	Sample ID	17			
	Depth, ft	32-34'			
	Test Number	CAD-3			
Initial	Height, cm	10.16			
	Diameter, cm	5.080			
	Moisture Content (from Cuttings), %	6.0			
	Dry Density, kN/m³	18.8			
	Saturation (Wet Method), %	41.7			
	Void Ratio	0.382			
Before Shear	Moisture Content, %	7.2			
	Dry Density, kN/m³	21.8			
	Cross-sectional Area (Method A), cm²	18.55			
	Saturation, %	100.0			
	Void Ratio	0.190			
	Back Pressure, kPa	517.0			
	Vertical Effective Consolidation Stress, kPa	861.2			
	Horizontal Effective Consolidation Stress, kPa	579.0			
	Vertical Strain after Consolidation, %	3.147			
	Volumetric Strain after Consolidation, %	5.786			
	Time to 50% Consolidation, min	---			
	Shear Strength, kPa	726.4			
	Strain at Failure, %	13.0			
	Strain Rate, %/min	0.01000			
	Deviator Stress at Failure, kPa	1453.			
	Effective Minor Principal Stress at Failure, kPa	579.1			
	Effective Major Principal Stress at Failure, kPa	2032.			
	B-Value	0.95			
	Notes: - Before Shear Saturation set to 100% for phase calculation. - Moisture Content determined by ASTM D2216. - Deviator Stress includes membrane correction. - Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions. Remarks:				

TX-033, Target Comp 20.34 kN/m3 at 8.0% mc. Final Diameters: 5.080 cm, 5.969 cm, 6.045 cm, 5.334 cm and 5.182 cm.

CONSOLIDATED DRAINED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION



	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
🟥	17	CAD-3	32-34'	trm	1/5/23	njh	1/16/23	316444-CAD-3n.dat

GeoTesting EXPRESS

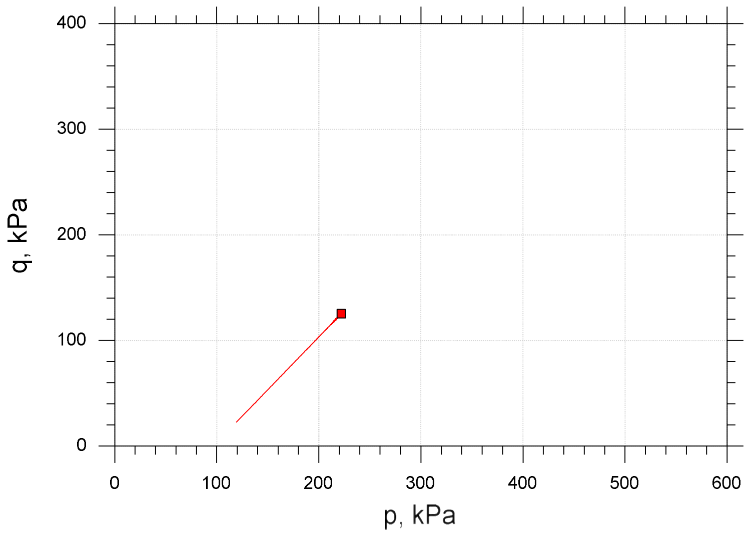
Project: Darlington NNP Phase II	Location: Ontario Canada	Project No.: GTX-316444
Boring No.: BH24	Sample Type: reconsitituted	

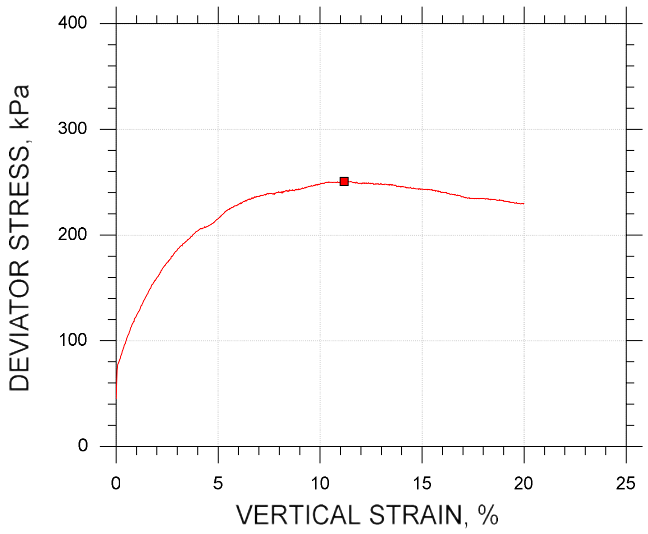
Description: Moist, gray silty sand with gravel, (Greater than #4 sieve removed)

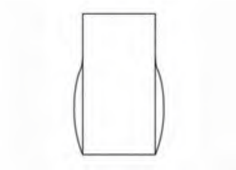
Remarks: TX-033, Target Comp 20.34 kN/m3 at 8.0% mc. Final Diameters: 5.080 cm, 5.969 cm, 6.045 cm, 5.334 cm and 5.182 cm.

Client: WSP Canada Inc.	
Project Name: Darlington NNP Phase II	
Project Location: Ontario, Canada	
Project Number: GTX- 316444	
Tested By: trm	Checked By: njh
Boring ID: BH24	
Preparation: reconstituted	
Description: Moist, gray silty sand with gravel, (Greater than #4 sieve removed)	
Classification: Silty SAND with Gravel	
Group Symbol: SM	
Liquid Limit: 13	Plastic Limit: 10
Plasticity Index: 3	Estimated Specific Gravity: 2.65

CONSOLIDATED DRAINED TRIAXIAL TEST - ANISOTROPIC CONSOLIDTION

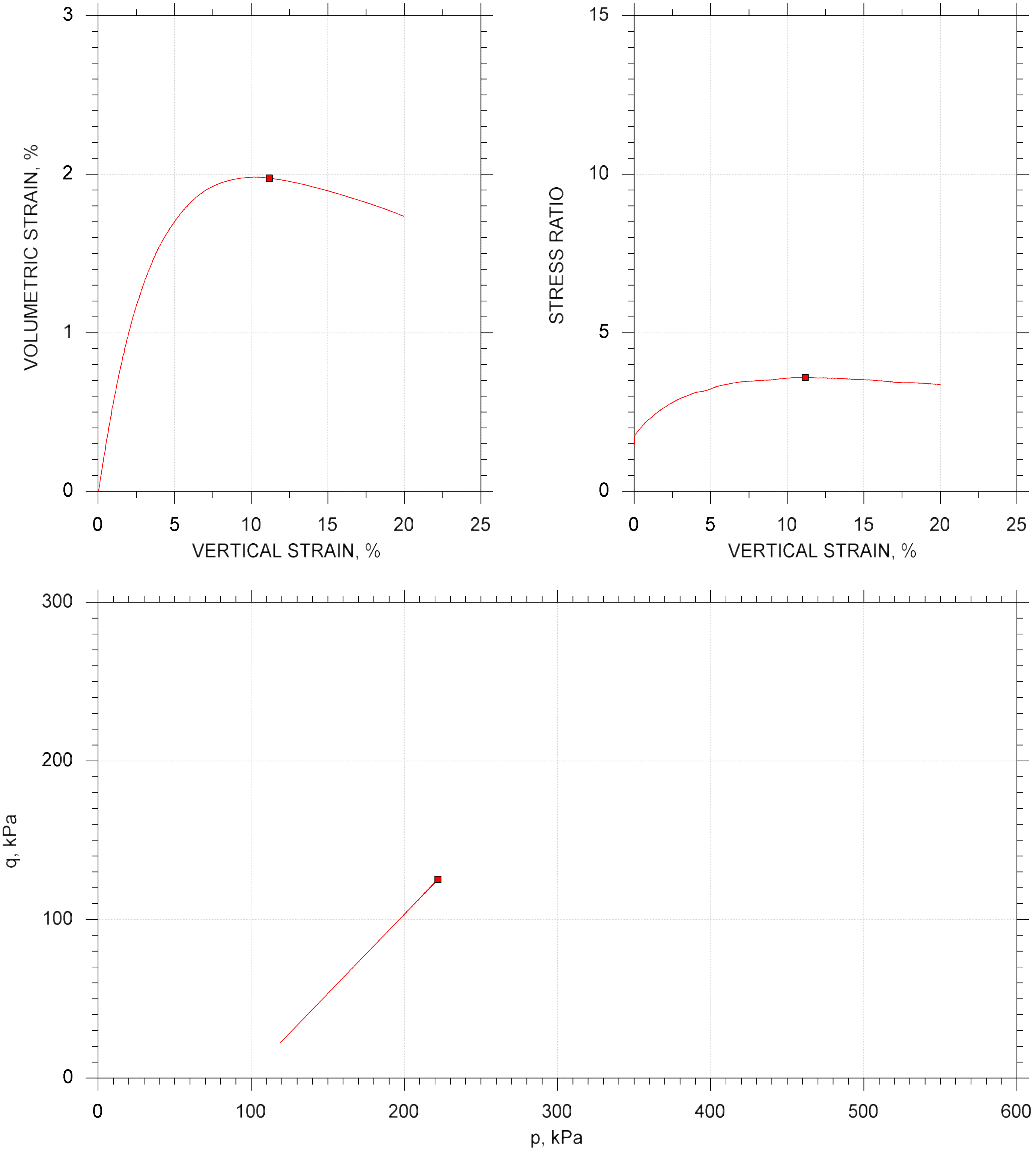




Symbol		🟥			
Sample ID		20			
Depth, ft		38-40'			
Test Number		CAD-4			
Initial	Height, cm	10.16			
	Diameter, cm	5.080			
	Moisture Content (from Cuttings), %	6.0			
	Dry Density, kN/m³	19.0			
	Saturation (Wet Method), %	43.6			
	Void Ratio	0.366			
Before Shear	Moisture Content, %	11.1			
	Dry Density, kN/m³	20.1			
	Cross-sectional Area (Method A), cm²	19.68			
	Saturation, %	100.0			
	Void Ratio	0.295			
	Back Pressure, kPa	1040			
Vertical Effective Consolidation Stress, kPa		140.4			
Horizontal Effective Consolidation Stress, kPa		96.65			
Vertical Strain after Consolidation, %		1.784			
Volumetric Strain after Consolidation, %		3.368			
Time to 50% Consolidation, min		---			
Shear Strength, kPa		125.3			
Strain at Failure, %		11.2			
Strain Rate, %/min		0.01000			
Deviator Stress at Failure, kPa		250.7			
Effective Minor Principal Stress at Failure, kPa		96.54			
Effective Major Principal Stress at Failure, kPa		347.2			
B-Value		0.98			
Notes: - Before Shear Saturation set to 100% for phase calculation. - Moisture Content determined by ASTM D2216. - Atterberg Limits determined by ASTM D4318. - Deviator Stress includes membrane correction. - Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions. Remarks:					

TX-010, Target Comp 20.63 kN/m3 at 7.0% mc. Final Diameters: 5.334 cm, 5.385 cm, 5.563 cm, 5.664 cm and 5.613 cm.

CONSOLIDATED DRAINED TRIAXIAL TEST
ANISOTROPIC CONSOLIDTION

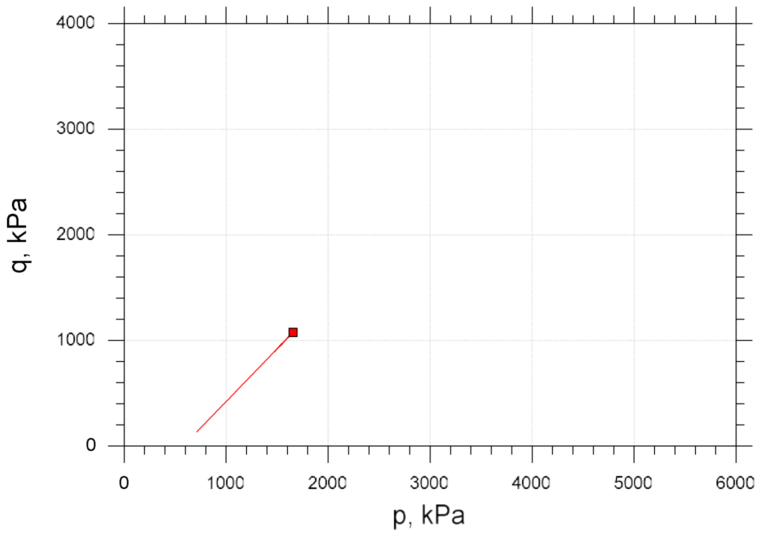


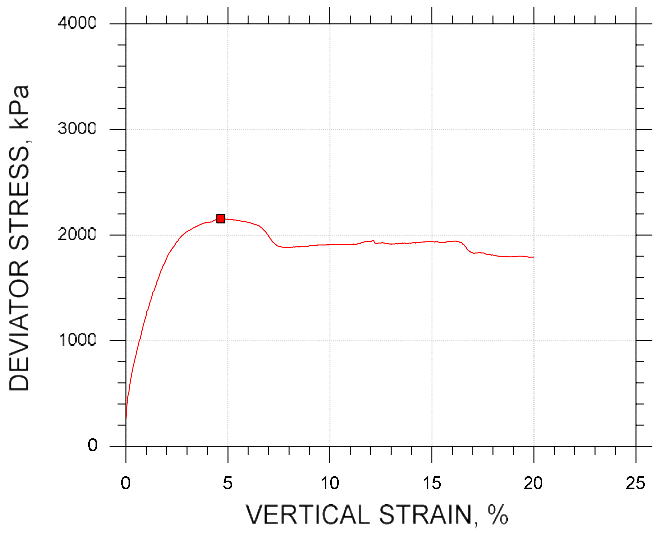
	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
🟥	20	CAD-4	38-40'	trm	1/5/23	njh	1/16/23	316444-CAD-4n.dat

Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX- 316444
Boring No.: BH24	Sample Type: reconstituted	
Description: Moist, gray silty sand with gravel, (Greater than #4 sieve removed)		
Remarks: TX-010, Target Comp 20.63 kN/m3 at 7.0% mc. Final Diameters: 5.334 cm, 5.385 cm, 5.563 cm, 5.664 cm and 5.613 cm.		

Client: WSP Canada Inc.	
Project Name: Darlington NNP Phase II	
Project Location: Ontario, Canada	
Project Number: GTX-316444	
Tested By: trm	Checked By: njh
Boring ID: BH24	
Preparation: reconstituted	
Description: Moist, gray silty sand with gravel, (Greater than #4 sieve removed)	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.65

CONSOLIDATED DRAINED TRIAXIAL TEST - ANISOTROPIC CONSOLIDATION

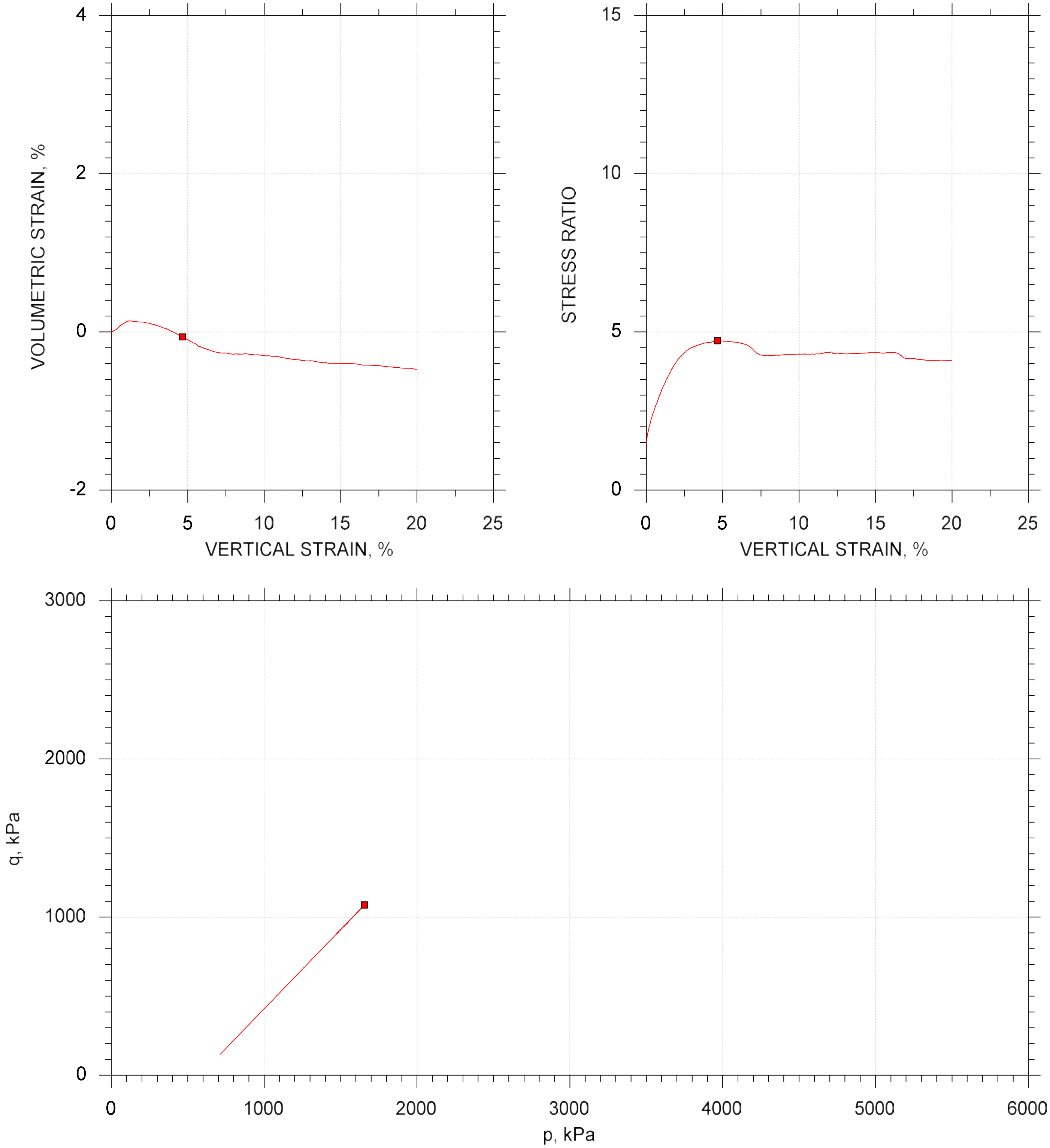




Symbol		🟥			
Sample ID		23			
Depth, ft		44-46'			
Test Number		CAD-5			
Initial	Height, cm	10.16			
	Diameter, cm	5.080			
	Moisture Content (from Cuttings), %	11.4			
	Dry Density, kN/m³	17.5			
	Saturation (Wet Method), %	62.3			
	Void Ratio	0.486			
Before Shear	Moisture Content, %	17.6			
	Dry Density, kN/m³	17.7			
	Cross-sectional Area (Method A), cm²	20.20			
	Saturation, %	100.0			
	Void Ratio	0.468			
	Back Pressure, kPa	834.2			
Vertical Effective Consolidation Stress, kPa		839.5			
Horizontal Effective Consolidation Stress, kPa		579.0			
Vertical Strain after Consolidation, %		0.8539			
Volumetric Strain after Consolidation, %		1.190			
Time to 50% Consolidation, min		---			
Shear Strength, kPa		1077.			
Strain at Failure, %		4.65			
Strain Rate, %/min		0.01000			
Deviator Stress at Failure, kPa		2154.			
Effective Minor Principal Stress at Failure, kPa		578.9			
Effective Major Principal Stress at Failure, kPa		2733.			
B-Value		0.95			
Notes: - Before Shear Saturation set to 100% for phase calculation. - Moisture Content determined by ASTM D2216. - Deviator Stress includes membrane correction. - Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions. Remarks:					

TX-016, Target Comp 20.63 kN/m3 at 13.0% mc. Final Diameters: 5.283 cm, 5.715 cm, 6.223 cm, 6.477 cm and 6.350 cm.

CONSOLIDATED DRAINED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION



	Sample No	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
🟥	23	CAD-5	44-46'	trm	1/6/23	njh	1/16/23	316444-CAD-5n.dat

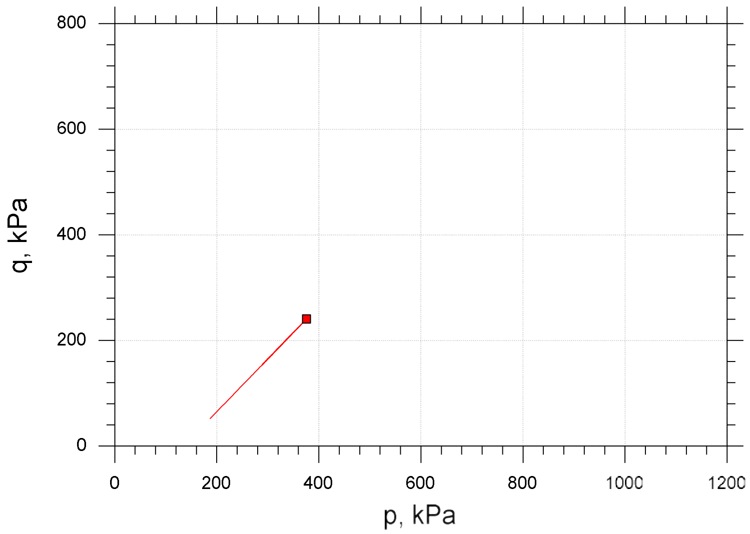
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Sample Type: reconstituted	

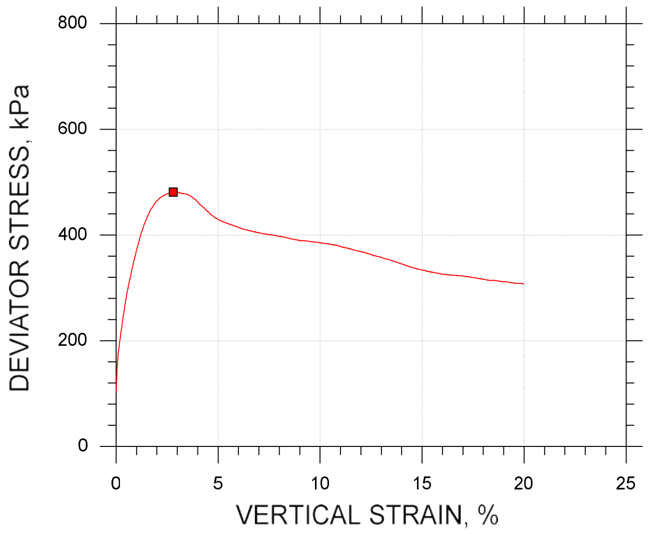
Description: Moist, gray silty sand with gravel, (Greater than #4 sieve removed)

Remarks: TX-016, Target Comp 20.63 kN/m3 at 13.0% mc. Final Diameters: 5.283 cm, 5.715 cm, 6.223 cm, 6.477 cm and 6.350 cm.

Client: WSP Canada Inc.	
Project Name: Darlington NNP Phase II	
Project Location: Ontario Canada	
Project Number: GTX-316444	
Tested By: trm	Checked By: njh
Boring ID: B24	
Preparation: reconstituted	
Description: Moist, gray silt with sand	
Classification: SILT with Sand	
Group Symbol: ML	
Liquid Limit: NP	Plastic Limit: NP
Plasticity Index: NP	Estimated Specific Gravity: 2.88

CONSOLIDATED DRAINED TRIAXIAL TEST - ANISOTROPIC CONSOLIDATION

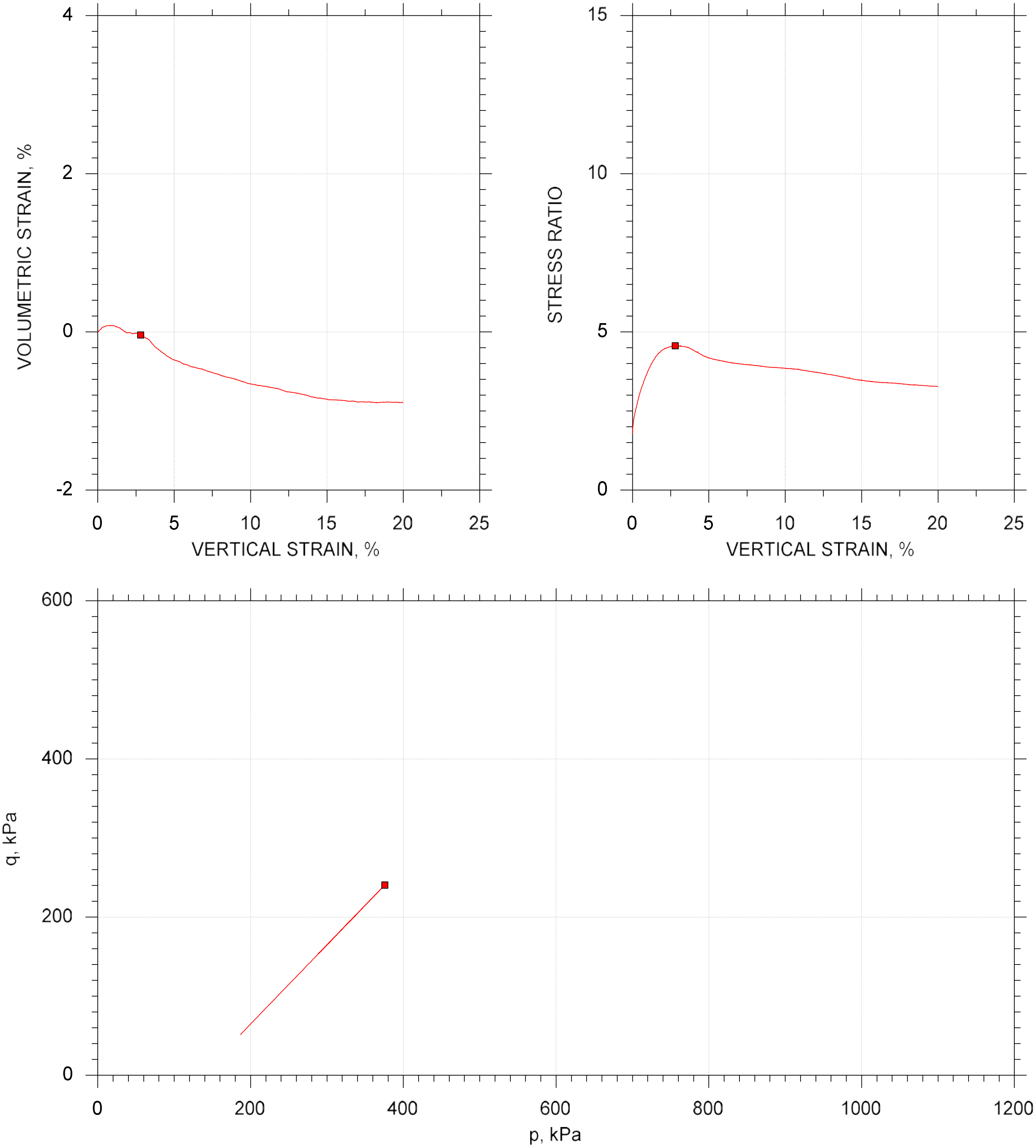




Symbol		🟥			
Sample ID		25			
Depth, ft		48-50'			
Test Number		CAD-11			
Initial	Height, cm	10.16			
	Diameter, cm	5.080			
	Moisture Content (from Cuttings), %	15.9			
	Dry Density, kN/m³	19.4			
	Saturation (Wet Method), %	99.9			
	Void Ratio	0.458			
Before Shear	Moisture Content, %	15.2			
	Dry Density, kN/m³	19.7			
	Cross-sectional Area (Method A), cm²	20.10			
	Saturation, %	100.0			
	Void Ratio	0.437			
	Back Pressure, kPa	902.2			
Vertical Effective Consolidation Stress, kPa		237.6			
Horizontal Effective Consolidation Stress, kPa		135.1			
Vertical Strain after Consolidation, %		0.4589			
Volumetric Strain after Consolidation, %		1.110			
Time to 50% Consolidation, min		---			
Shear Strength, kPa		240.6			
Strain at Failure, %		2.80			
Strain Rate, %/min		0.01000			
Deviator Stress at Failure, kPa		481.2			
Effective Minor Principal Stress at Failure, kPa		135.0			
Effective Major Principal Stress at Failure, kPa		616.1			
B-Value		0.99			
Notes: - Before Shear Saturation set to 100% for phase calculation. - Moisture Content determined by ASTM D2216. - Atterberg Limits determined by ASTM D4318. - Deviator Stress includes membrane correction. - Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions. Remarks:					

TX-007, Target Comp 19.20 kN/m3 at 17.0% mc. Final Diameters: 5.156 cm, 5.334 cm, 5.690 cm, 5.893 cm and 5.288 cm.

CONSOLIDATED DRAINED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION



	Sample No	Test No	Depth	Tested By	Test Date	Checked By	Check Date	Test File
🟥	25	CAD-11	48-50'	trm	1/9/23	njh	1/16/23	316444-CAD-11n.dat

GeoTesting EXPRESS

Project: Darlington NNP Phase II | Location: Ontario Canada | Project No.: GTX-316444

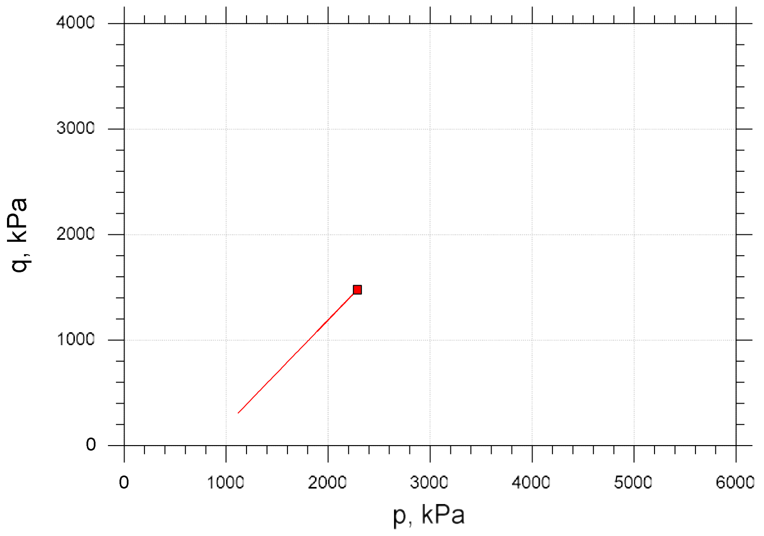
Boring No.: B24 | Sample Type: reconstituted

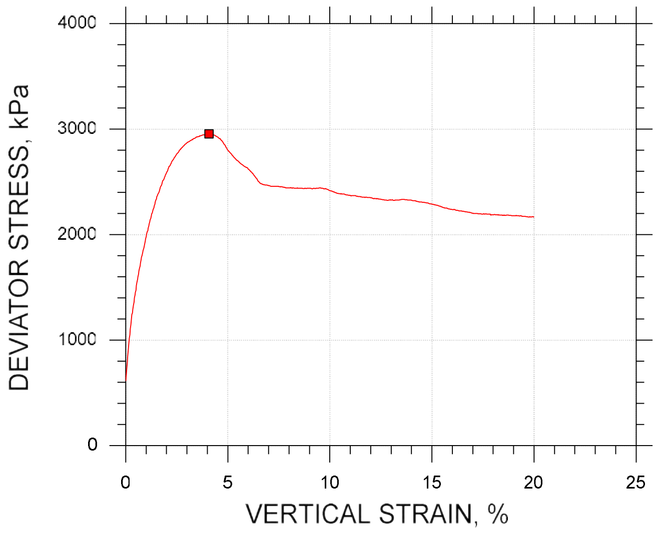
Description: Moist, gray silt with sand

Remarks: TX-007, Target Comp 19.20 kN/m3 at 17.0% mc. Final Diameters: 5.156 cm, 5.334 cm, 5.690 cm, 5.893 cm and 5.288 cm.

Client: WSP Canada Inc.	
Project Name: Darlington NNP Phase II	
Project Location: Ontario, Canada	
Project Number: GTX-316444	
Tested By: trm	Checked By: njh
Boring ID: BH24	
Preparation: reconstituted	
Description: Moist, gray silty sand	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.85

CONSOLIDATED DRAINED TRIAXIAL TEST - ANISOTROPIC CONSOLIDATION

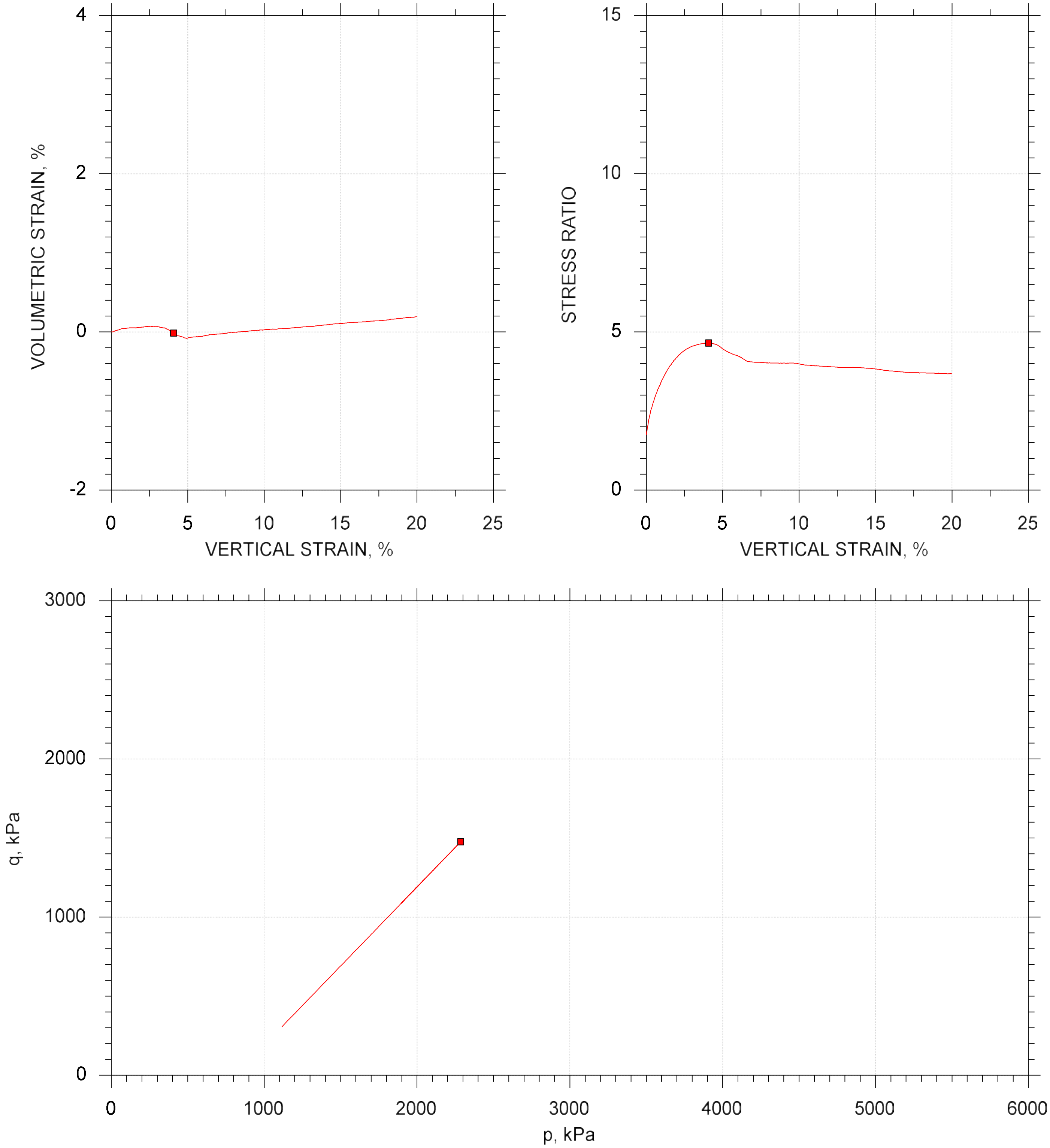




Symbol		🟥			
Sample ID		27			
Depth, ft		63-65'			
Test Number		CAD-12R			
Initial	Height, cm	10.16			
	Diameter, cm	5.080			
	Moisture Content (from Cuttings), %	15.7			
	Dry Density, kN/m³	19.3			
	Saturation (Wet Method), %	100.0			
	Void Ratio	0.447			
Before Shear	Moisture Content, %	15.3			
	Dry Density, kN/m³	19.5			
	Cross-sectional Area (Method A), cm²	20.23			
	Saturation, %	100.0			
	Void Ratio	0.435			
	Back Pressure, kPa	1040.			
Vertical Effective Consolidation Stress, kPa		1420.			
Horizontal Effective Consolidation Stress, kPa		808.9			
Vertical Strain after Consolidation, %		0.7959			
Volumetric Strain after Consolidation, %		1.324			
Time to 50% Consolidation, min		---			
Shear Strength, kPa		1477.			
Strain at Failure, %		4.08			
Strain Rate, %/min		0.01000			
Deviator Stress at Failure, kPa		2954.			
Effective Minor Principal Stress at Failure, kPa		808.9			
Effective Major Principal Stress at Failure, kPa		3763.			
B-Value		0.97			
Notes: - Before Shear Saturation set to 100% for phase calculation. - Moisture Content determined by ASTM D2216. - Deviator Stress includes membrane correction. - Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions. Remarks:					

TX-023, Target Comp 19.20 kN/m3 at 19.0% mc. Final Diameters: 5.080 cm, 5.309 cm, 5.563 cm, 5.842 cm and 5.944 cm.

CONSOLIDATED DRAINED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION

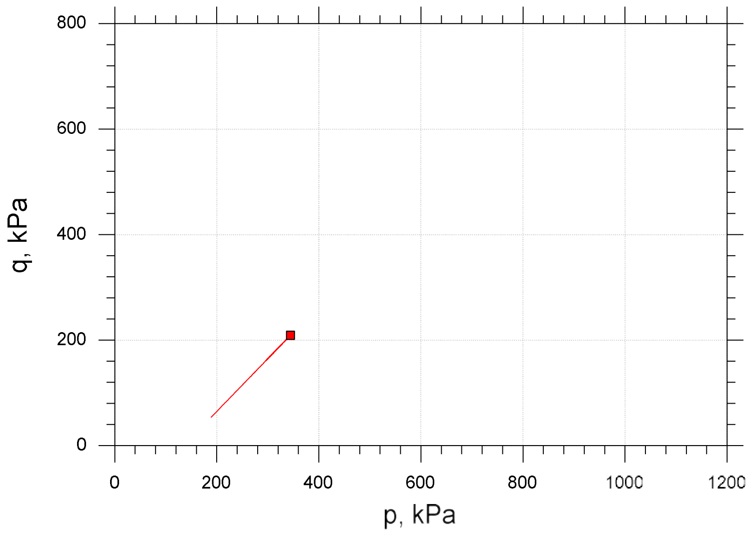


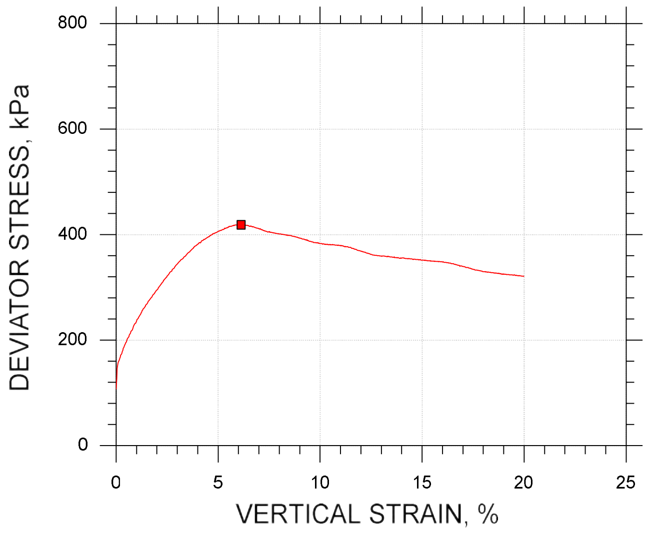
	Sample No	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
🟥	27	CAD-12R	63-65'	trm	1/23/23	njh	1/31/23	316444-CAD-12Rn.dat

Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Sample Type: reconstituted	
Description: Moist, gray silty sand		
Remarks: TX-023, Target Comp 19.20 kN/m3 at 19.0% mc. Final Diameters: 5.080 cm, 5.309 cm, 5.563 cm, 5.842 cm and 5.944 cm.		

Client: WSP Canada Inc.	
Project Name: Darlington NNP Phase II	
Project Location: Ontario, Canada	
Project Number: GTX-316444	
Tested By: trm	Checked By: njh
Boring ID: BH24	
Preparation: reconstituted	
Description: Moist, gray silty sand	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.75

CONSOLIDATED DRAINED TRIAXIAL TEST - ANISOTROPIC CONSOLIDATION

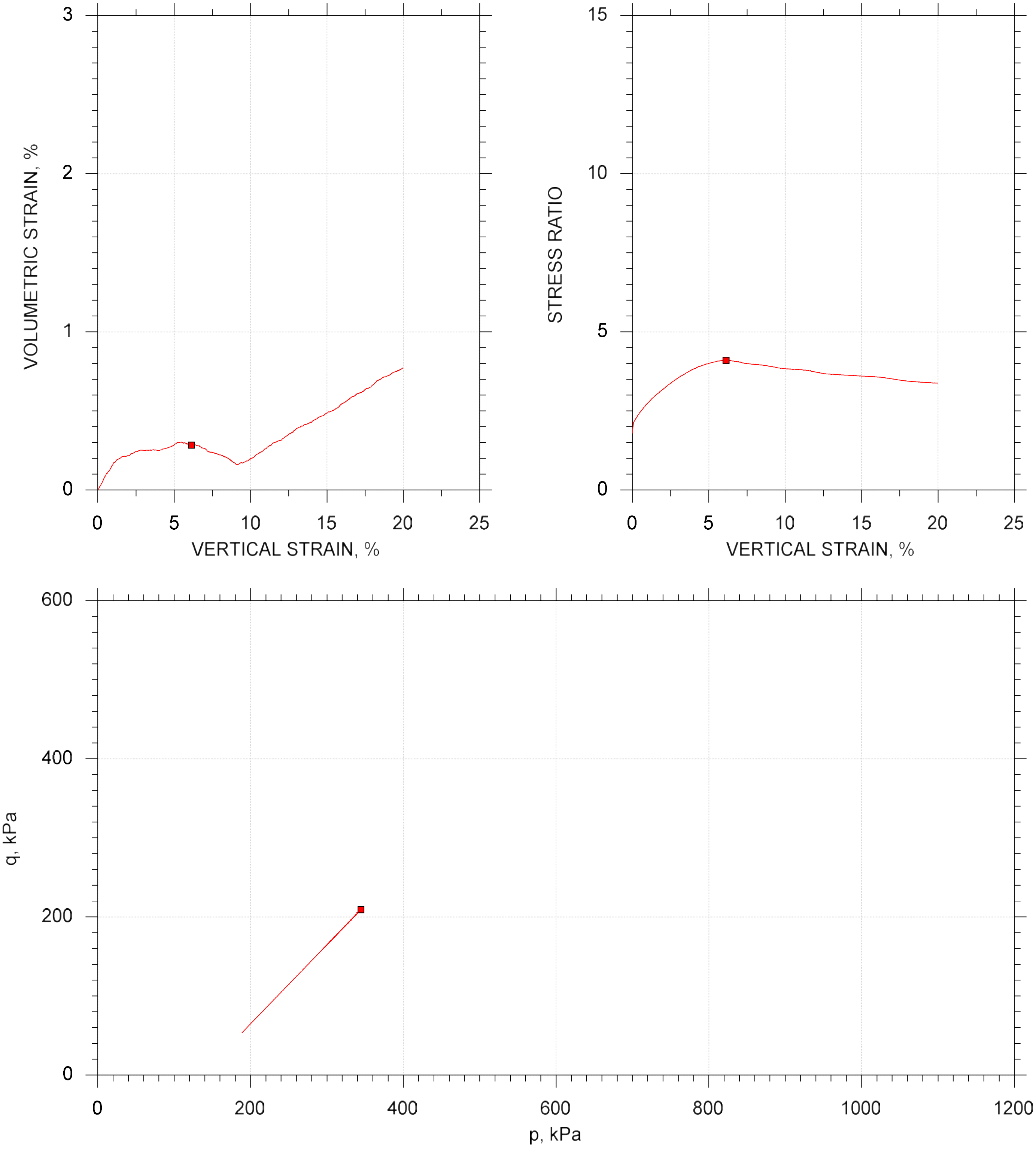




Symbol		🟥			
Sample ID		37			
Depth, ft		72-74'			
Test Number		CAD-13R			
Initial	Height, cm	10.16			
	Diameter, cm	5.080			
	Moisture Content (from Cuttings), %	18.1			
	Dry Density, kN/m³	18.0			
	Saturation (Wet Method), %	99.3			
	Void Ratio	0.502			
Before Shear	Moisture Content, %	14.4			
	Dry Density, kN/m³	19.3			
	Cross-sectional Area (Method A), cm²	19.46			
	Saturation, %	100.0			
	Void Ratio	0.397			
	Back Pressure, kPa	970.4			
Vertical Effective Consolidation Stress, kPa		240.7			
Horizontal Effective Consolidation Stress, kPa		135.1			
Vertical Strain after Consolidation, %		1.620			
Volumetric Strain after Consolidation, %		2.616			
Time to 50% Consolidation, min		---			
Shear Strength, kPa		209.3			
Strain at Failure, %		6.13			
Strain Rate, %/min		0.01000			
Deviator Stress at Failure, kPa		418.7			
Effective Minor Principal Stress at Failure, kPa		135.1			
Effective Major Principal Stress at Failure, kPa		553.8			
B-Value		1.00			
Notes: - Before Shear Saturation set to 100% for phase calculation. - Moisture Content determined by ASTM D2216. - Deviator Stress includes membrane correction. - Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions. Remarks:					

TX-009, Target Comp 19.20 kN/m3 at 22.0% mc. Final Diameters: 5.588 cm, 5.842 cm, 6.071 cm, 6.325 cm and 5.791 cm.

CONSOLIDATED DRAINED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION



	Sample No	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
🟥	37	CAD-13R	72-74'	trm	1/16/23	njh	1/25/23	316444-CAD-13Rn.dat

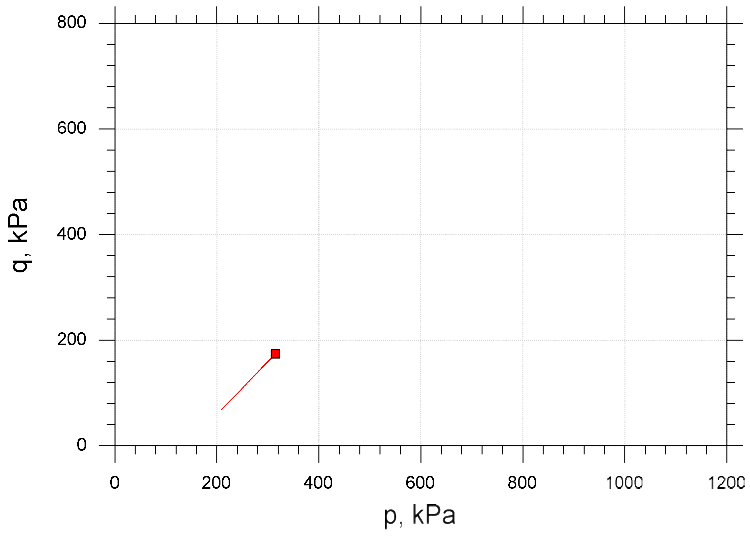
GeoTesting EXPRESS

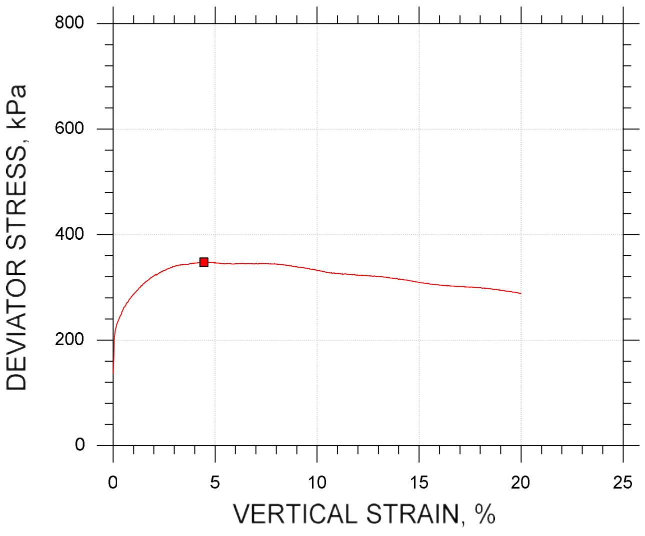
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Sample Type: reconstituted	
Description: Moist, gray silty sand		
Remarks: TX-009, Target Comp 19.20 kN/m3 at 22.0% mc. Final Diameters: 5.588 cm, 5.842 cm, 6.071 cm, 6.325 cm and 5.791 cm.		

GeoTesting
EXPRESS

Client: WSP Canada Inc.	
Project Name: Darlington NNP Phase II	
Project Location: Ontario, Canada	
Project Number: GTX-316444	
Tested By: trm	Checked By: njh
Boring ID: BH24	
Preparation: reconsituted	
Description: Moist, gray sandy clay	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.7

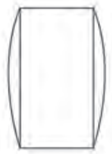
CONSOLIDATED DRAINED TRIAXIAL TEST - ANISOTROPIC CONSOLIDATION





Symbol		🟥			
Sample ID		34			
Depth, ft		66-68'			
Test Number		CAD-19			
Initial	Height, cm	11.43			
	Diameter, cm	5.080			
	Moisture Content (from Cuttings), %	9.5			
	Dry Density, kN/m³	17.7			
	Saturation (Wet Method), %	51.6			
	Void Ratio	0.497			
Before Shear	Moisture Content, %	15.1			
	Dry Density, kN/m³	18.8			
	Cross-sectional Area (Method A), cm²	21.83			
	Saturation, %	100.0			
	Void Ratio	0.408			
	Back Pressure, kPa	1041.			
Vertical Effective Consolidation Stress, kPa		269.1			
Horizontal Effective Consolidation Stress, kPa		140.6			
Vertical Strain after Consolidation, %		12.82			
Volumetric Strain after Consolidation, %		6.494			
Time to 50% Consolidation, min		---			
Shear Strength, kPa		173.9			
Strain at Failure, %		4.45			
Strain Rate, %/min		0.01000			
Deviator Stress at Failure, kPa		347.8			
Effective Minor Principal Stress at Failure, kPa		140.9			
Effective Major Principal Stress at Failure, kPa		488.7			
B-Value		0.96			

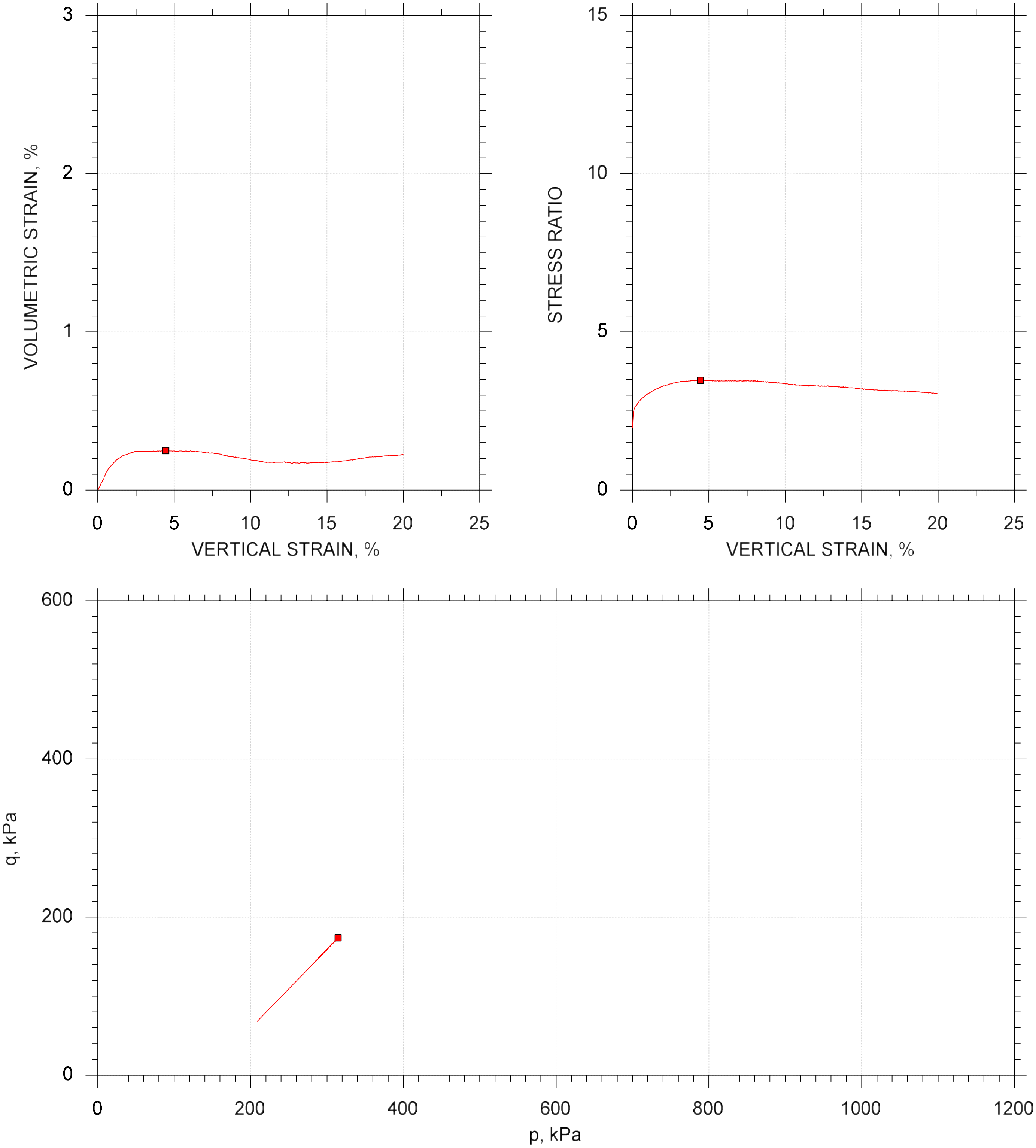
Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.



Remarks:

TX-019, Target Comp 19.82 kN/m3 at 10.0% mc. Final Diameters: 5.283 cm, 5.944 cm, 6.604 cm, 5.893 cm and 5.486 cm.

CONSOLIDATED DRAINED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION

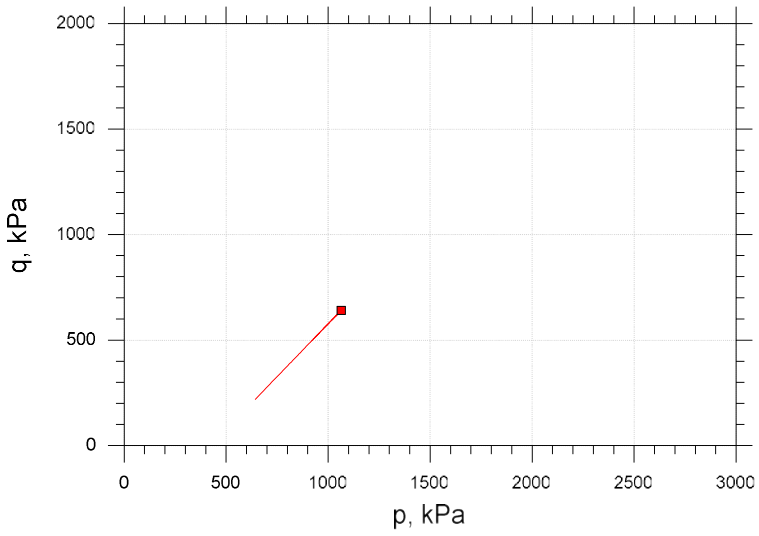


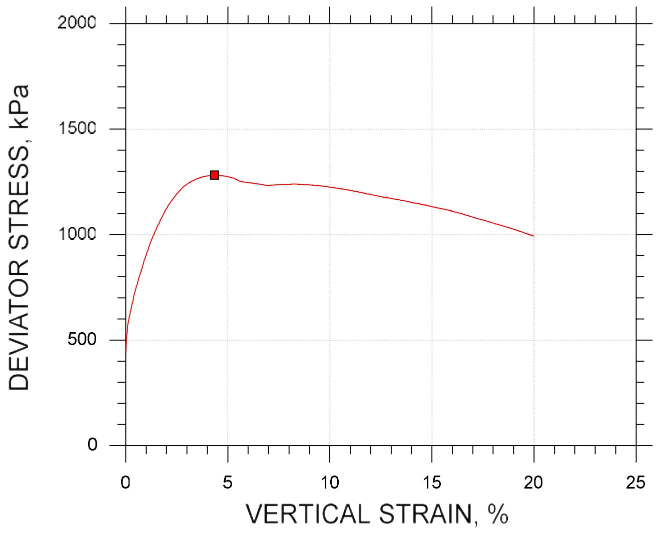
	Sample No	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
🟥	34	CAD-19	66-68'	trm	1/9/23	njh	1/16/23	316444-CAD-19n.dat

Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Sample Type: reconsituted	
Description: Moist, gray sandy clay		
Remarks: TX-019, Target Comp 19.82 kN/m3 at 10.0% mc. Final Diameters: 5.283 cm, 5.944 cm, 6.604 cm, 5.893 cm and 5.486 cm.		

Client: WSP Canada Inc.
Project Name: Darlington NNP Phase II
Project Location: Ontario, Canada
Project Number: GTX-316444
Tested By: trm
Checked By: njh
Boring ID: BH24
Preparation: reconstituted
Description: Moist, gray silt with sand
Classification: ---
Group Symbol: ---
Liquid Limit: ---
Plastic Limit: ---
Plasticity Index: ---
Estimated Specific Gravity: 2.65

CONSOLIDATED DRAINED TRIAXIAL TEST - ANISOTROPIC CONSOLIDATION





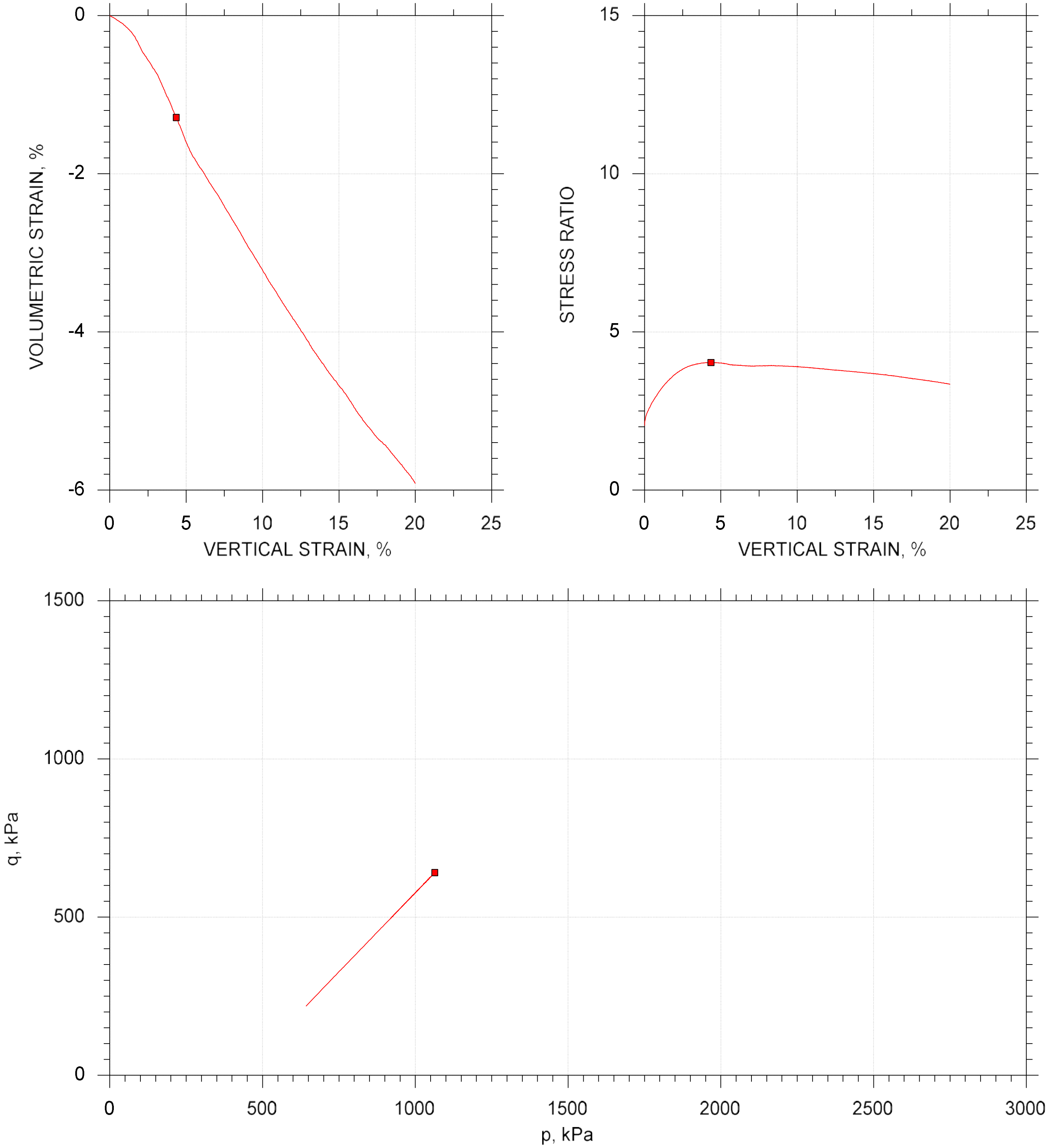
Symbol		🟥			
Sample ID		35			
Depth, ft		68-70'			
Test Number		CAD-20R			
Initial	Height, cm	10.16			
	Diameter, cm	5.080			
	Moisture Content (from Cuttings), %	11.0			
	Dry Density, kN/m³	19.6			
	Saturation (Wet Method), %	90.2			
	Void Ratio	0.324			
Before Shear	Moisture Content, %	11.9			
	Dry Density, kN/m³	19.8			
	Cross-sectional Area (Method A), cm²	20.34			
	Saturation, %	100.0			
	Void Ratio	0.316			
	Back Pressure, kPa	1174.			
Vertical Effective Consolidation Stress, kPa		860.2			
Horizontal Effective Consolidation Stress, kPa		422.9			
Vertical Strain after Consolidation, %		0.8401			
Volumetric Strain after Consolidation, %		0.2369			
Time to 50% Consolidation, min		---			
Shear Strength, kPa		641.0			
Strain at Failure, %		4.35			
Strain Rate, %/min		0.01000			
Deviator Stress at Failure, kPa		1282.			
Effective Minor Principal Stress at Failure, kPa		422.7			
Effective Major Principal Stress at Failure, kPa		1705.			
B-Value		1.00			

Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

Remarks:

TX-013, Target Comp 19.82 kN/m3 at 10.0% mc. Final Diameters: 5.588 cm, 5.842 cm, 6.045 cm, 6.172 cm and 5.867 cm.

CONSOLIDATED DRAINED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION



	Sample No	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
🟥	35	CAD-20R	68-70'	trm	1/20/23	njh	1/31/23	316444-CAD-20Rn.dat

GeoTesting EXPRESS

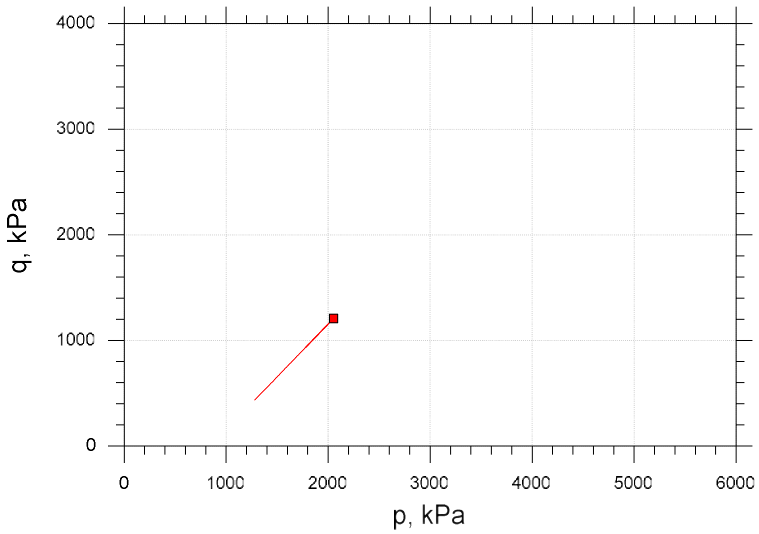
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Sample Type: reconstituted	

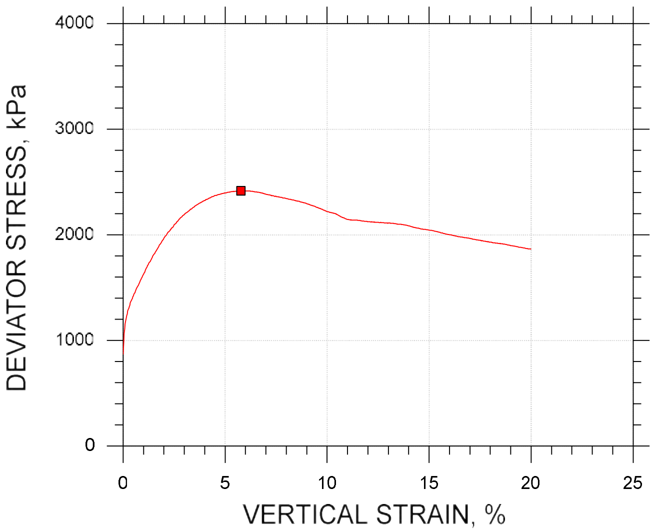
Description: Moist, gray silt with sand

Remarks: TX-013, Target Comp 19.82 kN/m3 at 10.0% mc. Final Diameters: 5.588 cm, 5.842 cm, 6.045 cm, 6.172 cm and 5.867 cm.

Client: WSP Canada Inc.	
Project Name: Darlington NNP Phase II	
Project Location: Ontario, Canada	
Project Number: GTX-316444	
Tested By: trm	Checked By: njh
Boring ID: BH24	
Preparation: reconstituted	
Description: Moist, gray silty clay with gravel	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.7

CONSOLIDATED DRAINED TRIAXIAL TEST - ANISOTROPIC CONSOLIDATION





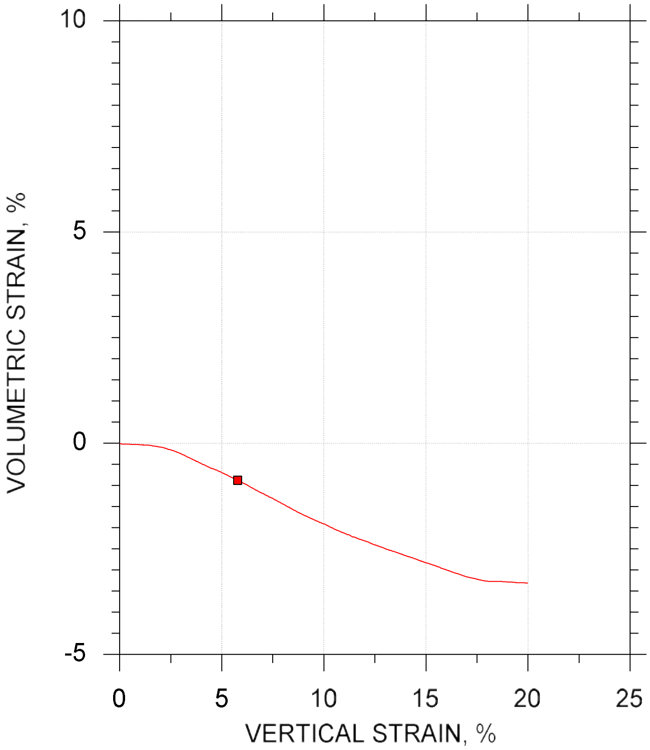
Symbol		🟥			
Sample ID		36			
Depth, ft		70-72'			
Test Number		CAD-21			
Initial	Height, cm	10.16			
	Diameter, cm	5.080			
	Moisture Content (from Cuttings), %	9.3			
	Dry Density, kN/m³	19.9			
	Saturation (Wet Method), %	76.3			
	Void Ratio	0.327			
Before Shear	Moisture Content, %	11.3			
	Dry Density, kN/m³	20.3			
	Cross-sectional Area (Method A), cm²	20.53			
	Saturation, %	100.0			
	Void Ratio	0.304			
	Back Pressure, kPa	1038.			
Vertical Effective Consolidation Stress, kPa		1711.			
Horizontal Effective Consolidation Stress, kPa		844.8			
Vertical Strain after Consolidation, %		2.512			
Volumetric Strain after Consolidation, %		0.3523			
Time to 50% Consolidation, min		---			
Shear Strength, kPa		1209.			
Strain at Failure, %		5.78			
Strain Rate, %/min		0.01000			
Deviator Stress at Failure, kPa		2417.			
Effective Minor Principal Stress at Failure, kPa		844.9			
Effective Major Principal Stress at Failure, kPa		3262.			
B-Value		0.97			

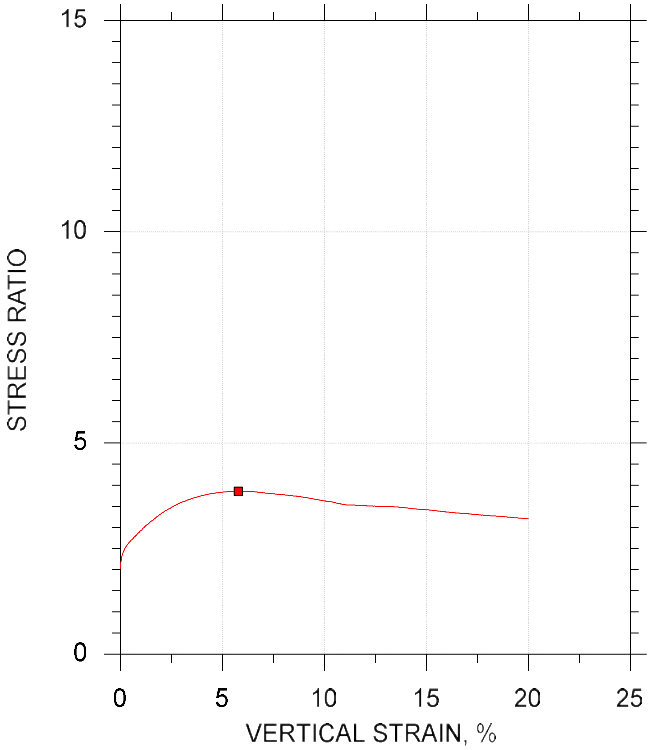
Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

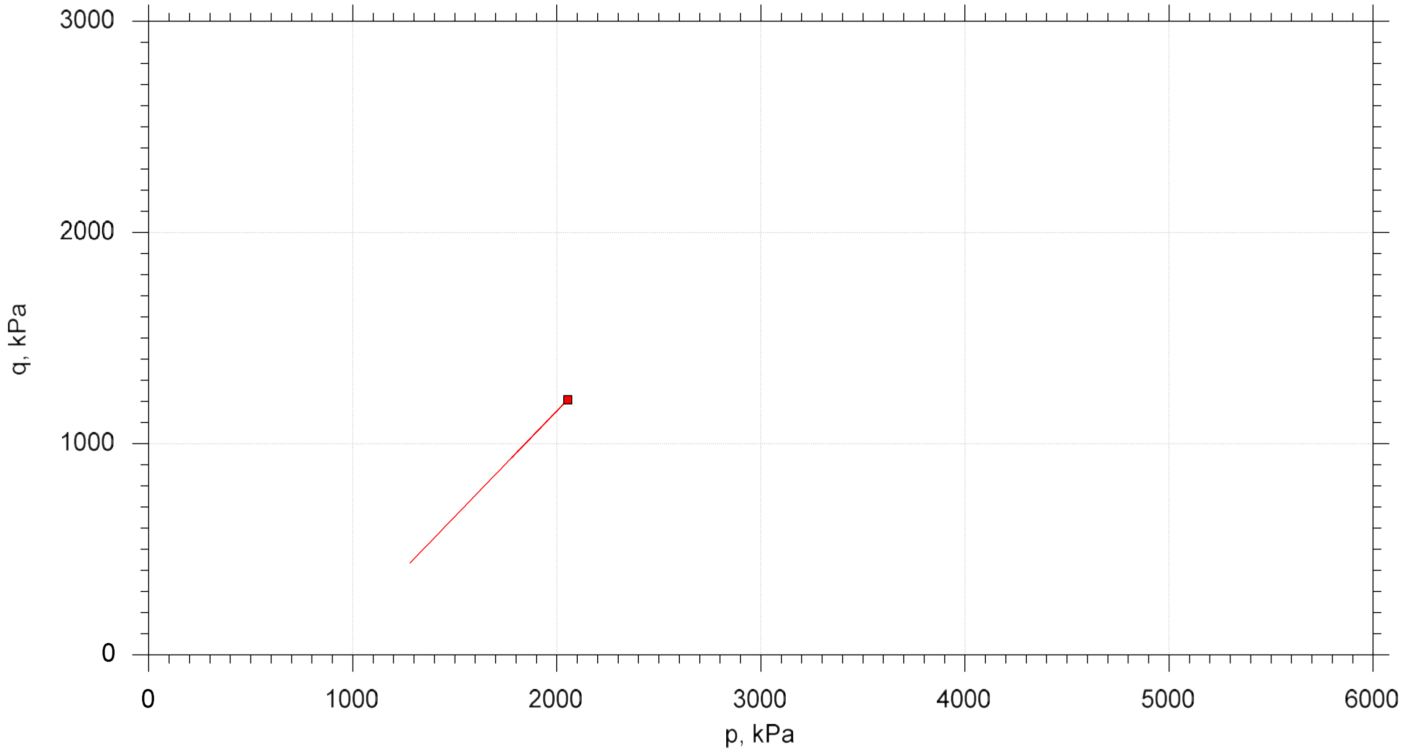
Remarks:

TX-013, Target Comp 19.82 kN/m3 at 10.0% mc. Final Diameters: 5.461 cm, 5.817 cm, 5.994 cm, 5.893 cm and 5.613 cm.

CONSOLIDATED DRAINED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION







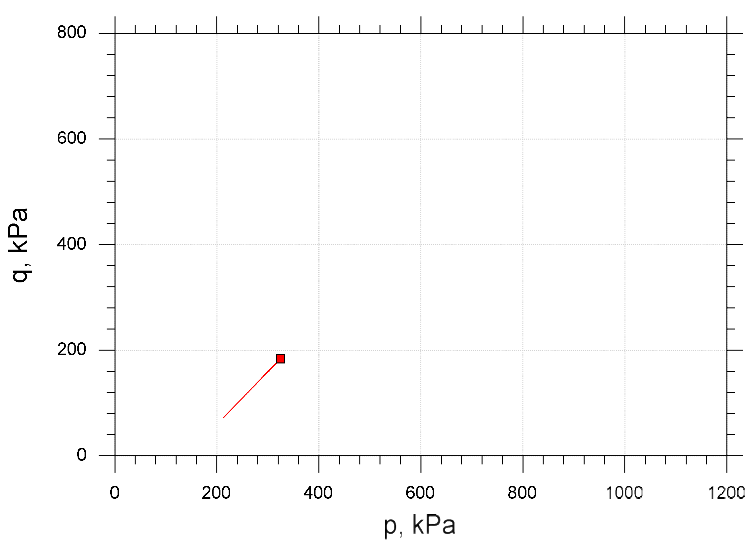
	Sample No	Test No	Depth	Tested By	Test Date	Checked By	Check Date	Test File
🟥	36	CAD-21	70-72'	trm	1/16/23	njh	1/25/23	316444-CAD-21n.dat

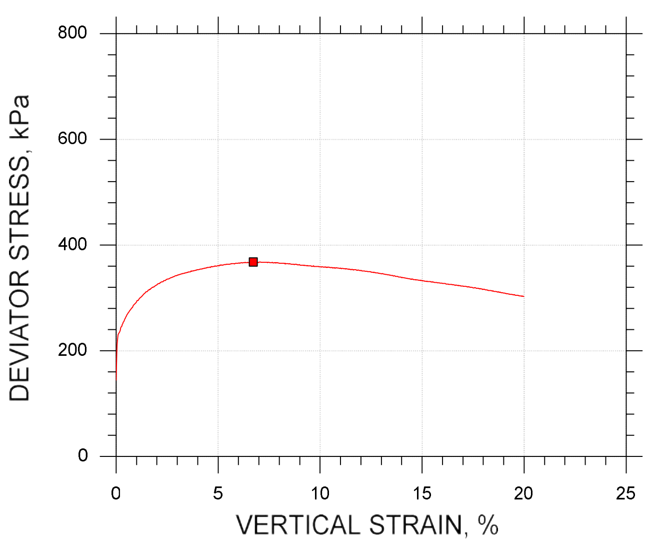
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Sample Type: reconstituted	

Description: Moist, gray silty clay with gravel
Remarks: TX-013, Target Comp 19.82 kN/m3 at 10.0% mc. Final Diameters: 5.461 cm, 5.817 cm, 5.994 cm, 5.893 cm and 5.613 cm.

Client: WSP Canada Inc.	
Project Name: Darlington NNP Phase II	
Project Location: Ontario, Canada	
Project Number: GTX-316444	
Tested By: trm	Checked By: njh
Boring ID: BH24	
Preparation: reconstituted	
Description: Moist, gray sandy clay	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.7

CONSOLIDATED DRAINED TRIAXIAL TEST - ANISOTROPIC CONSOLIDATION





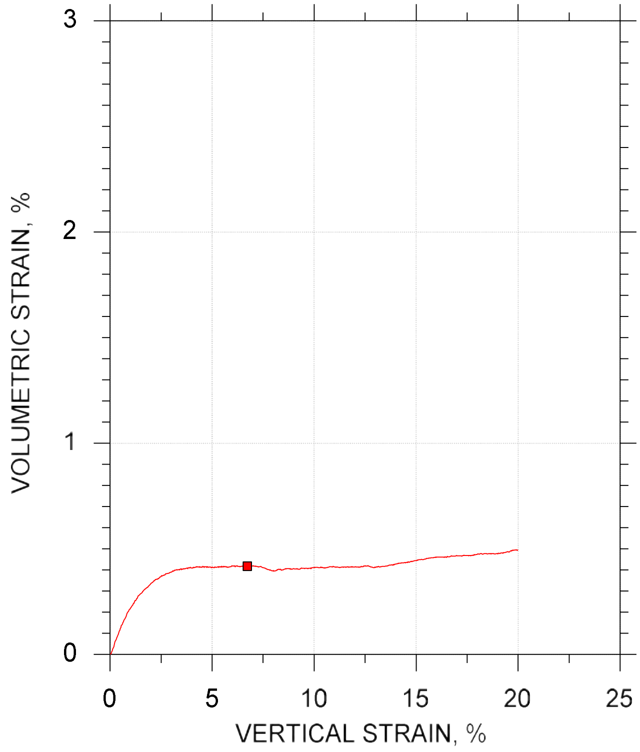
Symbol		🟥			
Sample ID		39A			
Depth, ft		76-76.83'			
Test Number		CAD-22			
Initial	Height, cm	10.16			
	Diameter, cm	5.080			
	Moisture Content (from Cuttings), %	6.9			
	Dry Density, kN/m³	20.4			
	Saturation (Wet Method), %	62.1			
	Void Ratio	0.298			
Before Shear	Moisture Content, %	9.3			
	Dry Density, kN/m³	21.1			
	Cross-sectional Area (Method A), cm²	20.66			
	Saturation, %	100.0			
	Void Ratio	0.252			
	Back Pressure, kPa	1041.			
Vertical Effective Consolidation Stress, kPa		281.3			
Horizontal Effective Consolidation Stress, kPa		140.8			
Vertical Strain after Consolidation, %		5.337			
Volumetric Strain after Consolidation, %		3.492			
Time to 50% Consolidation, min		---			
Shear Strength, kPa		183.9			
Strain at Failure, %		6.73			
Strain Rate, %/min		0.01000			
Deviator Stress at Failure, kPa		367.9			
Effective Minor Principal Stress at Failure, kPa		140.7			
Effective Major Principal Stress at Failure, kPa		508.6			
B-Value		0.95			

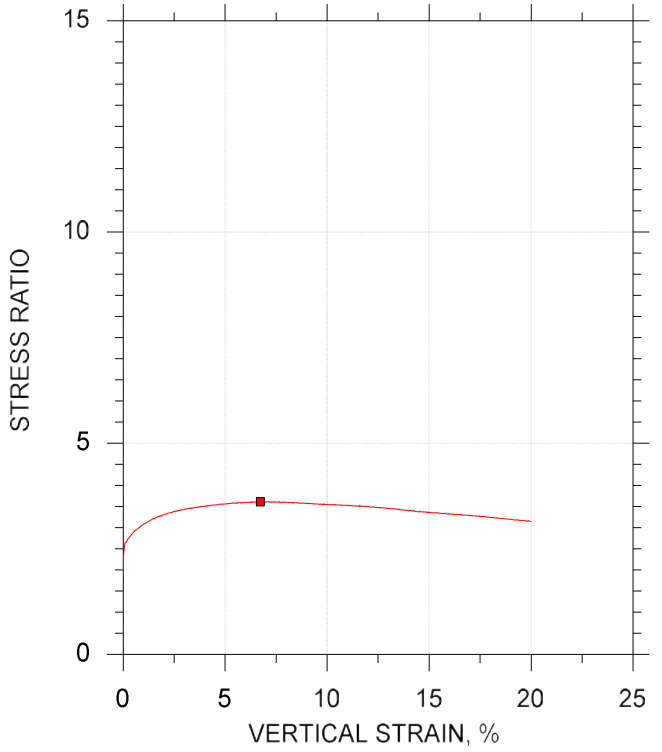
Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

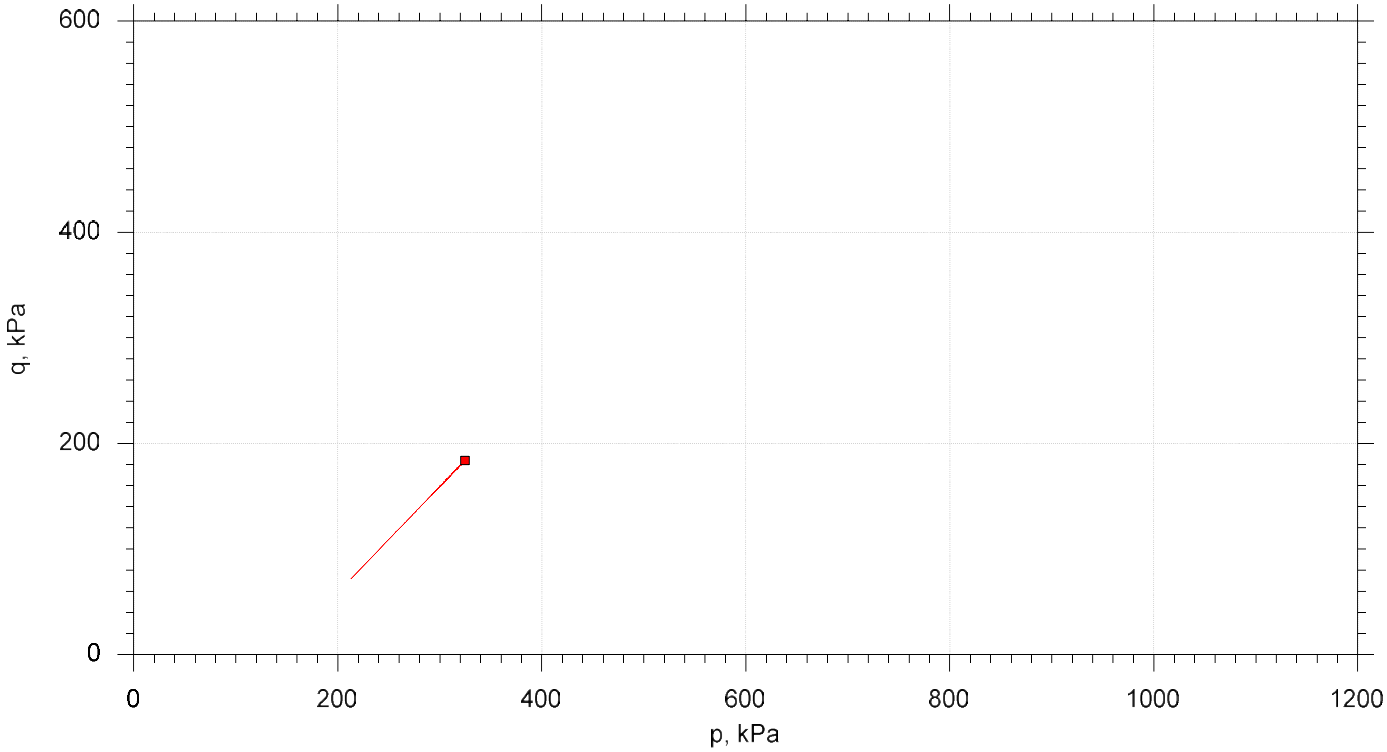
Remarks:

TX-024, Target Comp 19.82 kN/m3 at 10.0% mc. Final Diameters: 5.283 cm, 5.944 cm, 6.452 cm, 6.096 cm and 5.385 cm.

CONSOLIDATED DRAINED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION







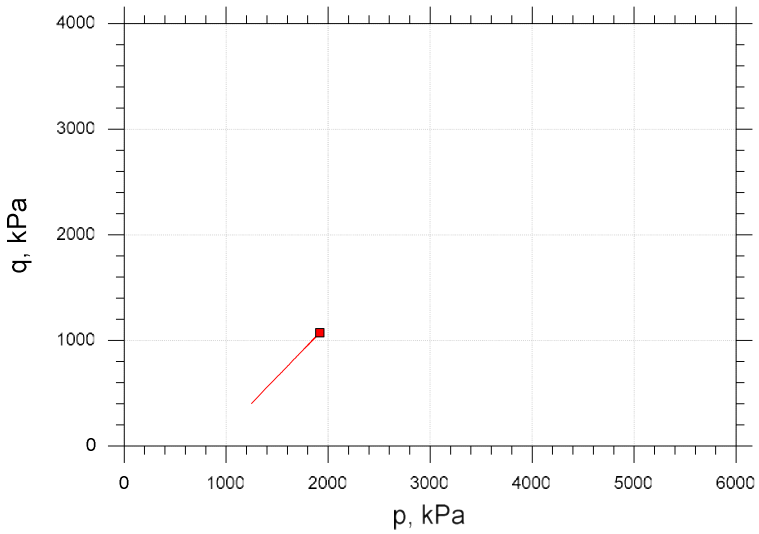
	Sample No	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
🟥	39A	CAD-22	76-76.83'	trm	1/9/23	njh	1/16/23	316444-CAD-22n.dat

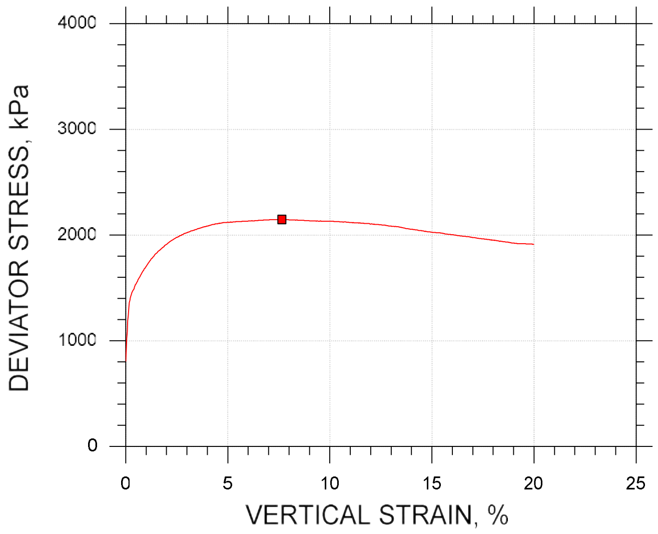
GeoTesting EXPRESS

Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Sample Type: reconstituted	
Description: Moist, gray sandy clay		
Remarks: TX-024, Target Comp 19.82 kN/m3 at 10.0% mc. Final Diameters: 5.283 cm, 5.944 cm, 6.452 cm, 6.096 cm and 5.385 cm.		

Client: WSP Canada Inc.	
Project Name: Darlington NNP Phase II	
Project Location: Ontario Canada	
Project Number: GTX-316444	
Tested By: trm	Checked By: njh
Boring ID: BH24	
Preparation: reconstituted	
Description: Moist, gray silty clay with gravel	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.7

CONSOLIDATED DRAINED TRIAXIAL TEST - ANISOTROPIC CONSOLIDATION

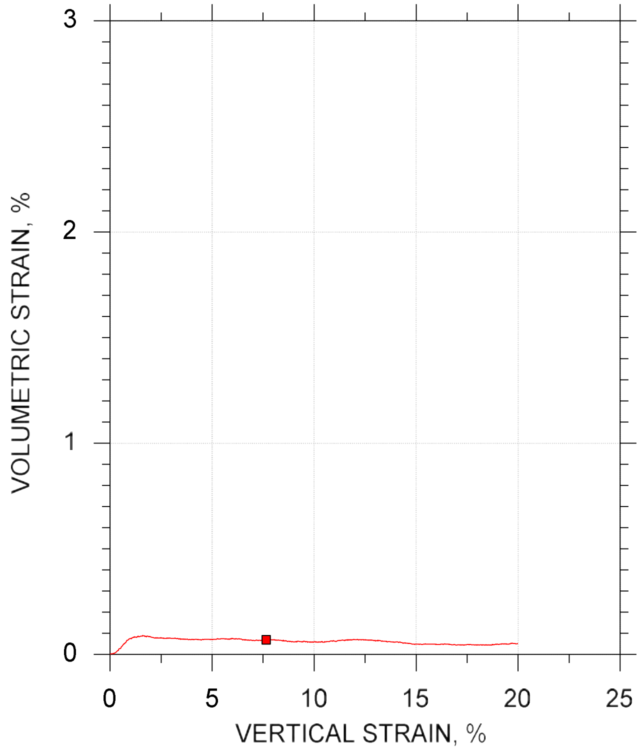


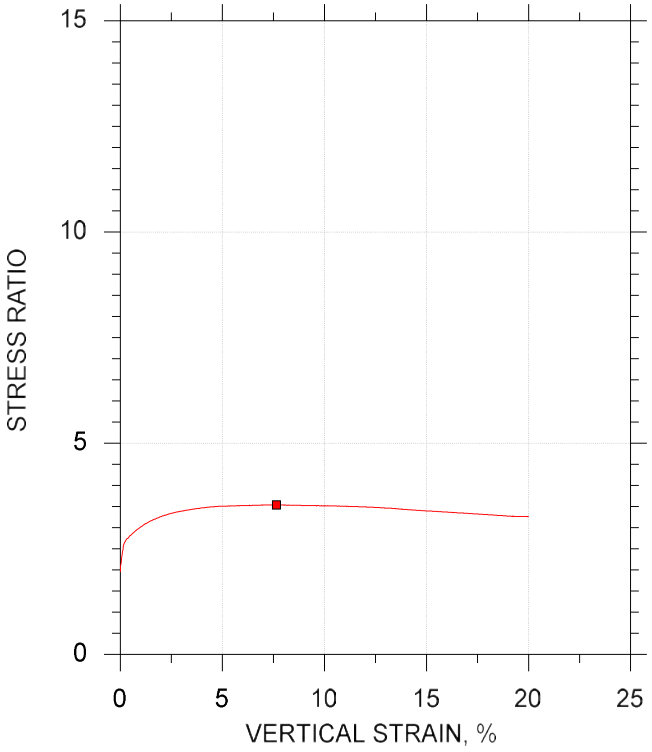


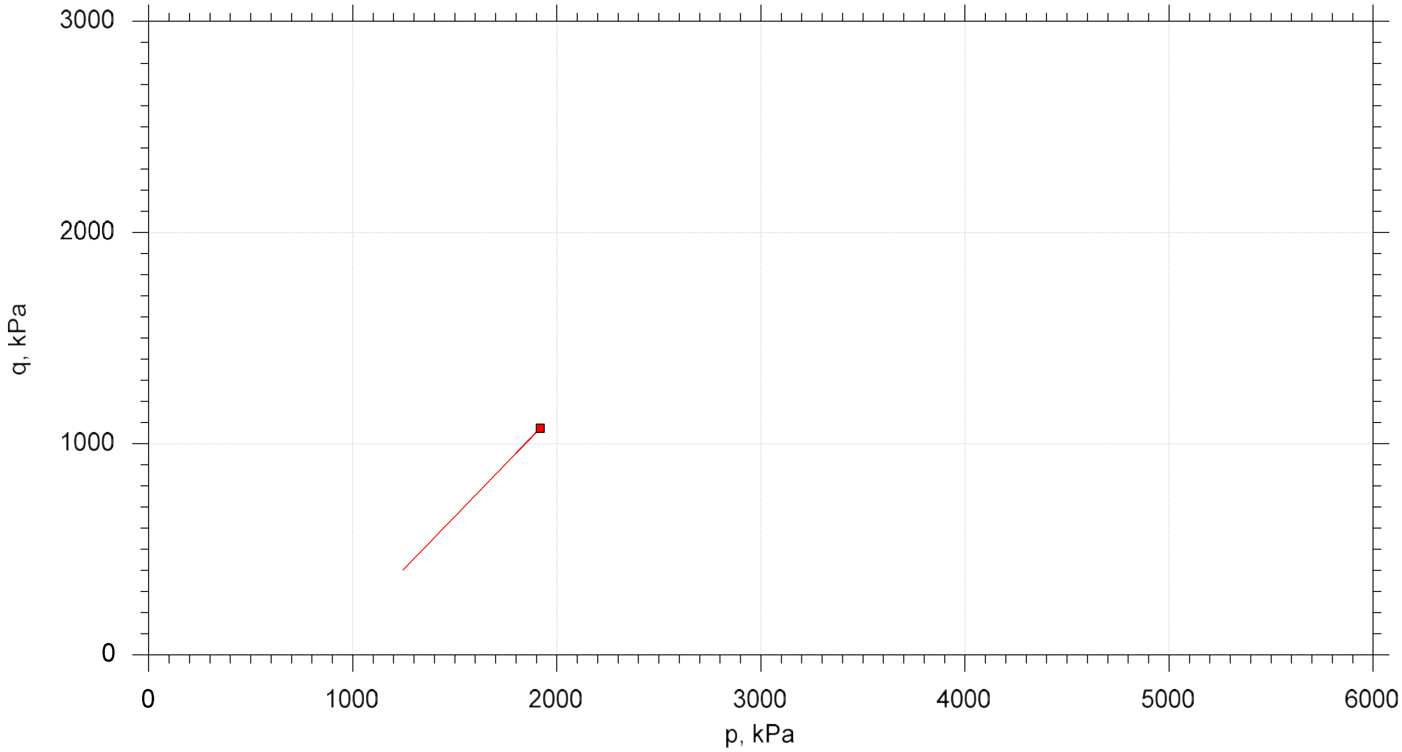
Symbol		🟥			
Sample ID		40			
Depth, ft		78-78.75'			
Test Number		CAD-23			
Initial	Height, cm	11.43			
	Diameter, cm	5.080			
	Moisture Content (from Cuttings), %	5.4			
	Dry Density, kN/m³	18.0			
	Saturation (Wet Method), %	31.3			
	Void Ratio	0.470			
Before Shear	Moisture Content, %	12.7			
	Dry Density, kN/m³	19.7			
	Cross-sectional Area (Method A), cm²	22.22			
	Saturation, %	100.0			
	Void Ratio	0.344			
	Back Pressure, kPa	1040.			
Vertical Effective Consolidation Stress, kPa		1637.			
Horizontal Effective Consolidation Stress, kPa		844.6			
Vertical Strain after Consolidation, %		16.70			
Volumetric Strain after Consolidation, %		9.009			
Time to 50% Consolidation, min		---			
Shear Strength, kPa		1074.			
Strain at Failure, %		7.65			
Strain Rate, %/min		0.01000			
Deviator Stress at Failure, kPa		2147.			
Effective Minor Principal Stress at Failure, kPa		844.6			
Effective Major Principal Stress at Failure, kPa		2992.			
B-Value		0.97			
Notes: - Before Shear Saturation set to 100% for phase calculation. - Moisture Content determined by ASTM D2216. - Deviator Stress includes membrane correction. - Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions. Remarks:					

TX-022, Target Comp 19.82 kN/m3 at 8.0% mc. Final Diameters: 5.486 cm, 6.553 cm, 5.944 cm, 5.639 cm and 5.359 cm.

CONSOLIDATED DRAINED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION







	Sample No	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
🟥	40	CAD-23	78-78.75'	trm	1/12/23	njh	1/20/23	316444-CAD-23n.dat

Project: Darlington NNP Phase II	Location: Ontario Canada	Project No.: GTX-316444
Boring No.: BH24	Sample Type: reconstituted	

Description: Moist, gray silty clay with gravel

Remarks: TX-022, Target Comp 19.82 kN/m3 at 8.0% mc. Final Diameters: 5.486 cm, 6.553 cm, 5.944 cm, 5.639 cm and 5.359 cm.

Client:	Golder Associates		
Project Name:	Darlington New Nuclear Plant		
Project Location:	Ontario, Canada		
GTX #:	316444		
Start Date:	1/4/2023	Tested By:	sjt/ges
End Date:	1/16/2023	Checked By:	ank
Boring #:	BH24	Test #:	---
Sample #:	13		
Depth:	7.32-7.92m		
Visual Description:	Moist, gray silt with sand		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084

Constant Volume

Sample Type:	Remold	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	---

Sample Preparation: Target Compaction: Dry density of 17.85 kN/m3 at the optimum moisture content of 9.3%. Values specified by client. Material > 3/8-inch screened out of sample prior to testing (30.5%)(As per client request). Trimmings moisture content =8.7 %

Parameter	Initial	Final
Height, cm	4.62	4.45
Diameter, cm	7.26	7.24
Area, cm^2	41.45	41.16
Volume, cm^3	191.60	182.94
Mass, g	418.9	415.7
Bulk Density, kN/m^3	21.44	22.28
Moisture Content, %	11.1	10.3
Dry Density, kN/m^3	19.3	20.2
Degree of Saturation, %	---	95

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	89.98	Increased Cell Pressure, psi:	95.04	Cell Pressure Increment, psi:	5.06
Sample Pressure, psi:	74.06	Corresponding Sample Pressure, psi:	77.34	Sample Pressure Increment, psi:	3.28
				B Coefficient:	0.65

FLOW DATA

Date	Trial #	Pressure, psi		Manometer Readings			Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp, °C	R_t	Permeability K @ 20 °C, cm/sec
		Cell	Sample	Z_1	Z_2	Z_1-Z_2						
1/13	1	90	74.05	8.0	7.9	0.1	30	22.7	1.1E-07	20	1.000	1.1E-07
1/13	2	90	74.05	8.0	7.9	0.1	30	22.7	1.1E-07	20	1.000	1.1E-07
1/13	3	90	74.05	8.0	7.9	0.1	31	22.7	1.1E-07	20	1.000	1.1E-07
1/13	4	90	74.05	8.0	7.9	0.1	30	22.7	1.1E-07	20	1.000	1.1E-07

PERMEABILITY AT 20° C: 1.1 x 10^{-7} cm/sec (@ 15.95 psi effective stress)

Client:	Golder Associates		
Project Name:	Darlington New Nuclear Plant		
Project Location:	Ontario, Canada		
GTX #:	316444		
Start Date:	1/4/2023	Tested By:	sjt/ges
End Date:	1/16/2023	Checked By:	ank
Boring #:	BH24	Test #:	---
Sample #:	17		
Depth:	9.75-10.36		
Visual Description:	Moist, gray sandy silt		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084

Constant Volume

Sample Type:	Remold	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	---

Sample Preparation: Target Compaction: Dry density of 20.52 kN/m3 at the optimum moisture content of 7.9%. Values specified by client. Material > 3/8-inch screened out of sample prior to testing (30.4%)(As per client request). Trimmings moisture content = 8.1%

Parameter	Initial	Final
Height, cm	5.21	4.83
Diameter, cm	7.24	7.24
Area, cm^2	41.16	41.16
Volume, cm^3	214.3	198.6
Mass, g	477	476
Bulk Density, kN/m^3	21.8	23.5
Moisture Content, %	7	6
Dry Density, kN/m^3	20.4	22.0
Degree of Saturation, %	---	96

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	89.98	Increased Cell Pressure, psi:	95.02	Cell Pressure Increment, psi:	5.04
Sample Pressure, psi:	69.71	Corresponding Sample Pressure, psi:	73.30	Sample Pressure Increment, psi:	3.59
				B Coefficient:	0.712301587

FLOW DATA

Date	Trial #	Pressure, psi		Manometer Readings			Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp, °C	R_t	Permeability K @ 20 °C, cm/sec
		Cell	Sample	Z_1	Z_2	Z_1-Z_2						
1/13	1	90	69.7	8.0	7.9	0.1	72	20.9	5.1E-08	20	1.000	5.1E-08
1/13	2	90	69.7	8.0	7.9	0.1	77	20.9	4.8E-08	20	1.000	4.8E-08
1/13	3	90	69.7	8.0	7.9	0.1	74	20.9	5.0E-08	20	1.000	5.0E-08
1/13	4	90	69.7	8.0	7.9	0.1	71	20.9	5.2E-08	20	1.000	5.2E-08

PERMEABILITY AT 20° C: 5.0 x 10^{-8} cm/sec (@ 20.3 psi effective stress)

GeoTesting EXPRESS

Client:	WSP Canada Inc.		
Project Name:	Darlington New Nuclear Plant		
Project Location:	Ontario, Canada		
GTX #:	316444		
Start Date:	1/4/2023	Tested By:	sjt/ges
End Date:	1/17/2023	Checked By:	ank
Boring #:	BH24	Test #:	---
Sample #:	22		
Depth:	42-44'		
Visual Description:	Moist, gray silt with sand		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084

Constant Volume

Sample Type:	Remold	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	---

Sample Preparation: Target Compaction: Dry density of 20.82 kN/m3 at 11.4% moisture content. Values specified by client. Material > 3/8-inch screened out of sample prior to testing (49.7%)(As per client request). Trimmings moisture content = 11%

Parameter	Initial	Final
Height, cm	5.33	5.08
Diameter, cm	7.24	7.24
Area, cm^2	41.16	41.16
Volume, cm^3	219.53	209.08
Mass, g	497.6	496.9
Bulk Density, kN/m^3	22.2	23.3
Moisture Content, %	8.9	8.7
Dry Density, kN/m^3	20.4	21.4
Degree of Saturation, %	---	100

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	90.05	Increased Cell Pressure, psi:	94.95	Cell Pressure Increment, psi:	4.90
Sample Pressure, psi:	64.66	Corresponding Sample Pressure, psi:	66.49	Sample Pressure Increment, psi:	1.83
				B Coefficient:	0.37

B-value did not increase with increase in pressure.
Final degree of saturation >95%.

FLOW DATA

Date	Trial #	Pressure, psi		Manometer Readings			Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp, °C	R_t	Permeability K @ 20 °C, cm/sec
		Cell	Sample	Z_1	Z_2	Z_1-Z_2						
1/16	1	90	64.62	8.0	7.9	0.1	70	19.8	5.5E-08	20	1.000	5.5E-08
1/16	2	90	64.62	8.0	7.9	0.1	71	19.8	5.5E-08	20	1.000	5.5E-08
1/16	3	90	64.62	8.0	7.9	0.1	69	19.8	5.6E-08	20	1.000	5.6E-08
1/16	4	90	64.62	8.0	7.9	0.1	75	19.8	5.2E-08	20	1.000	5.2E-08

PERMEABILITY AT 20° C: 5.4 x 10^{-8} cm/sec (@ 25.38 psi effective stress)

Client:	Goler Associates USA, Inc.		
Project Name:	Darlington New Nuclear Plant Phase II		
Project Location:	Ontario, Canada		
GTX #:	316444		
Start Date:	1/4/2023	Tested By:	ges/ sjt
End Date:	1/16/2023	Checked By:	ank
Boring #:	BH24	Test #:	---
Sample #:	26		
Depth:	50-52'		
Visual Description:	Moist, gray sandy silt		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084

Constant Volume

Sample Type:	Remold	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	---

Sample Preparation: Target Compaction: Dry density of 19.37 kN/m3 at 17.3% moisture content. Values specified by client. Material > 3/8-inch screened out of sample prior to testing (4.3%). Trimmings moisture content = 16.4%

Parameter	Initial	Final
Height, cm	5.84	5.46
Diameter, cm	7.24	7.24
Area, cm^2	41.16	41.16
Volume, cm^3	240.44	224.76
Mass, g	484.5	484.3
Bulk Density, kN/m^3	19.8	21.1
Moisture Content, %	15.9	15.9
Dry Density, kN/m^3	17.0	18.2
Degree of Saturation, %	---	99

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	89.97	Increased Cell Pressure, psi:	94.99	Cell Pressure Increment, psi:	5.02
Sample Pressure, psi:	60.33	Corresponding Sample Pressure, psi:	62.78	Sample Pressure Increment, psi:	5.00
				B Coefficient:	0.48

B-value did not increase with increase in pressure.
Final degree of saturation >95%.

FLOW DATA

Date	Trial #	Pressure, psi		Manometer Readings			Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp, °C	R_t	Permeability K @ 20 °C, cm/sec
		Cell	Sample	Z_1	Z_2	Z_1-Z_2						
1/13	1	90	60.27	8.0	4.6	3.4	30	18.5	6.2E-06	20	1.000	6.2E-06
1/13	2	90	60.27	8.0	4.6	3.4	31	18.5	6.0E-06	20	1.000	6.0E-06
1/13	3	90	60.27	8.0	4.6	3.4	30	18.5	6.2E-06	20	1.000	6.2E-06
1/13	4	90	60.27	8.0	4.6	3.4	30	18.5	6.2E-06	20	1.000	6.2E-06

PERMEABILITY AT 20° C: 6.1 x 10^{-6} cm/sec (@ 30 psi effective stress)

GeoTesting EXPRESS

Client:	WSP Canada Inc.		
Project Name:	Darlington New Nuclear Plant		
Project Location:	Ontario, Canada		
GTX #:	316444		
Start Date:	1/16/2023	Tested By:	sjt/ges
End Date:	1/19/2023	Checked By:	ank
Boring #:	BH24	Test #:	---
Sample #:	32		
Depth:	62-64'		
Visual Description:	Moist, gray silty clay		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084
Constant Volume

Sample Type:	Remold	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	---

Sample Preparation: Extruded from tube, cut, trimmed and placed into permeameter at as-received density and moisture content. Trimmings moisture content = 18.81 %.

Parameter	Initial	Final
Height, cm	5.92	5.84
Diameter, cm	7.11	6.93
Area, cm^2	39.73	37.76
Volume, cm^3	235.11	220.62
Mass, g	454.8	455.4
Bulk Density, kN/m^3	19.0	20.2
Moisture Content, %	20.4	20.6
Dry Density, kN/m^3	15.8	16.8
Degree of Saturation, %	---	99

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	90.00	Increased Cell Pressure, psi:	94.98	Cell Pressure Increment, psi:	4.98
Sample Pressure, psi:	54.49	Corresponding Sample Pressure, psi:	58.39	Sample Pressure Increment, psi:	5.00
				B Coefficient:	0.78

B-value did not increase with increase in pressure.
Final degree of saturation >95%.

FLOW DATA

Date	Trial #	Pressure, psi		Manometer Readings			Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp, °C	R_t	Permeability K @ 20 °C, cm/sec
		Cell	Sample	Z_1	Z_2	Z_1-Z_2						
1/18	1	90	54.47	8.0	7.9	0.1	102	17.3	4.8E-08	20	1.000	4.8E-08
1/18	2	90	54.47	8.0	7.9	0.1	108	17.3	4.5E-08	20	1.000	4.5E-08
1/18	3	90	54.47	8.0	7.9	0.1	99	17.3	4.9E-08	20	1.000	4.9E-08
1/18	4	90	54.47	8.0	7.9	0.1	95	17.3	5.1E-08	20	1.000	5.1E-08

PERMEABILITY AT 20° C: 4.8×10^{-8} cm/sec (@ 36 psi effective stress)

GeoTesting EXPRESS

Client:	Golder Associates		
Project Name:	Darlington New Nuclear Plant		
Project Location:	Ontario, Canada		
GTX #:	316444		
Start Date:	1/4/2023	Tested By:	sjt/ges
End Date:	1/20/2023	Checked By:	ank
Boring #:	BH24	Test #:	---
Sample #:	35		
Depth:	21.73-21.34		
Visual Description:	Moist, gray silt with sand		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084

Constant Volume

Sample Type:	Remold	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	---

Sample Preparation: Target Compaction: Dry density of 19.82 kN/m3 at 12.7% moisture content. Values specified by client.
Trimmings moisture content = 12.23%

Parameter	Initial	Final
Height, cm	3.94	3.68
Diameter, cm	7.26	7.14
Area, cm^2	41.45	40.01
Volume, cm^3	163.18	147.36
Mass, g	362.5	349.4
Bulk Density, kN/m^3	21.8	23.2
Moisture Content, %	11.0	7.0
Dry Density, kN/m^3	19.6	21.7
Degree of Saturation, %	---	95

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	89.99	Increased Cell Pressure, psi:	95.00	Cell Pressure Increment, psi:	5.01
Sample Pressure, psi:	51.56	Corresponding Sample Pressure, psi:	55.42	Sample Pressure Increment, psi:	5.00
				B Coefficient:	0.77

B-value did not increase with increase in pressure.
Final degree of saturation >95%.

FLOW DATA

Date	Trial #	Pressure, psi		Manometer Readings			Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp, °C	R_t	Permeability K @ 20 °C, cm/sec
		Cell	Sample	Z_1	Z_2	Z_1-Z_2						
1/19	1	90	51.56	8.0	7.7	0.3	36	27.4	2.4E-07	20	1.000	2.4E-07
1/19	2	90	51.56	8.0	7.7	0.3	37	27.4	2.4E-07	20	1.000	2.4E-07
1/19	3	90	51.56	8.0	7.7	0.3	38	27.4	2.3E-07	20	1.000	2.3E-07
1/19	4	90	51.56	8.0	7.7	0.3	35	27.4	2.5E-07	20	1.000	2.5E-07

PERMEABILITY AT 20° C: 2.4 x 10^{-7} cm/sec (@ 38 psi effective stress)

GeoTesting
EXPRESS

Client:	Golder Associates USA, Inc.		
Project Name:	Darlington New Nuclear Plant Phase II		
Project Location:	Ontario, Canada		
GTX #:	316444		
Start Date:	1/4/2023	Tested By:	sjt/ ges
End Date:	1/17/2023	Checked By:	jsc
Boring #:	BH24		
Sample #:	38A		
Depth:	22.56-23.01		
Visual Description:	Moist, dark gray sandy silt		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084

Constant Gradient

Sample Type:	Remolded	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	---

Sample Preparation: Target Compaction: Dry Density of 19.20 kN/m3 at 7.7% moisture content. Values specified by client.
Trimmings moisture content = 8.23%

Parameter	Initial	Final
Height, cm	5.46	5.36
Diameter, cm	7.24	7.29
Area, cm^2	41.16	41.74
Volume, cm^3	224.76	223.69
Mass, g	448.0	468.5
Bulk Density, kN/m^3	19.5	20.5
Moisture Content, %	12.3	17.4
Dry Density, kN/m^3	17.4	17.5
Degree of Saturation, %	---	95

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	85.02	Increased Cell Pressure, psi:	90.00	Cell Pressure Increment, ps	4.98
Sample Pressure, psi:	43.66	Corresponding Sample Pressure, psi:	48.17	Sample Pressure Increment	4.51
				B Coefficient:	0.91

B-value did not increase with increase in pressure.
Final degree of saturation >95%.

FLOW DATA

	Time,	Pressure, psi				Flow Volume, cc				Temp,		Permeability K @ 20 °C,
Date	sec	Cell	Inlet	Outlet	Gradient	In	Out	Δ In	Δ Out	°C	R_t	cm/sec
16-Jan	---	85.0	44.2	43.2	12.6	7.00	14.00	---	---	---	---	---
16-Jan	30	85.0	44.2	43.2	12.6	7.70	13.30	0.70	0.70	20.4	0.991	6.8E-06
16-Jan	----	85.0	44.2	43.2	12.6	7.00	14.00	---	---	---	---	---
16-Jan	30	85.0	44.2	43.2	12.6	7.70	13.30	0.70	0.70	20.4	0.991	6.8E-06
16-Jan	----	85.0	44.2	43.2	12.6	7.00	14.00	---	---	---	---	---
16-Jan	30	85.0	44.2	43.2	12.6	7.70	13.30	0.70	0.70	20.4	0.991	6.8E-06
16-Jan	----	85.0	44.2	43.2	12.6	7.00	14.00	---	---	---	---	---
16-Jan	30	85.0	44.2	43.2	12.6	7.70	13.30	0.70	0.70	20.4	0.991	6.8E-06

PERMEABILITY AT 20° C: 6.8×10^{-6} cm/sec (@ 41 psi effective stress)

Client:	Golder Associates		
Project Name:	Darlington New Nuclear Plant		
Project Location:	Ontario, Canada		
GTX #:	316444		
Start Date:	1/4/2023	Tested By:	sjt/ges
End Date:	1/16/2023	Checked By:	ank
Boring #:	BH24	Test #:	---
Sample #:	40		
Depth:	23.84-23.99m		
Visual Description:	Moist, gray silt with sand		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084

Constant Volume

Sample Type:	Remold	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	5/3/3

Sample Preparation: Target Compaction: Dry density of 19.82 kN/m3 at 7.8% moisture content. Values specified by client. Material > 3/8-inch screened out of sample prior to testing (25.6%)(As per client request). Trimmings moisture content = 7.4%

Parameter	Initial	Final
Height, cm	4.83	4.72
Diameter, cm	7.24	7.24
Area, cm^2	41.16	41.16
Volume, cm^3	198.63	194.44
Mass, g	462.7	452.5
Bulk Density, kN/m^3	22.8	22.8
Moisture Content, %	9.9	7.4
Dry Density, kN/m^3	20.8	21.2
Degree of Saturation, %	---	76

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	90.00	Increased Cell Pressure, psi:	95.02	Cell Pressure Increment, psi:	5.02
Sample Pressure, psi:	46.49	Corresponding Sample Pressure, psi:	50.27	Sample Pressure Increment, psi:	5.00
				B Coefficient:	0.75

B-value did not increase with increase in pressure.
Final degree of saturation >95%.

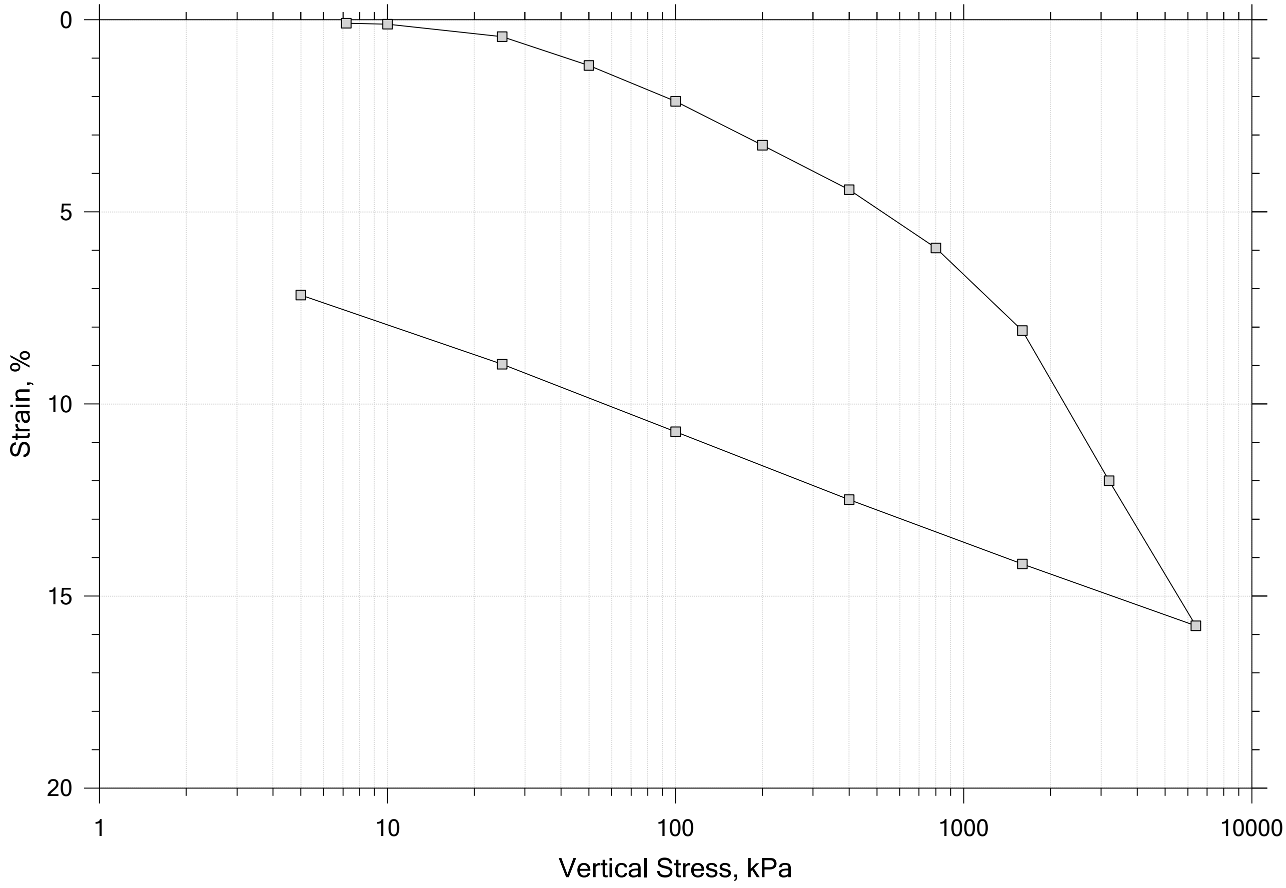
FLOW DATA

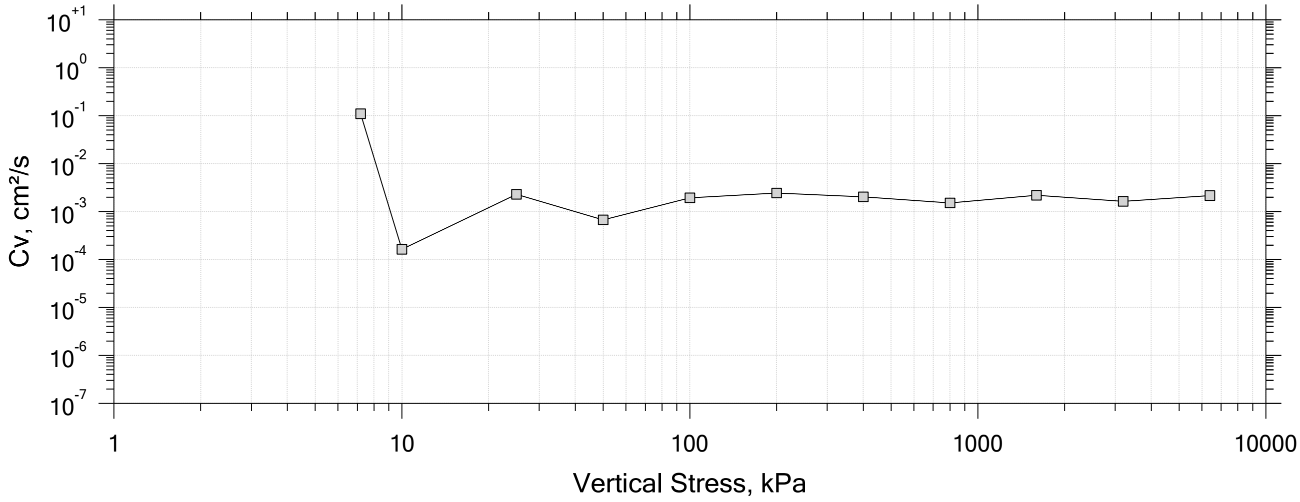
Date	Trial #	Pressure, psi		Manometer Readings			Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp, °C	R_t	Permeability K @ 20 °C, cm/sec
		Cell	Sample	Z_1	Z_2	Z_1-Z_2						
1/13	1	90	46.49	8.0	7.9	1.0	57	21.3	6.7E-07	20	1.000	6.7E-07
1/13	2	90	46.49	8.0	7.9	1.0	67	21.3	5.7E-07	20	1.000	5.7E-07
1/13	3	90	46.49	8.0	7.9	1.0	60	21.3	6.4E-07	20	1.000	6.4E-07
1/13	4	90	46.49	8.0	7.9	1.0	58	21.3	6.6E-07	20	1.000	6.6E-07

PERMEABILITY AT 20° C: 6.4 x 10^{-7} cm/sec (@ 44 psi effective stress)

One-Dimensional Consolidation by ASTM D2435 - Method B

Summary Report





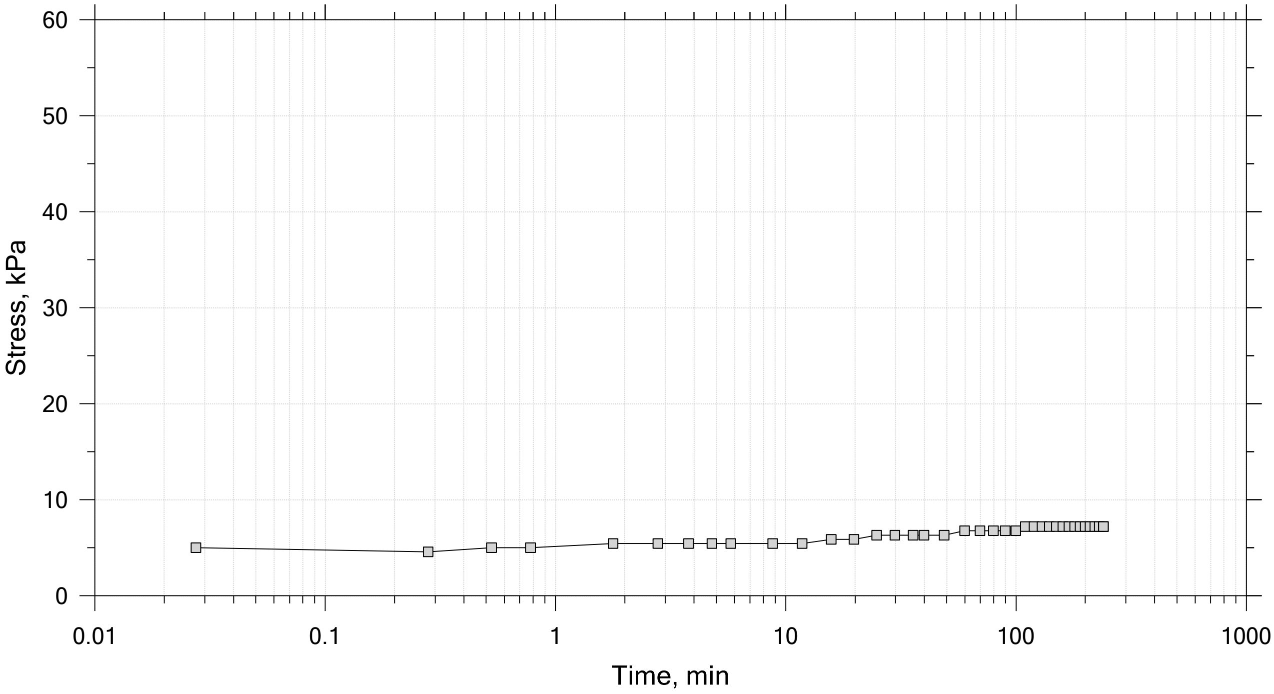
GeoTesting EXPRESS	Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH24	Tested By: trm	Checked By: anm
	Sample No.: 32-1	Test Date: 12/2/22	Depth: 62'7"-62'9"
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-034, Swell Pressure = 7.19 kPa		
	Displacement at End of Increment		

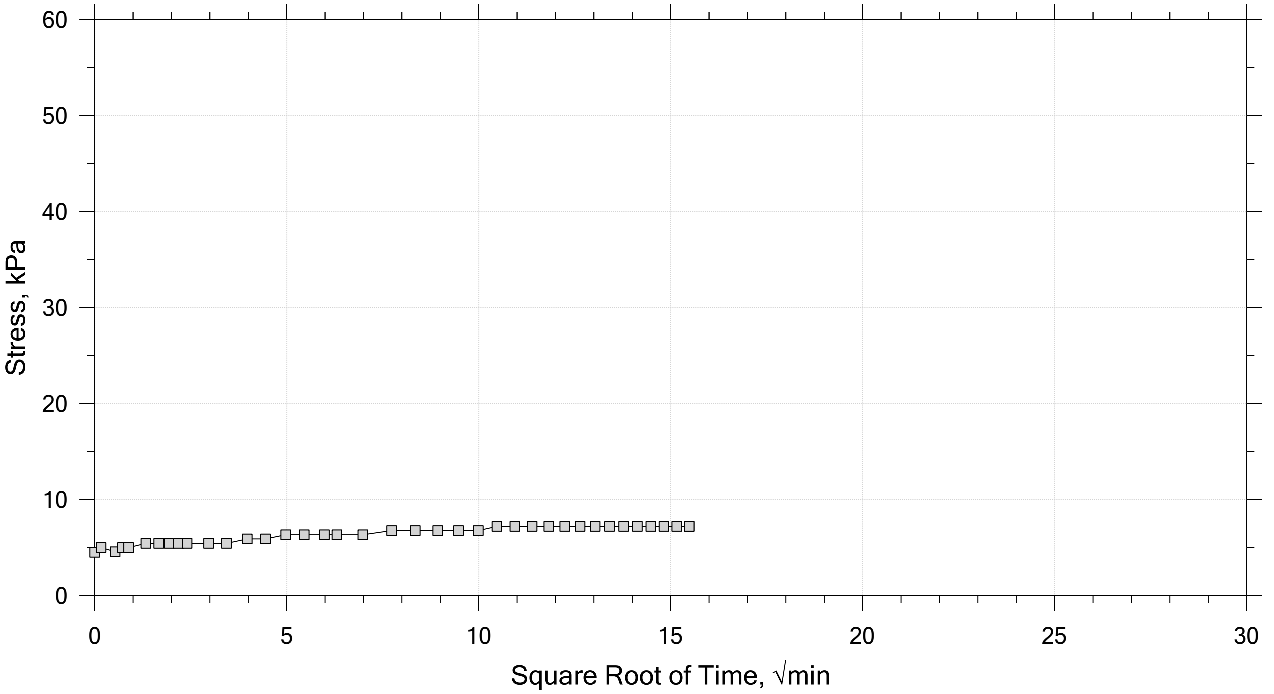
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 1 of 16

Constant Volume Step

Stress: 7.19 kPa





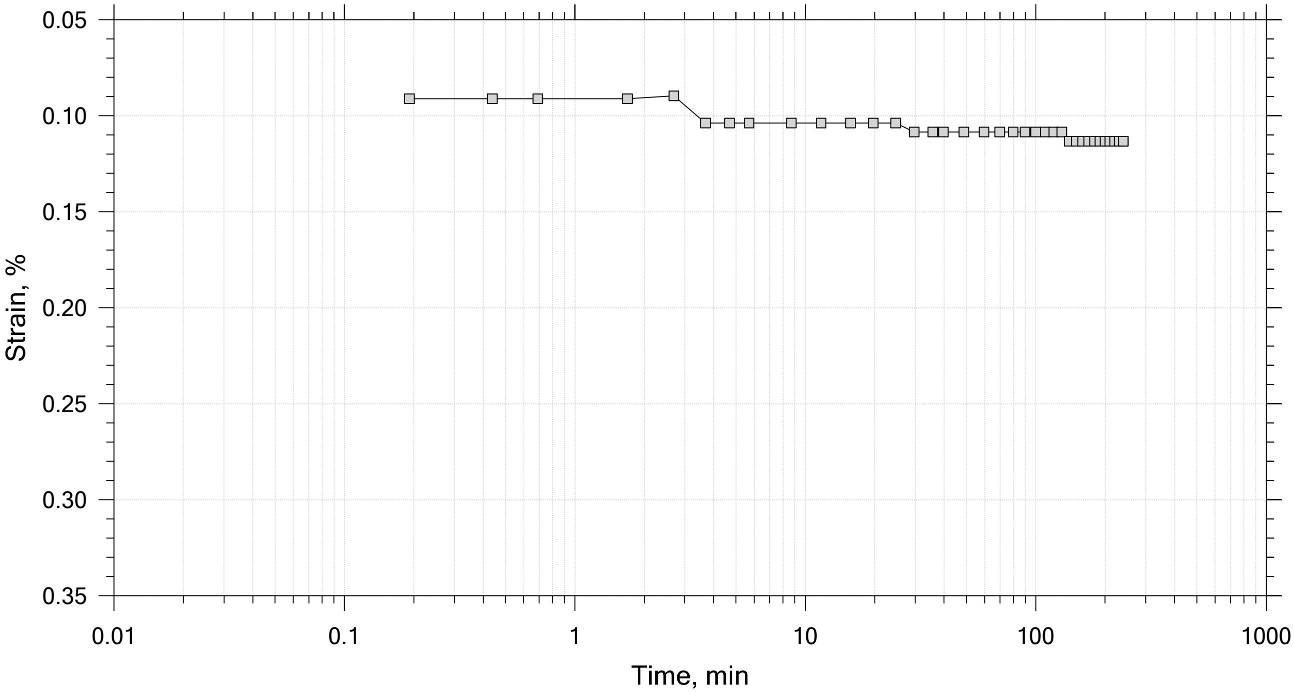
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 32-1	Test Date: 12/2/22	Depth: 62'7"-62'9"
Test No.: IP-1	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-034, Swell Pressure = 7.19 kPa		

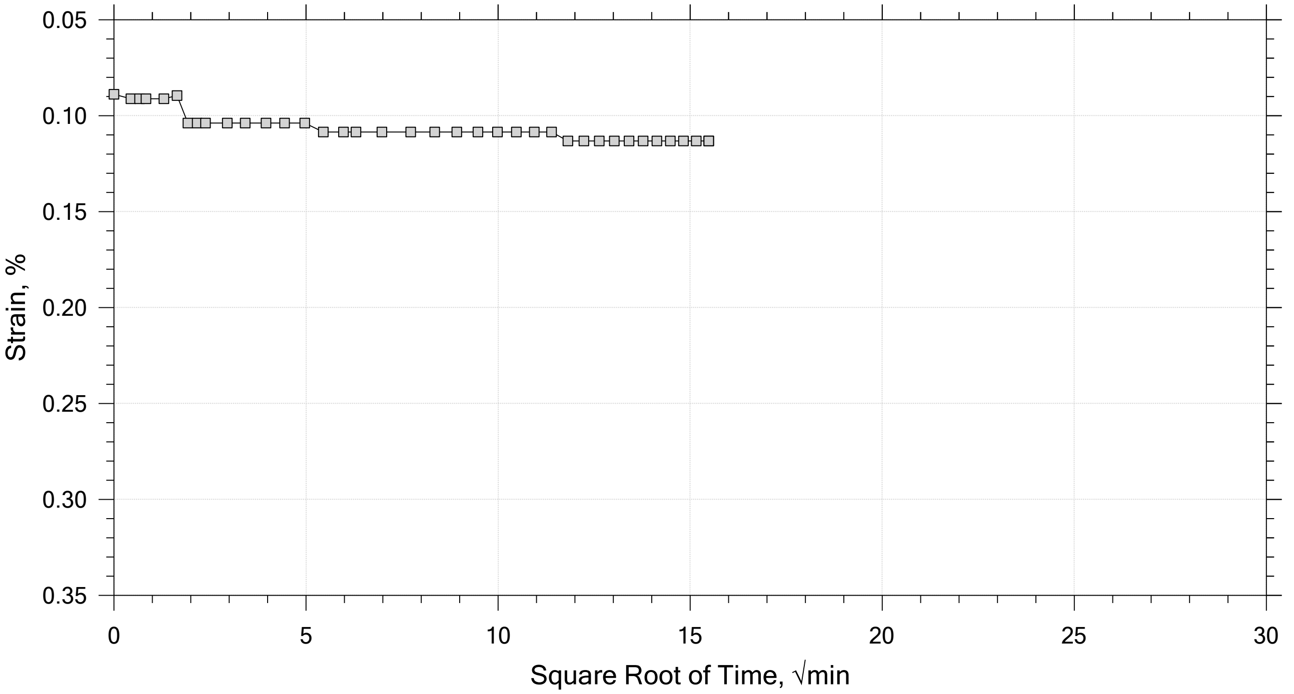
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 2 of 16

Constant Load Step

Stress: 10 kPa





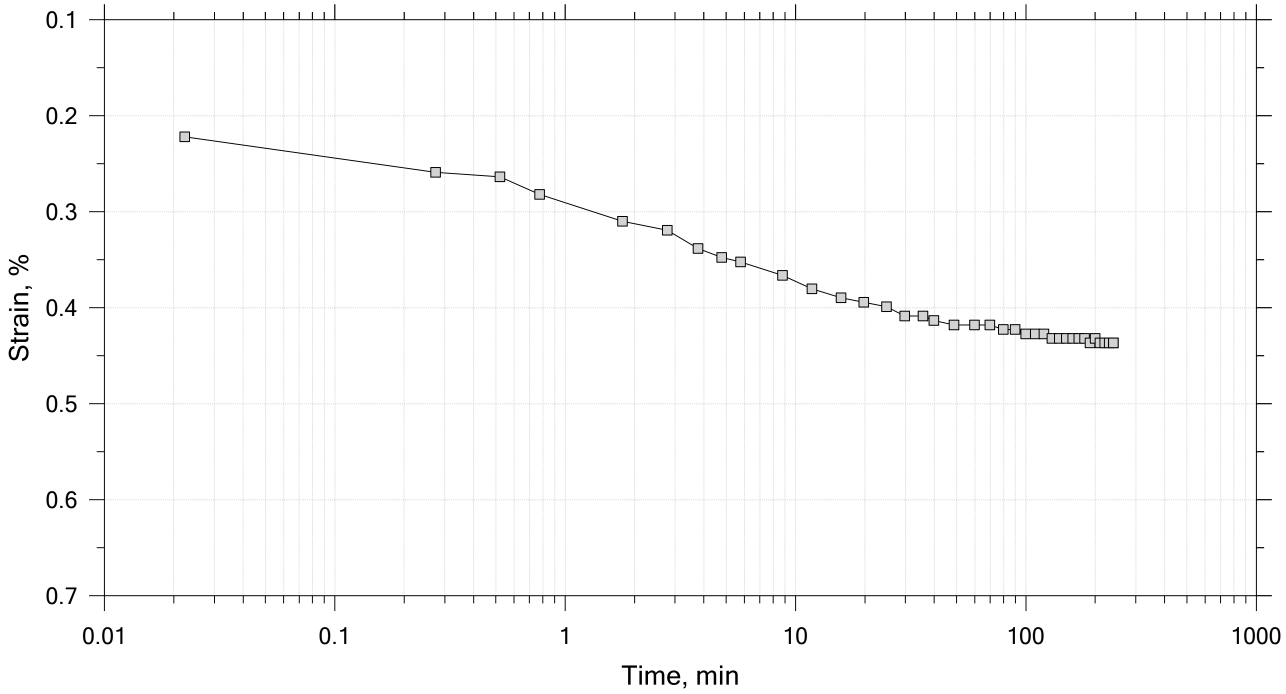
GeoTesting EXPRESS	Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH24	Tested By: trm	Checked By: anm
	Sample No.: 32-1	Test Date: 12/2/22	Depth: 62'7"-62'9"
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-034, Swell Pressure = 7.19 kPa		

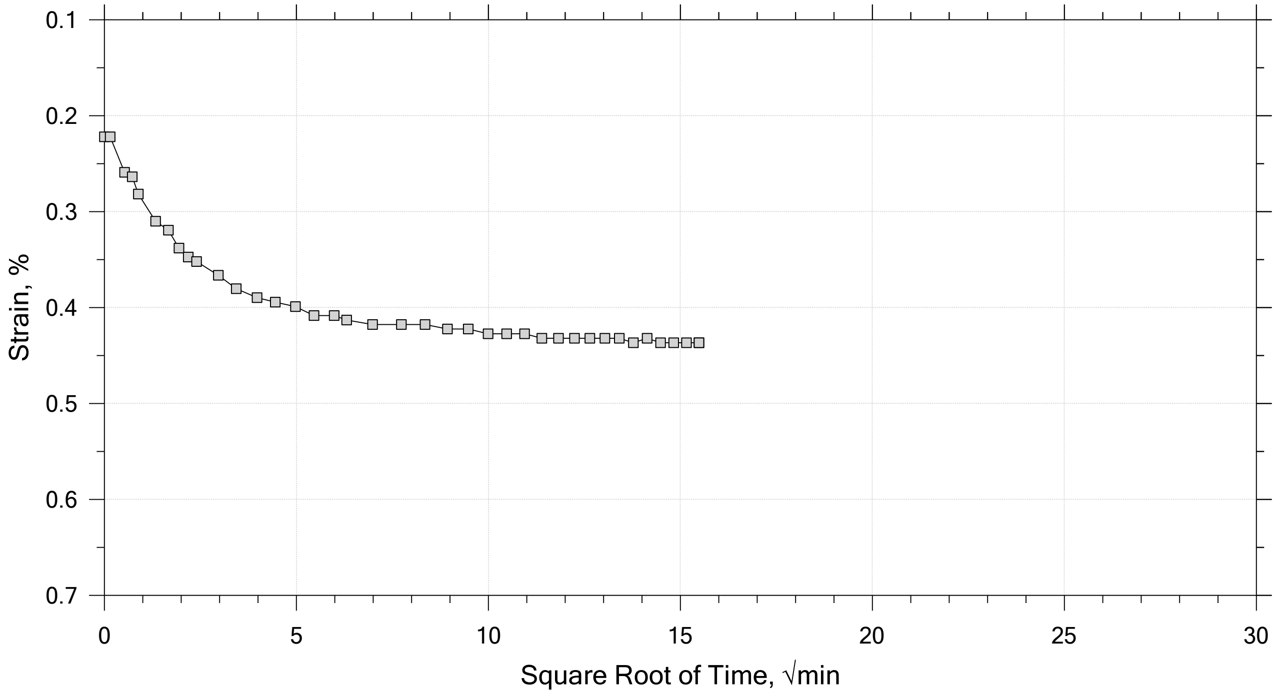
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 3 of 16

Constant Load Step

Stress: 25 kPa





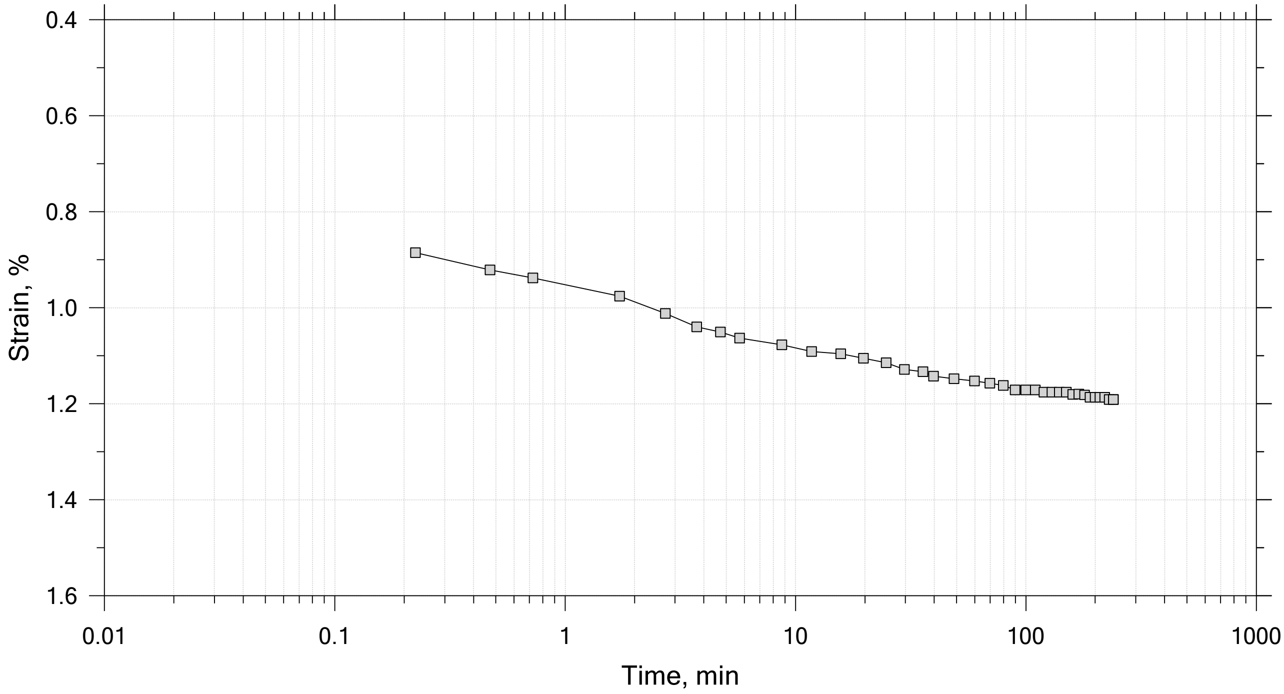
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 32-1	Test Date: 12/2/22	Depth: 62'7"-62'9"
Test No.: IP-1	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-034, Swell Pressure = 7.19 kPa		

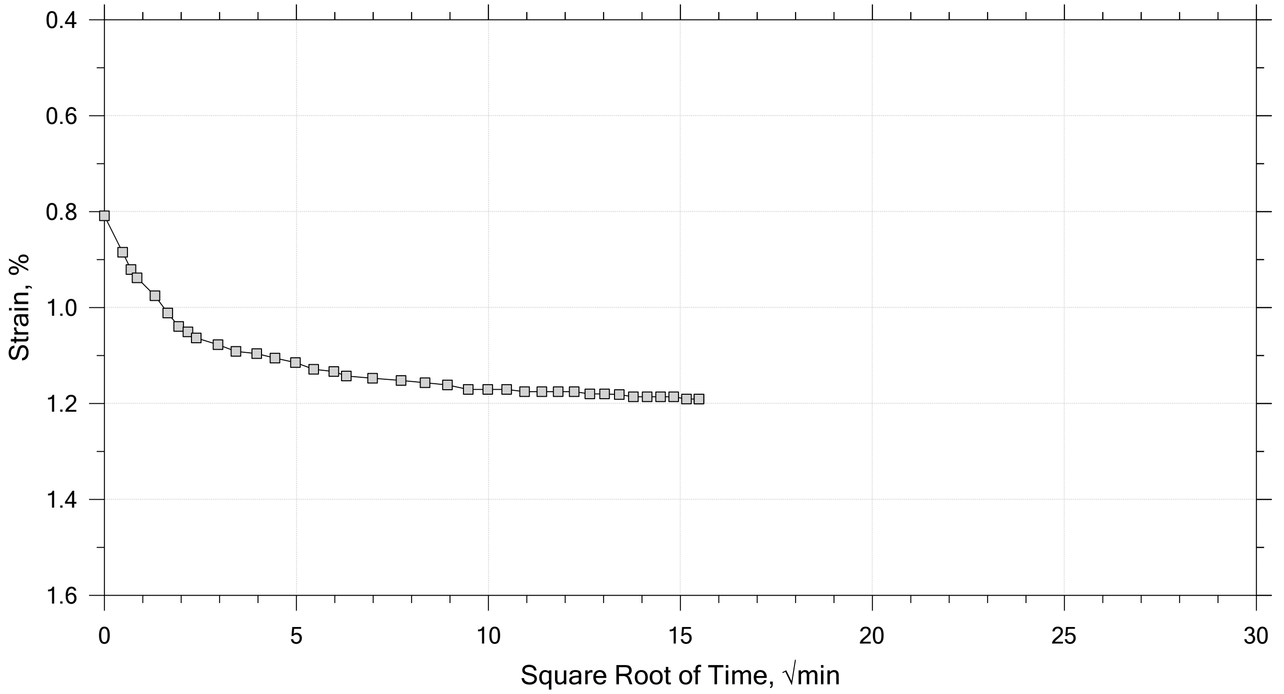
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 4 of 16

Constant Load Step

Stress: 50 kPa





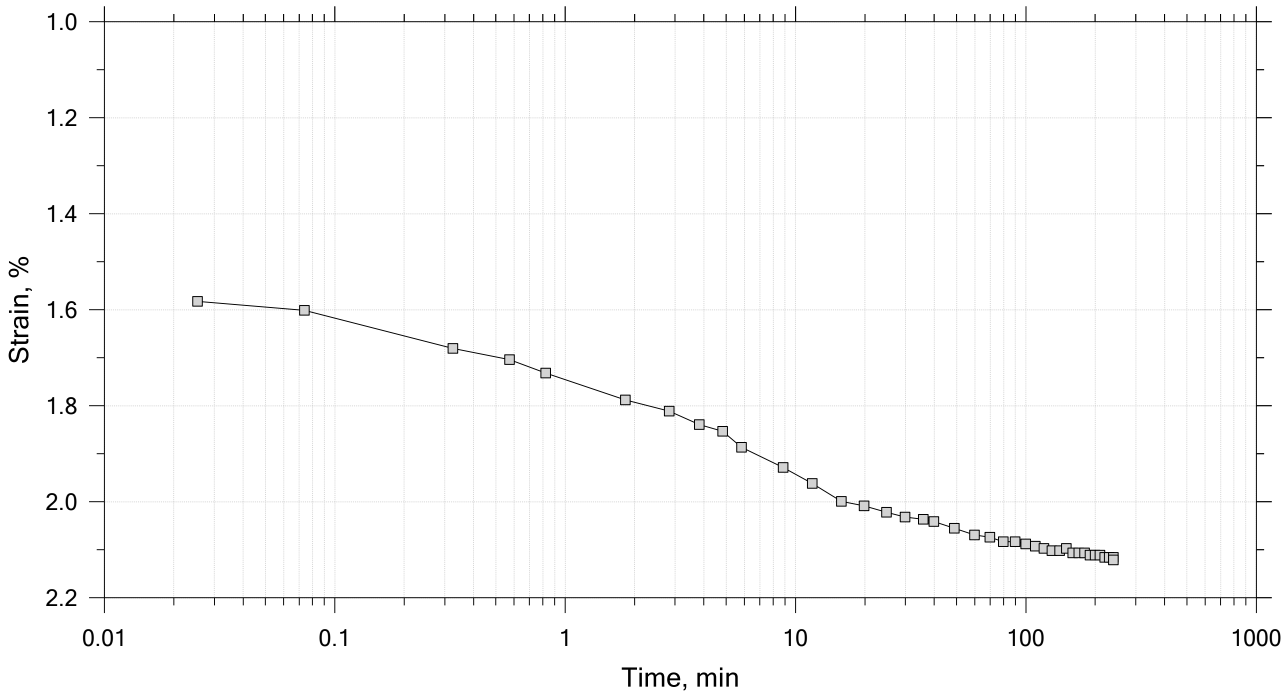
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 32-1	Test Date: 12/2/22	Depth: 62'7"-62'9"
Test No.: IP-1	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-034, Swell Pressure = 7.19 kPa		

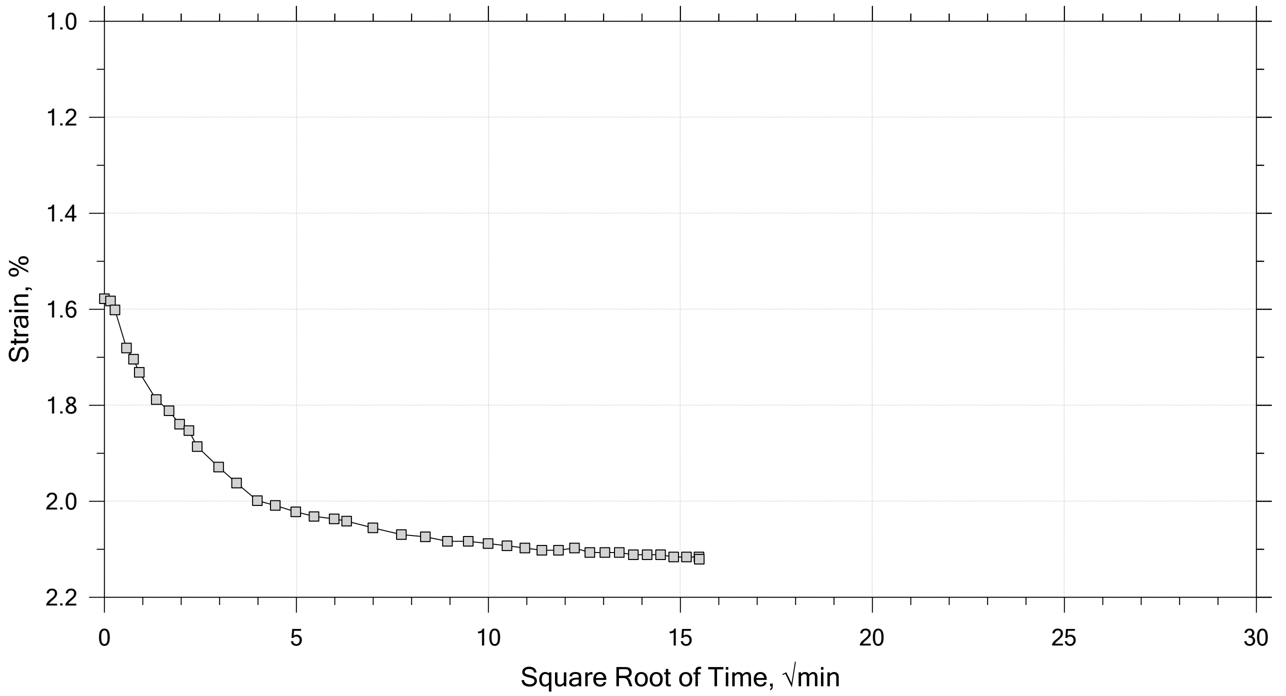
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 5 of 16

Constant Load Step

Stress: 100 kPa





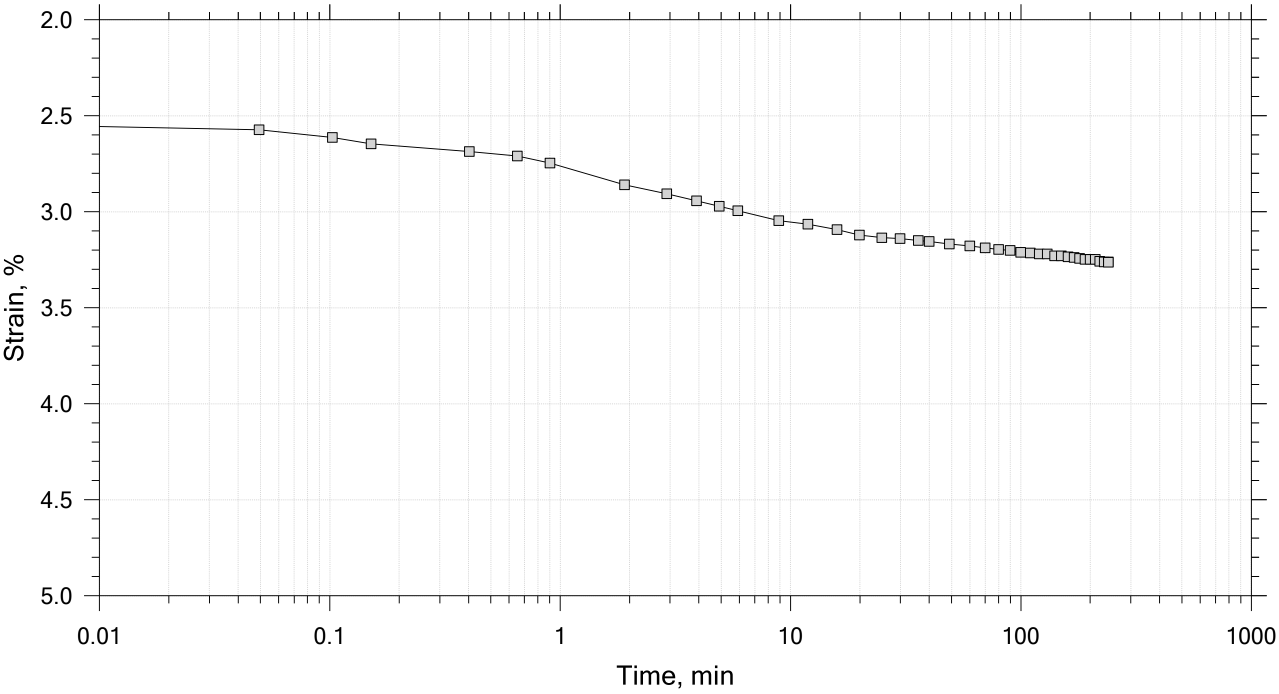
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 32-1	Test Date: 12/2/22	Depth: 62'7"-62'9"
Test No.: IP-1	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-034, Swell Pressure = 7.19 kPa		

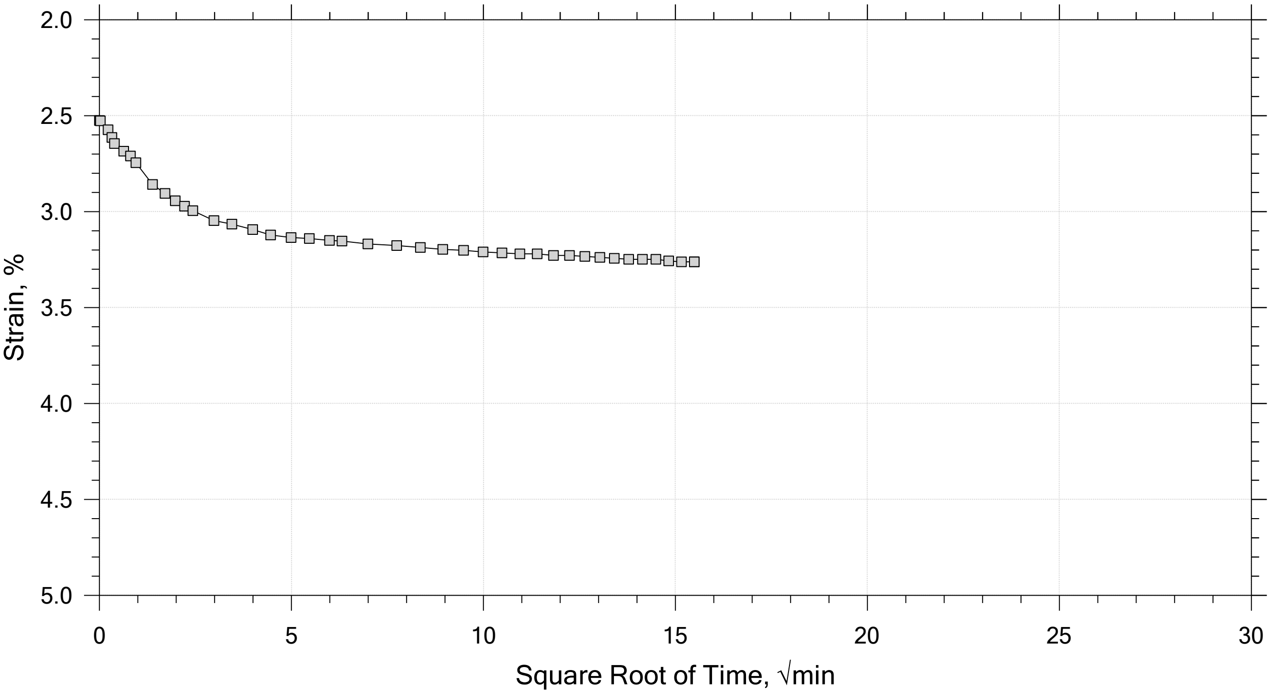
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 6 of 16

Constant Load Step

Stress: 200 kPa





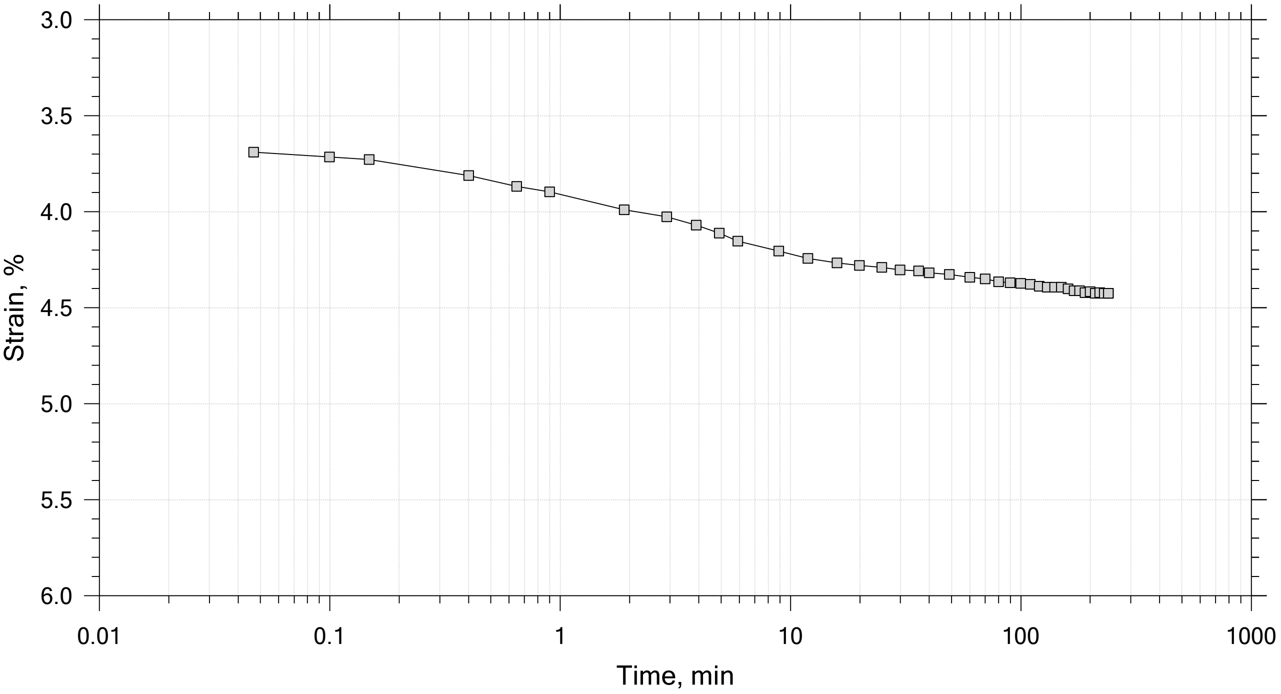
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 32-1	Test Date: 12/2/22	Depth: 62'7"-62'9"
Test No.: IP-1	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-034, Swell Pressure = 7.19 kPa		

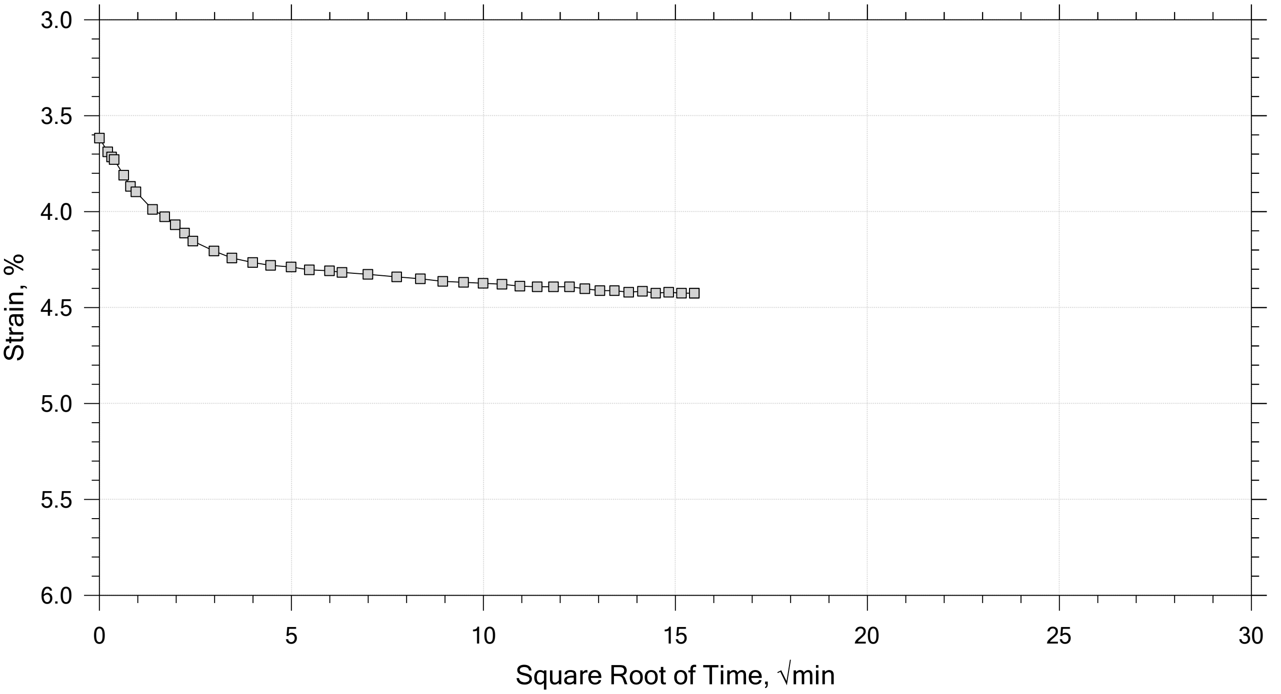
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 7 of 16

Constant Load Step

Stress: 400 kPa

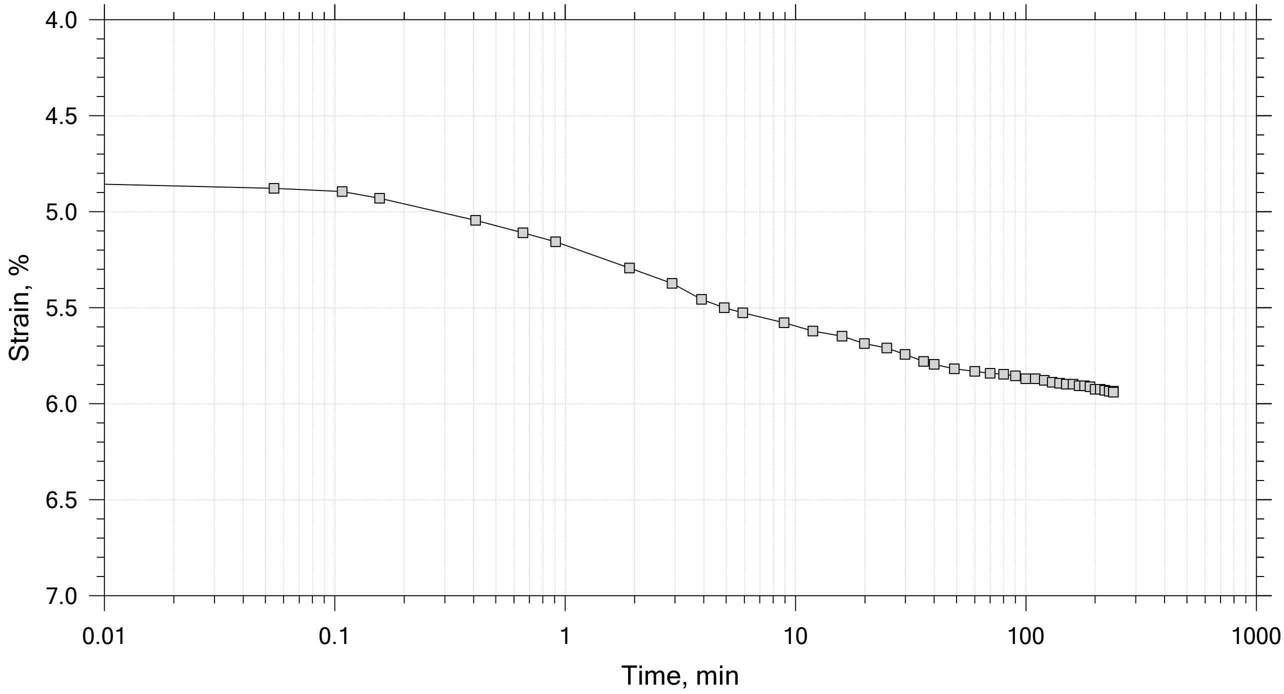


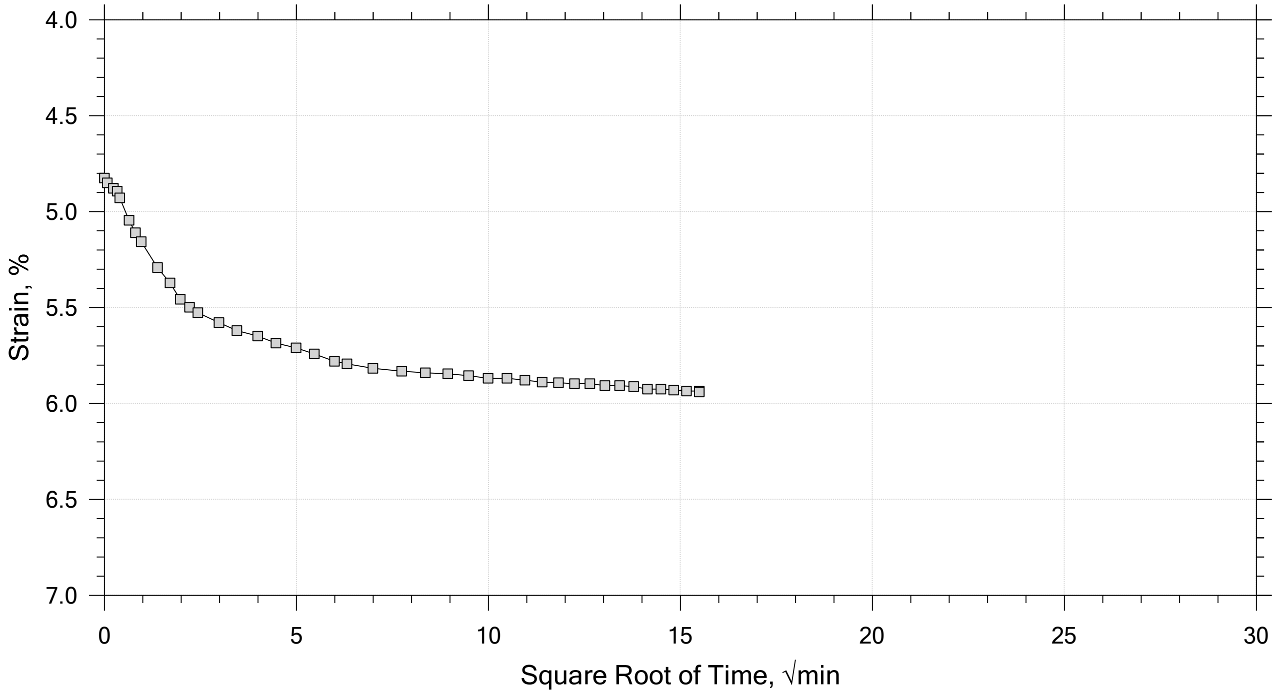


Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 32-1	Test Date: 12/2/22	Depth: 62'7"-62'9"
Test No.: IP-1	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-034, Swell Pressure = 7.19 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 8 of 16
Constant Load Step
Stress: 800 kPa





GeoTesting EXPRESS

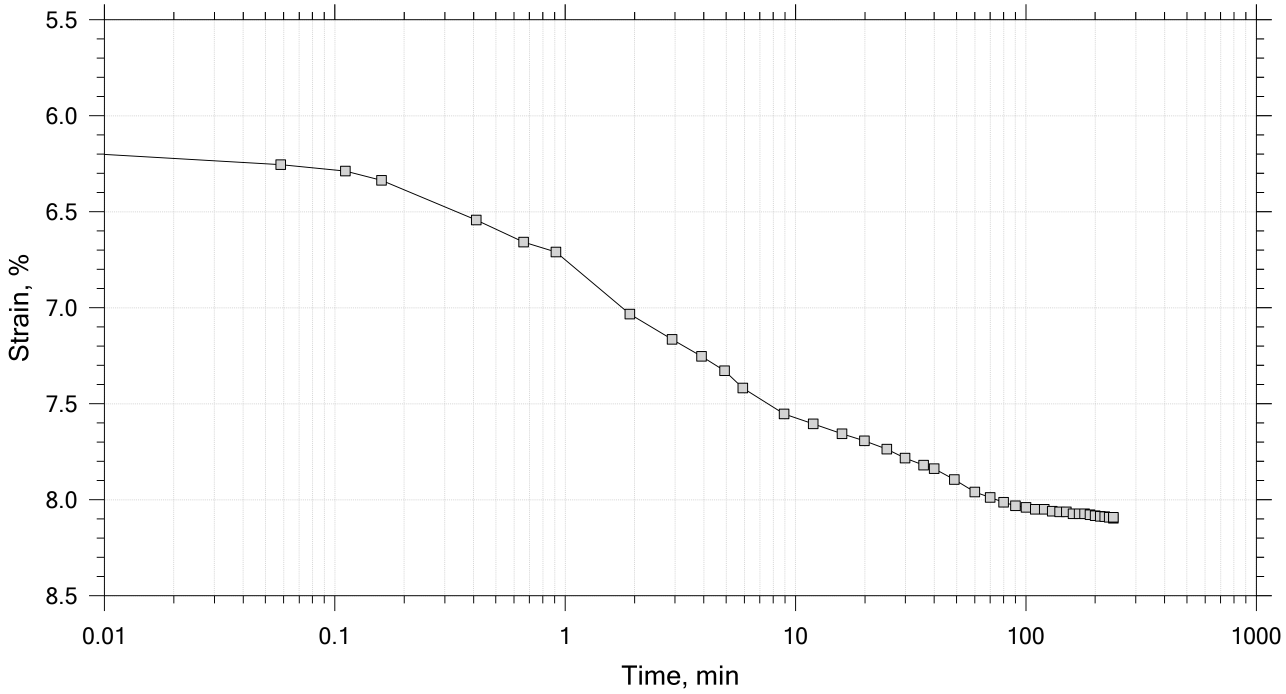
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 32-1	Test Date: 12/2/22	Depth: 62'7"-62'9"
Test No.: IP-1	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-034, Swell Pressure = 7.19 kPa		

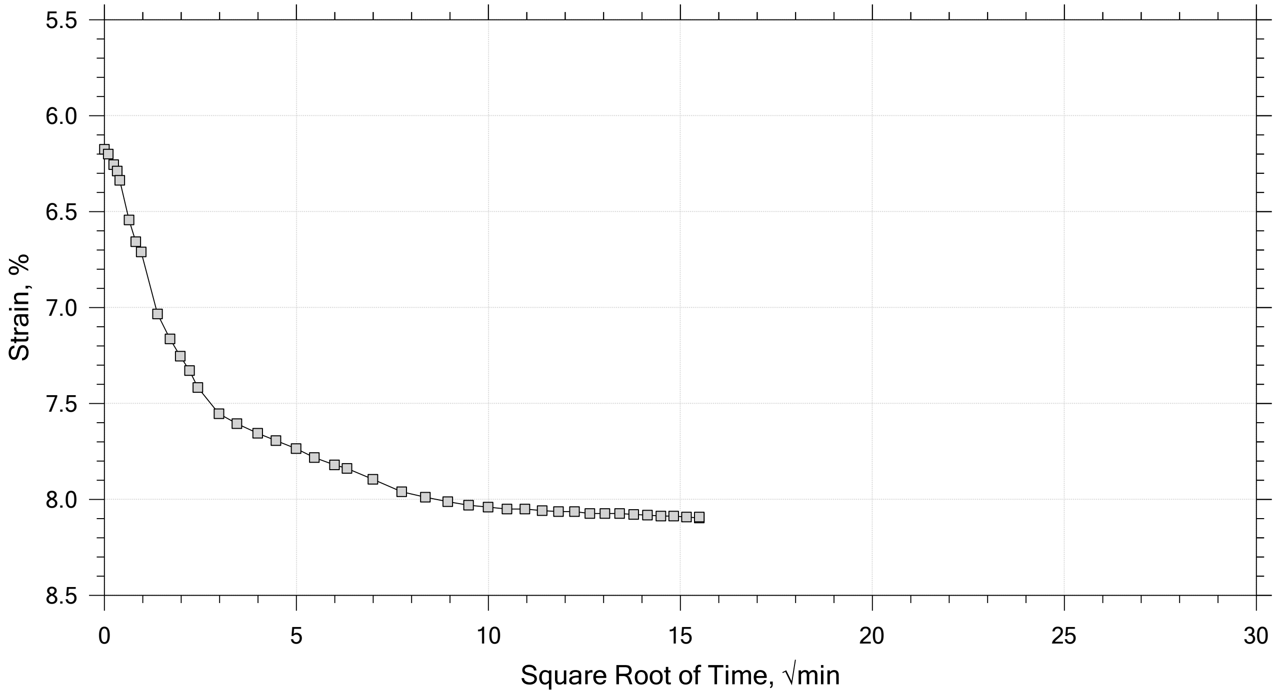
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 9 of 16

Constant Load Step

Stress: 1.6e+03 kPa

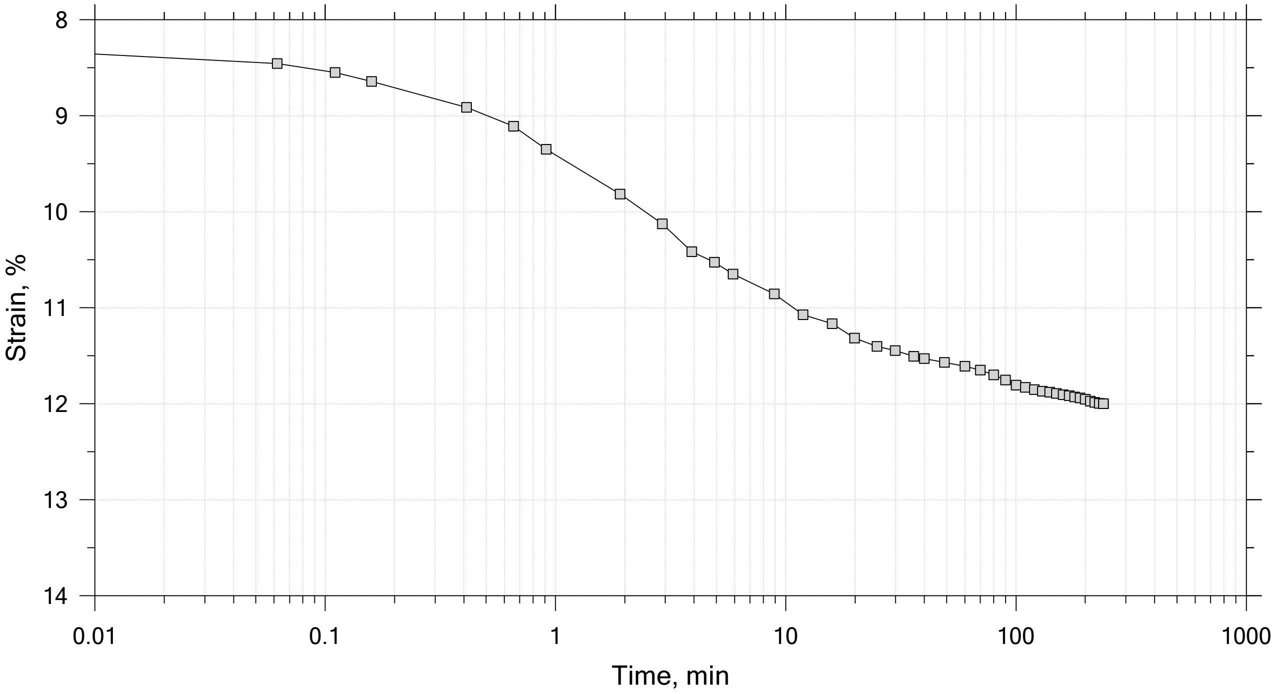


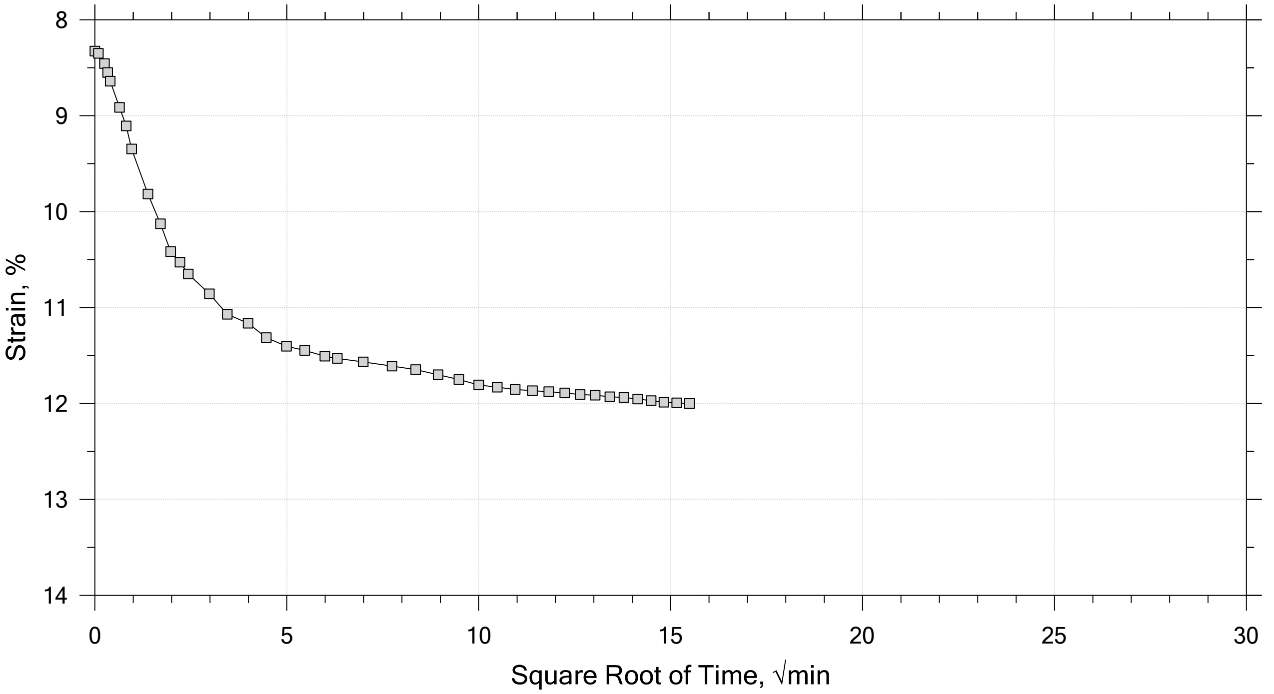


Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 32-1	Test Date: 12/2/22	Depth: 62'7"-62'9"
Test No.: IP-1	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-034, Swell Pressure = 7.19 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 10 of 16
Constant Load Step
Stress: 3.2e+03 kPa





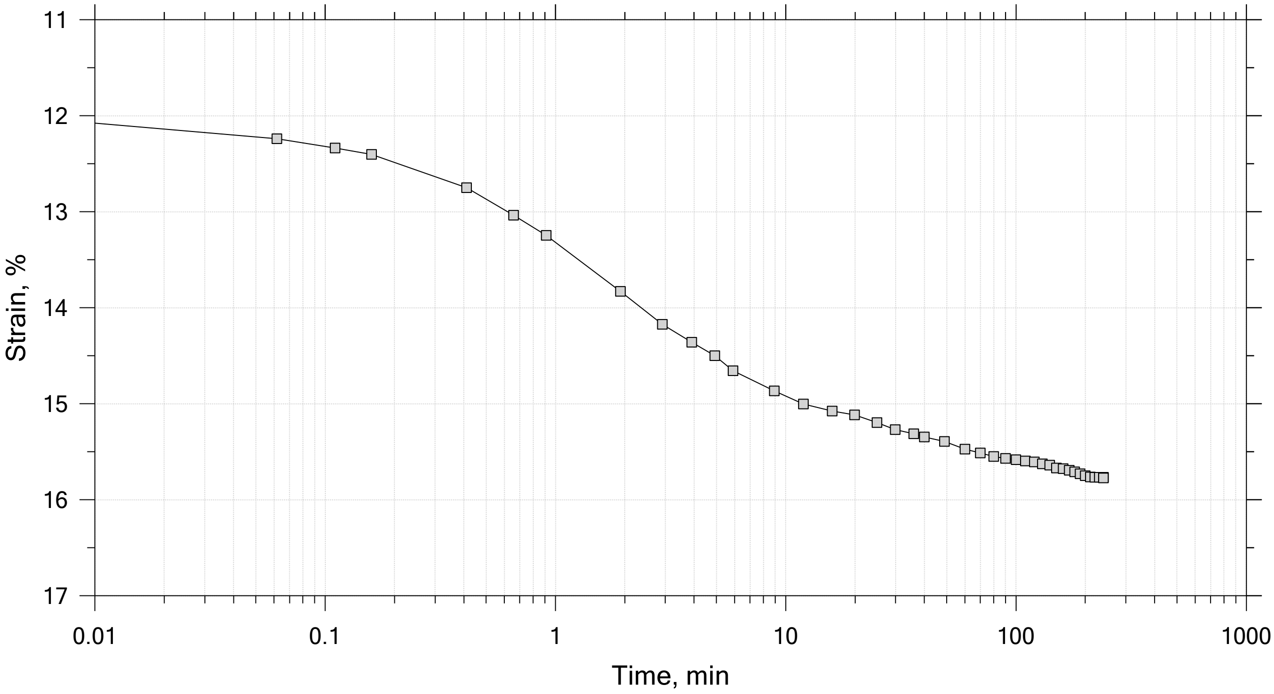
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 32-1	Test Date: 12/2/22	Depth: 62'7"-62'9"
Test No.: IP-1	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-034, Swell Pressure = 7.19 kPa		

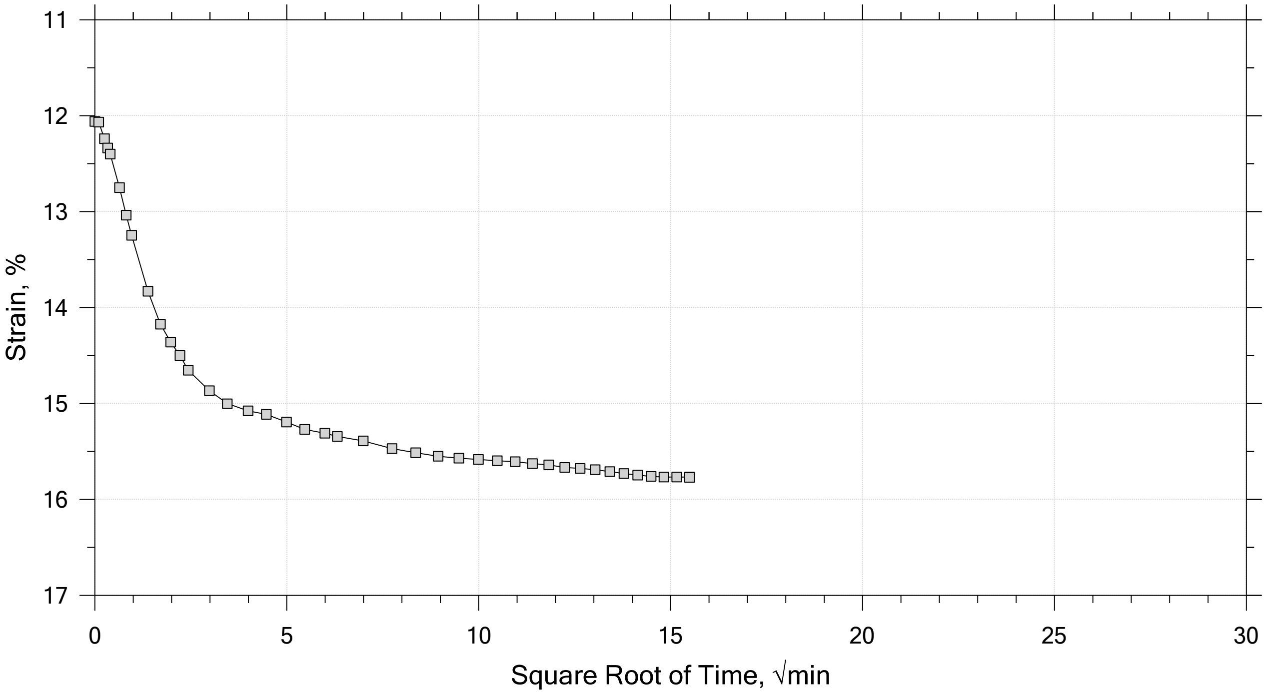
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 11 of 16

Constant Load Step

Stress: 6.4e+03 kPa

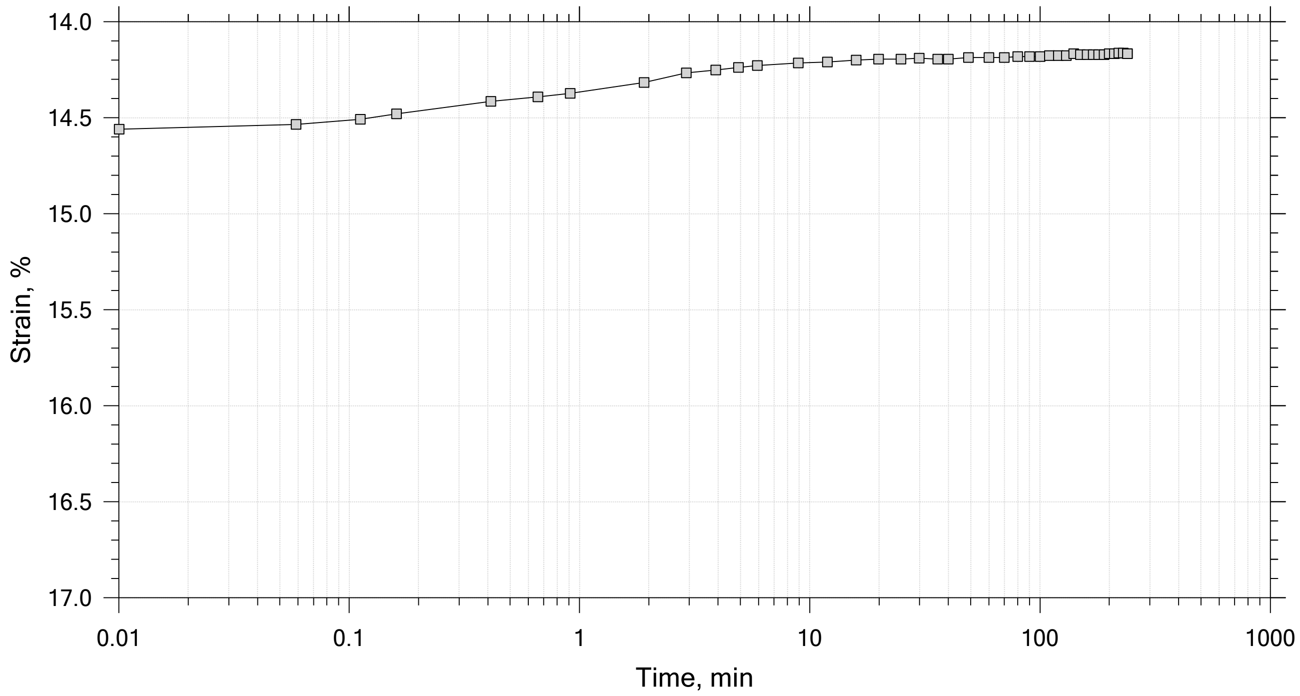


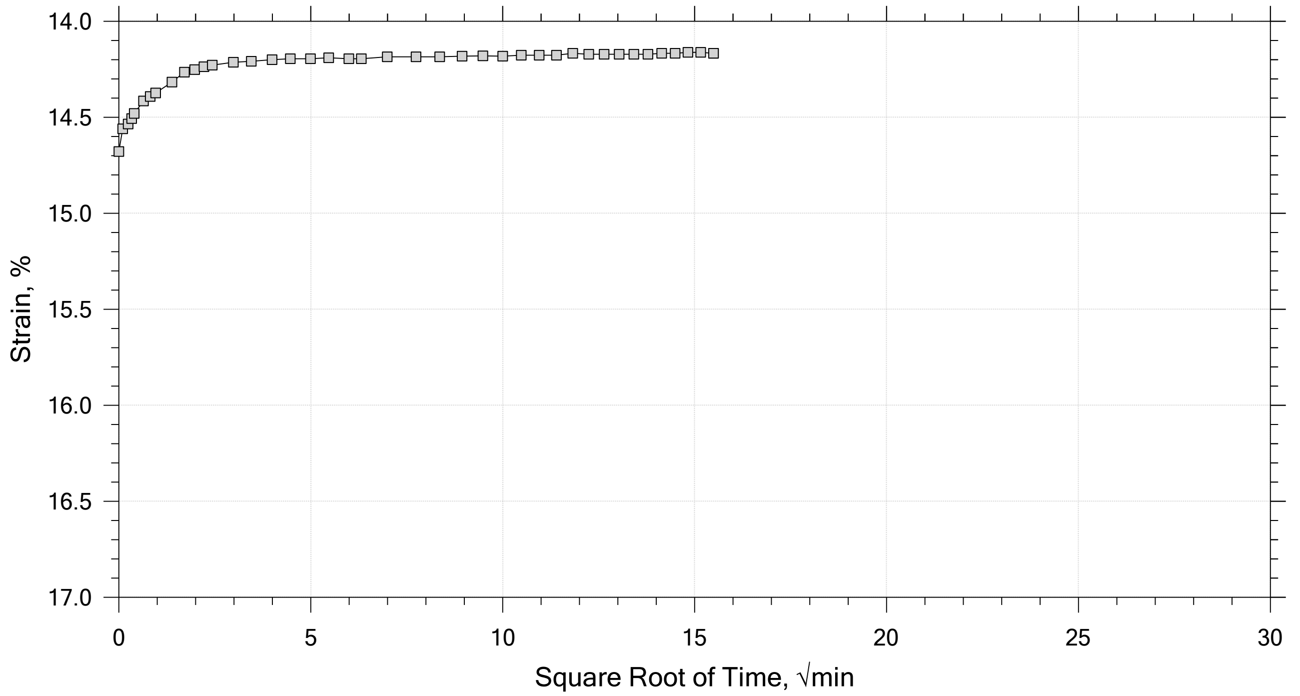


GeoTesting EXPRESS	Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH24	Tested By: trm	Checked By: anm
	Sample No.: 32-1	Test Date: 12/2/22	Depth: 62'7"-62'9"
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-034, Swell Pressure = 7.19 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 12 of 16
Constant Load Step
Stress: 1.6e+03 kPa





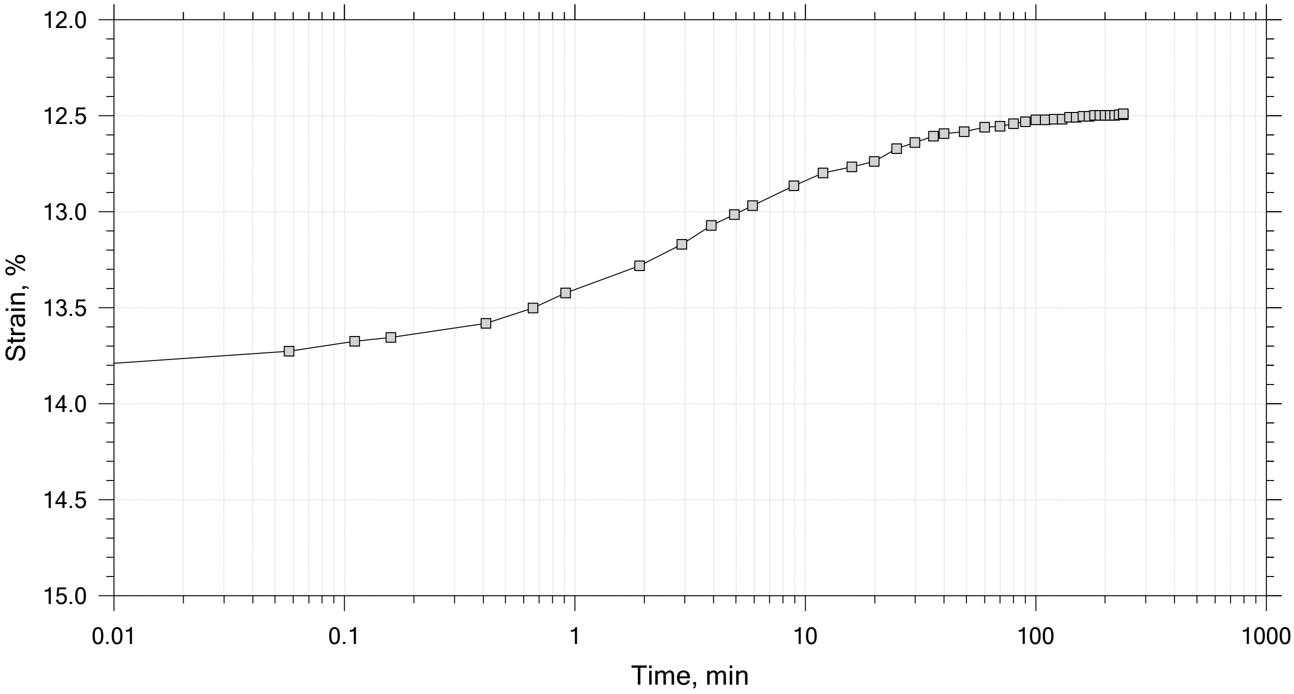
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 32-1	Test Date: 12/2/22	Depth: 62'7"-62'9"
Test No.: IP-1	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-034, Swell Pressure = 7.19 kPa		

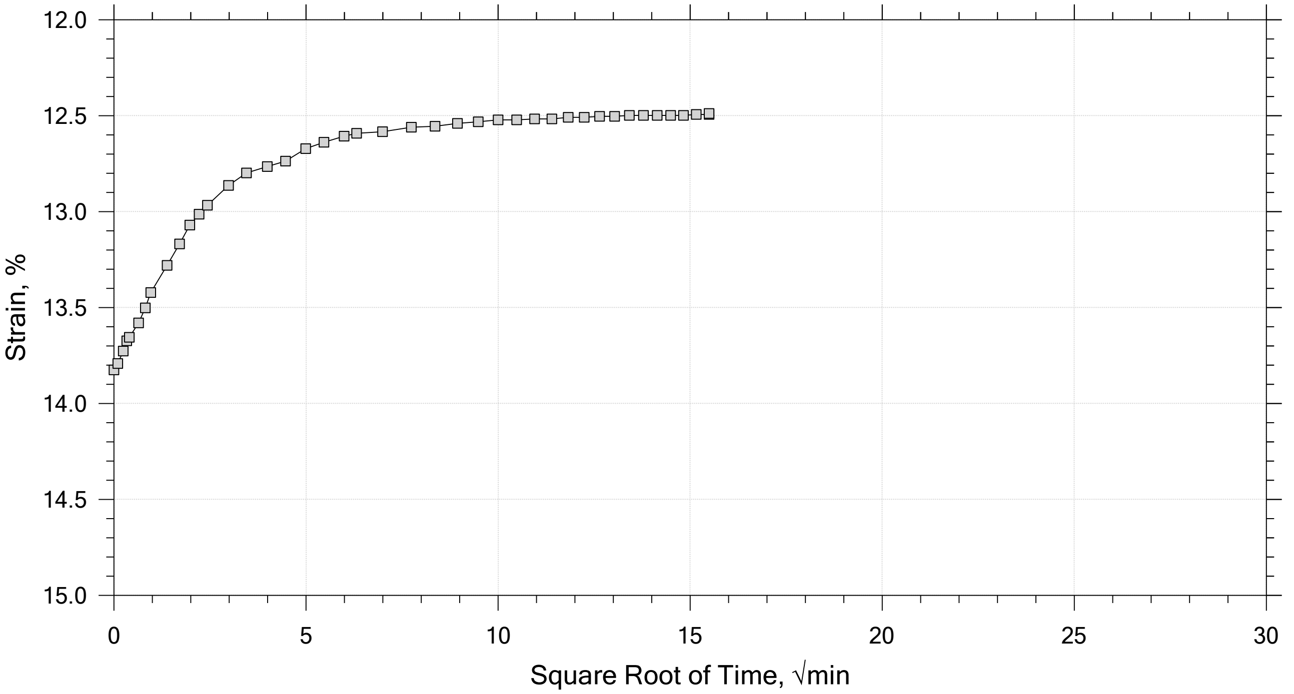
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 13 of 16

Constant Load Step

Stress: 400 kPa

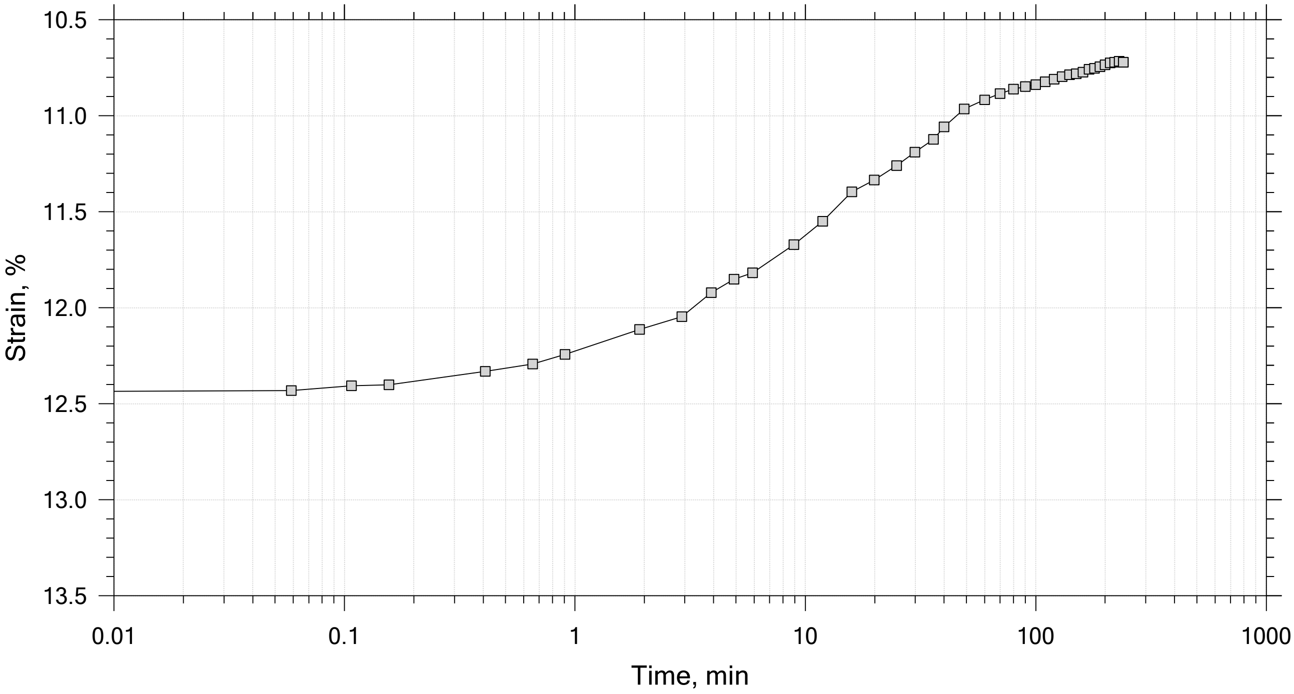


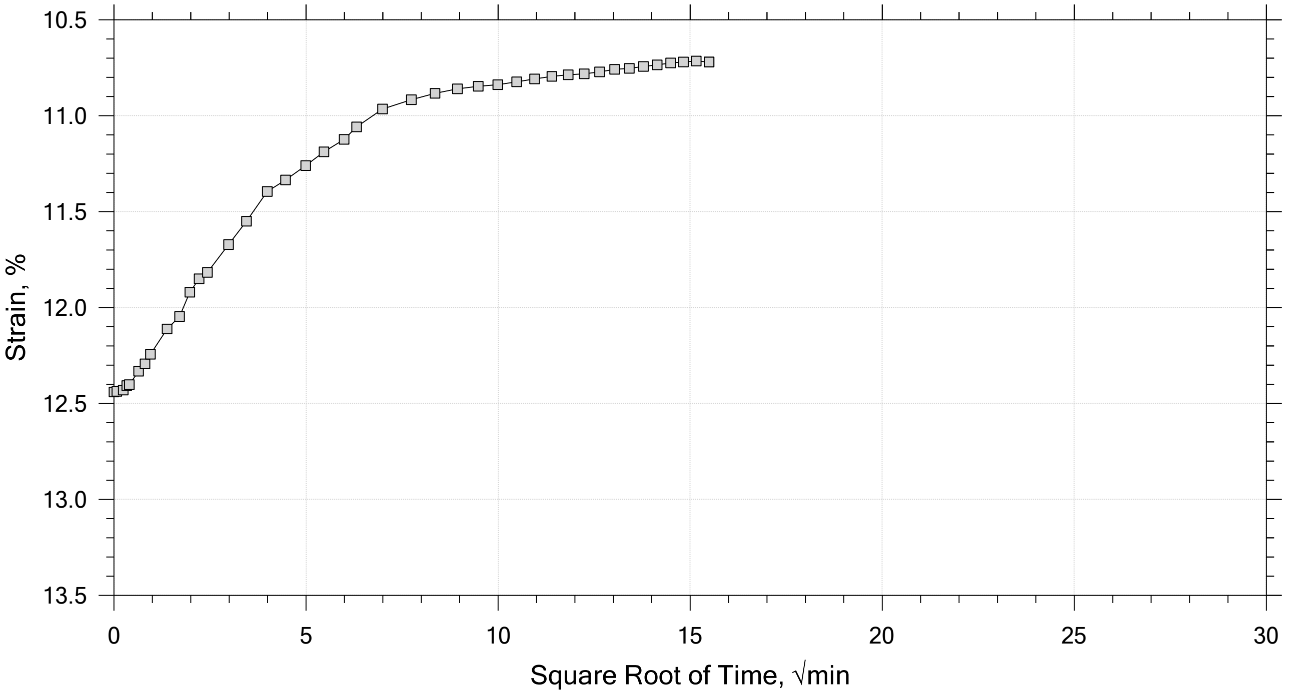


Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 32-1	Test Date: 12/2/22	Depth: 62'7"-62'9"
Test No.: IP-1	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-034, Swell Pressure = 7.19 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 14 of 16
Constant Load Step
Stress: 100 kPa





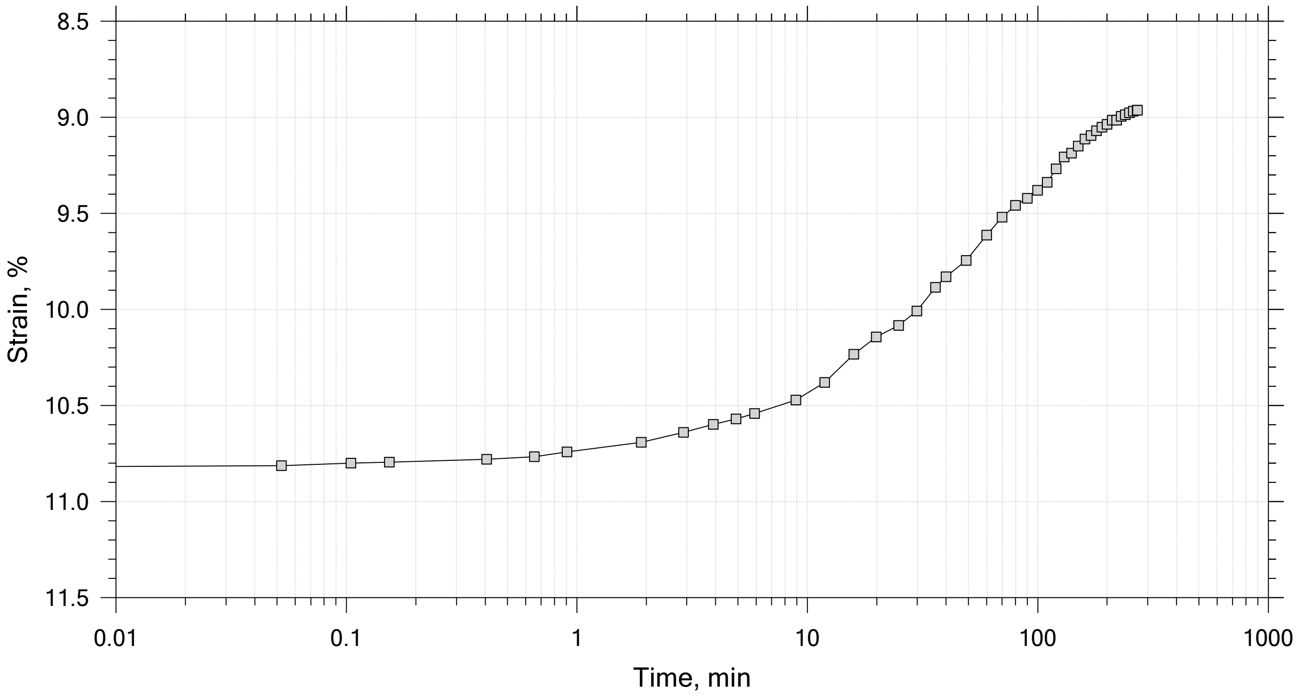
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 32-1	Test Date: 12/2/22	Depth: 62'7"-62'9"
Test No.: IP-1	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-034, Swell Pressure = 7.19 kPa		

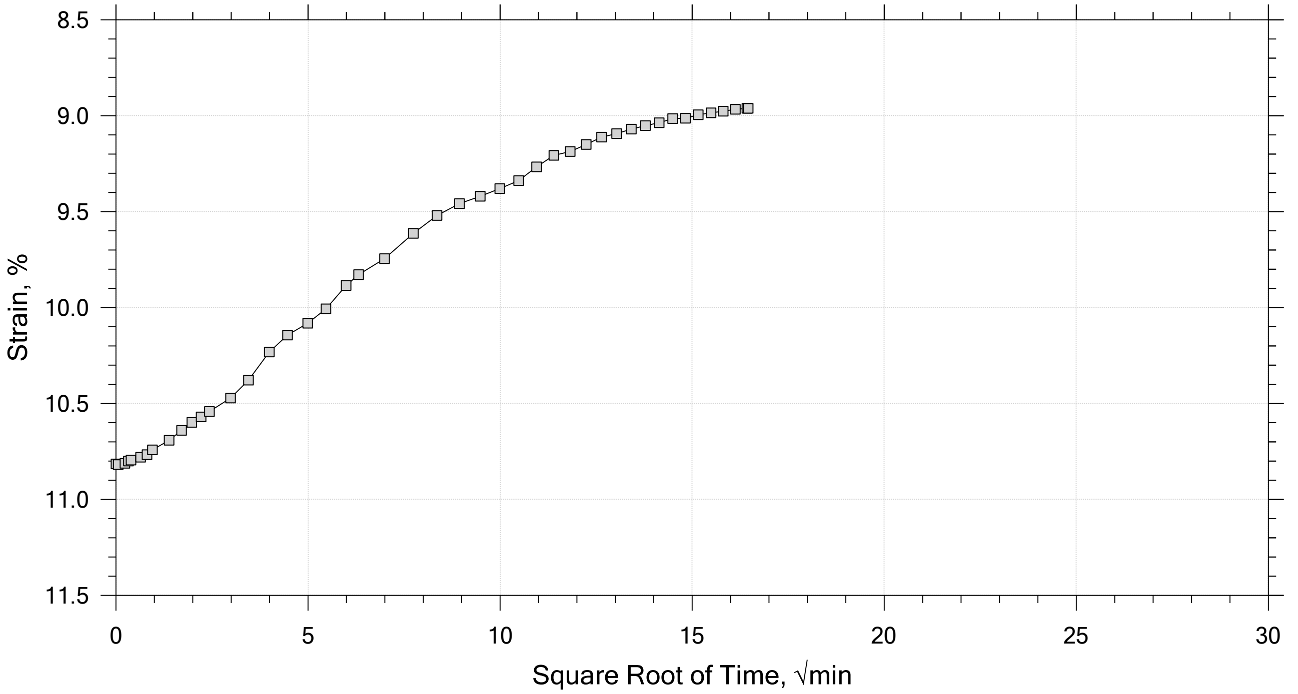
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 15 of 16

Constant Load Step

Stress: 25 kPa





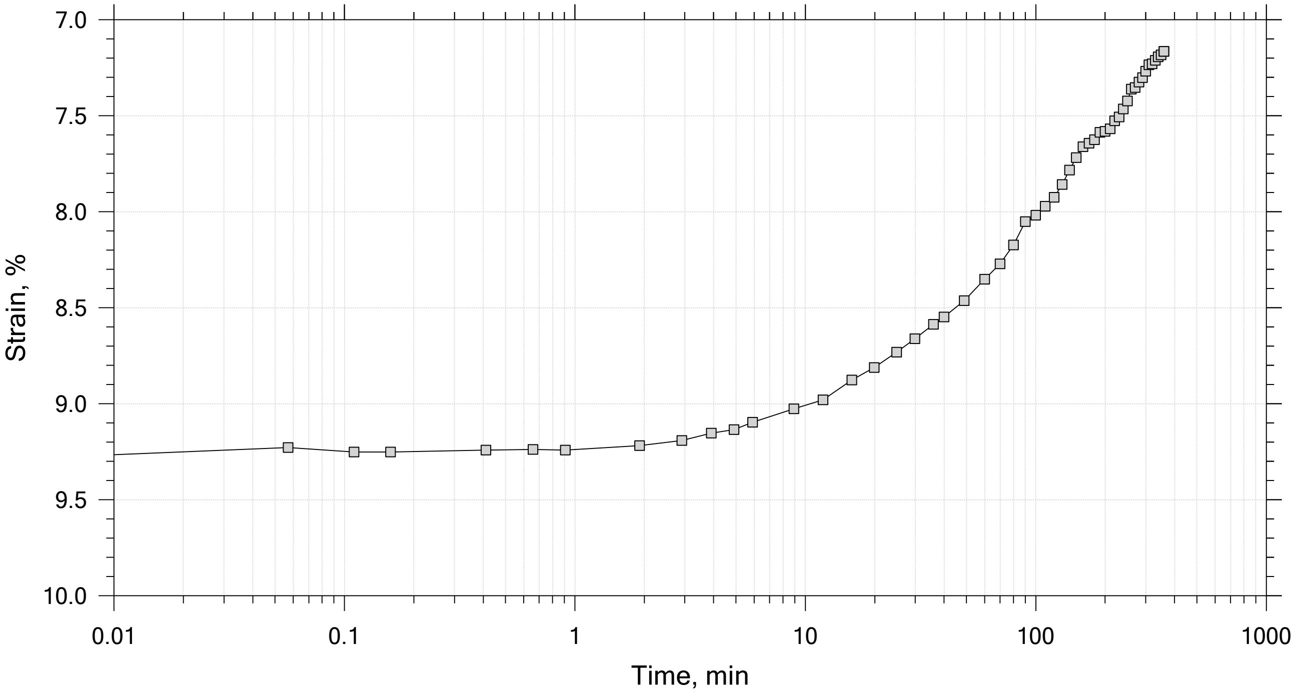
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 32-1	Test Date: 12/2/22	Depth: 62'7"-62'9"
Test No.: IP-1	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-034, Swell Pressure = 7.19 kPa		

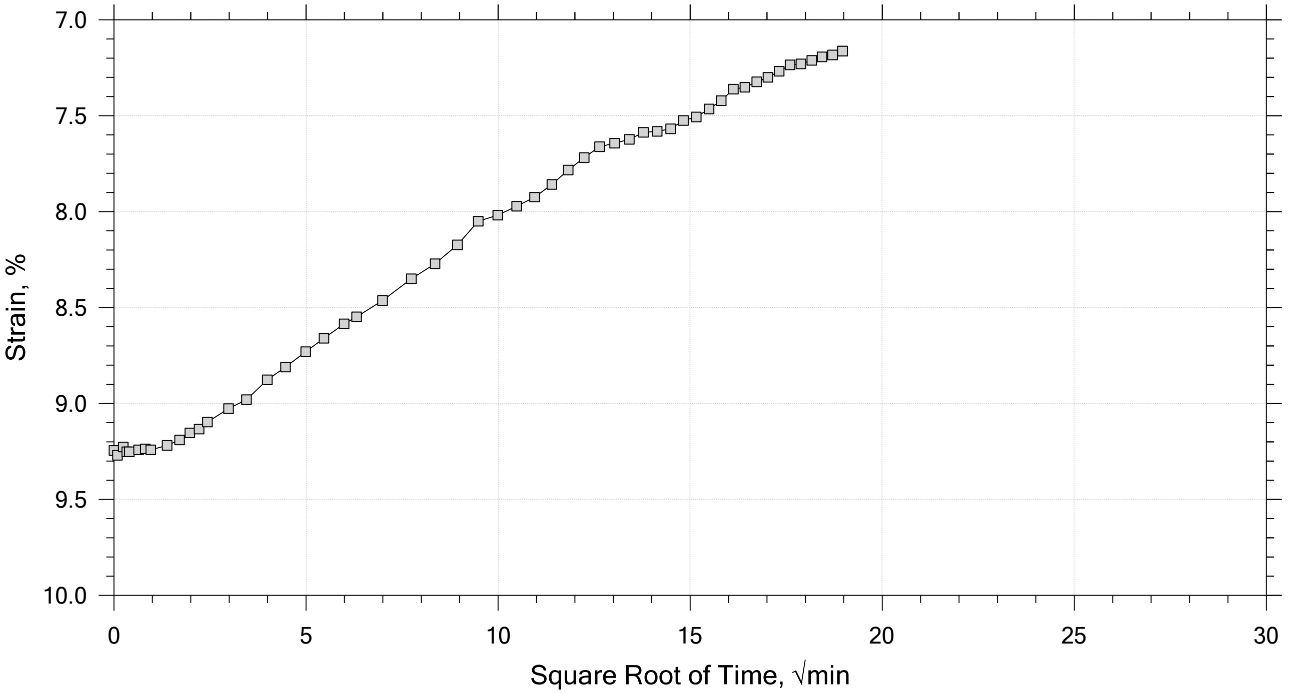
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 16 of 16

Constant Load Step

Stress: 5 kPa





Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 32-1	Test Date: 12/2/22	Depth: 62'7"-62'9"
Test No.: IP-1	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-034, Swell Pressure = 7.19 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Specimen Diameter: 6.35 cm	Estimated Specific Gravity: 2.75	Liquid Limit: ---
Initial Height: 2.54 cm	Initial Void Ratio: 0.686	Plastic Limit: ---
Final Height: 2.26 cm	Final Void Ratio: 0.5	Plasticity Index: ---

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	E0586	RING		E2508
Mass Container, gm	8.39	109.35	109.35	8.42
Mass Container + Wet Soil, gm	283.11	272.71	264.55	164.97
Mass Container + Dry Soil, gm	230.2	240.68	240.68	140.89
Mass Dry Soil, gm	221.81	131.33	131.33	132.47
Water Content, %	23.85	24.39	18.18	18.18
Void Ratio	---	0.69	0.50	---
Degree of Saturation, %	---	97.90	100.00	---
Dry Unit Weight, kN/m³	---	16.011	17.989	---

Note: Specific Gravity and Void Ratios are calculated assuming the degree of saturation equals 100% at the end of the test.
Therefore, values may not represent actual values for the specimen.

Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 32-1	Test Date: 12/2/22	Depth: 62'7"-62'9"
Test No.: IP-1	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-034, Swell Pressure = 7.19 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

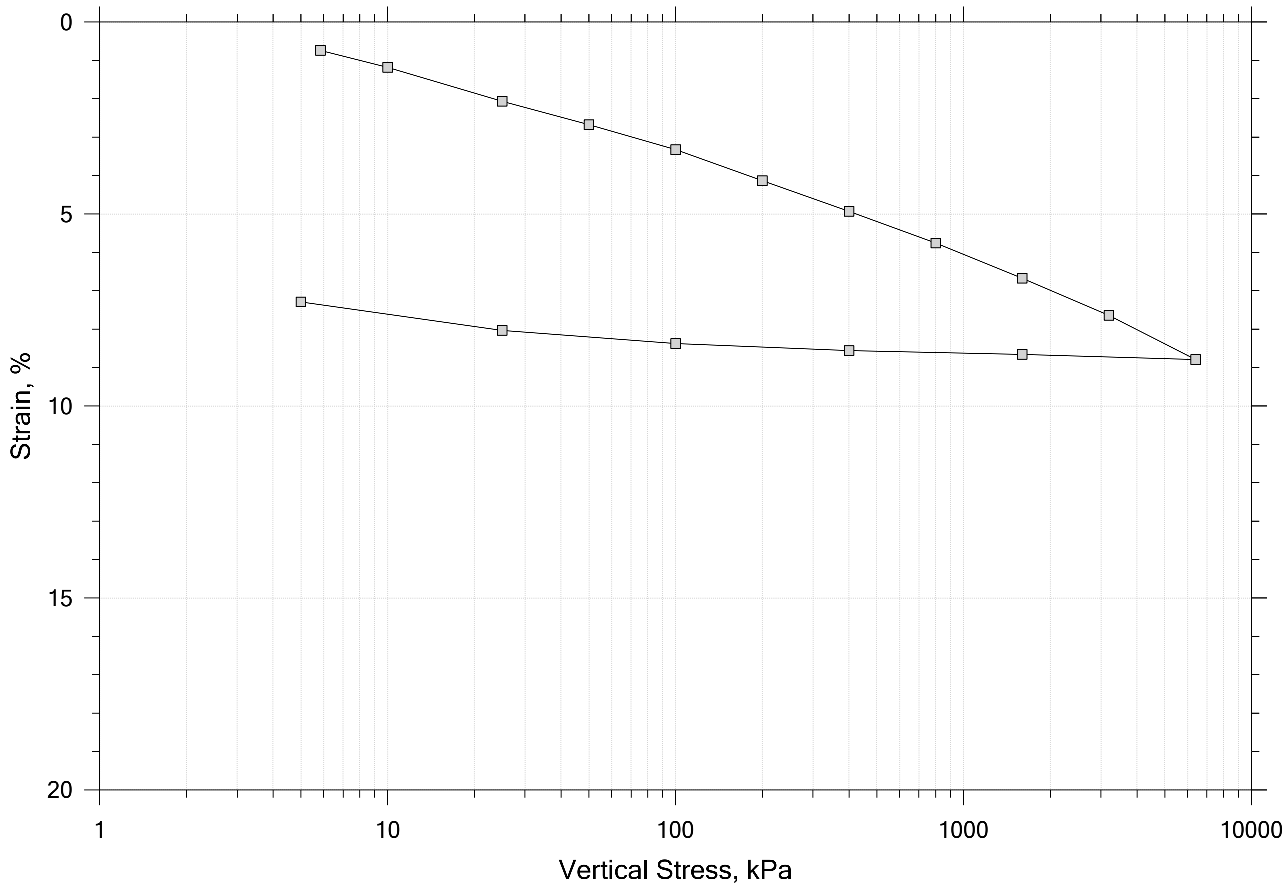
Square Root of Time Coefficients

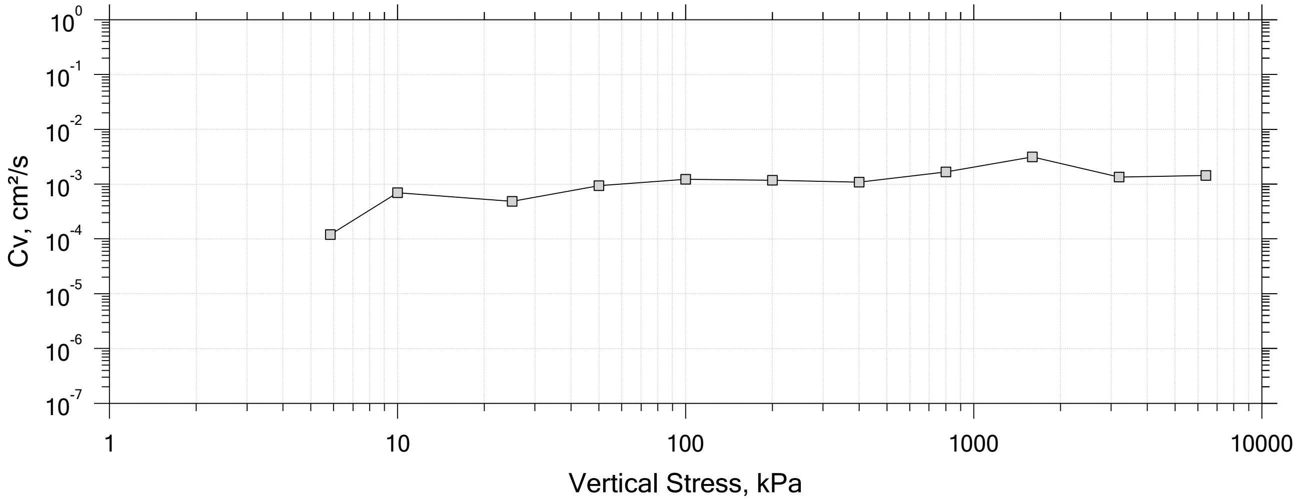
Step	Applied Stress kPa	Final Displacement cm	Void Ratio	Strain at End %	Sq.Rt. T90 min	Cv cm²/s	Mv 1/kPa	k cm/s
1	7.19	0.002204	0.684	0.0868	0.209	1.09e-01	1.21e-04	1.29e-06
2	10.0	0.002876	0.684	0.113	139.691	1.63e-04	9.43e-05	1.51e-09
3	25.0	0.01109	0.678	0.437	9.977	2.27e-03	2.16e-04	4.80e-08
4	50.0	0.03025	0.666	1.19	33.629	6.67e-04	3.02e-04	1.97e-08
5	100.	0.05387	0.650	2.12	11.426	1.93e-03	1.86e-04	3.52e-08
6	200.	0.08286	0.631	3.26	8.891	2.43e-03	1.14e-04	2.72e-08
7	400.	0.1124	0.611	4.43	10.445	2.02e-03	5.81e-05	1.15e-08
8	800.	0.1509	0.586	5.94	13.654	1.50e-03	3.79e-05	5.57e-09
9	1.60e+03	0.2055	0.549	8.09	9.077	2.17e-03	2.69e-05	5.73e-09
10	3.20e+03	0.3048	0.483	12.0	11.365	1.62e-03	2.44e-05	3.89e-09
11	6.40e+03	0.4006	0.420	15.8	7.846	2.15e-03	1.18e-05	2.49e-09
12	1.60e+03	0.3598	0.447	14.2	3.848	4.28e-03	3.34e-06	1.40e-09
13	400.	0.3172	0.475	12.5	8.475	2.02e-03	1.40e-05	2.77e-09
14	100.	0.2723	0.505	10.7	49.172	3.62e-04	5.90e-05	2.09e-09
15	25.0	0.2276	0.535	8.96	176.490	1.05e-04	2.34e-04	2.41e-09
16	5.00	0.1820	0.565	7.16	320.341	6.01e-05	8.99e-04	5.30e-09

Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 32-1	Test Date: 12/2/22	Depth: 62'7"-62'9"
Test No.: IP-1	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-034, Swell Pressure = 7.19 kPa		
Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Summary Report





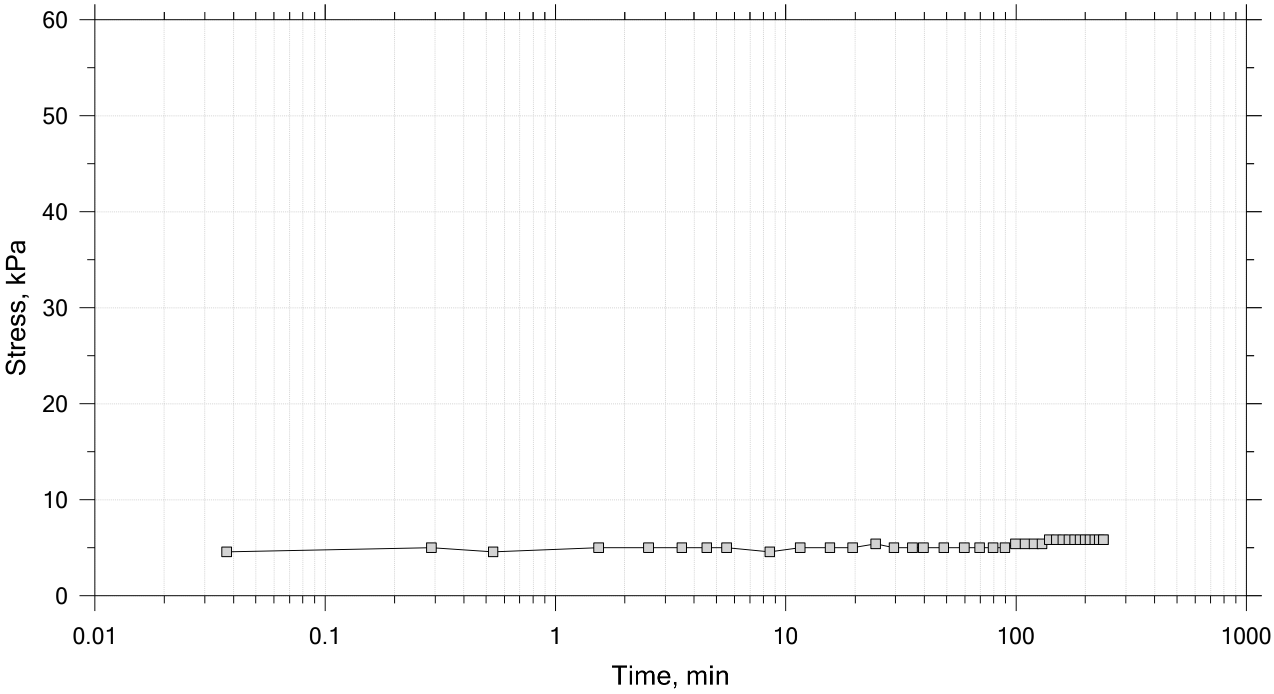
GeoTesting EXPRESS	Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH24	Tested By: trm	Checked By: anm
	Sample No.: 33-1	Test Date: 12/2/22	Depth: 65'4"-65'6"
	Test No.: IP-3	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-001, Swell Pressure = 5.84 kPa		
	Displacement at End of Increment		

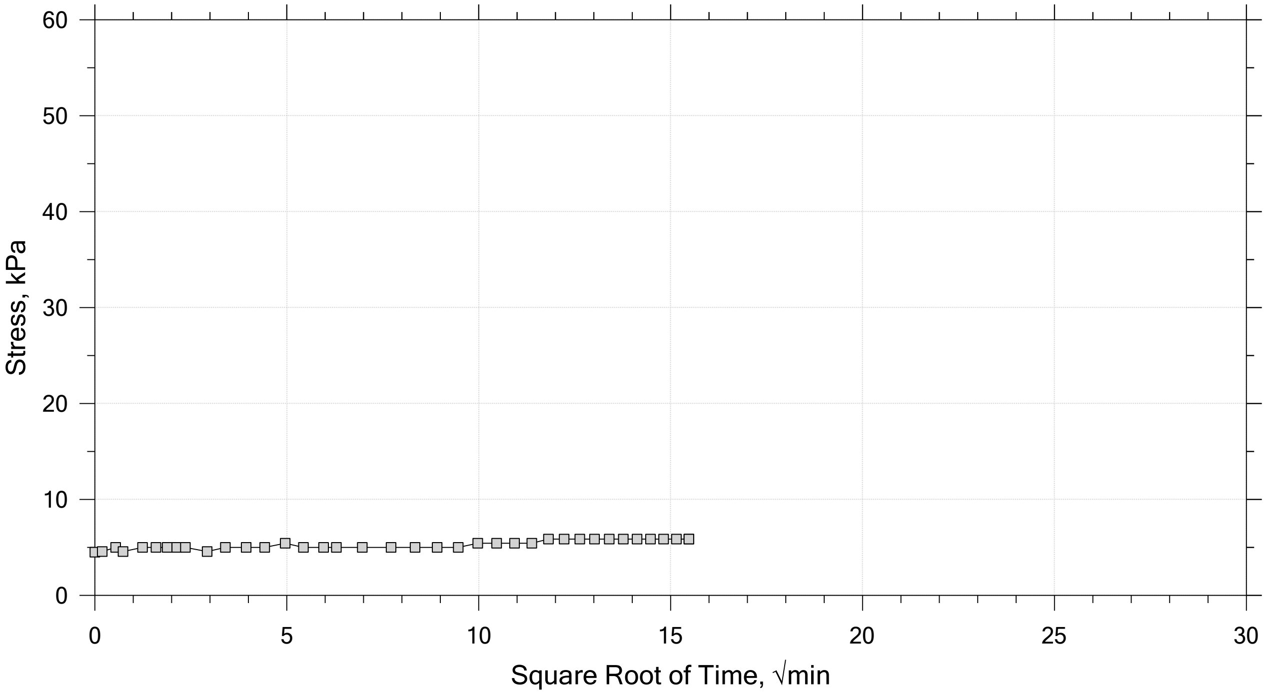
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 1 of 16

Constant Volume Step

Stress: 5.84 kPa





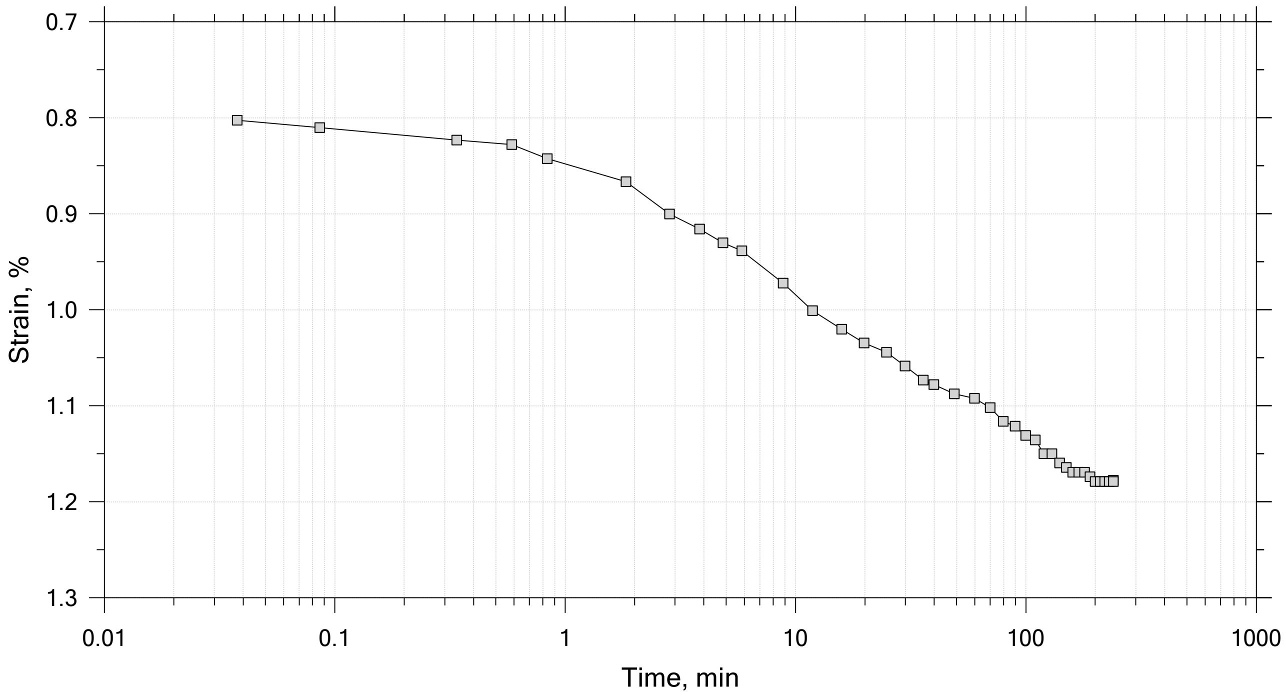
GeoTesting EXPRESS	Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH24	Tested By: trm	Checked By: anm
	Sample No.: 33-1	Test Date: 12/2/22	Depth: 65'4"-65'6"
	Test No.: IP-3	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-001, Swell Pressure = 5.84 kPa		

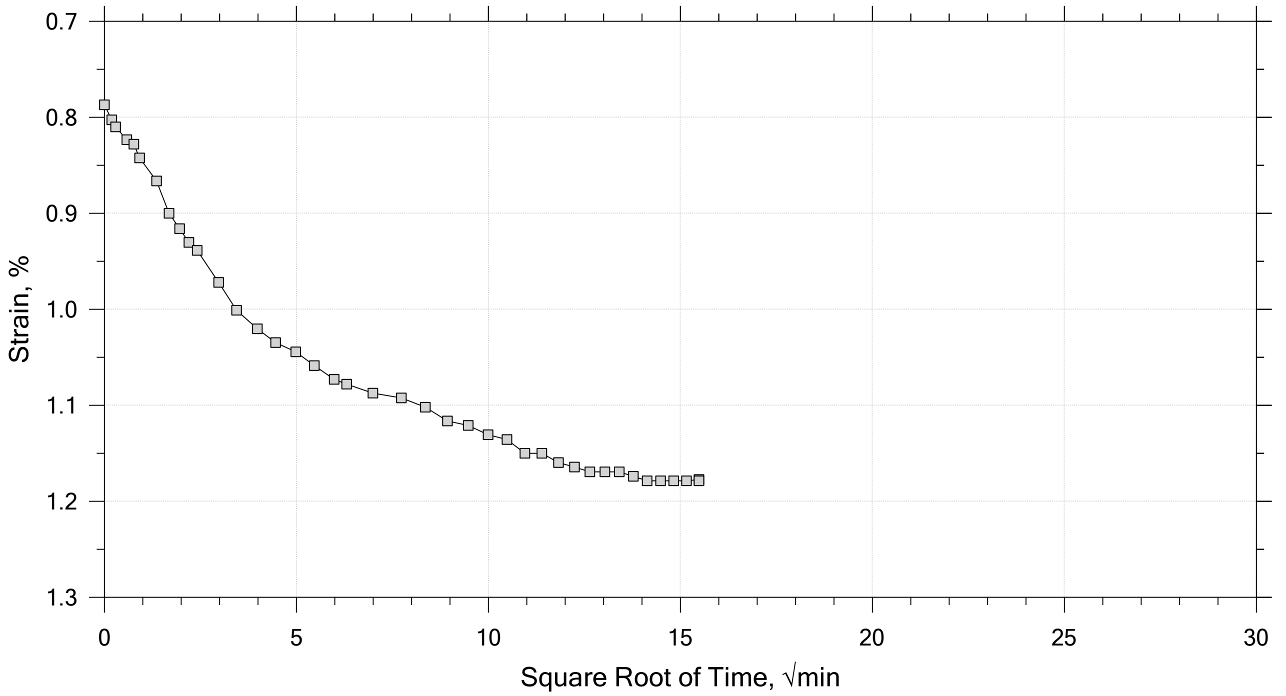
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 2 of 16

Constant Load Step

Stress: 10 kPa

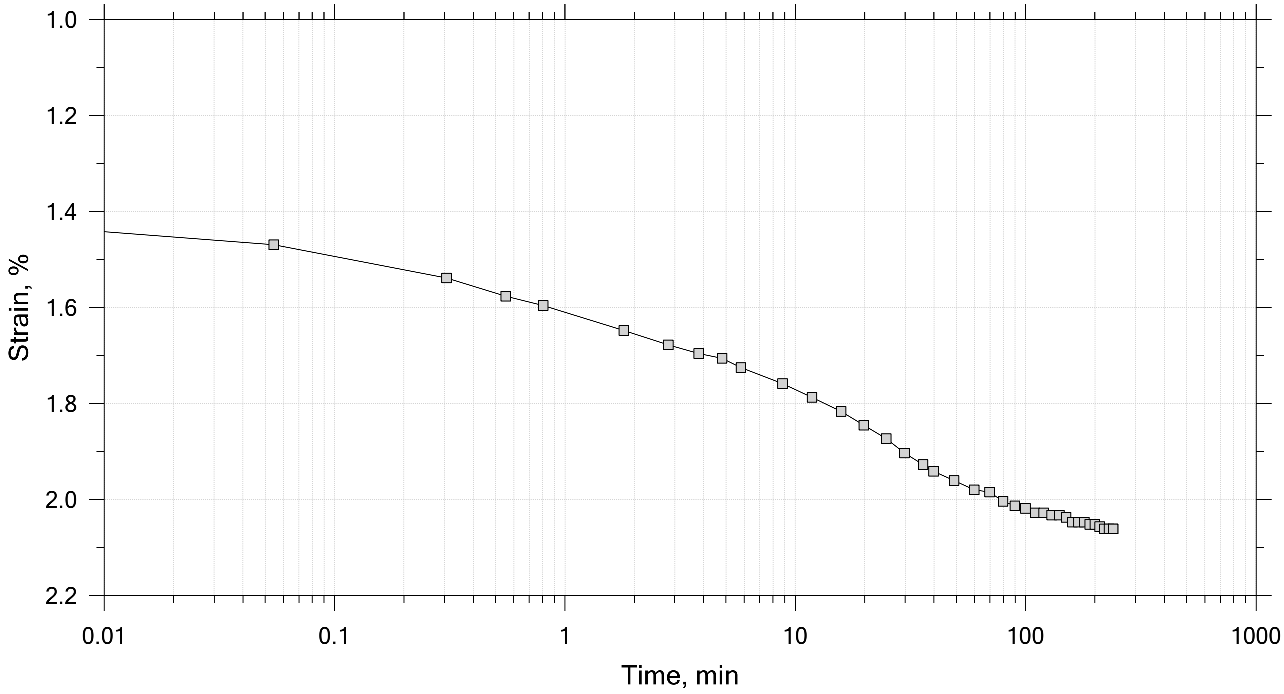


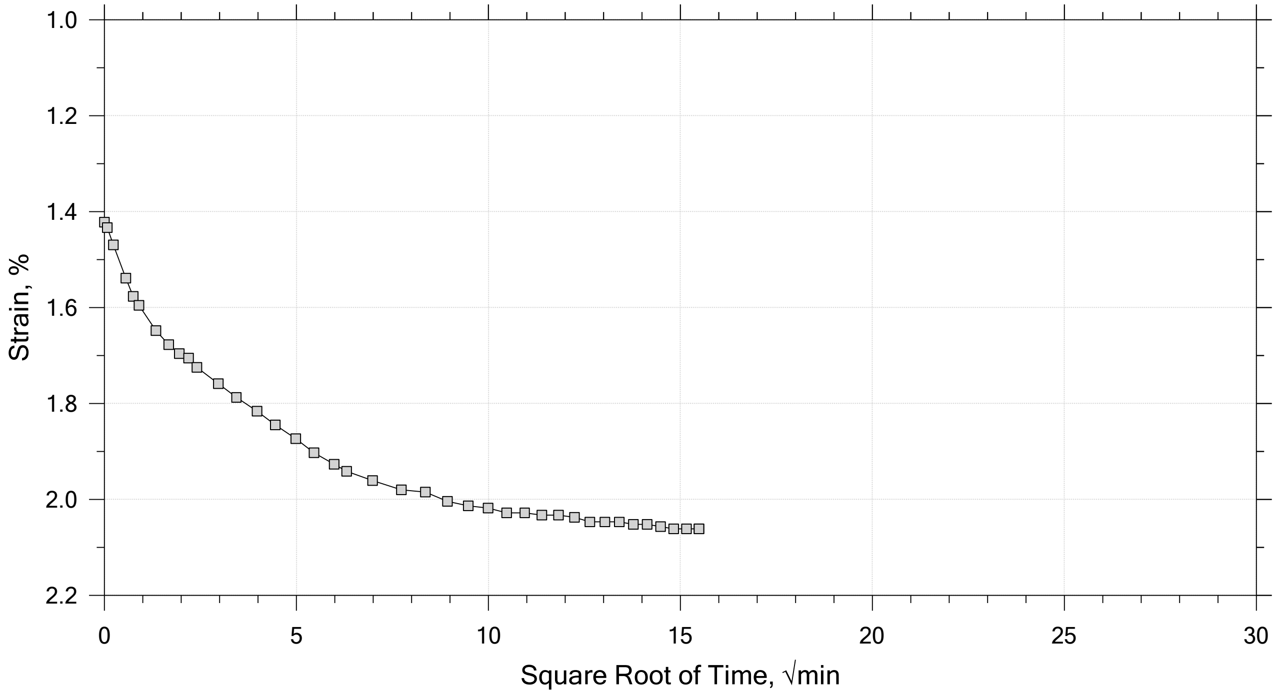


Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 33-1	Test Date: 12/2/22	Depth: 65'4"-65'6"
Test No.: IP-3	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 5.84 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 3 of 16
Constant Load Step
Stress: 25 kPa





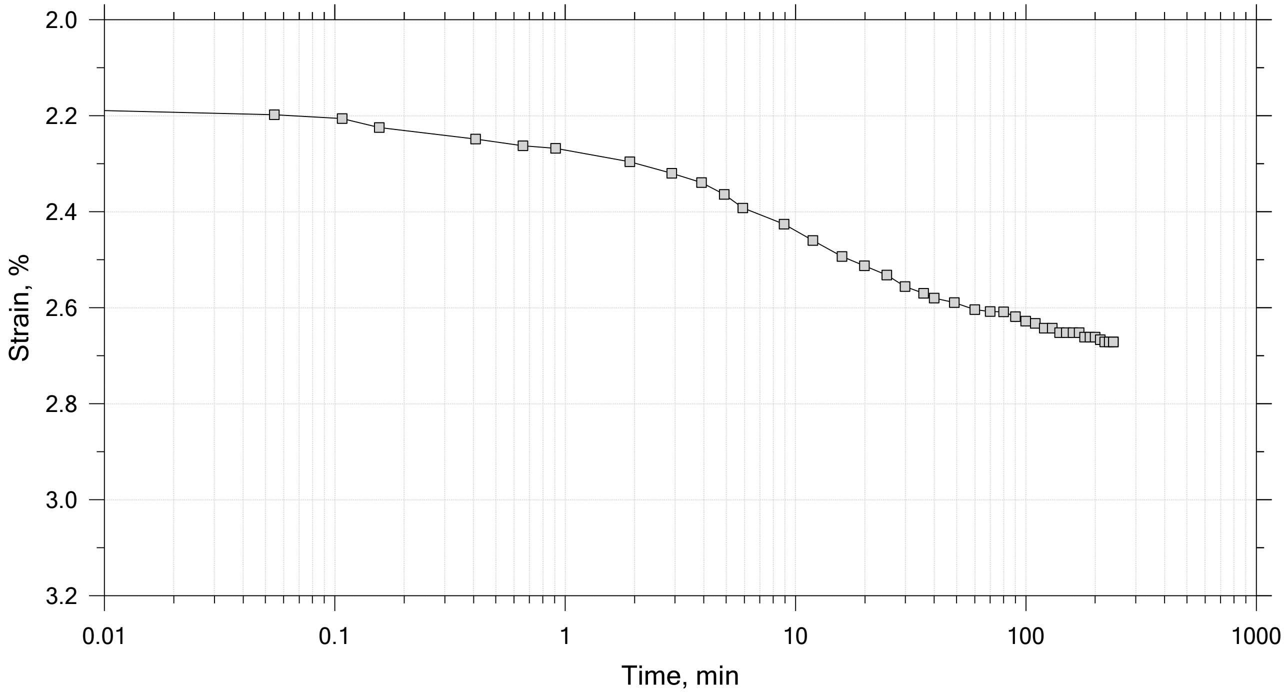
GeoTesting EXPRESS	Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH24	Tested By: trm	Checked By: anm
	Sample No.: 33-1	Test Date: 12/2/22	Depth: 65'4"-65'6"
	Test No.: IP-3	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-001, Swell Pressure = 5.84 kPa		

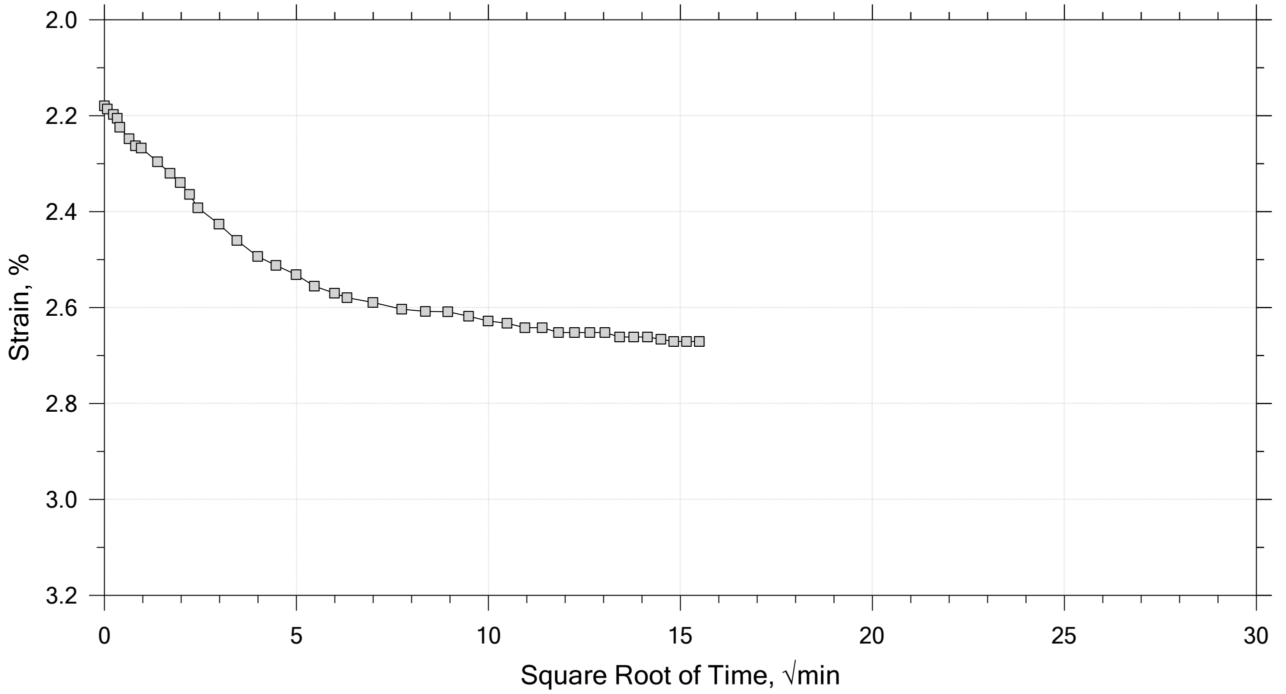
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 4 of 16

Constant Load Step

Stress: 50 kPa

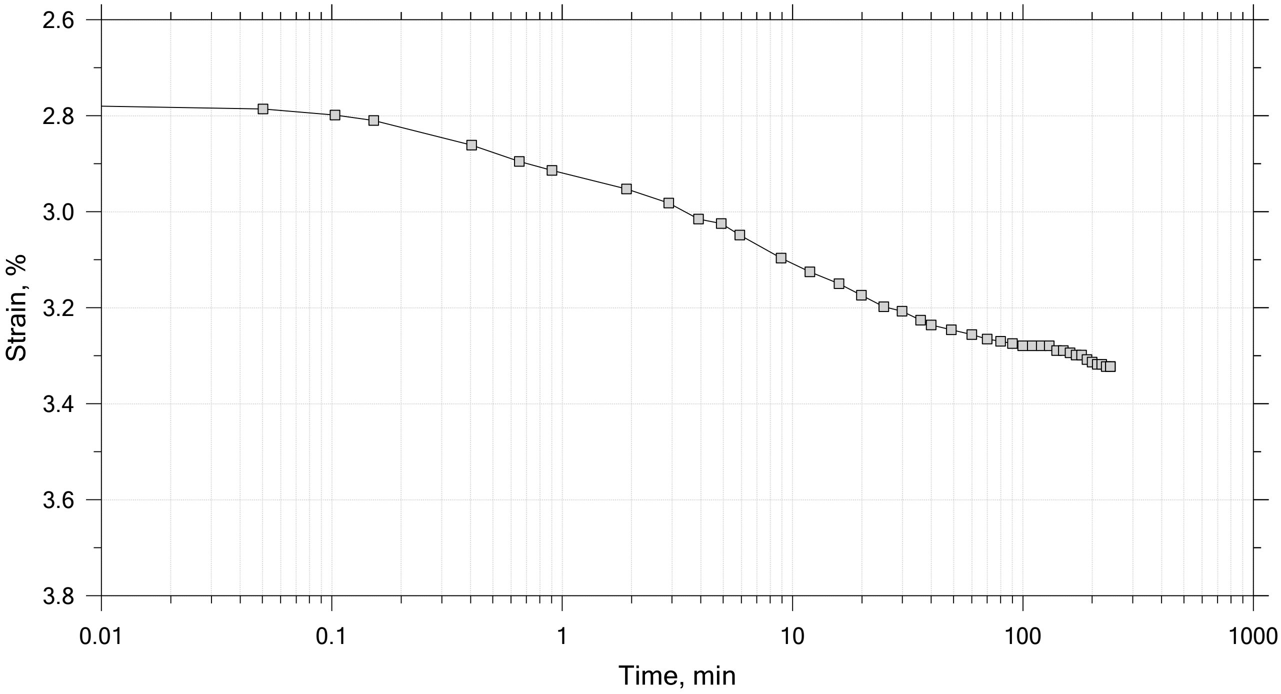


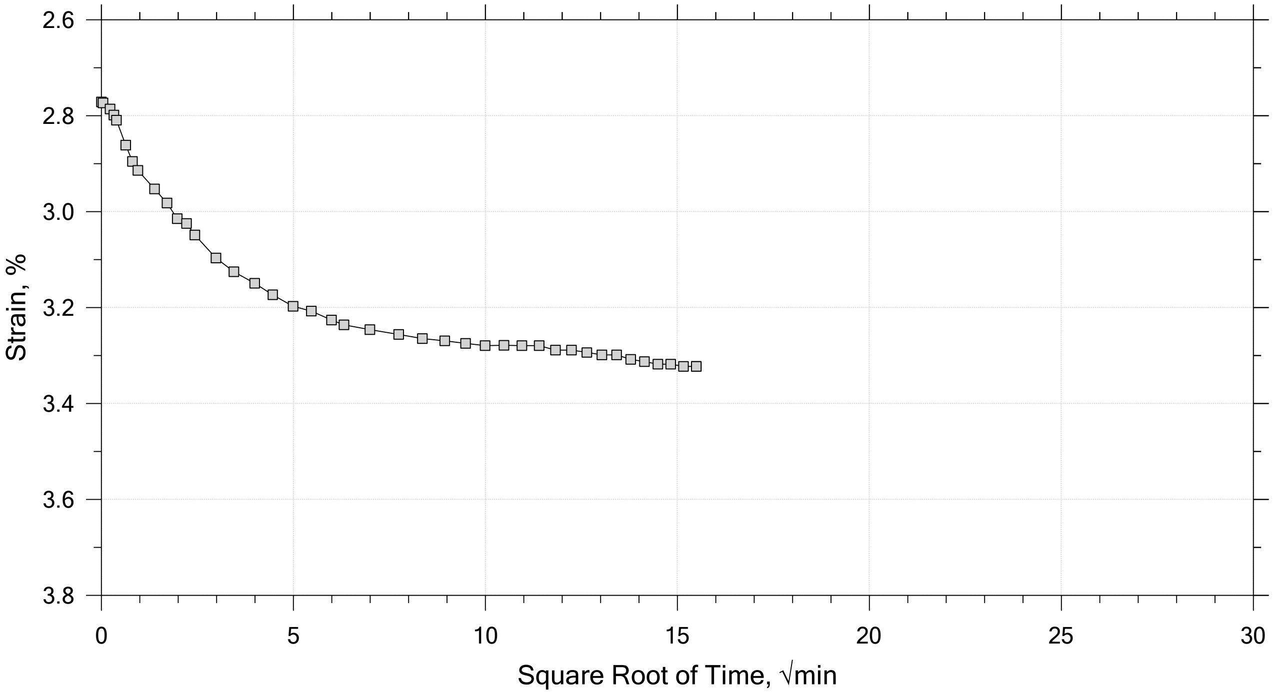


Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 33-1	Test Date: 12/2/22	Depth: 65'4"-65'6"
Test No.: IP-3	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 5.84 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 5 of 16
Constant Load Step
Stress: 100 kPa





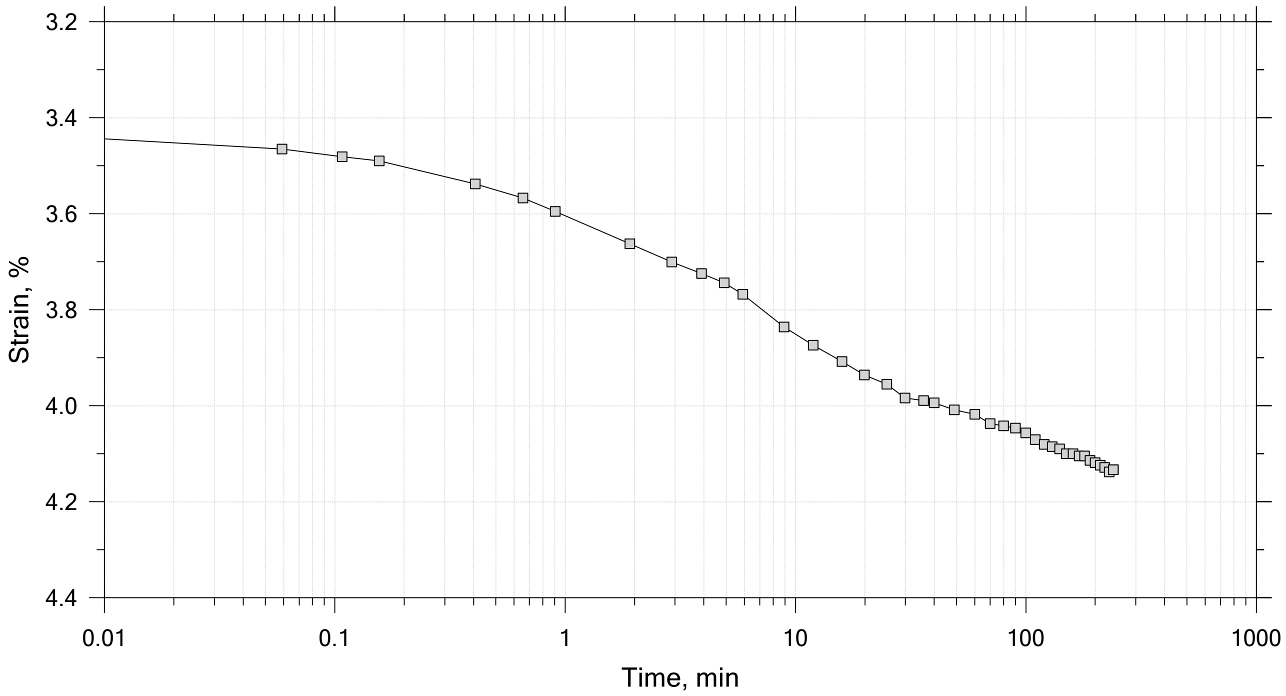
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 33-1	Test Date: 12/2/22	Depth: 65'4"-65'6"
Test No.: IP-3	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 5.84 kPa		

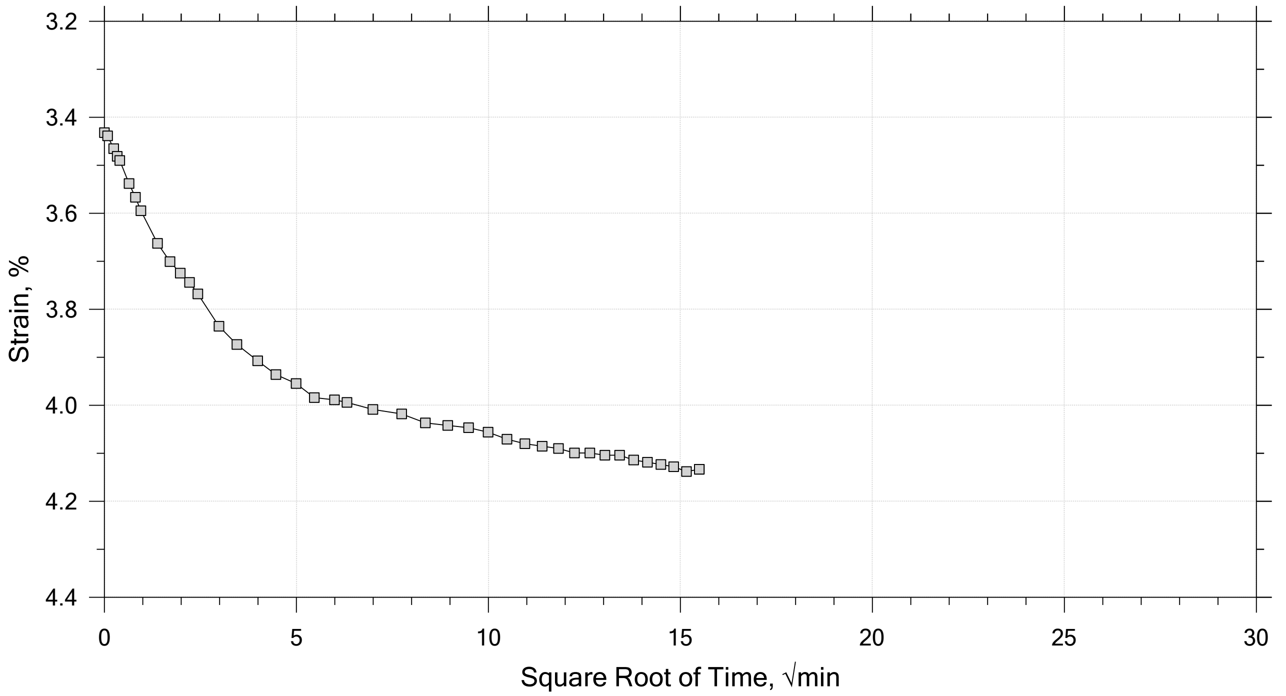
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 6 of 16

Constant Load Step

Stress: 200 kPa





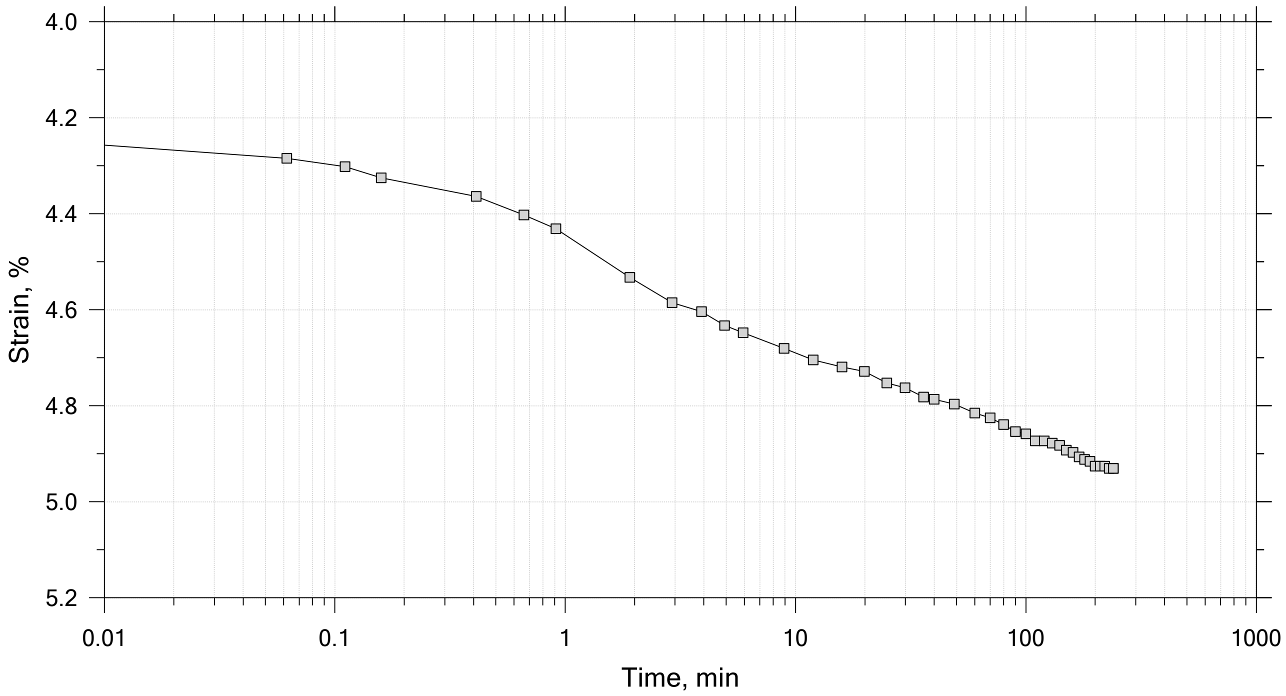
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 33-1	Test Date: 12/2/22	Depth: 65'4"-65'6"
Test No.: IP-3	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 5.84 kPa		

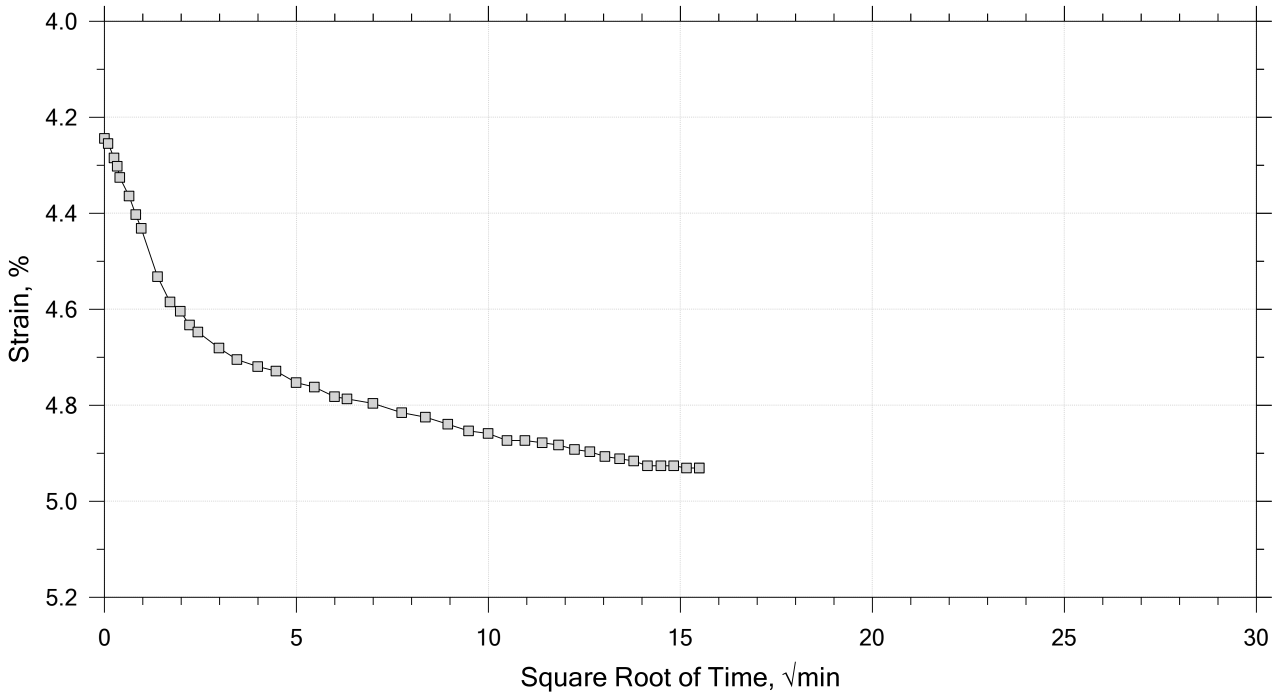
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 7 of 16

Constant Load Step

Stress: 400 kPa





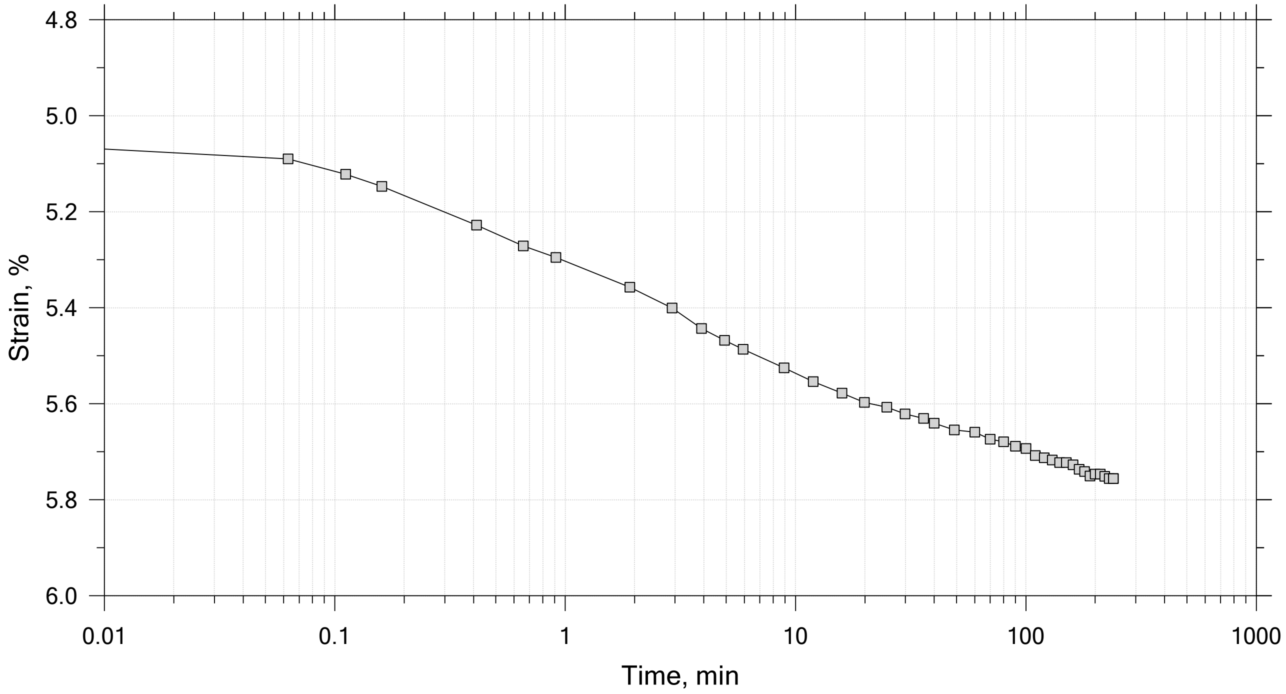
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 33-1	Test Date: 12/2/22	Depth: 65'4"-65'6"
Test No.: IP-3	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 5.84 kPa		

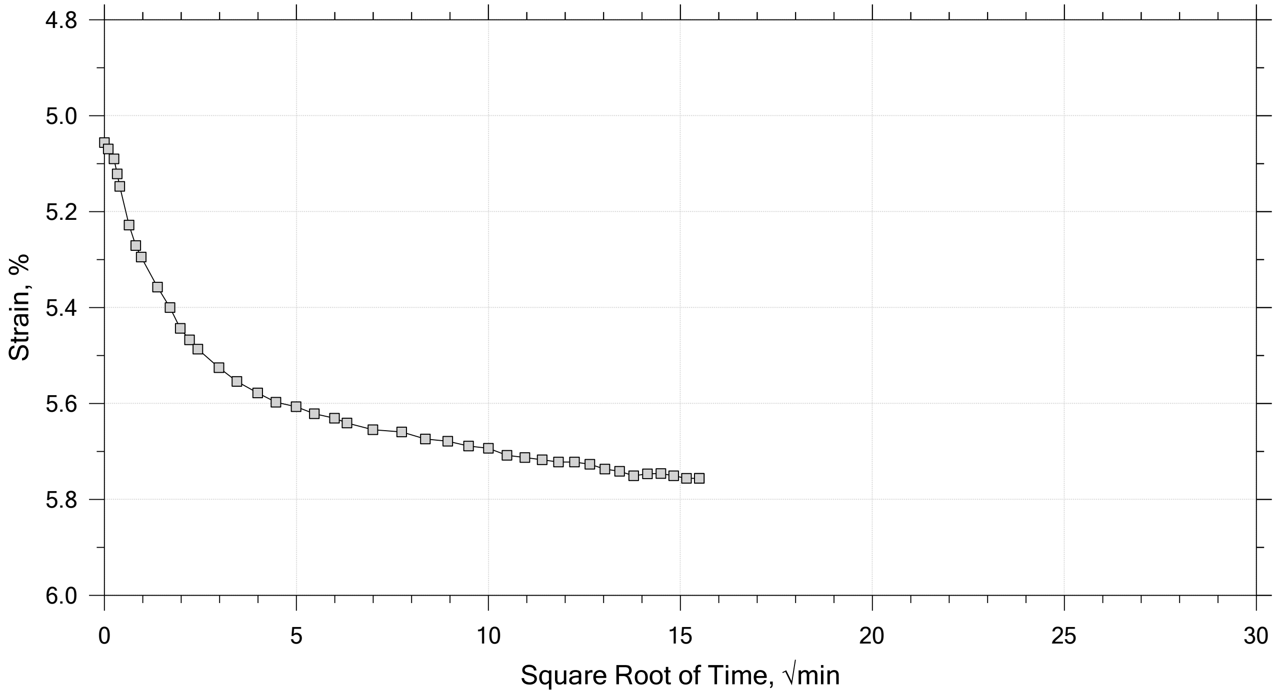
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 8 of 16

Constant Load Step

Stress: 800 kPa





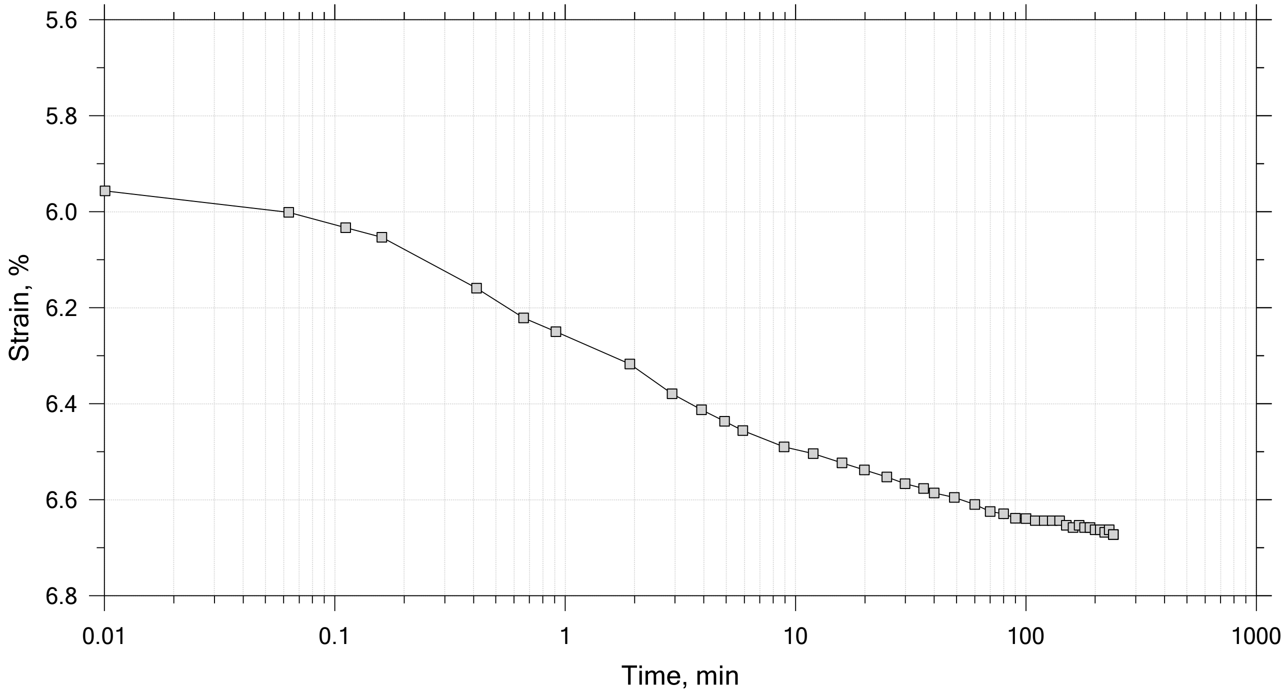
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 33-1	Test Date: 12/2/22	Depth: 65'4"-65'6"
Test No.: IP-3	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 5.84 kPa		

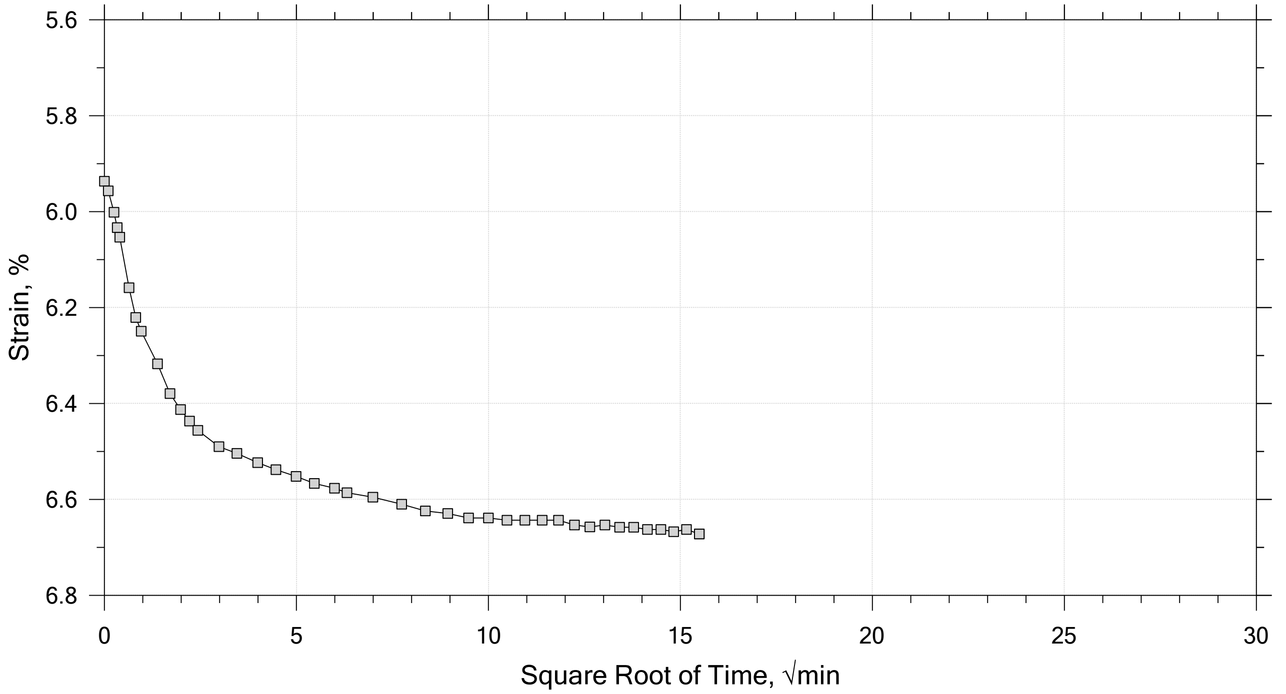
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 9 of 16

Constant Load Step

Stress: 1.6e+03 kPa

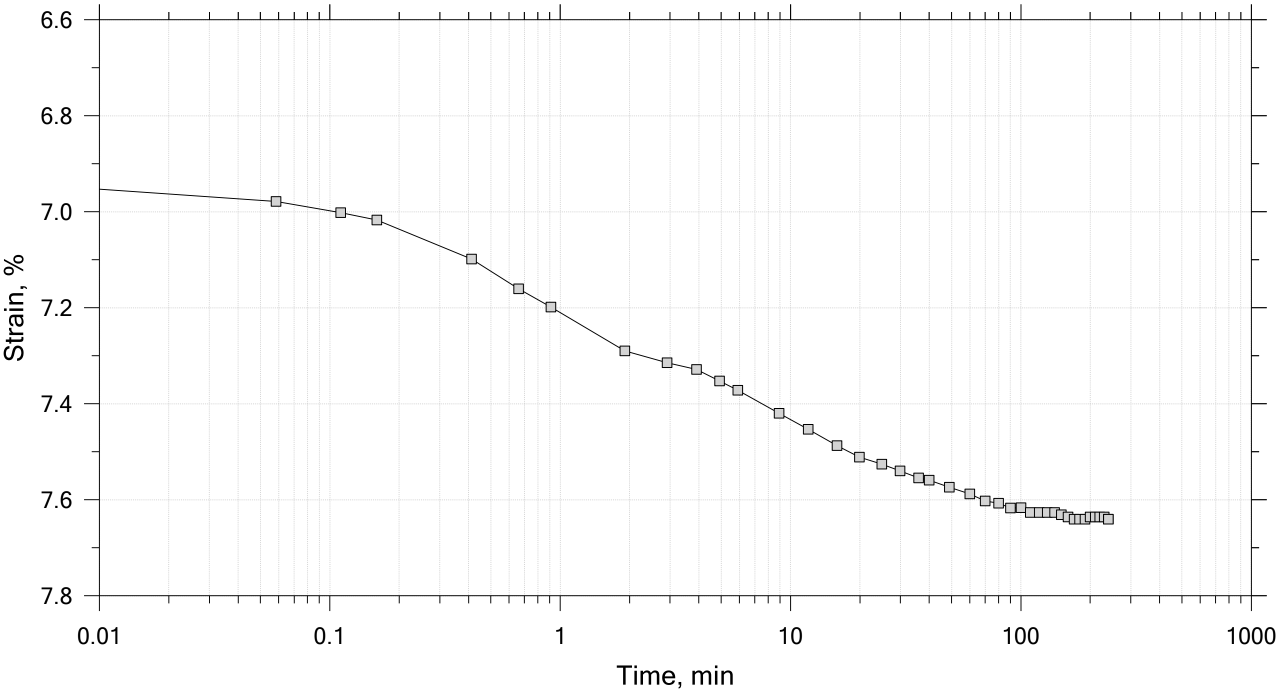


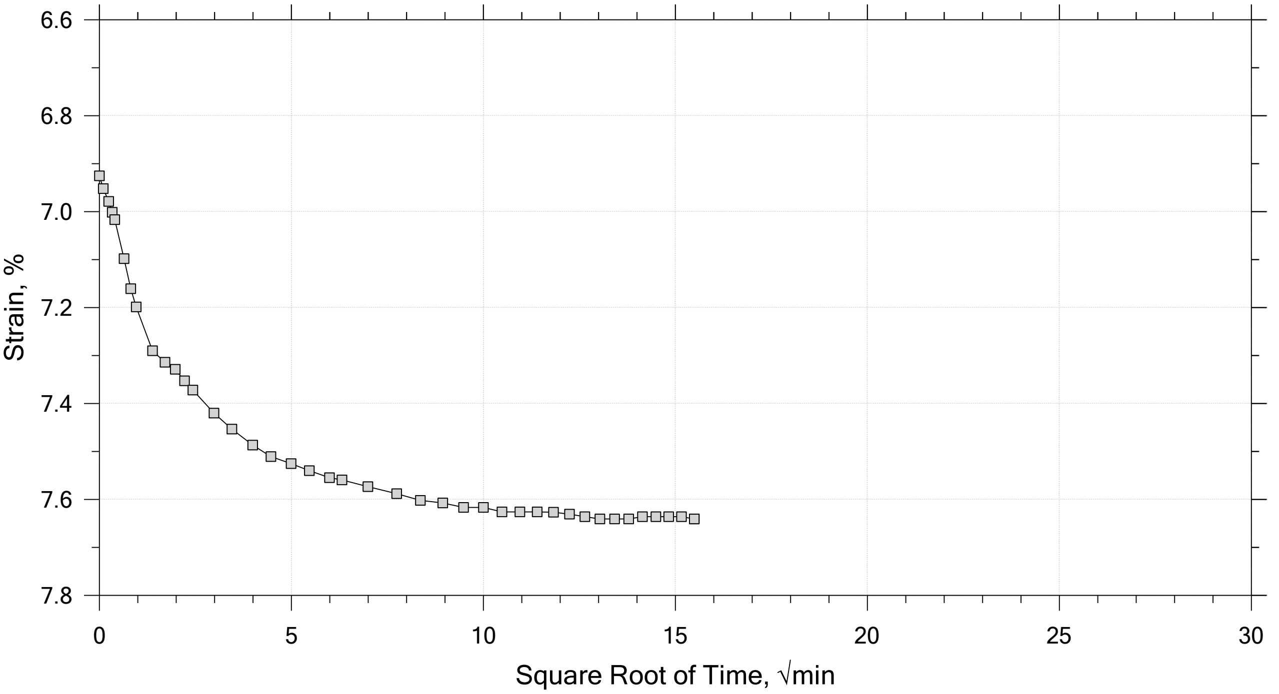


Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 33-1	Test Date: 12/2/22	Depth: 65'4"-65'6"
Test No.: IP-3	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 5.84 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 10 of 16
Constant Load Step
Stress: 3.2e+03 kPa





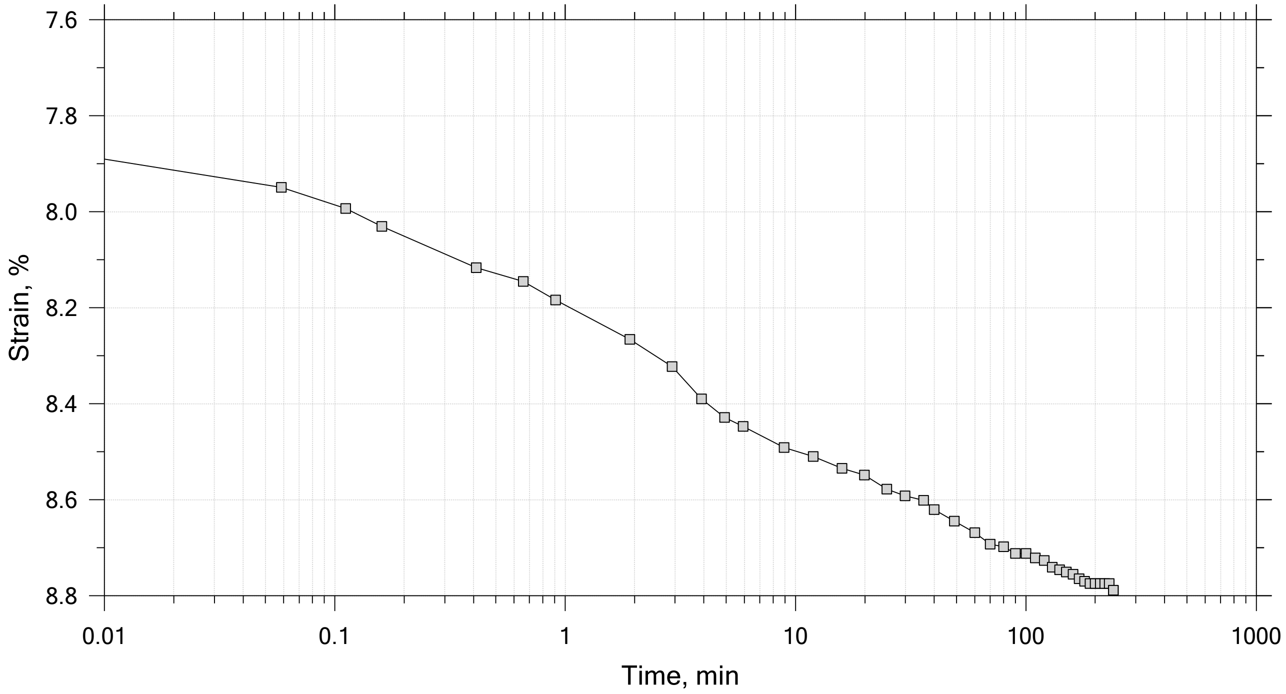
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 33-1	Test Date: 12/2/22	Depth: 65'4"-65'6"
Test No.: IP-3	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 5.84 kPa		

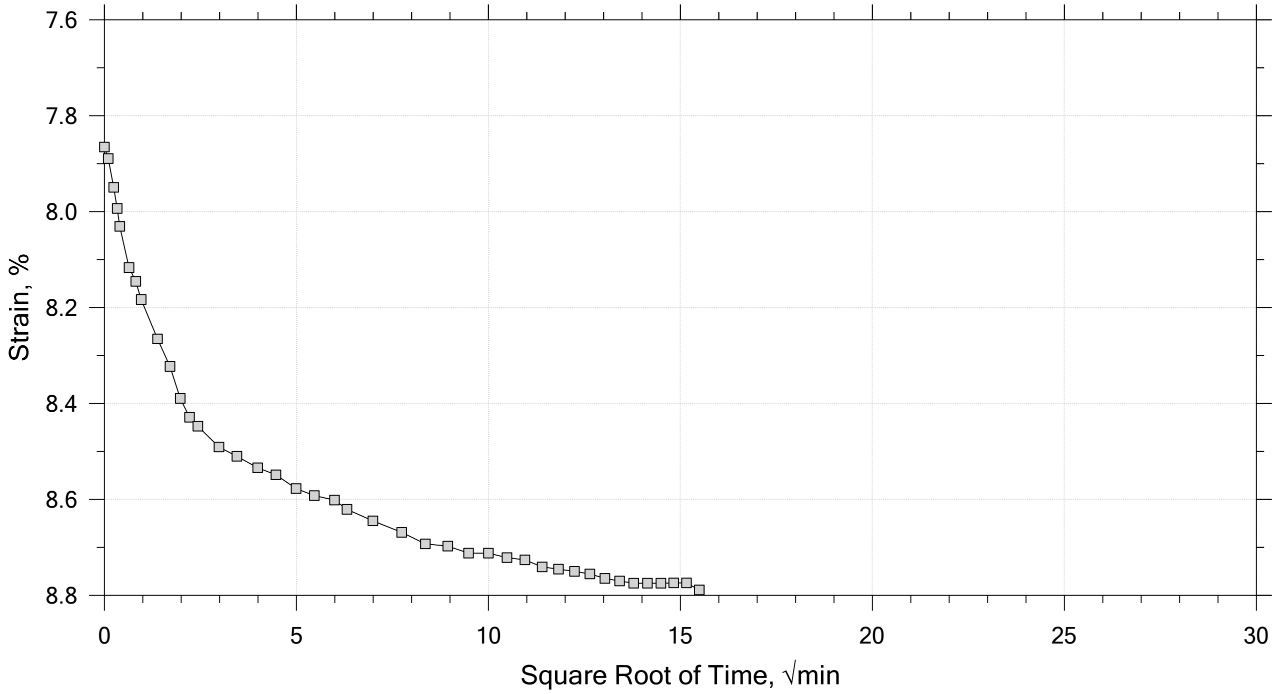
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 11 of 16

Constant Load Step

Stress: 6.4e+03 kPa

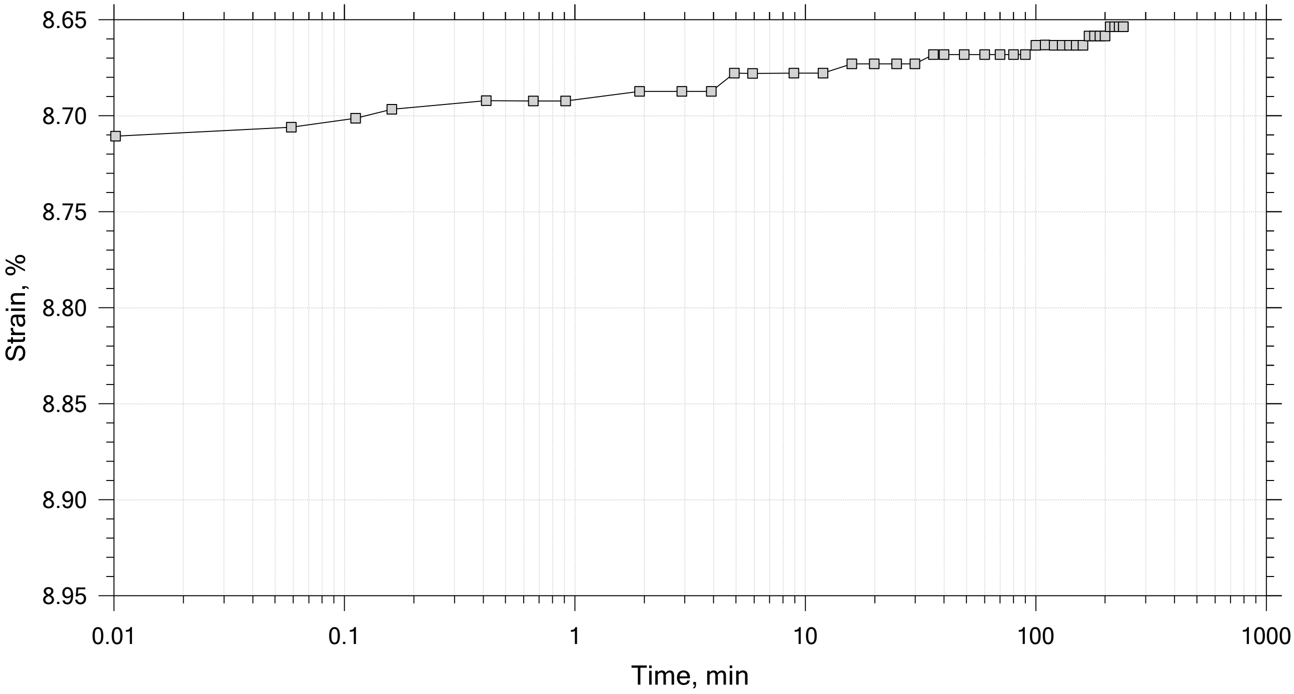


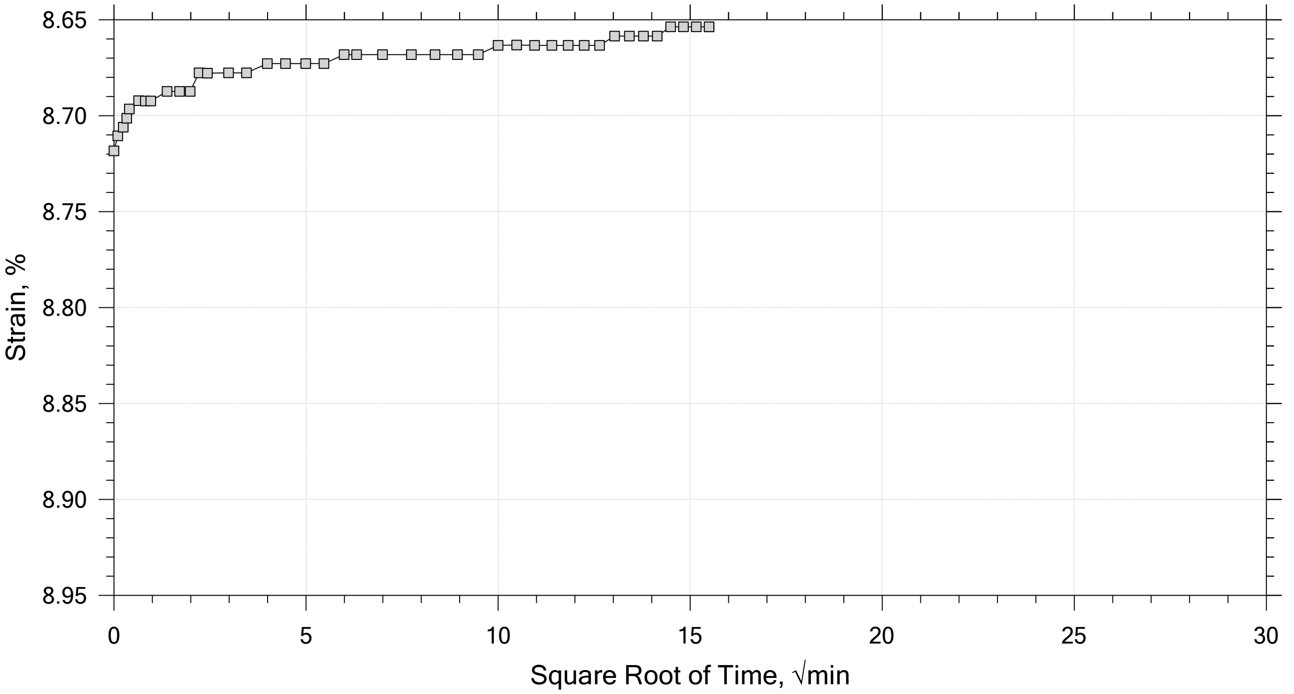


GeoTesting EXPRESS	Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH24	Tested By: trm	Checked By: anm
	Sample No.: 33-1	Test Date: 12/2/22	Depth: 65'4"-65'6"
	Test No.: IP-3	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-001, Swell Pressure = 5.84 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 12 of 16
Constant Load Step
Stress: 1.6e+03 kPa





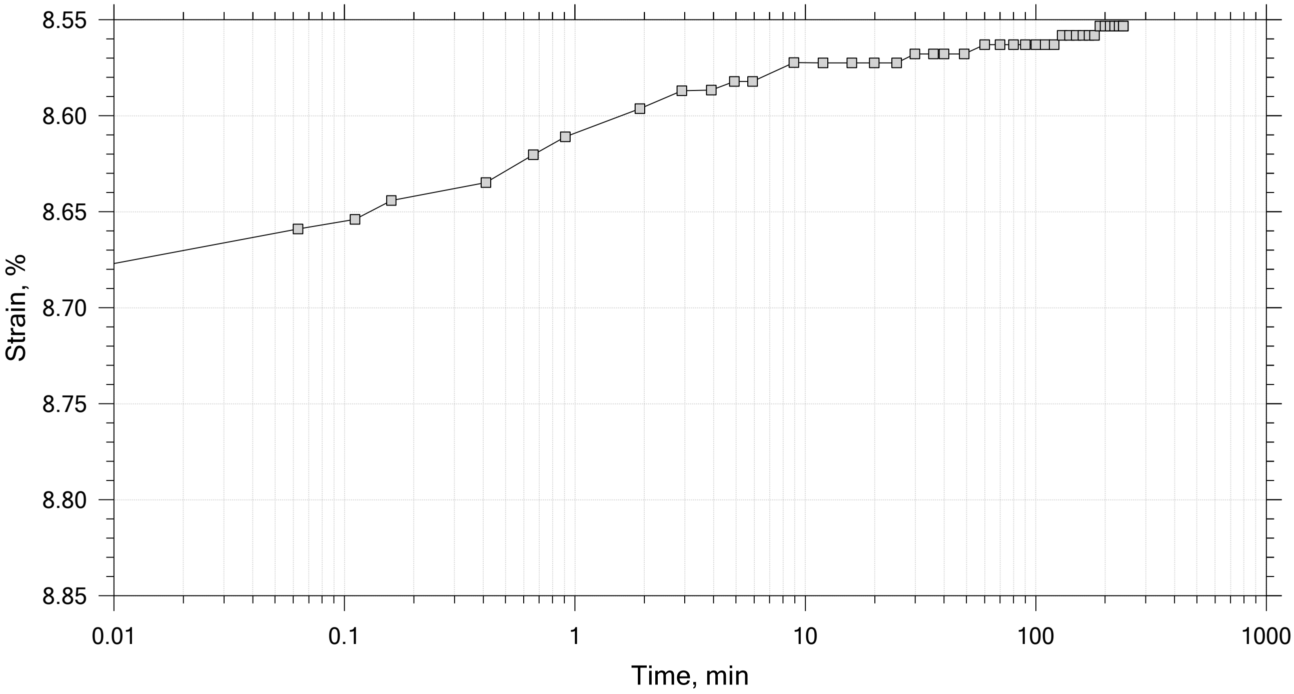
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 33-1	Test Date: 12/2/22	Depth: 65'4"-65'6"
Test No.: IP-3	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 5.84 kPa		

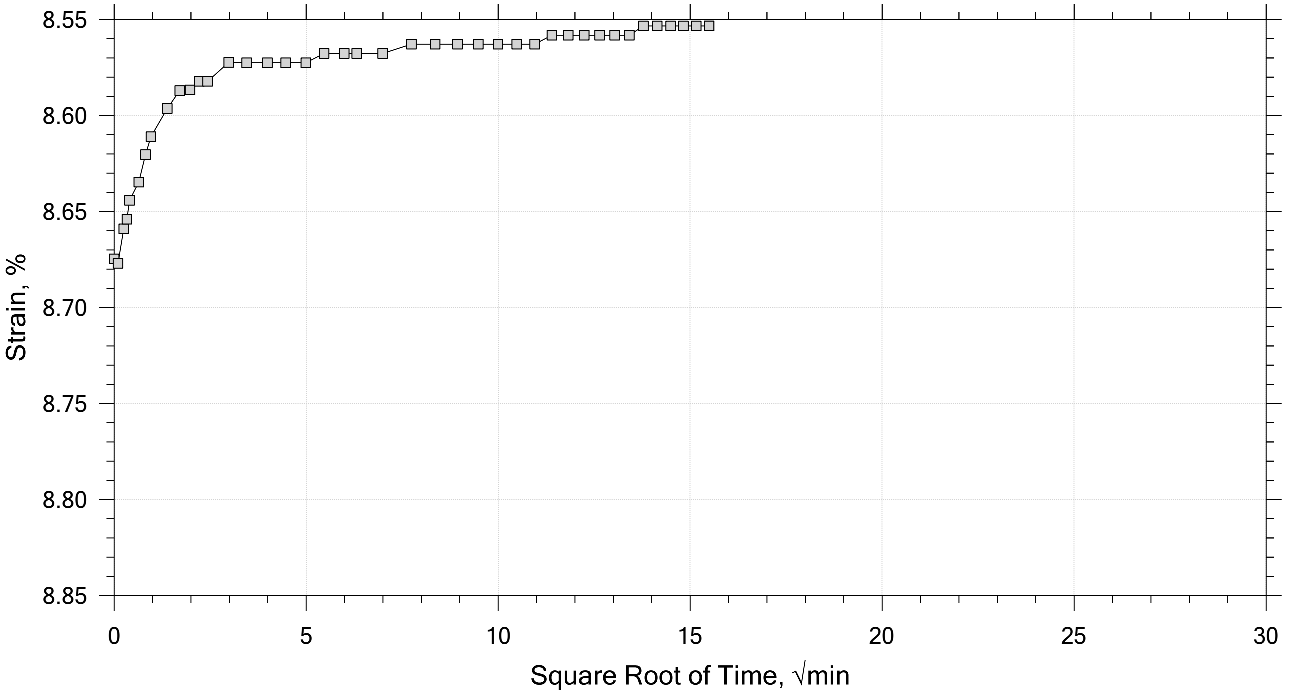
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 13 of 16

Constant Load Step

Stress: 400 kPa





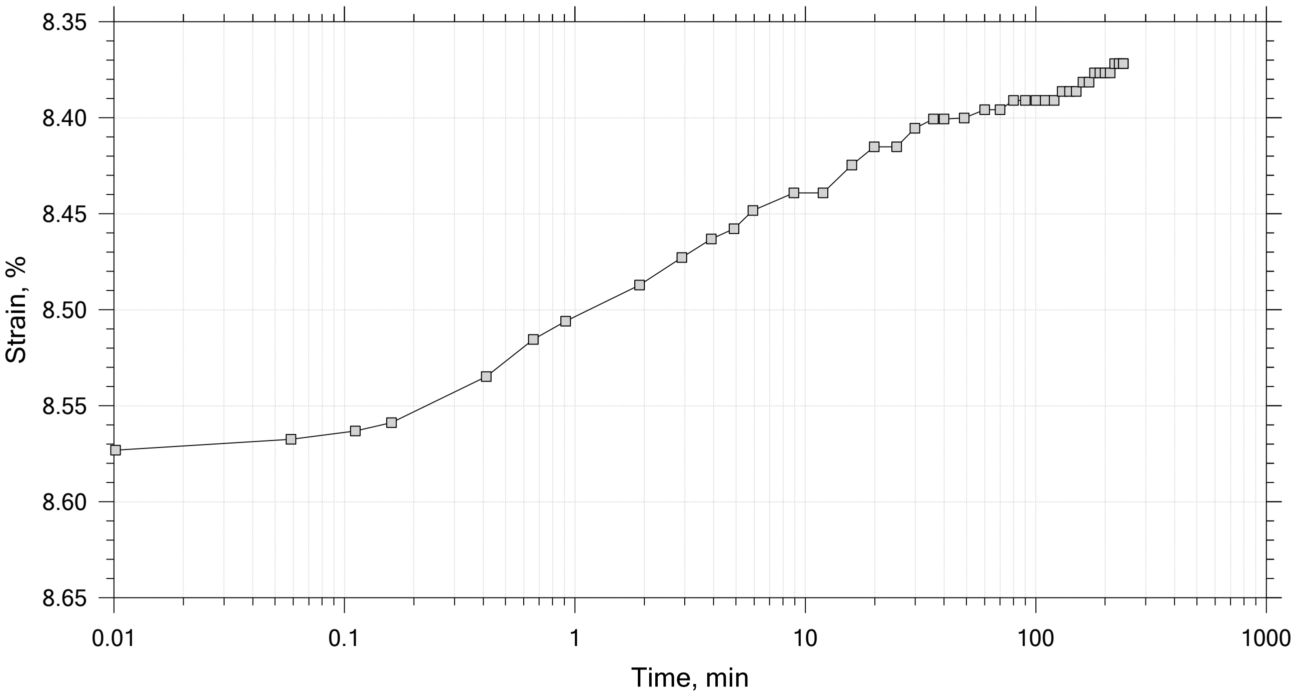
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 33-1	Test Date: 12/2/22	Depth: 65'4"-65'6"
Test No.: IP-3	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 5.84 kPa		

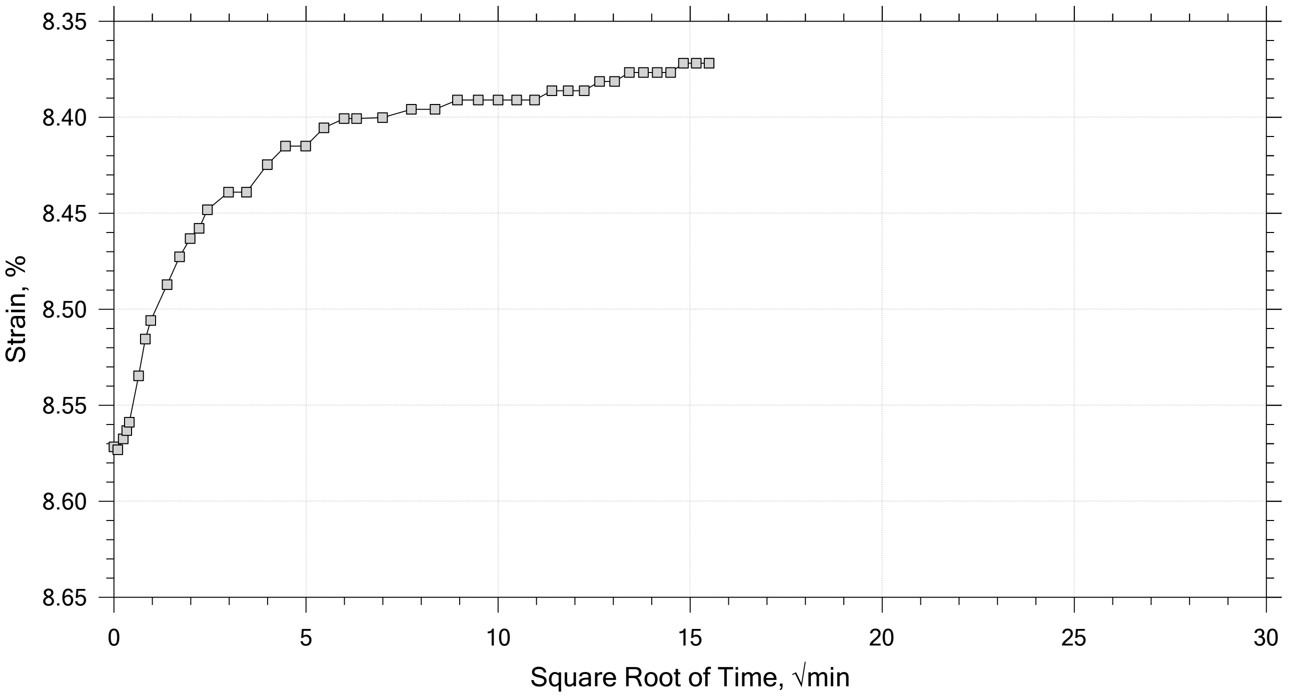
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 14 of 16

Constant Load Step

Stress: 100 kPa

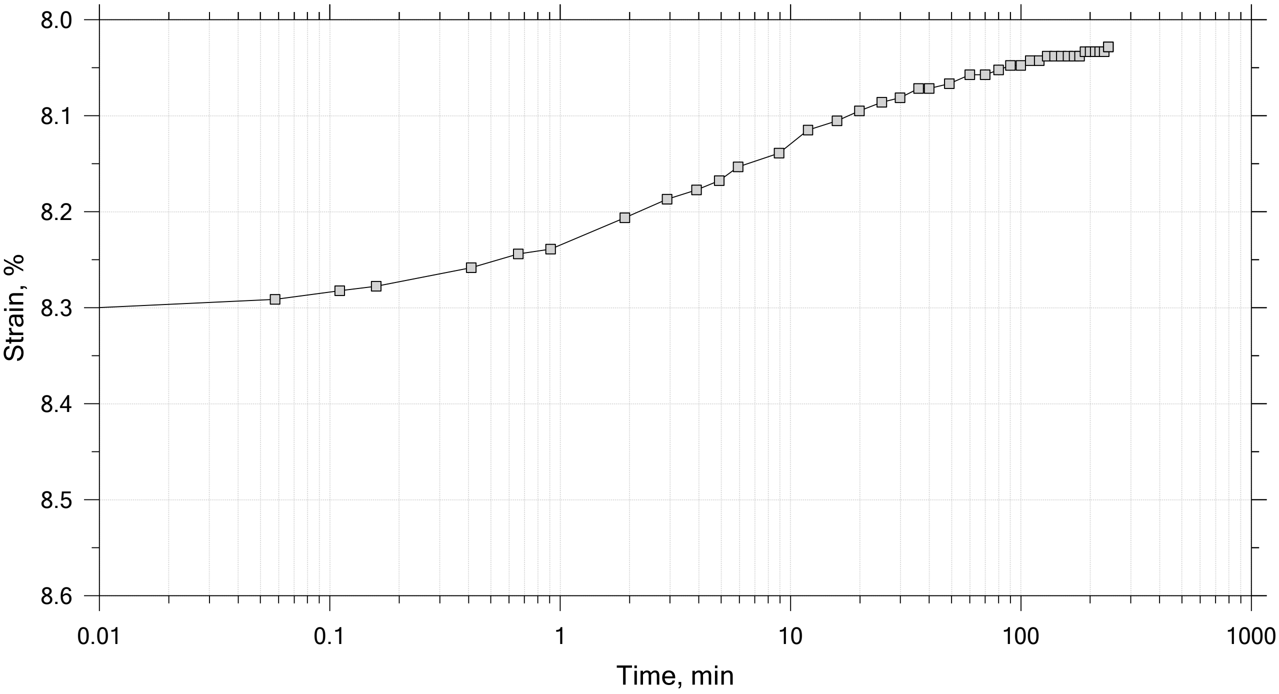


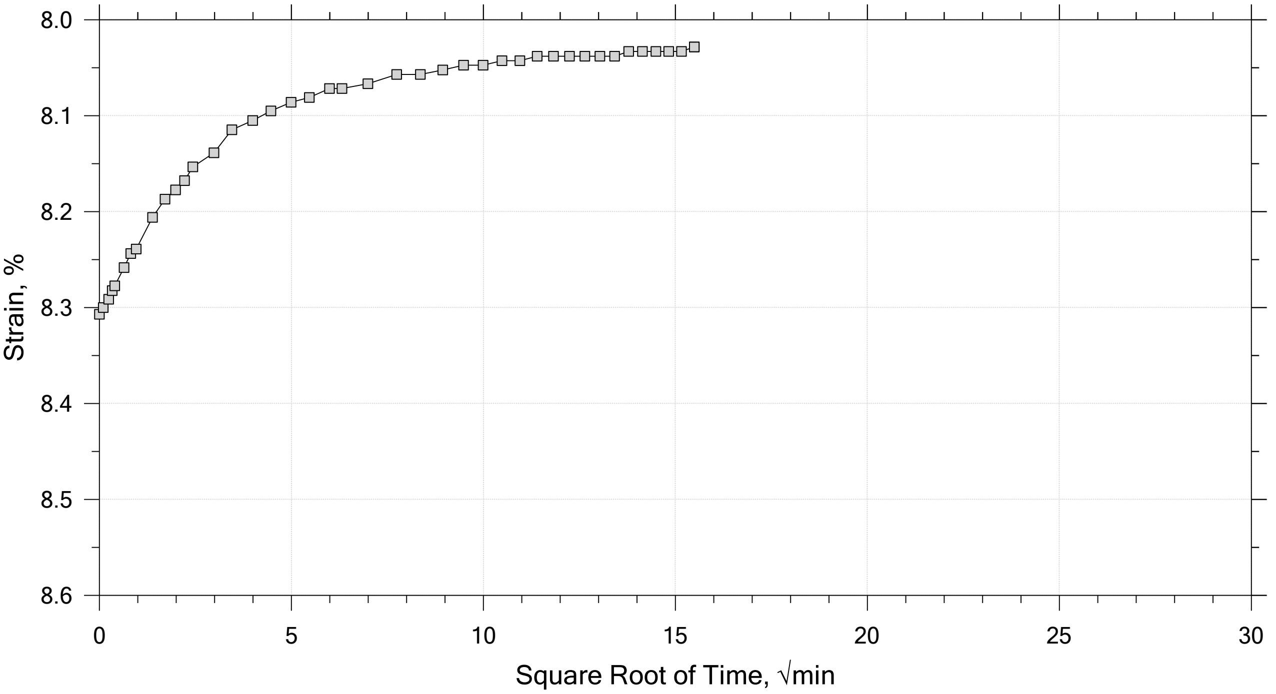


Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 33-1	Test Date: 12/2/22	Depth: 65'4"-65'6"
Test No.: IP-3	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 5.84 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 15 of 16
Constant Load Step
Stress: 25 kPa





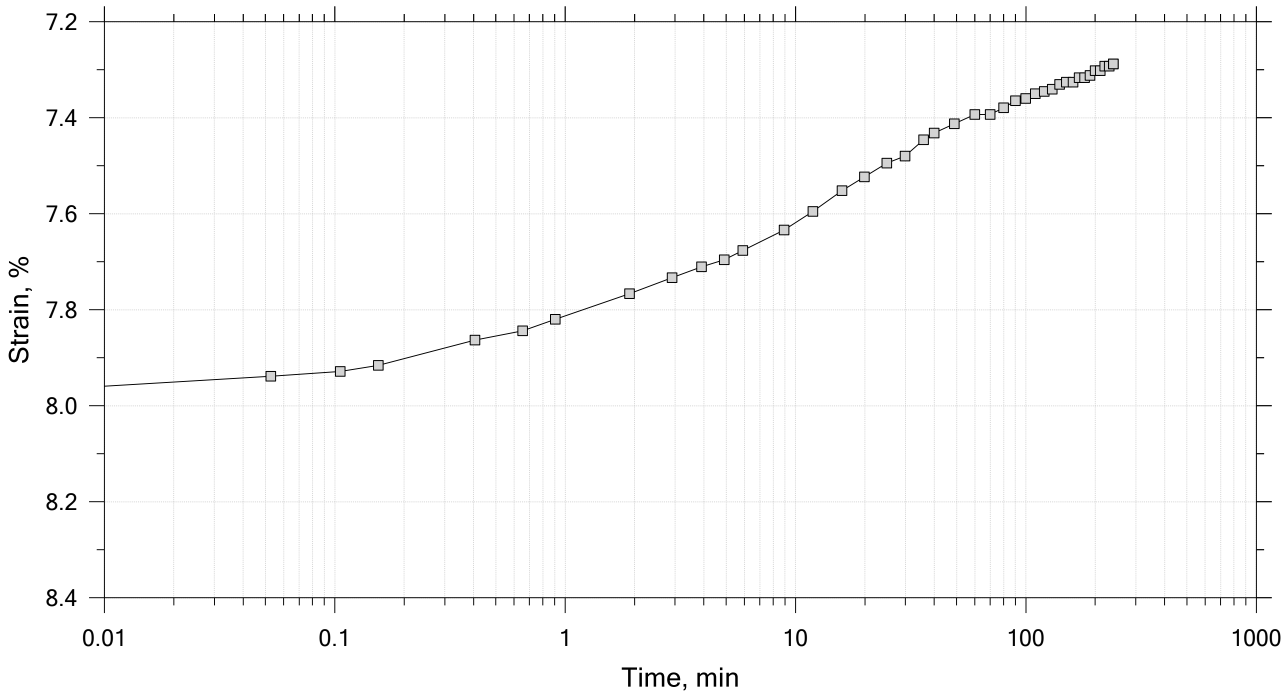
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 33-1	Test Date: 12/2/22	Depth: 65'4"-65'6"
Test No.: IP-3	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 5.84 kPa		

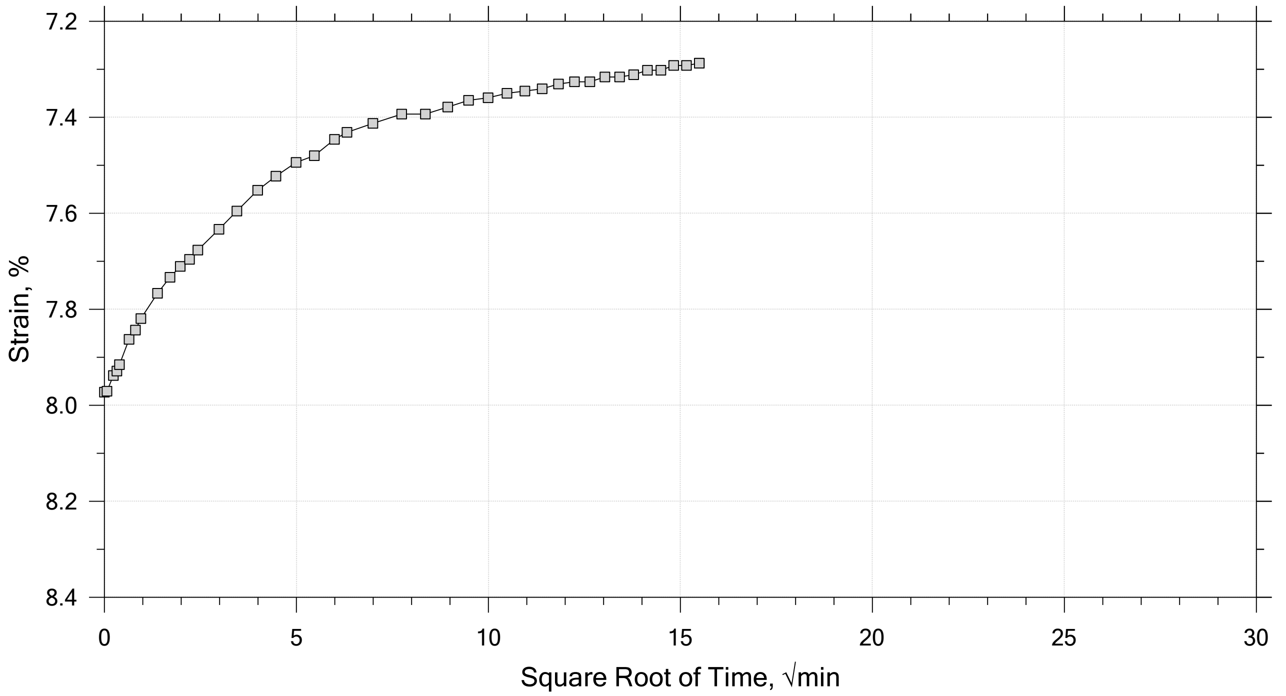
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 16 of 16

Constant Load Step

Stress: 5 kPa





Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 33-1	Test Date: 12/2/22	Depth: 65'4"-65'6"
Test No.: IP-3	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 5.84 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Specimen Diameter: 6.35 cm	Estimated Specific Gravity: 2.67	Liquid Limit: ---
Initial Height: 2.54 cm	Initial Void Ratio: 0.256	Plastic Limit: ---
Final Height: 2.41 cm	Final Void Ratio: 0.193	Plasticity Index: ---

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	E3495	RING		E3658
Mass Container, gm	8.25	107.68	107.68	8.22
Mass Container + Wet Soil, gm	122.3	294.52	291.07	190.21
Mass Container + Dry Soil, gm	107.77	278.72	278.72	177.95
Mass Dry Soil, gm	99.52	171.04	171.04	169.73
Water Content, %	14.60	9.24	7.22	7.22
Void Ratio	---	0.26	0.19	---
Degree of Saturation, %	---	96.51	100.00	---
Dry Unit Weight, kN/m³	---	20.851	21.949	---

Note: Specific Gravity and Void Ratios are calculated assuming the degree of saturation equals 100% at the end of the test.
Therefore, values may not represent actual values for the specimen.

Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Tested By: trm	Checked By: anm
Sample No.: 33-1	Test Date: 12/2/22	Depth: 65'4"-65'6"
Test No.: IP-3	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 5.84 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Square Root of Time Coefficients

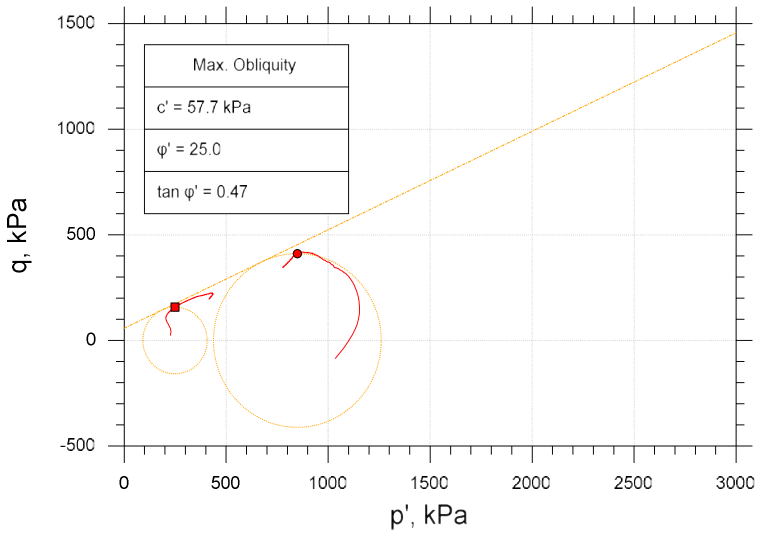
Step	Applied Stress kPa	Final Displacement cm	Void Ratio	Strain at End %	Sq.Rt. T90 min	Cv cm²/s	Mv 1/kPa	k cm/s
1	5.84	0.01876	0.246	0.739	189.535	1.19e-04	1.26e-03	1.48e-08
2	10.0	0.02994	0.241	1.18	32.183	6.95e-04	1.06e-03	7.22e-08
3	25.0	0.05236	0.230	2.06	45.808	4.82e-04	5.88e-04	2.78e-08
4	50.0	0.06785	0.222	2.67	23.129	9.39e-04	2.44e-04	2.25e-08
5	100.	0.08439	0.214	3.32	17.621	1.22e-03	1.30e-04	1.56e-08
6	200.	0.1050	0.204	4.13	17.879	1.18e-03	8.11e-05	9.39e-09
7	400.	0.1252	0.194	4.93	19.209	1.08e-03	3.99e-05	4.23e-09
8	800.	0.1462	0.183	5.76	12.251	1.67e-03	2.06e-05	3.37e-09
9	1.60e+03	0.1695	0.172	6.67	6.382	3.14e-03	1.15e-05	3.53e-09
10	3.20e+03	0.1941	0.160	7.64	14.582	1.35e-03	6.05e-06	8.00e-10
11	6.40e+03	0.2232	0.145	8.79	13.399	1.43e-03	3.59e-06	5.04e-10
12	1.60e+03	0.2198	0.147	8.65	169.112	1.12e-04	2.81e-07	3.10e-12
13	400.	0.2173	0.148	8.55	3.323	5.73e-03	8.37e-07	4.70e-10
14	100.	0.2126	0.151	8.37	19.912	9.59e-04	6.05e-06	5.69e-10
15	25.0	0.2039	0.155	8.03	15.875	1.21e-03	4.58e-05	5.44e-09
16	5.00	0.1851	0.164	7.29	24.861	7.82e-04	3.70e-04	2.84e-08

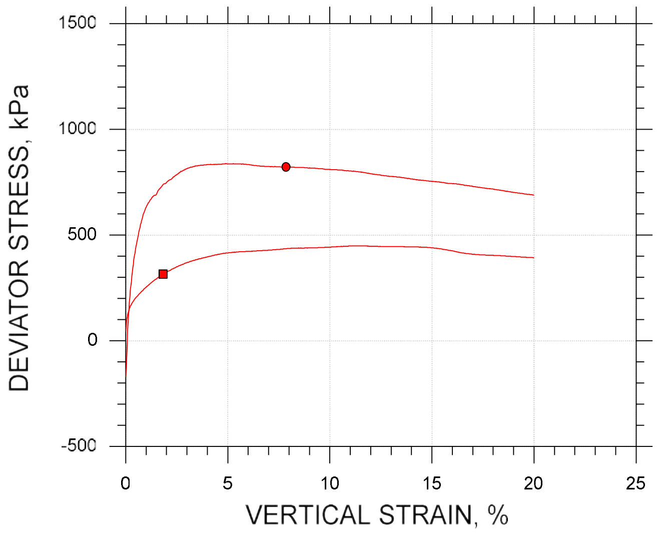
GeoTesting EXPRESS	Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH24	Tested By: trm	Checked By: anm
	Sample No.: 33-1	Test Date: 12/2/22	Depth: 65'4"-65'6"
	Test No.: IP-3	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-001, Swell Pressure = 5.84 kPa		
	Displacement at End of Increment		

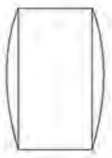
GeoTesting EXPRESS

Client: WSP Canada Inc.
Project Name: Darlington NNP Phase II
Project Location: Ontario, Canada
Project Number: GTX-316444
Tested By: trm | Checked By: njh
Boring ID: BH24
Preparation: intact
Description: Moist, gray clay
Classification: ---
Group Symbol: ---
Liquid Limit: --- | Plastic Limit: ---
Plasticity Index: --- | Estimated Specific Gravity: 2.7

CONSOLIDATED UNDRAINED TRIAXIAL TEST - Ko CONSOLIDATION

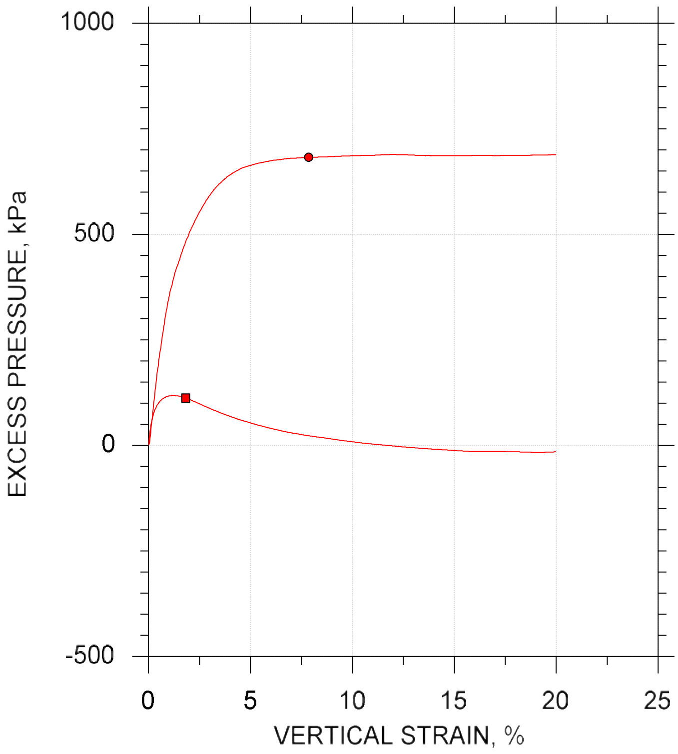


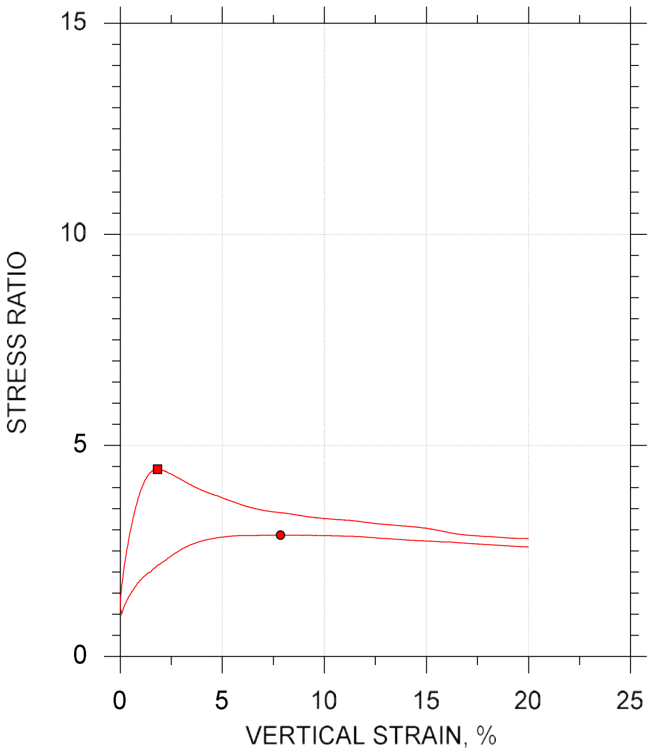


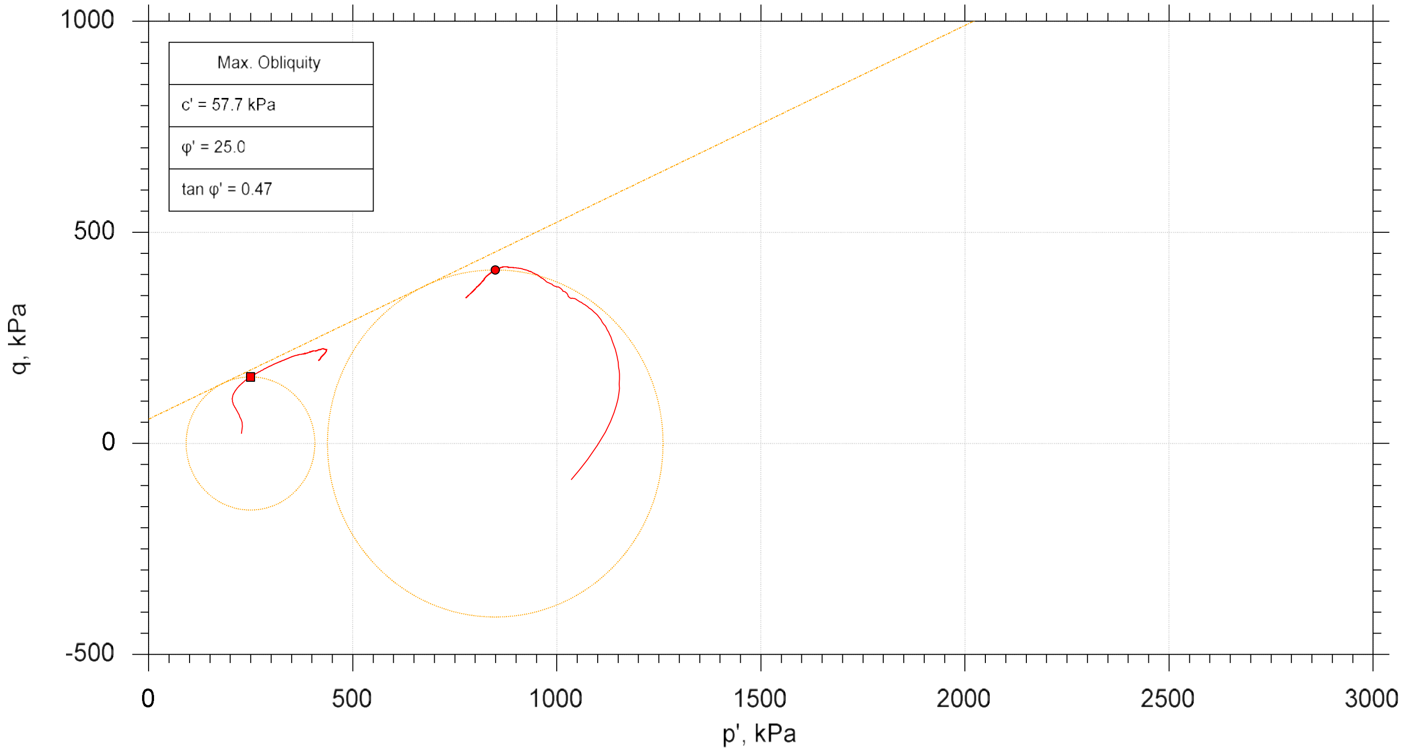
Symbol		🟥	●		
Sample ID		33-3	32-2		
Depth, ft		64'2"-64'8"	63'6"-63'10.5"		
Test Number		CKoUc-1-1	CKoUc-1-2Alt		
Initial	Height, cm	15.04	10.85		
	Diameter, cm	7.290	5.080		
	Moisture Content (from Cuttings), %	23.0	23.6		
	Dry Density, kN/m³	16.2	15.5		
	Saturation (Wet Method), %	98.0	90.8		
	Void Ratio	0.634	0.703		
Before Shear	Moisture Content, %	22.2	24.7		
	Dry Density, kN/m³	16.6	15.9		
	Cross-sectional Area (Method A), cm²	41.49	20.16		
	Saturation, %	100.0	100.0		
	Void Ratio	0.599	0.667		
	Back Pressure, kPa	1027.	1038.		
Vertical Effective Consolidation Stress, kPa		249.3	948.3		
Horizontal Effective Consolidation Stress, kPa		204.1	1121.		
Vertical Strain after Consolidation, %		1.401	1.366		
Volumetric Strain after Consolidation, %		1.726	1.467		
Time to 50% Consolidation, min		---	---		
Shear Strength, kPa		157.7	411.2		
Strain at Failure, %		1.83	7.85		
Strain Rate, %/min		0.01600	0.01600		
Deviator Stress at Failure, kPa		315.4	822.3		
Effective Minor Principal Stress at Failure, kPa		91.67	437.9		
Effective Major Principal Stress at Failure, kPa		407.0	1260.		
B-Value		0.92	0.94		
Notes: - Before Shear Saturation set to 100% for phase calculation. - Moisture Content determined by ASTM D2216. - Deviator Stress includes membrane correction. - Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions. Remarks:					

TX-034, Test 1-1: Ko = 0.82, Test 1-2Alt: Ko= 1.18

CONSOLIDATED UNDRAINED TRIAXIAL TEST
Ko CONSOLIDATION







	Sample No	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
🟥	33-3	CKoUc-1-1	64'2"-64'8"	trm	12/15/22	njh	1/26/23	316444-CKOUc-1-1n.dat
●	32-2	CKoUc-1-2Alt	63'6"-63'10.5"	trm	1/18/23	njh	1/26/23	316444-CKoUC-1-2Altn.dat

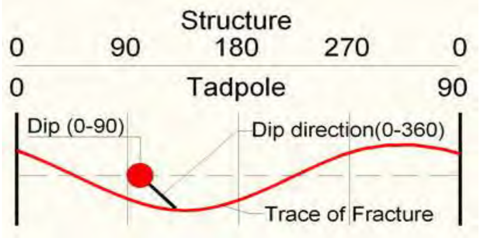
GeoTesting EXPRESS

Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH24	Sample Type: intact	
Description: Moist, gray clay		
Remarks: TX-034, Test 1-1: Ko = 0.82, Test 1-2Alt: Ko= 1.18		

Geophysical Record of Borehole: BH24

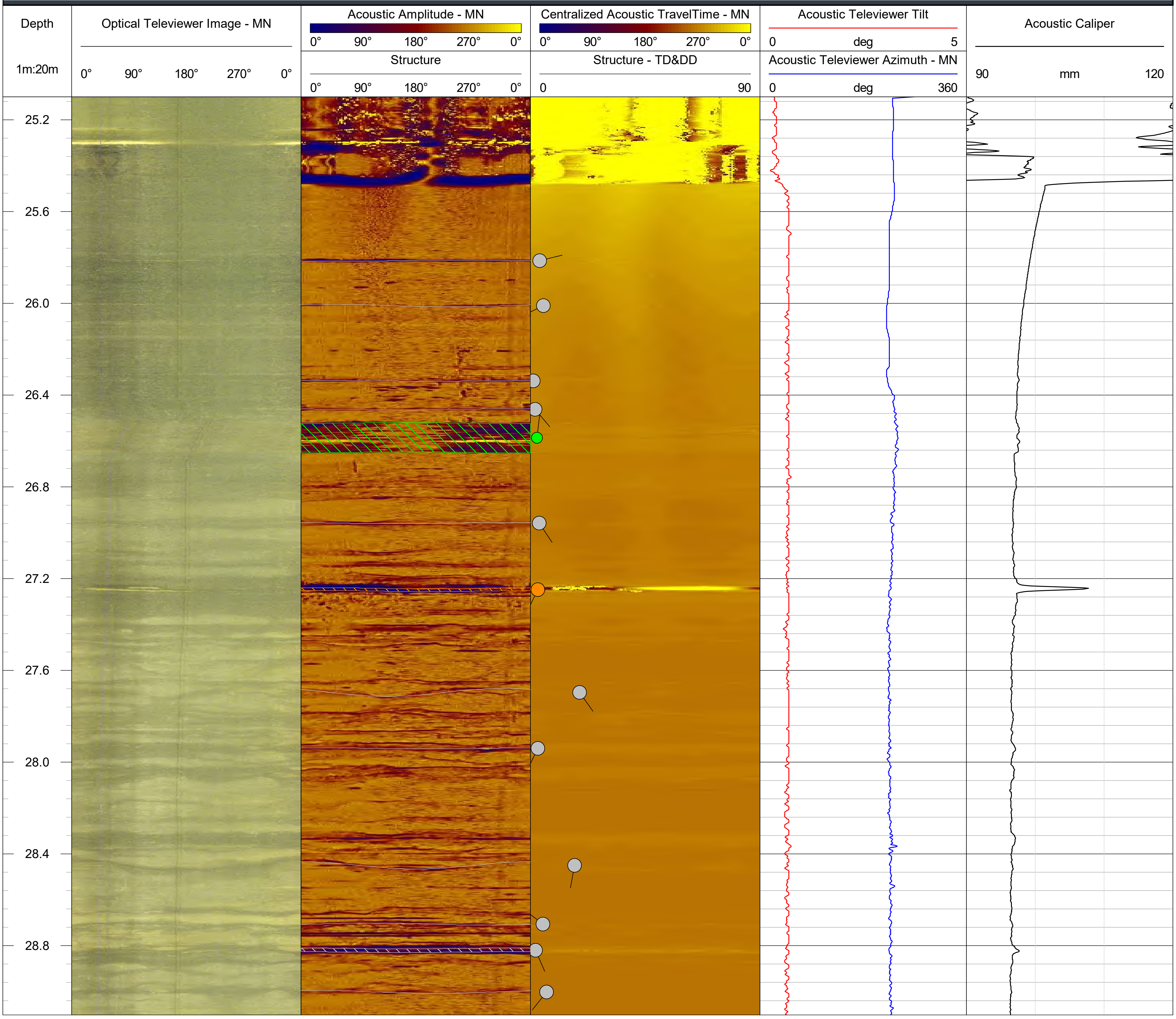
Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

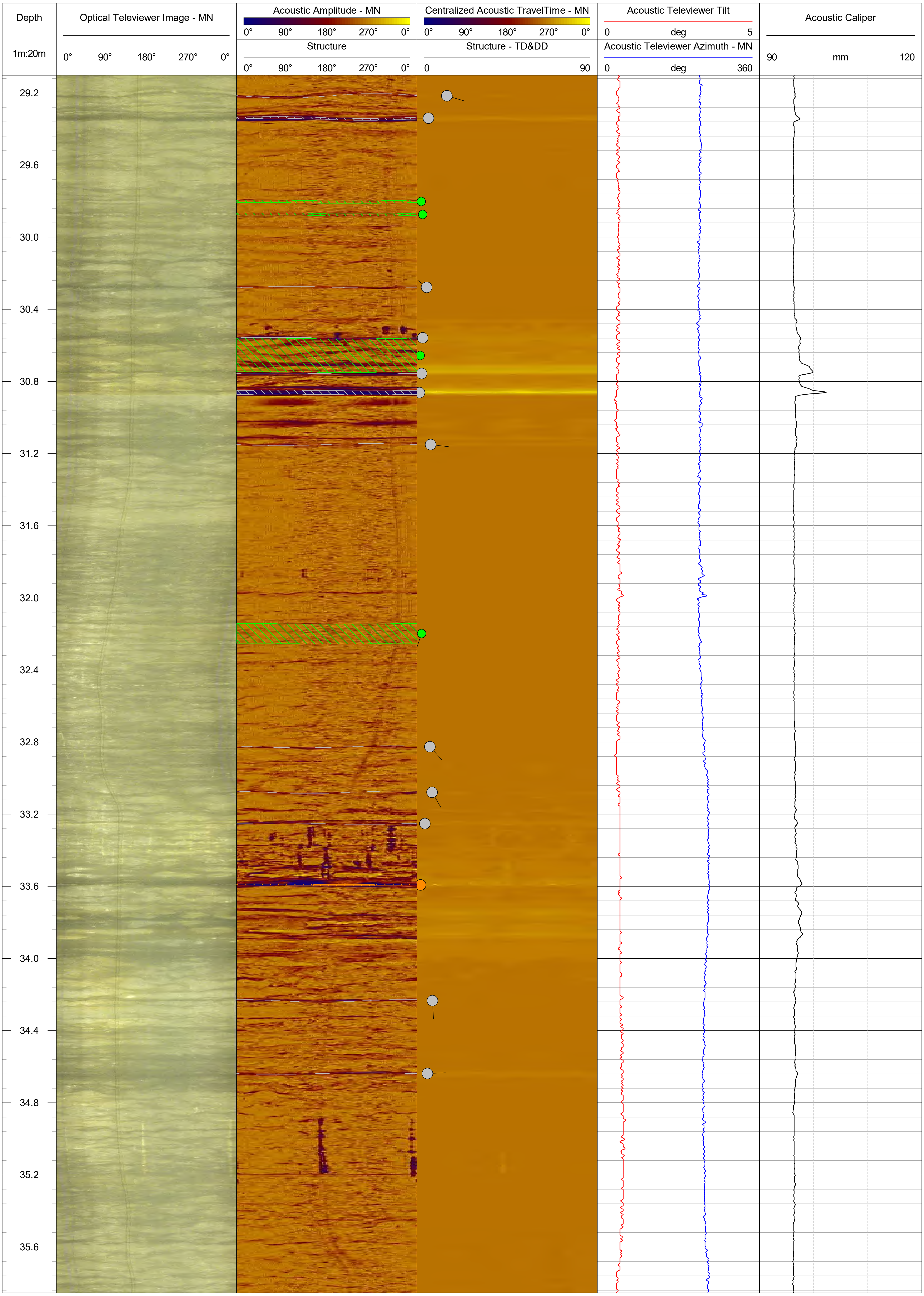
Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at ground	**Casing Depth:**	~25.20 m bgs	**Location:**	Darlington, Ontario
Easting:	683745.15 m	**Drilled Depth:**	79.83 m bgs	**Water Level:**	8.22 m bgs	**Log Date:**	July-7-2022
Northing:	4860135.33 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	89.00 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	J. Crawford

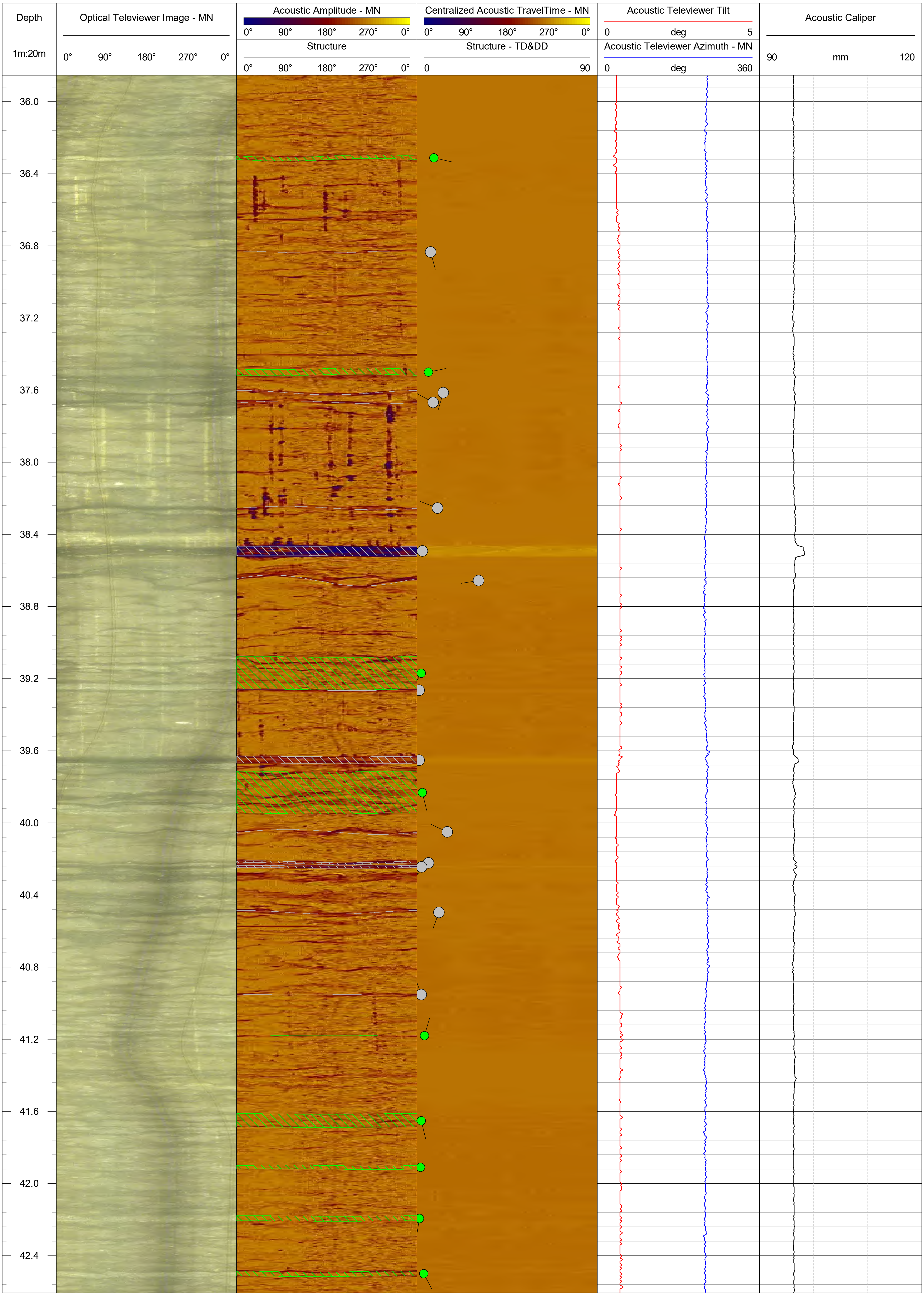


- 🟠 Partially Open Joint / Fracture
- ⚪ Filled Fracture / Joint
- 🟢 Bedding / Banding / Foliation

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)




Depth
1m:20m
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0
32.4
32.8
33.2
33.6
34.0
34.4
34.8
35.2
35.6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Optical Televiewer Image - MN
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Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
36.0
36.4
36.8
37.2
37.6
38.0
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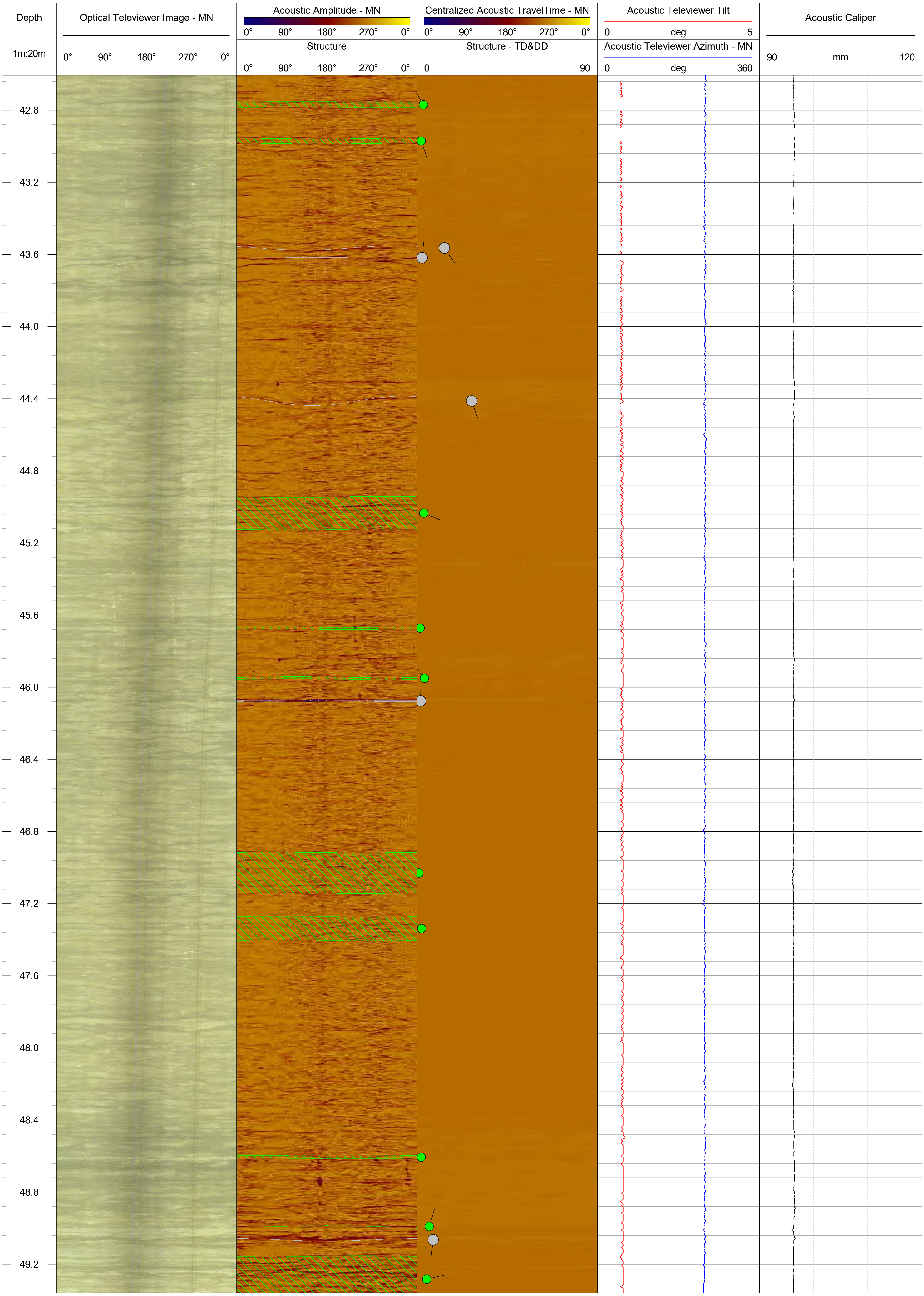
38.8
39.2
39.6
40.0
40.4
40.8
41.2
41.6
42.0
42.4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Optical Televiewer Image - MN
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Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
42.8
43.2
43.6
44.0
44.4
44.8
45.2
45.6
46.0
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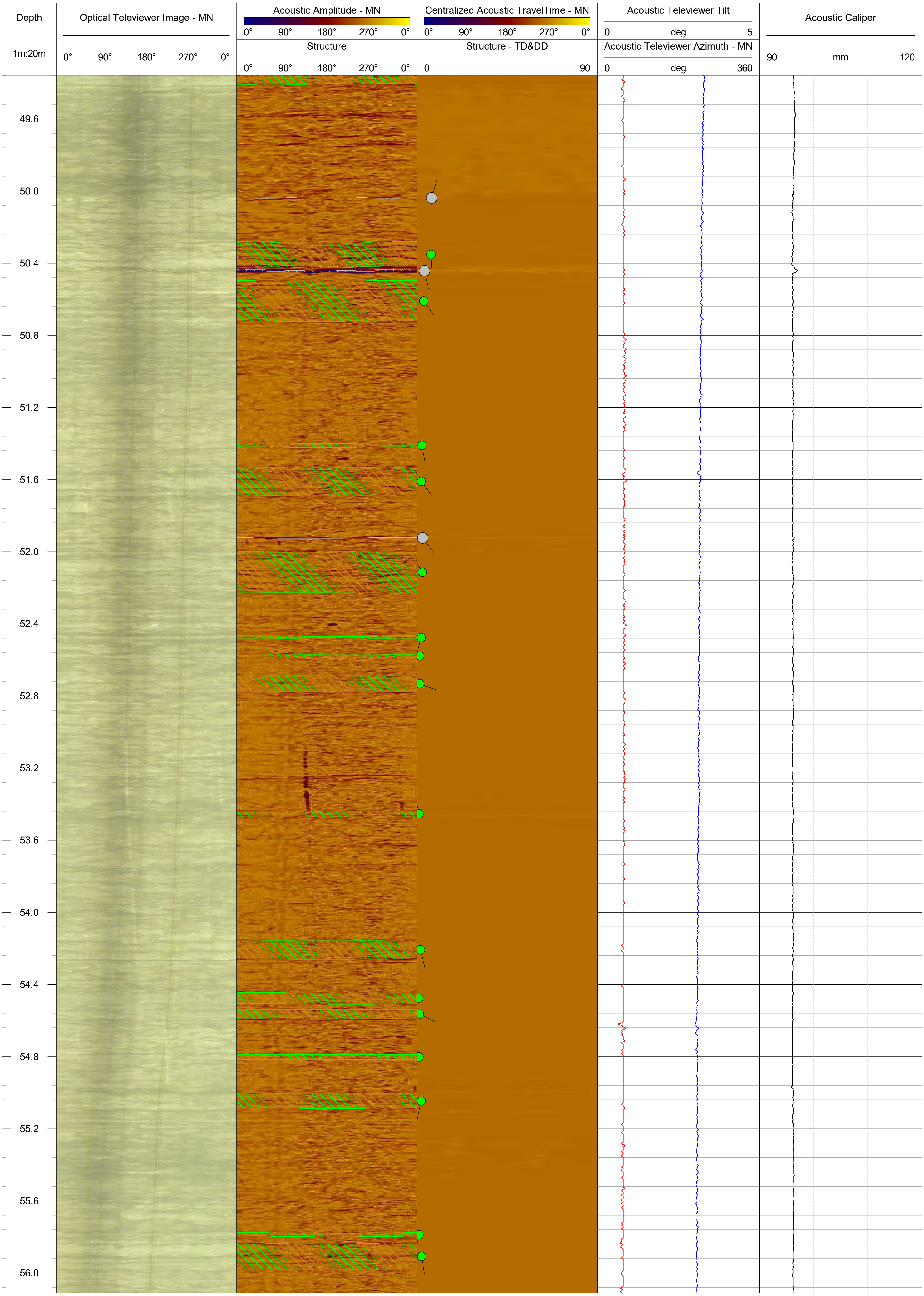
47.6
48.0
48.4
48.8
49.2


Depth
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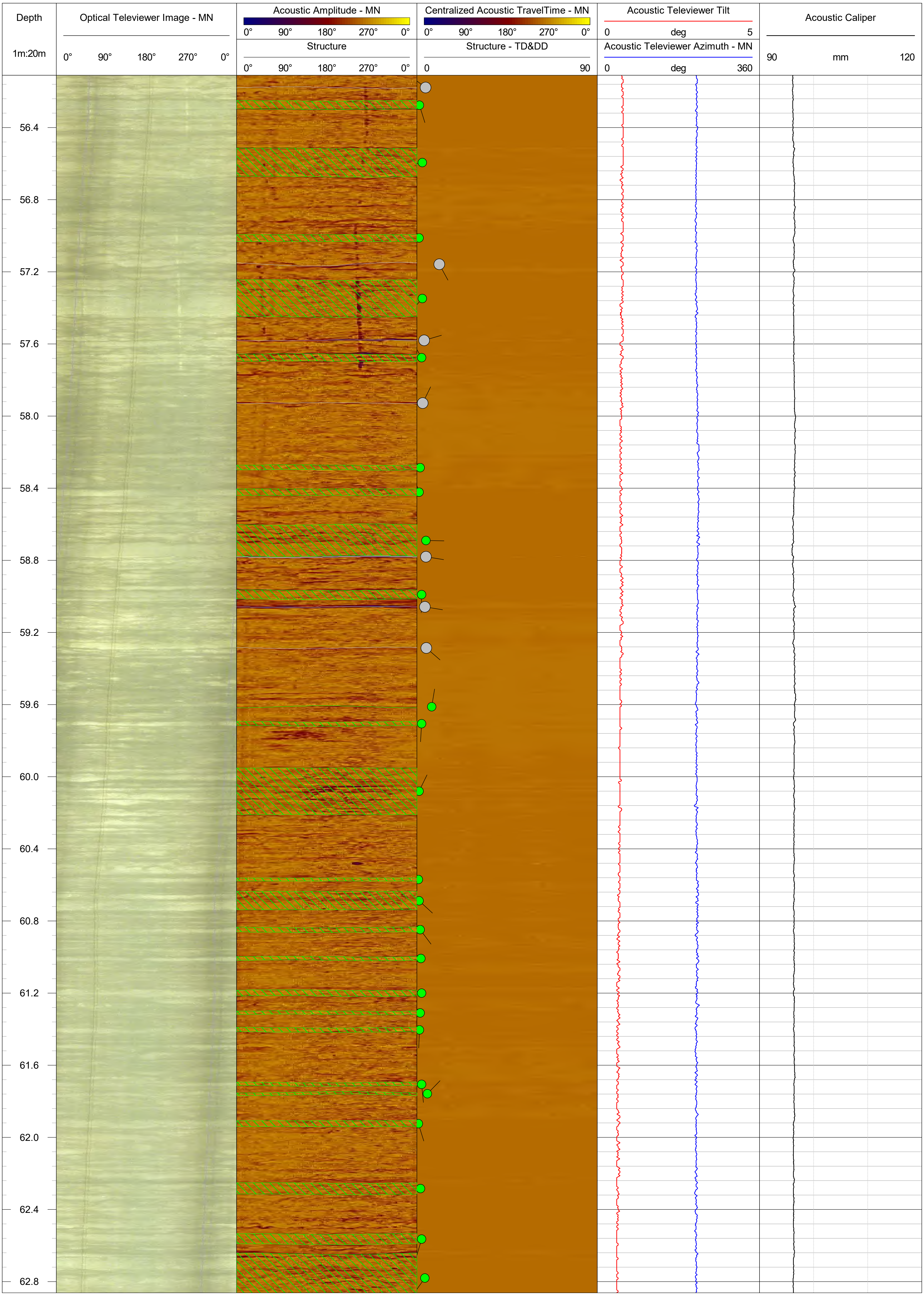
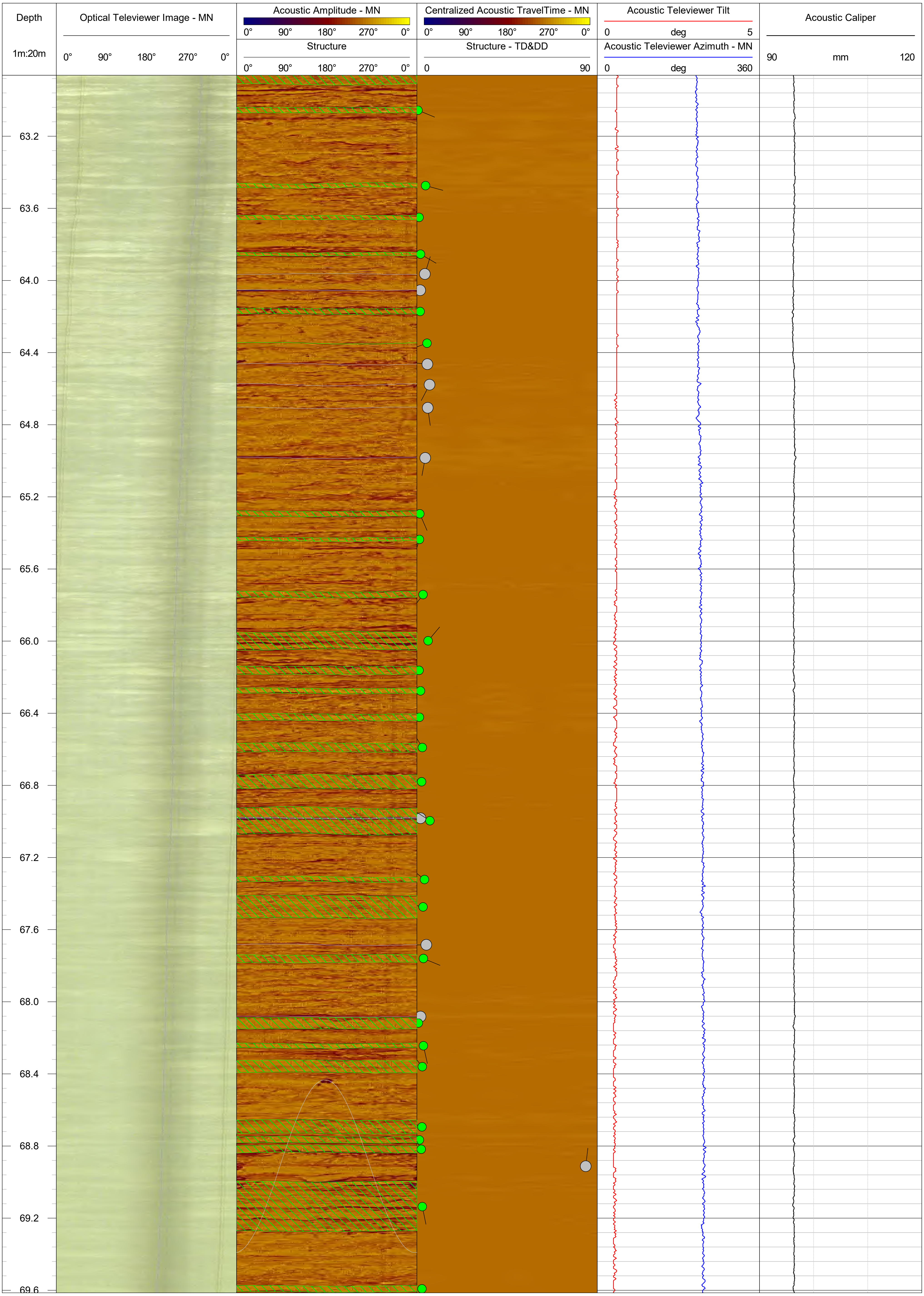
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
49.6
50.0
50.4
50.8
51.2
51.6
52.0
52.4
52.8
53.2
53.6
54.0
54.4
54.8
55.2
55.6
56.0


Depth
1m:20m
Optical Televiewer Image - MN
0°
90°
180°
270°
0°
Acoustic Amplitude - MN
0°
90°
180°
270°
0°
Structure
0°
90°
180°
270°
0°
Centralized Acoustic TravelTime - MN
0°
90°
180°
270°
0°
Structure - TD&DD
0
90
Acoustic Televiewer Tilt
0
deg
5
Acoustic Televiewer Azimuth - MN
0
deg
360
Acoustic Caliper
90
mm
120
56.4
56.8
57.2
57.6
58.0
58.4
58.8
59.2
59.6
60.0
60.4
60.8
61.2
61.6
62.0
62.4
62.8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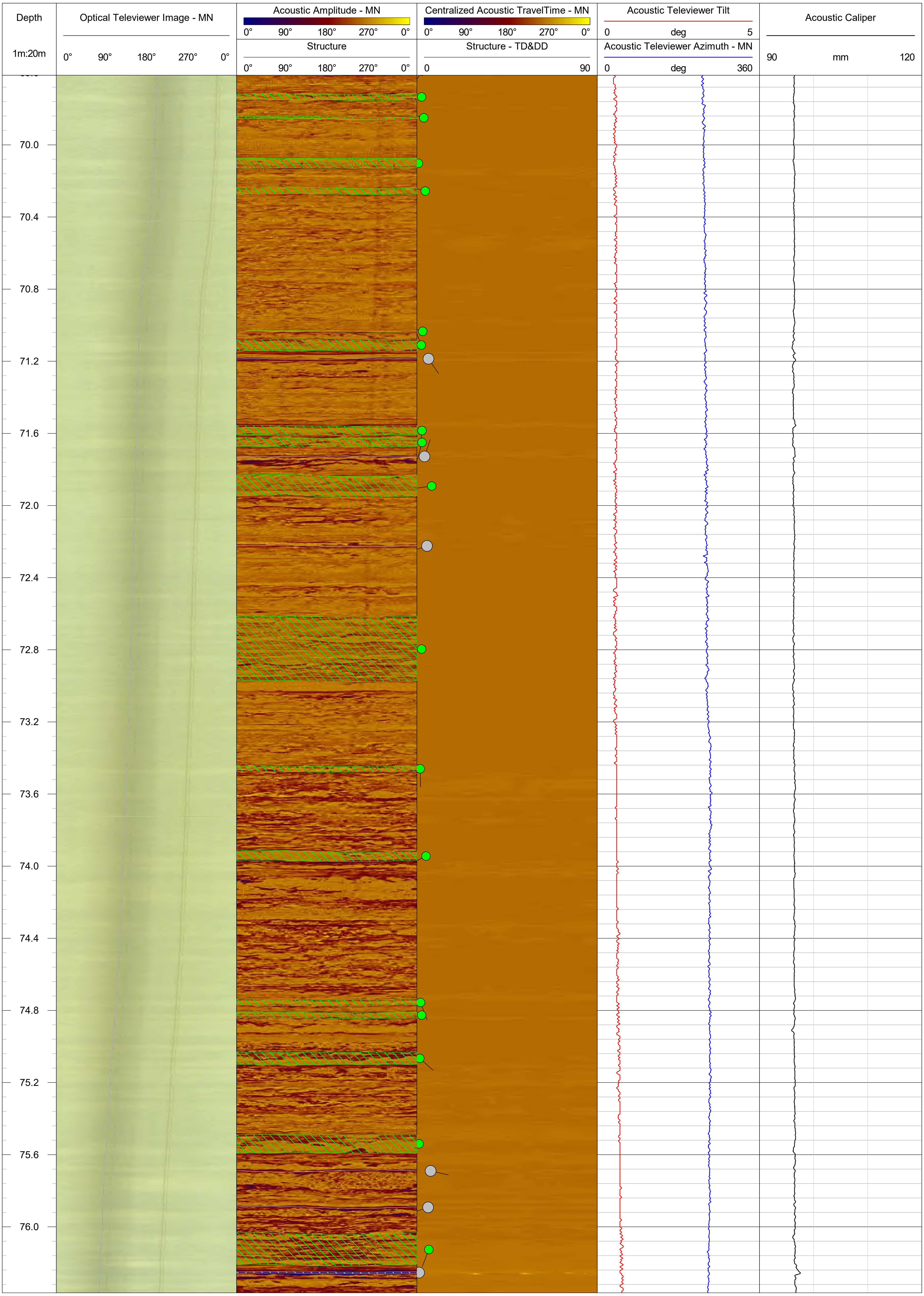
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
63.2
63.6
64.0
64.4
64.8
65.2
65.6
66.0
66.4
66.8
67.2
67.6
68.0
68.4
68.8
69.2
69.6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Optical Televiewer Image - MN
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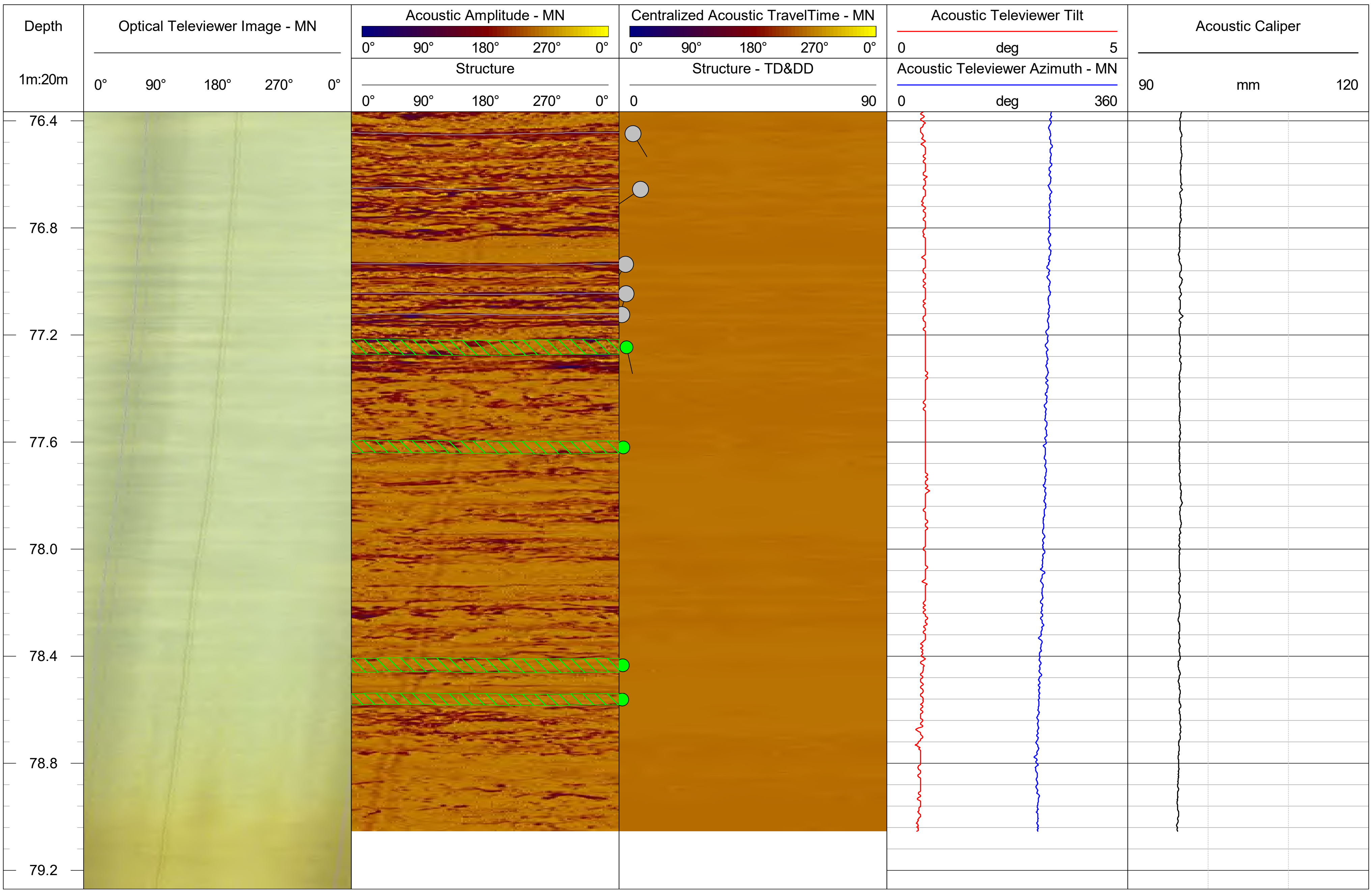
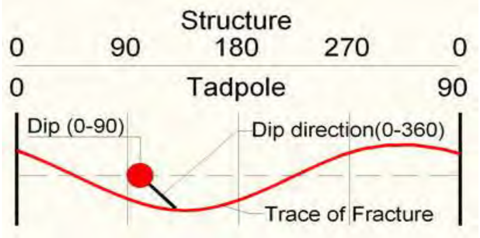
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
70.0
70.4
70.8
71.2
71.6
72.0
72.4
72.8
73.2
73.6
74.0
74.4
74.8
75.2
75.6
76.0


Depth
1m:20m
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
76.4
76.8
77.2
77.6
78.0
78.4
78.8
79.2

Geophysical Record of Borehole: BH24

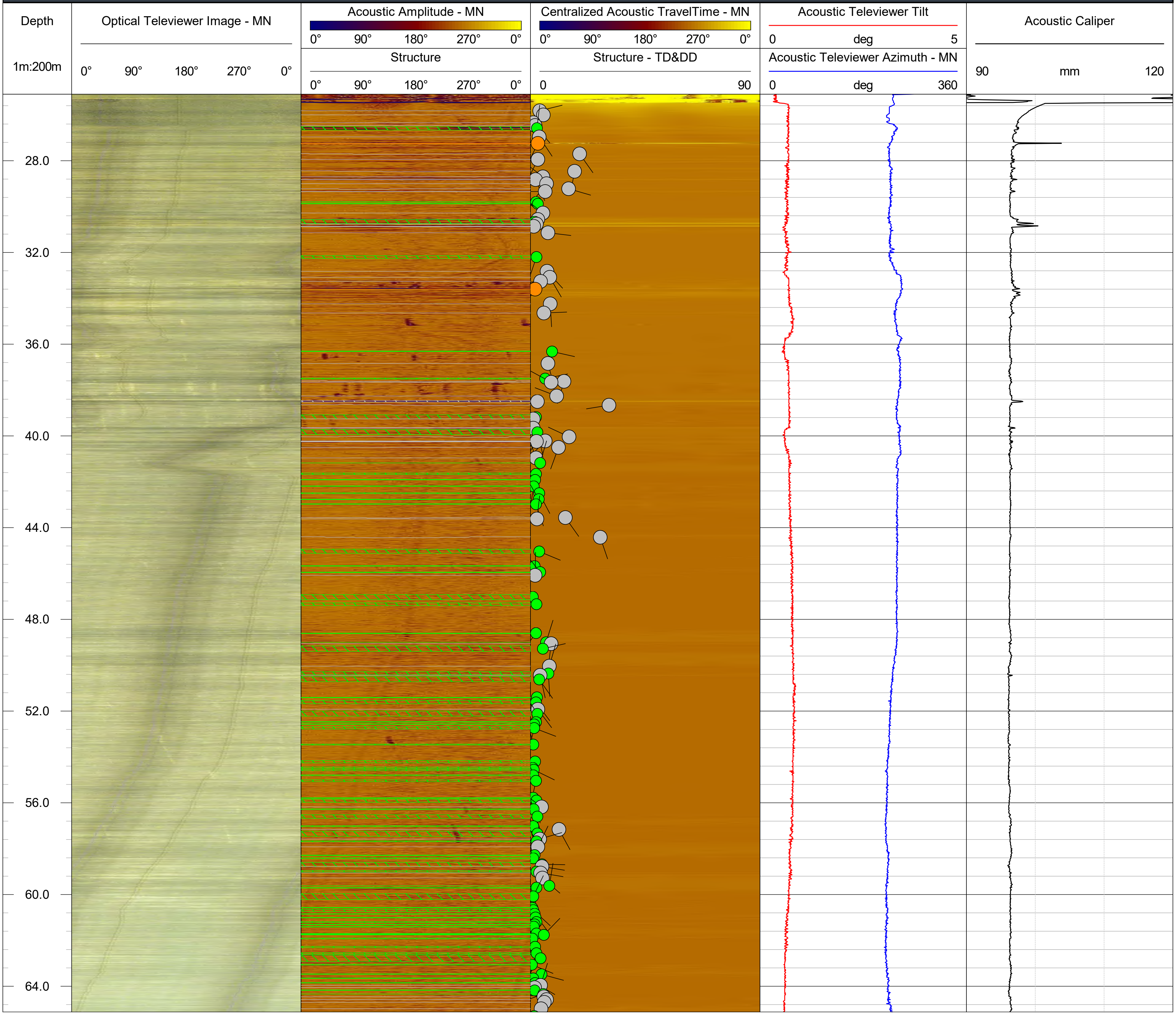
Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

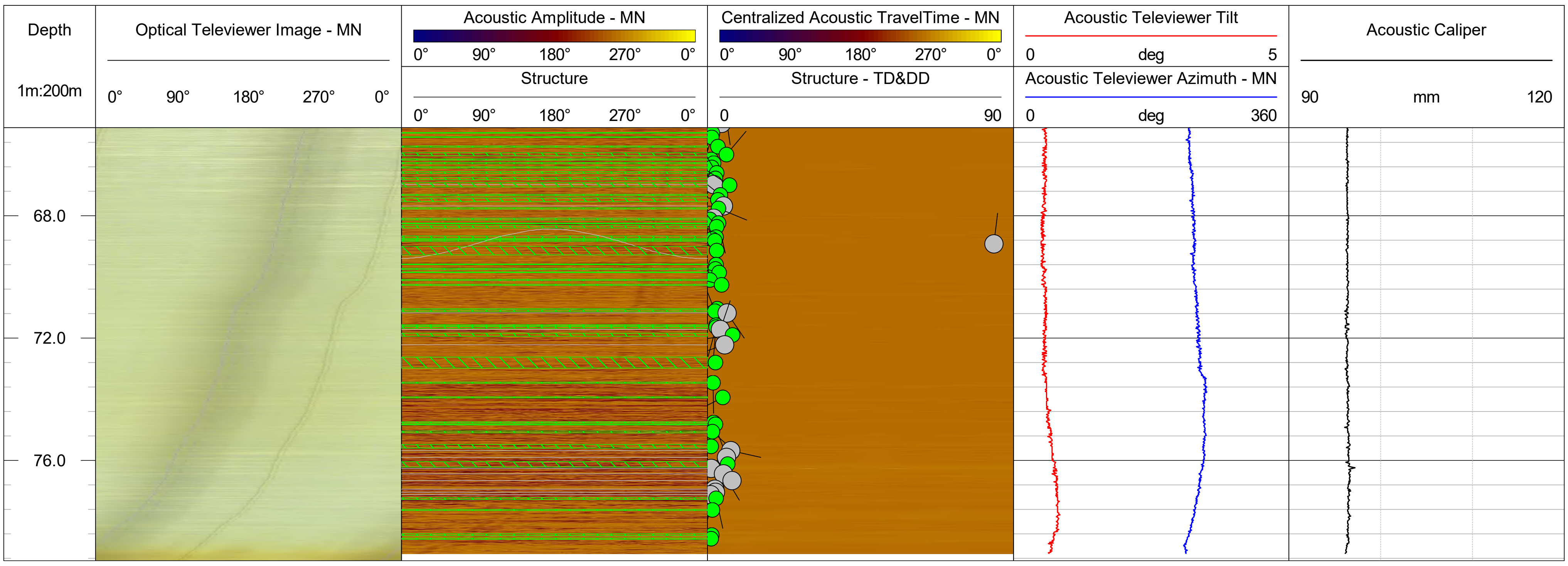
Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at ground	**Casing Depth:**	~25.20 m bgs	**Location:**	Darlington, Ontario
Easting:	683745.15 m	**Drilled Depth:**	79.83 m bgs	**Water Level:**	8.22 m bgs	**Log Date:**	July-7-2022
Northing:	4860135.33 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	89.00 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	J. Crawford



● Partially Open Joint / Fracture ● Filled Fracture / Joint ● Bedding / Banding / Foliation

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)

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Optical Televiewer Image - MN
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Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
68.0
72.0
76.0

A05-BH25

PROJECT: 21451329

LOCATION: N 4860087.78; E 683752.91

RECORD OF BOREHOLE: BH25

SHEET 1 OF 4

BORING DATE: June 24 to June 27, 2022

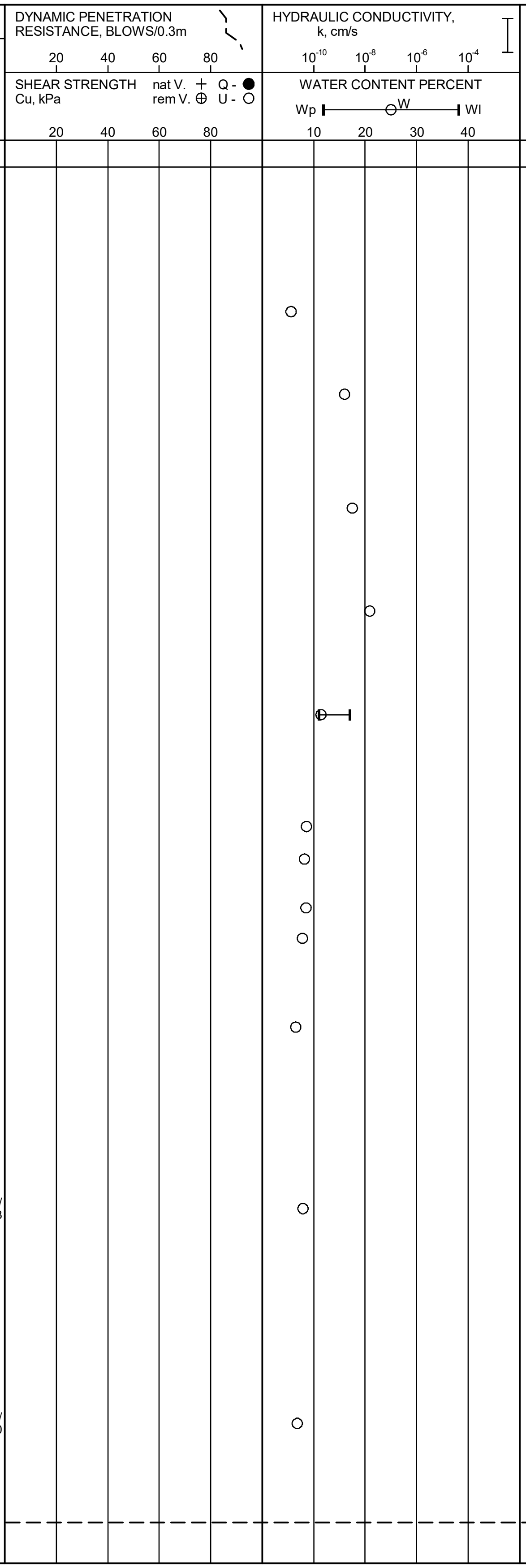
DATUM: Geodetic

DRILL RIG: Diedrich 120 Track Mounted

BORING METHOD: Power Augering, 210 mm O.D./110 mm I.D. Hollow Stem Augers (0 to approx. 3.05 m); Mud Rotary Wash Boring, HWT Casing (approx. 3.05 m to 10 m)

SOIL PROFILE – DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	88.30
Silty Sand with Gravel (SM), dense to medium dense, brown, grey at 0.8 m, moist, fine to coarse sand, angular to subangular fine to coarse gravel (Fill) (Unit 1) - Rock fragments in Spoon Sample 1 - Auger grinding 0.46 m-0.61 m and 1.22 m-1.37 m	0.00
Lean Clay with Sand (CL), very stiff, dark brown, moist, organic stains, fine sand, low to medium plasticity (Fill) (Unit 1)	86.93 1.37
Silty Sand (SM), medium dense, dark brown, moist, fine to medium sand (Fill) (Unit 1)	86.47 1.83
Lean Clay with Sand (CL), very stiff to stiff, brown, moist, trace to fine to coarse sand, trace to subangular fine to coarse gravel, low to medium plasticity (Glaciolacustrine) (Unit 2a) - Grey below 3.66 m - Sand and gravel increase below 3.66 m	86.17 2.13
Silty Sand (SM), medium dense, grey, moist, fine coarse sand, subangular to angular fine to coarse gravel (Glaciolacustrine) (Unit 2b) - Rock in tip of Spoon Sample 7B	83.73 4.57
Silty Gravel and Sand (GM), very dense, grey, moist, fine to coarse sand, angular to subangular fine to coarse gravel (Till) (Unit 3) - Rock fragments in Spoon Samples 9 and 10	82.70 5.60

SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1	SS	34		
2	SS	29		
3A	SS	25		
3B				
4	SS	12		
5	SS	20		
6	SS	9		4 28 46 22
7A	SS	15	NP	14 41 32 13
7B				
8A	SS	15		
8B				
9	SS	57		44 30 20 6
10	SS	100/0.13		
11	SS	100/0.10		



PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

CONTINUED NEXT PAGE

DEPTH SCALE 1 : 50

LOGGED: RV/SC

CHECKED: SEMP

PROJECT: 21451329

LOCATION: N 4860087.78; E 683752.91

RECORD OF BOREHOLE: BH25

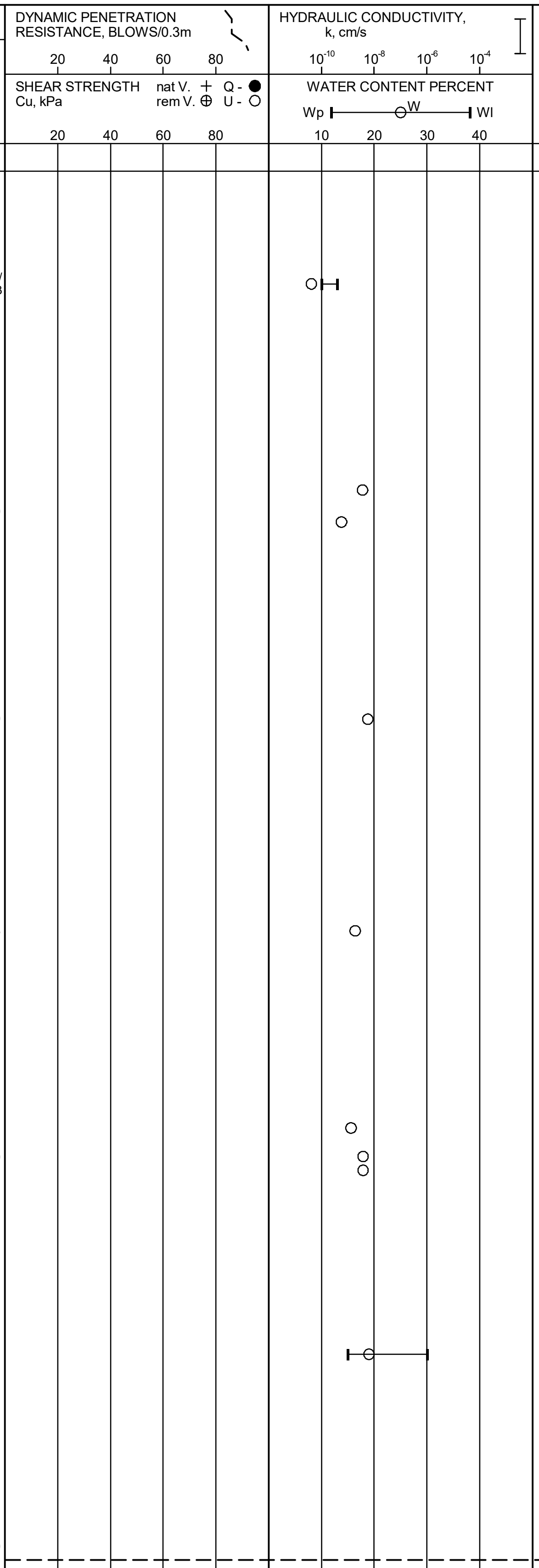
BORING DATE: June 24 to June 27, 2022

DRILL RIG: Diedrich 120 Track Mounted

SHEET 2 OF 4

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		--- CONTINUED FROM PREVIOUS PAGE ---					
10	Mud Rotary Wash Boring HWT Casing	**Silty Gravel and Sand (GM)**, very dense, grey, moist, fine to coarse sand, angular to subangular fine to coarse gravel (Till) (Unit 3)					
		- Low plasticity silt in Spoon Sample 12		12	SS	100/ 0.13	39 36 21 5
11							
		Sandy Silt (ML), very dense, grey, moist, fine to medium sand (Glaciolacustrine) (Unit 4a)	76.73 11.57				
12				13A	SS	150	
				13B			
13							
14				14	SS	170	
15				15	SS	148	0 30 67 3
16							
17				16A			
		- Silty Clay with sand layer from 17.02 m to 17.17 m		16B	SS	110	
				16C			
		Lean Clay (CL), very stiff, grey, moist, fine to medium sand, low to medium plasticity (Glaciolacustrine) (Unit 4b)	70.55 17.75				
18				17	SS	25	0 6 45 49
19		**Silty Clay with Sand (CL-ML)**, hard, grey, moist, fine to coarse sand, angular to subangular fine to coarse gravel, low plasticity (Till) (Unit 5)	69.02 19.28				
20				18	SS	150	
		CONTINUED NEXT PAGE					



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

LOGGED: RV/SC

CHECKED: SEMP

PROJECT: 21451329

LOCATION: N 4860087.78; E 683752.91

RECORD OF BOREHOLE: BH25

BORING DATE: June 24 to June 27, 2022

DRILL RIG: Diedrich 120 Track Mounted

SHEET 3 OF 4

DATUM: Geodetic

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
20	Mud Rotary Wash Boring HWT Casing	**Silty Clay with Sand (CL-ML)**, hard, grey, moist, fine to coarse sand, angular to subangular fine to coarse gravel, low plasticity (Till) (Unit 5)		18	SS	150	
21				19	SS	97	3 27 46 23
23				20	SS	100/0.13	
24		**Shale Bedrock Fragments** (Unit 6a) - Bedrock cored from 24.05 m to 28.71 m depth - Refer to Record of Drillhole BH25	64.25 24.10	21	SS	100/0.05	

Notes:

1. Efficiency of the SPT hammer utilized was 76.5 %.

2. Water level in open borehole could not be measured upon completion of soil drilling due to use of mud-rotary technique.

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○; 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-10} 10^{-8} 10^{-6} 10^{-4}

WATER CONTENT PERCENT: Wp ⊢ ○W ⊣ Wl; 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

LOGGED: RV/SC

CHECKED: SEMP

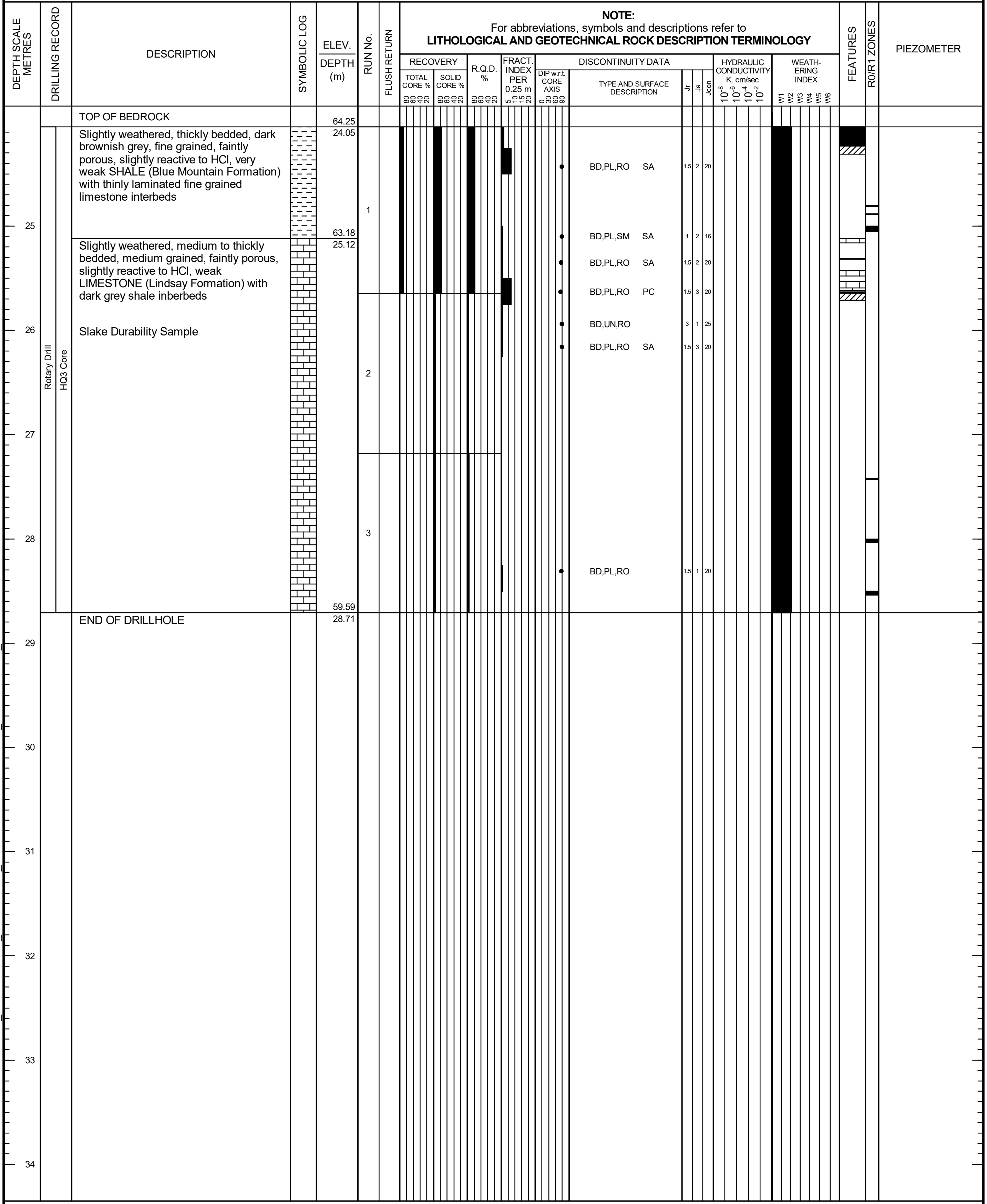
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4860087.78; E 683752.91
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH25

DRILLING DATE: June 29, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 4 OF 4
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



DESCRIPTION	ELEV. DEPTH (m)
TOP OF BEDROCK	64.25 24.05
Slightly weathered, thickly bedded, dark brownish grey, fine grained, faintly porous, slightly reactive to HCl, very weak SHALE (Blue Mountain Formation) with thinly laminated fine grained limestone interbeds	63.18 25.12
Slightly weathered, medium to thickly bedded, medium grained, faintly porous, slightly reactive to HCl, weak LIMESTONE (Lindsay Formation) with dark grey shale inberbeds Slake Durability Sample	59.59
END OF DRILLHOLE	28.71

DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION		Jr	Ja	Jcon
BD,PL,RO	SA	1.5	2	20
BD,PL,SM	SA	1	2	16
BD,PL,RO	SA	1.5	2	20
BD,PL,RO	PC	1.5	3	20
BD,UN,RO		3	1	25
BD,PL,RO	SA	1.5	3	20
BD,PL,RO		1.5	1	20

DEPTH SCALE
1 : 50

LOGGED: JS
CHECKED: AC

Water Content Summary
ASTM D2216

Test Request #	21451329-21600-610 BH25	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville		

Sample Location	Sample				Soil Description	Water Content %	Method	Remarks
	Ref	Top (m)	Base (m)	Type				
BH25	2	0.76	1.37	SS		5.6	B	
BH25	3A	1.52	1.83	SS		16.0	B	
BH25	4	2.29	2.74	SS		17.5	B	
BH25	5	3.05	3.51	SS		20.9	B	
BH25	6	3.81	4.27	SS		11.4	B	
BH25	7A	4.72	5.03	SS		8.6	B	
BH25	7B	5.03	5.18	SS		8.2	B	
BH25	8A	5.33	5.64	SS		8.5	B	
BH25	8B	5.64	5.79	SS		7.8	B	
BH25	9	6.10	6.55	SS		6.5	B	
BH25	10	7.62	7.75	SS		7.9	B	
BH25	11	9.14	9.40	SS		6.8	B	
BH25	12	10.67	10.95	SS		8.1	B	
BH25	13A	12.19	12.40	SS		17.8	B	
BH25	13B	12.40	12.65	SS		13.8	B	
BH25	14	13.72	14.17	SS		18.8	B	
BH25	15	15.24	15.70	SS		16.4	B	
BH25	16A	16.76	17.02	SS		15.6	B	
BH25	16B	17.02	17.17	SS		17.9	B	
BH25	16C	17.17	17.22	SS		17.9	B	
BH25	17	18.29	18.75	SS		19.0	B	
BH25	18	19.81	20.27	SS		11.4	B	

Notes:

Tested by: JTimms **Date:** 05 Oct 2022
Checked by: MRuck **Date:** 24 Oct 2022

Disclaimer:

Reviewed by: JoNorris **Date:** 09 Nov 2022

Water Content Summary
ASTM D2216

Test Request # 21451329-21600-610 BH25
Client: E.S. Fox Limited
Project Name: ES Fox/DNNP Invest/Bowmanville
Project Number: 21451329-21600-610
Project Location:

Sample Location	Sample				Soil Description	Water Content %	Method	Remarks
	Ref	Top (m)	Base (m)	Type				
BH25	19	21.34	21.79	SS		8.6	B	
BH25	20	22.86	22.99	SS		7.4	B	

Notes:

Tested by: JTimms **Date:** 05 Oct 2022
Checked by: MRuck **Date:** 24 Oct 2022

Disclaimer:

Reviewed by: JoNorris **Date:** 09 Nov 2022

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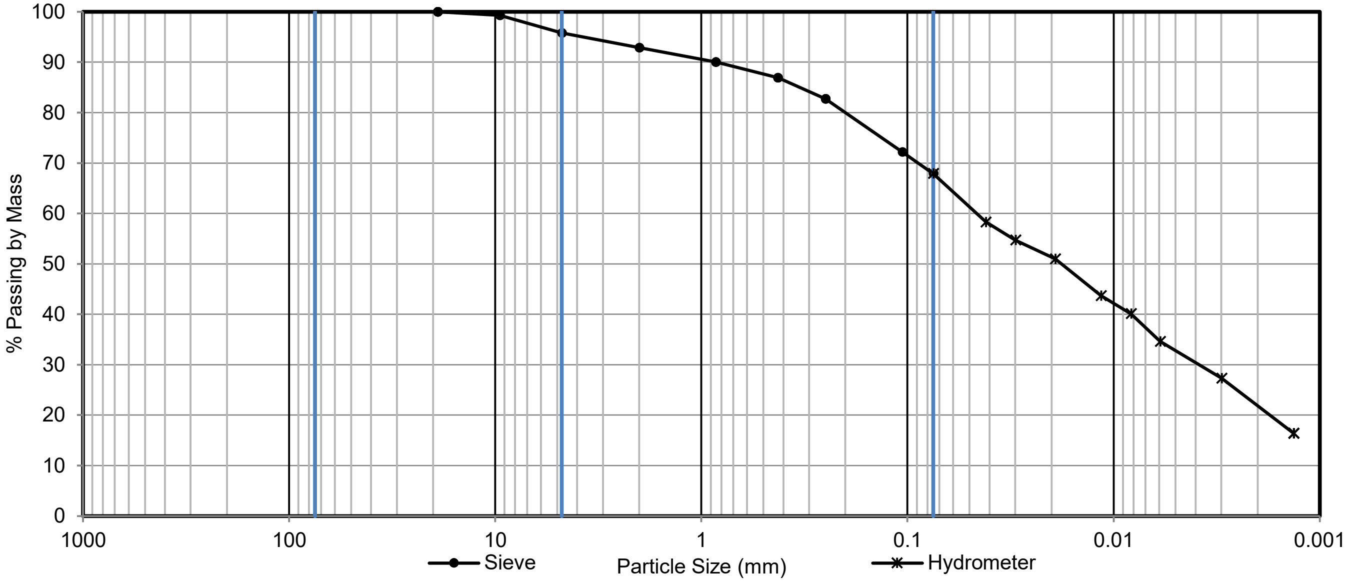
PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422
Method B

Test Request #	21451329-21600-610 BH25	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH25
Source:		Sample No.:	6
Soil Description:		Type:	SS
		Depth (m):	3.81 - 4.27

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	12 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)	BOULDERS	COBBLES	GRAVEL		SAND			FINES (Silt, Clay)
			Coarse	Fine	Coarse	Medium	Fine	
			4.2		27.9			67.9



Sieve			**Hydrometer Sedimentation**	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0416	58.3
3/8"	9.5	99.3	0.0299	54.7
#4	4.75	95.8	0.0192	51.0
#10	2	92.9	0.0115	43.7
#20	0.85	90.0	0.0082	40.1
#40	0.425	86.9	0.0059	34.6
#60	0.25	82.7	0.0030	27.3
#140	0.106	72.2	0.0013	16.4
#200	0.075	67.9		
			0.005 mm	32.77
			0.002 mm	21.84
			D60	0.05
			D30	0.00
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

Tested by: MKMarren **Date:** 12 Oct 2022 **Checked by:** MRuck **Date:** 24 Oct 2022 **Reviewed by:** JoNorris **Date:** 09 Nov 2022

PARTICLE SIZE DISTRIBUTION

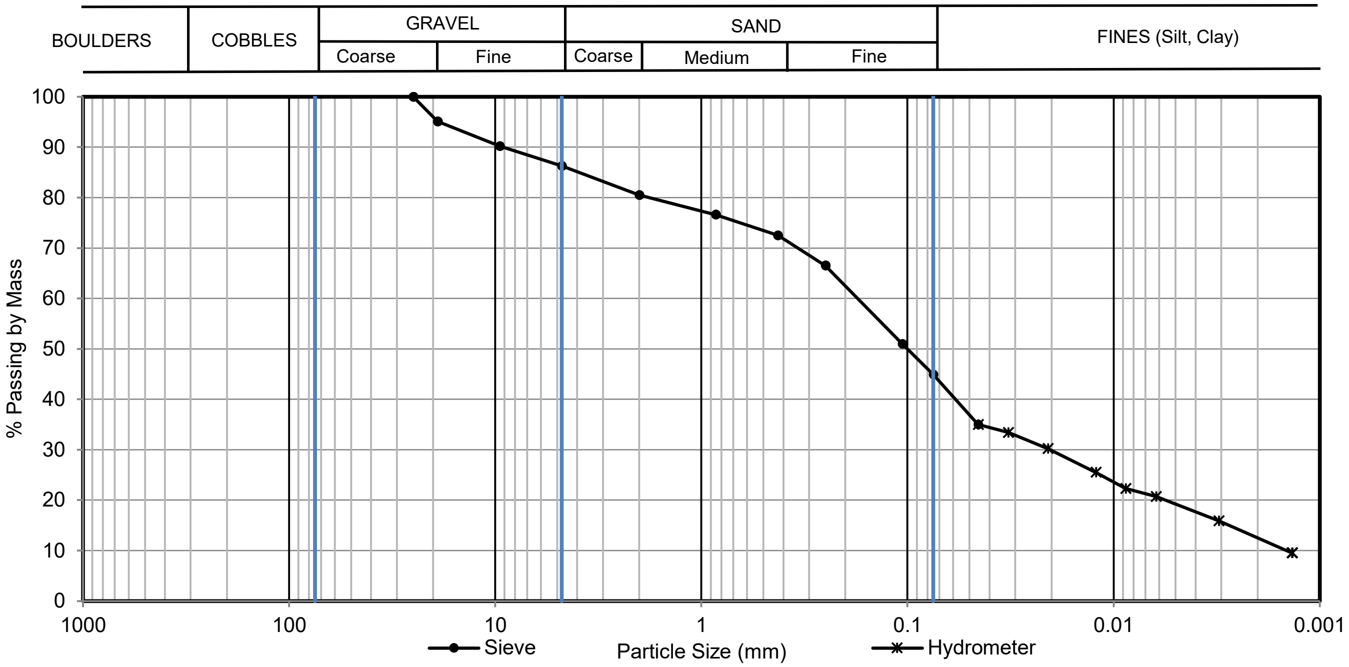
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH25	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH25
Source:		Sample No.:	7A
		Type:	SS
Soil Description:		Depth (m):	4.72 - 5.03

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	12 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%) 13.7 41.4 44.9



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1"	25	100.0	0.0454	35.0
3/4"	19	95.1	0.0324	33.4
3/8"	9.5	90.2	0.0208	30.2
#4	4.75	86.3	0.0122	25.5
#10	2	80.5	0.0088	22.3
#20	0.85	76.6	0.0062	20.7
#40	0.425	72.5	0.0031	15.9
#60	0.25	66.5	0.0014	9.5
#140	0.106	51.0		
#200	0.075	44.9		
			0.005 mm	19.20
			0.002 mm	12.51
			D60	0.18
			D30	0.02
			D10	0.00
			Cu	120.00
			Cc	1.60

Notes:

Disclaimer:

Tested by: MKMarren **Date:** 12 Oct 2022 **Checked by:** MRuck **Date:** 24 Oct 2022 **Reviewed by:** JoNorris **Date:** 09 Nov 2022

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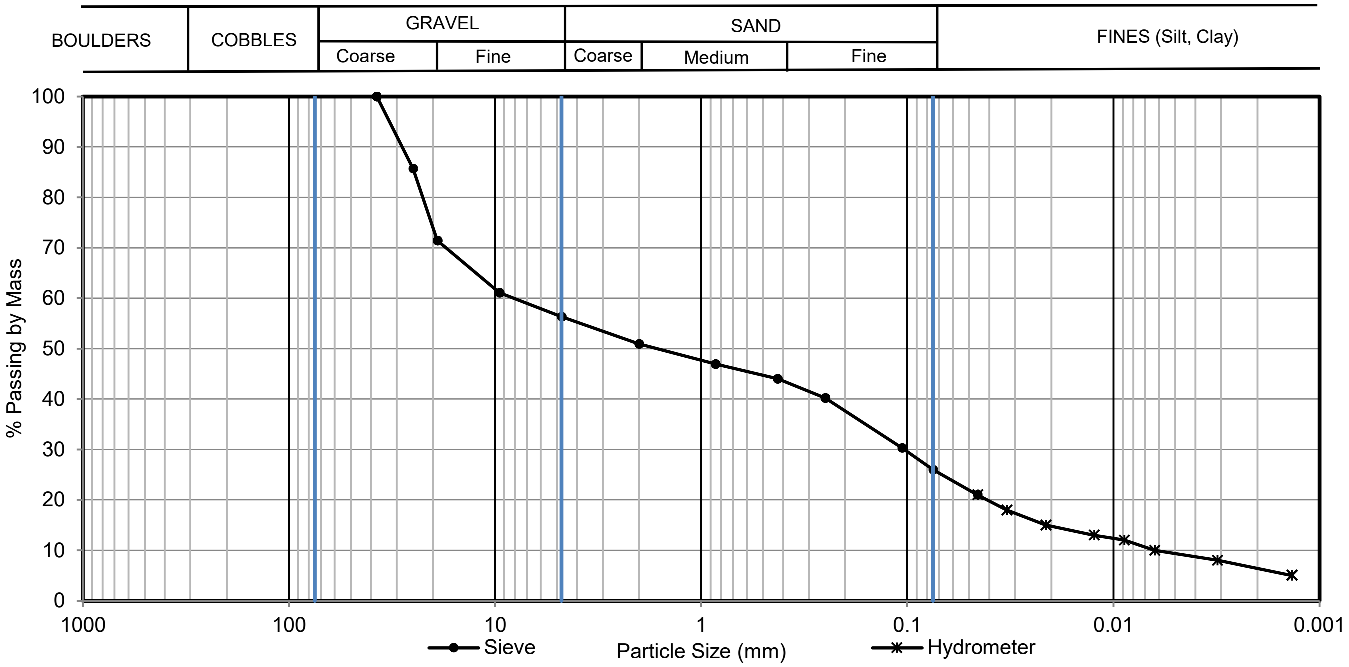
PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422
Method B

Test Request #	21451329-21600-610 BH25	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH25
Source:		Sample No.:	9
Soil Description:		Type:	SS
		Depth (m):	6.10 - 6.55

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	13 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)	Gravel	Sand	Fines (Silt, Clay)
	43.7	30.3	26.0



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1 1/2"	37.5	100.0	0.0456	21.0
1"	25	85.7	0.0329	18.0
3/4"	19	71.4	0.0213	15.0
3/8"	9.5	61.1	0.0124	13.0
#4	4.75	56.3	0.0089	12.0
#10	2	50.9	0.0063	10.0
#20	0.85	46.9	0.0031	8.0
#40	0.425	44.0	0.0014	5.0
#60	0.25	40.2		
#140	0.106	30.3		
#200	0.075	26.0		
			0.005 mm	9.33
			0.002 mm	6.39
			D60	8.10
			D30	0.10
			D10	0.01
			Cu	1300.00
			Cc	0.21

Notes:

Disclaimer:

Tested by: MKMarren **Date:** 13 Oct 2022 **Checked by:** MRuck **Date:** 24 Oct 2022 **Reviewed by:** JoNorris **Date:** 09 Nov 2022

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PARTICLE SIZE DISTRIBUTION

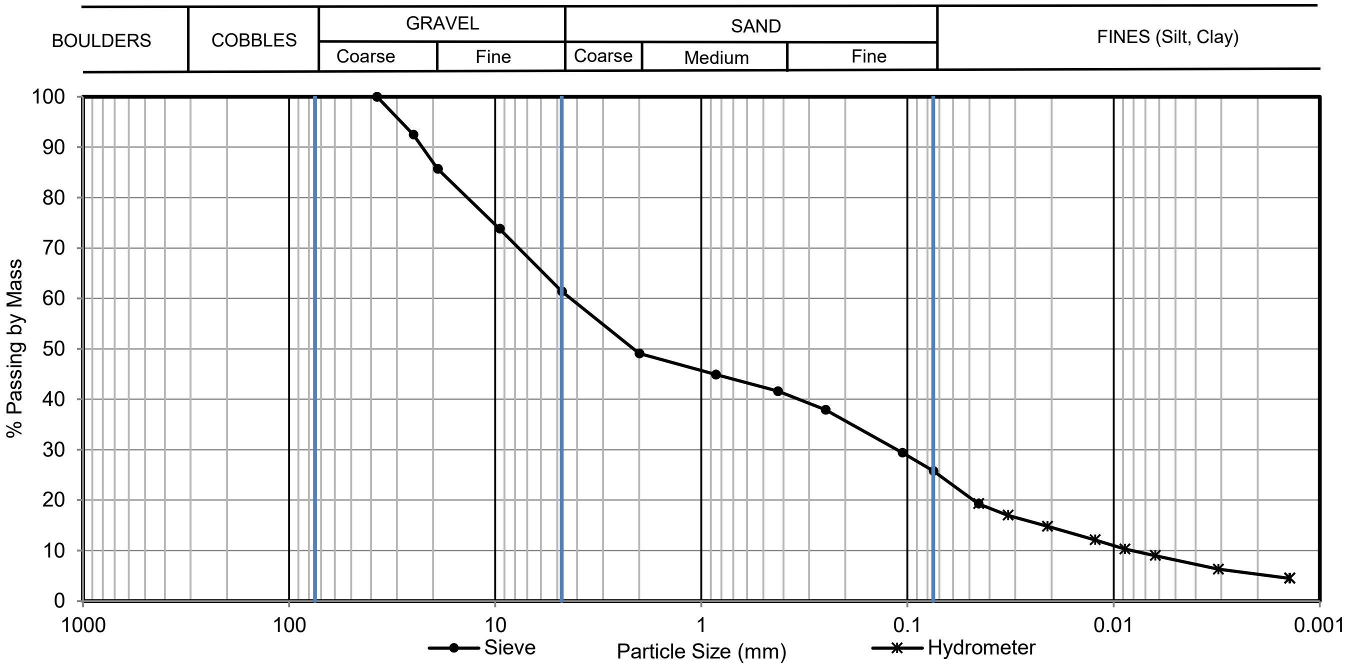
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH25	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH25
Source:		Sample No.:	12
Soil Description:		Type:	SS
		Depth (m):	10.67 - 10.95

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	24 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)	GRAVEL	SAND	FINES (Silt, Clay)
	38.6	35.6	25.8



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1 1/2"	37.5	100.0	0.0453	19.3
1"	25	92.5	0.0326	17.0
3/4"	19	85.7	0.0210	14.8
3/8"	9.5	73.8	0.0123	12.1
#4	4.75	61.4	0.0088	10.3
#10	2	49.1	0.0063	9.0
#20	0.85	44.9	0.0031	6.3
#40	0.425	41.6	0.0014	4.5
#60	0.25	37.9		
#140	0.106	29.4		
#200	0.075	25.8		
			0.005 mm	8.12
			0.002 mm	5.30
			D60	4.30
			D30	0.11
			D10	0.01
			Cu	530.00
			Cc	0.36

Notes:

Disclaimer:

Tested by: KGill **Date:** 24 Oct 2022 **Checked by:** MRuck **Date:** 09 Nov 2022 **Reviewed by:** JoNorris **Date:** 10 Nov 2022

GOLDER
MEMBER OF WSP

PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422

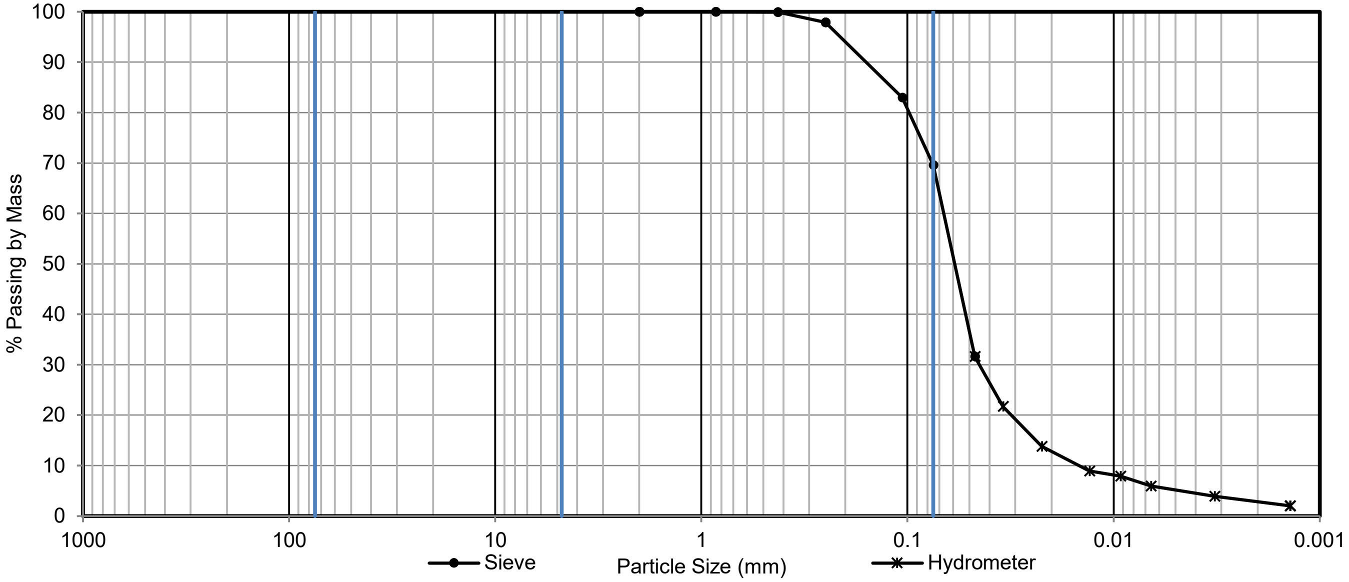
Method B

Test Request #	21451329-21600-610 BH25	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH25
Source:		Sample No.:	15
		Type:	SS
Soil Description:		Depth (m):	15.24 - 15.70

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	13 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)

BOULDERS	COBBLES	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	
		0.0		30.4			69.6



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
#10	2	100.0	0.0471	31.6
#20	0.85	100.0	0.0344	21.7
#40	0.425	99.9	0.0223	13.8
#60	0.25	97.9	0.0131	8.9
#140	0.106	83.0	0.0093	7.9
#200	0.075	69.6	0.0066	5.9
			0.0032	3.9
			0.0014	2.0
			0.005 mm	5.12
			0.002 mm	2.82
			D60	0.07
			D30	0.04
			D10	0.01
			Cu	4.50
			Cc	2.00

Notes:

Disclaimer:

Tested by: MKMarren **Date:** 13 Oct 2022 **Checked by:** MRuck **Date:** 24 Oct 2022 **Reviewed by:** JoNorris **Date:** 09 Nov 2022

Golder Associates
100 Scotia Court Whitby, ON L1N 8Y6 Canada
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PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422

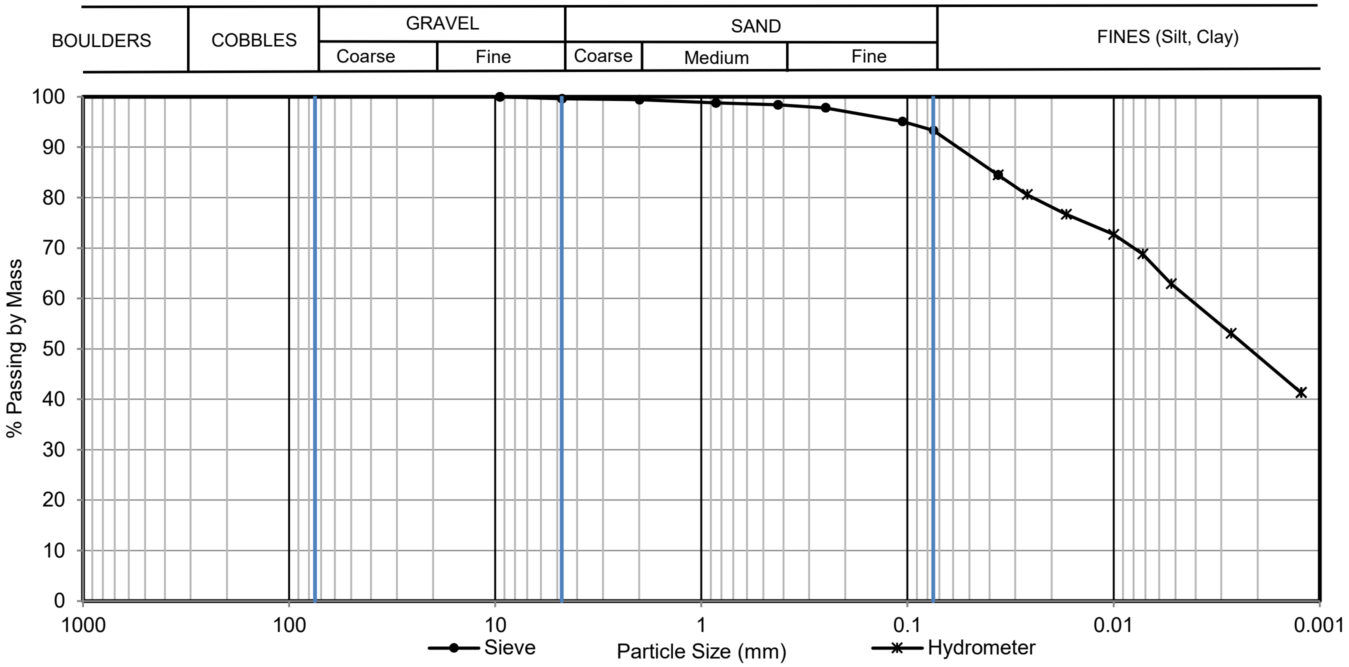
Method B

Test Request #	21451329-21600-610 BH25	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH25
Source:		Sample No.:	17
Soil Description:		Type:	SS
		Depth (m):	18.29 - 18.75

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	13 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)

BOULDERS	COBBLES	GRAVEL	SAND	FINES (Silt, Clay)
		0.4	6.3	93.3



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/8"	9.5	100.0	0.0364	84.5
#4	4.75	99.6	0.0263	80.6
#10	2	99.4	0.0170	76.7
#20	0.85	98.8	0.0100	72.7
#40	0.425	98.4	0.0072	68.8
#60	0.25	97.8	0.0053	62.9
#140	0.106	95.1	0.0027	53.1
#200	0.075	93.3	0.0012	41.3
			0.005 mm	62.16
			0.002 mm	48.60
			D60	0.00
			D30	
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

Tested by: MKMarren **Date:** 13 Oct 2022 **Checked by:** MRuck **Date:** 24 Oct 2022 **Reviewed by:** JoNorris **Date:** 09 Nov 2022

PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422

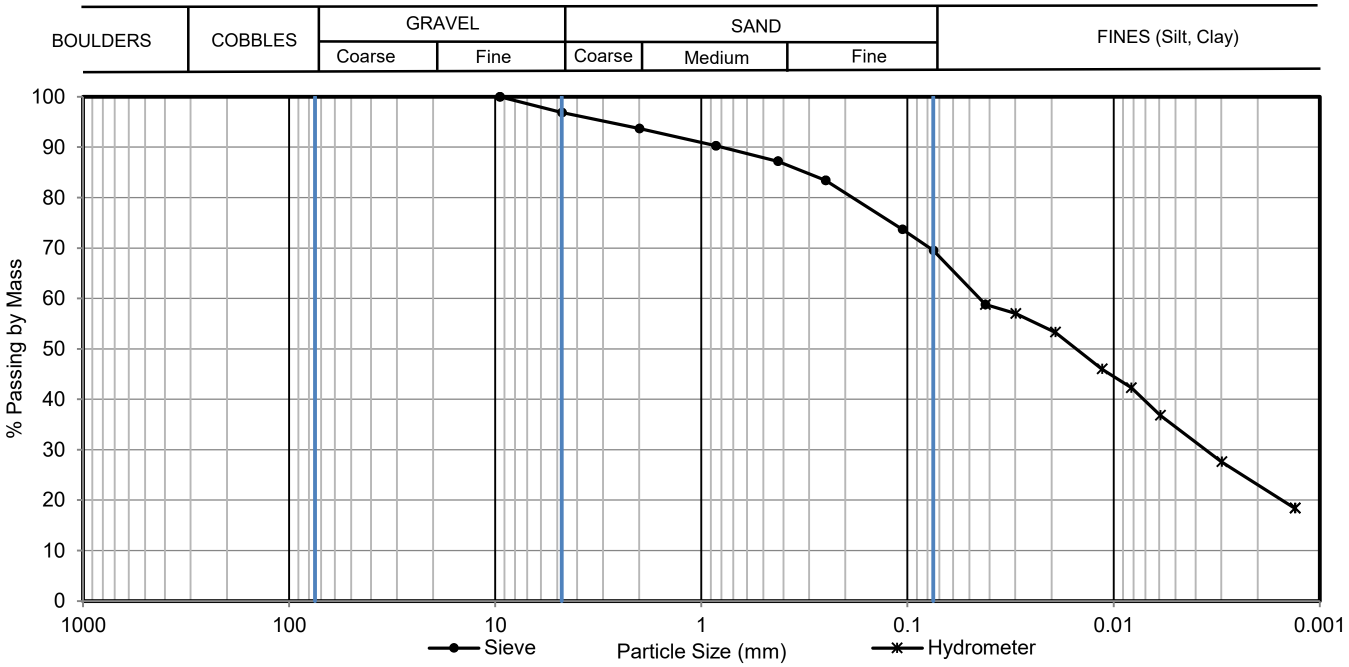
Method B

Test Request #	21451329-21600-610 BH25	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH25
Source:		Sample No.:	19
		Type:	SS
Soil Description:		Depth (m):	21.34 - 21.79

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	13 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)

BOULDERS	COBBLES	GRAVEL	SAND	FINES (Silt, Clay)
		3.1	27.4	69.5



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/8"	9.5	100.0	0.0419	58.8
#4	4.75	96.9	0.0299	57.0
#10	2	93.7	0.0192	53.3
#20	0.85	90.3	0.0114	46.0
#40	0.425	87.2	0.0082	42.3
#60	0.25	83.4	0.0059	36.8
#140	0.106	73.7	0.0030	27.6
#200	0.075	69.5	0.0013	18.4
			0.005 mm	34.51
			0.002 mm	23.08
			D60	0.04
			D30	0.00
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

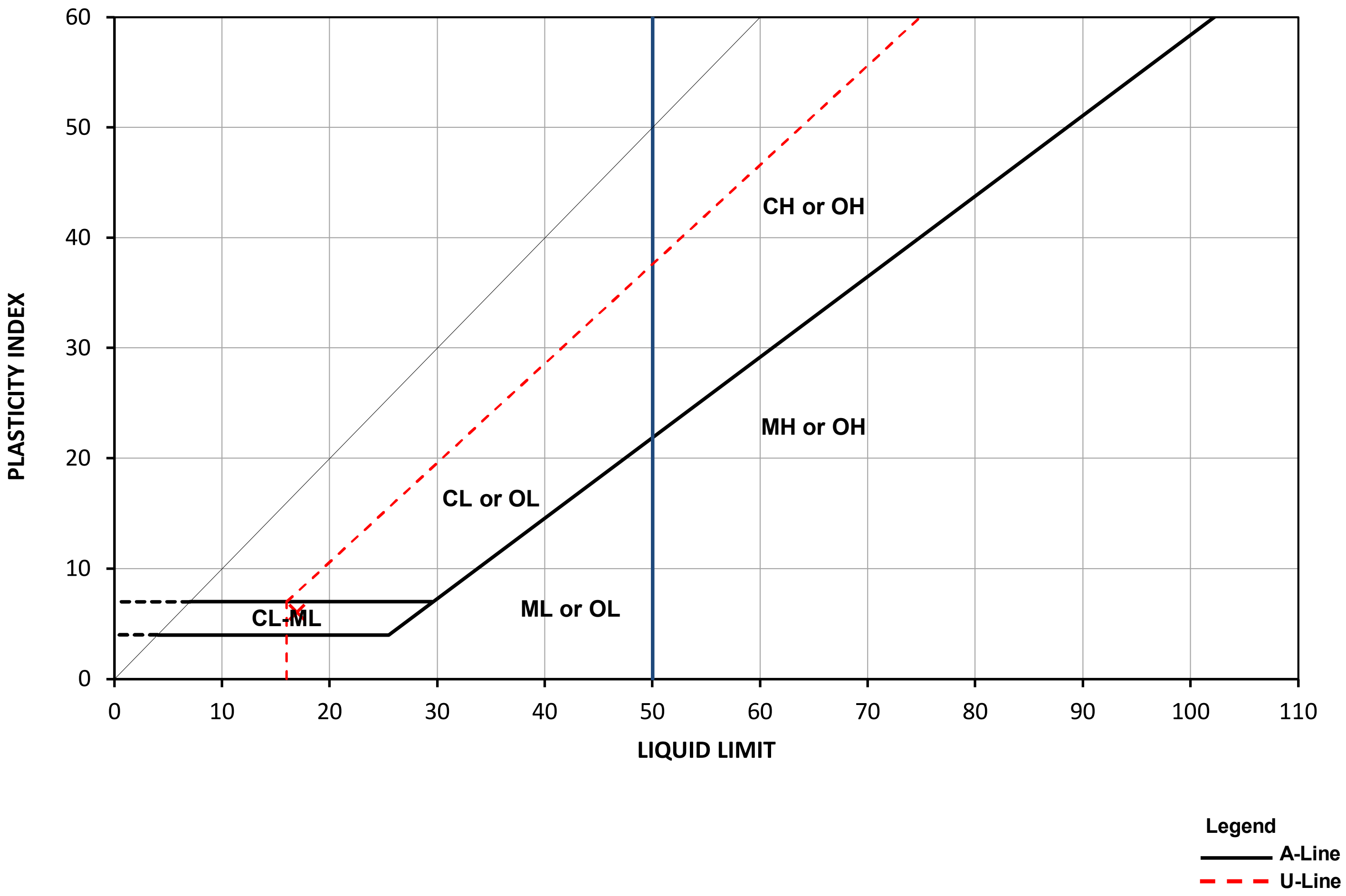
Tested by: MKMarren **Date:** 13 Oct 2022 **Checked by:** MRuck **Date:** 24 Oct 2022 **Reviewed by:** JoNorris **Date:** 09 Nov 2022

GOLDER
MEMBER OF WSP

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318
Method A - Multipoint Test

Test Request #	21451329-21600-610 BH25	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH25
Source:		Sample No.:	6
Soil Description:		Type:	SS
		Depth (m):	3.81 - 4.27

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	17 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH25	6	3.81	4.27	93	11.4	17	11	6	0.07

NP = Non-Plastic
ND = Not Determined

Test Preparation

Dry Preparation Tested after >425um removed

Notes:

Disclaimer:

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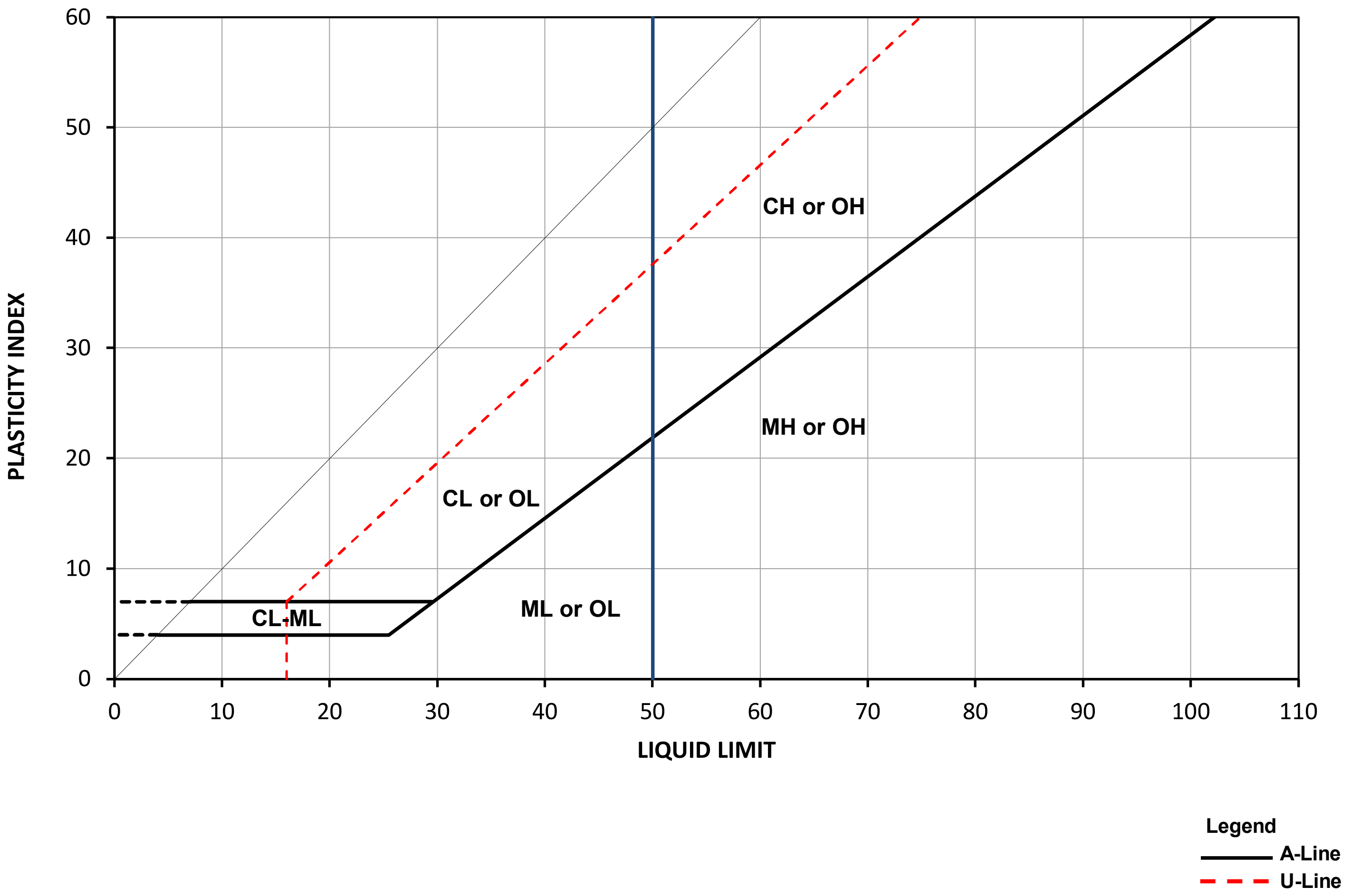
Tested by: JTimms **Date:** 17 Oct 2022
Checked by: MRuck **Date:** 24 Oct 2022
Reviewed by: JoNorris **Date:** 09 Nov 2022

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318

Test Request #	21451329-21600-610 BH25	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH25
Source:		Sample No.:	7A
Soil Description:		Type:	SS
		Depth (m):	4.72 - 5.03

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	17 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH25	7A	4.72	5.03	84	8.6		NP		

NP = Non-Plastic
ND = Not Determined

Test Preparation
Dry Preparation Tested after >425um removed

Notes:

Tested by: JTimms **Date:** 17 Oct 2022
Checked by: MRuck **Date:** 24 Oct 2022

Disclaimer:
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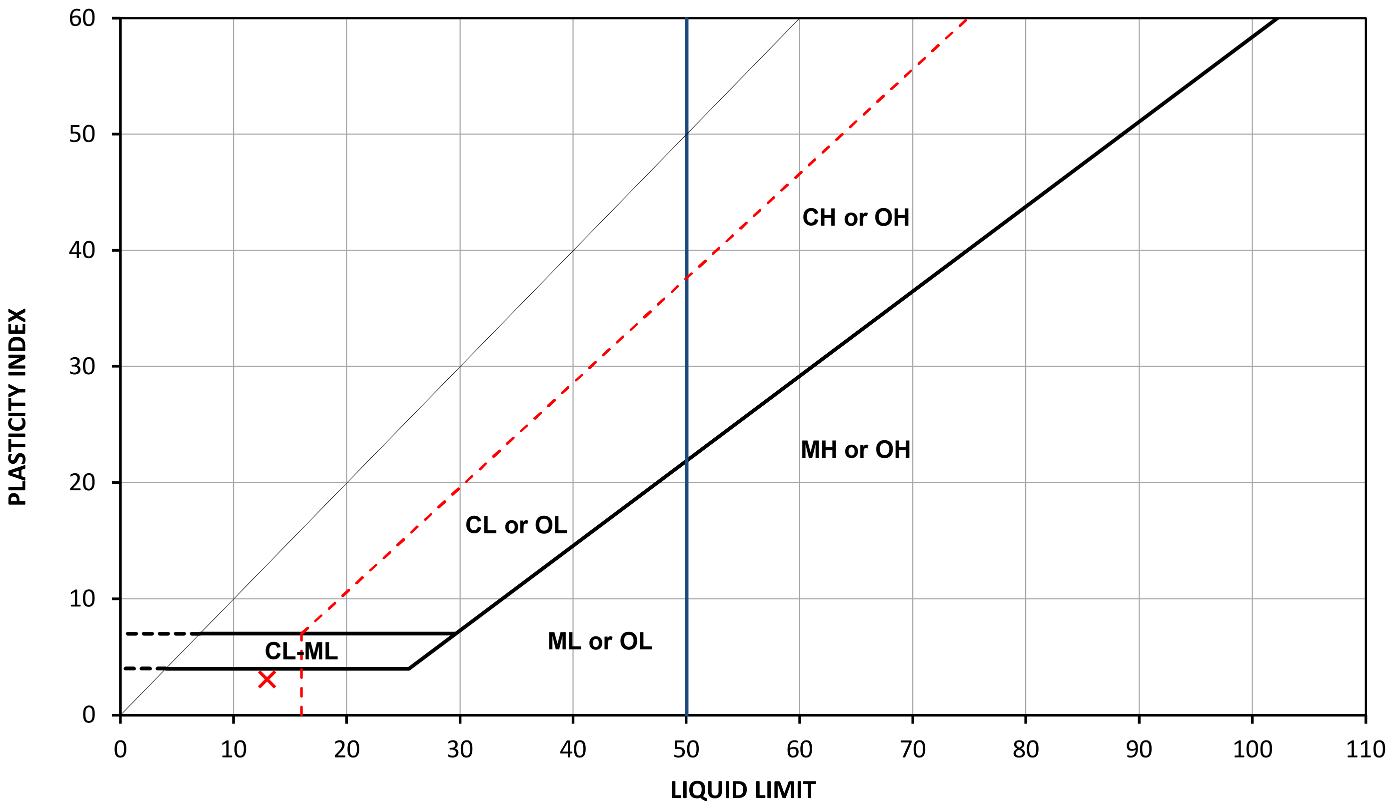
Reviewed by: JoNorris **Date:** 09 Nov 2022

GOLDER
MEMBER OF WSP

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318
Method B - One-point Test

Test Request #	21451329-21600-610 BH25	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH25
Source:		Sample No.:	12
Soil Description:		Type:	SS
		Depth (m):	10.67 - 10.95

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	28 Oct 2022
Specimen Description	NA				



Legend
A-Line
U-Line

Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH25	12	10.67	10.95	ND	8.1	13	10	3	-0.63

NP = Non-Plastic
ND = Not Determined

Test Preparation

Notes:

Disclaimer:
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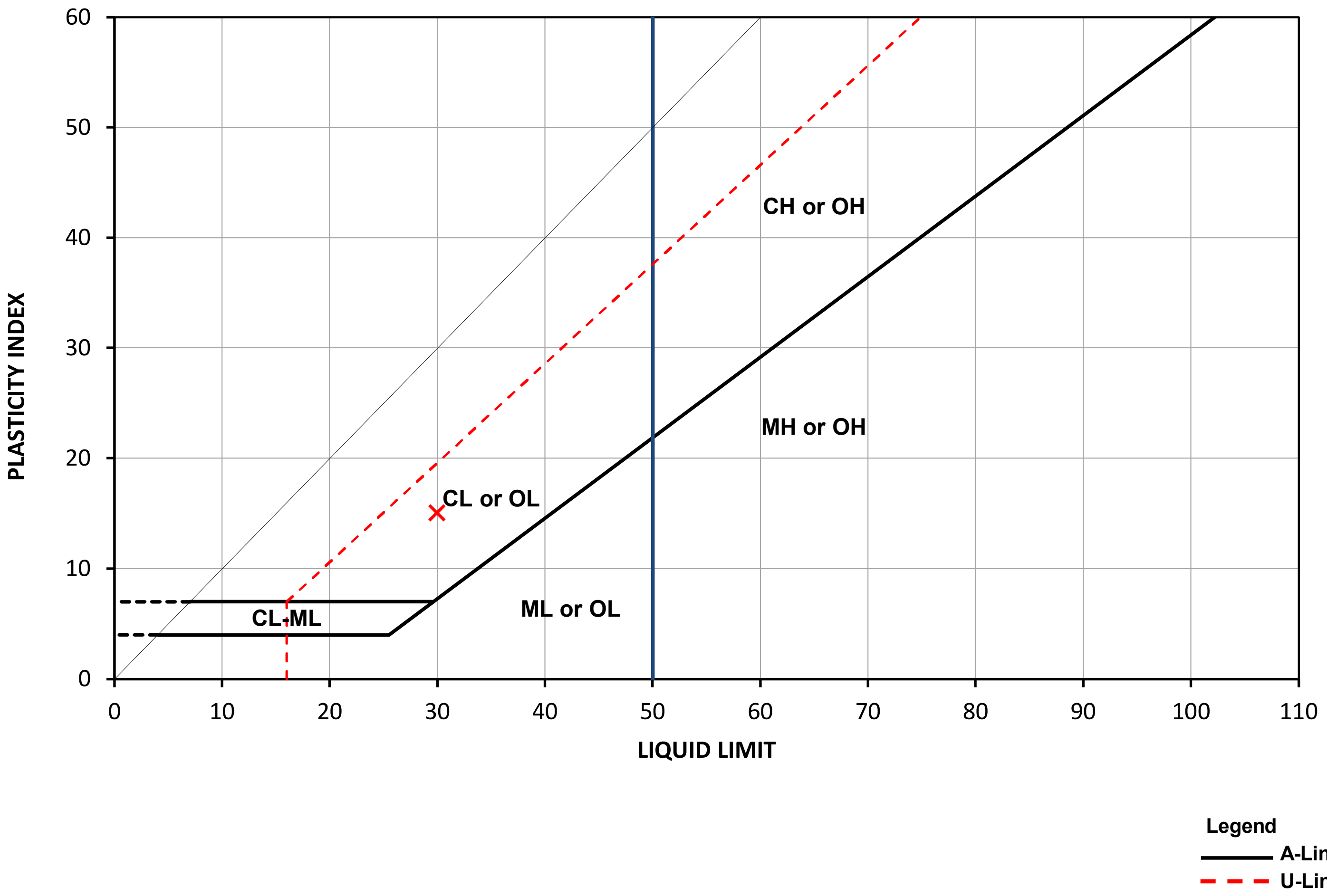
Tested by: XMeng **Date:** 28 Oct 2022
Checked by: MRuck **Date:** 08 Nov 2022
Reviewed by: JoNorris **Date:** 09 Nov 2022

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318
Method A - Multipoint Test

Test Request #	21451329-21600-610 BH25	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH25
Source:		Sample No.:	17
Soil Description:		Type:	SS
		Depth (m):	18.29 - 18.75

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	17 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH25	17	18.29	18.75	97	19.0	30	15	15	0.27

NP = Non-Plastic
ND = Not Determined

Test Preparation
Dry Preparation Tested after >425um removed

Notes:

Disclaimer:
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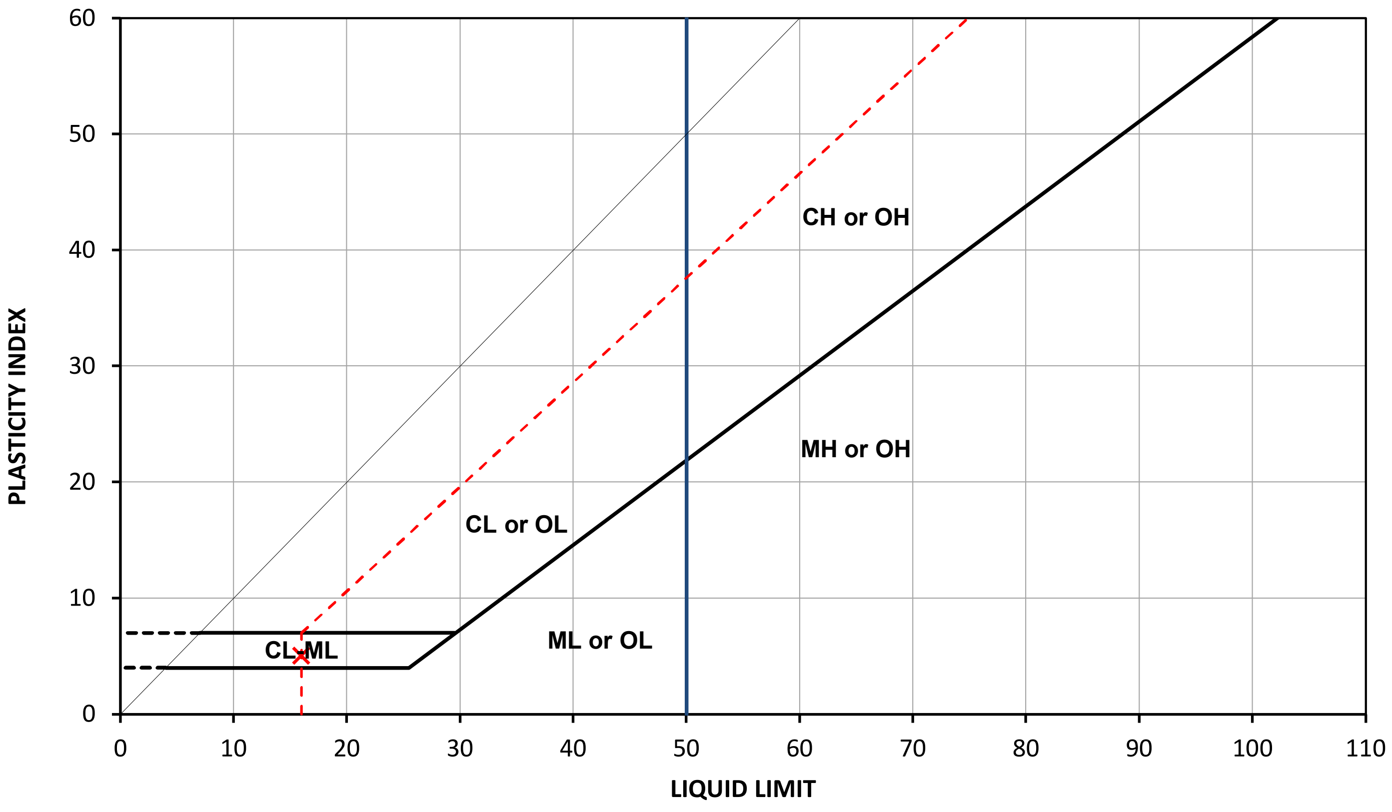
Tested by: JTimms **Date:** 17 Oct 2022
Checked by: MRuck **Date:** 24 Oct 2022
Reviewed by: JoNorris **Date:** 09 Nov 2022

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318
Method A - Multipoint Test

Test Request #	21451329-21600-610 BH25	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH25
Source:		Sample No.:	19
Soil Description:		Type:	SS
		Depth (m):	21.34 - 21.79

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	17 Oct 2022
Specimen Description	NA				



Legend
— A-Line
- - - U-Line

Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH25	19	21.34	21.79	89	8.6	16	11	5	-0.48

NP = Non-Plastic
ND = Not Determined

Test Preparation
Dry Preparation Tested after >425um removed

Notes:

Tested by: JTimms **Date:** 17 Oct 2022
Checked by: MRuck **Date:** 24 Oct 2022

Disclaimer:
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Reviewed by: JoNorris **Date:** 09 Nov 2022

GOLDER
MEMBER OF WSP

SPECIFIC GRAVITY OF SOIL SOLIDS
ASTM D854
Pycnometer Method B

Test Request #: 21451329-21600-610 BH25
Client: E.S. Fox Limited
Project Name: ES Fox/DNNP Invest/Bowmanville
Source:
Soil Description:

Project Number: 21451329-21600-610
Project Location: NA
Sample Location: BH25
Sample No.: 12
Type: SS
Depth (m) 10.67 - 10.95

Specimen Reference NA
Specimen Depth NA
Date of Test 28 Oct 2022

Specimen Description NA

Proportions		
Percentage Passing (4.75 mm)		%
Percentage Retained (4.75 mm)		%

Fine Fraction (D854)		
Calibrated Mass of Pycnometer		g
Calibrated Volume of Pycnometer	249.65	mL
Mass of Pycnometer	92.30	g
Test Temperature	17.8	oC
Mass of Pycnometer, soil and water	367.24	g
Mass of Container (or tare)	3.54	g
Mass of dry soil and container	44.26	g
Dry mass of soil solids	40.72	g
Specific Gravity at 20oC	**2.70**	

Coarse Fraction (C127)		
Mass of Oven Dry Sample		g
Mass of saturated-surface-dry in air		g
Apparent mass of saturated test sample in water		g
Specific Gravity Oven Dry		
Specific Gravity Saturated Surface Dry		
Specific Gravity with Weighted Average	**2.70**	

Notes:

Disclaimer:

Tested by: DPatel **Date:** 28 Oct 2022
Checked by: MRuck **Date:** 09 Nov 2022
Reviewed by: JoNorris **Date:** 10 Nov 2022

Water (Moisture) Content, Ash Content, and Organic Material of Soils
ASTM D2974 Method A

Test Request #	21451329-21600-610 BH25	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH25
Source:		Sample No.:	3A
Soil Description:		Type:	SS
		Depth (m):	1.52 - 1.83

Specimen Reference NA

Specimen Depth NA

Date of Test 05 Oct 2022

Specimen Description NA

Furnace Temperature During Test (°C)	440
Duration of Test (nearest 15 minutes)	8640
Mass of Crucible With Lid (g)	59.81
Moist Mass of Specimen Plus Crucible With Lid (g)	155.82
Oven Dry Mass of Specimen Plus Crucible With Lid (g)	141.47
Mass of Crucible With Lid Plus Ash (g)	139.85
Water Content (%)	18
Ash Content (%)	98.0
Organic Material (%)	2.0

Test Preparation

Notes:

Disclaimer:

Tested by: JTimms **Date:** 05 Oct 2022

Checked by: MRuck **Date:** 24 Oct 2022

Reviewed by: JoNorris **Date:** 09 Nov 2022

SOIL RESISTIVITY USING THE WENNER FOUR ELECTRODE METHOD (ASTM G57-20)

November 3, 2022
Golder Project Number: 21451329-21600-610

Attention: Sarah Poot

Sample Description: **BH25, SA7B*, 5.03-5.18m**

Date Scheduled:	October 3, 2022	Sampled By:	Golder Associates Ltd.
Date Received:	October 5, 2023	Golder Lab No.:	G-22-300
Date Tested:	October 27, 2023	Tested By:	E.Shallhorn

Resistivity Meter Model Number	Miller 400D
Soil Box Factor	0.976377953
Temperature of Sample (°C)	22.5
Measured Resistance (ohm)	3600.0
Resistivity (ohm•cm)	3515.0
Temperature Corrected Resistivity (ohm•cm)	**4130.1**

Note: *Material was combined with that of BH25 SA7A to obtain enough for testing as per Reza Vahdani

Data Input By: M. Ruck

Reviewed by:

Jodi Norris, Technical and Quality Coordinator

CCIL
The Voice Of Independent Canadian Laboratories
La voix des laboratoires indépendants canadiens

A06-BH26

PROJECT: 21451329

LOCATION: N 4859832.55; E 683916.52

RECORD OF BOREHOLE: BH26

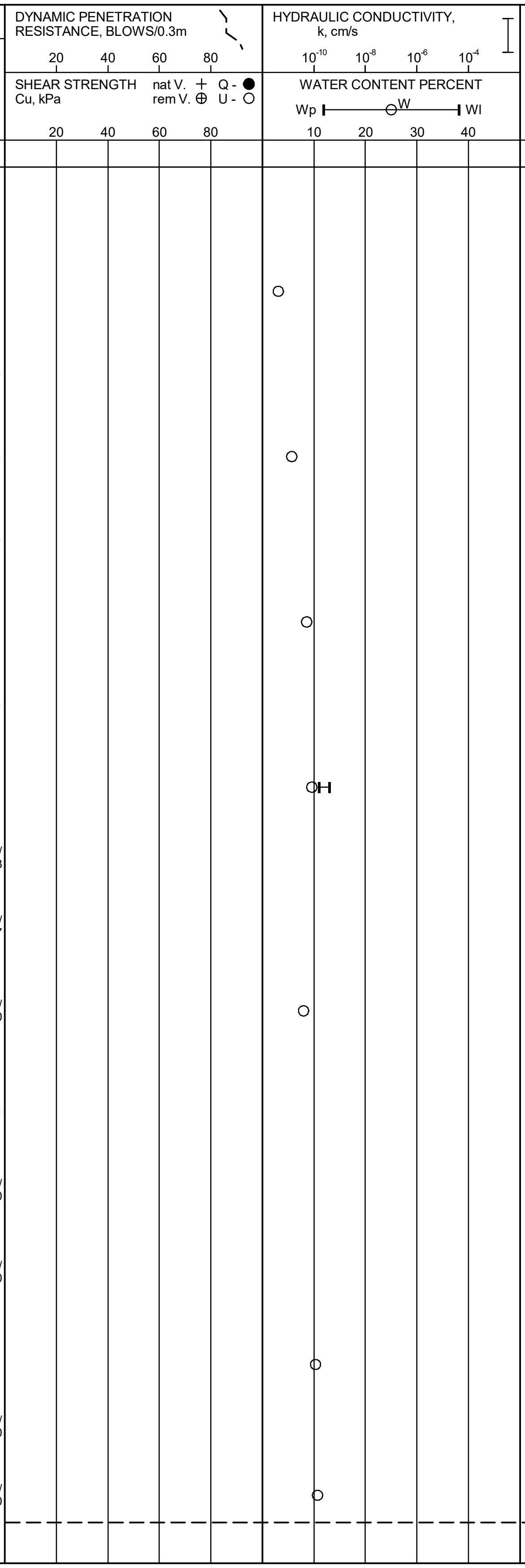
BORING DATE: July 12 to 19, 2022

DRILL RIG: Diedrich 50 Track Mounted

SHEET 1 OF 9

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		GROUND SURFACE	85.10				
0	Power Augering 250 mm O.D./150 mm I.D. Hollow Stem Auger	**Silty Sand with Gravel (SM)**, medium dense to very dense, brown, moist, fine to coarse sand, angular to subangular fine to coarse gravel (Fill) (Unit 1)	0.00	1	SS	17	
1				2	SS	32	
		- Auger grinding between 1.22 m and 1.83 m		3	SS	134	
2		**Silty Sand with Gravel (SM)**, very dense, brown to grey, moist to wet, fine to coarse sand, subangular coarse gravel (Till) (Unit 3)	83.27 1.83	4	SS	134	
	Mud Rotary Wash Boring PWT Casing	- Grey at 1.83 m		5	SS	168	
3				6	SS	65	
4				7	SS	113	
		- Moist to wet below 4.27 m - Low plasticity silt in Spoon Sample 8		8	SS	58	26 27 40 7
5				9	SS	134/0.28	
				10	SS	100/0.07	
6				11	SS	100/0.10	
7				12	SS	143	
		- Slight increase in plasticity below 7.32 m		13	SS	195/0.30	
8				14	SS	158/0.30	
		- Wet at 8.53 m		15	SS	151	
9				16	SS	150/0.20	
		- Spoon bouncing at 9.75 m		17	SS	130/0.10	
10							



PIEZOMETER OR STANDPIPE INSTALLATION

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

LOGGED: MH/BD

CHECKED: SEMP

PROJECT: 21451329

LOCATION: N 4859832.55; E 683916.52

RECORD OF BOREHOLE: BH26

BORING DATE: July 12 to 19, 2022

DRILL RIG: Diedrich 50 Track Mounted

SHEET 2 OF 9

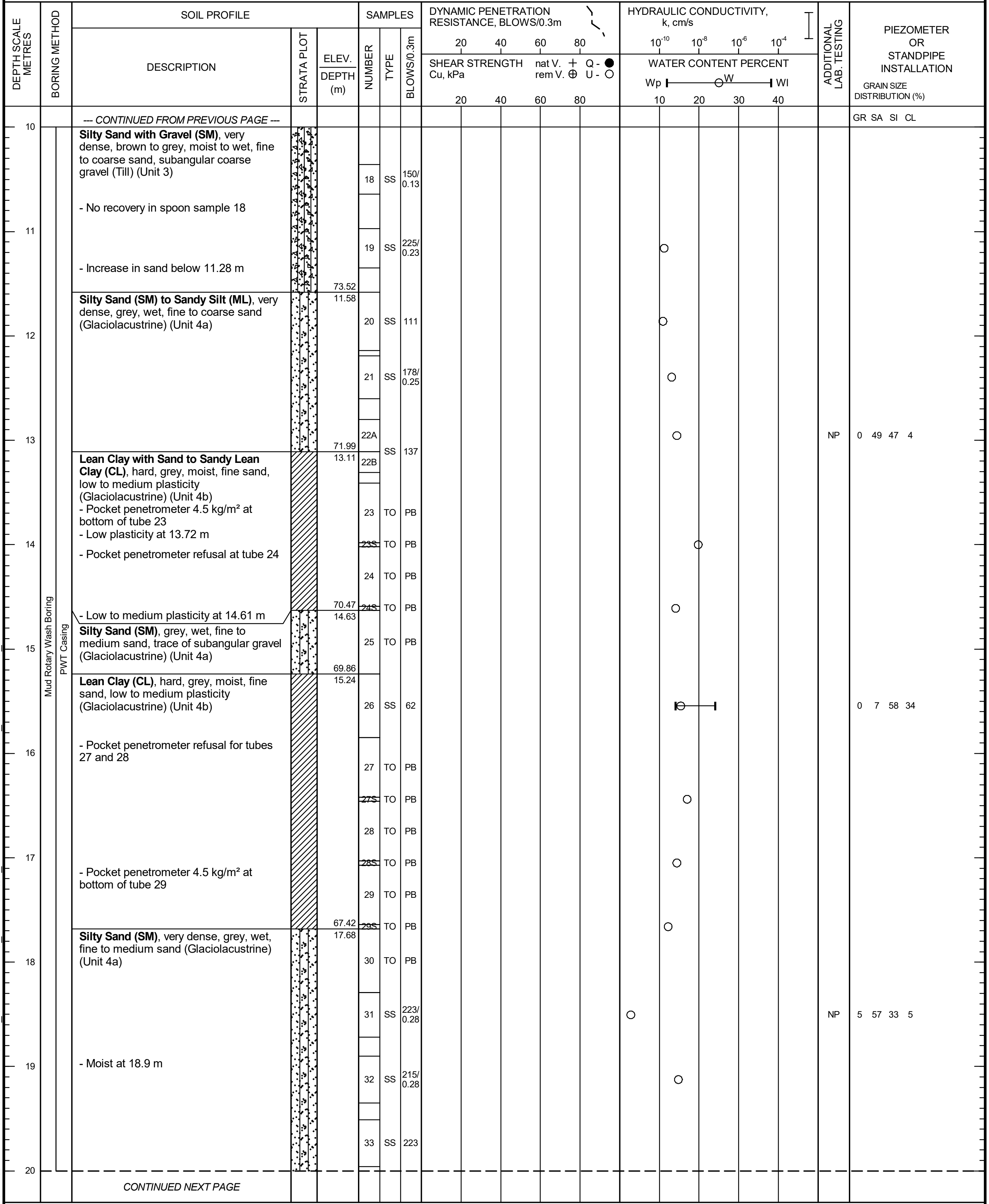
DATUM: Geodetic

--- *CONTINUED FROM PREVIOUS PAGE* ---

BORING METHOD: Mud Rotary Wash Boring; PWT Casing

DESCRIPTION	ELEV. / DEPTH (m)
Silty Sand with Gravel (SM), very dense, brown to grey, moist to wet, fine to coarse sand, subangular coarse gravel (Till) (Unit 3) - No recovery in spoon sample 18 - Increase in sand below 11.28 m	73.52 11.58
Silty Sand (SM) to Sandy Silt (ML), very dense, grey, wet, fine to coarse sand (Glaciolacustrine) (Unit 4a)	71.99 13.11
Lean Clay with Sand to Sandy Lean Clay (CL), hard, grey, moist, fine sand, low to medium plasticity (Glaciolacustrine) (Unit 4b) - Pocket penetrometer 4.5 kg/m² at bottom of tube 23 - Low plasticity at 13.72 m - Pocket penetrometer refusal at tube 24 - Low to medium plasticity at 14.61 m	70.47 14.63
Silty Sand (SM), grey, wet, fine to medium sand, trace of subangular gravel (Glaciolacustrine) (Unit 4a)	69.86 15.24
Lean Clay (CL), hard, grey, moist, fine sand, low to medium plasticity (Glaciolacustrine) (Unit 4b) - Pocket penetrometer refusal for tubes 27 and 28 - Pocket penetrometer 4.5 kg/m² at bottom of tube 29	67.42 17.68
Silty Sand (SM), very dense, grey, wet, fine to medium sand (Glaciolacustrine) (Unit 4a) - Moist at 18.9 m	

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
18	SS	150/ 0.13		
19	SS	225/ 0.23		
20	SS	111		
21	SS	178/ 0.25		
22A 22B	SS	137	NP	0 49 47 4
23	TO	PB		
23S	TO	PB		
24	TO	PB		
24S	TO	PB		
25	TO	PB		
26	SS	62		0 7 58 34
27	TO	PB		
27S	TO	PB		
28	TO	PB		
28S	TO	PB		
29	TO	PB		
29S	TO	PB		
30	TO	PB		
31	SS	223/ 0.28	NP	5 57 33 5
32	SS	215/ 0.28		
33	SS	223		



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DEPTH SCALE

1 : 50

LOGGED: MH/BD

CHECKED: SEMP

PROJECT: 21451329

LOCATION: N 4859832.55; E 683916.52

RECORD OF BOREHOLE: BH26

SHEET 3 OF 9

BORING DATE: July 12 to 19, 2022

DATUM: Geodetic

DRILL RIG: Diedrich 50 Track Mounted

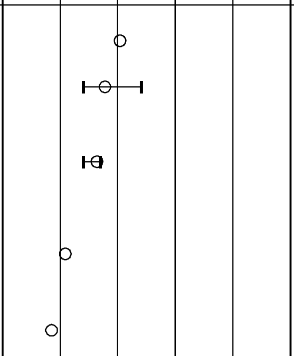
DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
20	Mud Rotary Wash Boring PWT Casing	--- CONTINUED FROM PREVIOUS PAGE ---		34A	SS	95	
		Silt with Sand (ML), very dense, grey, mosit, trace fine to coarse sand, trace subangular fine to coarse gravel (Till) (Till) (Unit 5) - Lean clay layer in Spoon Sample 34B - Low plasticity silt in Spoon Sample 35	64.75 20.35	34B			
21				35	SS	82	9 9 63 19
				36	SS	62	
22			62.85	37A	SS	120/ 0.13	
		Shale Bedrock Fragments (Unit 6a) - Bedrock cored from 22.31 m to 75.04 m depth - Refer to Record of Drillhole BH26	22.31	37B			

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-10} 10^{-8} 10^{-6} 10^{-4}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl : 10 20 30 40



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Notes:

1. Water level in open borehole could not be measured upon completion of soil drilling due to use of mud-rotary technique.

2. Efficiency of the SPT hammer utilized was 68.2 %.

3. After standard 2 inch diameter split spoon testing, 3 inch diameter split spoon utilized to obtain more sample volume along the same depth.

Depth scale: 20 21 22 23 24 25 26 27 28 29 30

GTA-BHS 005 S:\CLIENTS\OPG\DARLINGTON_GENERATING_STATION\02_DATA\GINT\DARLINGTON_GENERATING_STATION.GPJ GAL-MIS.GDT 6/9/23

DEPTH SCALE

1 : 50

LOGGED: MH/BD

CHECKED: SEMP

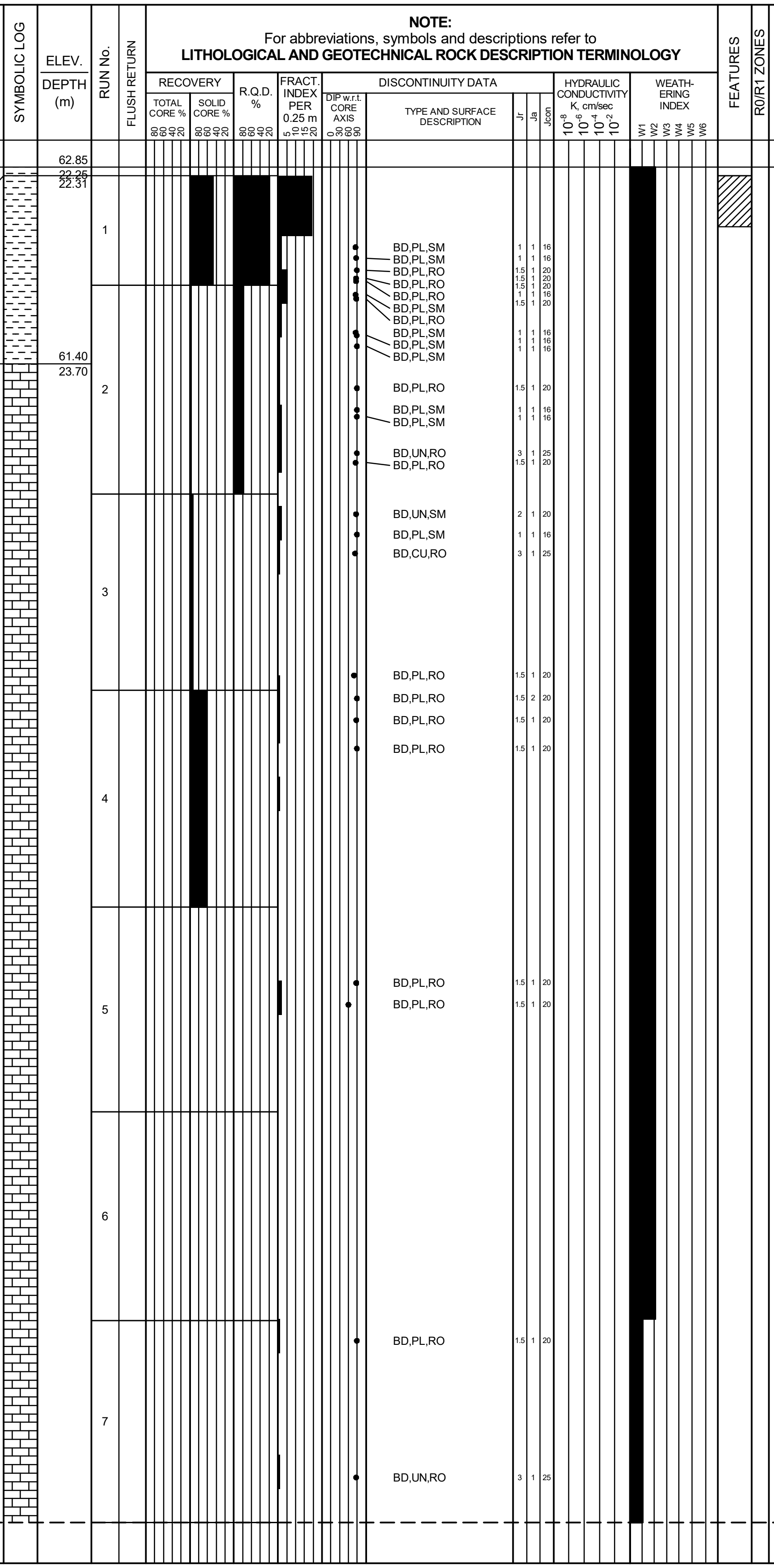
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859832.55; E 683916.52
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH26

DRILLING DATE: July 22 to August 4, 2022
DRILL RIG: Diedrich 50 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 4 OF 9
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



DESCRIPTION	ELEV. DEPTH (m)
TOP OF BEDROCK	62.85 22.25
Shale Bedrock Fragments	22.31
Slightly weathered, very thinly to medium bedded, dark brownish grey, fine grained, faintly porous, slightly reactive to HCl, weak SHALE (Blue Mountain Formation) with laminated to very thin, grey, fine to medium grained limestone interbeds Brazilian Sample UCS with Modulus Sample Brazilian Sample	61.40 23.70
Slightly weathered to fresh, very thinly to very thickly bedded, medium grained, faintly porous, slightly reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with dark grey laminated shale inberbeds	

DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,PL,SM	1	1	16
BD,PL,RO	1.5	1	20
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,PL,RO	1.5	1	20
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,UN,RO	3	1	25
BD,PL,RO	1.5	1	20
BD,UN,SM	2	1	20
BD,PL,SM	1	1	16
BD,CU,RO	3	1	25
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	2	20
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,UN,RO	3	1	25

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: BD/DR
CHECKED: AC

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859832.55; E 683916.52
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH26

DRILLING DATE: July 22 to August 4, 2022
DRILL RIG: Diedrich 50 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 5 OF 9
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

--- CONTINUED FROM PREVIOUS PAGE ---

DRILLING RECORD: Rotary Drill, HQ3 Core

DEPTH SCALE METRES	DESCRIPTION	RUN No.	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
	Slightly weathered to fresh, very thinly to very thickly bedded, medium grained, faintly porous, slightly reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with dark grey laminated shale inberbeds		BD,PL,RO	1.5	1	20
			BD,UN,RO	3	1	25
		8				
33						
			BD,UN,RO	3	1	25
			BD,UN,RO	3	1	25
34						
		9				
35						
36						
		10				
37						
	UCS Sample	11				
			BD,UN,RO	3	1	25
38						
			BD,UN,RO	3	1	25
39						
		12				
40	UCS with Modulus Sample					
			BD,UN,RO	3	1	25
		13				
41			BD,PL,RO	1.5	1	20
		14				
42	Direct Shear Sample					
			BD,PL,RO	1.5	1	20

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: BD/DR
CHECKED: AC

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859832.55; E 683916.52
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH26

DRILLING DATE: July 22 to August 4, 2022
DRILL RIG: Diedrich 50 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 6 OF 9
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE % 80 60 40 20	RECOVERY SOLID CORE % 80 60 40 20	R.Q.D. % 80 60 40 20	FRACT. INDEX PER 0.25 m 5 10 15 20	DIP w.r.t. CORE AXIS 0 30 60 90	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2}	WEATHERING INDEX W1 W2 W3 W4 W5 W6	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
		Slightly weathered to fresh, very thinly to very thickly bedded, medium grained, faintly porous, slightly reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with dark grey laminated shale inberbeds			14															
43											●	BD,UN,RO	3	1	25					
											●	BD,PL,RO	1.5	1	20					
					15															
44																				
45											●	BD,PL,RO	1.5	1	20					
					16															
46																				
		Specific Gravity Sample																		
					17															
47	Rotary Drill HQ3 Core																			
48																				
					18															
49																				
					19															
50																				
51																				
					20															
52																				
					21															

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: BD/DR
CHECKED: AC

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859832.55; E 683916.52
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH26

DRILLING DATE: July 22 to August 4, 2022
DRILL RIG: Diedrich 50 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 7 OF 9
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

Columns: DEPTH SCALE METRES | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (m) | RUN No. | FLUSH RETURN | RECOVERY (TOTAL CORE % 80 60 40 20; SOLID CORE % 80 60 40 20) | R.Q.D. % 80 60 40 20 | FRACT. INDEX PER 0.25 m 5 10 15 20 | DISCONTINUITY DATA (DIP w.r.t. CORE AXIS 0 30 60 90; TYPE AND SURFACE DESCRIPTION; Jr; Ja; Jcon) | HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2} | WEATHERING INDEX W1 W2 W3 W4 W5 W6 | FEATURES | R0/R1 ZONES | PIEZOMETER

--- CONTINUED FROM PREVIOUS PAGE ---

Slightly weathered to fresh, very thinly to very thickly bedded, medium grained, faintly porous, slightly reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with dark grey laminated shale inberbeds

Drilling record: Rotary Drill, HQ3 Core

Depth scale: 53, 54, 55, 56, 57, 58, 59, 60, 61, 62

RUN No.	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
21				
22	BD,PL,RO	1.5	1	20
23	BD,UN,RO	3	1	25
24				
25				
26	BD,PL,RO	1.5	1	20
27				

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: BD/DR
CHECKED: AC

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859832.55; E 683916.52
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH26

DRILLING DATE: July 22 to August 4, 2022
DRILL RIG: Diedrich 50 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 8 OF 9
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE % 80 60 40 20	RECOVERY SOLID CORE % 80 60 40 20	R.Q.D. % 80 60 40 20	FRACT. INDEX PER 0.25 m 5 10 15 20	DIP w.r.t. CORE AXIS 0 30 60 90	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2}	WEATHERING INDEX W1 W2 W3 W4 W5 W6	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
	Rotary Drill HQ3 Core	Slightly weathered to fresh, very thinly to very thickly bedded, medium grained, faintly porous, slightly reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with dark grey laminated shale inberbeds			27															
63					28															
64																				
65					29															
66					30															
67											●	BD,PL,RO	1.5	1	20					
68					31															
69					32						●	BD,PL,RO	1.5	1	20					
70											●	BD,PL,RO	1.5	1	20					
71					33						●	BD,UN,RO	3	1	25					
72					34															

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: BD/DR
CHECKED: AC

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859832.55; E 683916.52
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH26

DRILLING DATE: July 22 to August 4, 2022
DRILL RIG: Diedrich 50 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 9 OF 9
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE % 80 60 40 20	RECOVERY SOLID CORE % 80 60 40 20	R.Q.D. % 80 60 40 20	FRACT. INDEX PER 0.25 m 5 10 15 20	DISCONTINUITY DATA DIP w.r.t. CORE AXIS 0 30 60 90	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2}	WEATH-ERING INDEX W1 W2 W3 W4 W5 W6	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
	Rotary Drill HQ3 Core	Slightly weathered to fresh, very thinly to very thickly bedded, medium grained, faintly porous, slightly reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with dark grey laminated shale inberbeds			34															
73												BD,UN,RO	3	1	25					
74												BD,CU,RO	3	1	25					
					35															
75				10.06 75.04																
		END OF DRILLHOLE																		
76																				
77																				
78																				
79																				
80																				
81																				
82																				

DEPTH SCALE
1 : 50

LOGGED: BD/DR
CHECKED: AC

Water Content Summary
ASTM D2216

Test Request #	21451329-21600-610 BH26	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville		

Sample Location	Sample				Soil Description	Water Content %	Method	Remarks
	Ref	Top (m)	Base (m)	Type				
BH26	2A	0.61	1.16	SS		3.1	B	

Notes:

Disclaimer:

Tested by: JTimms **Date:** 12 Oct 2022

Checked by: MRuck **Date:** 19 Oct 2022

Reviewed by: JoNorris **Date:** 03 Nov 2022

Client:	Golder Associates USA, Inc.				
Project:	Darlington New Nuclear Plant Phase II				
Location:	Ontario, Canada			Project No:	GTX-316444
Boring ID:	---	Sample Type:	---	Tested By:	ckg
Sample ID:	---	Test Date:	12/08/22	Checked By:	ank
Depth :	---	Test Id:	697146		

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content,%
BH26	37	72-72.92'	Moist, gray silt with sand	8.5
BH26	22	42-43.67'	Moist, gray sandy silt	16.7
BH26	23S	44-46'	Moist, gray clay	19.8
BH26	24S	46-48'	Moist, light gray clay	14.1
BH26	26	50-52'	Moist, gray clay	15.4
BH26	27S	52-54'	Moist, light gray clay	17.0
BH26	28S	54-56'	Moist, gray clay	14.4
BH26	29S	56-58'	Moist, gray clay	12.2
BH26	34B	66.75-68'	Moist, gray sandy clay	17.8
BH26	36	70-72 ft	Moist, gray silt with sand	10.9

Notes: Temperature of Drying : 110º Celsius

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GeoTesting EXPRESS

Client:	Golder Associates USA, Inc.				
Project:	Darlington New Nuclear Plant Phase II				
Location:	Ontario, Canada			Project No:	GTX-316444
Boring ID:	---	Sample Type:	---	Tested By:	ckg
Sample ID:	---	Test Date:	12/12/22	Checked By:	ank
Depth :	---	Test Id:	697174		

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content,%
BH24	42	82-82.25'	Moist, dark brown silty sand with gravel	10.7
BH26	35	68-70'	Moist, gray silt with sand	16.4

Notes: Temperature of Drying : 110º Celsius

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GeoTesting
EXPRESS

Client:	Golder Associates USA, Inc.				
Project:	Darlington New Nuclear Plant Phase II				
Location:	Ontario, Canada			Project No:	GTX-316444
Boring ID:	---	Sample Type:	---	Tested By:	ckg
Sample ID:	---	Test Date:	12/15/22	Checked By:	ank
Depth :	---	Test Id:	697080		

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	**Sample ID**	**Depth**	**Description**	**Moisture Content,%**
BH26	20	38-39.83'	Moist, gray silt with sand	10.9
BH26	21	40-41.33'	Moist, gray silt with sand	13.1
BH26	22A	42-43'	Moist, gray sand with clay	14.4
BH26	31	60-61.42'	Moist, gray silty sand	2.8
BH26	32	62-63.42'	Moist, gray silty sand	14.8
BH26	34A	66-66.75'	Moist, gray silty sand	20.4
BH26	4	6-8'	Moist, gray silty sand with gravel	5.7
BH26	6	10-12'	Moist, gray sandy silt	8.6
BH26	8	14-16'	Moist, silty sand with gravel	9.6
BH26	11	20-22'	Moist, gray sandy silt with gravel	8.0

Notes: Temperature of Drying : 110° Celsius

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Client:	Golder Associates USA, Inc.				
Project:	Darlington New Nuclear Plant Phase II				
Location:	Ontario, Canada			Project No:	GTX-316444
Boring ID:	---	Sample Type:	---	Tested By:	ckg
Sample ID:	---	Test Date:	12/15/22	Checked By:	ank
Depth :	---	Test Id:	697083		

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content, %
BH26	15	28-30'	Moist, gray silty sand	10.3
BH26	17	32-33.33'	Moist, gray silty sand	10.7
BH26	19	36-37.25'	Moist, light gray silty gravel	11.2

Notes: Temperature of Drying : 110° Celsius

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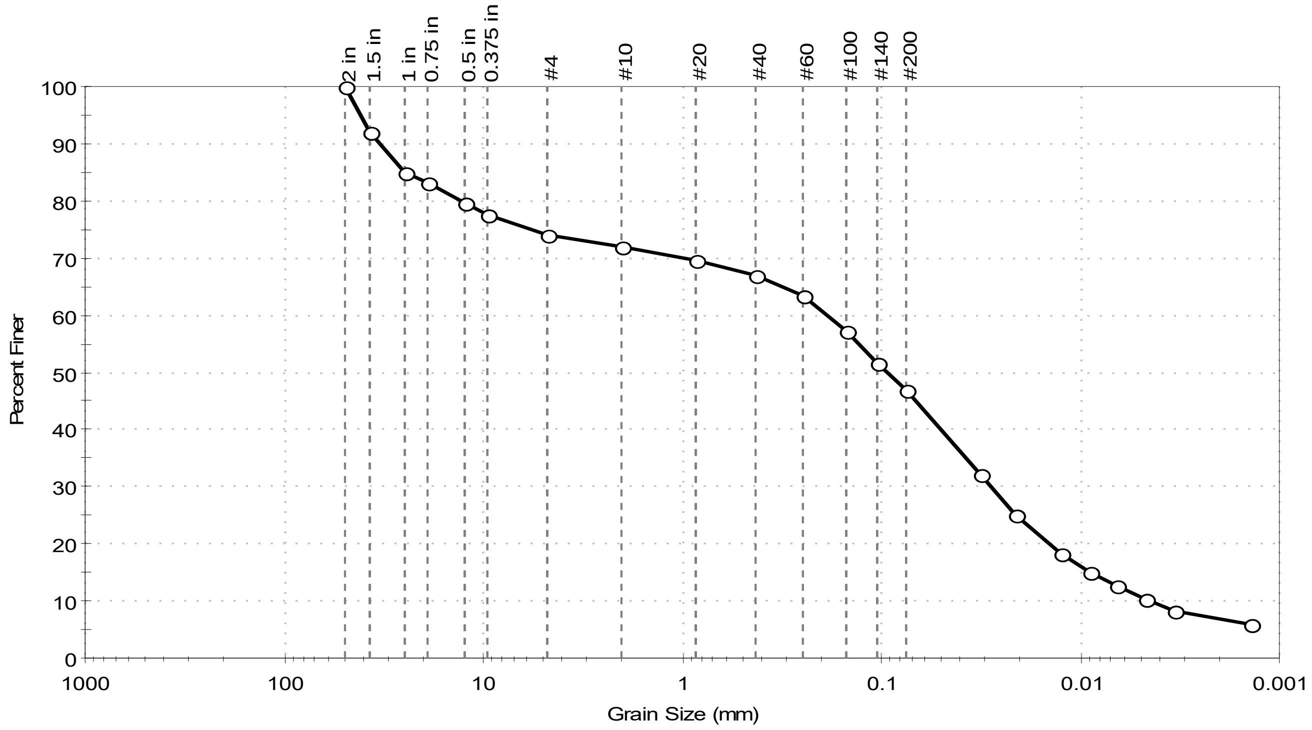
Client: WSP Canada Inc.
Project: Darlington New Nuclear Plant Phase II
Location: Ontario, Canada
Project No: GTX-316444

Boring ID: BH26
Sample ID: 8
Depth : 14-16'
Sample Type: jar
Test Date: 12/14/22
Test Id: 697131
Tested By: ckg
Checked By: ank

Test Comment: ---
Visual Description: Moist, silty sand with gravel
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	25.9	27.2	46.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
2 in	50.00	100		
1.5 in	37.50	92		
1 in	25.00	85		
0.75 in	19.00	83		
0.5 in	12.50	80		
0.375 in	9.50	77		
#4	4.75	74		
#10	2.00	72		
#20	0.85	70		
#40	0.42	67		
#60	0.25	64		
#100	0.15	57		
#140	0.11	52		
#200	0.075	47		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0315	32		
---	0.0212	25		
---	0.0125	18		
---	0.0089	15		
---	0.0065	13		
---	0.0047	10		
---	0.0034	8		
---	0.0014	6		

Coefficients

D_{85} = 25.1682 mm
D_{30} = 0.0281 mm
D_{60} = 0.1883 mm
D_{15} = 0.0089 mm
D_{50} = 0.0936 mm
D_{10} = 0.0044 mm
C_u = 42.795
C_c = 0.953

Classification

ASTM Silty SAND with Gravel (SM)

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve

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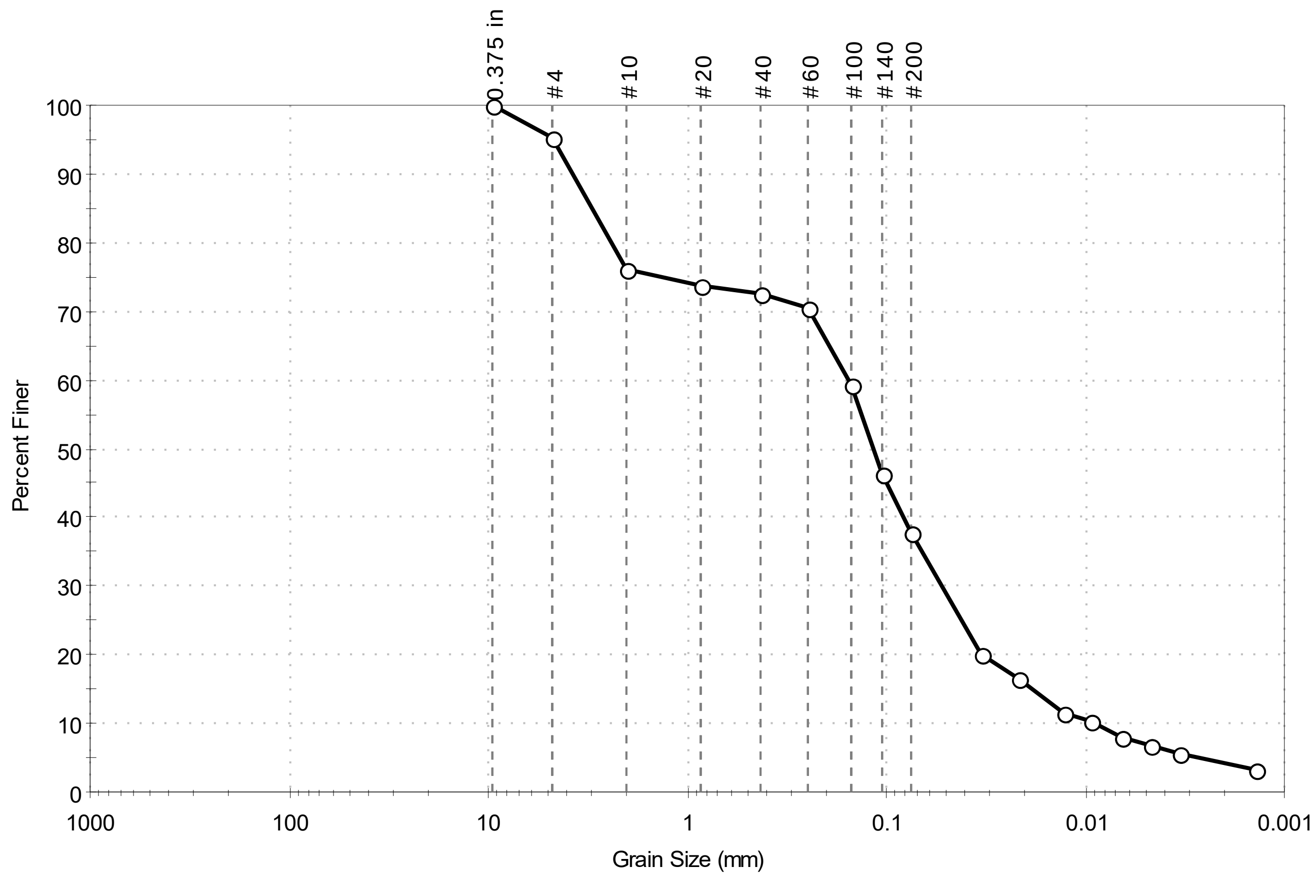
GeoTesting
EXPRESS

Client: WSP Canada Inc.
Project: Darlington New Nuclear Plant Phase II
Location: Ontario, Canada
Project No: GTX-316444

Boring ID:	BH26	Sample Type:	jar	Tested By:	ckg
Sample ID:	31	Test Date:	12/12/22	Checked By:	ank
Depth :	60-61.42'	Test Id:	697176		

Test Comment: ---
Visual Description: Moist, gray silty sand
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	4.8	57.4	37.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	95		
#10	2.00	76		
#20	0.85	74		
#40	0.42	73		
#60	0.25	70		
#100	0.15	59		
#140	0.11	46		
#200	0.075	38		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0336	20		
---	0.0218	16		
---	0.0129	12		
---	0.0094	10		
---	0.0066	8		
---	0.0048	7		
---	0.0034	6		
---	0.0014	3		

Coefficients

D_{85} = 2.9934 mm	D_{30} = 0.0528 mm
D_{60} = 0.1559 mm	D_{15} = 0.0187 mm
D_{50} = 0.1169 mm	D_{10} = 0.0088 mm
C_u = 17.716	C_c = 2.032

Classification

ASTM	Silty SAND (SM)
AASHTO	Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve

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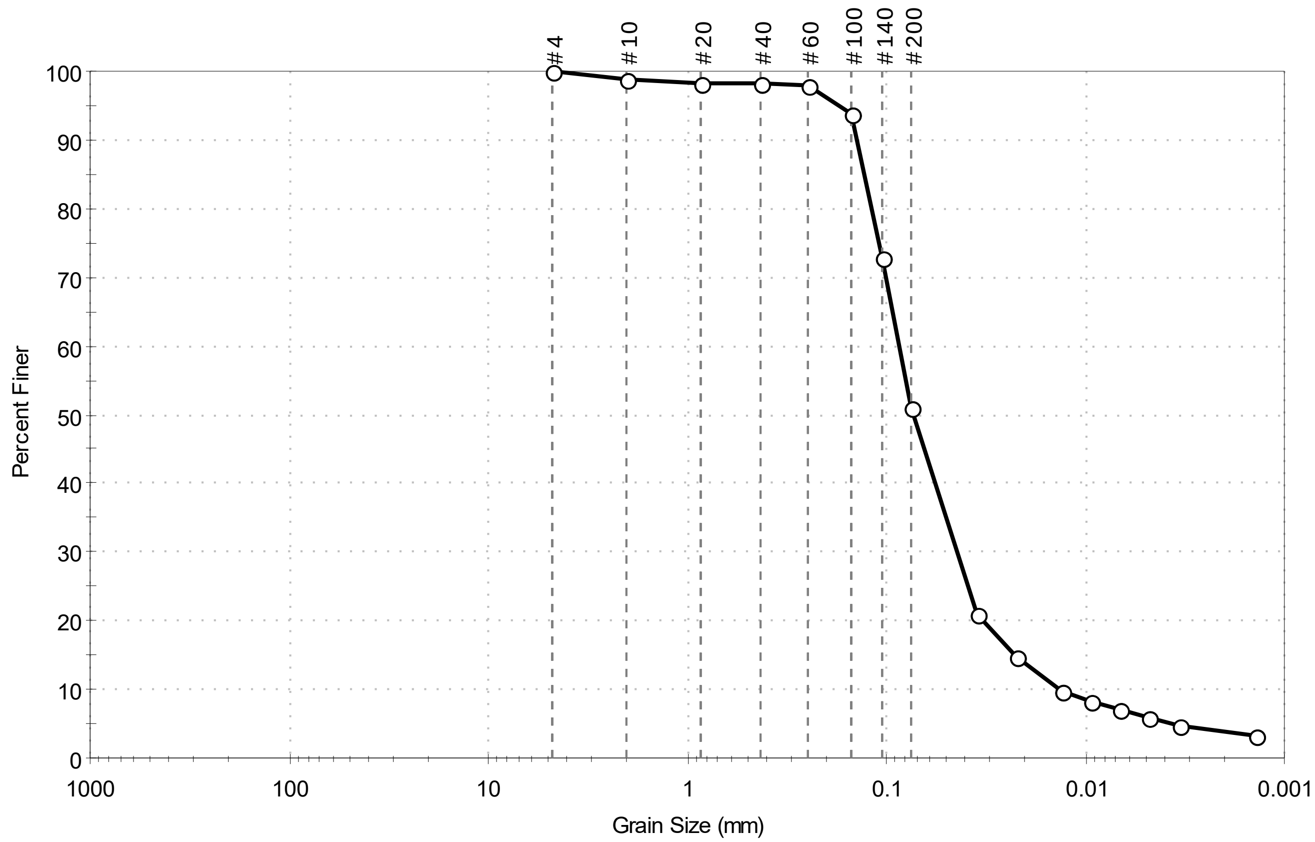
Client:	WSP Canada Inc.				
Project:	Darlington New Nuclear Plant Phase II				
Location:	Ontario, Canada			Project No:	GTX-316444
Boring ID:	BH26	Sample Type:	jar	Tested By:	ckg
Sample ID:	22	Test Date:	12/12/22	Checked By:	ank
Depth :	42-43.67'	Test Id:	697178		

Test Comment: ---
Visual Description: Moist, gray sandy silt
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	48.8	51.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	99		
#20	0.85	98		
#40	0.42	98		
#60	0.25	98		
#100	0.15	94		
#140	0.11	73		
#200	0.075	51		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0349	21		
---	0.0225	15		
---	0.0132	10		
---	0.0095	8		
---	0.0067	7		
---	0.0048	6		
---	0.0034	5		
---	0.0014	3		

Coefficients

D_{85} =0.1294 mm	D_{30} =0.0438 mm
D_{60} =0.0863 mm	D_{15} =0.0230 mm
D_{50} =0.0728 mm	D_{10} =0.0137 mm
C_u =6.299	C_c =1.623

Classification

ASTM	Sandy SILT (ML)
AASHTO	Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve

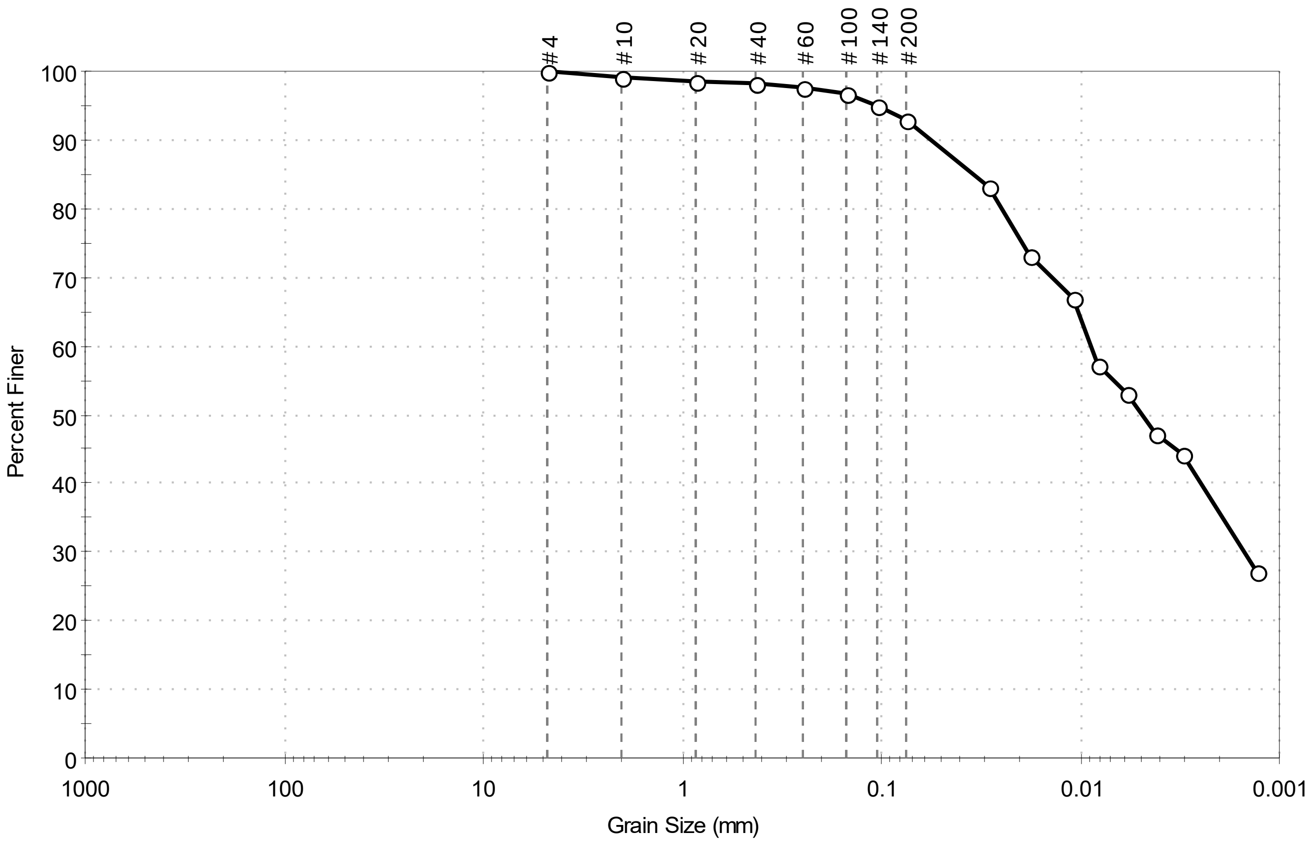
printed 1/20/2023 11:29:05 AM

Client: WSP Canada Inc.
Project: Darlington New Nuclear Plant Phase II
Location: Ontario, Canada
Project No: GTX-316444

Boring ID:	BH26	Sample Type:	jar	Tested By:	ckg
Sample ID:	26	Test Date:	12/12/22	Checked By:	ank
Depth :	50-52'	Test Id:	697179		

Test Comment: ---
Visual Description: Moist, gray clay
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	7.0	93.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	99		
#20	0.85	99		
#40	0.42	98		
#60	0.25	98		
#100	0.15	97		
#140	0.11	95		
#200	0.075	93		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0289	83		
---	0.0179	73		
---	0.0108	67		
---	0.0082	57		
---	0.0059	53		
---	0.0042	47		
---	0.0030	44		
---	0.0013	27		

Coefficients

D_{85} = 0.0348 mm	D_{30} = 0.0015 mm
D_{60} = 0.0089 mm	D_{15} = N/A
D_{50} = 0.0049 mm	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM	Lean CLAY (CL)
AASHTO	Silty Soils (A-4 (7))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #200 Sieve

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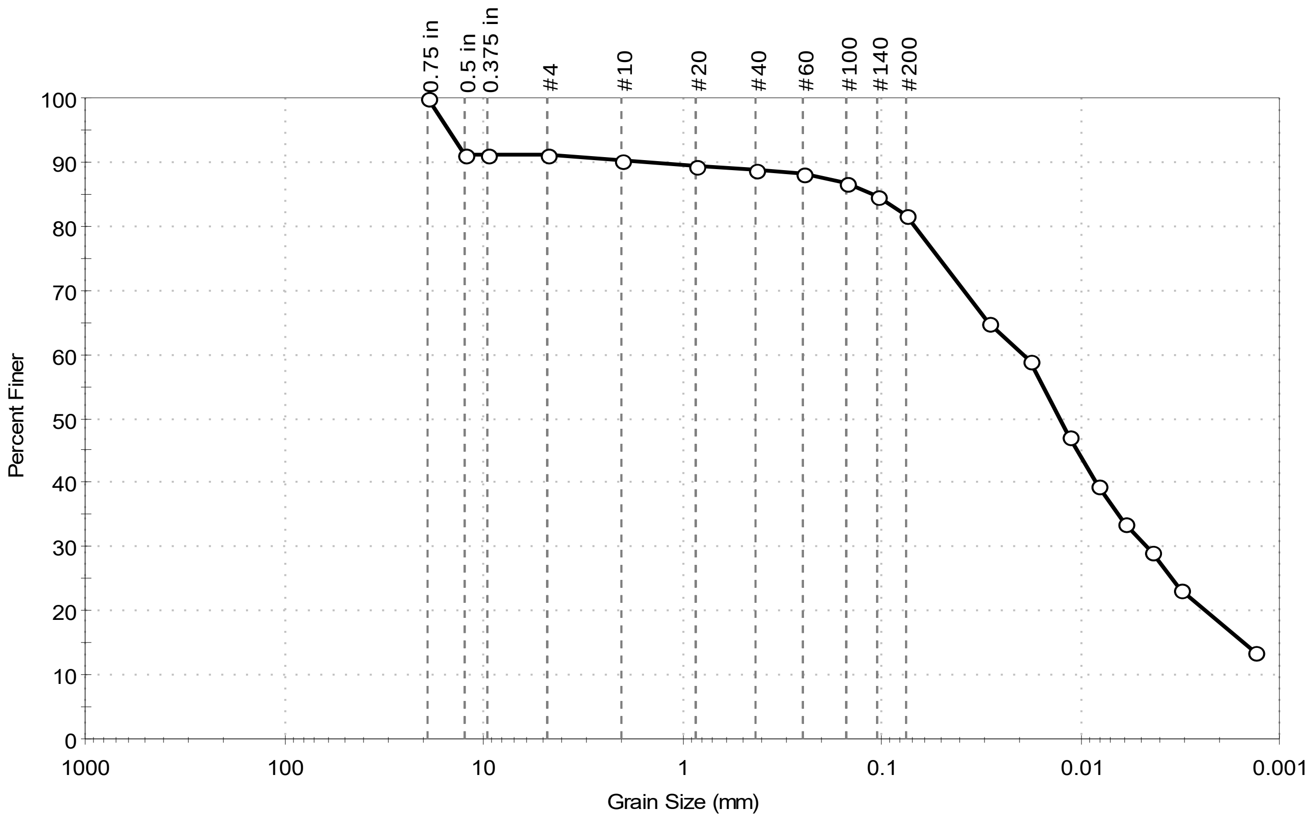
GeoTesting EXPRESS

Client:	WSP Canada Inc.				
Project:	Darlington New Nuclear Plant Phase II				
Location:	Ontario, Canada			Project No:	GTX-316444
Boring ID:	BH26	Sample Type:	jar	Tested By:	ckg
Sample ID:	35	Test Date:	12/12/22	Checked By:	ank
Depth :	68-70'	Test Id:	697181		

Test Comment: ---
Visual Description: Moist, gray silt with sand
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
–	8.9	9.3	81.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	91		
0.375 in	9.50	91		
#4	4.75	91		
#10	2.00	90		
#20	0.85	89		
#40	0.42	89		
#60	0.25	88		
#100	0.15	87		
#140	0.11	85		
#200	0.075	82		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0287	65		
---	0.0180	59		
---	0.0113	47		
---	0.0082	40		
---	0.0060	34		
---	0.0043	29		
---	0.0032	23		
---	0.0013	14		

Coefficients

D_{85} =0.1140 mm	D_{30} =0.0046 mm
D_{60} =0.0195 mm	D_{15} =0.0015 mm
D_{50} =0.0127 mm	D_{10} =N/A
C_u =N/A	C_c =N/A

Classification

ASTM	SILT with Sand (ML)
AASHTO	Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve

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Client:	WSP Canada Inc.				
Project:	Darlington New Nuclear Plant Phase II				
Location:	Ontario, Canada			Project No:	GTX-316444
Boring ID:	BH26	Sample Type:	jar	Tested By:	cam
Sample ID:	22	Test Date:	12/08/22	Checked By:	ank
Depth :	42-43.67'	Test Id:	697186		

Test Comment: ---

Visual Description: Moist, gray sandy silt

Sample Comment: ---

Atterberg Limits - ASTM D4318

Sample Determined to be non-plastic

Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	22	BH26	42-43.67'	17	n/a	n/a	n/a	n/a	Sandy SILT (ML)

2% Retained on #40 Sieve

Dry Strength: LOW

Dilatancy: RAPID

Toughness: n/a

The sample was determined to be Non-Plastic

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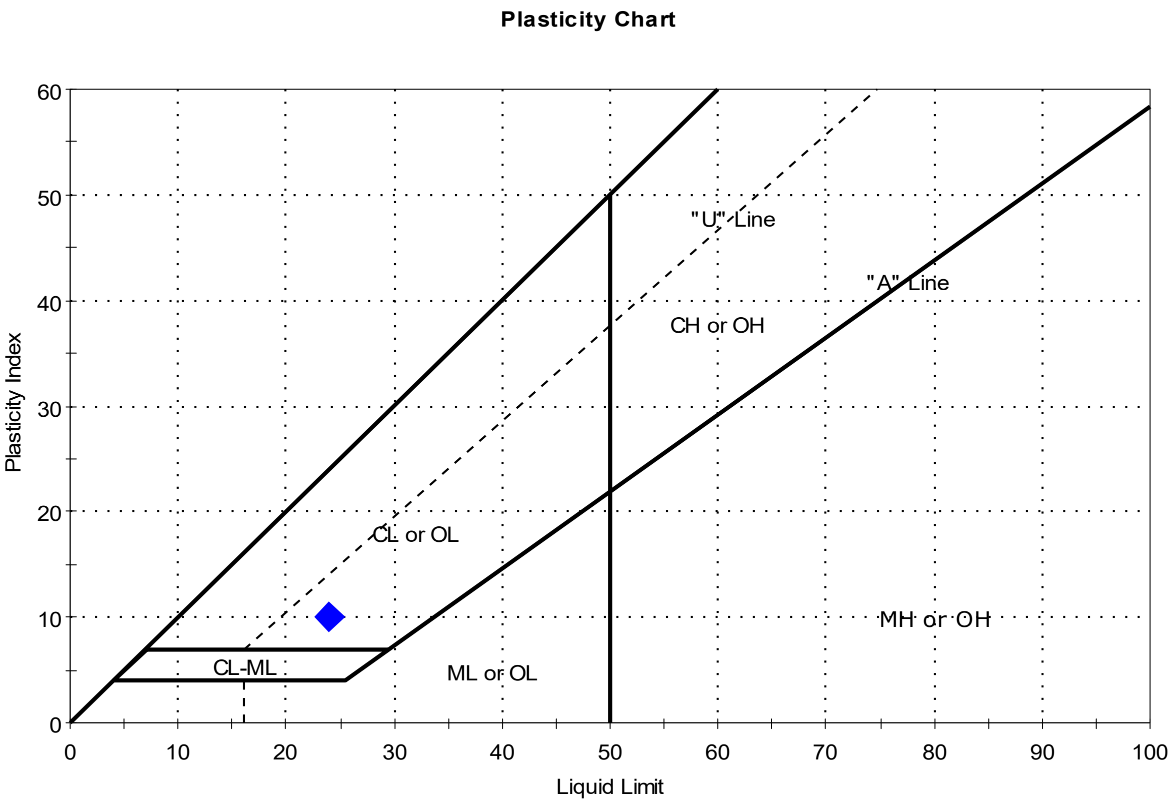
Client:	WSP Canada Inc.		
Project:	Darlington New Nuclear Plant Phase II		
Location:	Ontario, Canada	Project No:	GTX-316444

Boring ID:	BH26	Sample Type:	jar	Tested By:	cam
Sample ID:	26	Test Date:	12/14/22	Checked By:	ank
Depth :	50-52'	Test Id:	697187		

Test Comment:	---
Visual Description:	Moist, gray clay
Sample Comment:	---

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	26	BH26	50-52'	15	24	14	10	0.1	Lean CLAY (CL)

Sample Prepared using the WET method

2% Retained on #40 Sieve

Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	WSP Canada Inc.				
Project:	Darlington New Nuclear Plant Phase II				
Location:	Ontario, Canada			Project No:	GTX-316444
Boring ID:	BH26	Sample Type:	jar	Tested By:	cam
Sample ID:	31	Test Date:	12/08/22	Checked By:	ank
Depth :	60-61.42'	Test Id:	697182		

Test Comment: ---
Visual Description: Moist, gray silty sand
Sample Comment: ---

Atterberg Limits - ASTM D4318

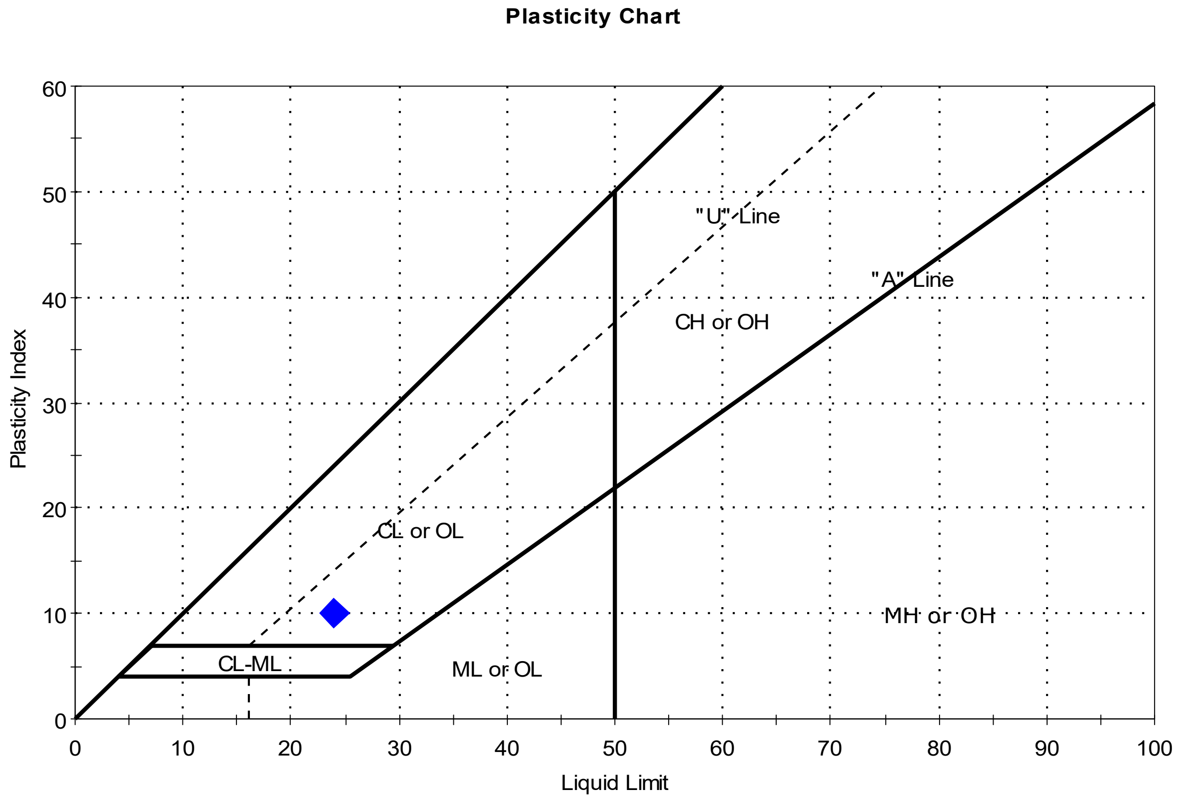
Sample Determined to be non-plastic

Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	31	BH26	60-61.42'	3	n/a	n/a	n/a	n/a	Silty SAND (SM)

27% Retained on #40 Sieve
Dry Strength: LOW
Dilatancy: RAPID
Toughness: n/a
The sample was determined to be Non-Plastic

Client: WSP Canada Inc.
Project: Darlington New Nuclear Plant Phase II
Location: Ontario, Canada
Project No: GTX-316444
Boring ID: BH26
Sample Type: jar
Tested By: cam
Sample ID: 34B
Test Date: 12/15/22
Checked By: n/a
Depth : 66.75-68'
Test Id: 697190
Test Comment: ---
Visual Description: Moist, gray sandy clay
Sample Comment: ---

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	34B	BH26	66.75-68'	18	24	14	10	0.4	

Sample Prepared using the WET method

Dry Strength: VERY HIGH
Dilatancy: SLOW
Toughness: LOW

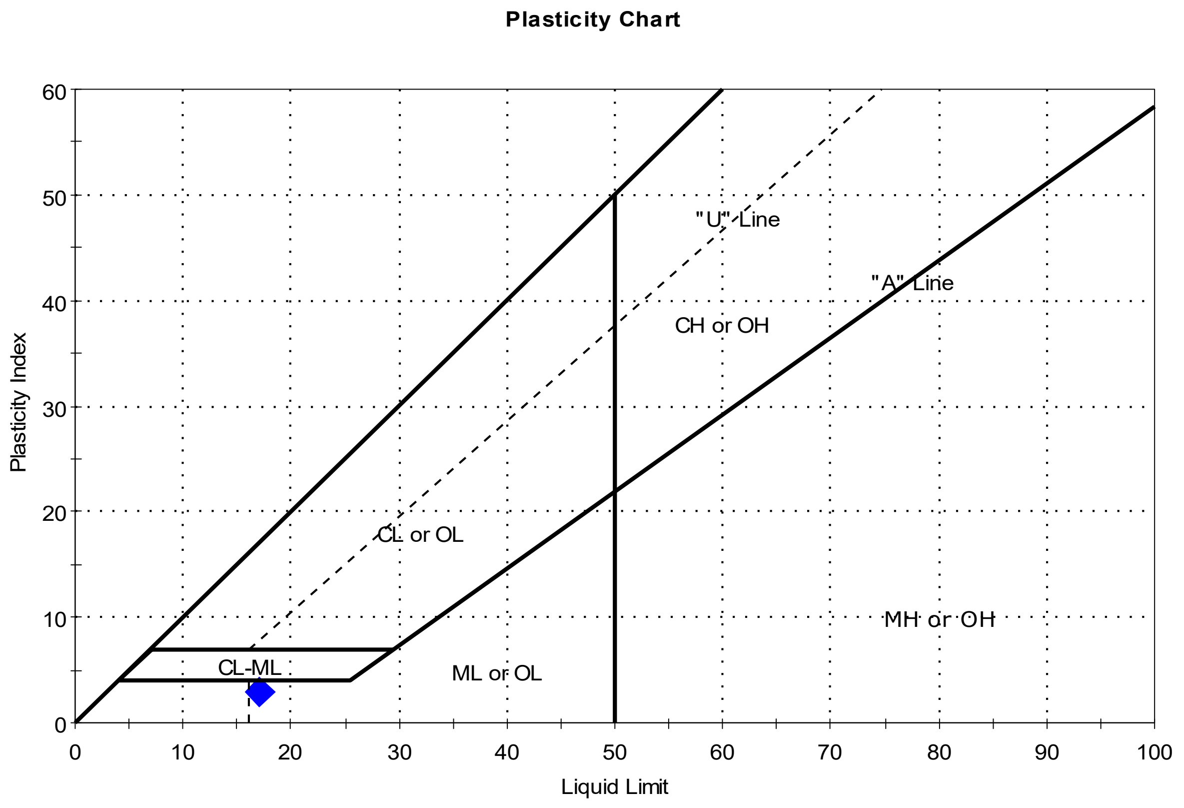
Client:	WSP Canada Inc.				
Project:	Darlington New Nuclear Plant Phase II				
Location:	Ontario, Canada			Project No:	GTX-316444
Boring ID:	BH26	Sample Type:	jar	Tested By:	cam
Sample ID:	35	Test Date:	12/15/22	Checked By:	n/a
Depth :	68-70'	Test Id:	697191		

Test Comment: ---

Visual Description: Moist, gray silt with sand

Sample Comment: ---

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	35	BH26	68-70'	16	17	14	3	0.8	SILT with Sand (ML)

Sample Prepared using the WET method

11% Retained on #40 Sieve

Dry Strength: VERY HIGH

Dilatancy: SLOW

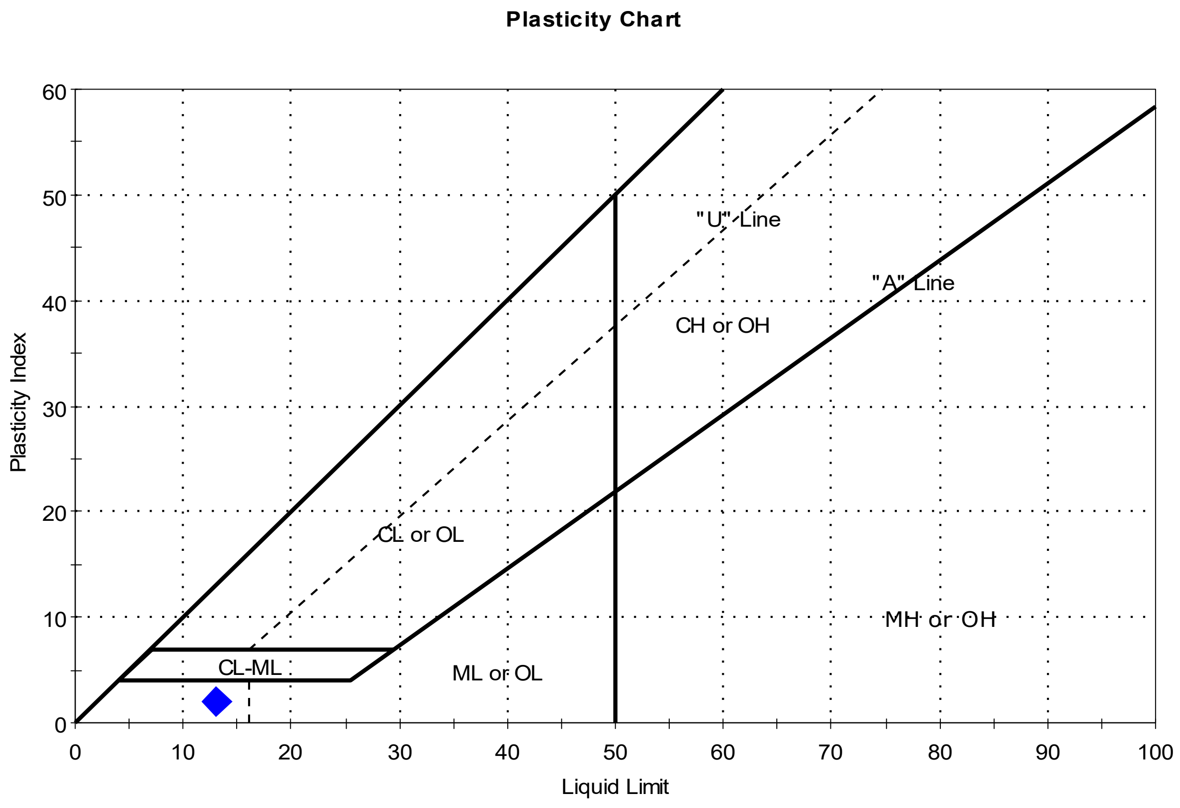
Toughness: LOW

Client: WSP Canada Inc.
Project: Darlington New Nuclear Plant Phase II
Location: Ontario, Canada
Project No: GTX-316444

Boring ID: BH26
Sample Type: jar
Tested By: cam
Sample ID: 8
Test Date: 12/14/22
Checked By: ank
Depth : 14-16'
Test Id: 697138

Test Comment: ---
Visual Description: Moist, silty sand with gravel
Sample Comment: ---

Atterberg Limits - ASTM D4318


Plasticity Chart

Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	8	BH26	14-16'	10	13	11	2	-0.7	Silty SAND with Gravel (SM)

Sample Prepared using the WET method

33% Retained on #40 Sieve

Dry Strength: HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	WSP Canada Inc.				
Project:	Darlington New Nuclear Plant Phase II				
Location:	Ontario, Canada			Project No:	GTX-316444
Boring ID:	---	Sample Type:	---	Tested By:	ckg
Sample ID:	---	Test Date:	12/12/22	Checked By:	ank
Depth :	---	Test Id:	697199		

Specific Gravity of Soils by ASTM D854

Boring ID	Sample ID	Depth	Visual Description	Specific Gravity	Comment
BH24	28	54-56 ft	Moist, light gray sandy silt	2.77	
BH26	31	60-61.42'	Moist, gray silty sand	2.68	
BH24	29	56-58'	Moist, gray silty clay with sand	2.67	
BH26	26	50-52'	Moist, gray clay	2.69	
BH24	16	30-32'	Moist, gray silty sand	2.68	
BH26	10	18-20'	Moist, gray gravel with silt	2.68	
BH26	35	68-70'	Moist, gray silt with sand	2.68	

Notes: Specific Gravity performed by using method B (oven dried specimens) of ASTM D854
Moisture Content determined by ASTM D2216.

WSP GOLDER

Water (Moisture) Content, Ash Content, and Organic Material of Soils ASTM D2974 Method A

Test Request #	21451329-21600-610 BH26	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH26
Source:		Sample No.:	2
Soil Description:		Type:	SS
		Depth (m):	0.61 - 1.22

Specimen Reference NA

Specimen Depth NA

Date of Test 12 Oct 2022

Specimen Description NA

Furnace Temperature During Test (°C)	440
Duration of Test (nearest 15 minutes)	5850
Mass of Crucible With Lid (g)	64.55
Moist Mass of Specimen Plus Crucible With Lid (g)	157.07
Oven Dry Mass of Specimen Plus Crucible With Lid (g)	154.22
Mass of Crucible With Lid Plus Ash (g)	153.91
Water Content (%)	3
Ash Content (%)	99.7
Organic Material (%)	0.3

Test Preparation

Notes:

Disclaimer:

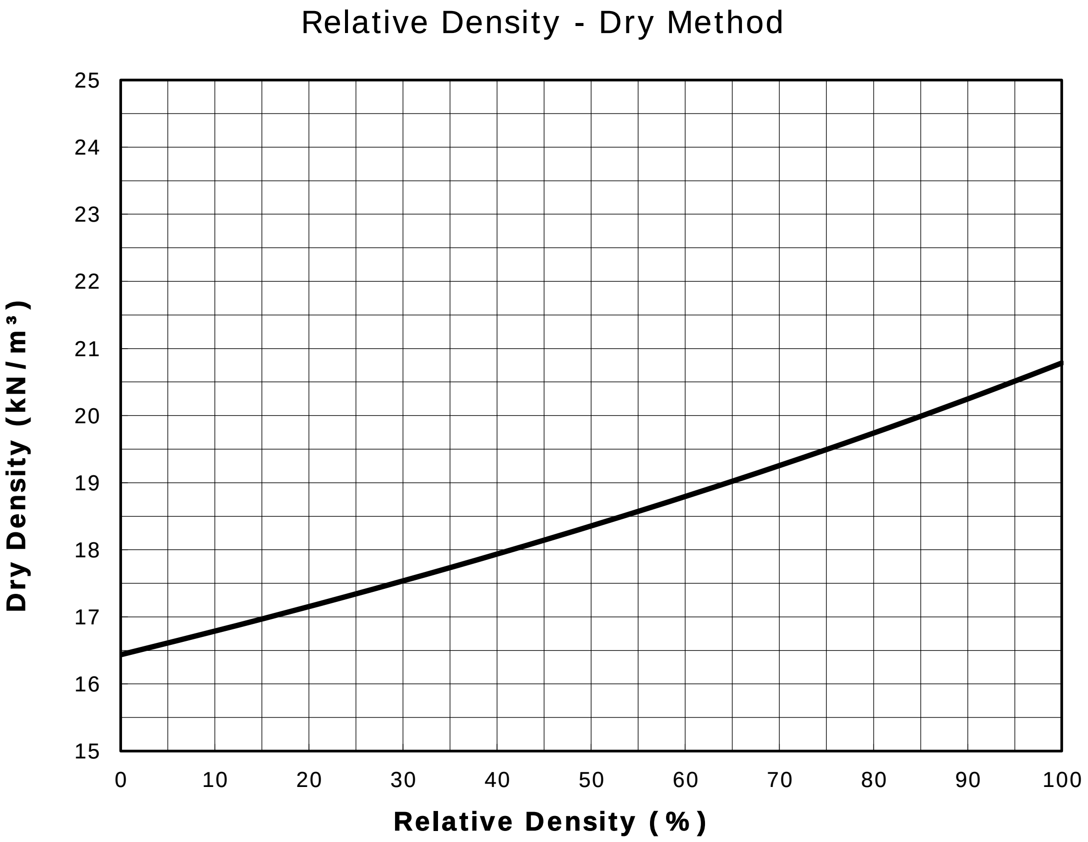
Tested by: JTimms **Date:** 12 Oct 2022

Checked by: MRuck **Date:** 19 Oct 2022

Reviewed by: JoNorris **Date:** 03 Nov 2022

Client:	Golder Associates
Project Name:	Darlington New Nuclear Plant Phase II
Project Location:	Ontario, Canada
GTX #:	316444
Test Date:	12/09/22
Tested By:	lam
Checked By:	as
Boring ID:	BH26
Sample ID:	4, 5 / RD-3
Depth:	---
Description:	Moist, dark gray sandy silt

Relative Density Test by ASTM D4253/D4254



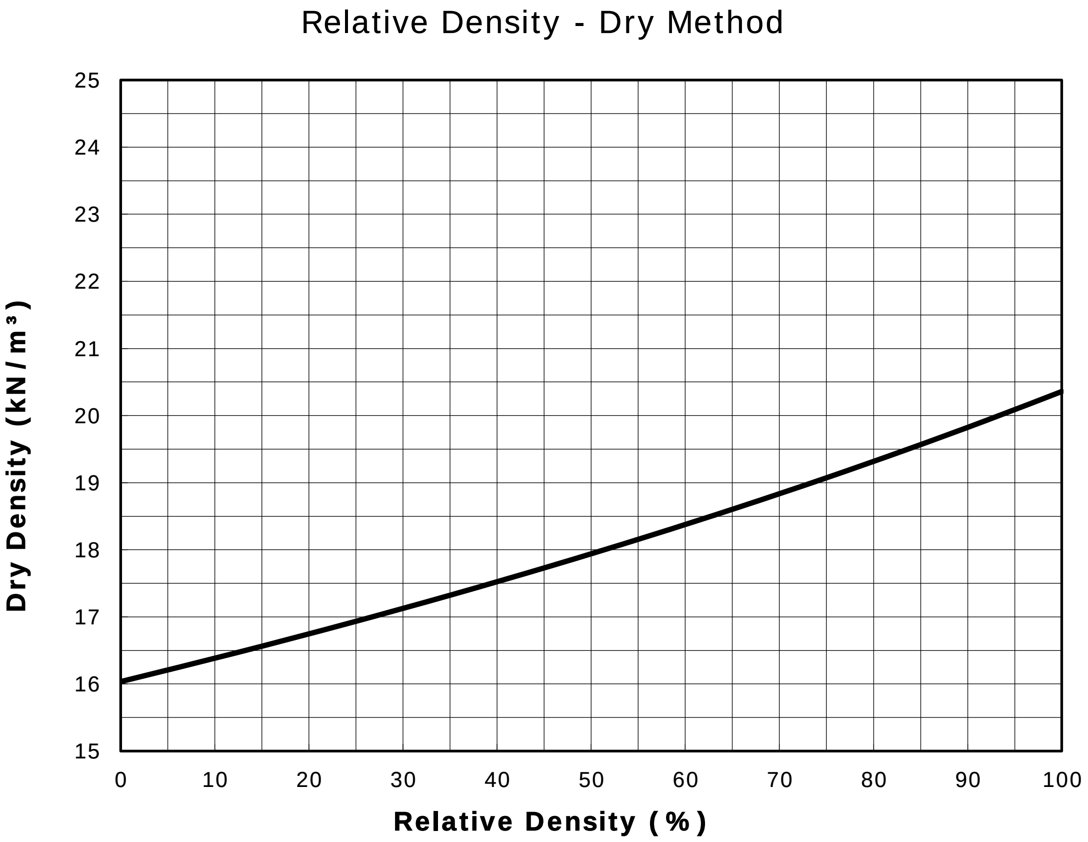
Minimum Density		16.44	kN/m³
Maximum Density	Dry Method	20.78	kN/m³
	Wet Method	---	kN/m³

Notes: Only Dry Method performed.

GeoTesting EXPRESS

Client:	Golder Associates
Project Name:	Darlington New Nuclear Plant Phase II
Project Location:	Ontario, Canada
GTX #:	316444
Test Date:	12/09/22
Tested By:	lam
Checked By:	as
Boring ID:	BH26
Sample ID:	13, 14 / RD-4
Depth:	---
Description:	Moist, dark gray sandy silt

Relative Density Test by ASTM D4253/D4254

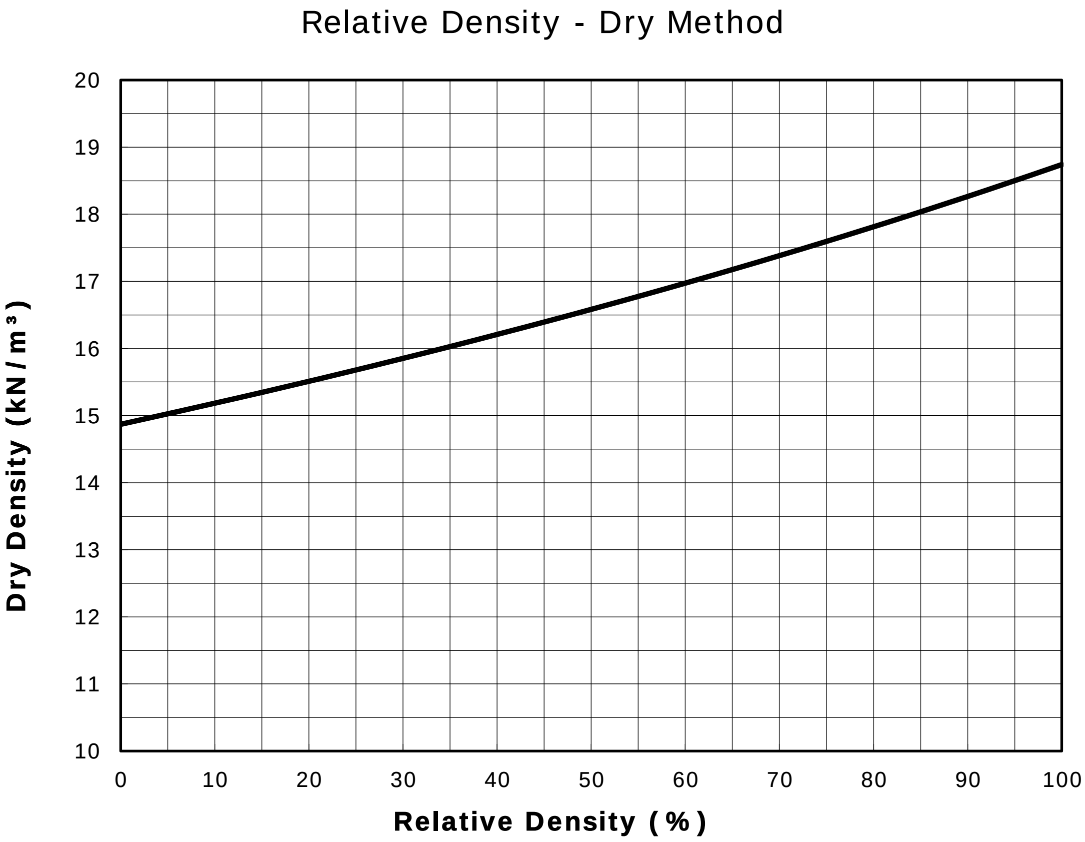


Minimum Density		16.04	kN/m³
Maximum Density	Dry Method	20.36	kN/m³
	Wet Method	---	kN/m³

Notes: Only Dry Method performed.

Client:	Golder Associates
Project Name:	Darlington New Nuclear Plant Phase II
Project Location:	Ontario, Canada
GTX #:	316444
Test Date:	12/09/22
Tested By:	lam
Checked By:	as
Boring ID:	BH26
Sample ID:	32, 33, 34A / RD-6
Depth:	---
Description:	Moist, dark gray sandy silt

Relative Density Test by ASTM D4253/D4254



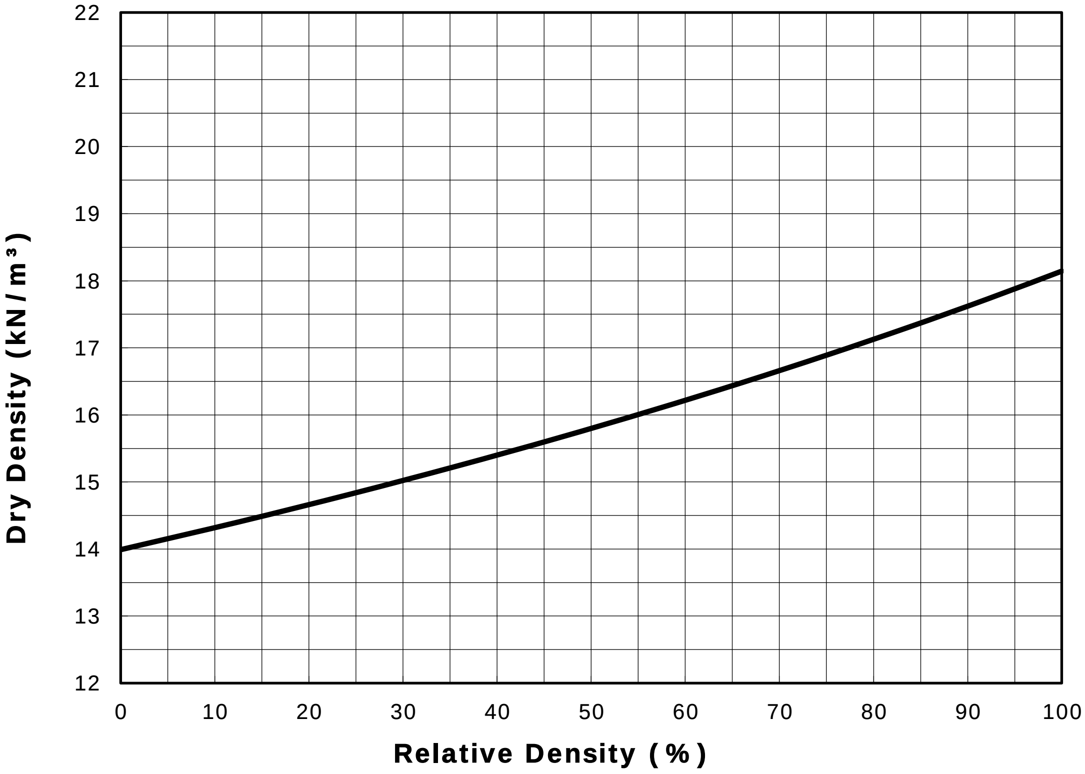
Minimum Density		14.87	kN/m³
Maximum Density	Dry Method	18.74	kN/m³
	Wet Method	---	kN/m³

Notes: Only Dry Method performed.

Client:	Golder Associates
Project Name:	Darlington New Nuclear Plant Phase II
Project Location:	Ontario, Canada
GTX #:	316444
Test Date:	12/13/22
Tested By:	lam
Checked By:	jsc
Boring ID:	BH26
Sample ID:	36, 37 / RD-8
Depth:	---
Description:	Moist, dark gray silty clay

Relative Density Test by ASTM D4253/D4254

Relative Density - Dry Method

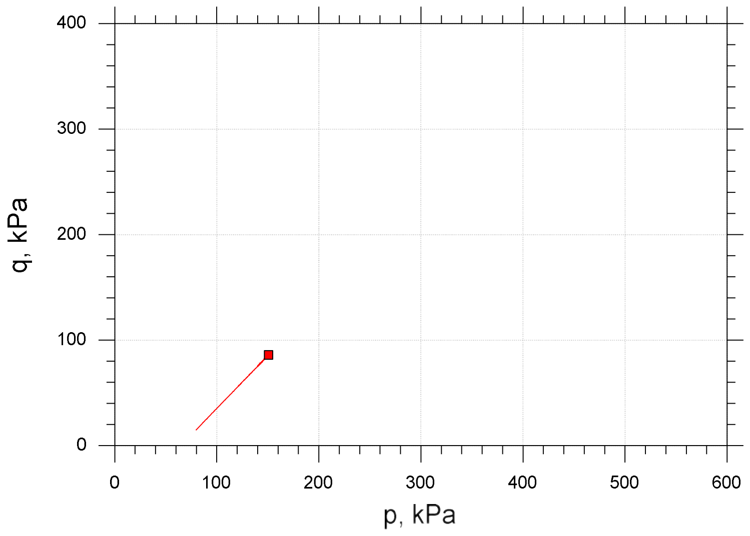


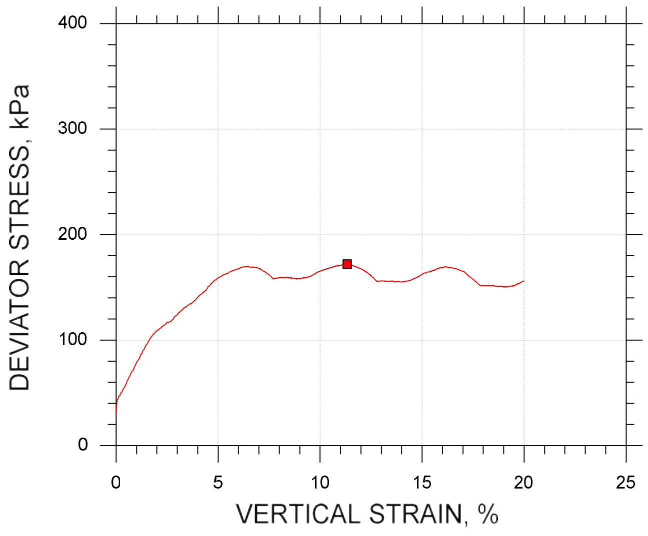
Minimum Density		13.99	kN/m³
Maximum Density	Dry Method	18.14	kN/m³
	Wet Method	---	kN/m³

Notes: Only Dry Method performed.

Client: WSP Canada Inc.	
Project Name: Darlington NNP Phase II	
Project Location: Ontario, Canada	
Project Number: GTX-316444	
Tested By: trm	Checked By: njh
Boring ID: BH26	
Preparation: reconstituted	
Description: Moist, gray silty sand with gravel (Greater than #4 sieve removed)	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.65

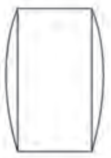
CONSOLIDATED DRAINED TRIAXIAL TEST - ANISOTROPIC CONSOLIDATION





Symbol		🟥			
Sample ID		4			
Depth, ft		6-8'			
Test Number		CAD-6			
Initial	Height, cm	10.16			
	Diameter, cm	5.080			
	Moisture Content (from Cuttings), %	4.9			
	Dry Density, kN/m³	21.0			
	Saturation (Wet Method), %	54.9			
	Void Ratio	0.239			
Before Shear	Moisture Content, %	7.7			
	Dry Density, kN/m³	21.6			
	Cross-sectional Area (Method A), cm²	19.95			
	Saturation, %	100.0			
	Void Ratio	0.204			
	Back Pressure, kPa	971.0			
Vertical Effective Consolidation Stress, kPa		93.60			
Horizontal Effective Consolidation Stress, kPa		64.75			
Vertical Strain after Consolidation, %		1.064			
Volumetric Strain after Consolidation, %		2.287			
Time to 50% Consolidation, min		---			
Shear Strength, kPa		86.00			
Strain at Failure, %		11.3			
Strain Rate, %/min		0.01000			
Deviator Stress at Failure, kPa		172.0			
Effective Minor Principal Stress at Failure, kPa		64.75			
Effective Major Principal Stress at Failure, kPa		236.8			
B-Value		0.93			

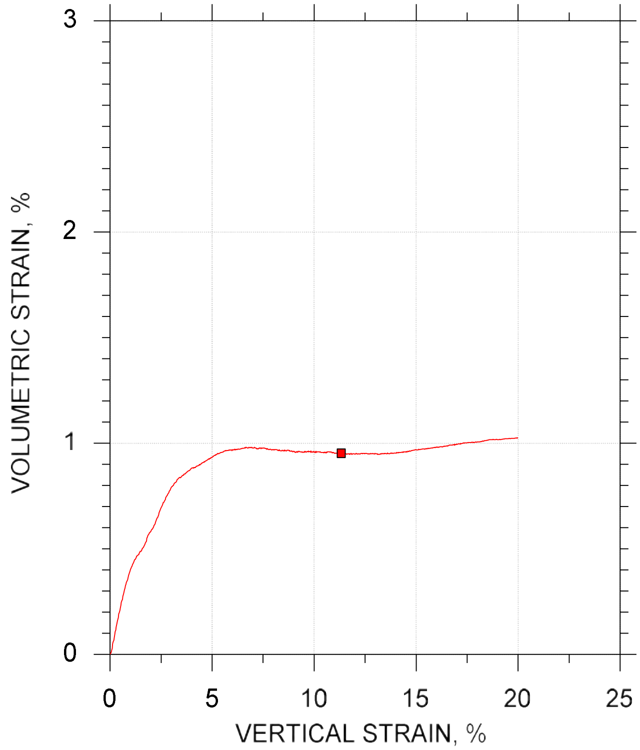
Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

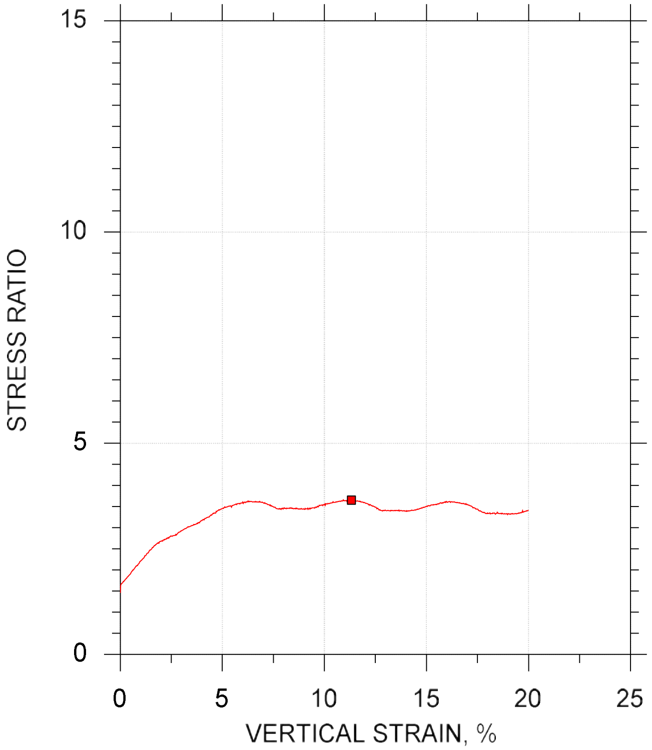


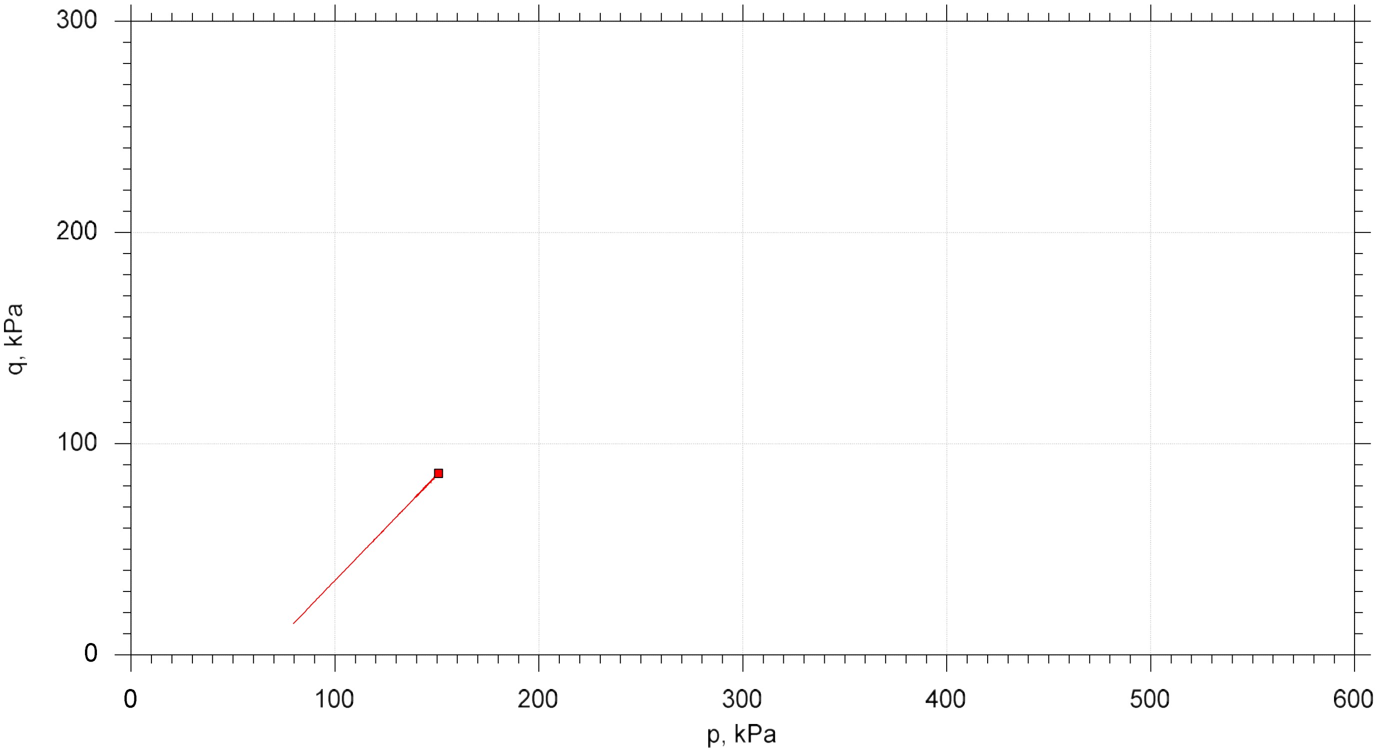
Remarks:

TX-023, Target Comp 20.78 kN/m3 at 6.0% mc. Final Diameters: 5.207 cm, 5.715 cm, 5.994 cm, 5.588 cm and 5.461 cm.

CONSOLIDATED DRAINED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION







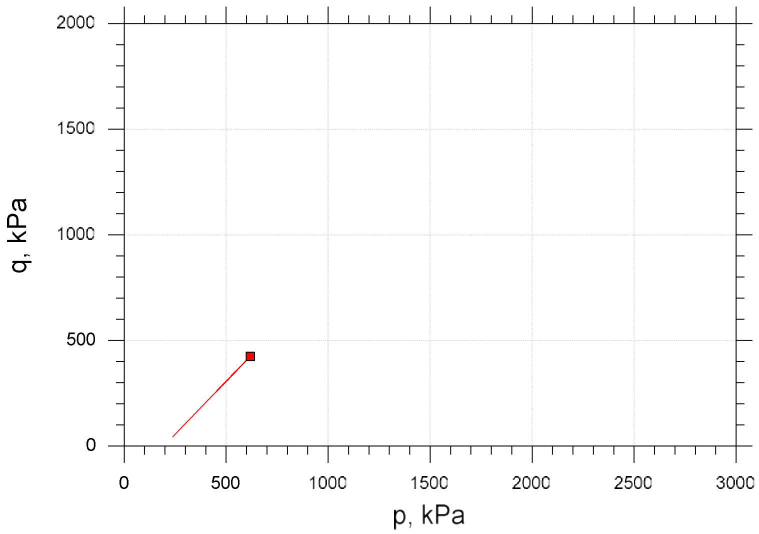
	Sample No	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
🟥	4	CAD-6	6-8'	trm	1/16/23	njh	1/24/23	316444-CAD-6n.dat

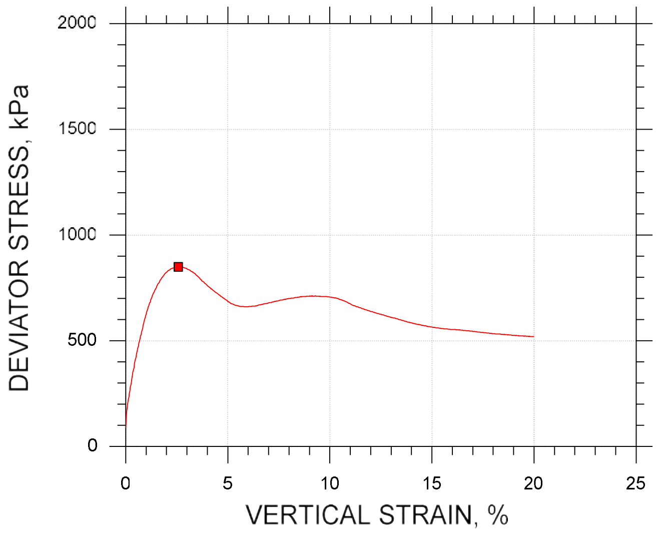
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Sample Type: reconstituted	
Description: Moist, gray silty sand with gravel (Greater than #4 sieve removed)		
Remarks: TX-023, Target Comp 20.78 kN/m3 at 6.0% mc. Final Diameters: 5.207 cm, 5.715 cm, 5.994 cm, 5.588 cm and 5.461 cm.		

GeoTesting
EXPRESS

Client: WSP Canada Inc.	
Project Name: Darlington NNP Phase II	
Project Location: Ontario, Canada	
Project Number: GTX-316444	
Tested By: trm	Checked By: njh
Boring ID: BH26	
Preparation: reconstituted	
Description: Moisr, gray silty sand with gravel (Greater than #4 sieve removed)	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.65

CONSOLIDATED DRAINED TRIAXIAL TEST - ANISOTROPIC CONSOLIDATION

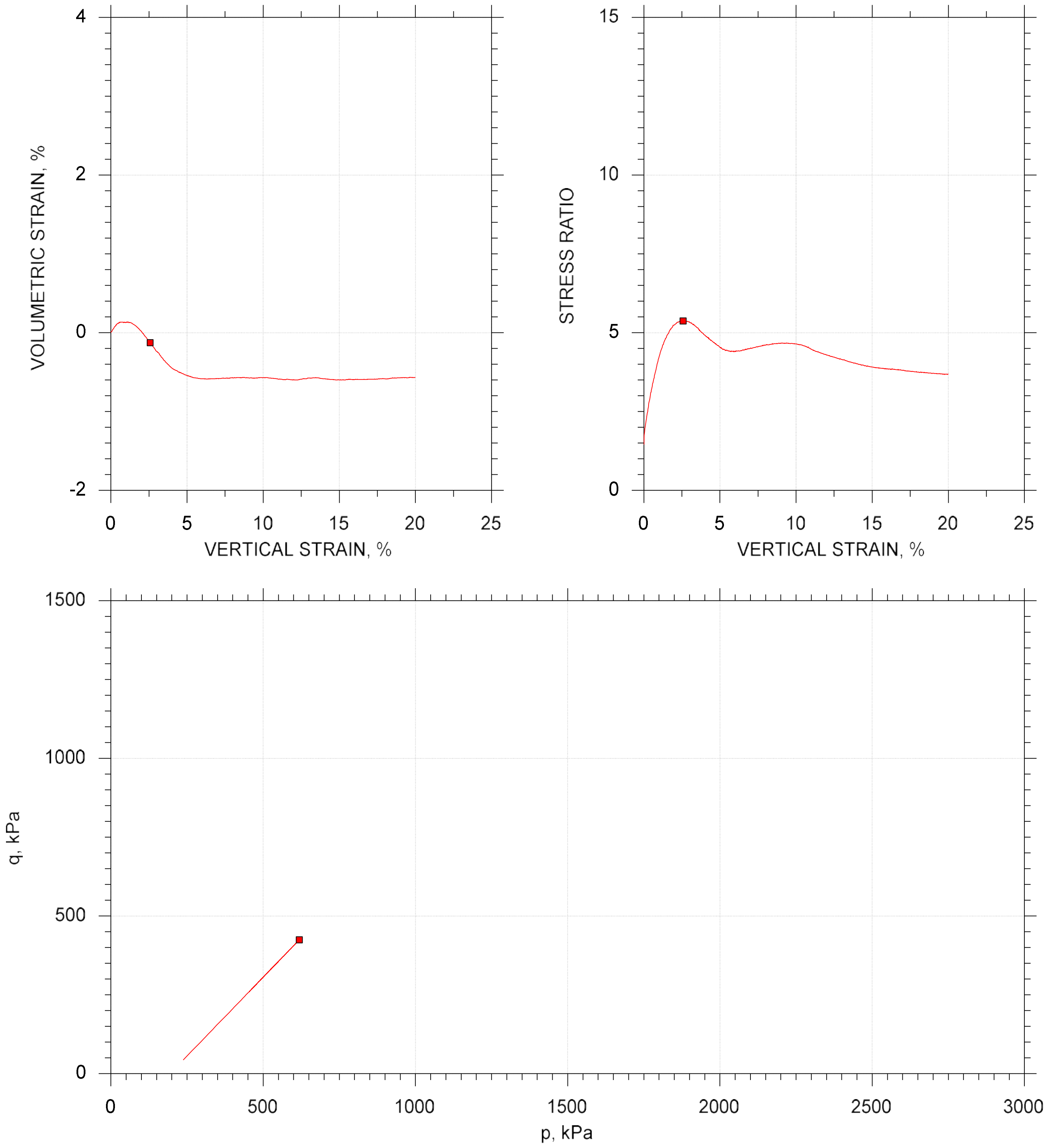




Symbol		🟥			
Sample ID		7			
Depth, ft		12-14'			
Test Number		CAD-7R			
Initial	Height, cm	10.16			
	Diameter, cm	5.080			
	Moisture Content (from Cuttings), %	7.8			
	Dry Density, kN/m³	21.2			
	Saturation (Wet Method), %	91.4			
	Void Ratio	0.226			
Before Shear	Moisture Content, %	8.4			
	Dry Density, kN/m³	21.2			
	Cross-sectional Area (Method A), cm²	20.33			
	Saturation, %	100.0			
	Void Ratio	0.224			
	Back Pressure, kPa	971.4			
Vertical Effective Consolidation Stress, kPa		280.1			
Horizontal Effective Consolidation Stress, kPa		193.8			
Vertical Strain after Consolidation, %		0.7437			
Volumetric Strain after Consolidation, %		0.9678			
Time to 50% Consolidation, min		---			
Shear Strength, kPa		424.8			
Strain at Failure, %		2.58			
Strain Rate, %/min		0.01000			
Deviator Stress at Failure, kPa		849.6			
Effective Minor Principal Stress at Failure, kPa		194.2			
Effective Major Principal Stress at Failure, kPa		1044.			
B-Value		0.98			
Notes: - Before Shear Saturation set to 100% for phase calculation. - Moisture Content determined by ASTM D2216. - Deviator Stress includes membrane correction. - Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions. Remarks:					

TX-015, Target Comp 20.78 kN/m3 at 10.0% mc. Final Diameters: 5.105 cm, 5.791 cm, 6.147 cm, 5.969 cm and 5.639 cm.

CONSOLIDATED DRAINED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION



	Sample No	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
🟥	7	CAD-7R	12-14'	trm	1/24/23	njh	1/31/23	316444-CAD-7Rn.dat

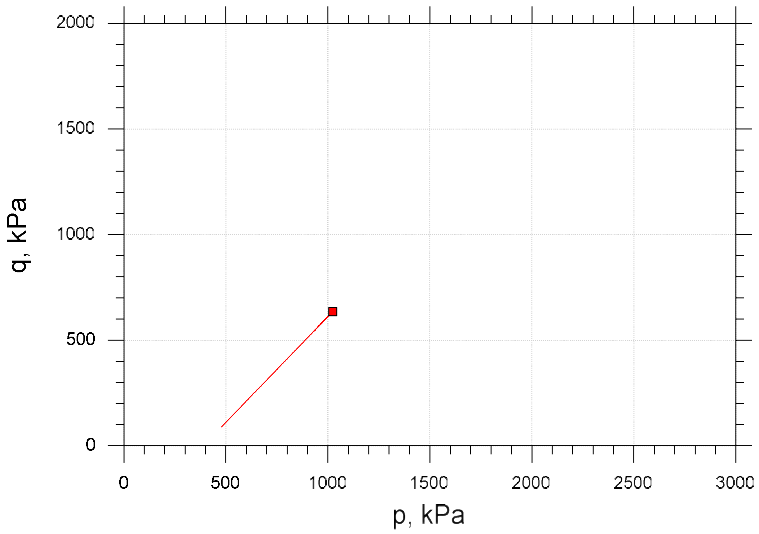
GeoTesting EXPRESS

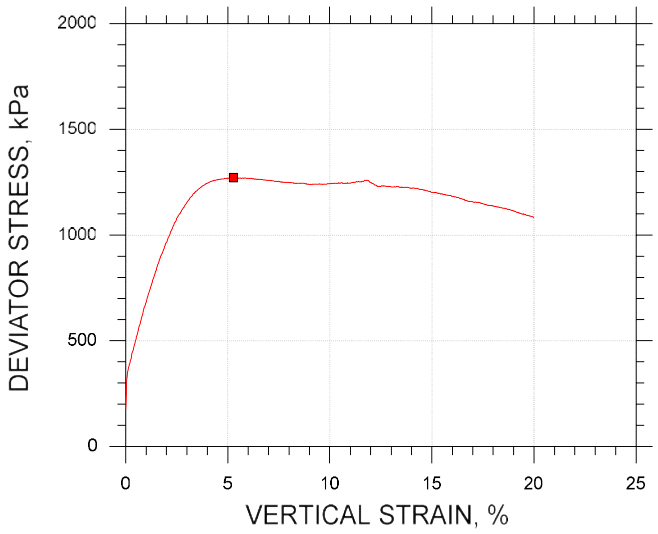
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Sample Type: reconstituted	
Description: Moisr, gray silty sand with gravel (Greater than #4 sieve removed)		
Remarks: TX-015, Target Comp 20.78 kN/m3 at 10.0% mc. Final Diameters: 5.105 cm, 5.791 cm, 6.147 cm, 5.969 cm and 5.639 cm.		

GeoTesting
EXPRESS

Client: WSP Canada Inc.	
Project Name: Darlington NNP Phase II	
Project Location: Ontario, Canada	
Project Number: GTX-316444	
Tested By: trm	Checked By: njh
Boring ID: BH26	
Preparation: reconstituted	
Description: Moist, gray silty sand with gravel (Greater than #4 sieve removed)	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.65

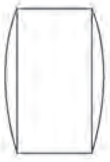
CONSOLIDATED DRAINED TRIAXIAL TEST - ANISOTROPIC CONSOLIDATION





Symbol		🟥			
Sample ID		11			
Depth, ft		20-22'			
Test Number		CAD-8			
Initial	Height, cm	10.16			
	Diameter, cm	5.080			
	Moisture Content (from Cuttings), %	7.3			
	Dry Density, kN/m³	20.5			
	Saturation (Wet Method), %	71.7			
	Void Ratio	0.268			
Before Shear	Moisture Content, %	9.2			
	Dry Density, kN/m³	20.9			
	Cross-sectional Area (Method A), cm²	20.02			
	Saturation, %	100.0			
	Void Ratio	0.243			
	Back Pressure, kPa	1040.			
Vertical Effective Consolidation Stress, kPa		564.9			
Horizontal Effective Consolidation Stress, kPa		388.8			
Vertical Strain after Consolidation, %		0.9389			
Volumetric Strain after Consolidation, %		2.387			
Time to 50% Consolidation, min		---			
Shear Strength, kPa		635.5			
Strain at Failure, %		5.28			
Strain Rate, %/min		0.01000			
Deviator Stress at Failure, kPa		1271.			
Effective Minor Principal Stress at Failure, kPa		388.8			
Effective Major Principal Stress at Failure, kPa		1660.			
B-Value		0.97			

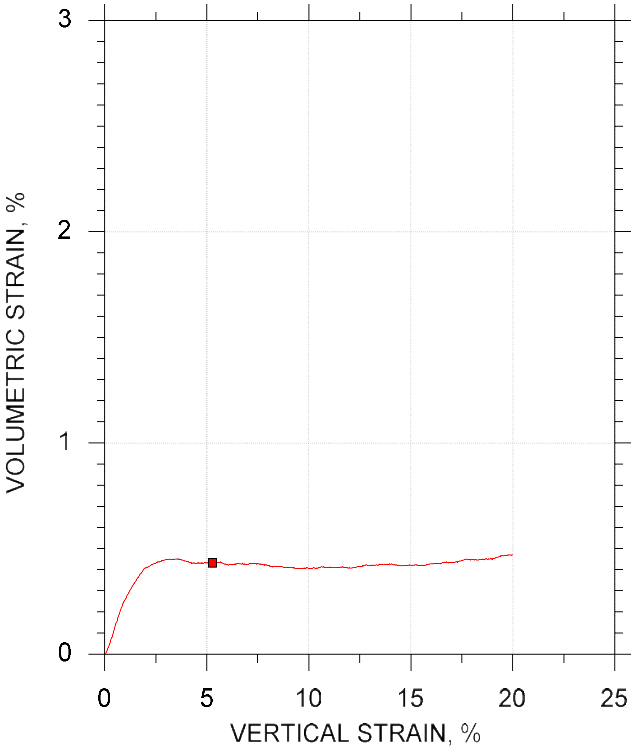
Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

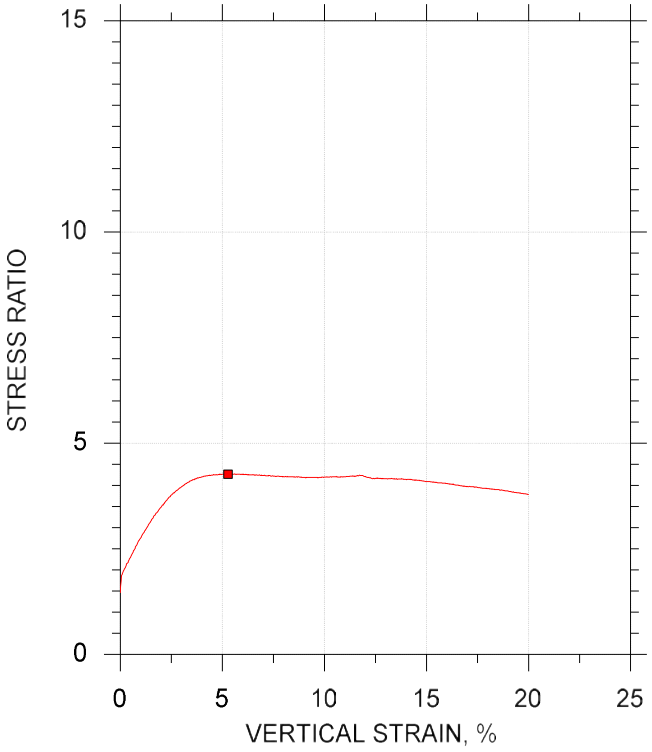


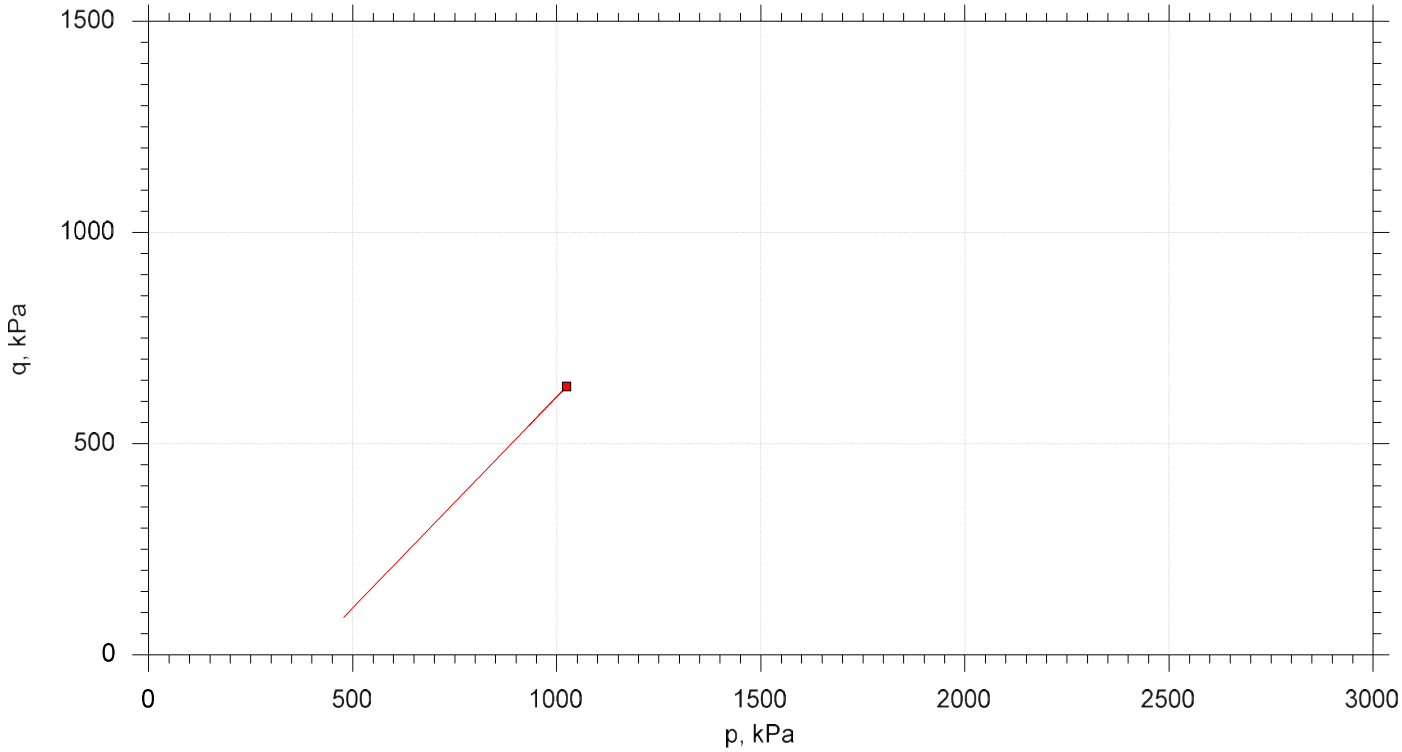
Remarks:

TX-014, Target Comp 20.36 kN/m3 at 8.0% mc. Final Diameters: 5.563 cm, 6.121 cm, 6.248 cm, 6.071 cm and 5.588 cm.

CONSOLIDATED DRAINED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION





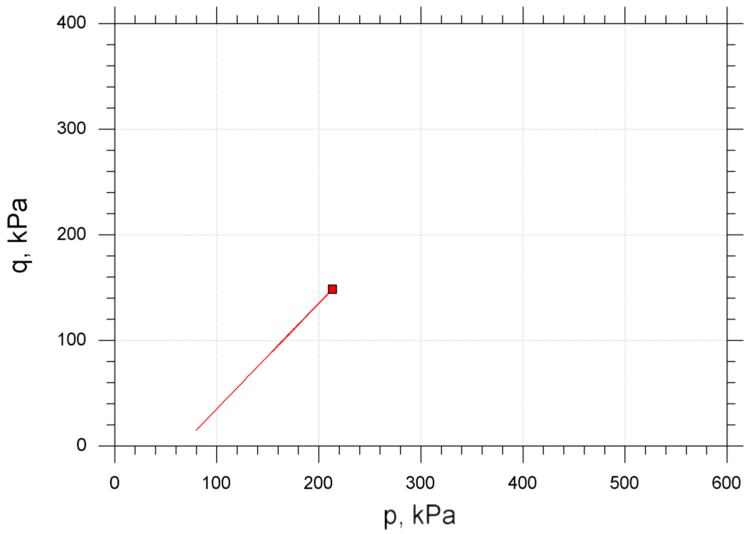


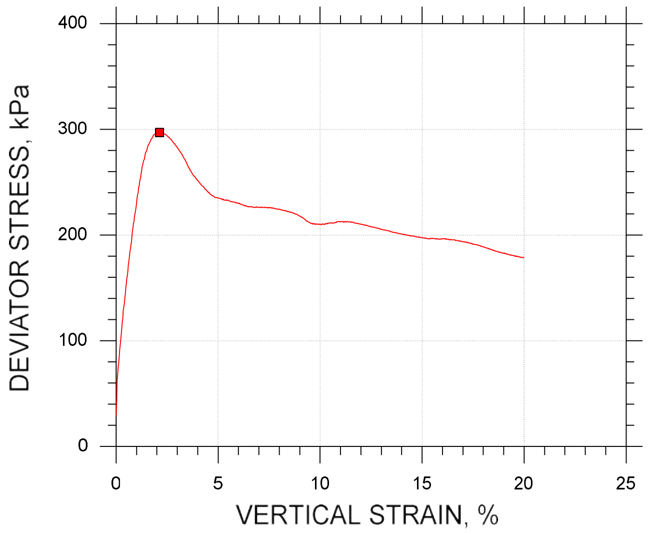
	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
🟥	11	CAD-8	20-22'	trm	1/16/23	njh	1/25/23	316444-CAD-8n.dat

GeoTesting EXPRESS	Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Sample Type: reconstituted	
	Description: Moist, gray silty sand with gravel (Greater than #4 sieve removed)		
	Remarks: TX-014, Target Comp 20.36 kN/m3 at 8.0% mc. Final Diameters: 5.563 cm, 6.121 cm, 6.248 cm, 6.071 cm and 5.588 cm.		

Client: WSP Canada Inc.	
Project Name: Darlington NNP Phase II	
Project Location: Ontario, Canada	
Project Number: GTX-316444	
Tested By: trm	Checked By: njh
Boring ID: BH26	
Preparation: reconstituted	
Description: Moist, gray silty sand with gravel, (Greater than #4 sieve removed)	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.65

CONSOLIDATED DRAINED TRIAXIAL TEST - ANISOTROPIC CONSOLIDATION





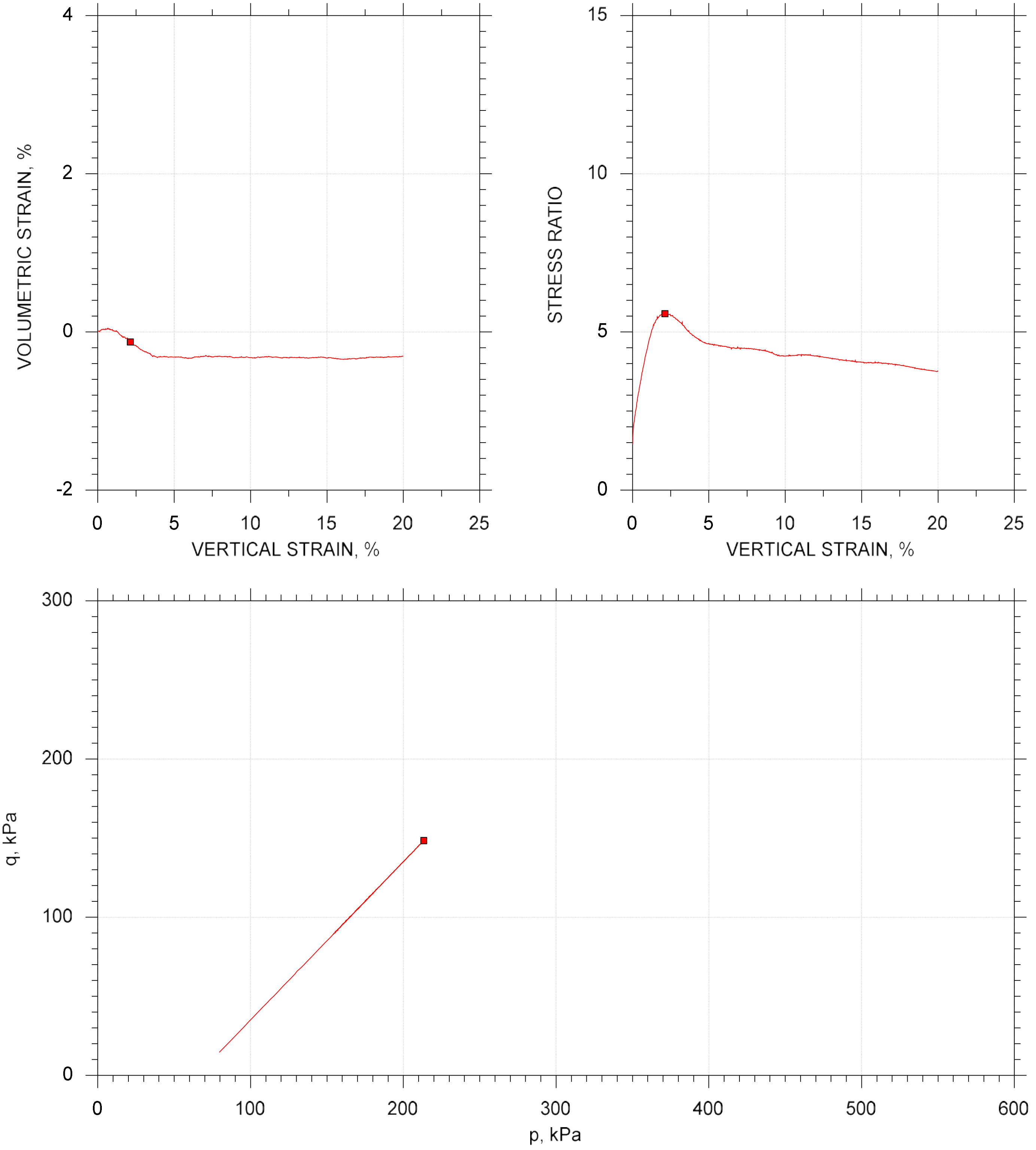
Symbol		🟥			
Sample ID		15			
Depth, ft		28-30'			
Test Number		CAD-9			
Initial	Height, cm	10.16			
	Diameter, cm	5.080			
	Moisture Content (from Cuttings), %	8.4			
	Dry Density, kN/m³	19.5			
	Saturation (Wet Method), %	67.0			
	Void Ratio	0.331			
Before Shear	Moisture Content, %	12.0			
	Dry Density, kN/m³	19.7			
	Cross-sectional Area (Method A), cm²	20.15			
	Saturation, %	100.0			
	Void Ratio	0.318			
	Back Pressure, kPa	1039.			
Vertical Effective Consolidation Stress, kPa		93.93			
Horizontal Effective Consolidation Stress, kPa		64.85			
Vertical Strain after Consolidation, %		0.1402			
Volumetric Strain after Consolidation, %		0.2935			
Time to 50% Consolidation, min		---			
Shear Strength, kPa		148.5			
Strain at Failure, %		2.13			
Strain Rate, %/min		0.01000			
Deviator Stress at Failure, kPa		297.0			
Effective Minor Principal Stress at Failure, kPa		64.85			
Effective Major Principal Stress at Failure, kPa		361.9			
B-Value		0.99			

Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

Remarks:

TX-005, Target Comp 20.36 kN/m3 at 10.0% mc. Final Diameters: 5.080 cm, 5.156 cm, 5.715 cm, 6.452 cm and 6.299 cm.

CONSOLIDATED DRAINED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION



	Sample No	Test No	Depth	Tested By	Test Date	Checked By	Check Date	Test File
🟥	15	CAD-9	28-30'	trm	1/5/23	njh	1/16/23	316444-CAD-9n.dat

GeoTesting EXPRESS

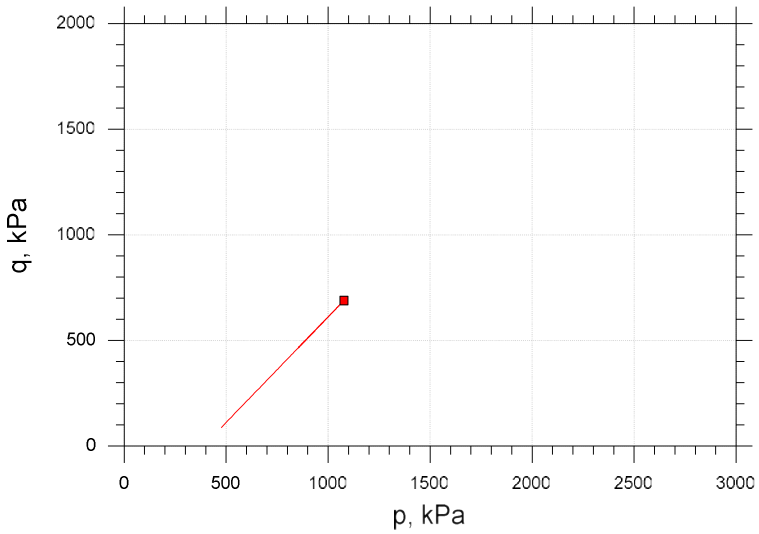
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Sample Type: reconstituted	

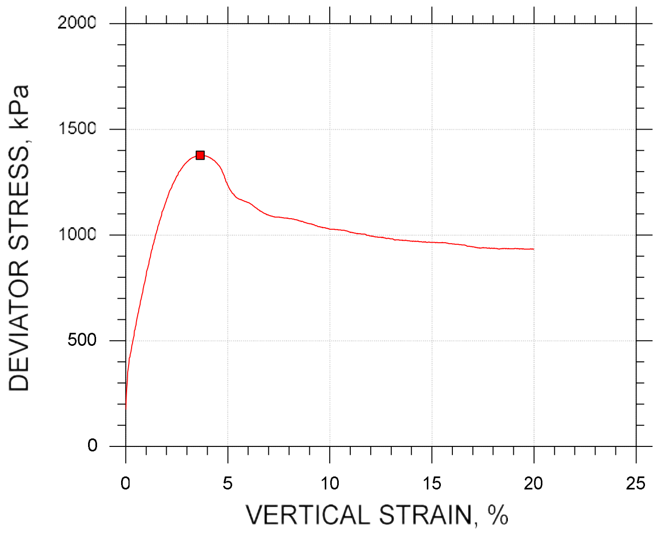
Description: Moist, gray silty sand with gravel, (Greater than #4 sieve removed)

Remarks: TX-005, Target Comp 20.36 kN/m3 at 10.0% mc. Final Diameters: 5.080 cm, 5.156 cm, 5.715 cm, 6.452 cm and 6.299 cm.

Client: WSP Canada, Inc.	
Project Name: Darlington NNP Phase II	
Project Location: Ontario, Canada	
Project Number: GTX-316444	
Tested By: trm	Checked By: njh
Boring ID: BH26	
Preparation: reconstituted	
Description: Moist, gray silty sand with gravel (Greater than #4 sieve removed)	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.65

CONSOLIDATED DRAINED TRIAXIAL TEST - ANISOTROPIC CONSOLIDATION

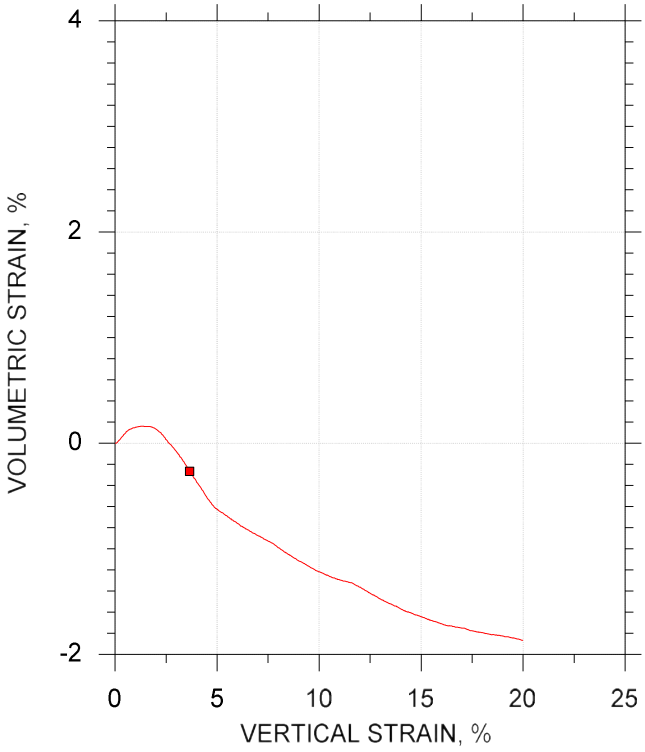


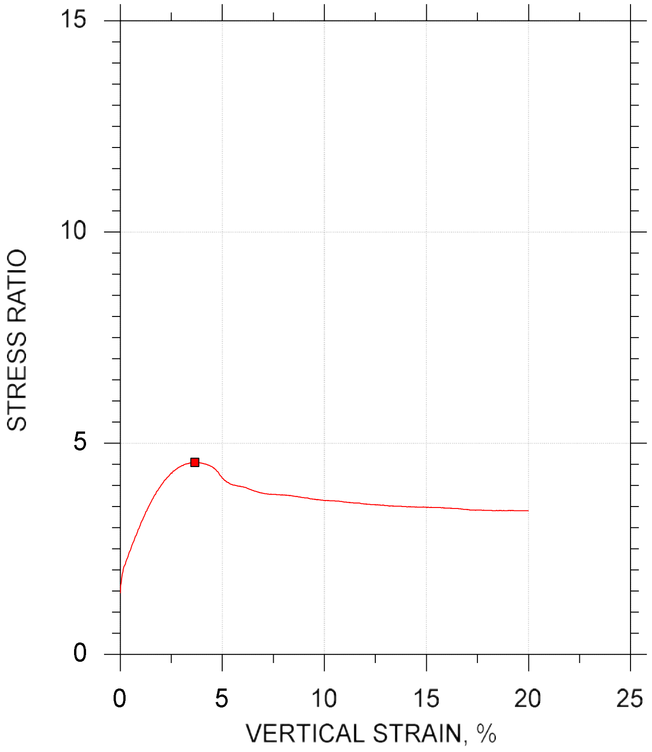


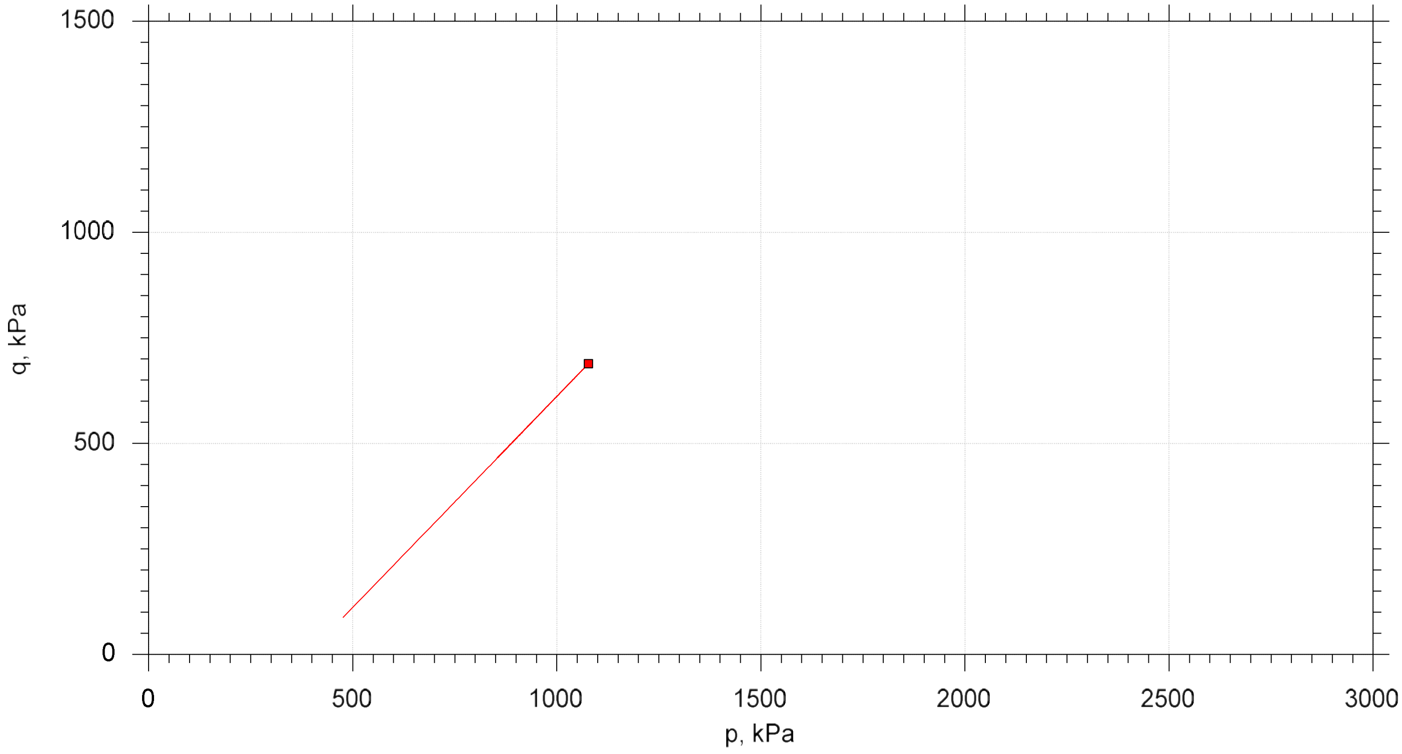
Symbol		🟥			
Sample ID		17			
Depth, ft		32-33.33'			
Test Number		CAD-10			
Initial	Height, cm	10.16			
	Diameter, cm	5.080			
	Moisture Content (from Cuttings), %	9.9			
	Dry Density, kN/m³	20.6			
	Saturation (Wet Method), %	99.2			
	Void Ratio	0.264			
Before Shear	Moisture Content, %	9.3			
	Dry Density, kN/m³	20.8			
	Cross-sectional Area (Method A), cm²	20.26			
	Saturation, %	100.0			
	Void Ratio	0.248			
	Back Pressure, kPa	1178.			
Vertical Effective Consolidation Stress, kPa		562.2			
Horizontal Effective Consolidation Stress, kPa		388.3			
Vertical Strain after Consolidation, %		1.053			
Volumetric Strain after Consolidation, %		0.5978			
Time to 50% Consolidation, min		---			
Shear Strength, kPa		688.9			
Strain at Failure, %		3.65			
Strain Rate, %/min		0.01000			
Deviator Stress at Failure, kPa		1378.			
Effective Minor Principal Stress at Failure, kPa		388.3			
Effective Major Principal Stress at Failure, kPa		1766.			
B-Value		0.96			
Notes: - Before Shear Saturation set to 100% for phase calculation. - Moisture Content determined by ASTM D2216. - Deviator Stress includes membrane correction. - Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions. Remarks:					

TX-027, Target Comp 20.36 kN/m3 at 11.0% mc. Final Diameters: 5.842 cm, 5.969 cm, 5.893 cm, 5.613 cm and 5.512 cm.

CONSOLIDATED DRAINED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION





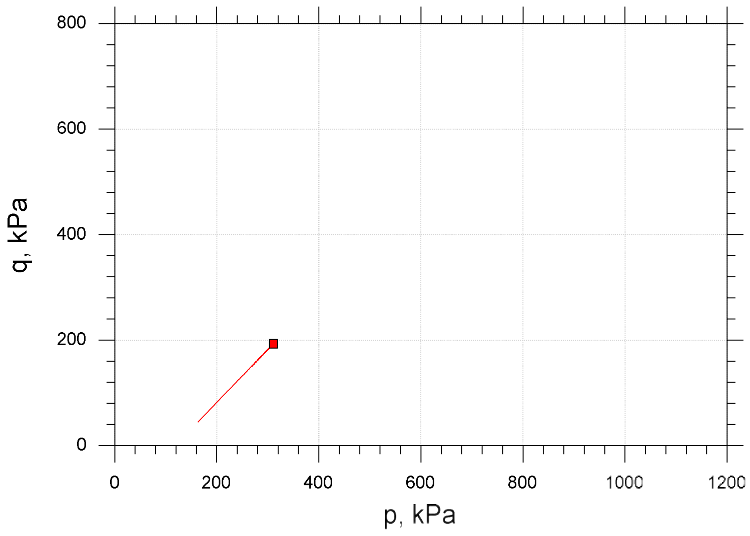


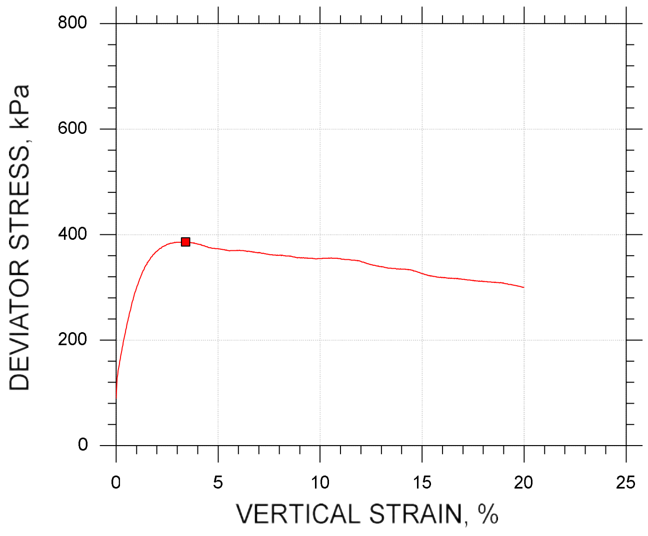
	Sample No	Test No	Depth	Tested By	Test Date	Checked By	Check Date	Test File
🟥	17	CAD-10	32-33.33'	trm	1/12/23	njh	1/19/23	316444-CAD-10n.dat

GeoTesting EXPRESS	Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Sample Type: reconstituted	
	Description: Moist, gray silty sand with gravel (Greater than #4 sieve removed)		
	Remarks: TX-027, Target Comp 20.36 kN/m3 at 11.0% mc. Final Diameters: 5.842 cm, 5.969 cm, 5.893 cm, 5.613 cm and 5.512 cm.		

Client: WSP Canada Inc.	
Project Name: Darlington NNP Phase II	
Project Location: Ontario, Canada	
Project Number: GTX-316444	
Tested By: trm	Checked By: njh
Boring ID: BH26	
Preparation: reconstituted	
Description: Moist, gray silt with sand	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.65

CONSOLIDATED DRAINED TRIAXIAL TEST - ANISOTROPIC CONSOLIDATION

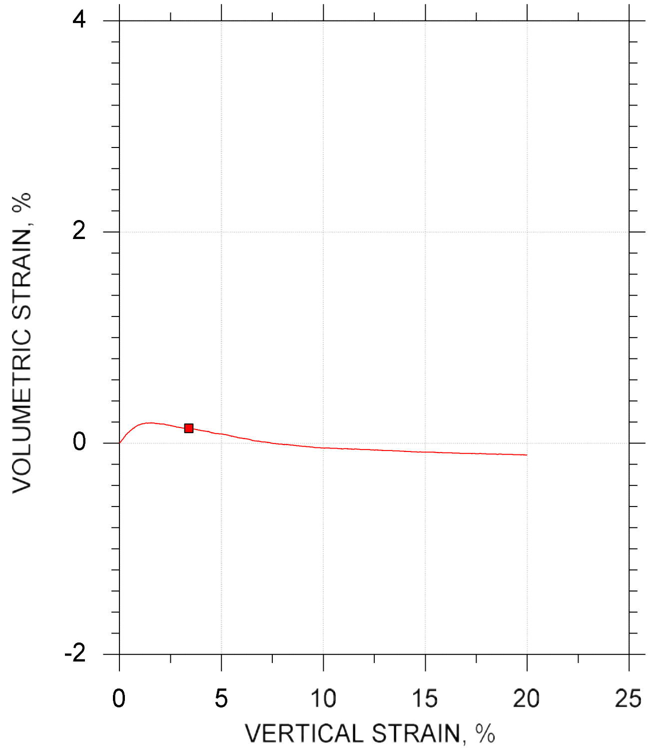


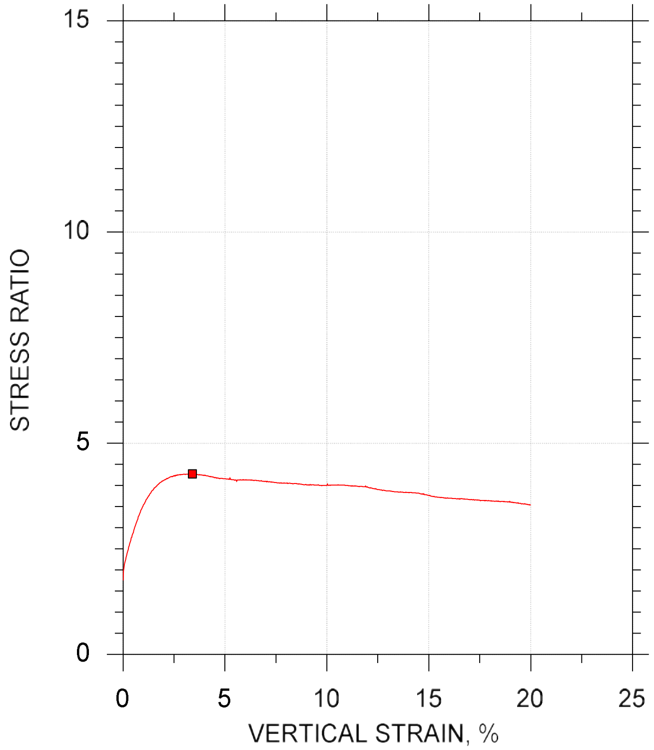


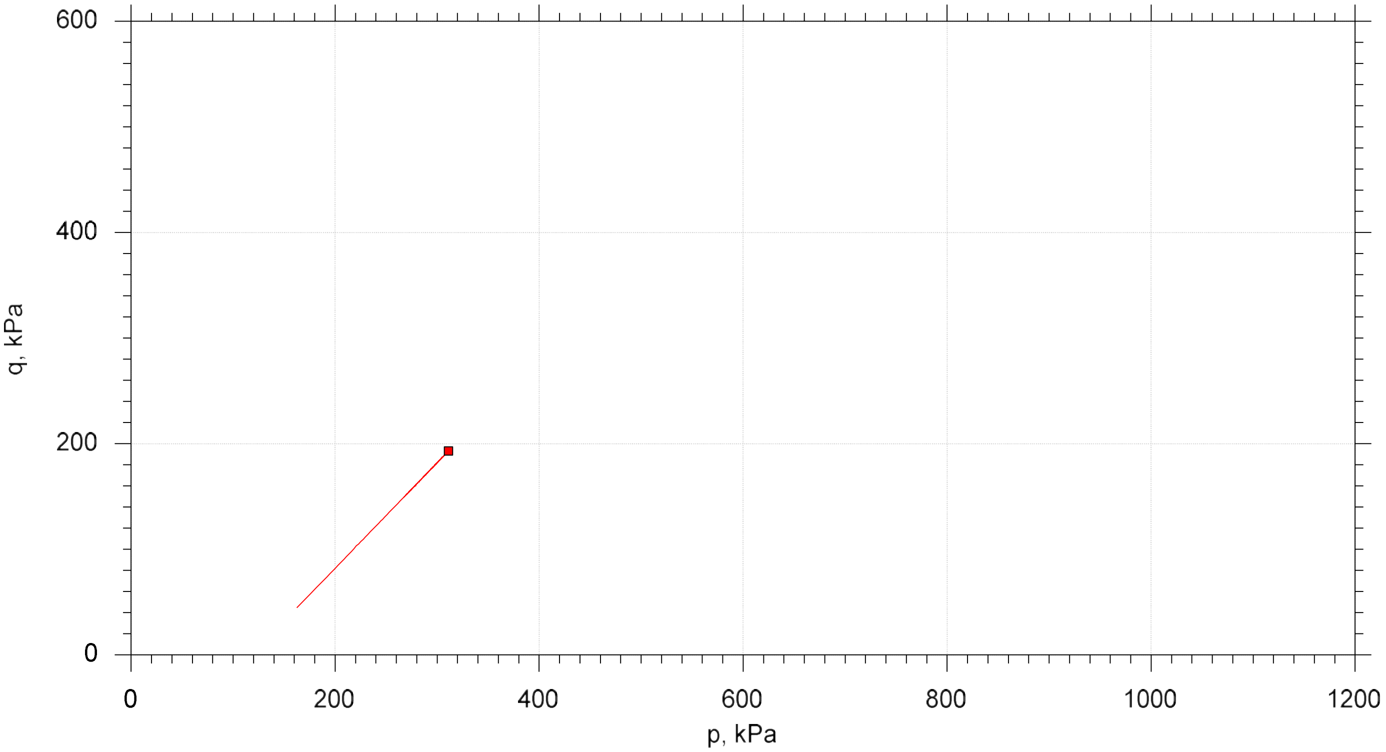
Symbol		🟥			
Sample ID		20			
Depth, ft		38-39.83			
Test Number		CAD-15			
Initial	Height, cm	10.16			
	Diameter, cm	5.080			
	Moisture Content (from Cuttings), %	9.2			
	Dry Density, kN/m³	19.0			
	Saturation (Wet Method), %	66.9			
	Void Ratio	0.365			
Before Shear	Moisture Content, %	13.3			
	Dry Density, kN/m³	19.2			
	Cross-sectional Area (Method A), cm²	20.20			
	Saturation, %	100.0			
	Void Ratio	0.352			
	Back Pressure, kPa	1041.			
Vertical Effective Consolidation Stress, kPa		206.7			
Horizontal Effective Consolidation Stress, kPa		117.9			
Vertical Strain after Consolidation, %		0.6881			
Volumetric Strain after Consolidation, %		1.140			
Time to 50% Consolidation, min		---			
Shear Strength, kPa		193.2			
Strain at Failure, %		3.40			
Strain Rate, %/min		0.01000			
Deviator Stress at Failure, kPa		386.3			
Effective Minor Principal Stress at Failure, kPa		117.9			
Effective Major Principal Stress at Failure, kPa		504.3			
B-Value		0.95			
Notes: - Before Shear Saturation set to 100% for phase calculation. - Moisture Content determined by ASTM D2216. - Deviator Stress includes membrane correction. - Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions. Remarks:					

TX-008, Target Comp 18.74 kN/m3 at 11.0% mc. Final Diameters: 5.283 cm, 6.096 cm, 6.401 cm, 6.121 cm and 5.791 cm.

CONSOLIDATED DRAINED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION







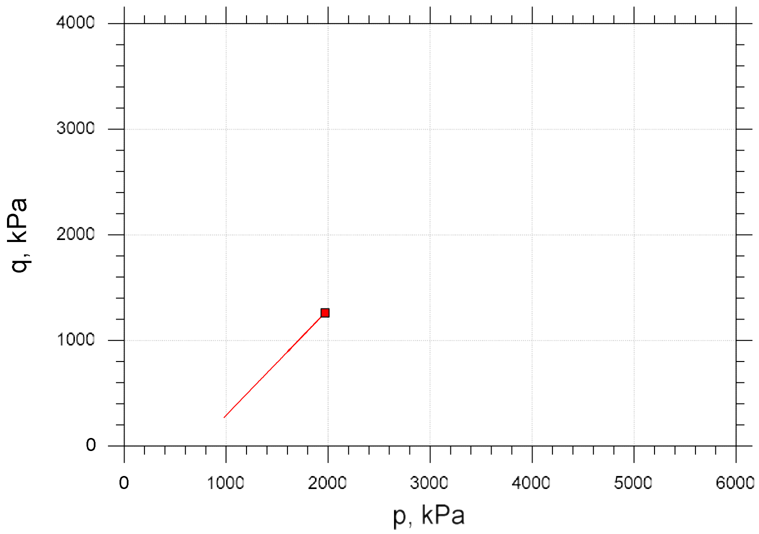
	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
🟥	20	CAD-15	38-39.83	trm	1/6/23	njh	1/16/23	316444-CAD-15n.dat

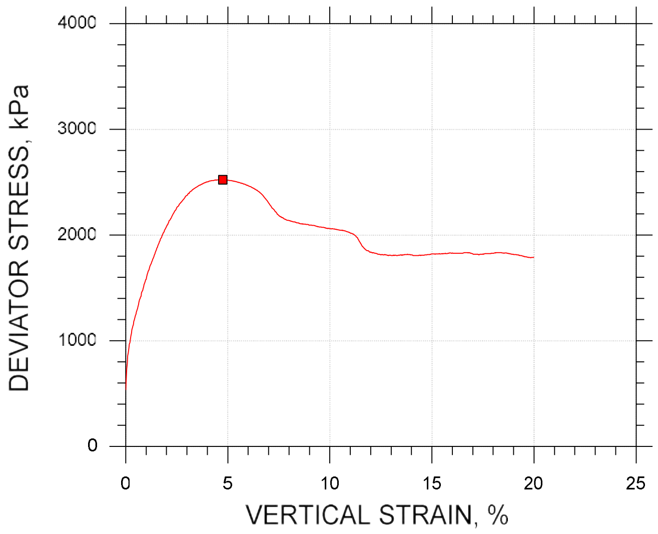
GeoTesting
EXPRESS

Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Sample Type: reconstituted	
Description: Moist, gray silt with sand		
Remarks: TX-008, Target Comp 18.74 kN/m3 at 11.0% mc. Final Diameters: 5.283 cm, 6.096 cm, 6.401 cm, 6.121 cm and 5.791 cm.		

Client: WSP Canada Inc.	
Project Name: Darlington NNP Phase II	
Project Location: Ontario, Canada	
Project Number: GTX-316444	
Tested By: trm	Checked By: njh
Boring ID: BH26	
Preparation: reconsituted	
Description: Moist, gray silty sand	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.65

CONSOLIDATED DRAINED TRIAXIAL TEST - ANISOTROPIC CONSOLIDATION

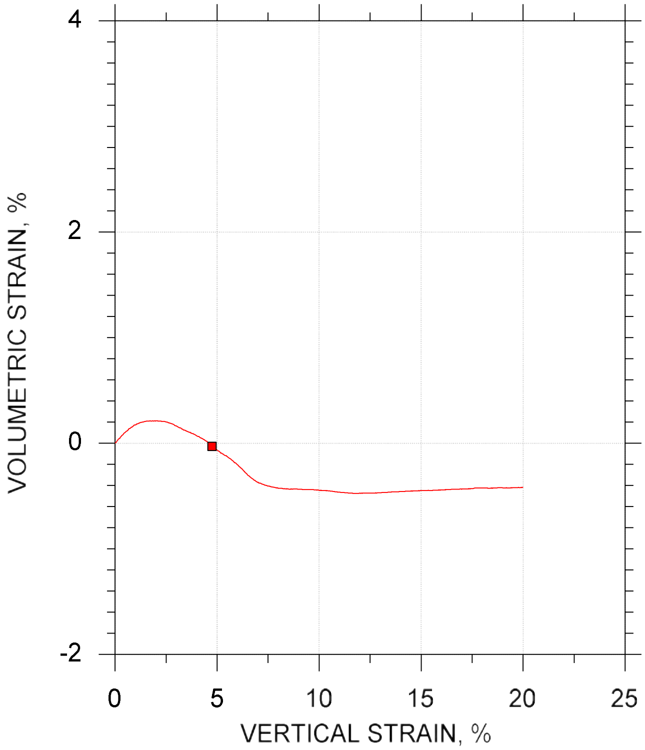


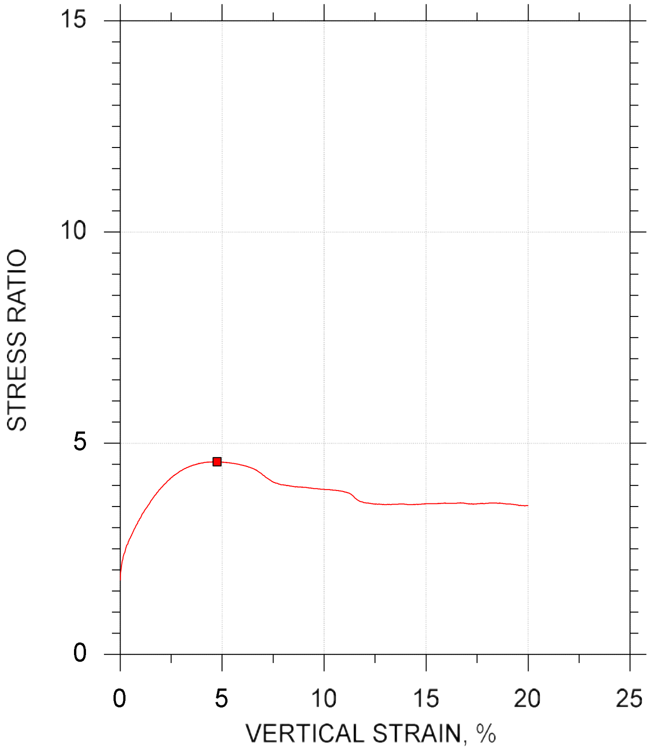


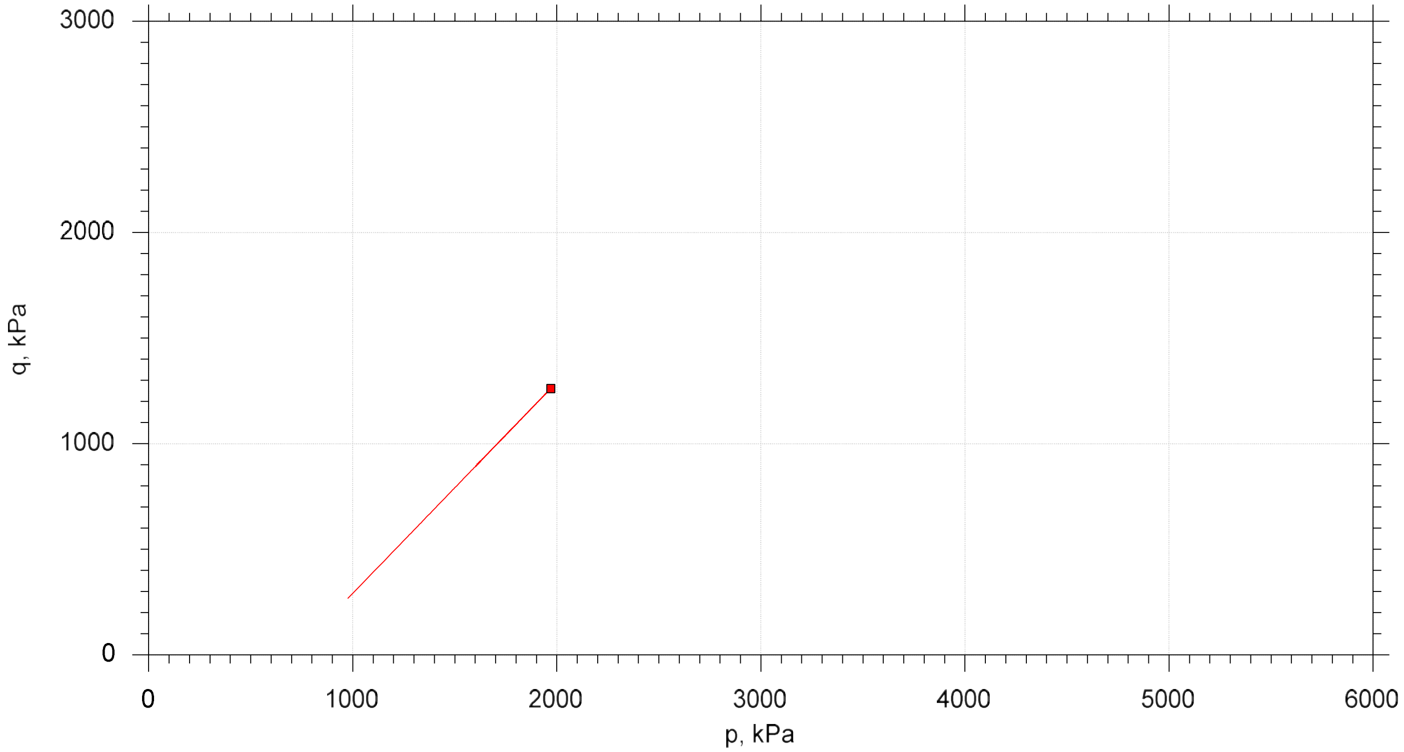
Symbol		🟥			
Sample ID		21			
Depth, ft		40-41.33'			
Test Number		CAD-16			
Initial	Height, cm	10.67			
	Diameter, cm	5.080			
	Moisture Content (from Cuttings), %	10.9			
	Dry Density, kN/m³	18.2			
	Saturation (Wet Method), %	67.1			
	Void Ratio	0.429			
Before Shear	Moisture Content, %	15.3			
	Dry Density, kN/m³	18.5			
	Cross-sectional Area (Method A), cm²	20.25			
	Saturation, %	100.0			
	Void Ratio	0.405			
	Back Pressure, kPa	1109.			
Vertical Effective Consolidation Stress, kPa		1242.			
Horizontal Effective Consolidation Stress, kPa		708.5			
Vertical Strain after Consolidation, %		1.767			
Volumetric Strain after Consolidation, %		2.081			
Time to 50% Consolidation, min		---			
Shear Strength, kPa		1262.			
Strain at Failure, %		4.75			
Strain Rate, %/min		0.01000			
Deviator Stress at Failure, kPa		2523.			
Effective Minor Principal Stress at Failure, kPa		707.8			
Effective Major Principal Stress at Failure, kPa		3231.			
B-Value		0.99			
Notes: - Before Shear Saturation set to 100% for phase calculation. - Moisture Content determined by ASTM D2216. - Deviator Stress includes membrane correction. - Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions. Remarks:					

TX-019, Target Comp 18.74 kN/m3 at 13.0% mc. Final Diameters: 5.715 cm, 5.969 cm, 6.147 cm, 5.944 cm and 5.690 cm.

CONSOLIDATED DRAINED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION







	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
🟥	21	CAD-16	40-41.33'	trm	1/12/23	njh	1/19/23	316444-CAD-16n.dat

GeoTesting EXPRESS

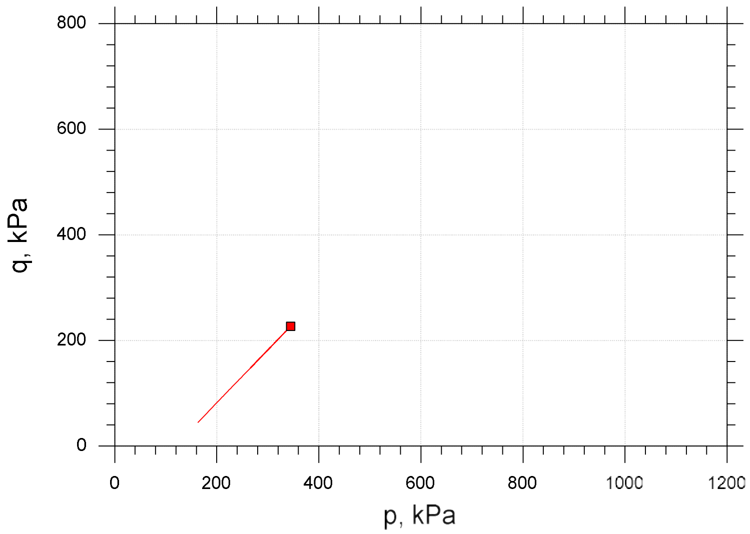
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Sample Type: reconsituted	

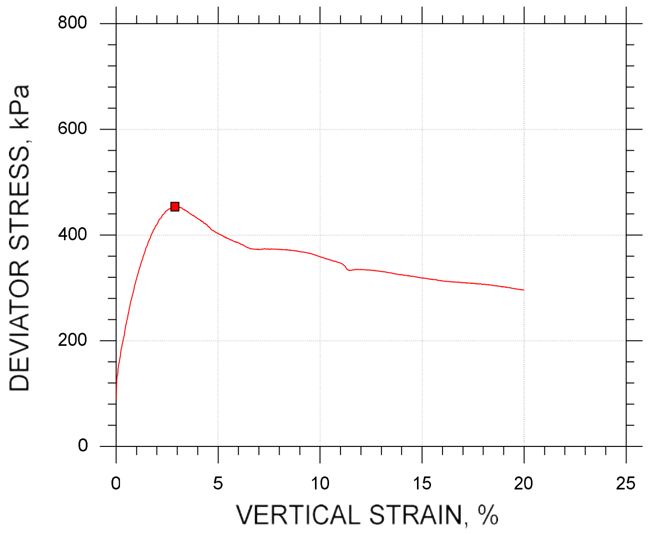
Description: Moist, gray silty sand

Remarks: TX-019, Target Comp 18.74 kN/m3 at 13.0% mc. Final Diameters: 5.715 cm, 5.969 cm, 6.147 cm, 5.944 cm and 5.690 cm.

Client: WSP Canada Inc.	
Project Name: Darlington NNP Phase II	
Project Location: Ontario, Canada	
Project Number: GTX-316444	
Tested By: trm	Checked By: njh
Boring ID: BH26	
Preparation: reconstituted	
Description: Moist, gray silty sand	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.65

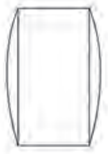
CONSOLIDATED DRAINED TRIAXIAL TEST - ANISOTROPIC CONSOLIDATION





Symbol		🟥			
Sample ID		32			
Depth, ft		62-63.42'			
Test Number		CAD-17R			
Initial	Height, cm	10.67			
	Diameter, cm	5.080			
	Moisture Content (from Cuttings), %	14.5			
	Dry Density, kN/m³	17.9			
	Saturation (Wet Method), %	85.3			
	Void Ratio	0.450			
Before Shear	Moisture Content, %	16.4			
	Dry Density, kN/m³	18.1			
	Cross-sectional Area (Method A), cm²	20.23			
	Saturation, %	100.0			
	Void Ratio	0.435			
	Back Pressure, kPa	1040.			
Vertical Effective Consolidation Stress, kPa		206.6			
Horizontal Effective Consolidation Stress, kPa		118.0			
Vertical Strain after Consolidation, %		0.9558			
Volumetric Strain after Consolidation, %		1.300			
Time to 50% Consolidation, min		---			
Shear Strength, kPa		226.9			
Strain at Failure, %		2.88			
Strain Rate, %/min		0.01000			
Deviator Stress at Failure, kPa		453.8			
Effective Minor Principal Stress at Failure, kPa		118.0			
Effective Major Principal Stress at Failure, kPa		571.8			
B-Value		0.98			

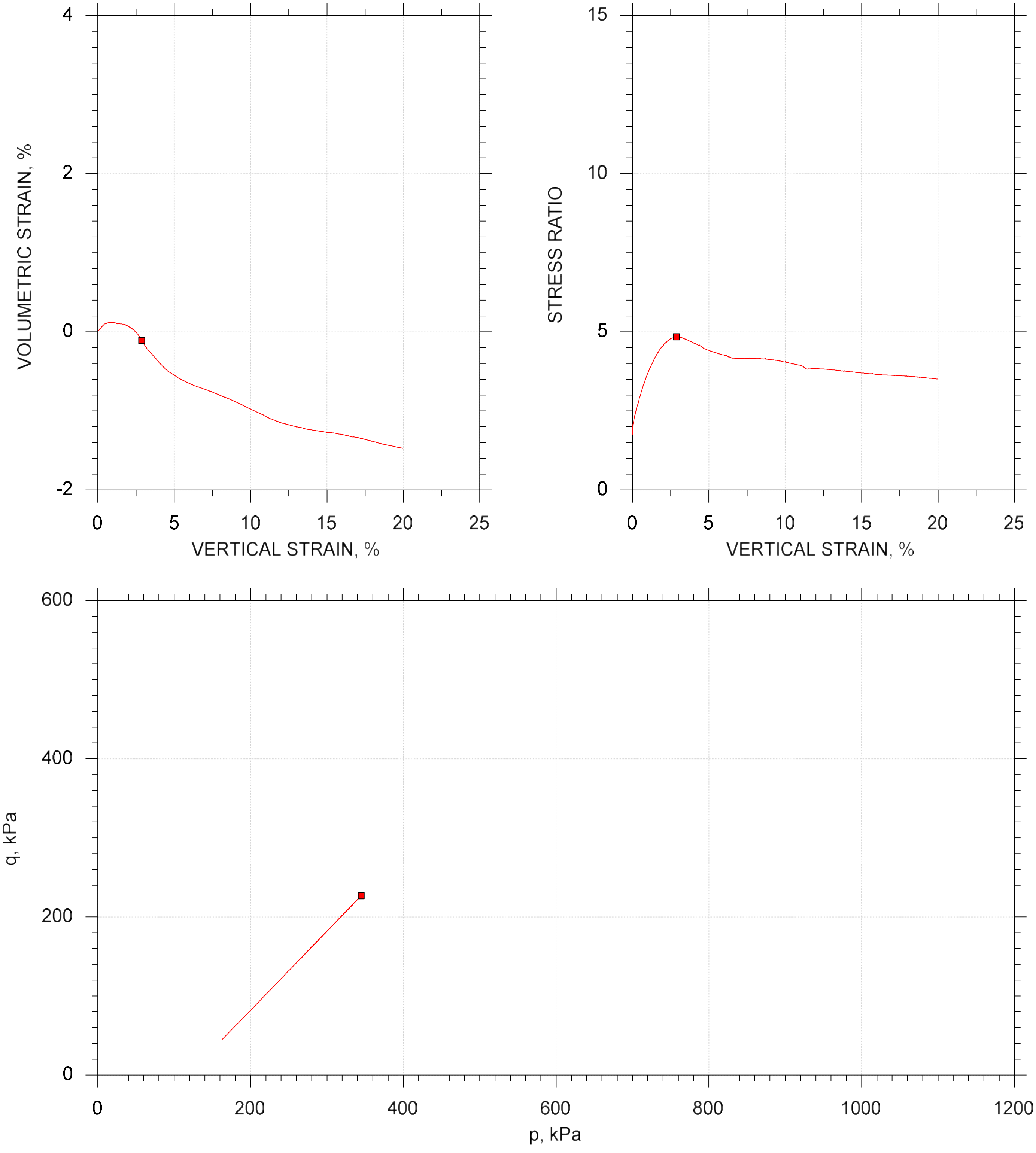
Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.



Remarks:

TX-024, Target Comp 18.74 kN/m3 at 15.0% mc. Final Diameters: 5.334 cm, 5.715 cm, 5.867 cm, 5.639 cm and 5.283 cm.

CONSOLIDATED DRAINED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION



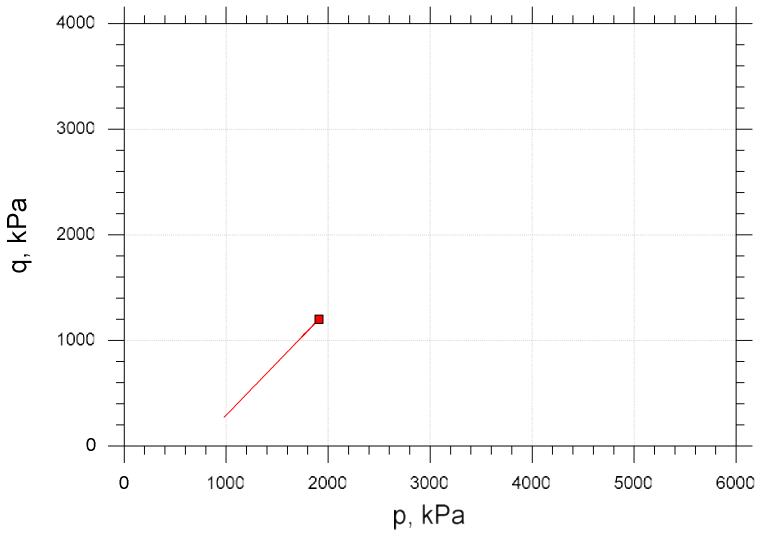
	Sample No	Test No	Depth	Tested By	Test Date	Checked By	Check Date	Test File
🟥	32	CAD-17R	62-63.42'	trm	1/23/23	njh	1/27/23	316444-CAD-17Rn.dat

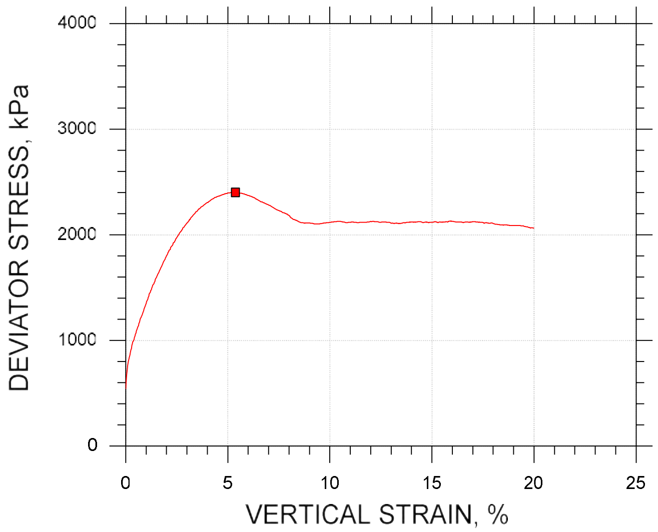
GeoTesting EXPRESS

Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Sample Type: reconstituted	
Description: Moist, gray silty sand		
Remarks: TX-024, Target Comp 18.74 kN/m3 at 15.0% mc. Final Diameters: 5.334 cm, 5.715 cm, 5.867 cm, 5.639 cm and 5.283 cm.		

Client: WSP Canada Inc.
Project Name: Darlington NNP Phase II
Project Location: Ontario, Canada
Project Number: GTX-316444
Tested By: trm
Checked By: njh
Boring ID: BH26
Preparation: reconstituted
Description: Moist, gray silty sand
Classification: ---
Group Symbol: ---
Liquid Limit: ---
Plastic Limit: ---
Plasticity Index: ---
Estimated Specific Gravity: 2.65

CONSOLIDATED DRAINED TRIAXIAL TEST - ANISOTROPIC CONSOLIDATION

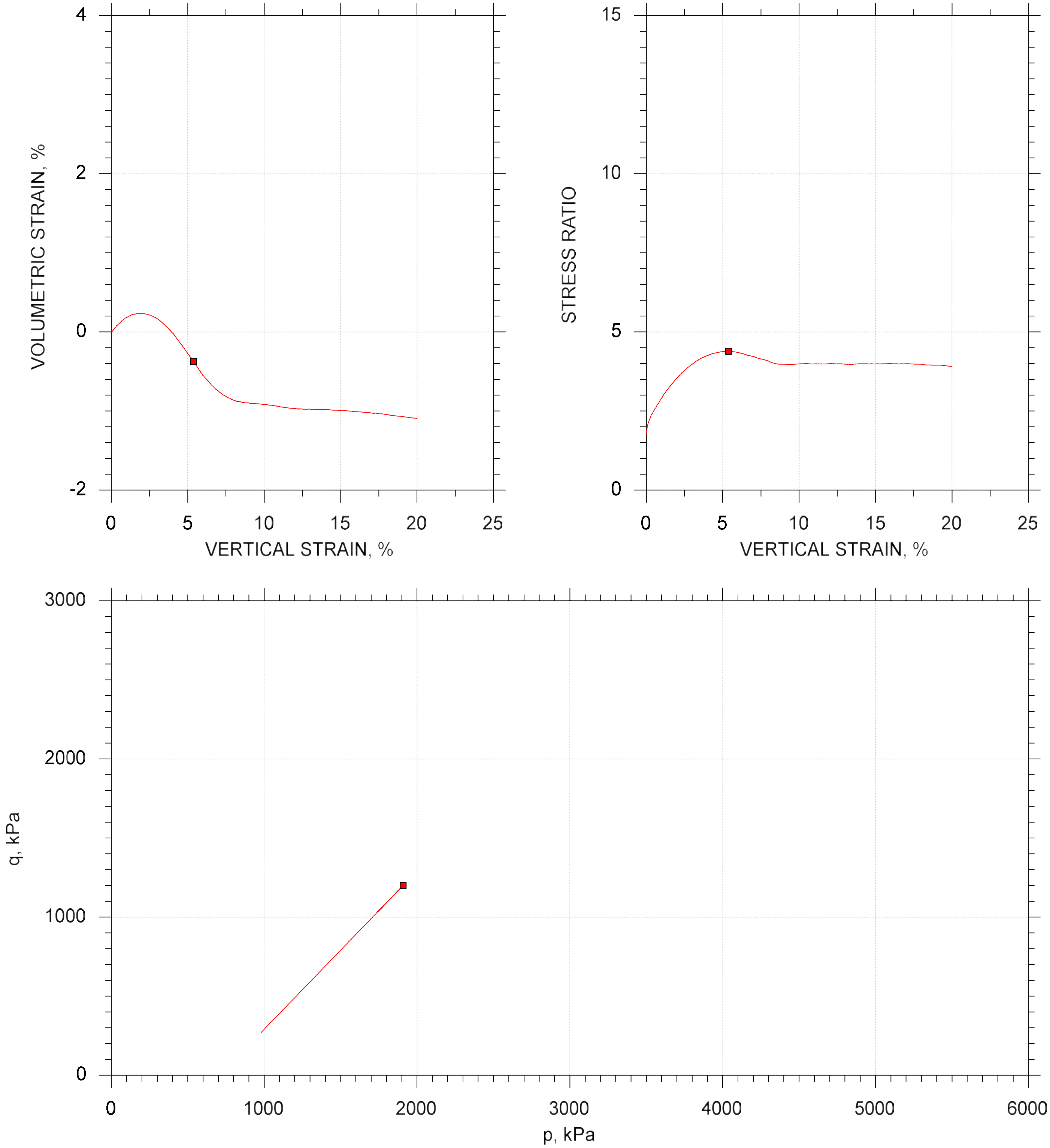




Symbol		🟥			
Sample ID		34A			
Depth, ft		66-66.75'			
Test Number		CAD-18			
Initial	Height, cm	11.18			
	Diameter, cm	5.080			
	Moisture Content (from Cuttings), %	19.1			
	Dry Density, kN/m³	17.2			
	Saturation (Wet Method), %	98.3			
	Void Ratio	0.514			
Before Shear	Moisture Content, %	17.7			
	Dry Density, kN/m³	17.7			
	Cross-sectional Area (Method A), cm²	20.11			
	Saturation, %	100.0			
	Void Ratio	0.470			
	Back Pressure, kPa	903.1			
Vertical Effective Consolidation Stress, kPa		1246.			
Horizontal Effective Consolidation Stress, kPa		708.8			
Vertical Strain after Consolidation, %		2.118			
Volumetric Strain after Consolidation, %		2.692			
Time to 50% Consolidation, min		---			
Shear Strength, kPa		1201.			
Strain at Failure, %		5.38			
Strain Rate, %/min		0.01000			
Deviator Stress at Failure, kPa		2402.			
Effective Minor Principal Stress at Failure, kPa		708.3			
Effective Major Principal Stress at Failure, kPa		3111.			
B-Value		0.95			
Notes: - Before Shear Saturation set to 100% for phase calculation. - Moisture Content determined by ASTM D2216. - Deviator Stress includes membrane correction. - Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions. Remarks:					

TX-014, Target Comp 18.74 kN/m3 at 20.0% mc. Final Diameters: 5.486 cm, 5.613 cm, 5.791 cm, 5.715 cm and 5.639 cm.

CONSOLIDATED DRAINED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION



	Sample No	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
🟥	34A	CAD-18	66-66.75'	trm	1/11/23	njh	1/19/23	316444-CAD-18n.dat

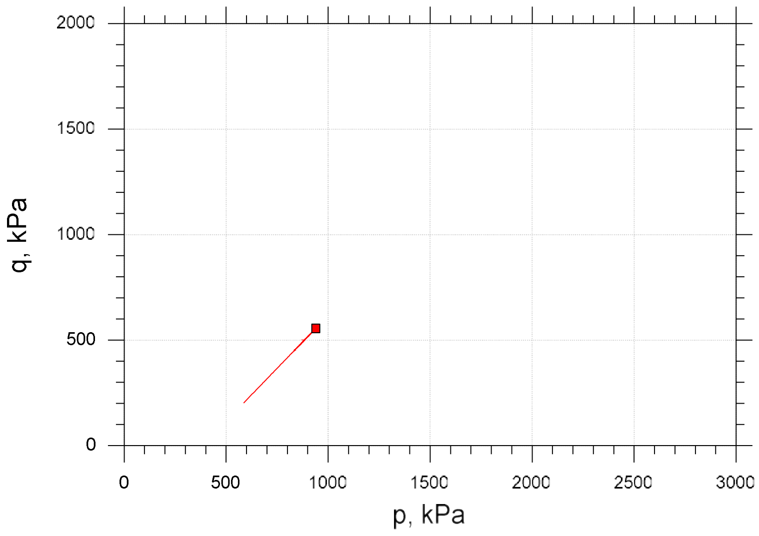
GeoTesting EXPRESS

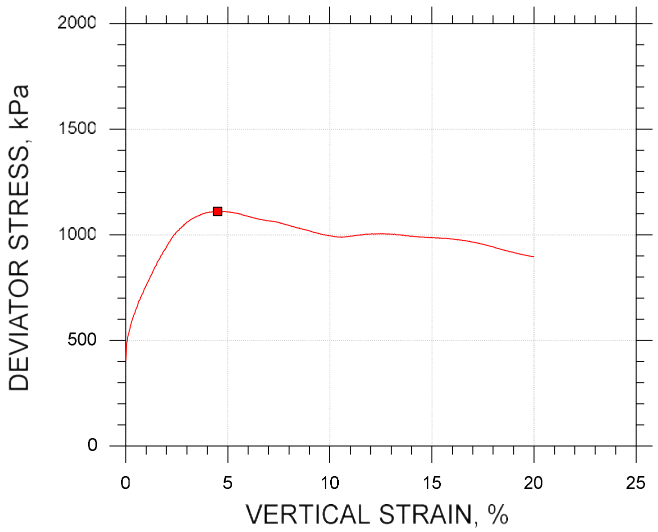
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Sample Type: reconstituted	
Description: Moist, gray silty sand		
Remarks: TX-014, Target Comp 18.74 kN/m3 at 20.0% mc. Final Diameters: 5.486 cm, 5.613 cm, 5.791 cm, 5.715 cm and 5.639 cm.		

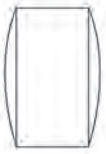
GeoTesting EXPRESS

Client: WSP Canada Inc.
Project Name: Darlington NNP Phase II
Project Location: Ontario, Canada
Project Number: GTX-316444
Tested By: trm
Checked By: njh
Boring ID: BH26
Preparation: reconstituted
Description: Moist, gray silt with sand
Classification: SILT with Sand
Group Symbol: ML
Liquid Limit: 17
Plastic Limit: 14
Plasticity Index: 3
Measured Specific Gravity: 2.68

CONSOLIDATED DRAINED TRIAXIAL TEST - ANISOTROPIC CONSOLIDATION

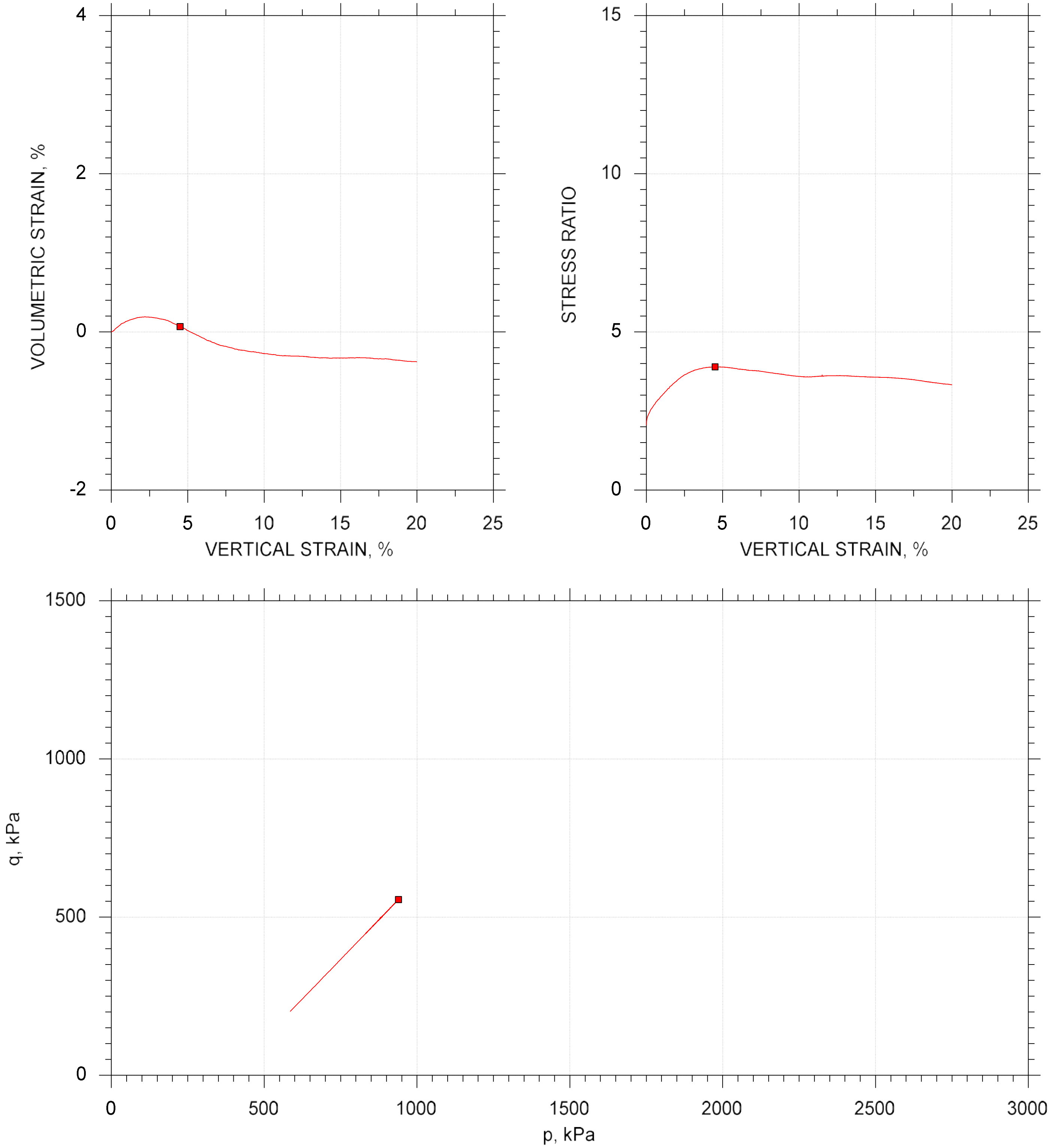




Symbol		🟥			
Sample ID		35			
Depth, ft		68-70'			
Test Number		CAD-25			
Initial	Height, cm	10.16			
	Diameter, cm	5.080			
	Moisture Content (from Cuttings), %	14.6			
	Dry Density, kN/m³	18.4			
	Saturation (Wet Method), %	90.5			
	Void Ratio	0.432			
Before Shear	Moisture Content, %	14.6			
	Dry Density, kN/m³	18.9			
	Cross-sectional Area (Method A), cm²	20.08			
	Saturation, %	100.0			
	Void Ratio	0.390			
	Back Pressure, kPa	902.4			
Vertical Effective Consolidation Stress, kPa		785.5			
Horizontal Effective Consolidation Stress, kPa		383.5			
Vertical Strain after Consolidation, %		1.774			
Volumetric Strain after Consolidation, %		2.270			
Time to 50% Consolidation, min		---			
Shear Strength, kPa		555.5			
Strain at Failure, %		4.50			
Strain Rate, %/min		0.01000			
Deviator Stress at Failure, kPa		1111.			
Effective Minor Principal Stress at Failure, kPa		383.5			
Effective Major Principal Stress at Failure, kPa		1495.			
B-Value		0.97			
Notes: - Before Shear Saturation set to 100% for phase calculation. - Moisture Content determined by ASTM D2216. - Specific Gravity determined by ASTM D854. - Atterberg Limits determined by ASTM D4318. - Deviator Stress includes membrane correction. - Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions. Remarks:					

TX-026, Target Comp 18.14 kN/m3 at 16.0% mc. Final Diameters: 5.359 cm, 5.817 cm, 6.096 cm, 5.867 cm and 5.283 cm.

CONSOLIDATED DRAINED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION



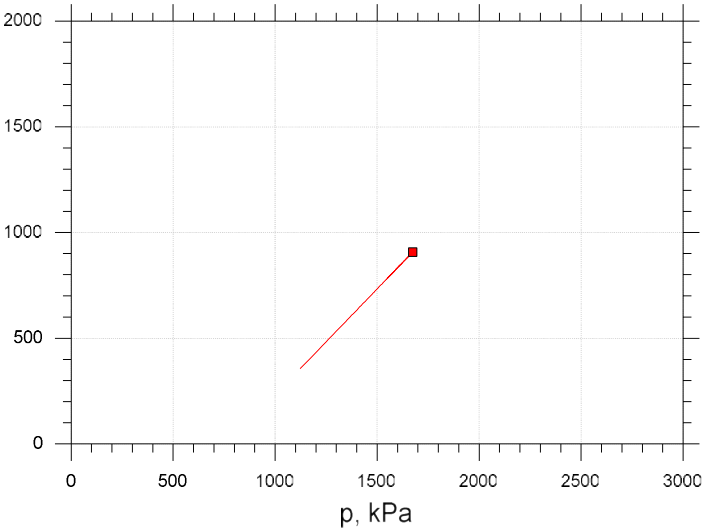
	Sample No	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
🟥	35	CAD-25	68-70'	trm	1/9/23	njh	1/16/23	316444-CAD-25n.dat

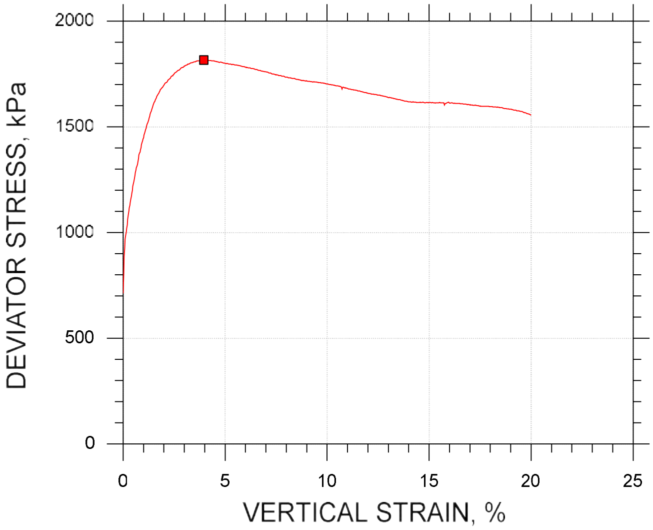
GeoTesting EXPRESS

Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Sample Type: reconstituted	
Description: Moist, gray silt with sand		
Remarks: TX-026, Target Comp 18.14 kN/m3 at 16.0% mc. Final Diameters: 5.359 cm, 5.817 cm, 6.096 cm, 5.867 cm and 5.283 cm.		

Client: WSP Canada Inc.
Project Name: Darlington NNP Phase II
Project Location: Ontario, Canada
Project Number: GTX-316444
Tested By: trm
Checked By: njh
Boring ID: BH26
Preparation: reconstituted
Description: Moist, gray silt
Classification: ---
Group Symbol: ---
Liquid Limit: ---
Plastic Limit: ---
Plasticity Index: ---
Estimated Specific Gravity: 2.7

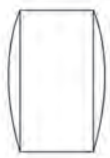
CONSOLIDATED DRAINED TRIAXIAL TEST - ANISOTROPIC CONSOLIDATION





	Symbol	🟥			
	Sample ID	36			
	Depth, ft	70-72'			
	Test Number	CAD-26			
Initial	Height, cm	10.41			
	Diameter, cm	5.080			
	Moisture Content (from Cuttings), %	10.2			
	Dry Density, kN/m³	17.8			
	Saturation (Wet Method), %	56.6			
	Void Ratio	0.486			
Before Shear	Moisture Content, %	14.3			
	Dry Density, kN/m³	19.1			
	Cross-sectional Area (Method A), cm²	22.71			
	Saturation, %	100.0			
	Void Ratio	0.386			
	Back Pressure, kPa	833.8			
	Vertical Effective Consolidation Stress, kPa	1470.			
	Horizontal Effective Consolidation Stress, kPa	766.7			
	Vertical Strain after Consolidation, %	16.02			
	Volumetric Strain after Consolidation, %	4.257			
	Time to 50% Consolidation, min	---			
	Shear Strength, kPa	908.1			
	Strain at Failure, %	3.95			
	Strain Rate, %/min	0.01000			
	Deviator Stress at Failure, kPa	1816.			
	Effective Minor Principal Stress at Failure, kPa	766.7			
	Effective Major Principal Stress at Failure, kPa	2583.			
	B-Value	0.96			

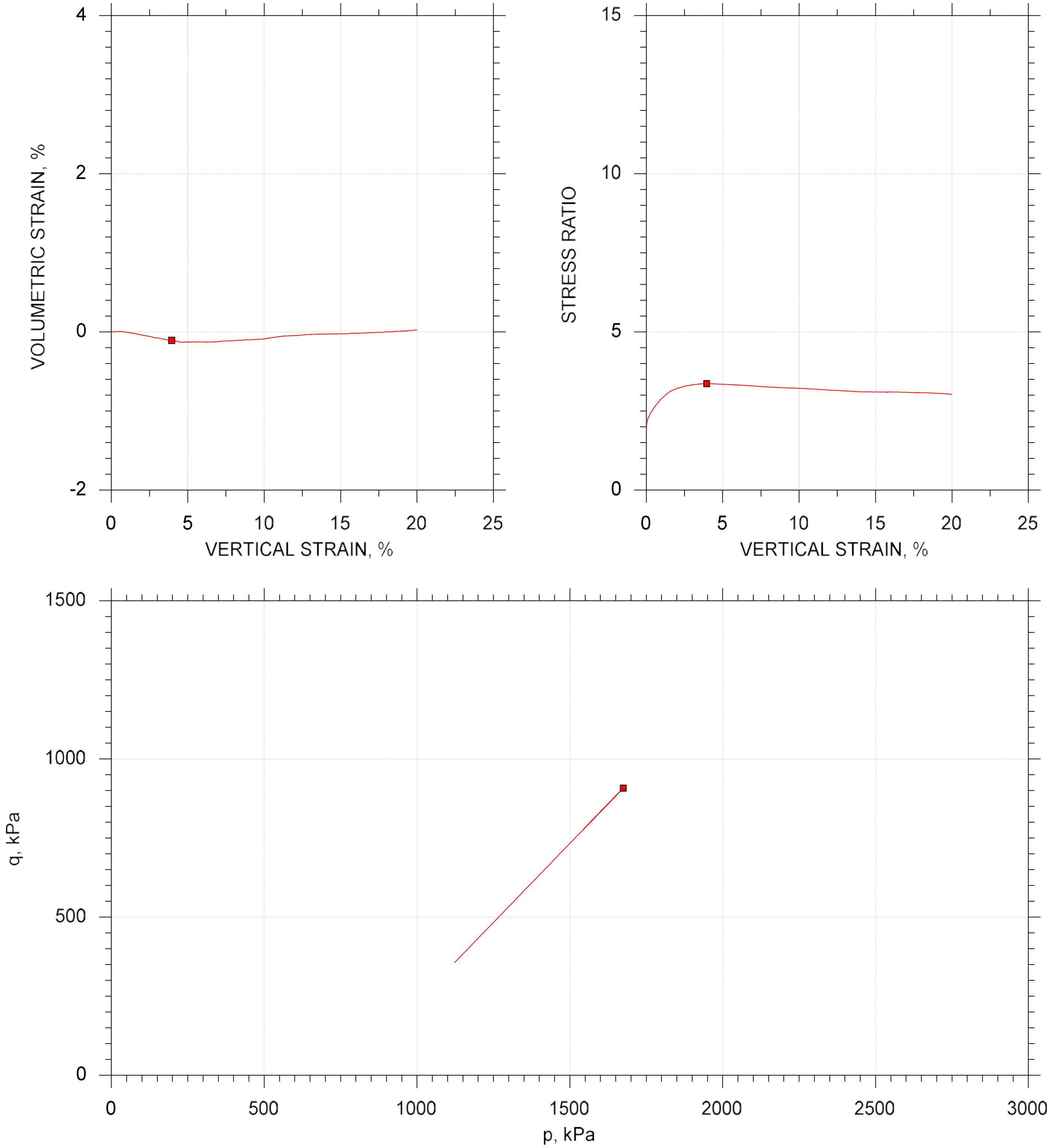
Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.



Remarks:

TX-022, Target Comp 18.14 kN/m3 at 11.0% mc. Final Diameters: 5.486 cm, 6.350 cm, 6.502 cm, 6.121 cm and 5.283 cm.

CONSOLIDATED DRAINED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION



	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
🟥	36	CAD-26	70-72'	trm	1/9/23	njh	1/16/23	316444-CAD-26n.dat

GeoTesting
EXPRESS

Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Sample Type: reconstituted	
Description: Moist, gray silt		
Remarks: TX-022, Target Comp 18.14 kN/m3 at 11.0% mc. Final Diameters: 5.486 cm, 6.350 cm, 6.502 cm, 6.121 cm and 5.283 cm.		

Client:	WSP Canada Inc.		
Project Name:	Darlington New Nuclear Plant		
Project Location:	Ontario, Canada		
GTX #:	316444		
Start Date:	1/4/2023	Tested By:	sjt/ges
End Date:	1/17/2023	Checked By:	ank
Boring #:	BH26	Test #:	---
Sample #:	6		
Depth:	3.05-3.66m		
Visual Description:	Moist, gray silt with sand		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084

Constant Volume

Sample Type:	Remold	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	---

Sample Preparation: Target Compaction: Dry density of 20.97 kN/m3 at the optimum moisture content of 8.6%. Values specified by client. Material > 3/8-inch screened out of sample prior to testing (35.2%)(Values Specified by client). Trimmings moisture content = 7.4%

Parameter	Initial	Final
Height, cm	5.08	5.08
Diameter, cm	7.24	7.24
Area, cm^2	41.16	41.16
Volume, cm^3	209.08	209.08
Mass, g	490.6	484.8
Bulk Density, kN/m^3	23.0	22.7
Moisture Content, %	10.3	9.0
Dry Density, kN/m^3	20.9	20.9
Degree of Saturation, %	---	97

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	90.04	Increased Cell Pressure, psi:	94.97	Cell Pressure Increment, psi:	4.93
Sample Pressure, psi:	81.98	Corresponding Sample Pressure, psi:	85.67	Sample Pressure Increment, psi:	3.69
				B Coefficient:	0.74

FLOW DATA

Date	Trial #	Pressure, psi		Manometer Readings			Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp, °C	R_t	Permeability K @ 20 °C, cm/sec
		Cell	Sample	Z_1	Z_2	Z_1-Z_2						
1/16	1	90	82.02	8.0	7.9	0.1	55	19.8	7.0E-08	20	1.000	7.0E-08
1/16	2	90	82.02	8.0	7.9	0.1	51	19.8	7.6E-08	20	1.000	7.6E-08
1/16	3	90	82.02	8.0	7.9	0.1	57	19.8	6.8E-08	20	1.000	6.8E-08
1/16	4	90	82.02	8.0	7.9	0.1	58	19.8	6.7E-08	20	1.000	6.7E-08

PERMEABILITY AT 20° C: 7.0 x 10^{-8} cm/sec (@ 7.98 psi effective stress)

GeoTesting
EXPRESS

Client:	WSP Canada Inc.		
Project Name:	Darlington New Nuclear Plant		
Project Location:	Ontario, Canada		
GTX #:	316444		
Start Date:	1/4/2023	Tested By:	sjt/ges
End Date:	1/17/2023	Checked By:	ank
Boring #:	BH26	Test #:	---
Sample #:	8		
Depth:	4.27-4.88m		
Visual Description:	Moist, gray silt		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084
Constant Volume

Sample Type:	Remold	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	---

Sample Preparation: Target Compaction: Dry density of 20.97 kN/m3 at the optimum moisture content of 9.6%. Values specified by client. Material > 3/8-inch screened out of sample prior to testing (0%). Trimmings moisture content = 9.3%

Parameter	Initial	Final
Height, cm	5.33	5.21
Diameter, cm	7.24	7.24
Area, cm^2	41.16	41.16
Volume, cm^3	219.53	214.31
Mass, g	492.1	493.9
Bulk Density, kN/m^3	22.0	22.6
Moisture Content, %	9.6	10.0
Dry Density, kN/m^3	20.1	20.5
Degree of Saturation, %	---	100

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	89.95	Increased Cell Pressure, psi:	95.02	Cell Pressure Increment, psi:	5.07
Sample Pressure, psi:	79.81	Corresponding Sample Pressure, psi:	83.46	Sample Pressure Increment, psi:	3.65
				B Coefficient:	0.72

FLOW DATA

Date	Trial #	Pressure, psi		Manometer Readings			Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp, °C	R_t	Permeability K @ 20 °C, cm/sec
		Cell	Sample	Z_1	Z_2	Z_1-Z_2						
1/16	1	90	79.85	8	7.5	0.5	30	19.4	6.8E-07	20	1.000	6.8E-07
1/16	2	90	79.85	8	7.5	0.5	34	19.4	6.0E-07	20	1.000	6.0E-07
1/16	3	90	79.85	8	7.5	0.5	35	19.4	5.8E-07	20	1.000	5.8E-07
1/16	4	90	79.85	8	7.5	0.5	38	19.4	5.4E-07	20	1.000	5.4E-07

PERMEABILITY AT 20^o C: 6.0 x 10^{-7} cm/sec (@ 10.15 psi effective stress)

GeoTesting
EXPRESS

Client:	Golder Associates USA, Inc.		
Project Name:	Darlington New Nuclear Plant Phase II		
Project Location:	Ontario, Canada		
GTX #:	316444		
Start Date:	1/4/2023	Tested By:	sjt/ ges
End Date:	1/12/2023	Checked By:	ank
Boring #:	BH26		
Sample #:	15		
Depth:	28-30'		
Visual Description:	Moist, dark gray silty sand		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084

Constant Gradient

Sample Type:	Remolded	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	---

Sample Preparation: Target Compaction: Dry density of 130.78 pcf at the optimum moisture content of 10.3%. Values specified by client. Material > 3/8-inch screened out of sample prior to testing (0%). Trimmings moisture content = 9.6%

Assumed Specific Gravity: 2.70

Parameter	Initial	Final
Height, in	2.15	2.04
Diameter, in	2.86	2.84
Area, in^2	6.42	6.33
Volume, in^3	13.81	12.92
Mass, g	484.2	487.1
Bulk Density, pcf	133.3	143.3
Moisture Content, %	10.2	10.8
Dry Density, pcf	121.0	129.3
Degree of Saturation, %	70	96

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	89.97	Increased Cell Pressure, psi:	94.99	Cell Pressure Increment, ps	5.02
Sample Pressure, psi:	72.56	Corresponding Sample Pressure, psi:	77.17	Sample Pressure Increment	4.61
				B Coefficient:	0.92

FLOW DATA

Date	Time, sec	Pressure, psi			Gradient	Flow Volume, cc				Temp, °C	R_t	Permeability K @ 20 °C, cm/sec
		Cell	Inlet	Outlet		In	Out	Δ In	Δ Out			
11-Jan	---	90.0	73.1	72.1	13.6	7.00	14.00	---	---	---	---	---
11-Jan	300	90.0	73.1	72.1	13.6	8.60	12.40	1.60	1.60	19.5	1.013	9.7E-06
11-Jan	----	90.0	73.1	72.1	13.6	7.00	14.00	---	---	---	---	---
11-Jan	300	90.0	73.1	72.1	13.6	8.60	12.40	1.60	1.60	19.5	1.013	9.7E-06
11-Jan	----	90.0	73.1	72.1	13.6	7.00	14.00	---	---	---	---	---
11-Jan	300	90.0	73.1	72.1	13.6	8.60	12.40	1.60	1.60	19.5	1.013	9.7E-06
11-Jan	----	90.0	73.1	72.1	13.6	7.00	14.00	---	---	---	---	---
11-Jan	300	90.0	73.1	72.1	13.6	8.60	12.40	1.60	1.60	19.5	1.013	9.7E-06

PERMEABILITY AT 20° C: 9.7 x 10^{-6} cm/sec (@ 17.41 psi effective stress)

GeoTesting EXPRESS

Client:	Golder Associates		
Project Name:	Darlington New Nuclear Plant		
Project Location:	Ontario, Canada		
GTX #:	316444		
Start Date:	1/16/2023	Tested By:	sjt/ges
End Date:	1/20/2023	Checked By:	ank
Boring #:	BH26	Test #:	---
Sample #:	27		
Depth:	52-54'		
Visual Description:	Moist, gray clayey silt		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084

Constant Volume

Sample Type:	Remold	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	---

Sample Preparation: Extruded from tube, cut, trimmed and placed into permeameter at as-received density and moisture content. Trimmings moisture content = 21.15 %.

Parameter	Initial	Final
Height, cm	7.37	7.01
Diameter, cm	7.29	7.11
Area, cm^2	41.74	39.73
Volume, cm^3	307.43	278.49
Mass, g	629.0	617.7
Bulk Density, kN/m^3	20.1	21.8
Moisture Content, %	15.4	13.4
Dry Density, kN/m^3	17.4	19.2
Degree of Saturation, %	---	100

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	89.96	Increased Cell Pressure, psi:	95.03	Cell Pressure Increment, psi:	5.07
Sample Pressure, psi:	60.30	Corresponding Sample Pressure, psi:	64.64	Sample Pressure Increment, psi:	5.00
				B Coefficient:	0.85

B-value did not increase with increase in pressure.
Final degree of saturation >95%.

FLOW DATA

Date	Trial #	Pressure, psi		Manometer Readings			Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp, °C	R_t	Permeability K @ 20 °C, cm/sec
		Cell	Sample	Z_1	Z_2	Z_1-Z_2						
1/19	1	90	60.27	8.0	7.9	0.1	69	14.4	8.0E-08	20	1.000	8.0E-08
1/19	2	90	60.27	8.0	7.9	0.1	68	14.4	8.1E-08	20	1.000	8.1E-08
1/19	3	90	60.27	8.0	7.9	0.1	66	14.4	8.4E-08	20	1.000	8.4E-08
1/19	4	90	60.27	8.0	7.9	0.1	66	14.4	8.4E-08	20	1.000	8.4E-08

PERMEABILITY AT 20° C: 8.2 x 10^{-8} cm/sec (@30 psi effective stress)

GeoTesting EXPRESS

Client:	WSP Canada Inc.		
Project Name:	Darlington New Nuclear Plant		
Project Location:	Ontario, Canada		
GTX #:	316444		
Start Date:	1/16/2023	Tested By:	sjt/ges
End Date:	1/19/2023	Checked By:	ank
Boring #:	BH26	Test #:	---
Sample #:	29		
Depth:	56-58'		
Visual Description:	Moist, gray silty clay		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084
Constant Volume

Sample Type:	Remold	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	---

Sample Preparation: Extruded from tube, cut, trimmed and placed into permeameter at as-received density and moisture content. Trimmings moisture content = 13.25 %.

Parameter	Initial	Final
Height, cm	7.19	7.16
Diameter, cm	7.24	7.24
Area, cm^2	41.16	41.16
Volume, cm^3	295.8	294.8
Mass, g	624.4	623.0
Bulk Density, kN/m^3	20.7	20.7
Moisture Content, %	16.7	16.5
Dry Density, kN/m^3	17.7	17.8
Degree of Saturation, %	---	95

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	89.95	Increased Cell Pressure, psi:	95.01	Cell Pressure Increment, psi:	5.06
Sample Pressure, psi:	58.80	Corresponding Sample Pressure, psi:	63.08	Sample Pressure Increment, psi:	5.00
				B Coefficient:	0.84

B-value did not increase with increase in pressure.
Final degree of saturation >95%.

FLOW DATA

Date	Trial #	Pressure, psi		Manometer Readings			Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp, °C	R_t	Permeability K @ 20 °C, cm/sec
		Cell	Sample	Z_1	Z_2	Z_1-Z_2						
1/18	1	90	58.82	8.0	7.9	0.1	56	14.1	9.7E-08	20	1.000	9.7E-08
1/18	2	90	58.82	8.0	7.9	0.1	54	14.1	1.0E-07	20	1.000	1.0E-07
1/18	3	90	58.82	8.0	7.9	0.1	59	14.1	9.3E-08	20	1.000	9.3E-08
1/18	4	90	58.82	8.0	7.9	0.1	53	14.1	1.0E-07	20	1.000	1.0E-07

PERMEABILITY AT 20° C: 9.9×10^{-8} cm/sec (@ 31 psi effective stress)

GeoTesting
EXPRESS

Client:	WSP Canada, Inc.		
Project Name:	Darlington New Nuclear Plant		
Project Location:	Ontario, Canada		
GTX #:	316444		
Start Date:	1/4/2023	Tested By:	sjt/ges
End Date:	1/18/2023	Checked By:	ank
Boring #:	BH26		
Sample #:	31		
Depth:	18.29-18.72m		
Visual Description:	Moist, dark gray sandy silt		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084

Constant Gradient

Sample Type:	Remolded	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	---

Sample Preparation: Target Compaction: Dry density of 18.91 kN/m3 at 2.8% moisture content. Values specified by client.
Trimmings moisture content = 3.1%

Parameter	Initial	Final
Height, cm	5.59	5.33
Diameter, cm	7.24	7.37
Area, cm^2	41.16	42.61
Volume, cm^3	229.99	227.30
Mass, g	418.7	467.8
Bulk Density, kN/m^3	17.9	20.2
Moisture Content, %	4.7	16.9
Dry Density, kN/m^3	17.1	17.3
Degree of Saturation, %	---	97

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	89.99	Increased Cell Pressure, psi:	94.99	Cell Pressure Increment, ps	5.00
Sample Pressure, psi:	56.64	Corresponding Sample Pressure, psi:	57.20	Sample Pressure Increment	0.56
				B Coefficient:	0.11

B-value did not increase with increase in pressure.
Final degree of saturation >95%.

FLOW DATA

	Time,	Pressure, psi				Flow Volume, cc				Temp,		Permeability K @ 20 °C,
Date	sec	Cell	Inlet	Outlet	Gradient	In	Out	Δ In	Δ Out	°C	R_t	cm/sec
17-Jan	---	90.0	57.1	56.1	13.2	7.00	14.00	---	---	---	---	---
17-Jan	30	90.0	57.1	56.1	13.2	9.00	12.00	2.00	2.00	20.4	0.991	1.8E-05
17-Jan	----	90.0	57.1	56.1	13.2	7.00	14.00	---	---	---	---	---
17-Jan	32	90.0	57.1	56.1	13.2	9.00	12.00	2.00	2.00	20.4	0.991	1.7E-05
17-Jan	----	90.0	57.1	56.1	13.2	7.00	14.00	---	---	---	---	---
17-Jan	34	90.0	57.1	56.1	13.2	9.00	12.00	2.00	2.00	20.4	0.991	1.6E-05
17-Jan	----	90.0	57.1	56.1	13.2	7.00	14.00	---	---	---	---	---
17-Jan	34	90.0	57.1	56.1	13.2	9.00	12.00	2.00	2.00	20.4	0.991	1.6E-05

PERMEABILITY AT 20° C: 1.7 x 10^{-5} cm/sec (@ 33 psi effective stress)

Client:	Golder Associates		
Project Name:	Darlington New Nuclear Plant		
Project Location:	Ontario, Canada		
GTX #:	316444		
Start Date:	1/18/2023	Tested By:	sjt/ges
End Date:	1/20/2023	Checked By:	njh
Boring #:	BH26	Test #:	---
Sample #:	36		
Depth:	21.34-21.95		
Visual Description:	Moist, gray silt		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084
Constant Volume

Sample Type:	Remold	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	0

Sample Preparation: Target Compaction: 100% of the target dry density (18.14 kN/m3) at the optimum moisture content (10.9%). Values specified by client. Material > 3/8-inch screened out of sample prior to testing (0%). Trimmings moisture content = 10.42%

Parameter	Initial	Final
Height, cm	5.08	4.67
Diameter, cm	5.08	5.08
Area, cm^2	20.27	20.27
Volume, cm^3	103.0	94.7
Mass, g	160	212
Bulk Density, kN/m^3	15.2	21.9
Moisture Content, %	-17	10
Dry Density, kN/m^3	18.3	19.9
Degree of Saturation, %	---	90

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	90.00	Increased Cell Pressure, psi:	94.95	Cell Pressure Increment, psi:	4.95
Sample Pressure, psi:	51.54	Corresponding Sample Pressure, psi:	55.71	Sample Pressure Increment, psi:	5.00
				B Coefficient:	0.842424242

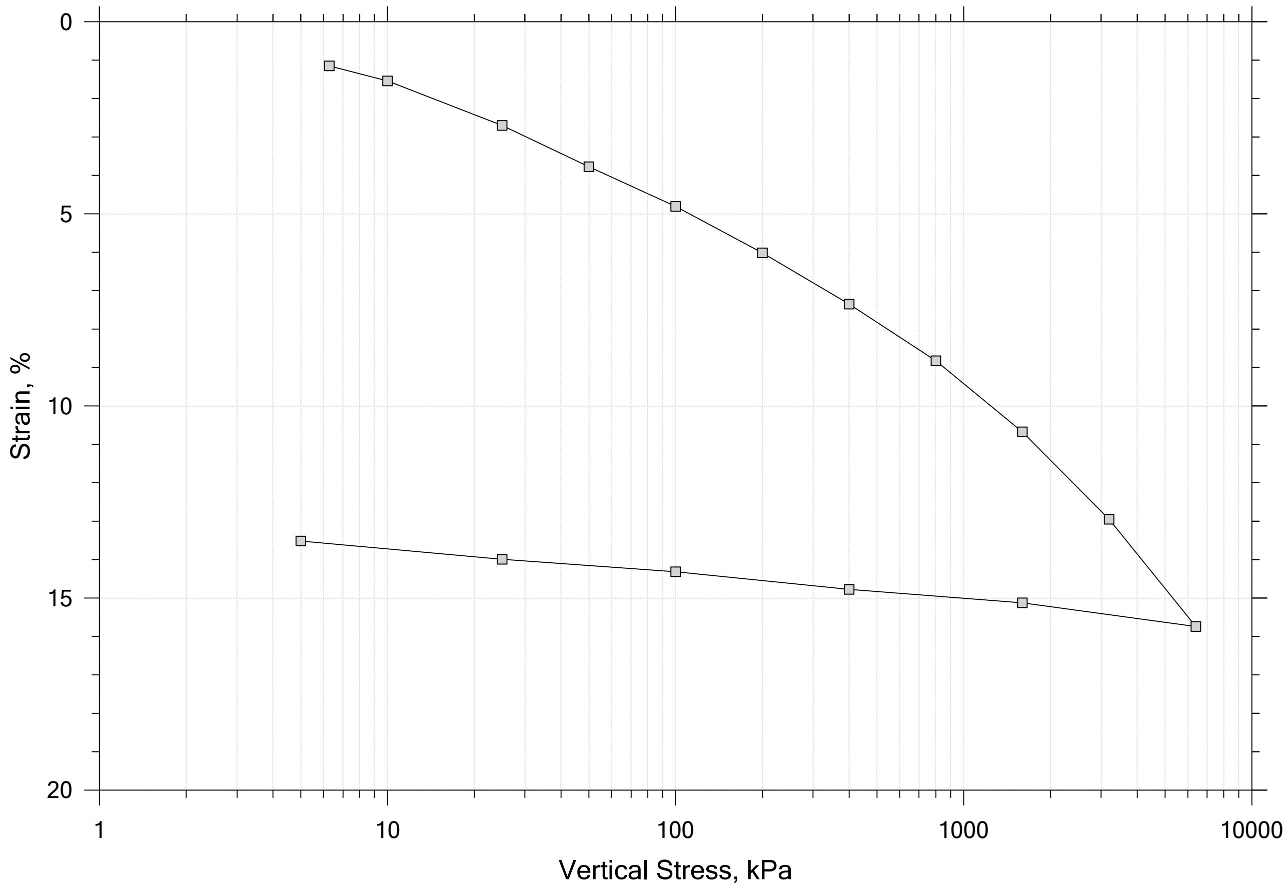
FLOW DATA

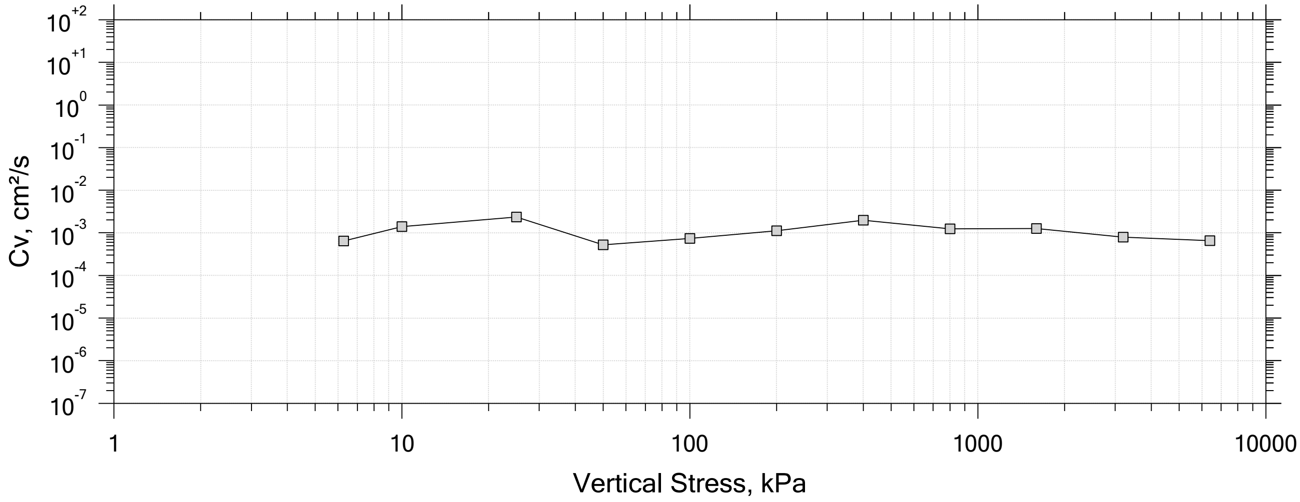
Date	Trial #	Pressure, psi		Manometer Readings			Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp, °C	R_t	Permeability K @ 20 °C, cm/sec
		Cell	Sample	Z_1	Z_2	Z_1-Z_2						
1/19	1	90	51.56	8.0	7.9	0.1	69	21.6	1.0E-07	20	1.000	1.0E-07
1/19	2	90	51.56	8.0	7.9	0.1	64	21.6	1.1E-07	20	1.000	1.1E-07
1/19	3	90	51.56	8.0	7.9	0.1	58	21.6	1.2E-07	20	1.000	1.2E-07
1/19	4	90	51.56	8.0	7.9	0.1	66	21.6	1.1E-07	20	1.000	1.1E-07

PERMEABILITY AT 20° C: 1.13 x 10^{-7} cm/sec (@ 38.44 psi effective stress)

One-Dimensional Consolidation by ASTM D2435 - Method B

Summary Report





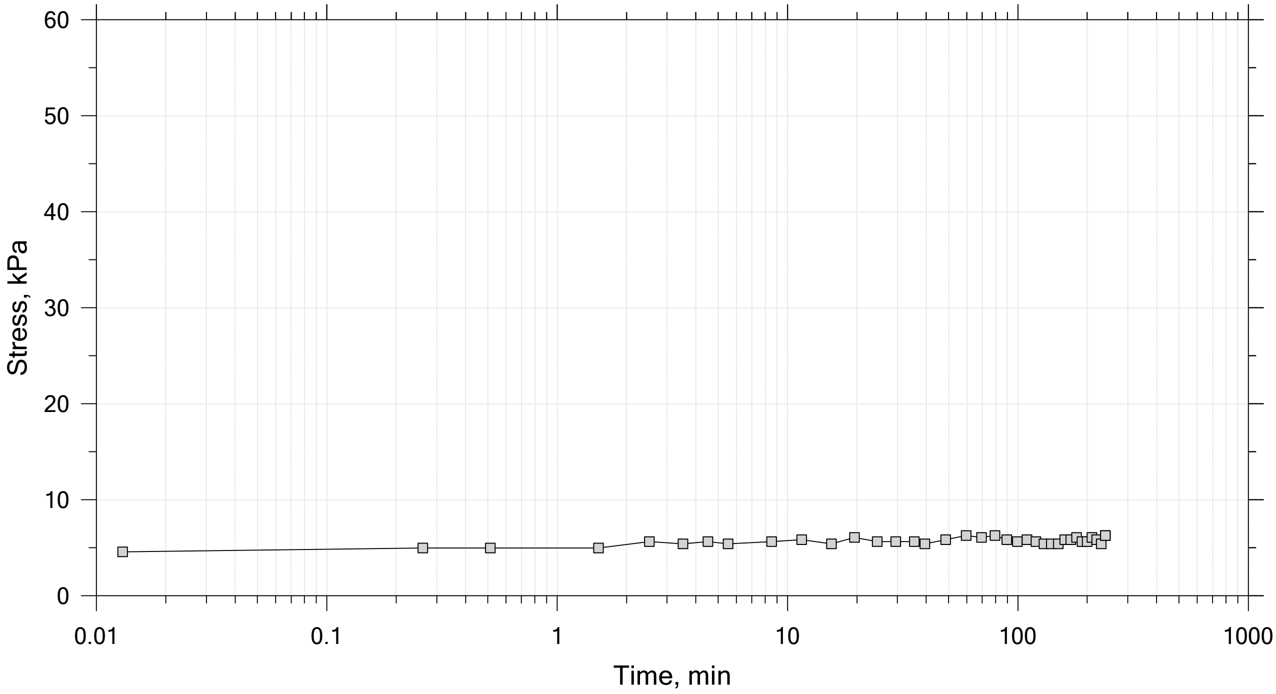
GeoTesting EXPRESS	Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: anm
	Sample No.: 24-1	Test Date: 12/2/22	Depth: 46'1"-46'3"
	Test No.: IP-5	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-032, Swell Pressure = 6.27 kPa		
	Displacement at End of Increment		

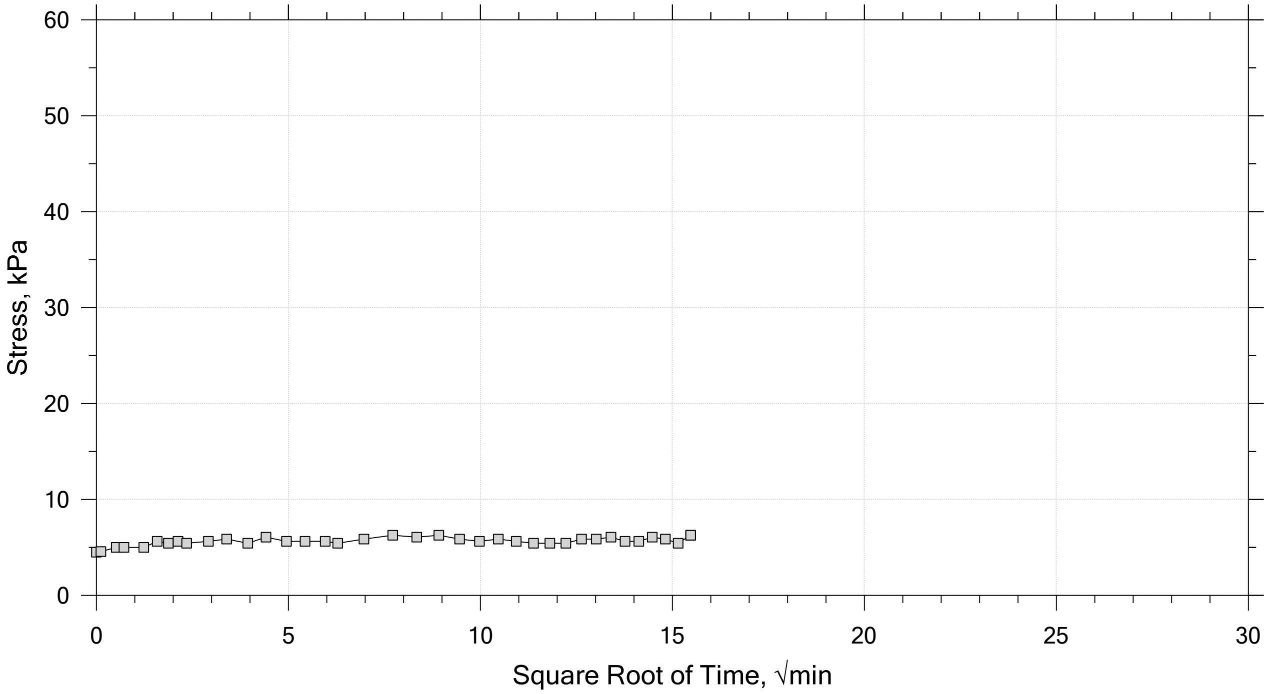
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 1 of 16

Constant Volume Step

Stress: 6.27 kPa





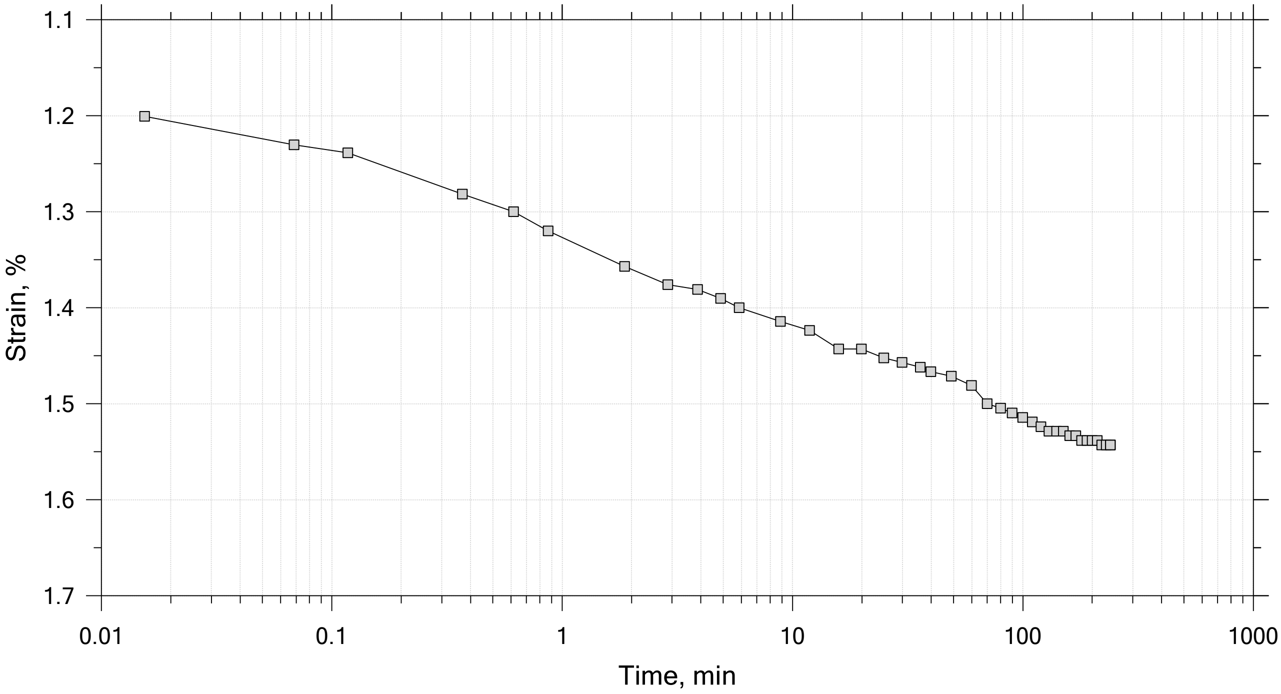
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 24-1	Test Date: 12/2/22	Depth: 46'1"-46'3"
Test No.: IP-5	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 6.27 kPa		

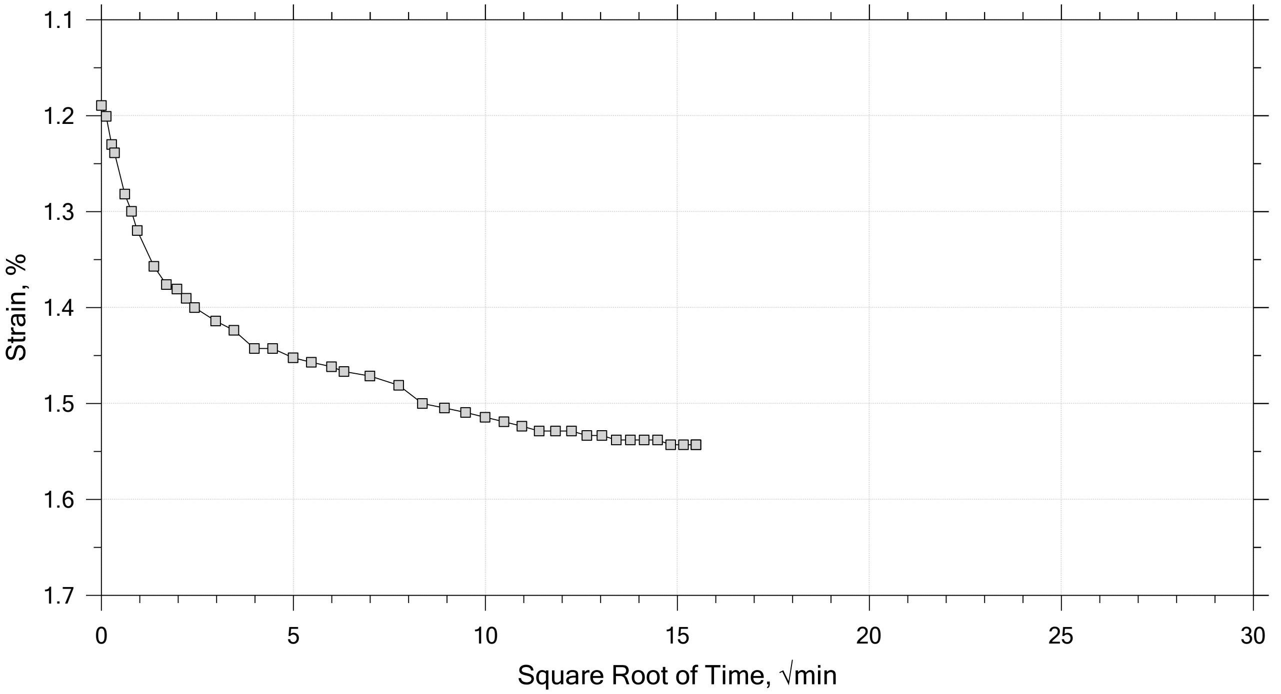
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 2 of 16

Constant Load Step

Stress: 10 kPa





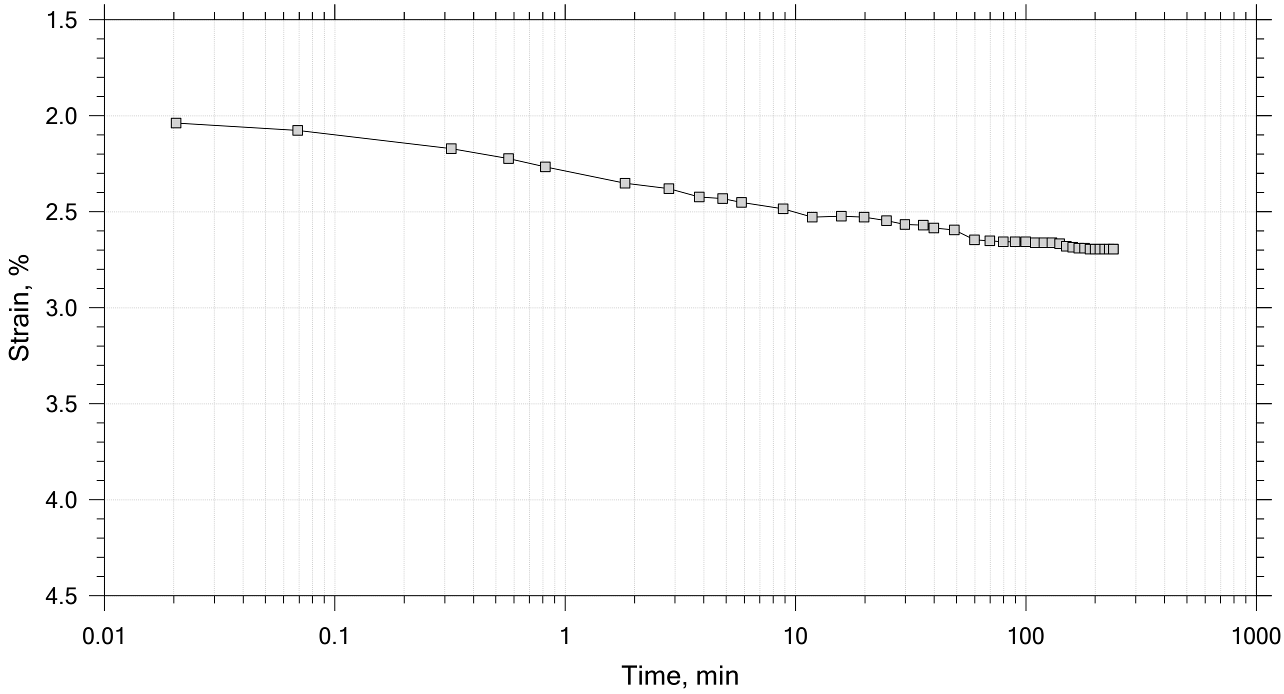
GeoTesting EXPRESS	Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: anm
	Sample No.: 24-1	Test Date: 12/2/22	Depth: 46'1"-46'3"
	Test No.: IP-5	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-032, Swell Pressure = 6.27 kPa		

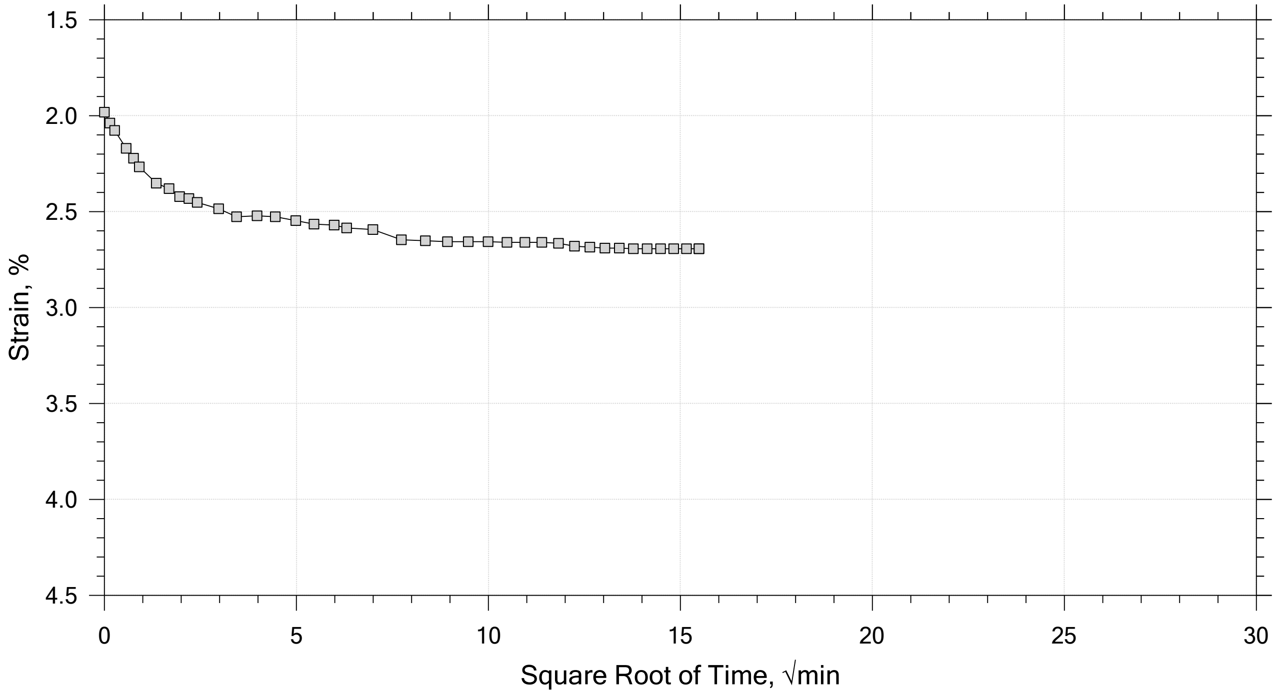
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 3 of 16

Constant Load Step

Stress: 25 kPa

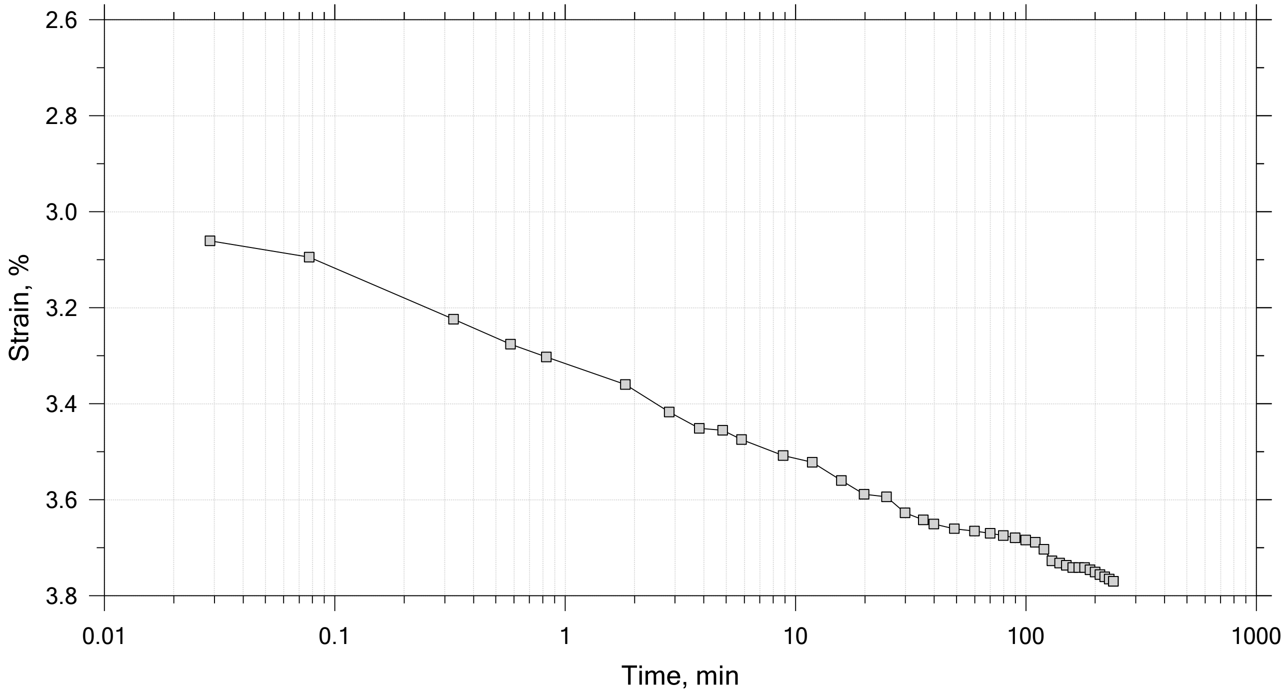


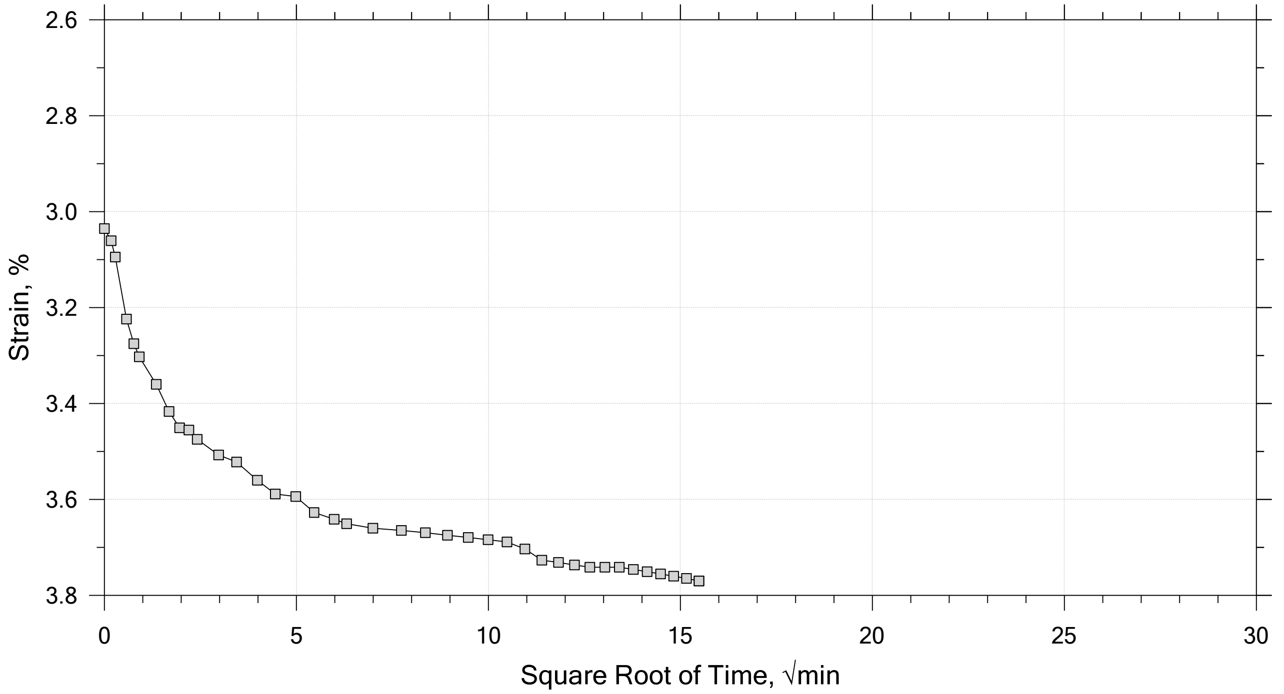


Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 24-1	Test Date: 12/2/22	Depth: 46'1"-46'3"
Test No.: IP-5	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 6.27 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 4 of 16
Constant Load Step
Stress: 50 kPa





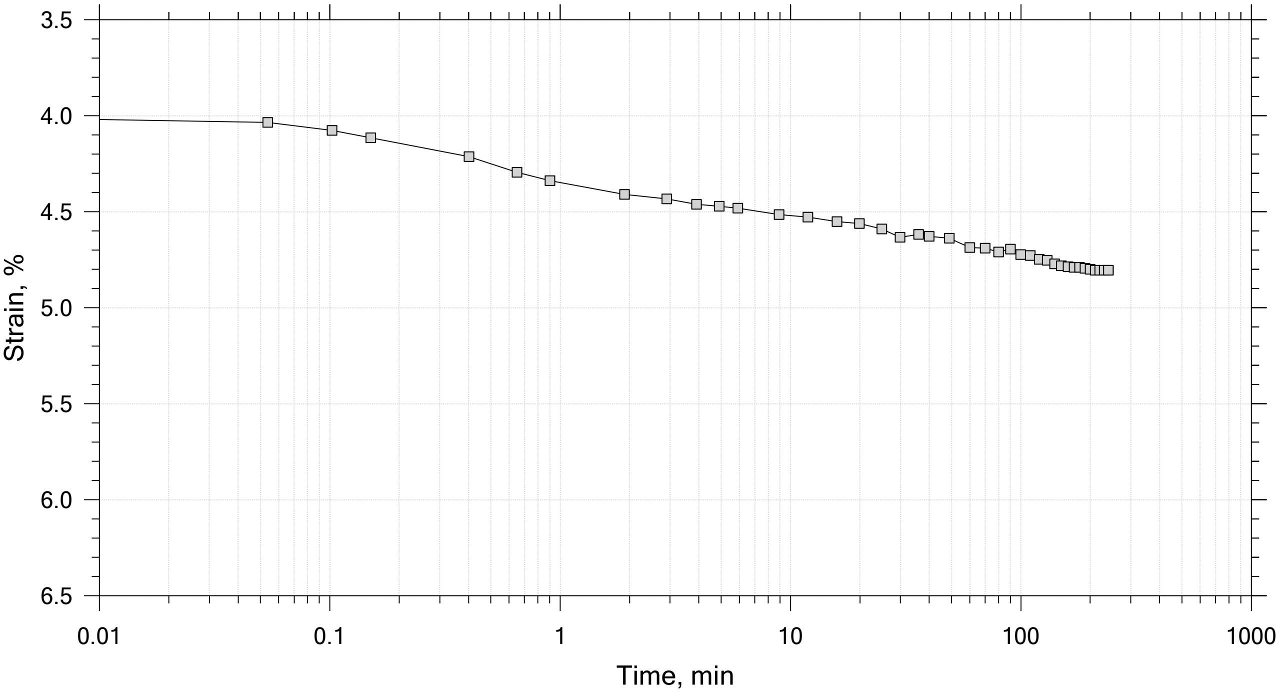
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 24-1	Test Date: 12/2/22	Depth: 46'1"-46'3"
Test No.: IP-5	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 6.27 kPa		

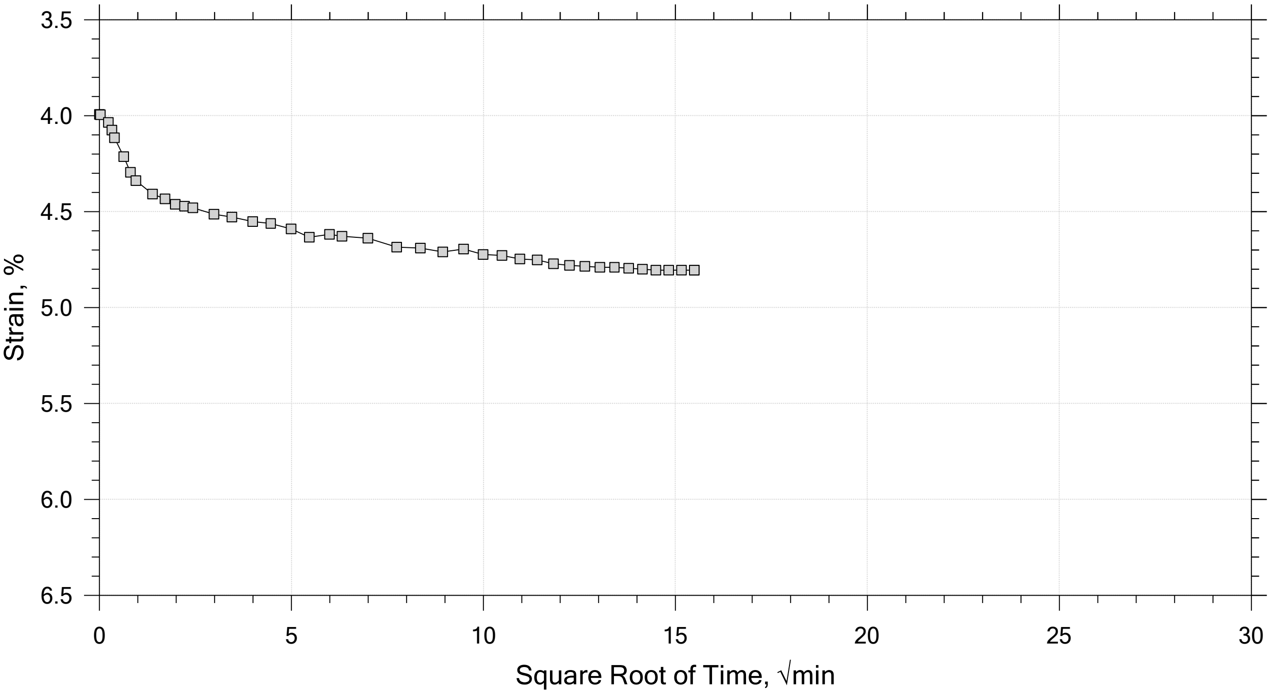
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 5 of 16

Constant Load Step

Stress: 100 kPa





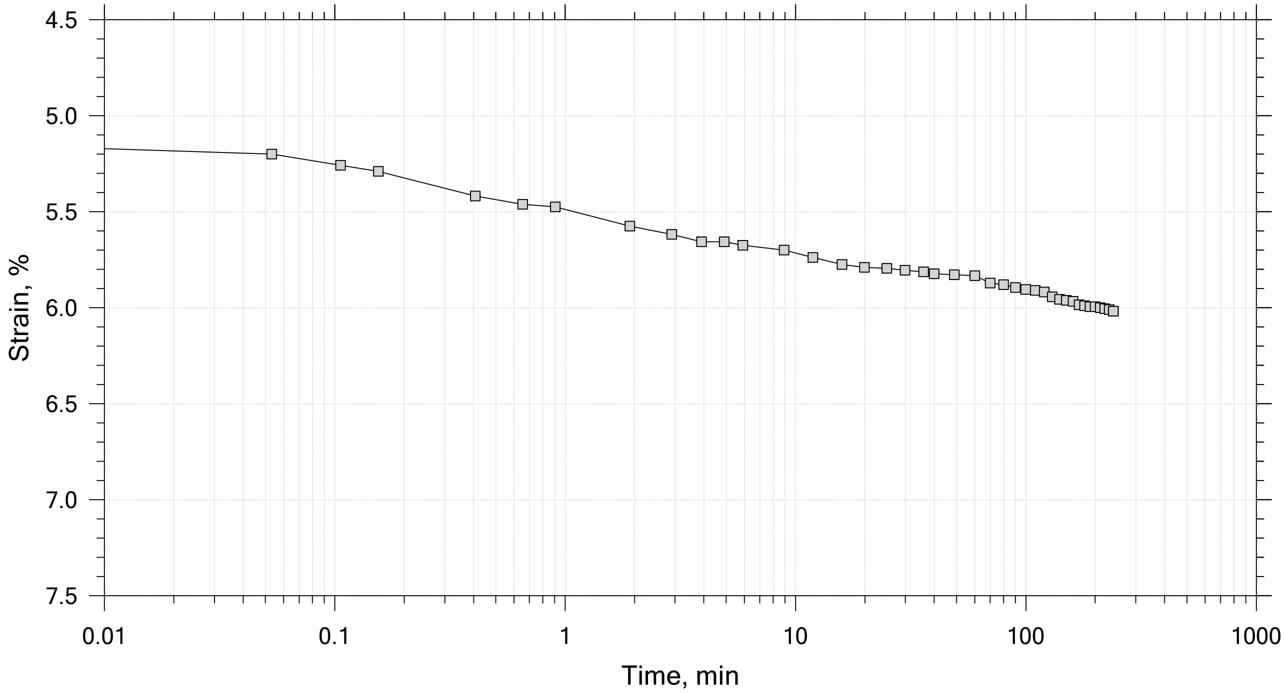
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 24-1	Test Date: 12/2/22	Depth: 46'1"-46'3"
Test No.: IP-5	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 6.27 kPa		

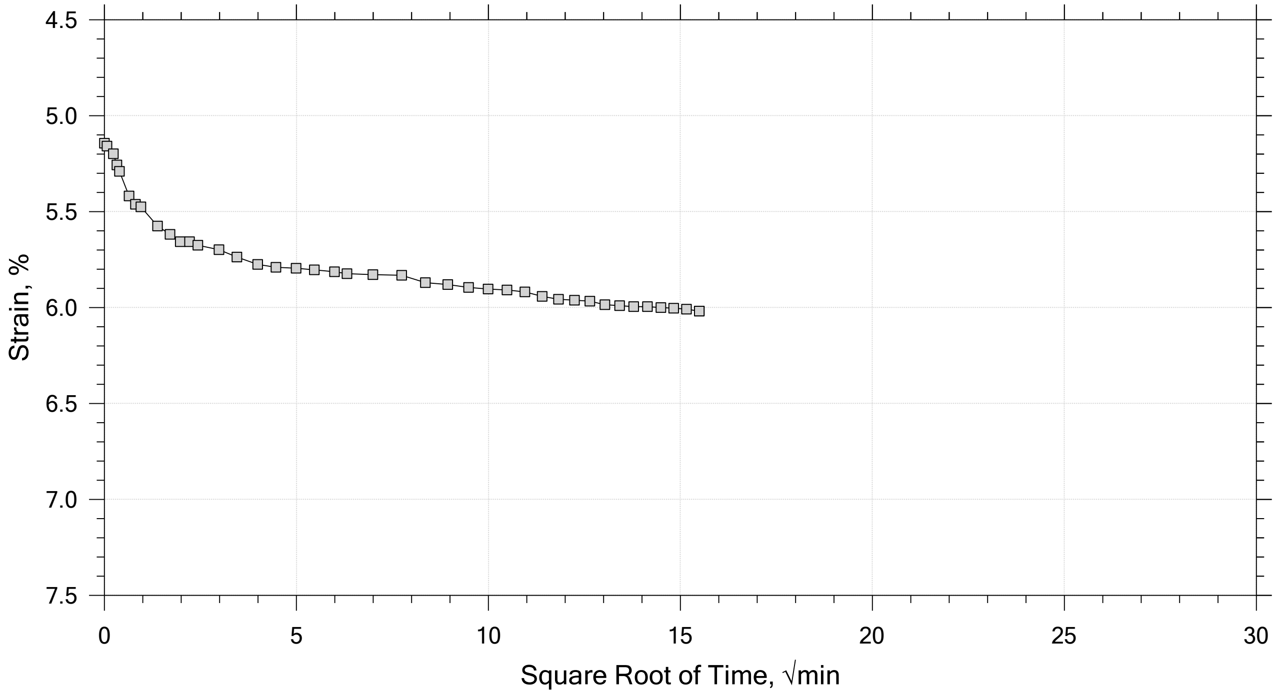
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 6 of 16

Constant Load Step

Stress: 200 kPa

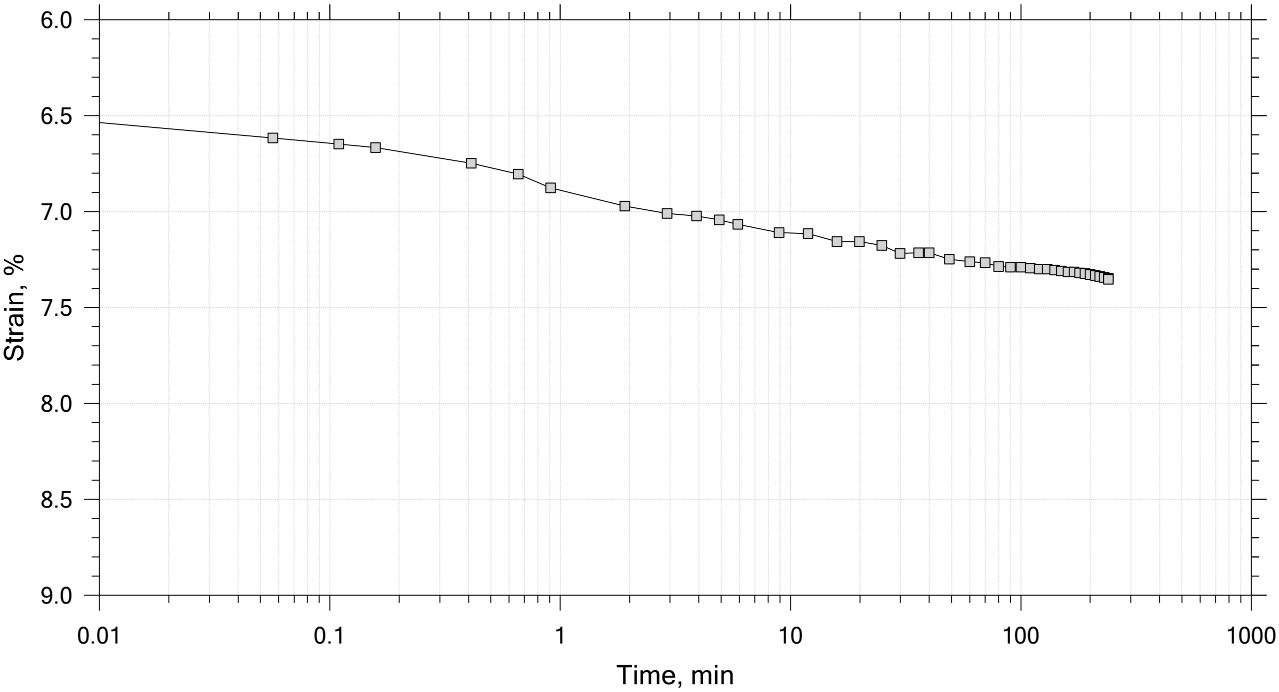


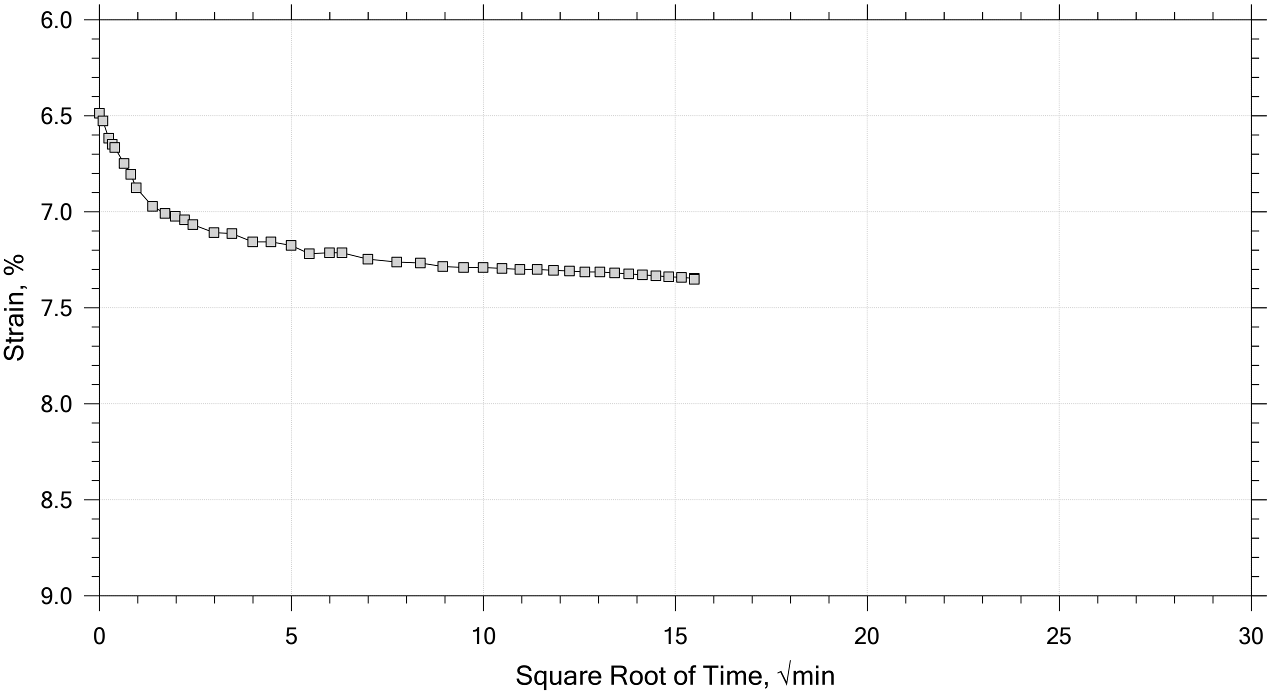


Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 24-1	Test Date: 12/2/22	Depth: 46'1"-46'3"
Test No.: IP-5	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 6.27 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 7 of 16
Constant Load Step
Stress: 400 kPa





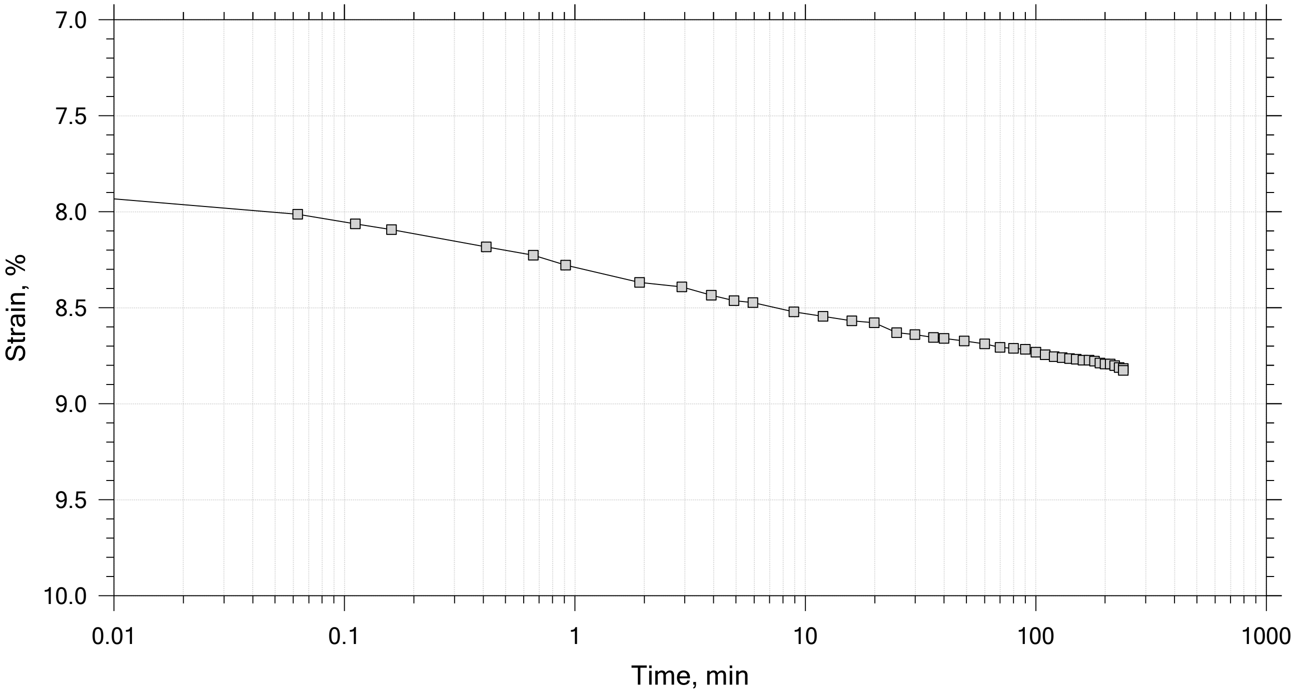
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 24-1	Test Date: 12/2/22	Depth: 46'1"-46'3"
Test No.: IP-5	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 6.27 kPa		

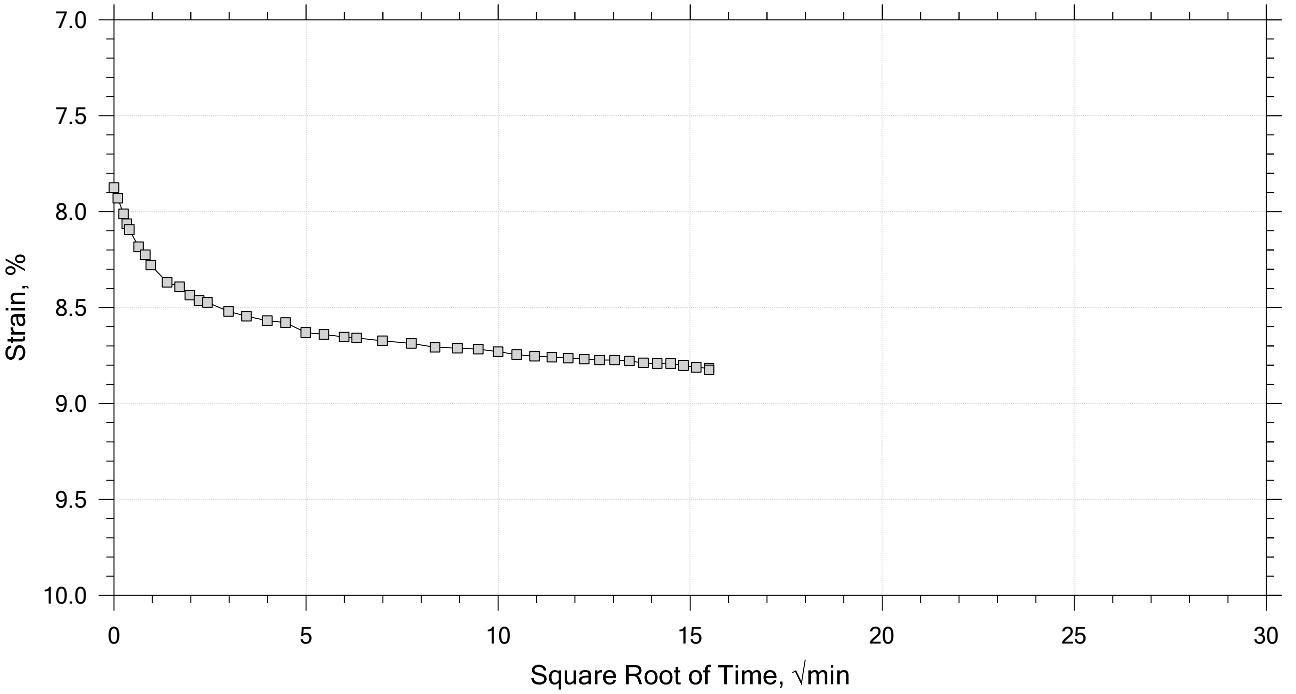
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 8 of 16

Constant Load Step

Stress: 800 kPa





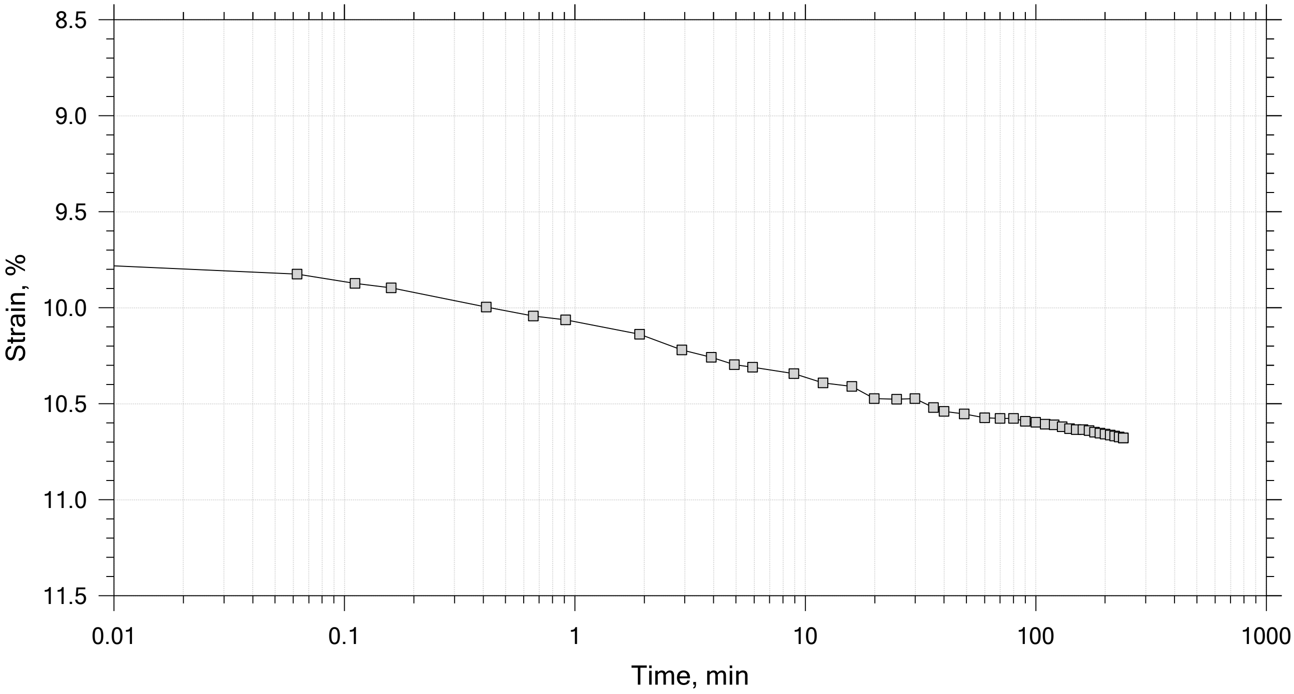
	Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: anm
	Sample No.: 24-1	Test Date: 12/2/22	Depth: 46'1"-46'3"
GeoTesting EXPRESS	Test No.: IP-5	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-032, Swell Pressure = 6.27 kPa		

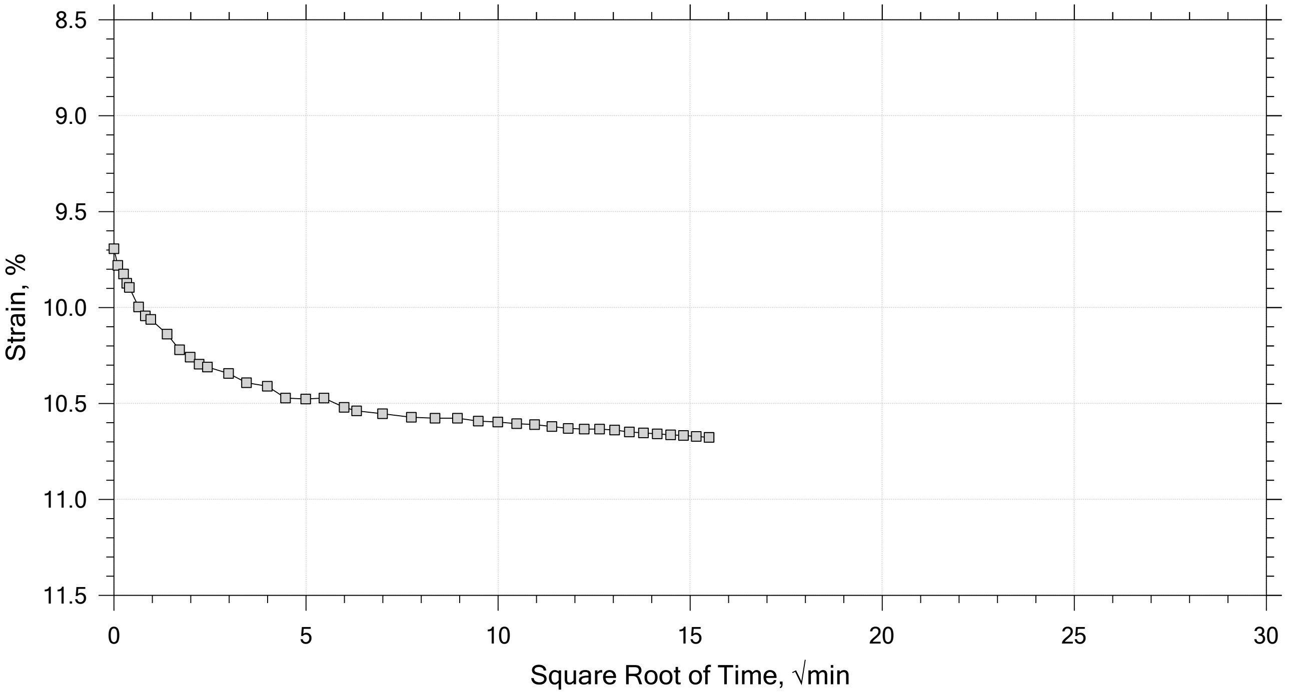
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 9 of 16

Constant Load Step

Stress: 1.6e+03 kPa

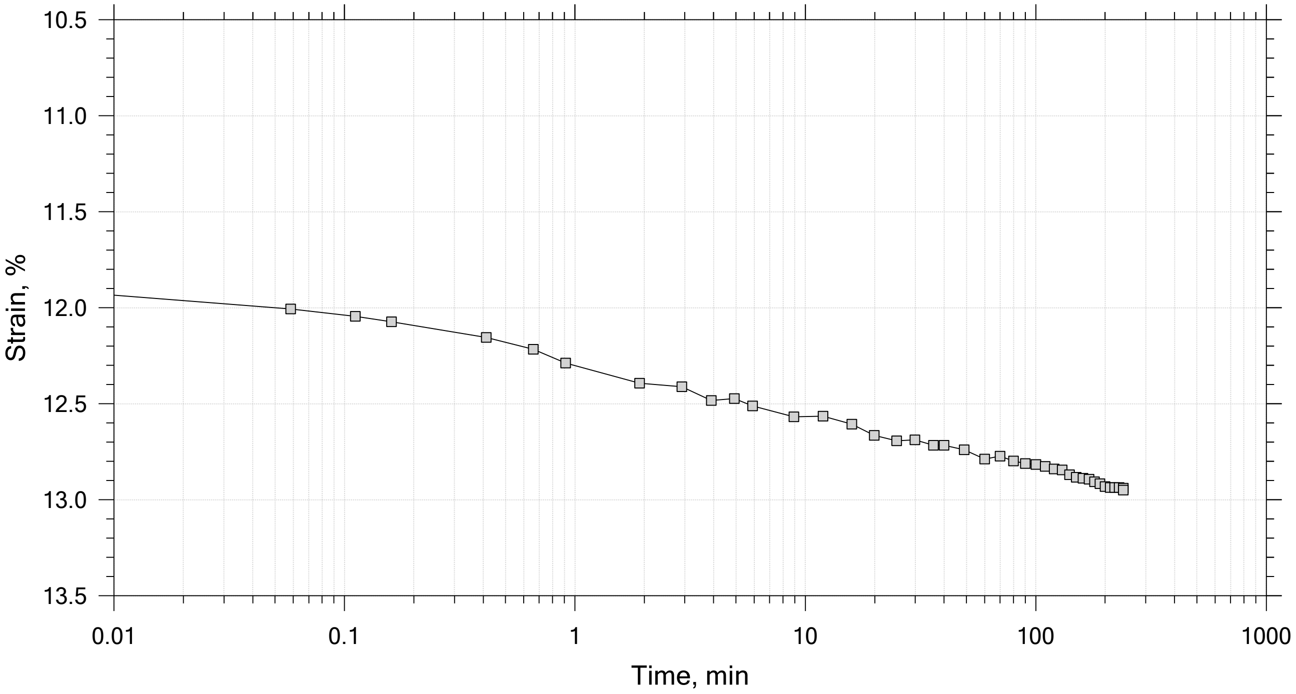


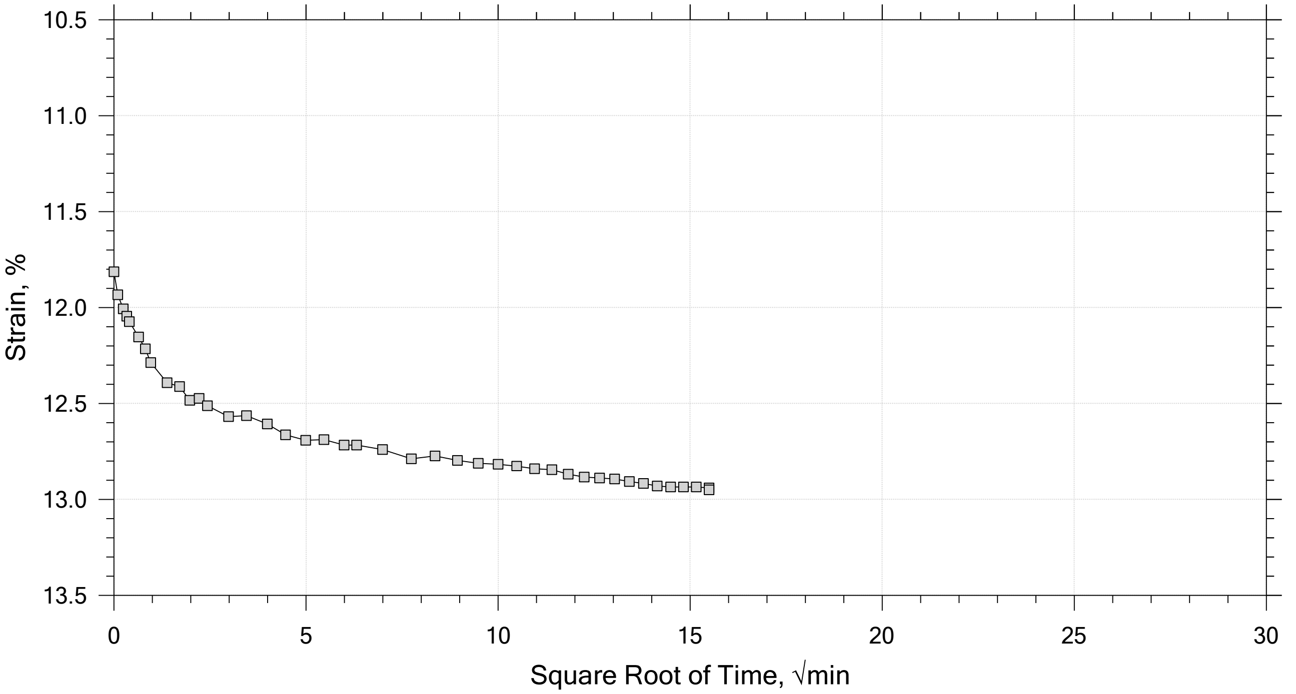


Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 24-1	Test Date: 12/2/22	Depth: 46'1"-46'3"
Test No.: IP-5	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 6.27 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 10 of 16
Constant Load Step
Stress: 3.2e+03 kPa





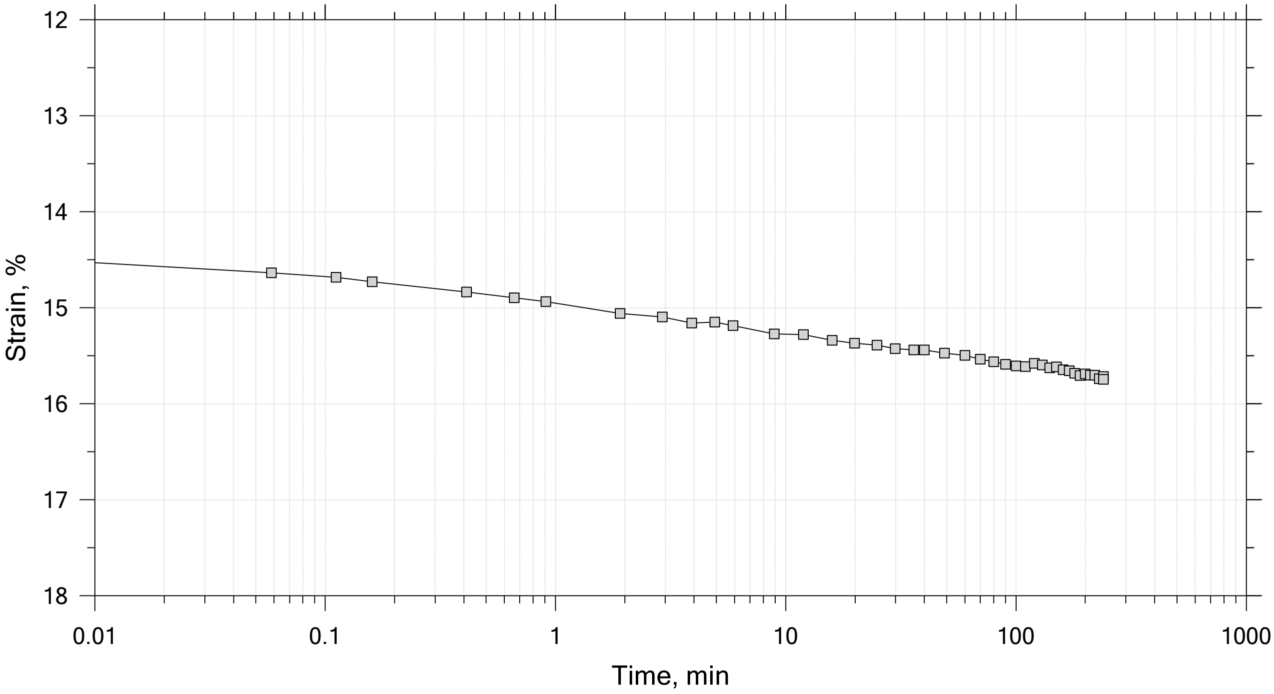
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 24-1	Test Date: 12/2/22	Depth: 46'1"-46'3"
Test No.: IP-5	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 6.27 kPa		

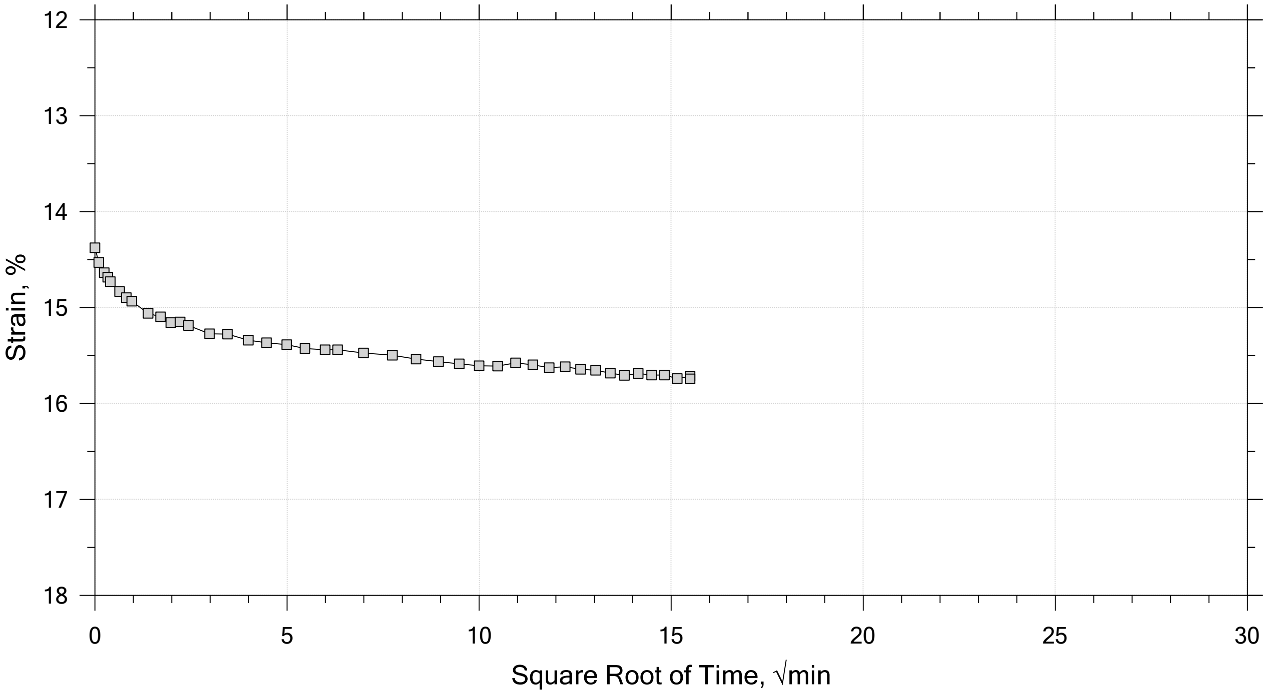
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 11 of 16

Constant Load Step

Stress: 6.4e+03 kPa





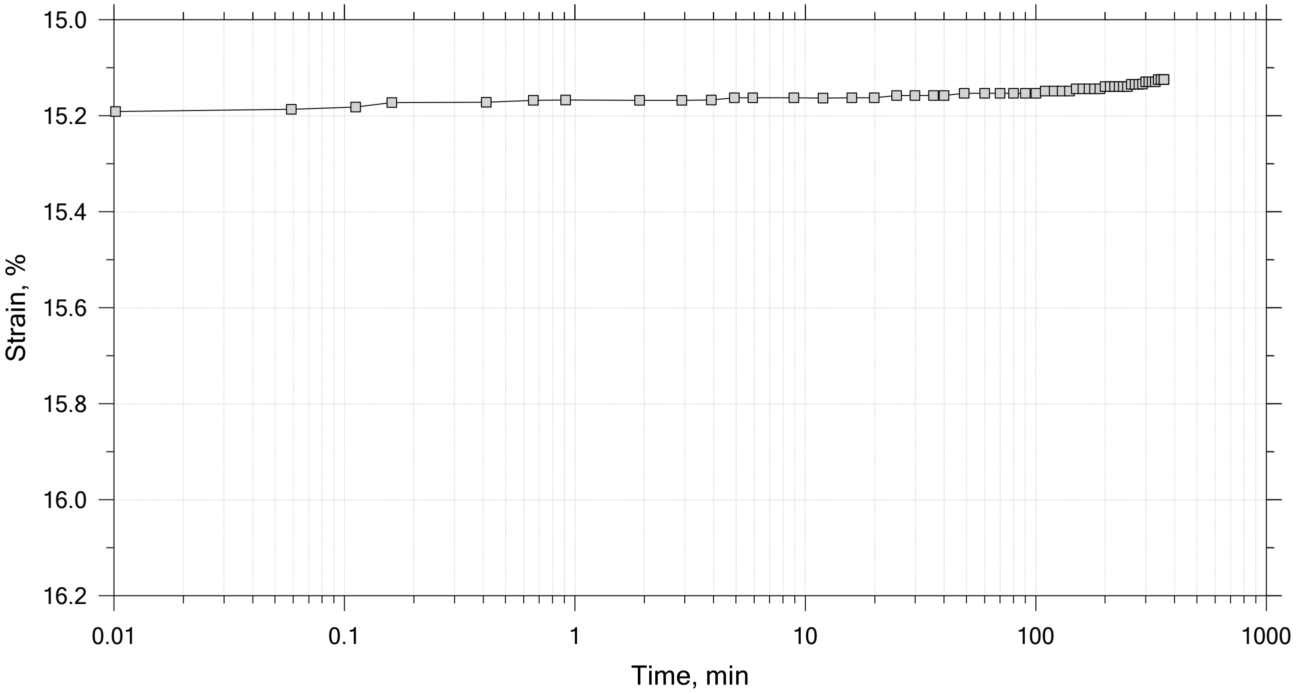
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 24-1	Test Date: 12/2/22	Depth: 46'1"-46'3"
Test No.: IP-5	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 6.27 kPa		

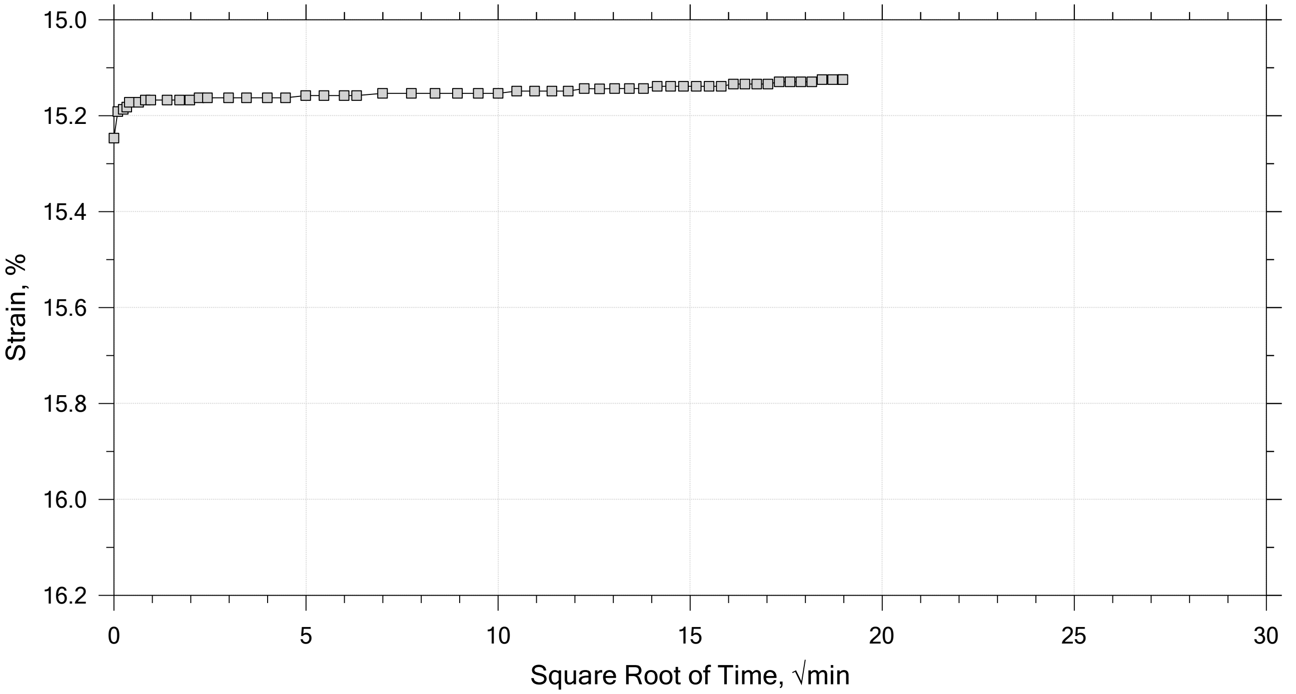
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 12 of 16

Constant Load Step

Stress: 1.6e+03 kPa





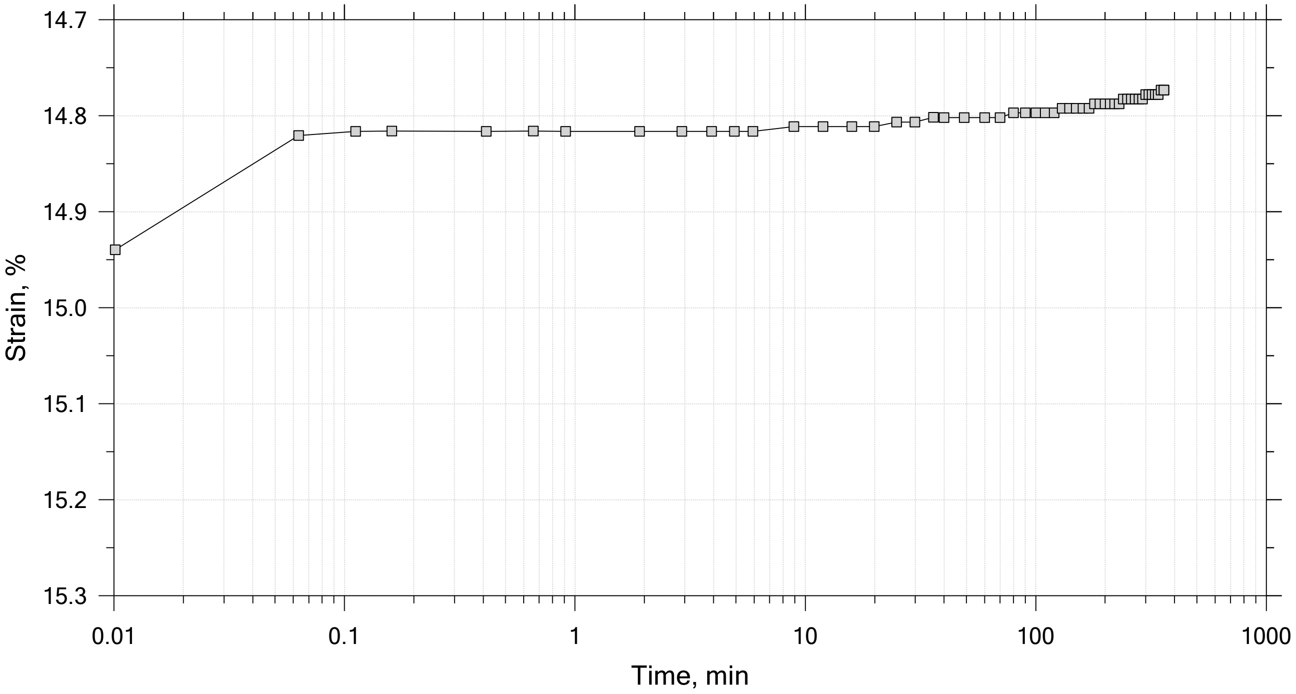
GeoTesting EXPRESS	Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: anm
	Sample No.: 24-1	Test Date: 12/2/22	Depth: 46'1"-46'3"
	Test No.: IP-5	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-032, Swell Pressure = 6.27 kPa		

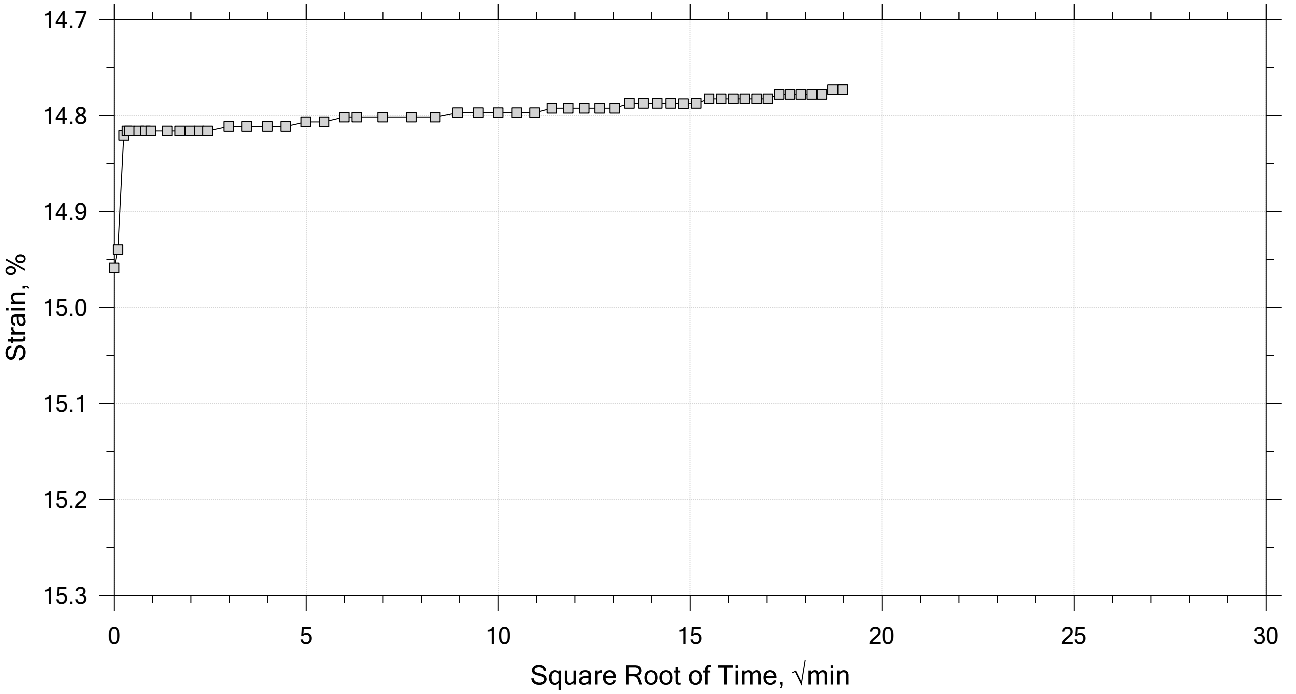
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 13 of 16

Constant Load Step

Stress: 400 kPa

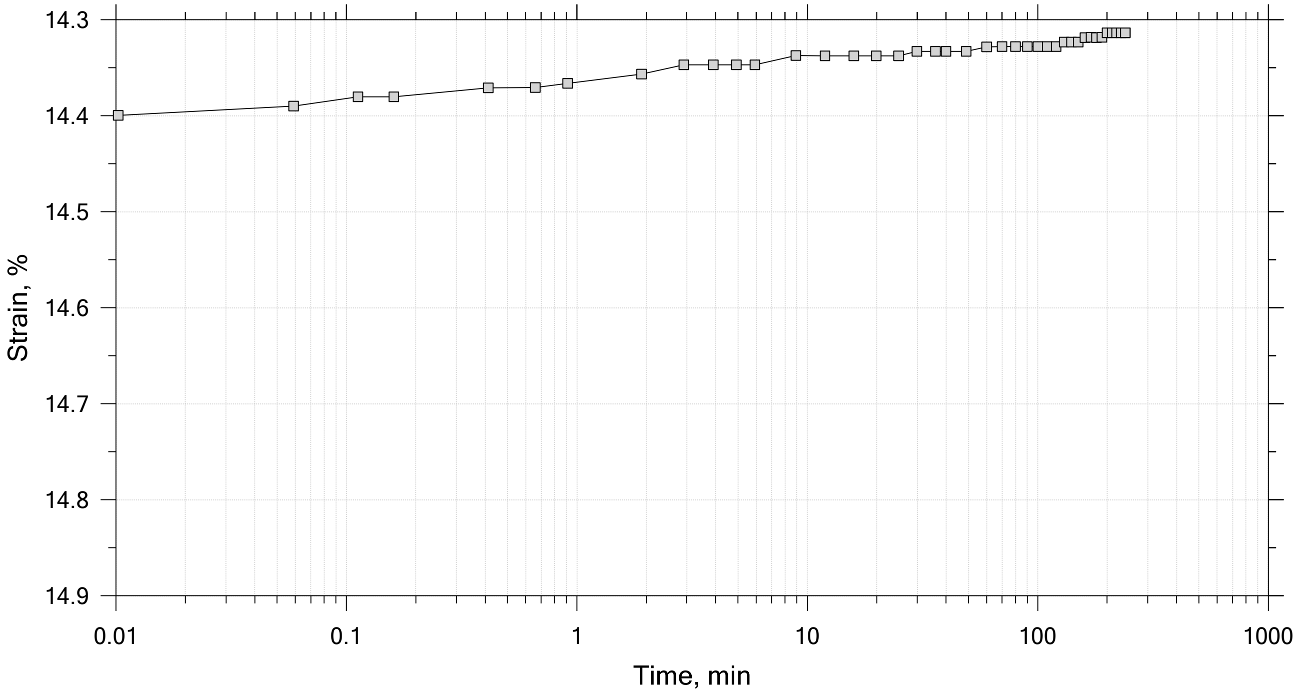


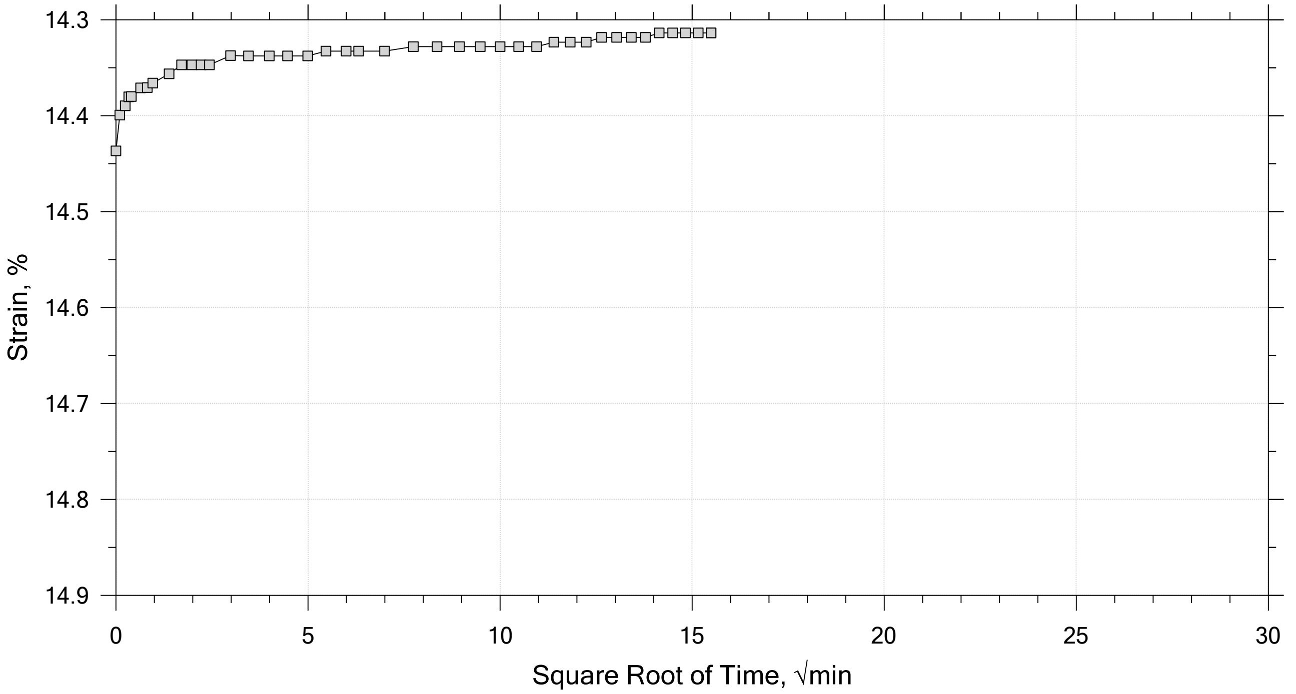


GeoTesting EXPRESS	Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: anm
	Sample No.: 24-1	Test Date: 12/2/22	Depth: 46'1"-46'3"
	Test No.: IP-5	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-032, Swell Pressure = 6.27 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 14 of 16
Constant Load Step
Stress: 100 kPa





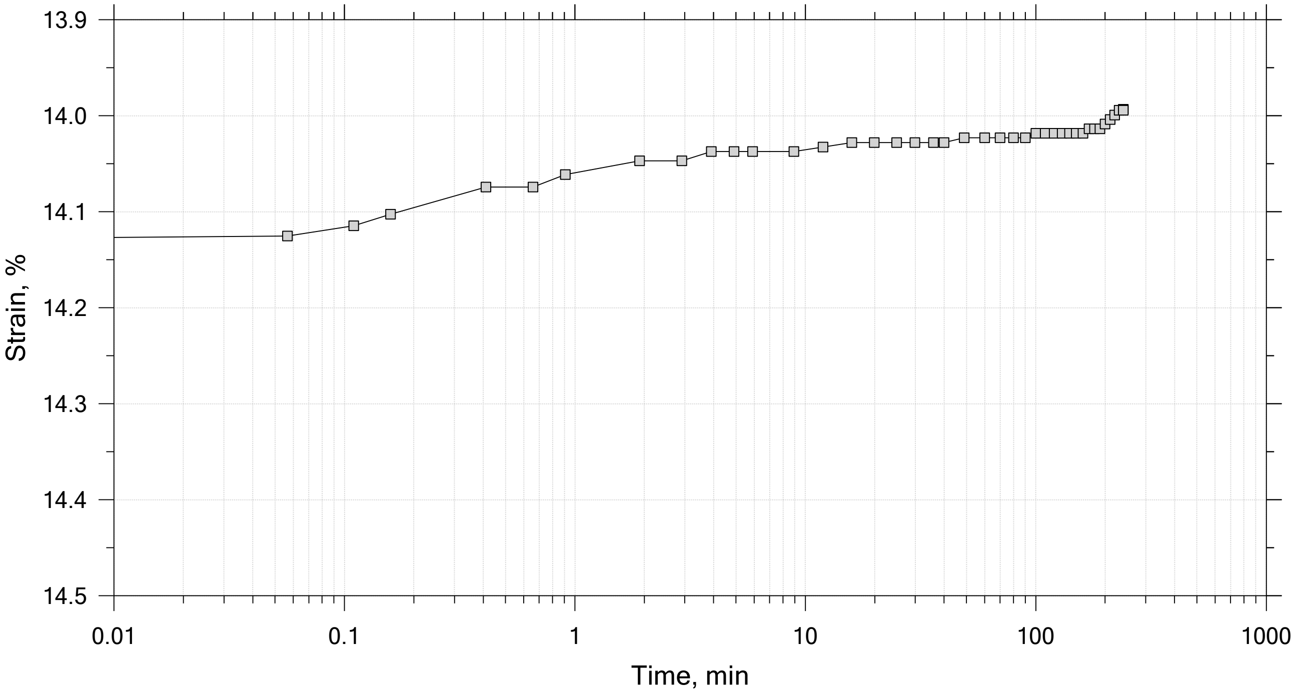
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 24-1	Test Date: 12/2/22	Depth: 46'1"-46'3"
Test No.: IP-5	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 6.27 kPa		

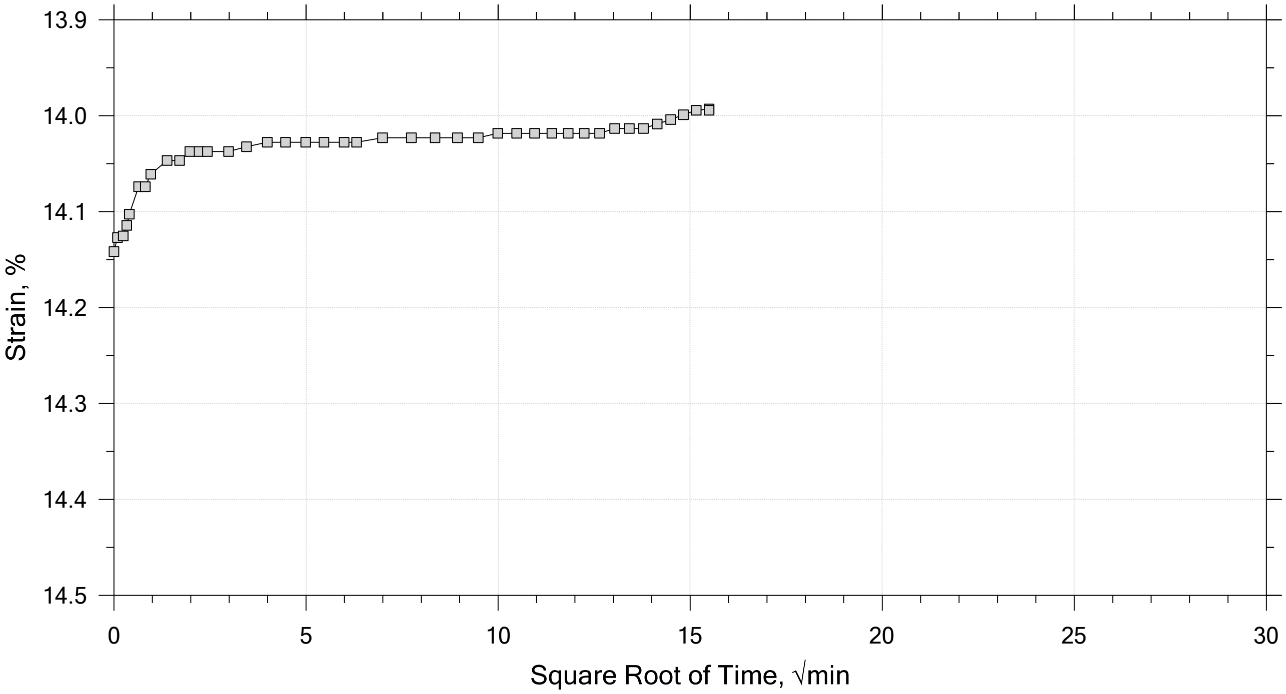
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 15 of 16

Constant Load Step

Stress: 25 kPa





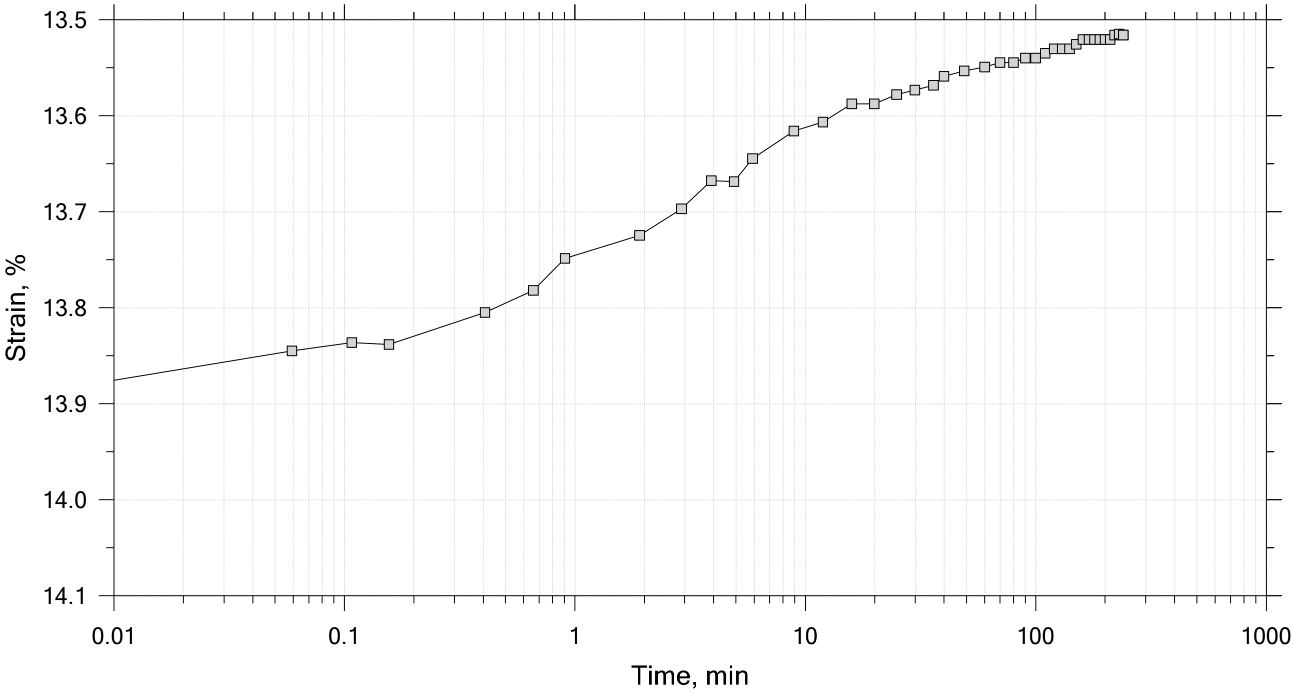
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 24-1	Test Date: 12/2/22	Depth: 46'1"-46'3"
Test No.: IP-5	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 6.27 kPa		

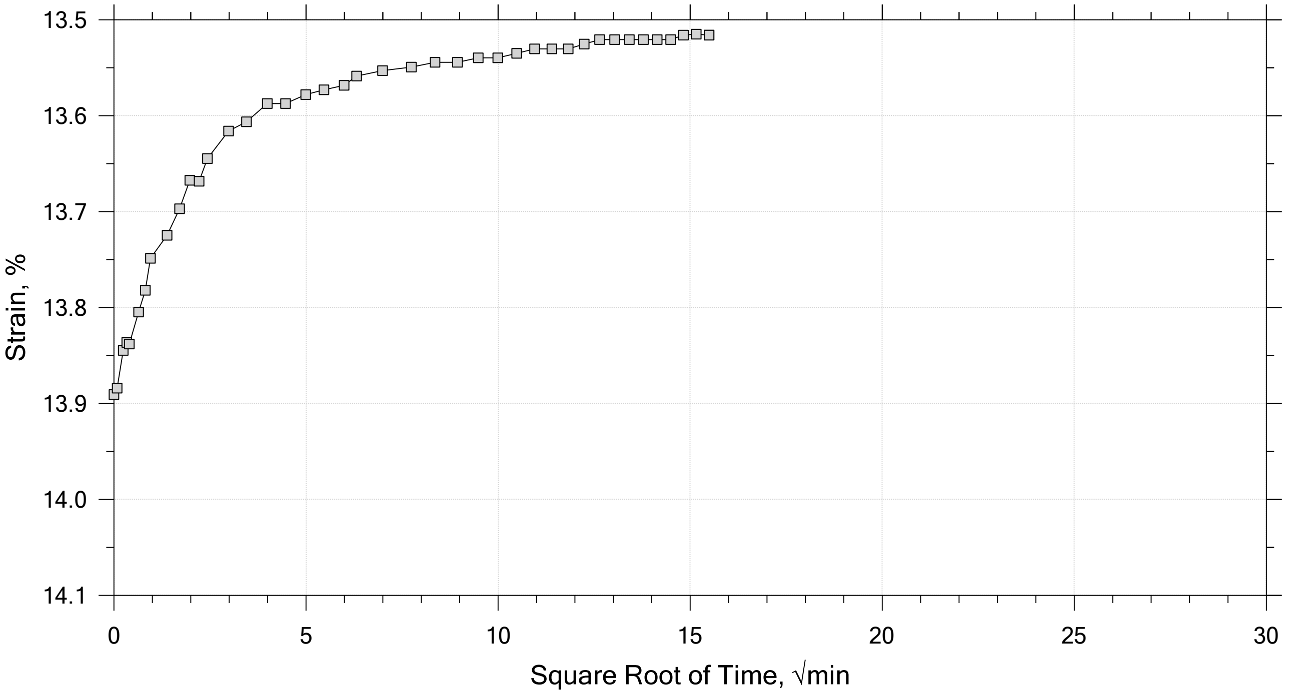
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 16 of 16

Constant Load Step

Stress: 5 kPa





Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 24-1	Test Date: 12/2/22	Depth: 46'1"-46'3"
Test No.: IP-5	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 6.27 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Specimen Diameter: 6.35 cm	Estimated Specific Gravity: 2.68	Liquid Limit: ---
Initial Height: 2.54 cm	Initial Void Ratio: 0.719	Plastic Limit: ---
Final Height: 2.21 cm	Final Void Ratio: 0.496	Plasticity Index: ---

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	E1582	RING		E5905
Mass Container, gm	8.24	107.99	107.99	8.3
Mass Container + Wet Soil, gm	244.08	265.65	256.81	156.67
Mass Container + Dry Soil, gm	197.09	233.62	233.62	133.55
Mass Dry Soil, gm	188.85	125.63	125.63	125.25
Water Content, %	24.88	25.50	18.46	18.46
Void Ratio	---	0.72	0.50	---
Degree of Saturation, %	---	95.19	100.00	---
Dry Unit Weight, kN/m³	---	15.316	17.604	---

Note: Specific Gravity and Void Ratios are calculated assuming the degree of saturation equals 100% at the end of the test.
Therefore, values may not represent actual values for the specimen.

Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 24-1	Test Date: 12/2/22	Depth: 46'1"-46'3"
Test No.: IP-5	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 6.27 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Square Root of Time Coefficients

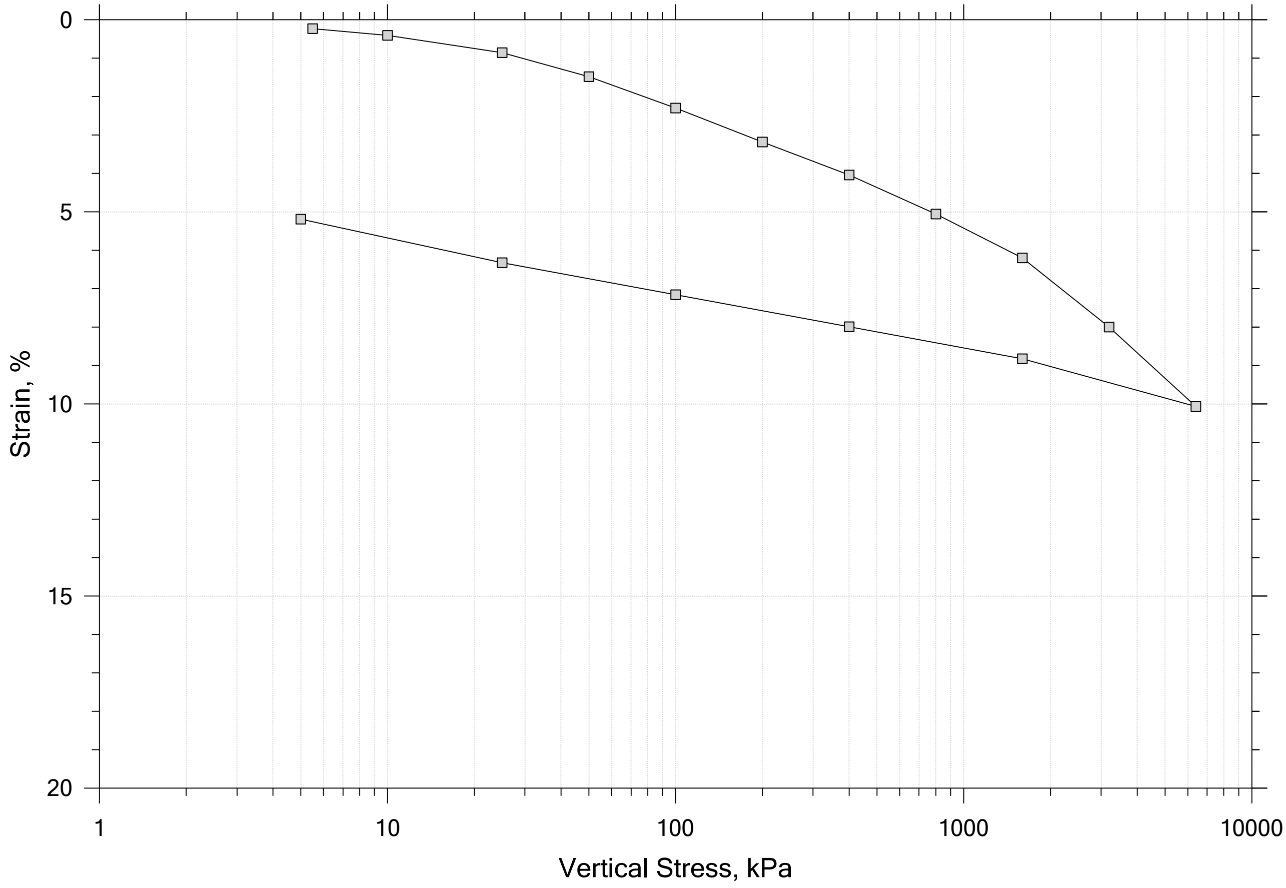
Step	Applied Stress kPa	Final Displacement cm	Void Ratio	Strain at End %	Sq.Rt. T90 min	Cv cm^2/s	Mv 1/kPa	k cm/s
1	6.27	0.02917	0.699	1.15	35.289	6.39e-04	1.83e-03	1.15e-07
2	10.0	0.03919	0.693	1.54	15.867	1.40e-03	1.06e-03	1.45e-07
3	25.0	0.06843	0.673	2.69	9.373	2.33e-03	7.68e-04	1.75e-07
4	50.0	0.09576	0.654	3.77	40.774	5.24e-04	4.30e-04	2.21e-08
5	100.	0.1220	0.636	4.80	28.434	7.34e-04	2.07e-04	1.49e-08
6	200.	0.1529	0.616	6.02	18.282	1.12e-03	1.21e-04	1.33e-08
7	400.	0.1867	0.593	7.35	10.061	1.97e-03	6.67e-05	1.29e-08
8	800.	0.2242	0.567	8.83	15.425	1.25e-03	3.68e-05	4.51e-09
9	1.60e+03	0.2712	0.536	10.7	14.619	1.27e-03	2.31e-05	2.88e-09
10	3.20e+03	0.3289	0.496	13.0	22.449	7.90e-04	1.42e-05	1.10e-09
11	6.40e+03	0.3999	0.448	15.7	25.389	6.59e-04	8.73e-06	5.64e-10
12	1.60e+03	0.3842	0.459	15.1	---	---	---	---
13	400.	0.3752	0.465	14.8	0.112	1.47e-01	2.93e-06	4.23e-08
14	100.	0.3636	0.473	14.3	8.891	1.87e-03	1.53e-05	2.81e-09
15	25.0	0.3555	0.479	14.0	---	---	---	---
16	5.00	0.3433	0.487	13.5	8.912	1.90e-03	2.39e-04	4.46e-08

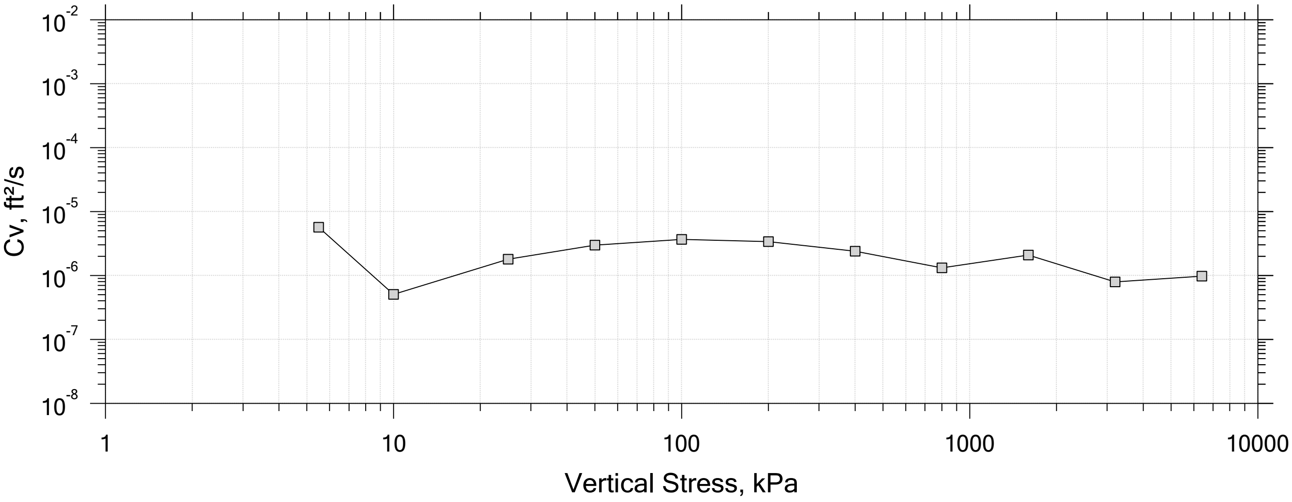
GeoTesting EXPRESS

Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 24-1	Test Date: 12/2/22	Depth: 46'1"-46'3"
Test No.: IP-5	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 6.27 kPa		
Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Summary Report





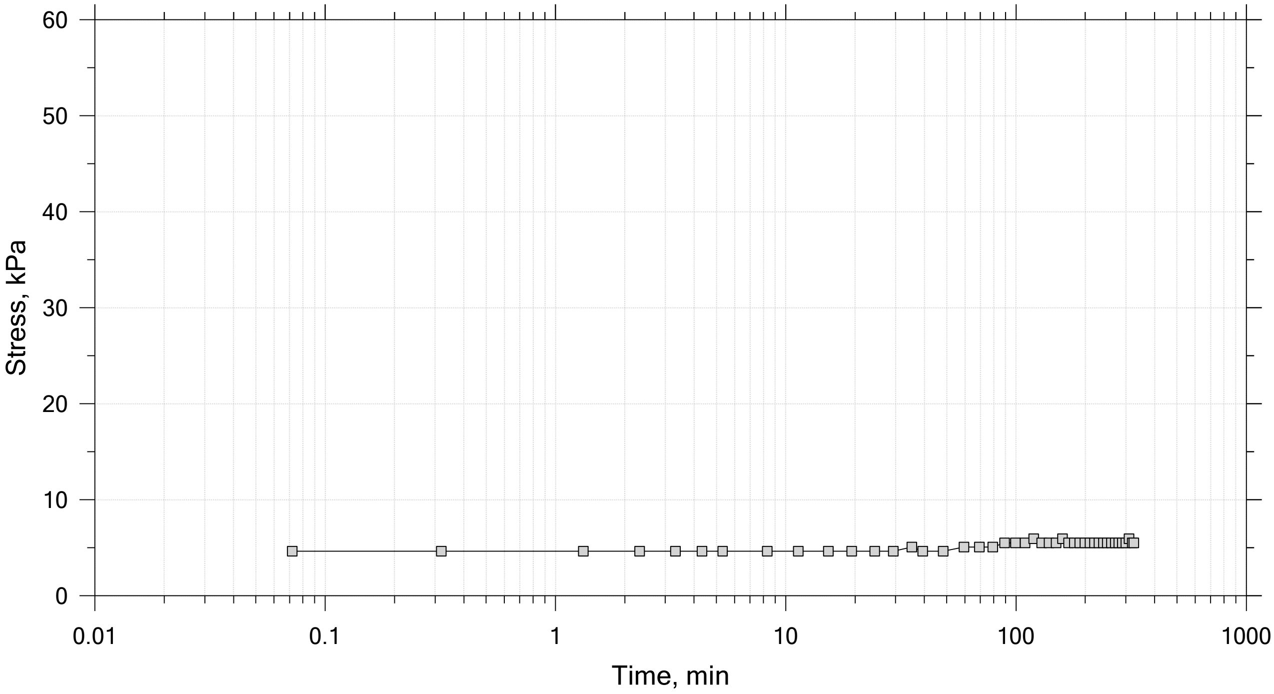
GeoTesting EXPRESS			
	Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: njh
	Sample No.: 24-2	Test Date: 12/2/22	Depth: 47'9"-47'11"
	Test No.: IP-6	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-007, Swell Pressure = 5.49 kPa		
	Displacement at End of Increment		

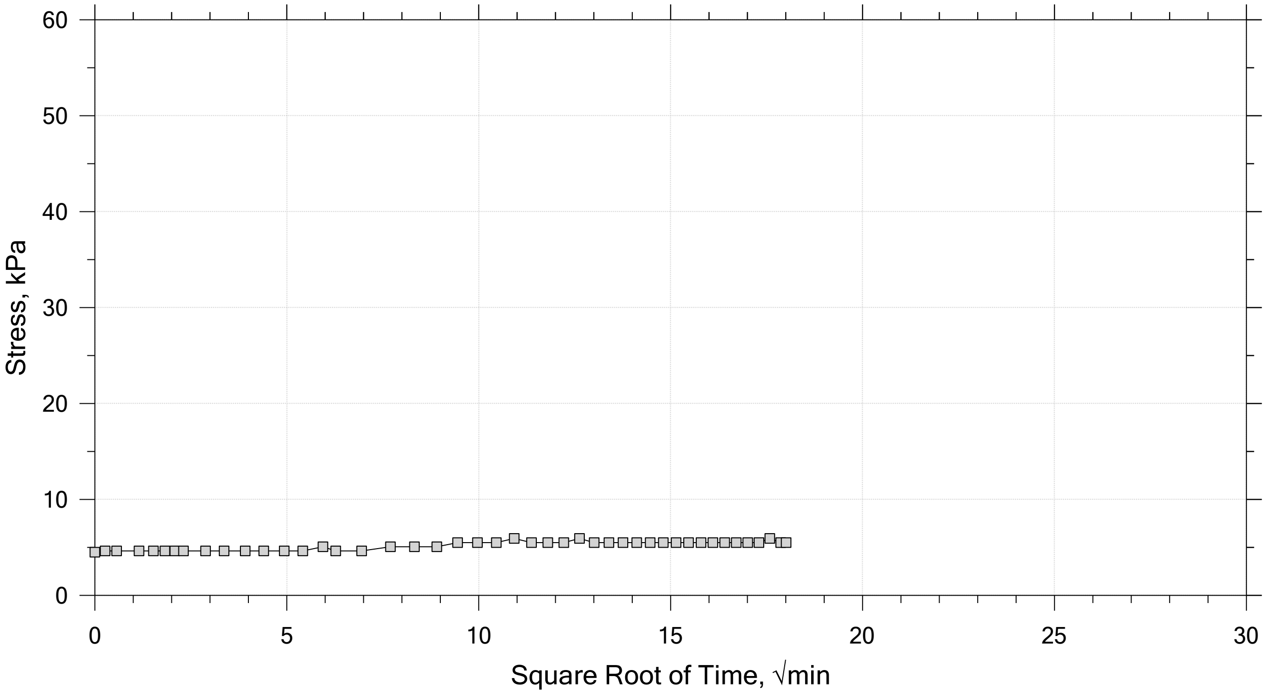
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 1 of 16

Constant Volume Step

Stress: 5.49 kPa

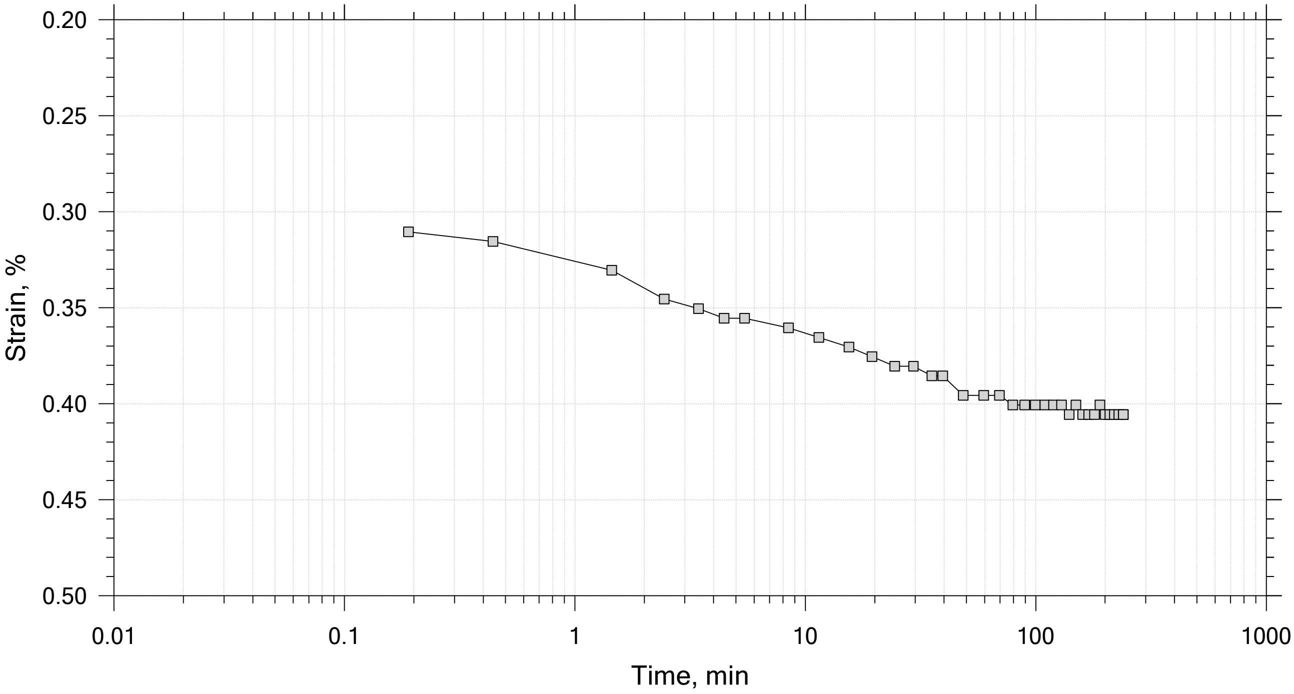


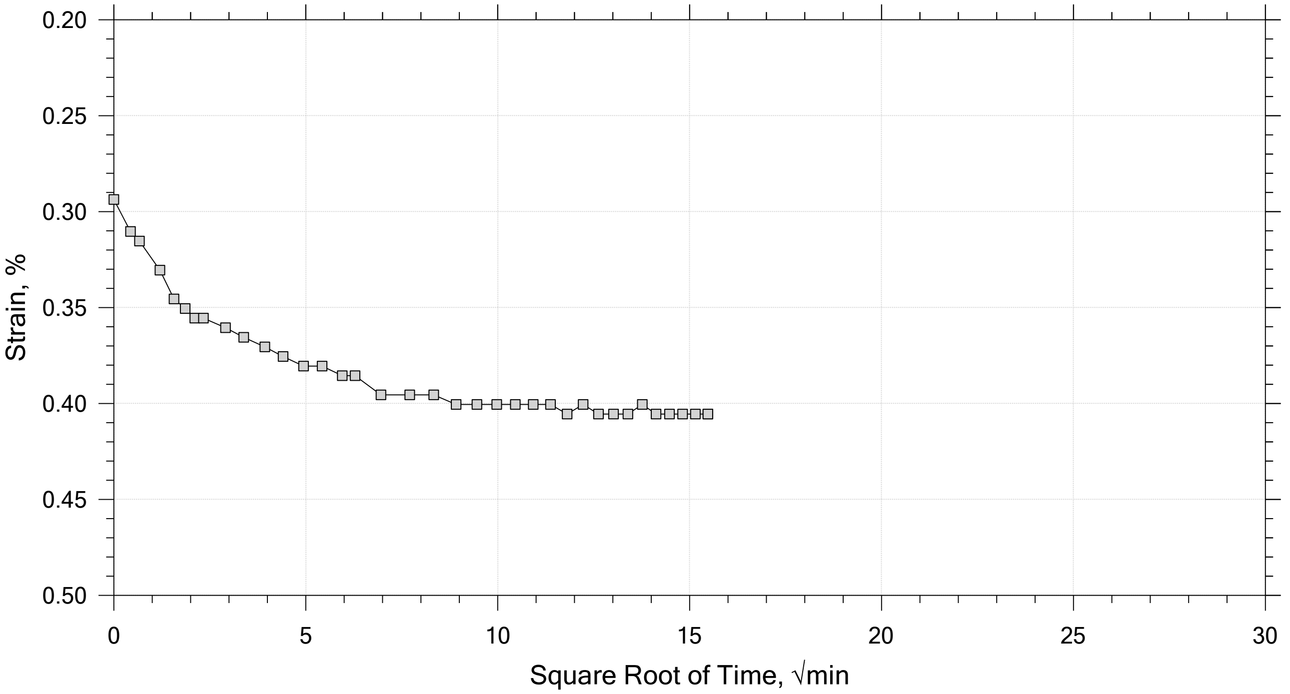


GeoTesting EXPRESS	Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: njh
	Sample No.: 24-2	Test Date: 12/2/22	Depth: 47'9"-47'11"
	Test No.: IP-6	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-007, Swell Pressure = 5.49 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 2 of 16
Constant Load Step
Stress: 10 kPa





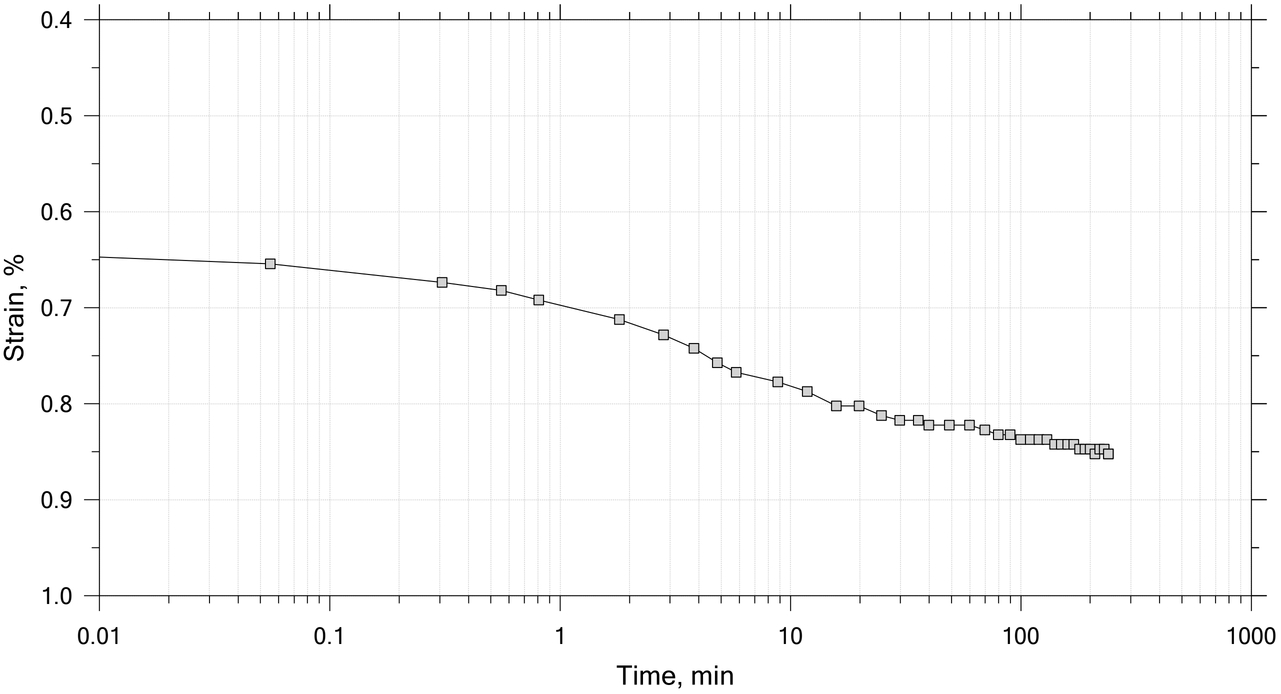
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: njh
Sample No.: 24-2	Test Date: 12/2/22	Depth: 47'9"-47'11"
Test No.: IP-6	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-007, Swell Pressure = 5.49 kPa		

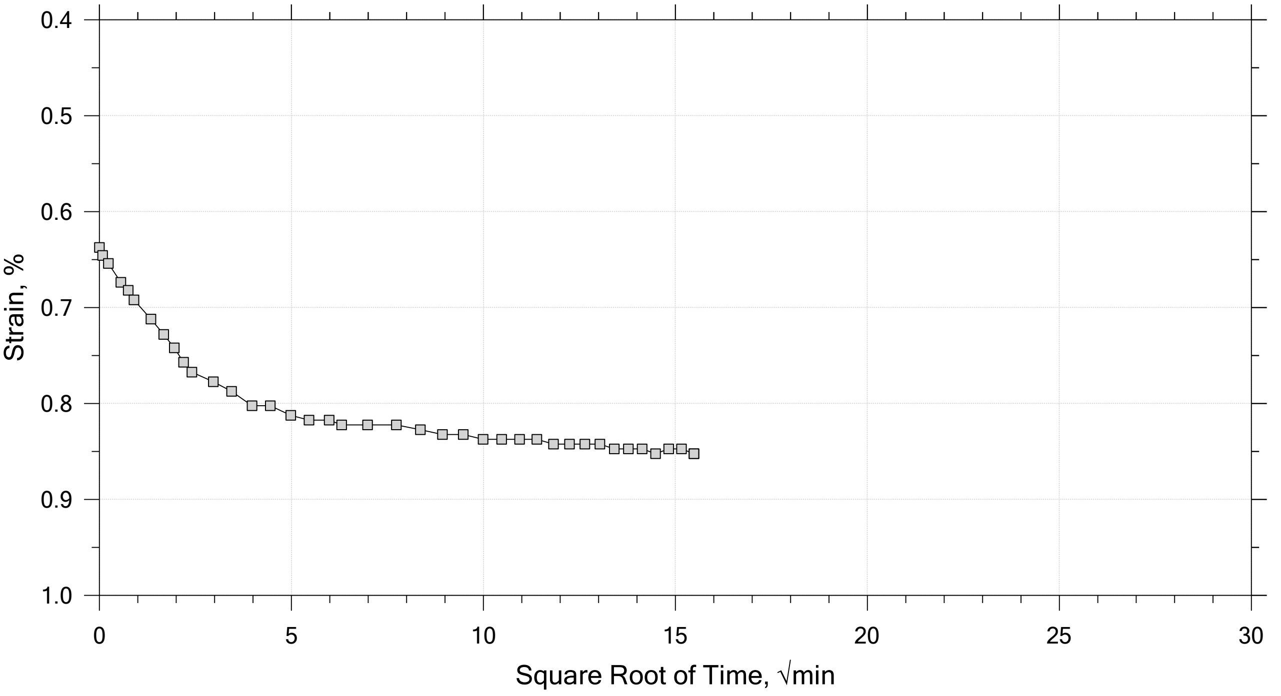
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 3 of 16

Constant Load Step

Stress: 25 kPa





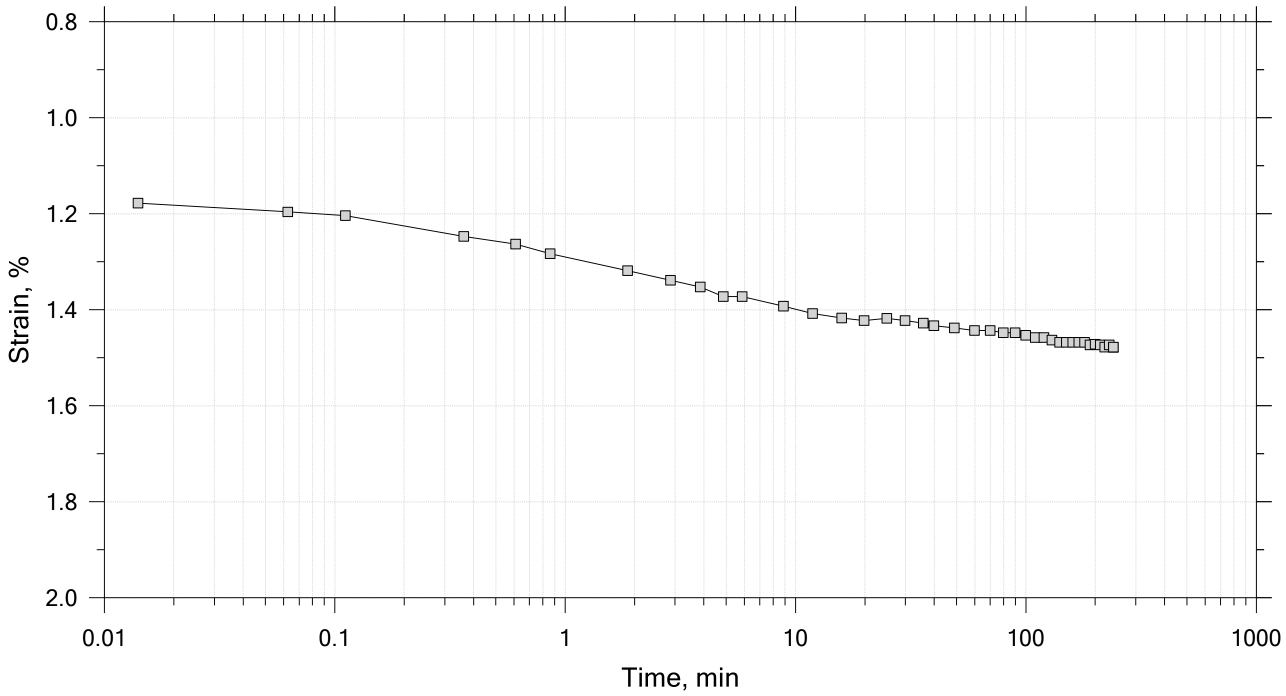
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: njh
Sample No.: 24-2	Test Date: 12/2/22	Depth: 47'9"-47'11"
Test No.: IP-6	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-007, Swell Pressure = 5.49 kPa		

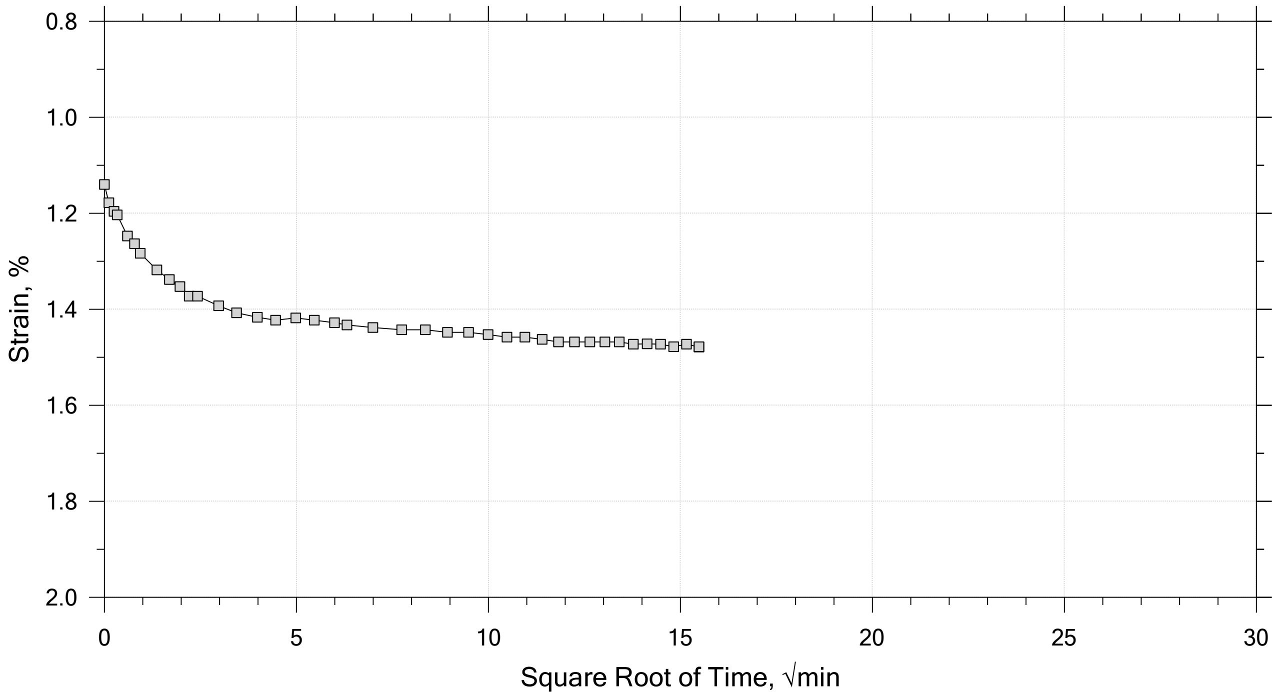
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 4 of 16

Constant Load Step

Stress: 50 kPa





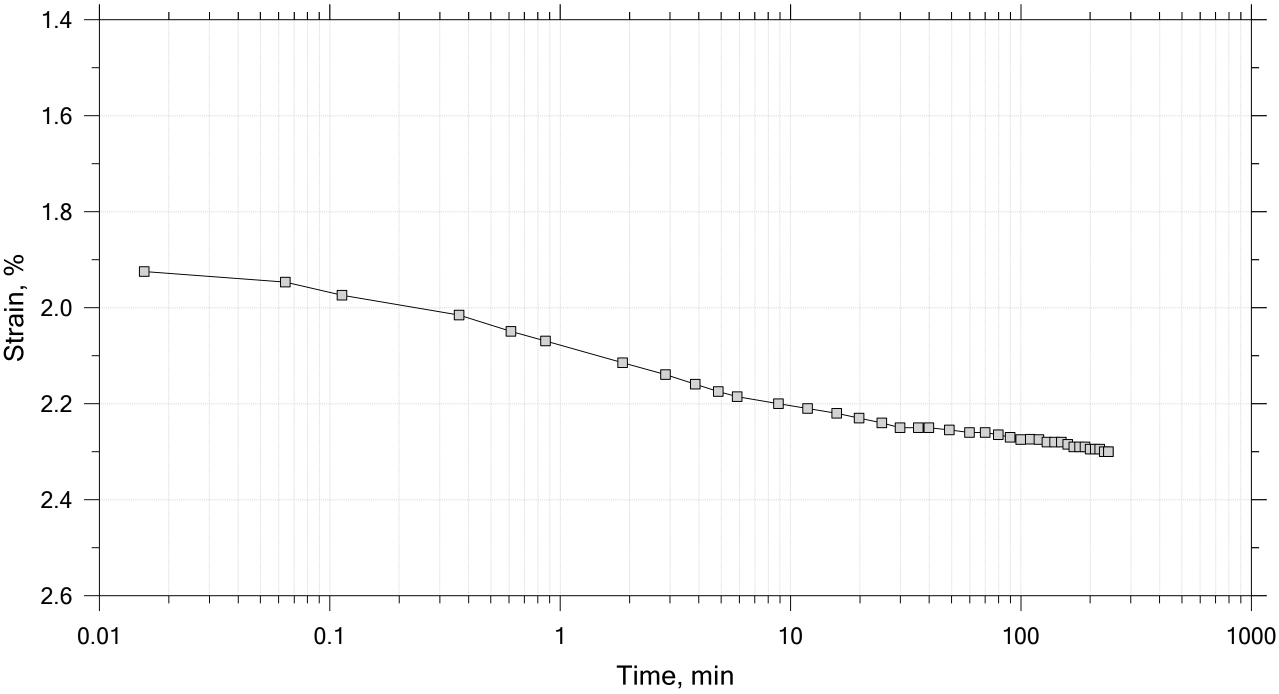
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: njh
Sample No.: 24-2	Test Date: 12/2/22	Depth: 47'9"-47'11"
Test No.: IP-6	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-007, Swell Pressure = 5.49 kPa		

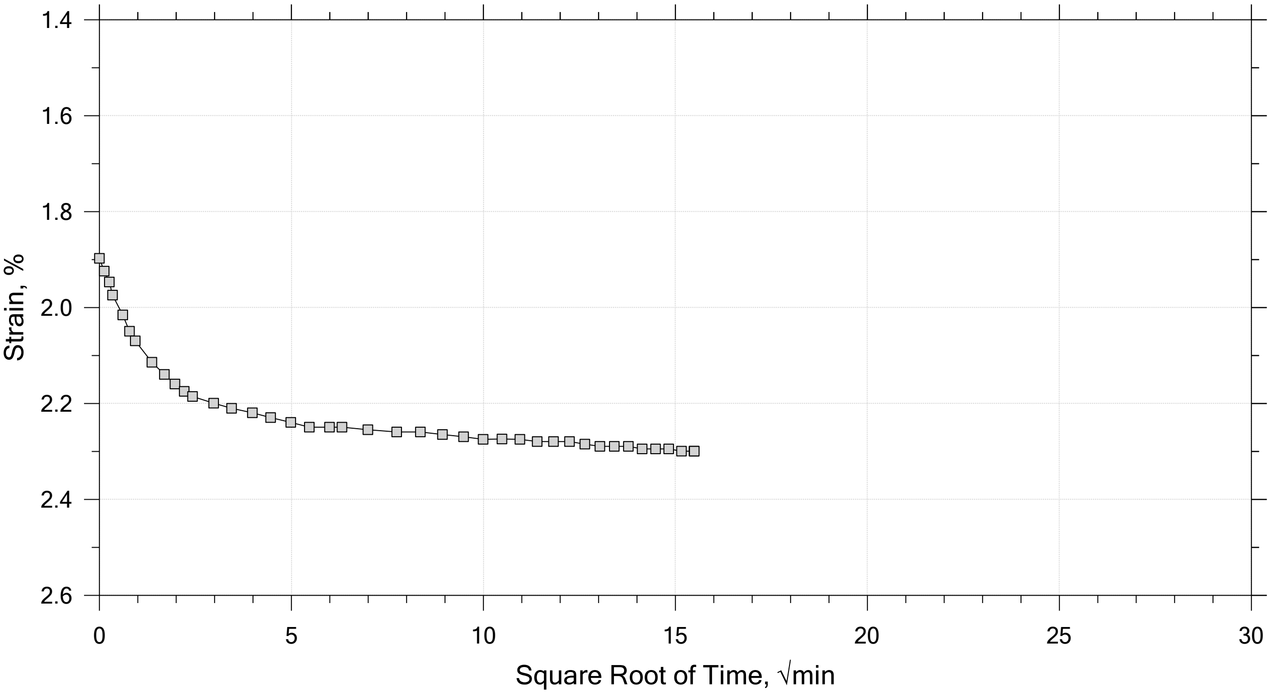
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 5 of 16

Constant Load Step

Stress: 100 kPa





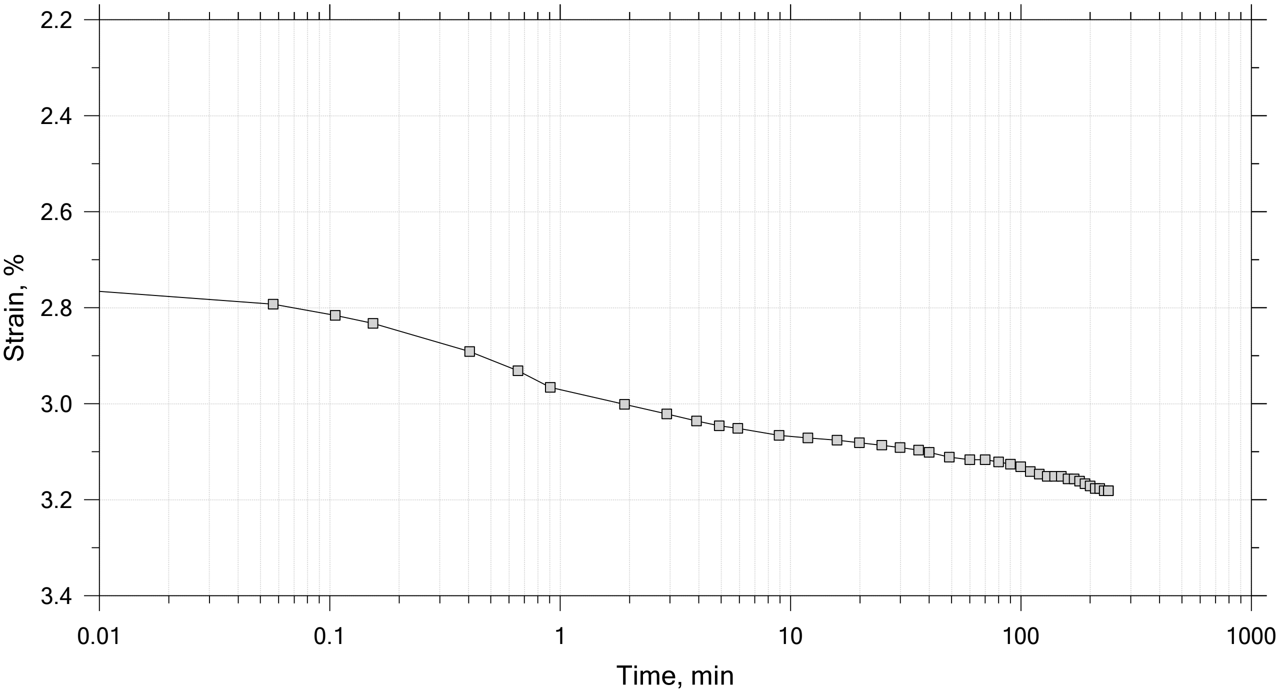
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: njh
Sample No.: 24-2	Test Date: 12/2/22	Depth: 47'9"-47'11"
Test No.: IP-6	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-007, Swell Pressure = 5.49 kPa		

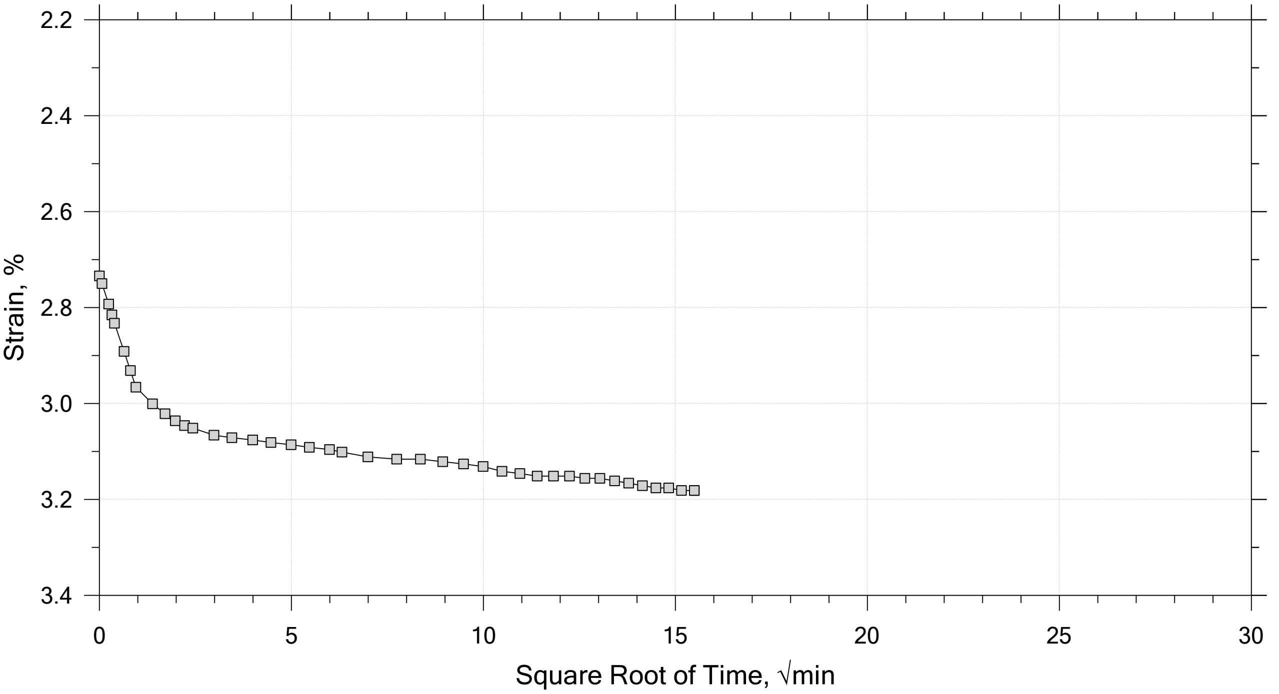
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 6 of 16

Constant Load Step

Stress: 200 kPa





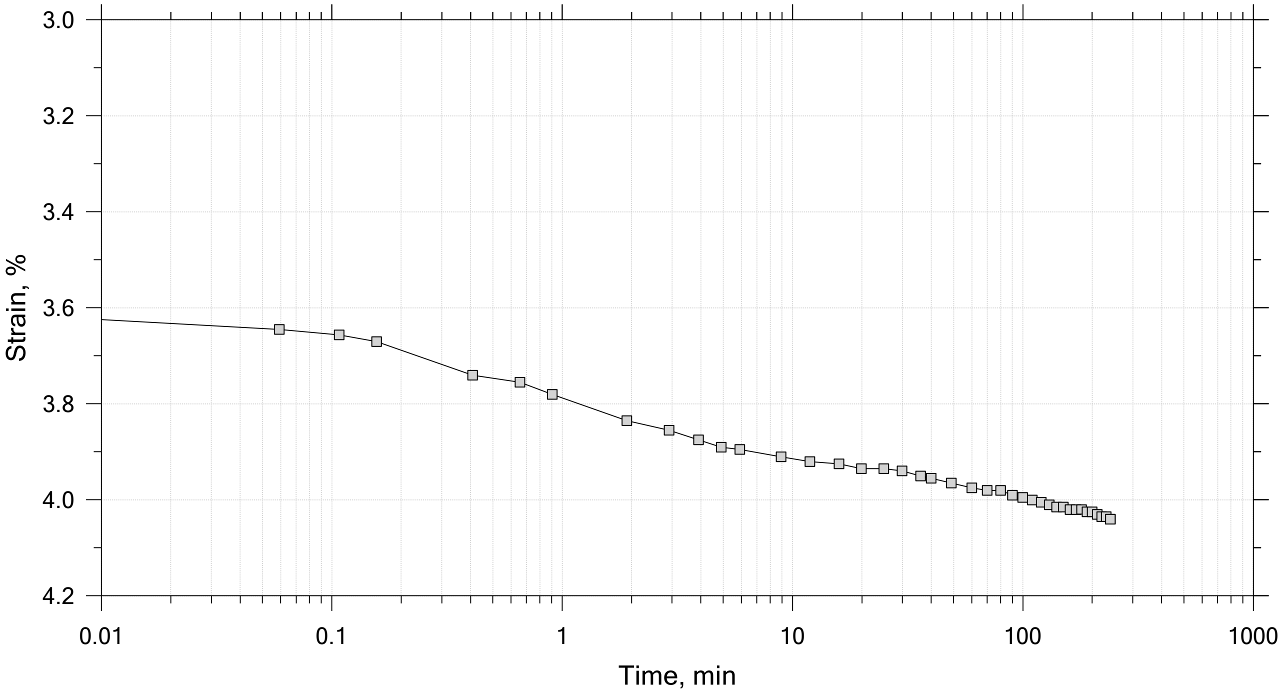
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: njh
Sample No.: 24-2	Test Date: 12/2/22	Depth: 47'9"-47'11"
Test No.: IP-6	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-007, Swell Pressure = 5.49 kPa		

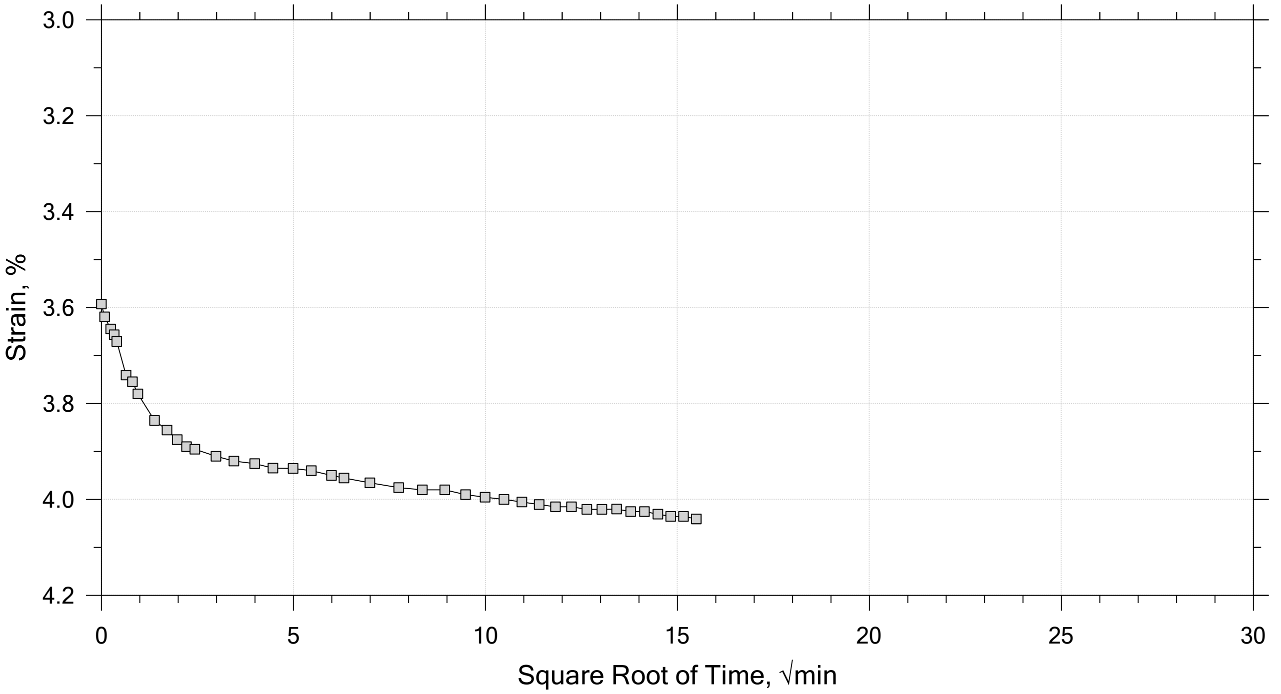
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 7 of 16

Constant Load Step

Stress: 400 kPa

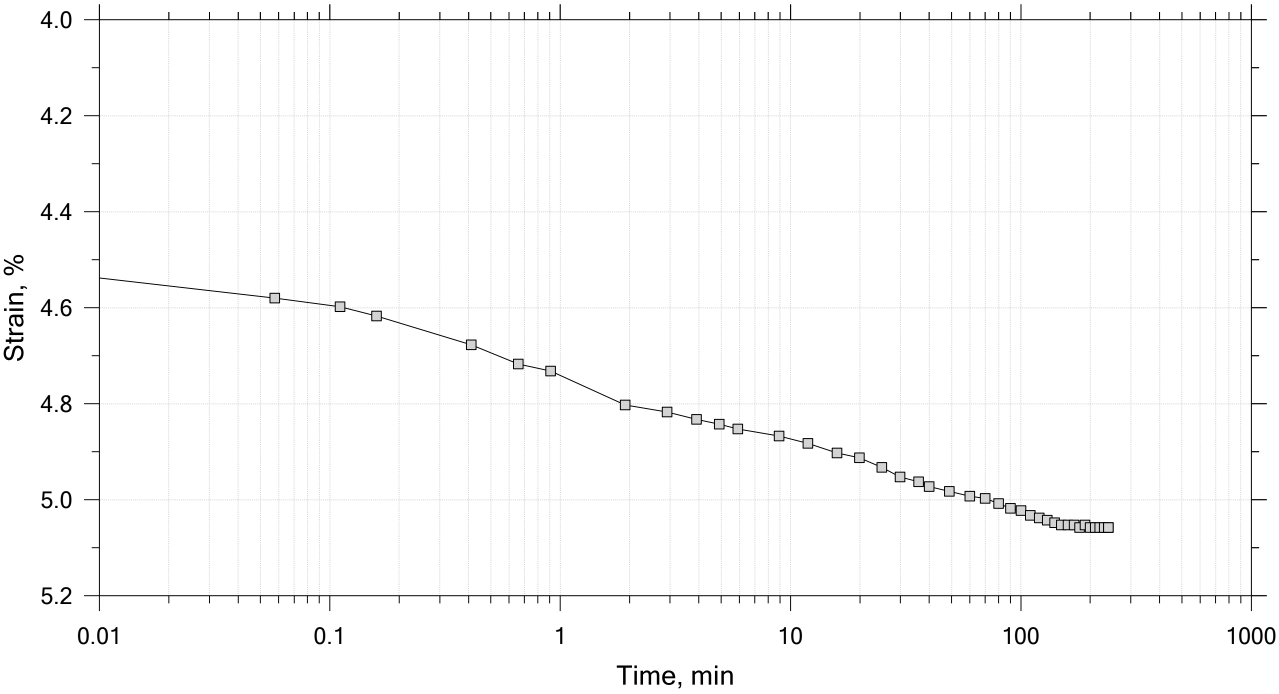


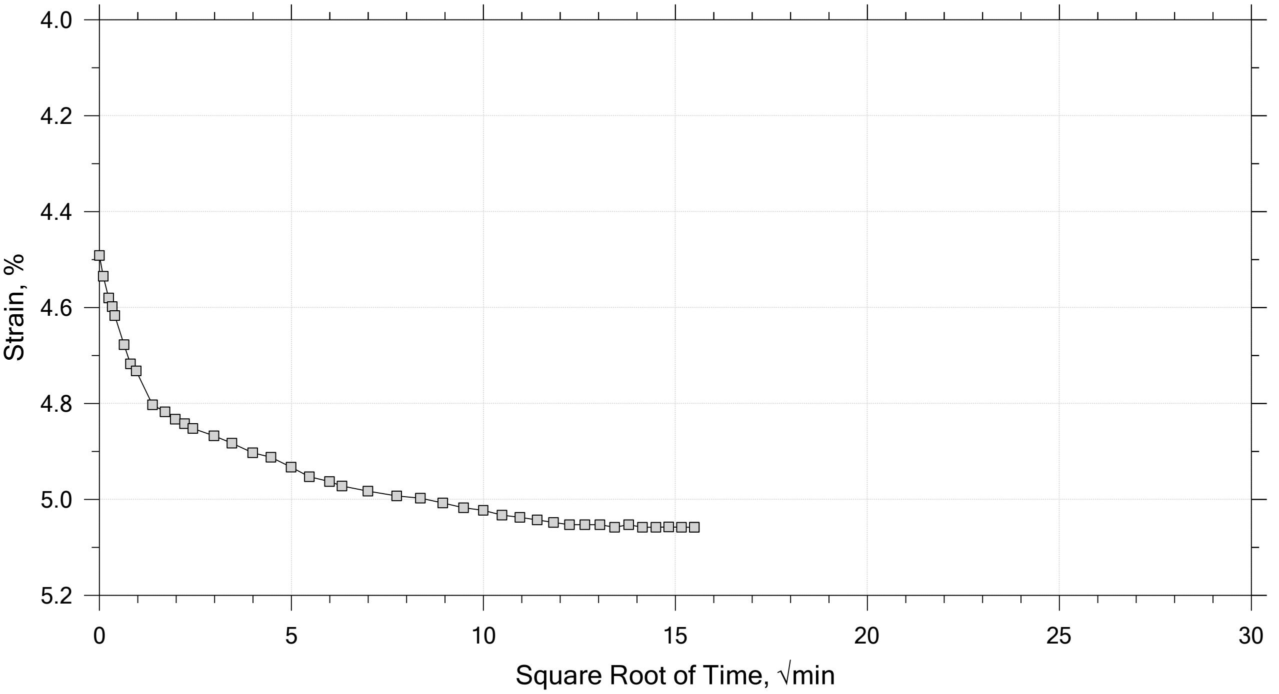


	Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: njh
	Sample No.: 24-2	Test Date: 12/2/22	Depth: 47'9"-47'11"
GeoTesting EXPRESS	Test No.: IP-6	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-007, Swell Pressure = 5.49 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 8 of 16
Constant Load Step
Stress: 800 kPa





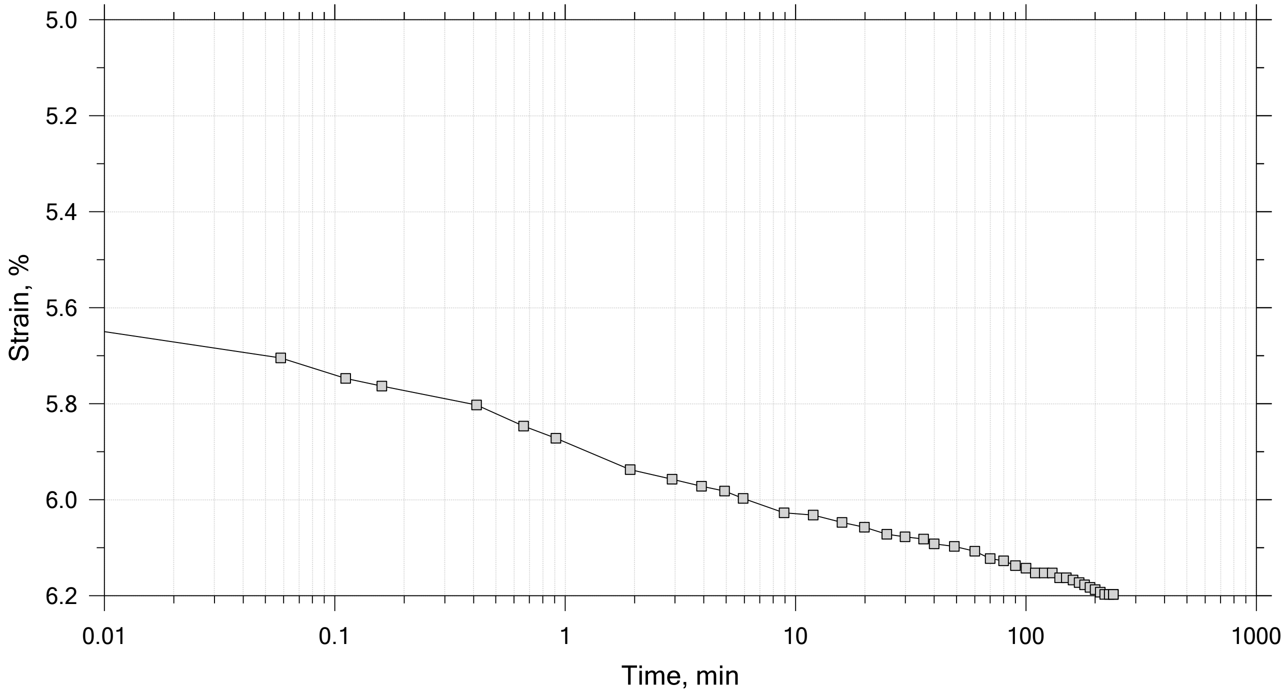
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: njh
Sample No.: 24-2	Test Date: 12/2/22	Depth: 47'9"-47'11"
Test No.: IP-6	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-007, Swell Pressure = 5.49 kPa		

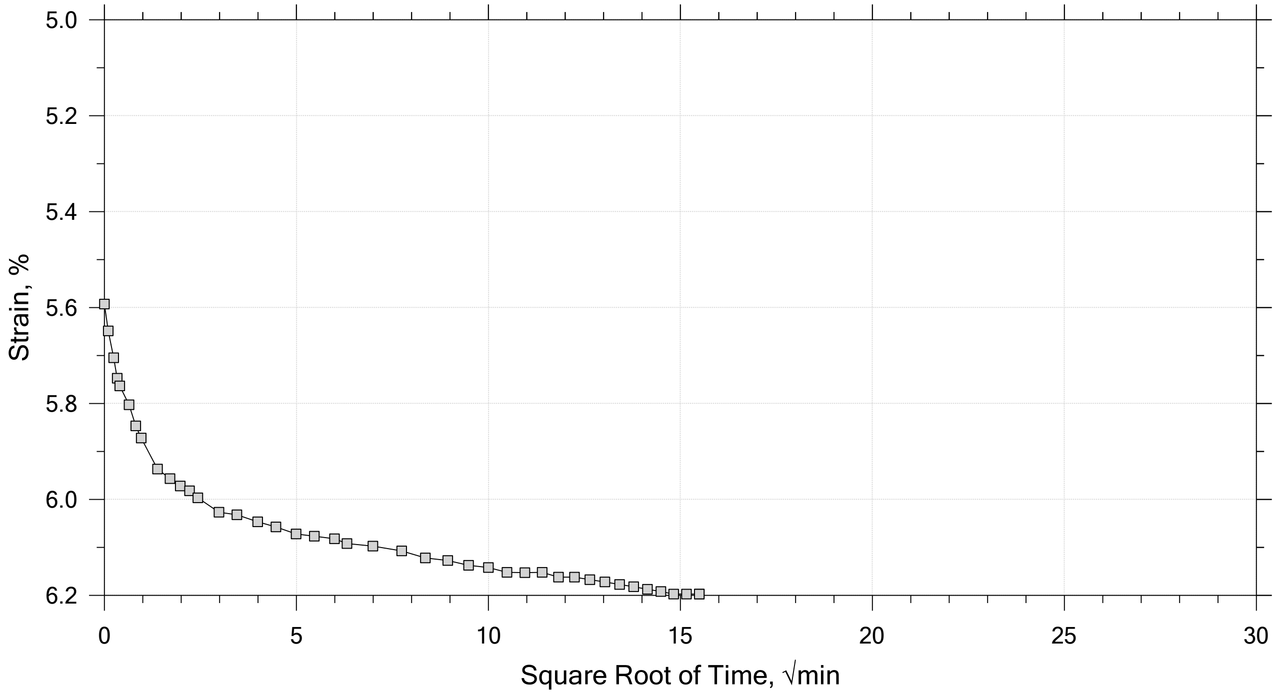
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 9 of 16

Constant Load Step

Stress: 1.6e+03 kPa





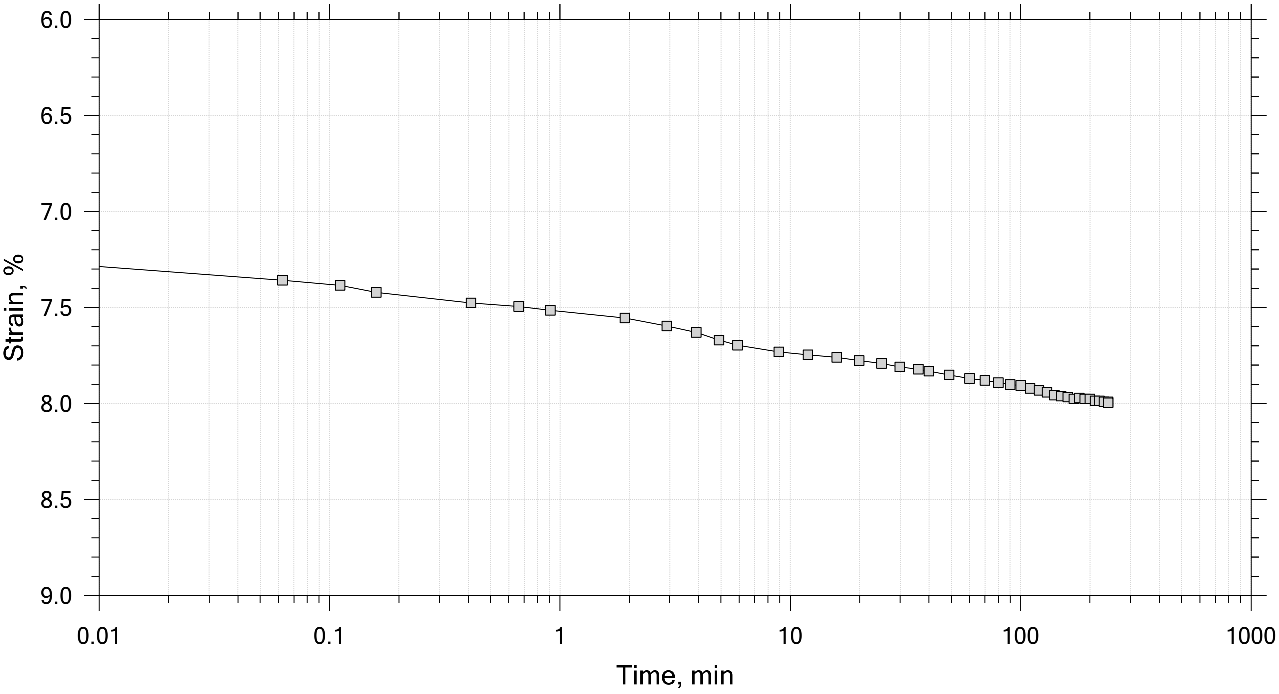
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: njh
Sample No.: 24-2	Test Date: 12/2/22	Depth: 47'9"-47'11"
Test No.: IP-6	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-007, Swell Pressure = 5.49 kPa		

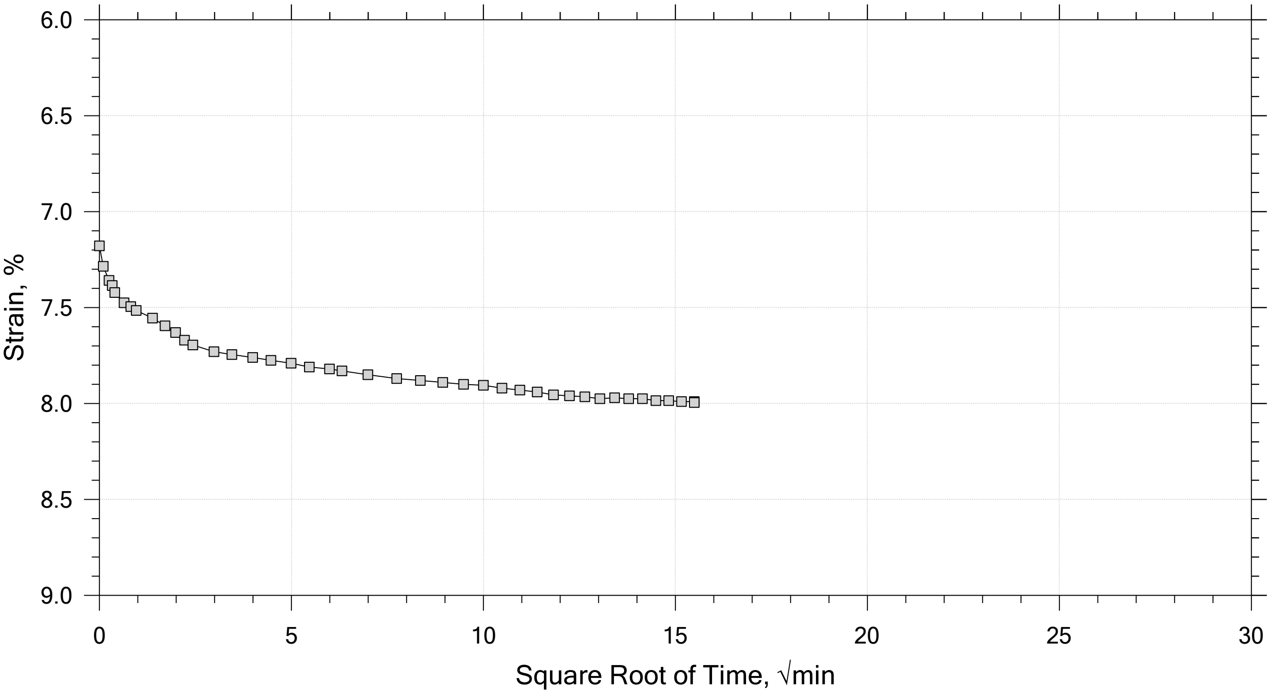
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 10 of 16

Constant Load Step

Stress: 3.2e+03 kPa





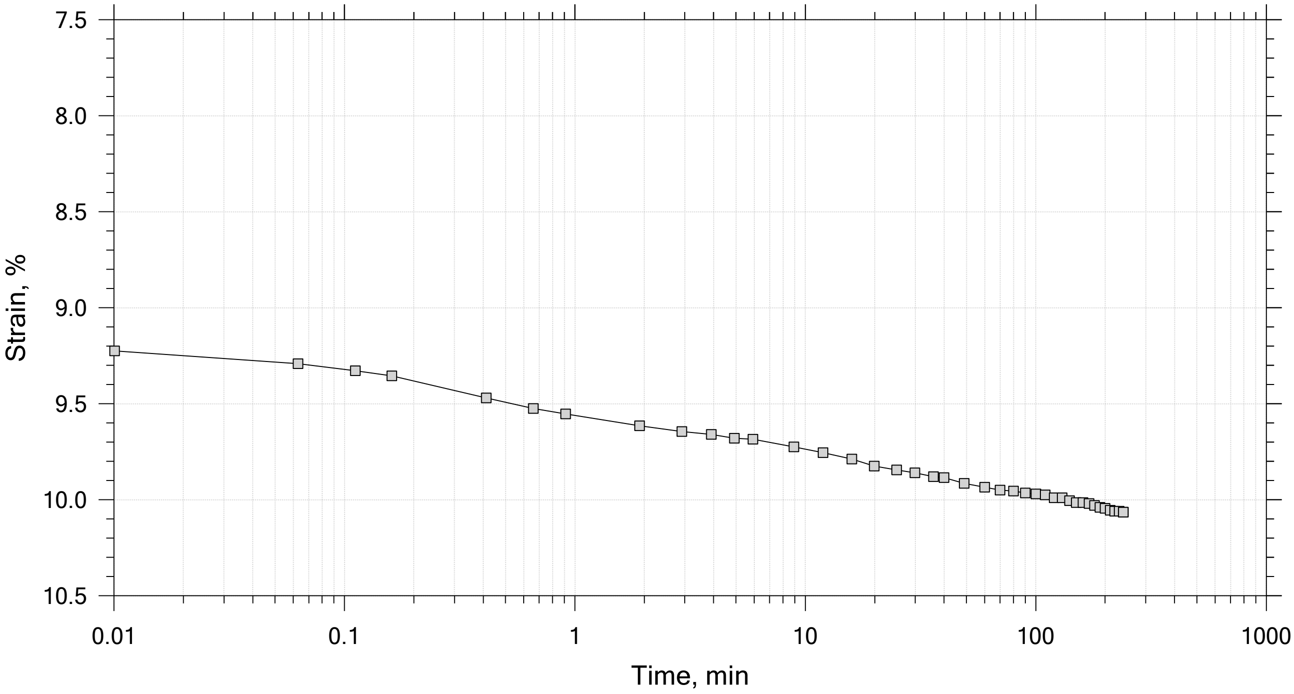
GeoTesting EXPRESS	Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: njh
	Sample No.: 24-2	Test Date: 12/2/22	Depth: 47'9"-47'11"
	Test No.: IP-6	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-007, Swell Pressure = 5.49 kPa		

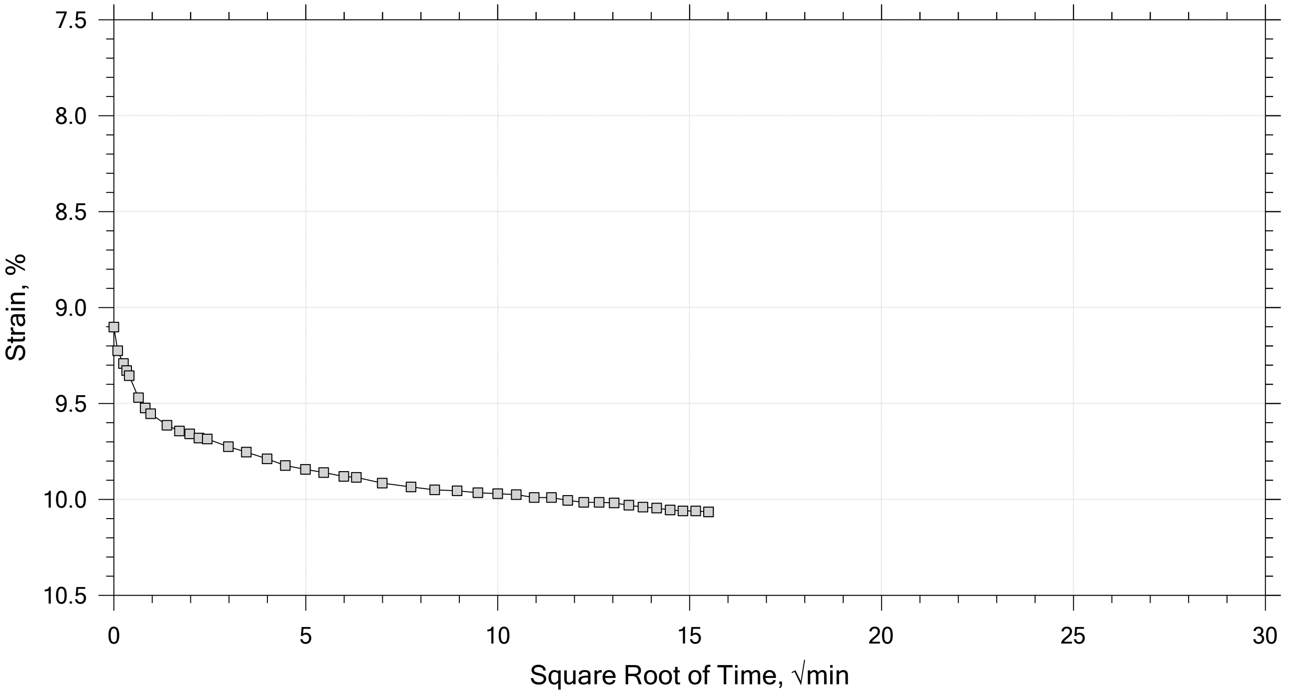
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 11 of 16

Constant Load Step

Stress: 6.4e+03 kPa

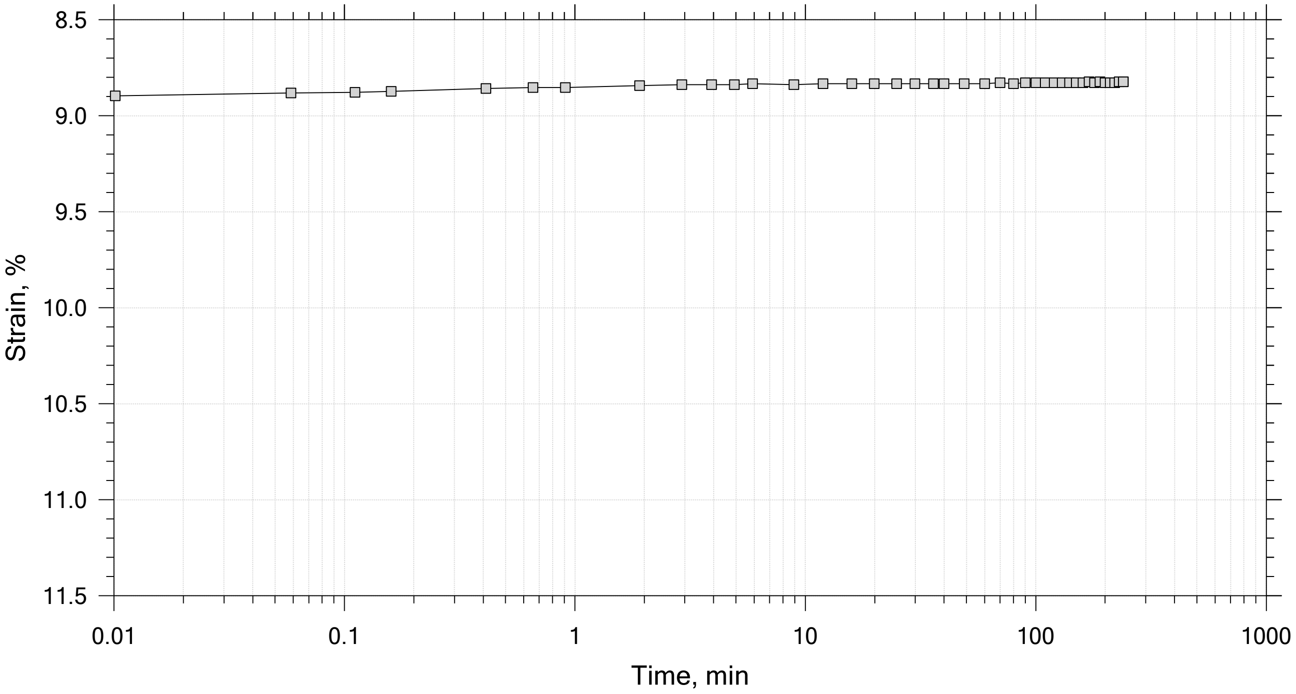


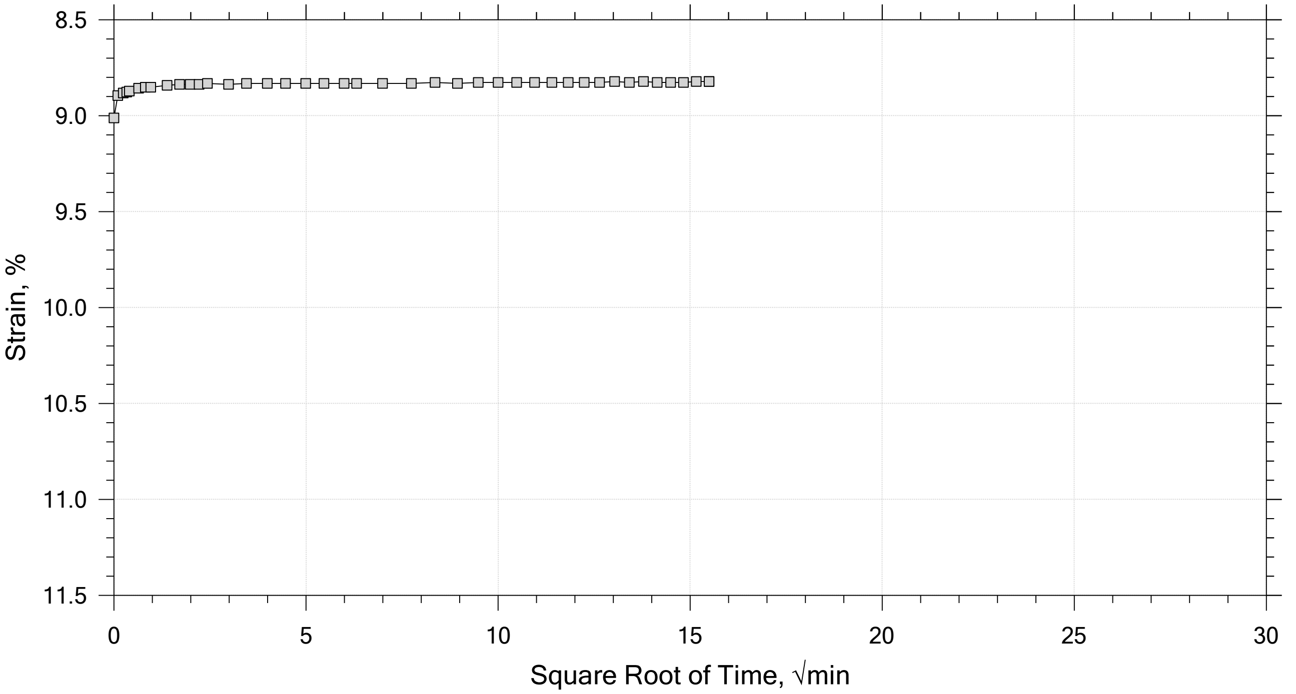


GeoTesting EXPRESS	Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: njh
	Sample No.: 24-2	Test Date: 12/2/22	Depth: 47'9"-47'11"
	Test No.: IP-6	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-007, Swell Pressure = 5.49 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 12 of 16
Constant Load Step
Stress: 1.6e+03 kPa





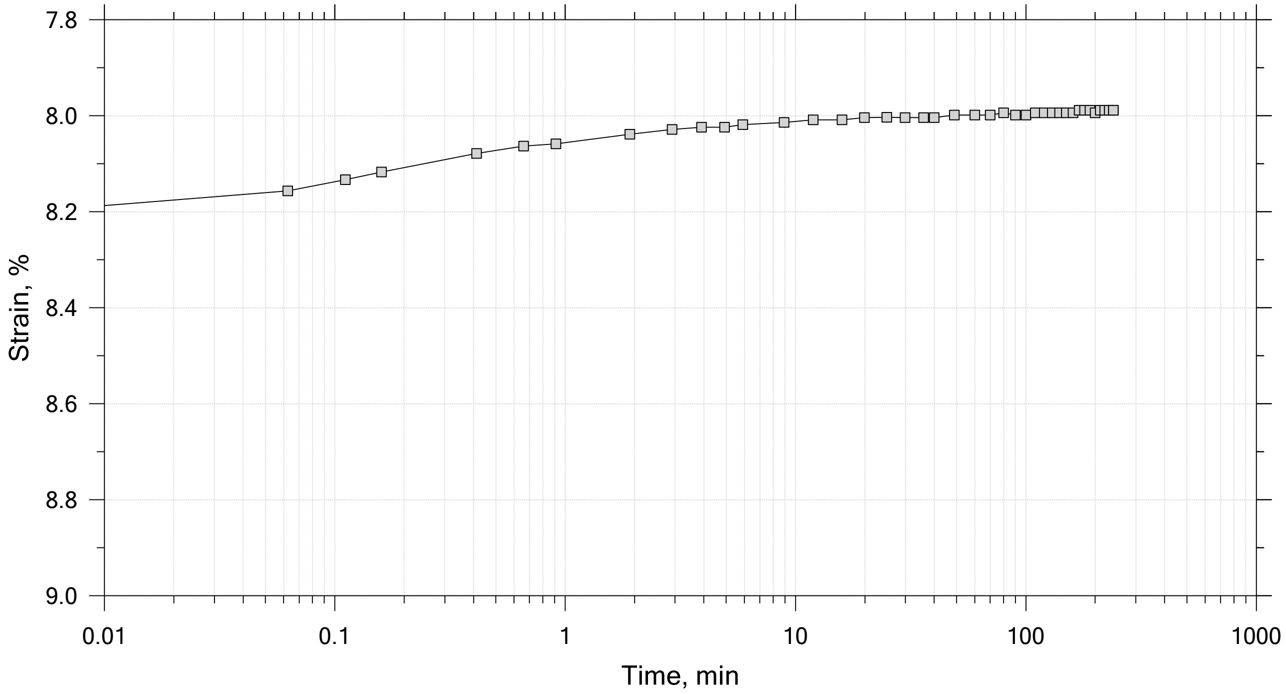
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: njh
Sample No.: 24-2	Test Date: 12/2/22	Depth: 47'9"-47'11"
Test No.: IP-6	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-007, Swell Pressure = 5.49 kPa		

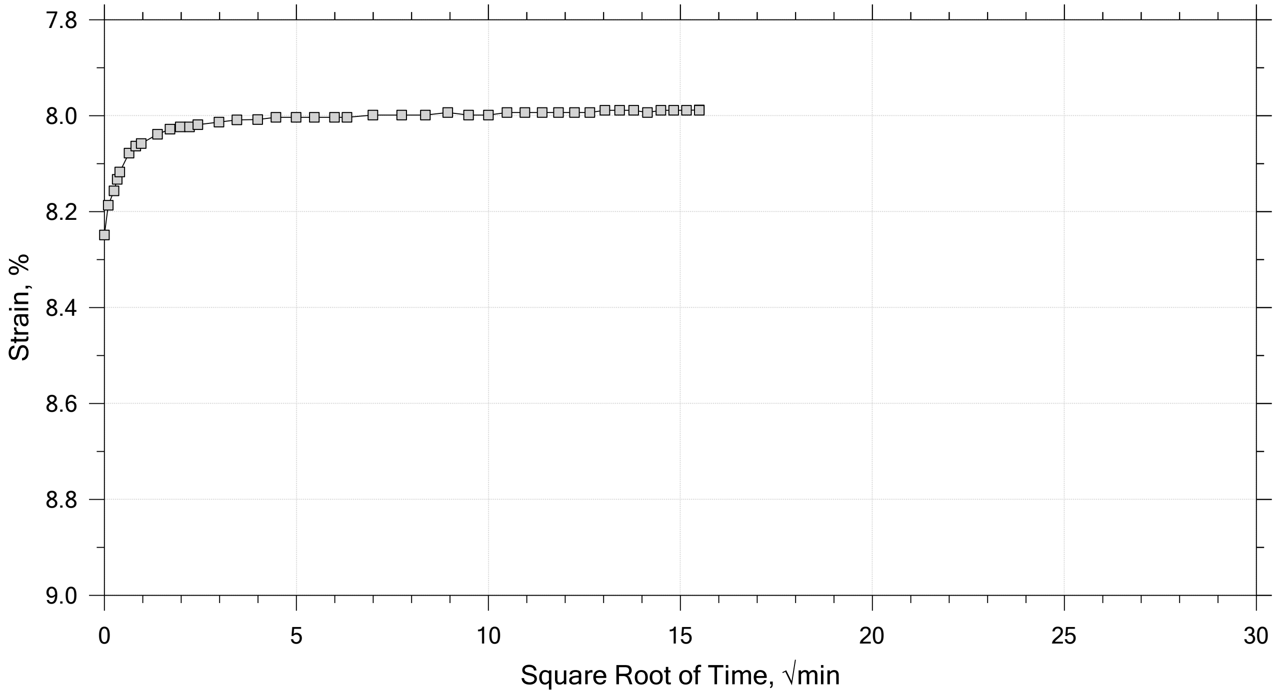
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 13 of 16

Constant Load Step

Stress: 400 kPa





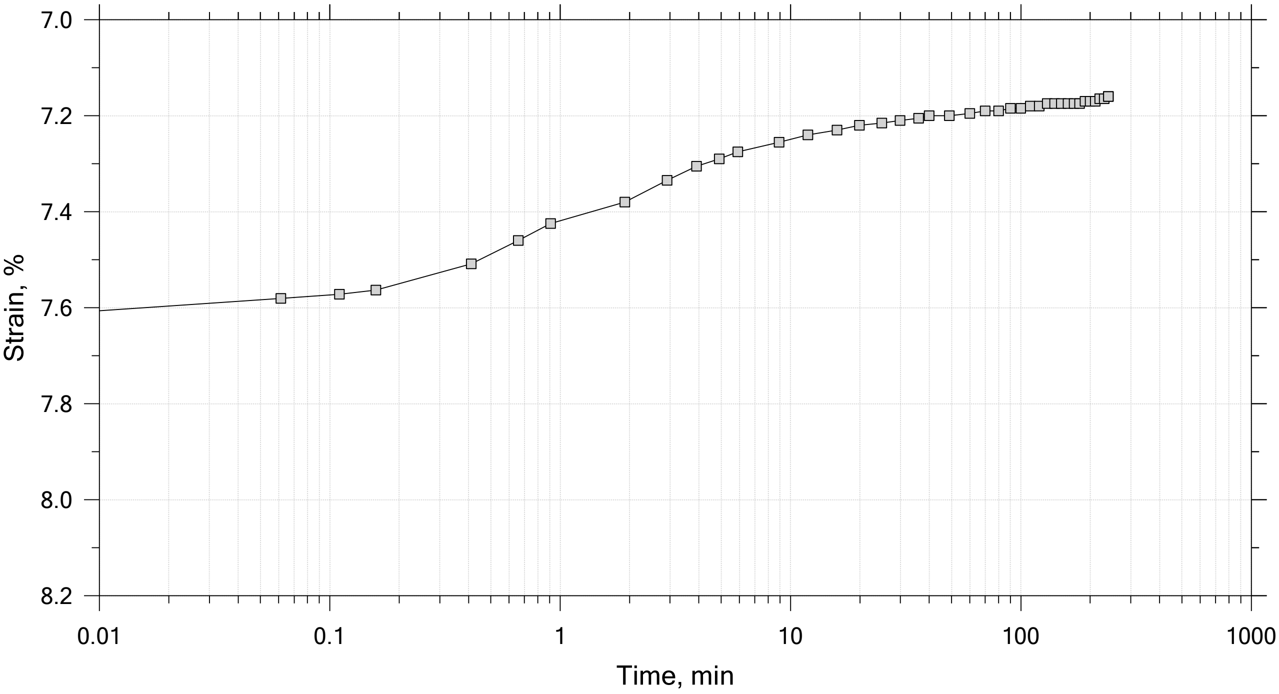
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: njh
Sample No.: 24-2	Test Date: 12/2/22	Depth: 47'9"-47'11"
Test No.: IP-6	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-007, Swell Pressure = 5.49 kPa		

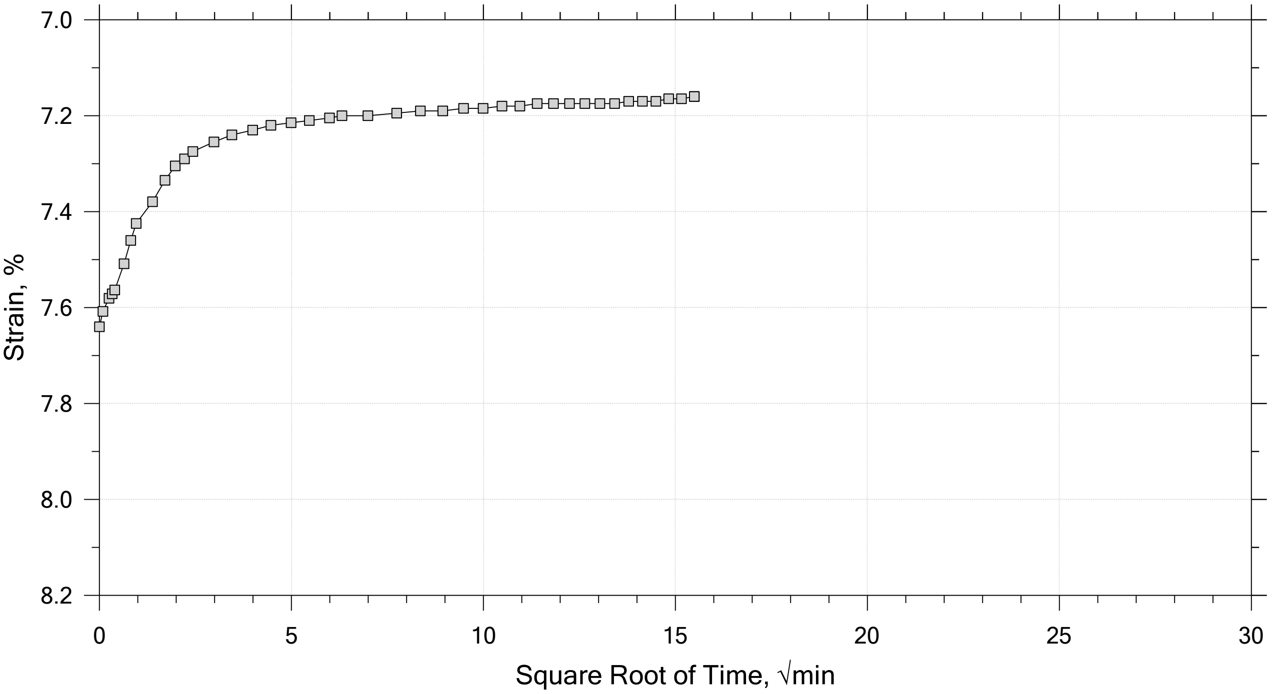
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 14 of 16

Constant Load Step

Stress: 100 kPa





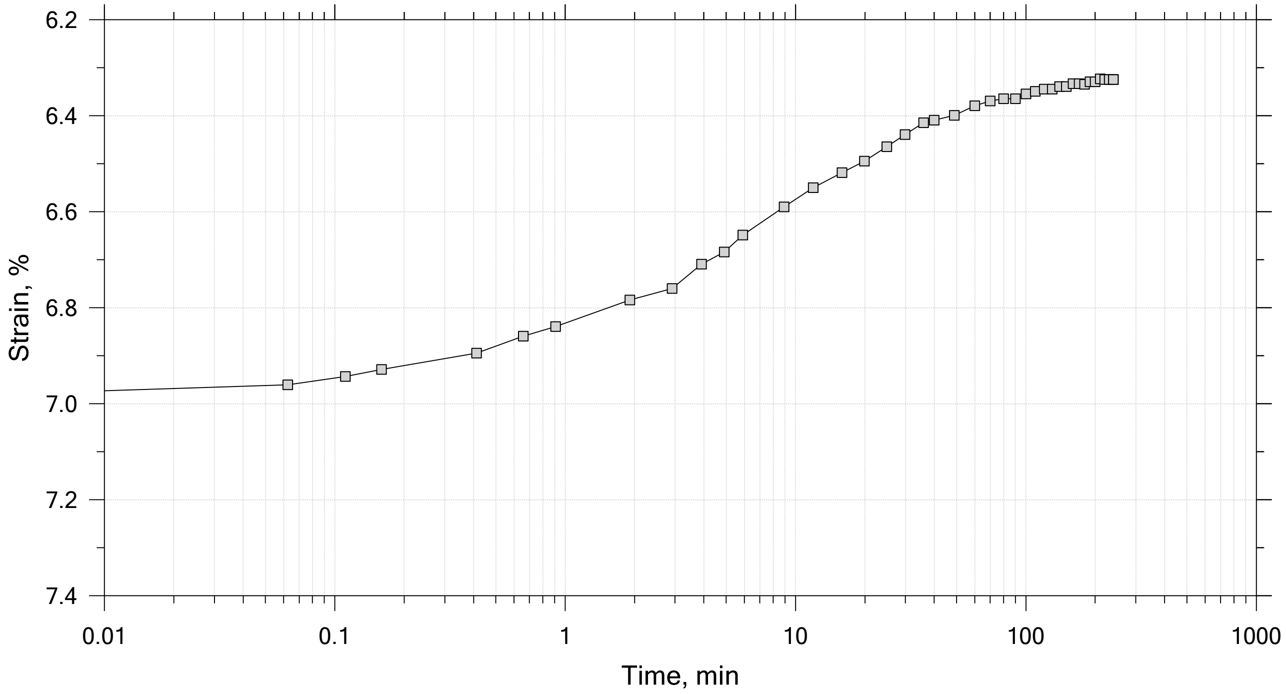
GeoTesting EXPRESS	Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: njh
	Sample No.: 24-2	Test Date: 12/2/22	Depth: 47'9"-47'11"
	Test No.: IP-6	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-007, Swell Pressure = 5.49 kPa		

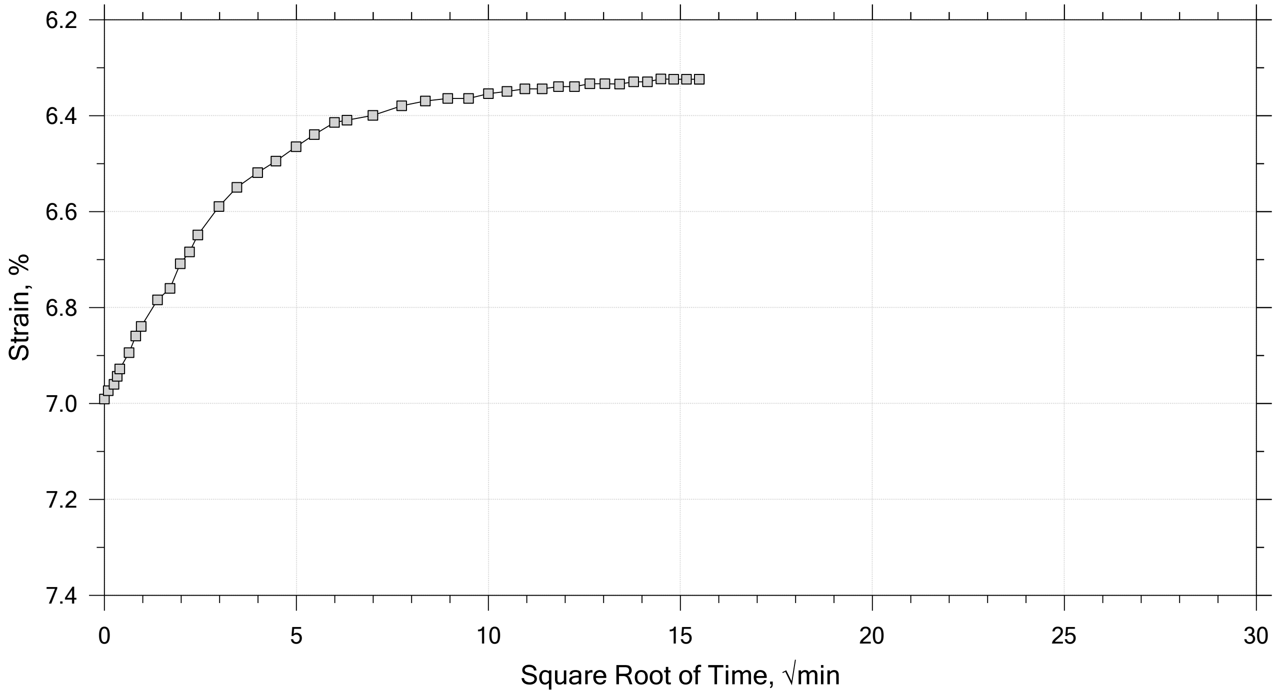
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 15 of 16

Constant Load Step

Stress: 25 kPa





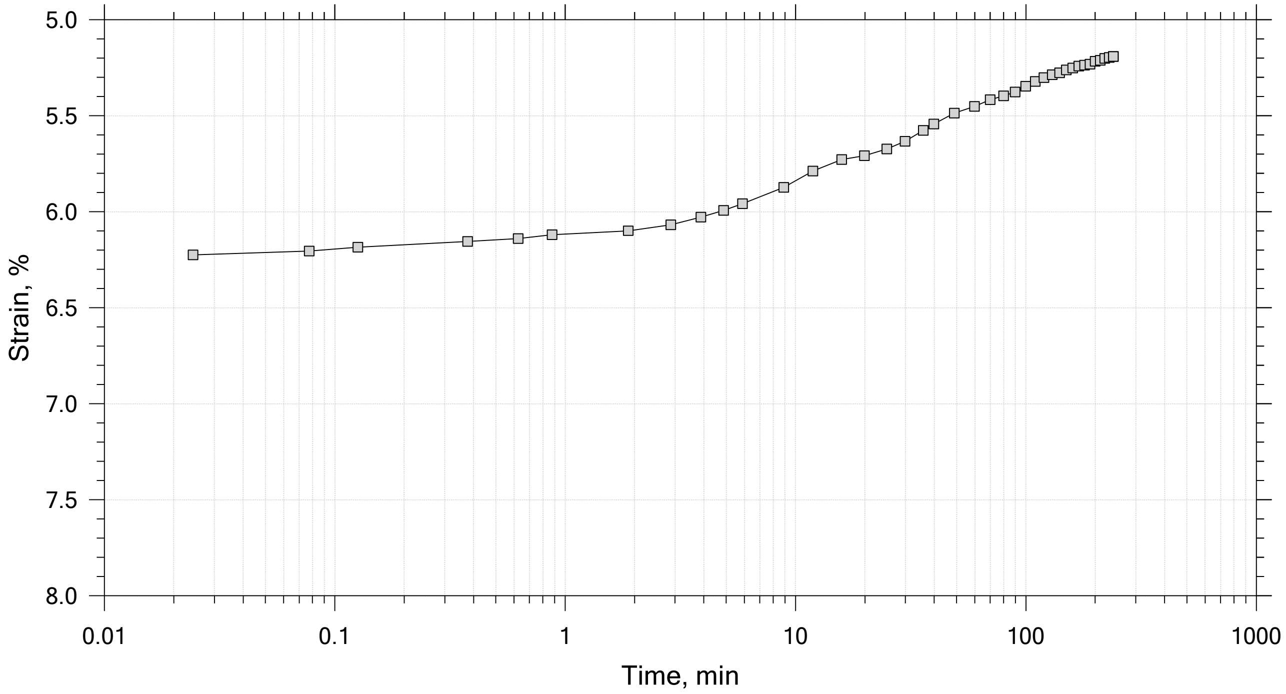
GeoTesting EXPRESS	Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: njh
	Sample No.: 24-2	Test Date: 12/2/22	Depth: 47'9"-47'11"
	Test No.: IP-6	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-007, Swell Pressure = 5.49 kPa		

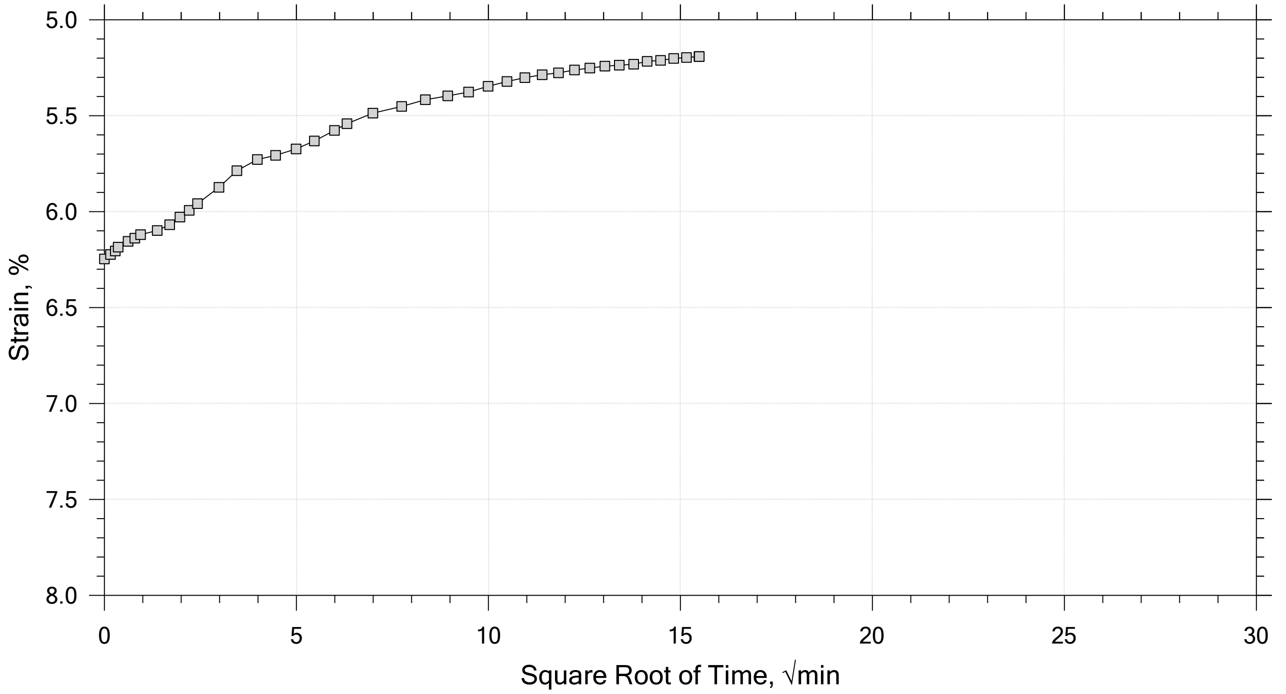
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 16 of 16

Constant Load Step

Stress: 5 kPa





	Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: njh
GeoTesting EXPRESS	Sample No.: 24-2	Test Date: 12/2/22	Depth: 47'9"-47'11"
	Test No.: IP-6	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-007, Swell Pressure = 5.49 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Specimen Diameter: 2.50 in	Estimated Specific Gravity: 2.78	Liquid Limit: ---
Initial Height: 1.00 in	Initial Void Ratio: 0.663	Plastic Limit: ---
Final Height: 0.94 in	Final Void Ratio: 0.564	Plasticity Index: ---

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	E7467	RING		E5587
Mass Container, gm	8.4	109.72	109.72	8.3
Mass Container + Wet Soil, gm	222.94	276.09	271.52	173.52
Mass Container + Dry Soil, gm	191.78	244.27	244.27	145.69
Mass Dry Soil, gm	183.38	134.55	134.55	137.39
Water Content, %	16.99	23.65	20.26	20.26
Void Ratio	---	0.66	0.56	---
Degree of Saturation, %	---	99.20	100.00	---
Dry Unit Weight, pcf	---	104.42	111.08	---

Warning: The change in the sample wet weight during the test is not consistent with the change in the moisture content.

Note: Specific Gravity and Void Ratios are calculated assuming the degree of saturation equals 100% at the end of the test.
Therefore, values may not represent actual values for the specimen.

Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: njh
Sample No.: 24-2	Test Date: 12/2/22	Depth: 47'9"-47'11"
Test No.: IP-6	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-007, Swell Pressure = 5.49 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

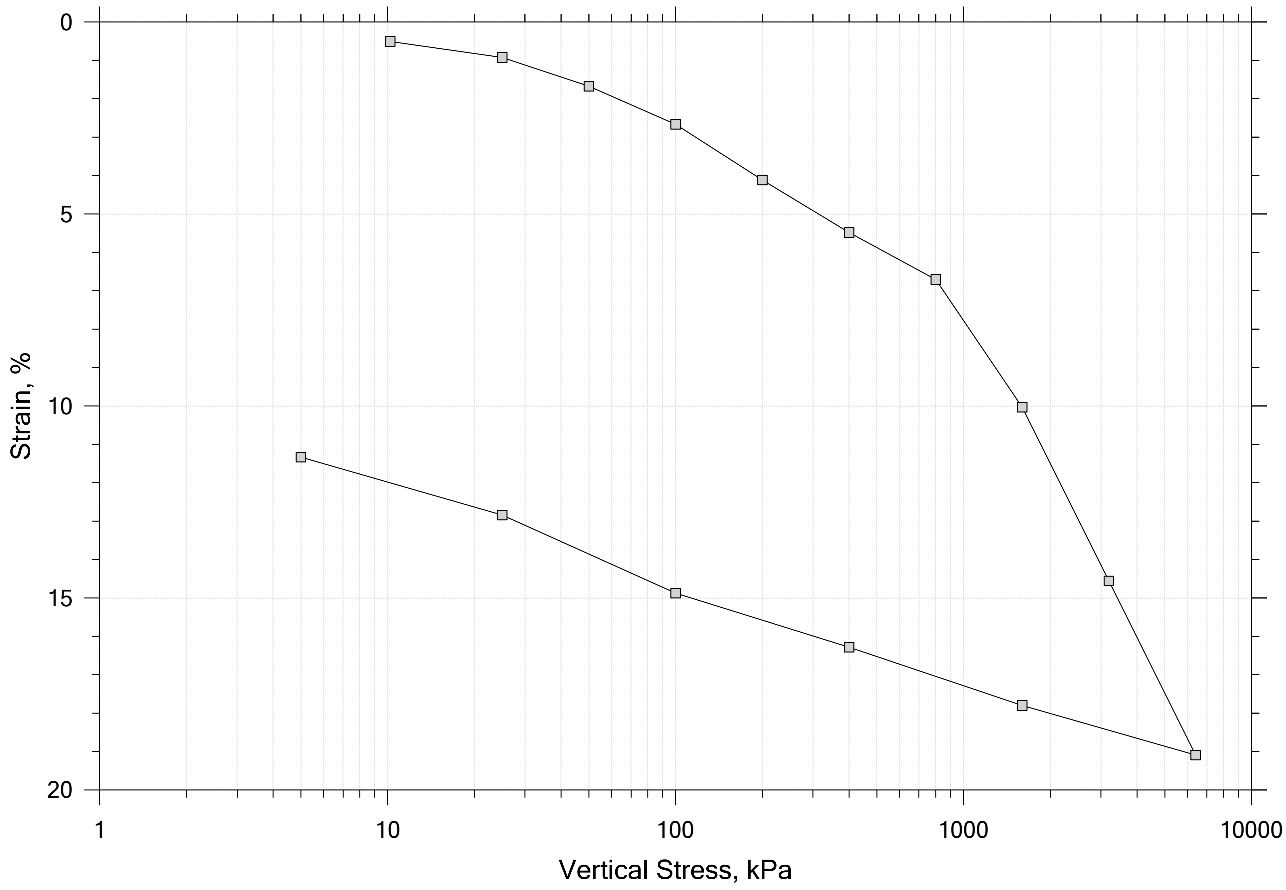
Square Root of Time Coefficients

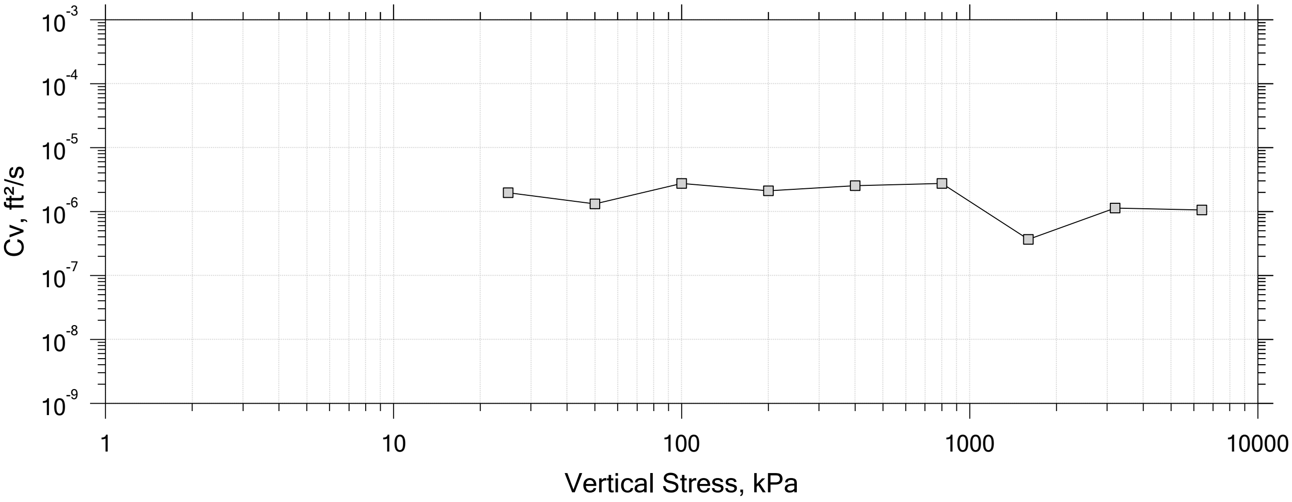
Step	Applied Stress kPa	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt. T90 min	Cv ft²/s	Mv 1/kPa	k ft/day
1	5.49	0.002278	0.660	0.228	4.321	5.67e-06	4.15e-04	6.07e-04
2	10.0	0.004056	0.657	0.406	48.442	5.03e-07	3.94e-04	5.13e-05
3	25.0	0.008524	0.649	0.852	13.575	1.78e-06	2.98e-04	1.37e-04
4	50.0	0.01478	0.639	1.48	8.090	2.96e-06	2.50e-04	1.91e-04
5	100.	0.02300	0.625	2.30	6.418	3.68e-06	1.64e-04	1.56e-04
6	200.	0.03181	0.610	3.18	6.868	3.38e-06	8.82e-05	7.70e-05
7	400.	0.04041	0.596	4.04	9.481	2.40e-06	4.30e-05	2.67e-05
8	800.	0.05058	0.579	5.06	16.994	1.32e-06	2.54e-05	8.64e-06
9	1.60e+03	0.06197	0.560	6.20	10.503	2.08e-06	1.42e-05	7.65e-06
10	3.20e+03	0.07996	0.530	8.00	26.615	7.96e-07	1.12e-05	2.31e-06
11	6.40e+03	0.1006	0.496	10.1	20.743	9.79e-07	6.47e-06	1.63e-06
12	1.60e+03	0.08822	0.517	8.82	1.909	1.05e-05	2.59e-06	7.05e-06
13	400.	0.07988	0.530	7.99	1.740	1.18e-05	6.95e-06	2.12e-05
14	100.	0.07160	0.544	7.16	6.378	3.29e-06	2.76e-05	2.34e-05
15	25.0	0.06324	0.558	6.32	15.766	1.35e-06	1.11e-04	3.89e-05
16	5.00	0.05191	0.577	5.19	64.932	3.36e-07	5.66e-04	4.91e-05

Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: njh
Sample No.: 24-2	Test Date: 12/2/22	Depth: 47'9"-47'11"
Test No.: IP-6	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-007, Swell Pressure = 5.49 kPa		
Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Summary Report





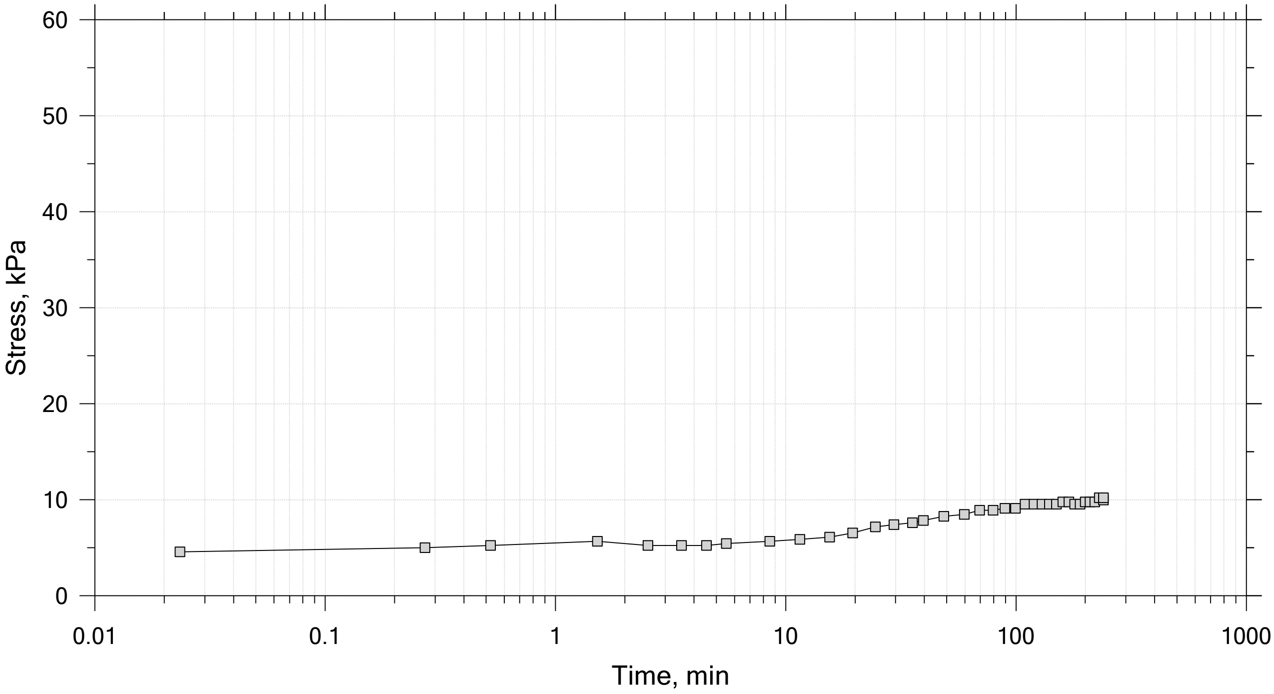
GeoTesting EXPRESS	Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: njh
	Sample No.: 27-1	Test Date: 1/17/23	Depth: 53'9"-53'11"
	Test No.: IP-4	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-032, Swell Pressure = 10.2 kPa		
	Displacement at End of Increment		

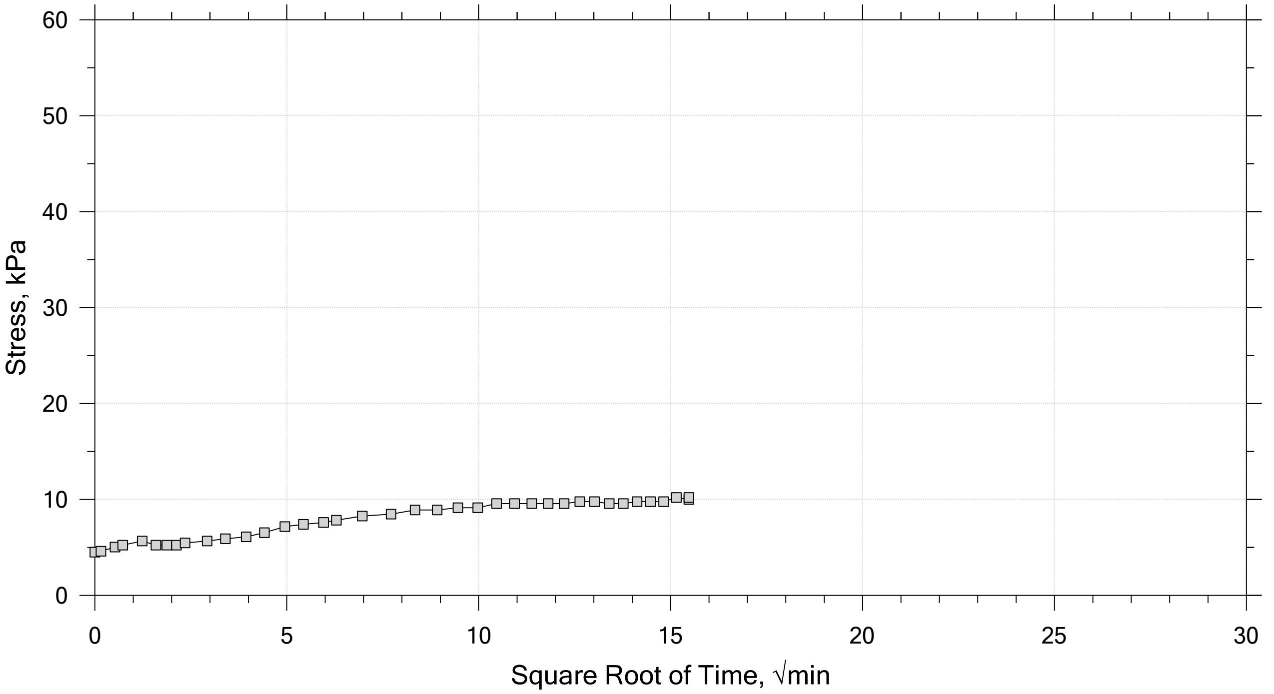
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 1 of 15

Constant Volume Step

Stress: 10.2 kPa





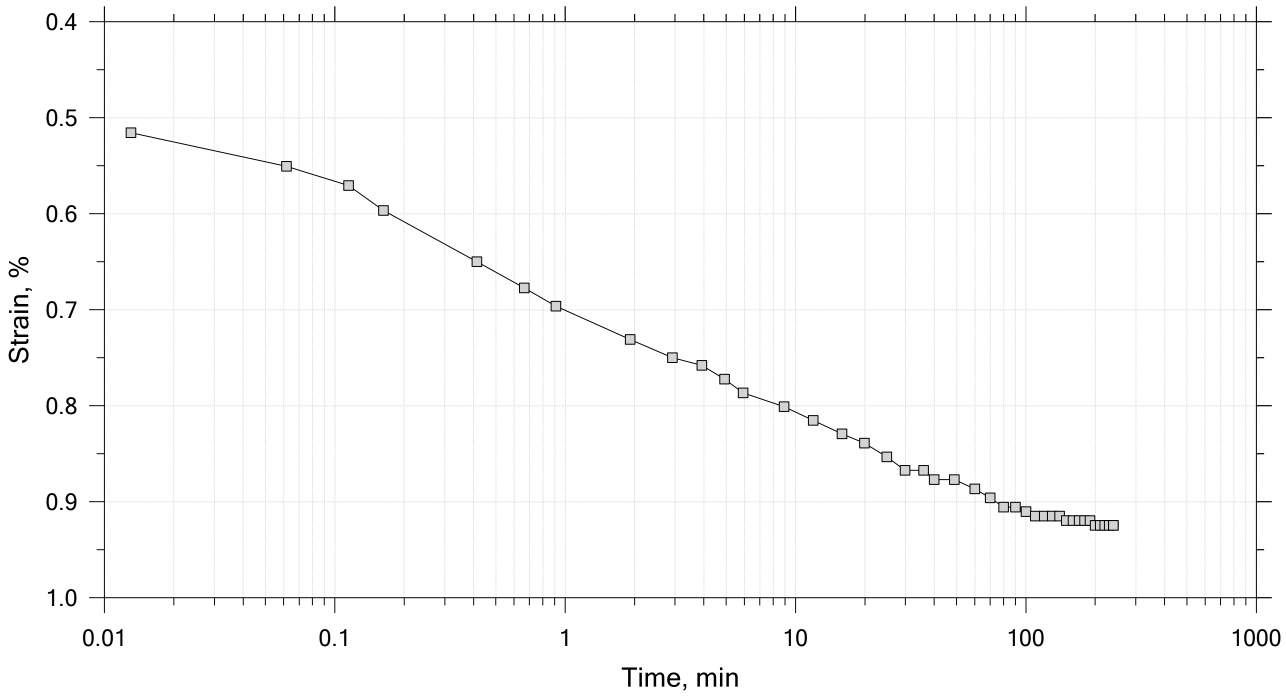
GeoTesting EXPRESS	Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: njh
	Sample No.: 27	Test Date: 1/17/23	Depth: 53'9"-53'11"
	Test No.: IP-4	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-032, Swell Pressure = 10.2 kPa		

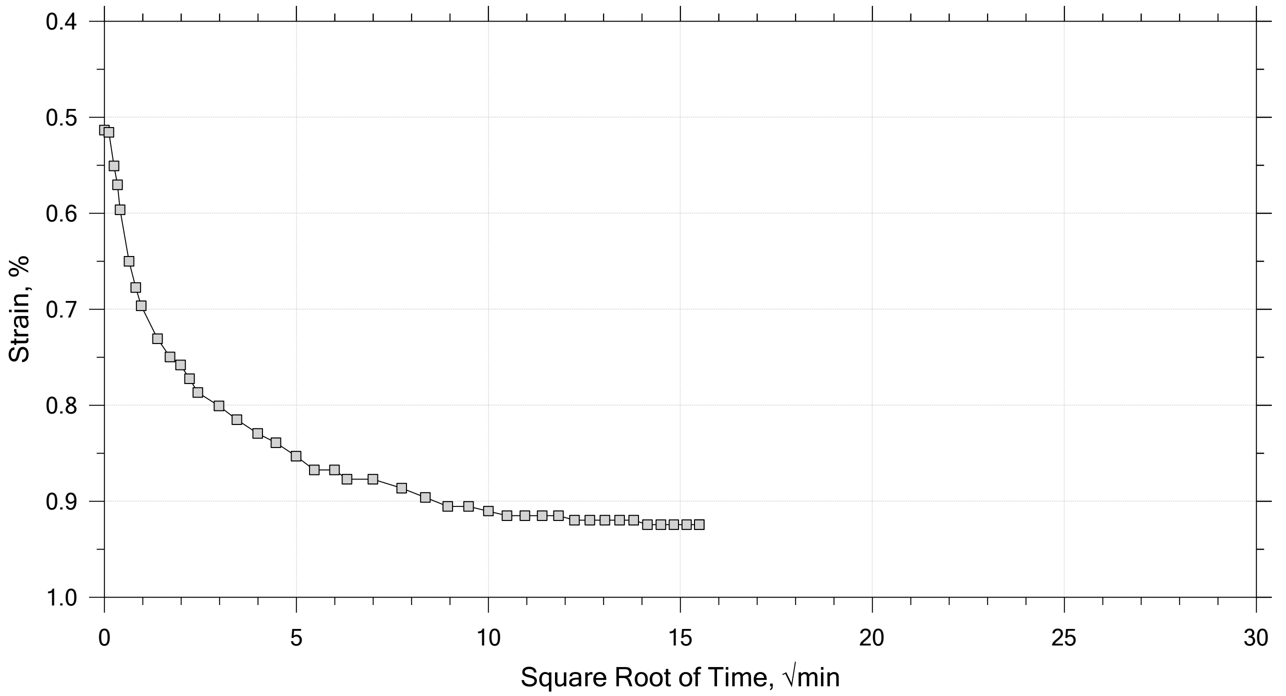
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 2 of 15

Constant Load Step

Stress: 25 kPa

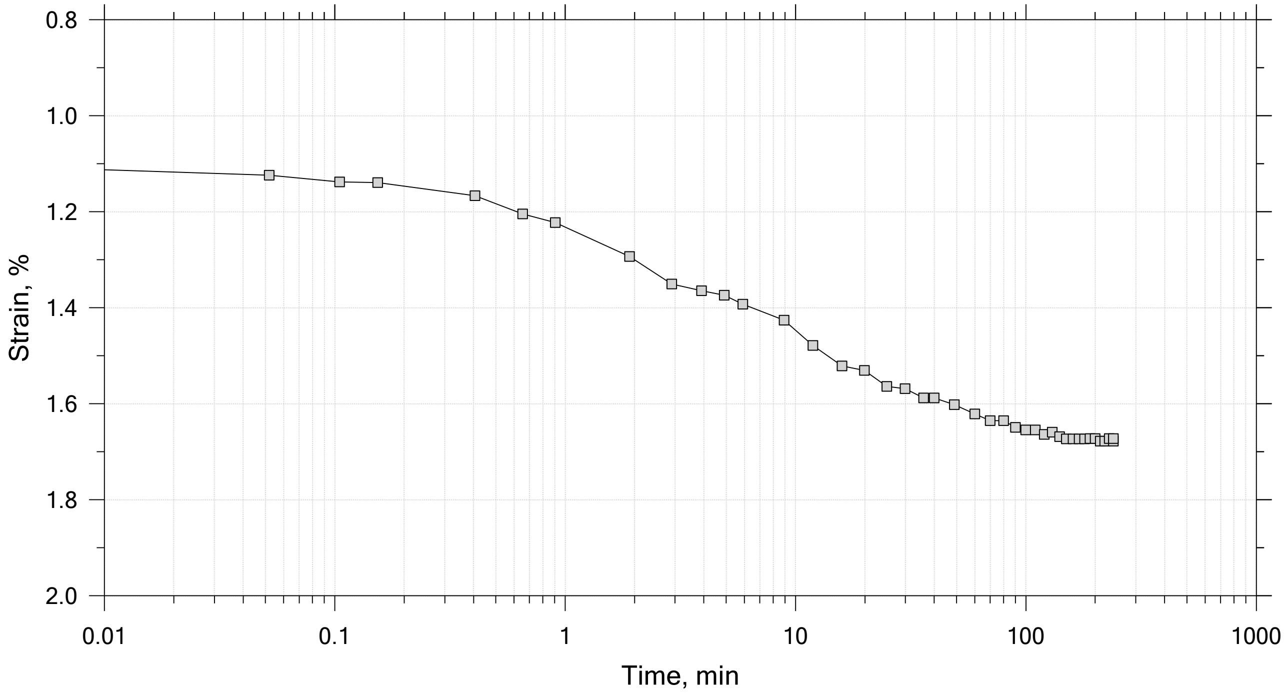


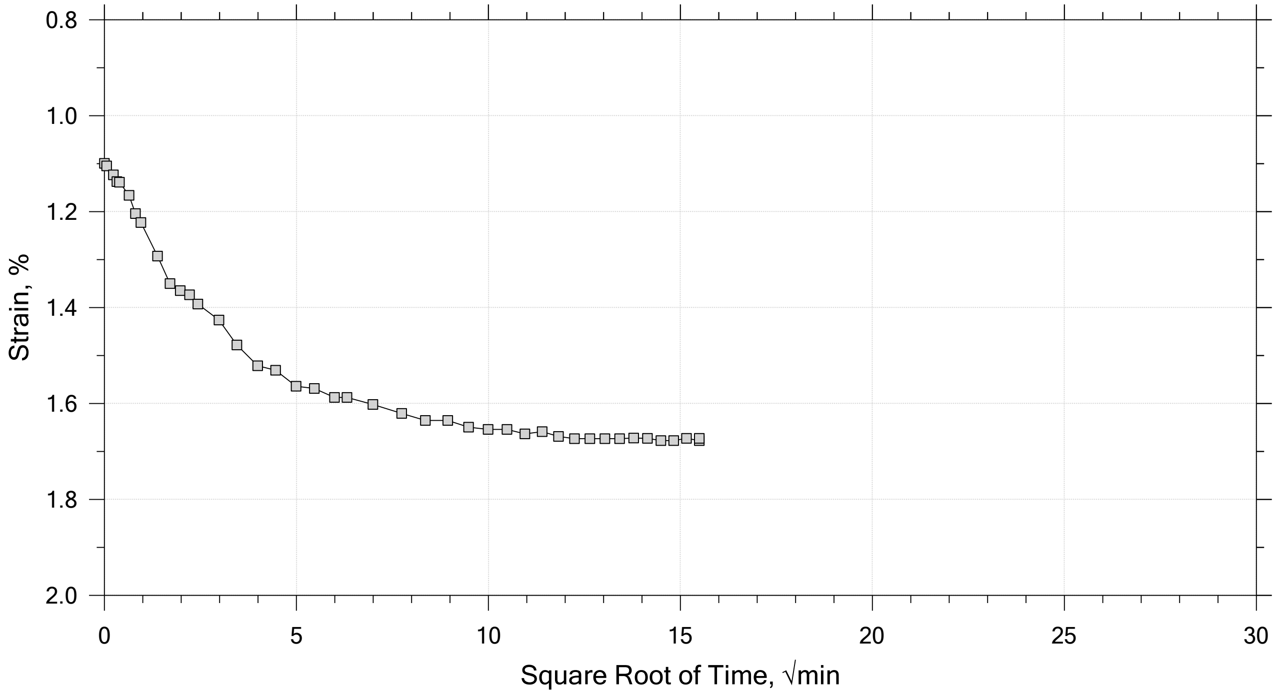


GeoTesting EXPRESS	Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: njh
	Sample No.: 27	Test Date: 1/17/23	Depth: 53'9"-53'11"
	Test No.: IP-4	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-032, Swell Pressure = 10.2 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 3 of 15
Constant Load Step
Stress: 50 kPa





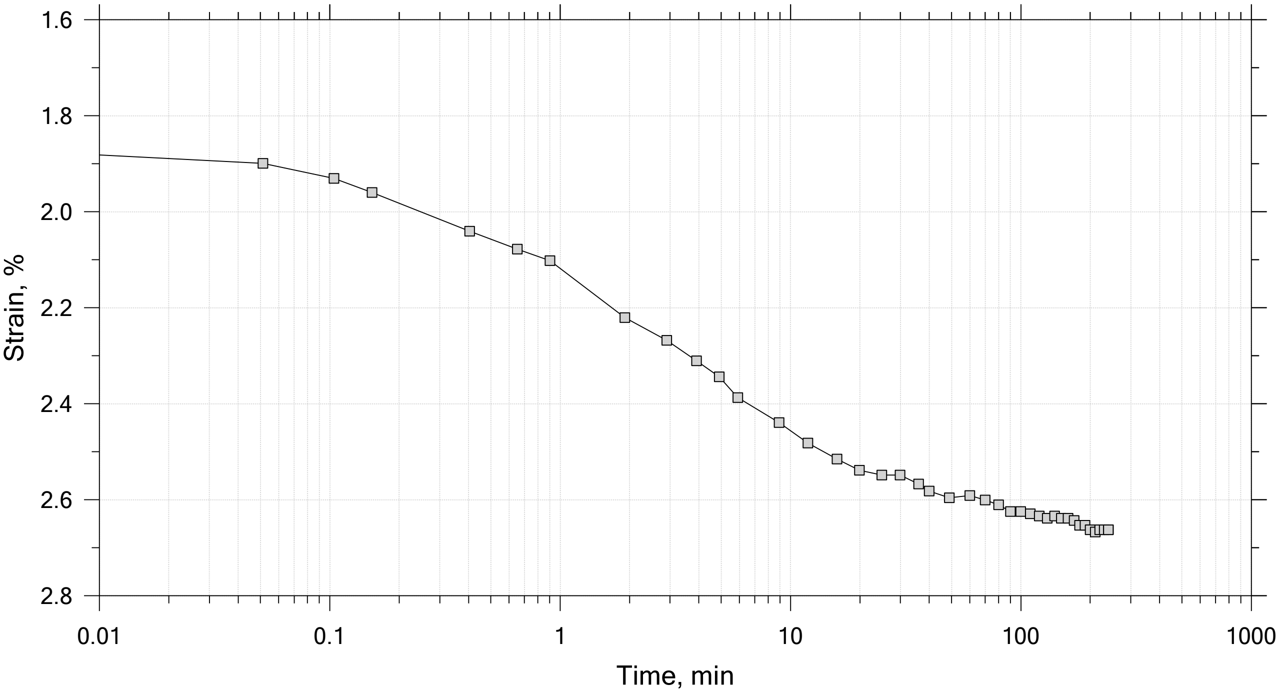
GeoTesting EXPRESS	Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: njh
	Sample No.: 27	Test Date: 1/17/23	Depth: 53'9"-53'11"
	Test No.: IP-4	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-032, Swell Pressure = 10.2 kPa		

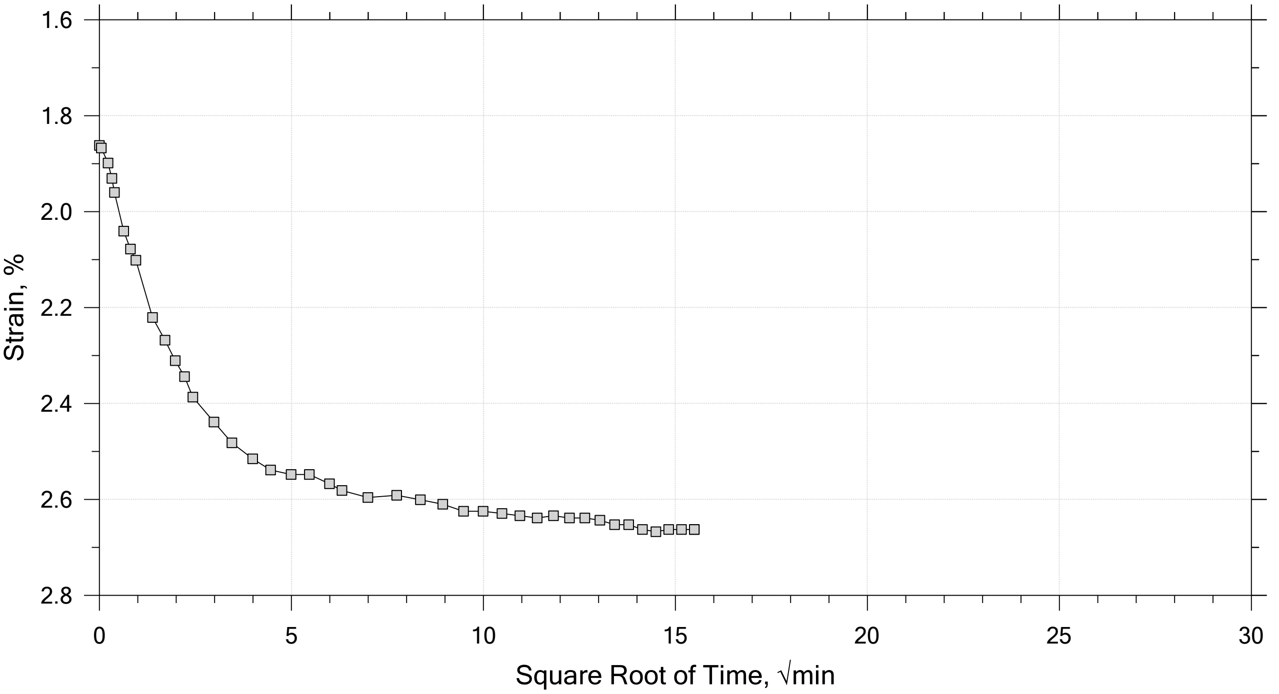
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 4 of 15

Constant Load Step

Stress: 100 kPa

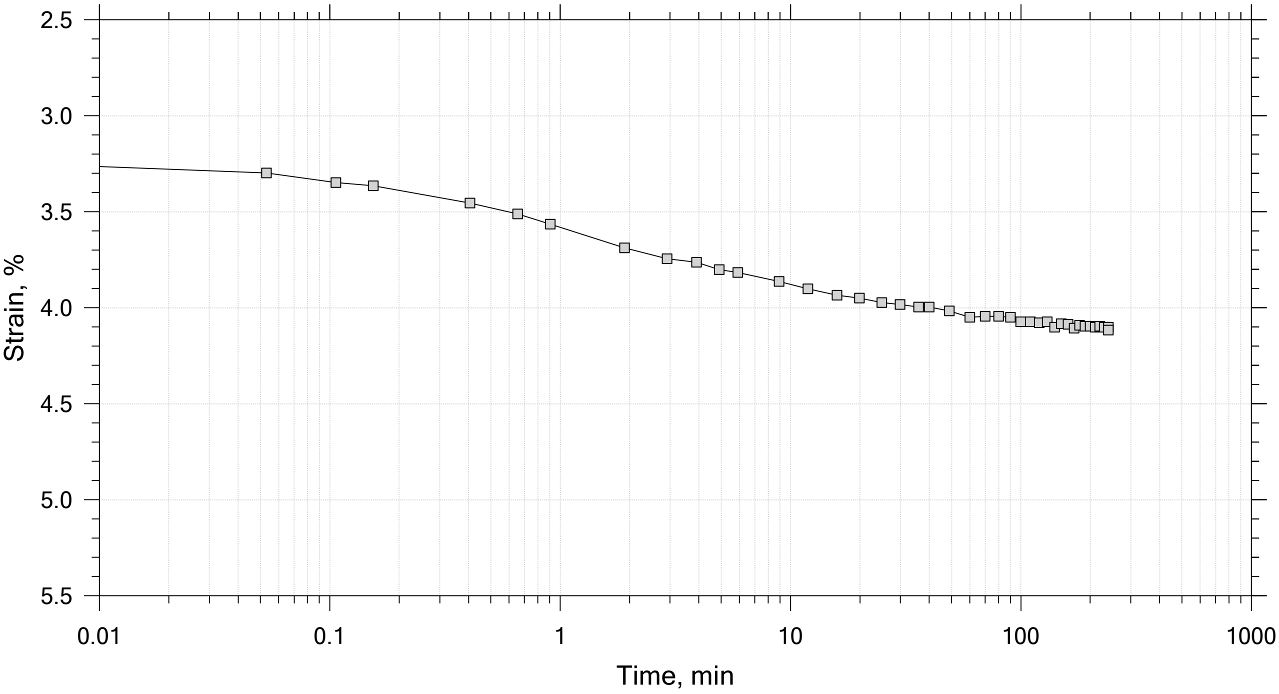


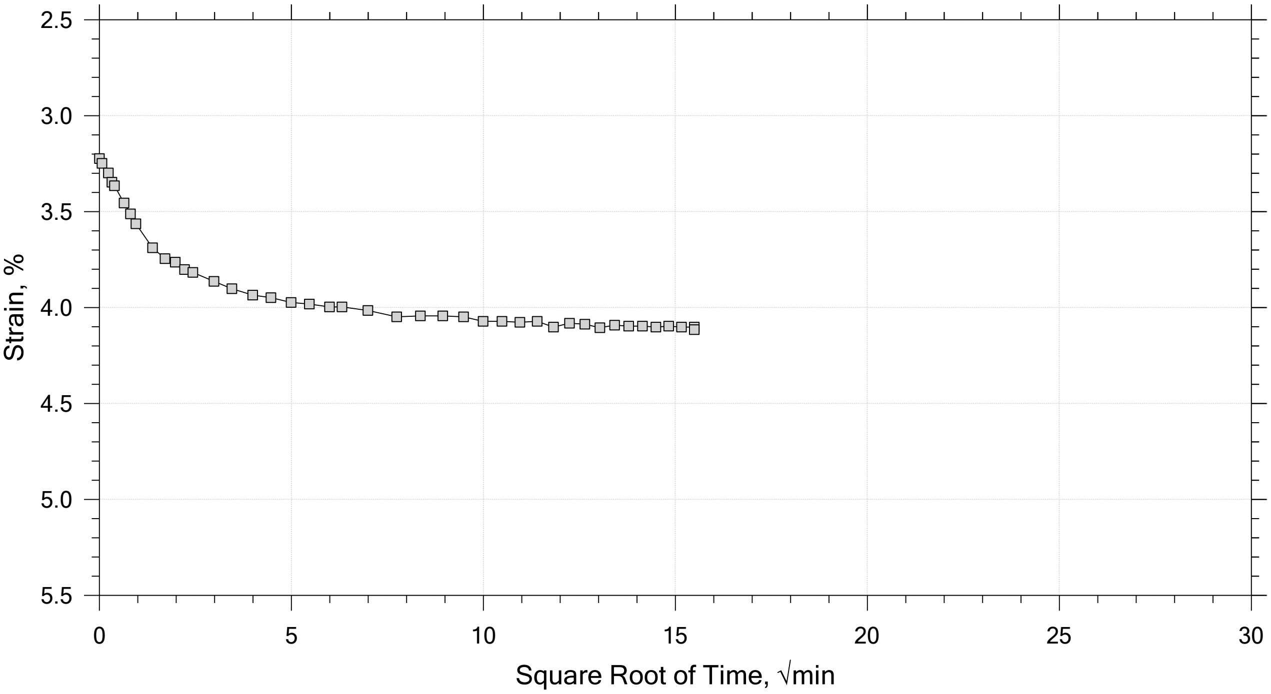


Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: njh
Sample No.: 27	Test Date: 1/17/23	Depth: 53'9"-53'11"
Test No.: IP-4	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 10.2 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 5 of 15
Constant Load Step
Stress: 200 kPa





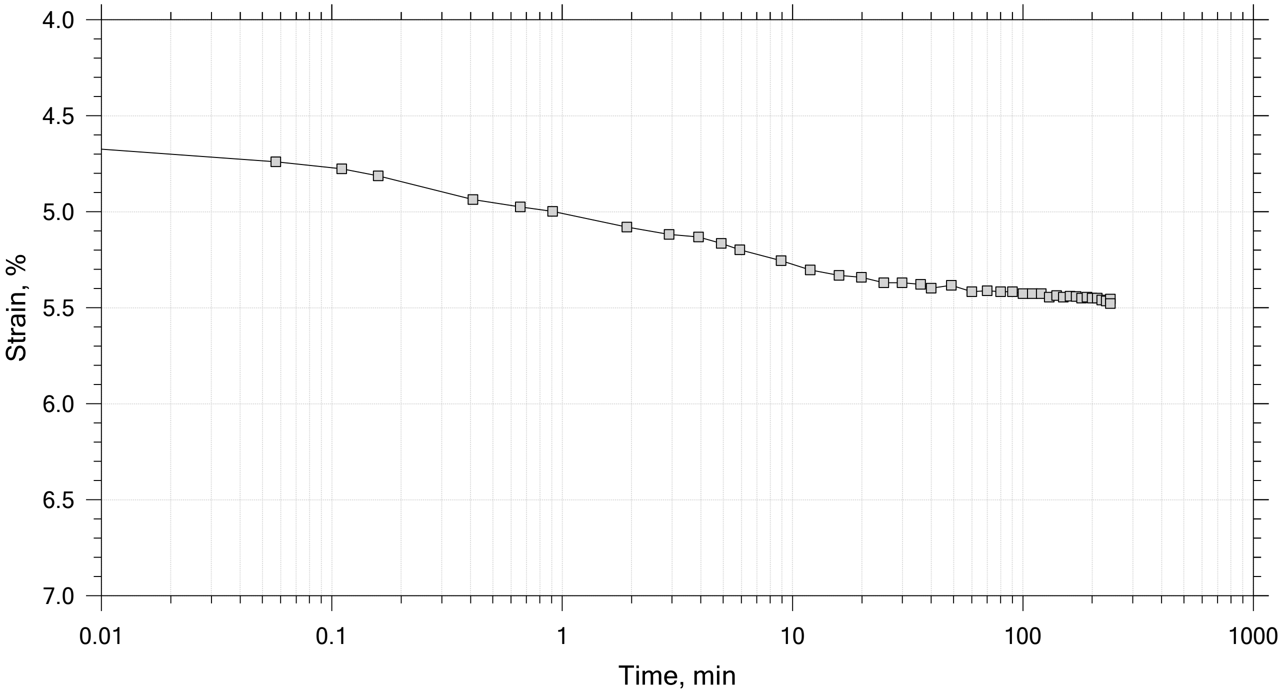
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: njh
Sample No.: 27	Test Date: 1/17/23	Depth: 53'9"-53'11"
Test No.: IP-4	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 10.2 kPa		

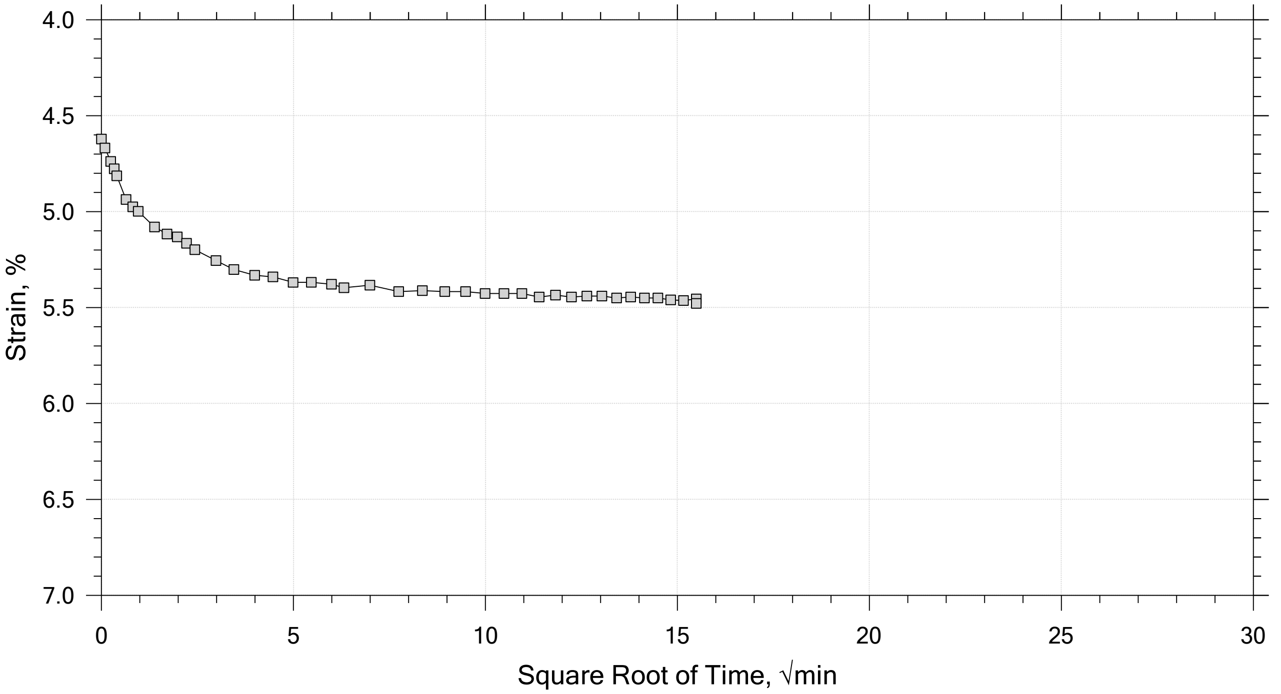
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 6 of 15

Constant Load Step

Stress: 400 kPa





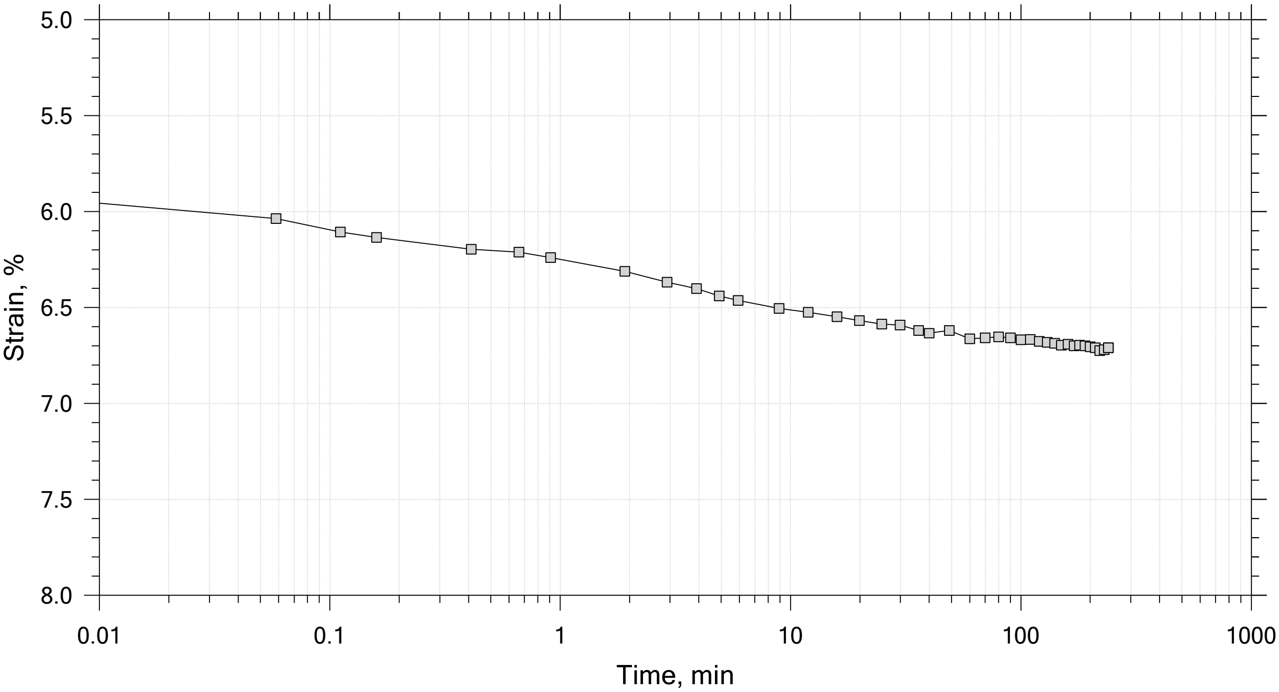
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: njh
Sample No.: 27	Test Date: 1/17/23	Depth: 53'9"-53'11"
Test No.: IP-4	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 10.2 kPa		

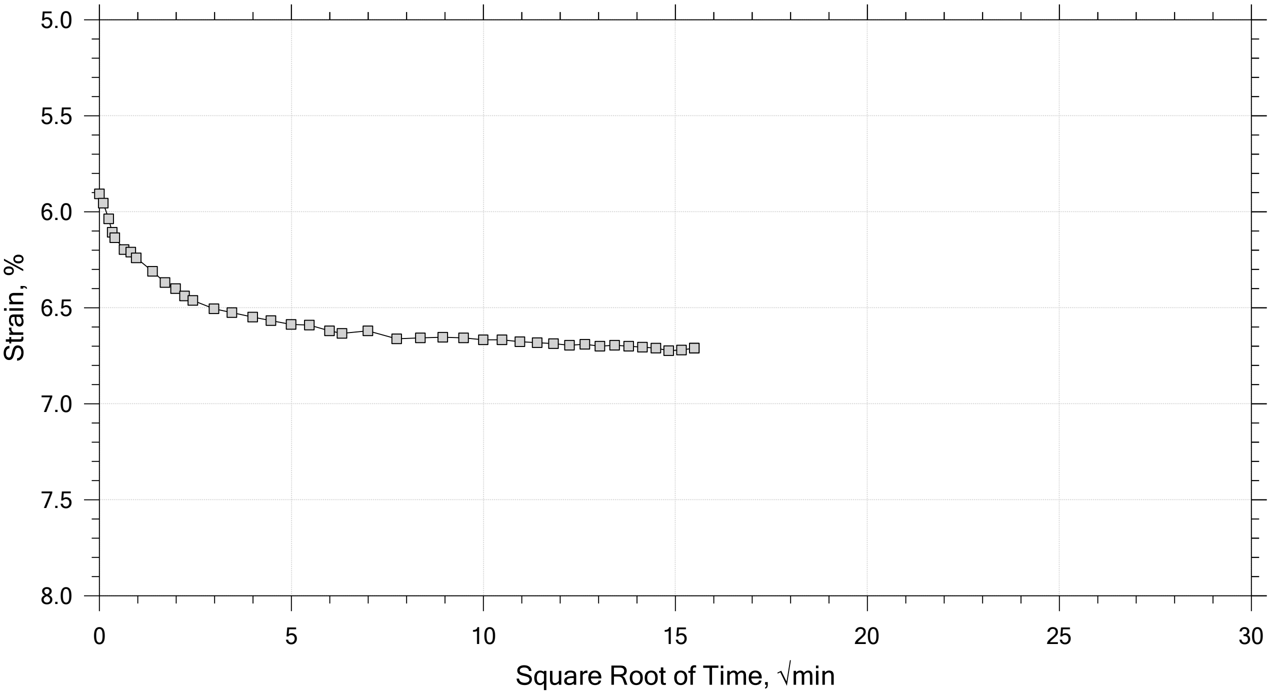
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 7 of 15

Constant Load Step

Stress: 800 kPa





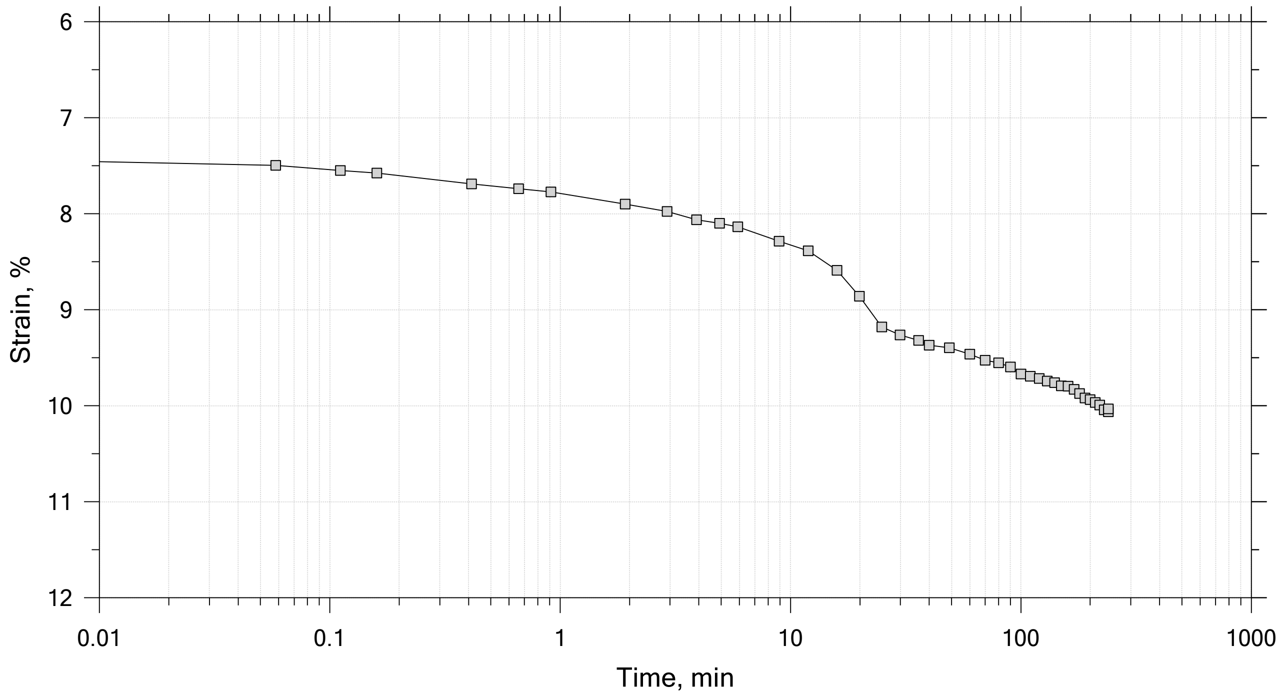
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: njh
Sample No.: 27	Test Date: 1/17/23	Depth: 53'9"-53'11"
Test No.: IP-4	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 10.2 kPa		

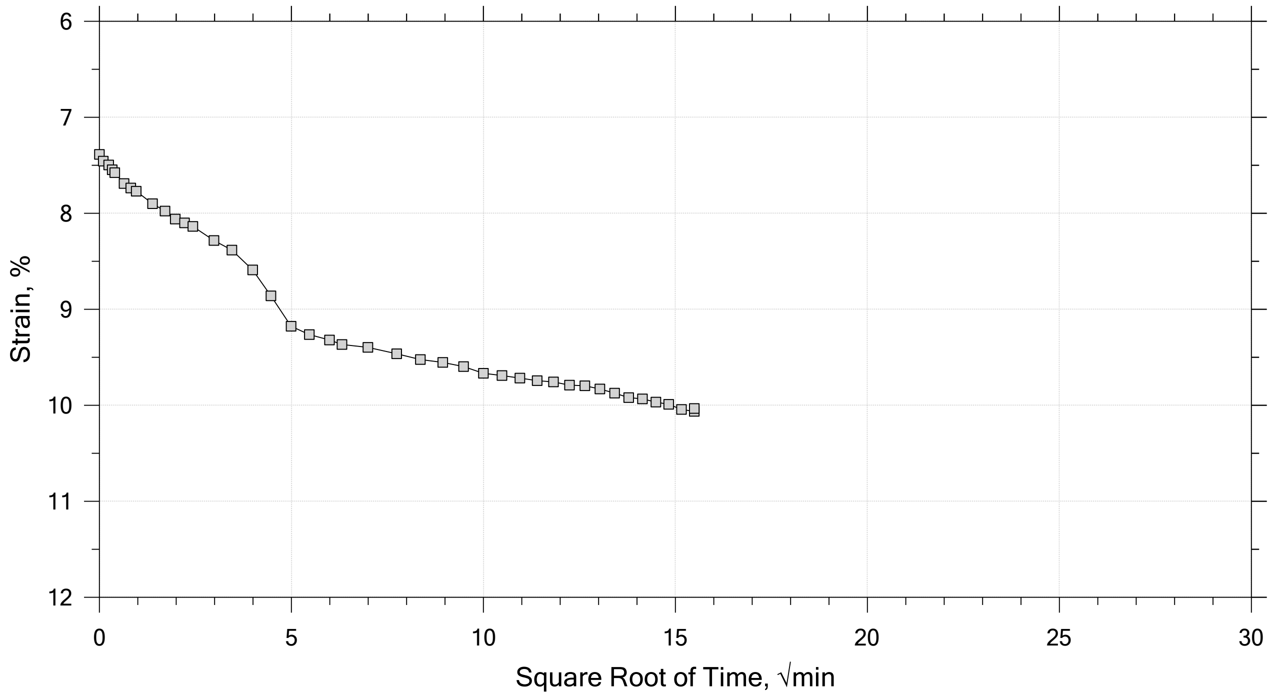
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 8 of 15

Constant Load Step

Stress: 1.6e+03 kPa





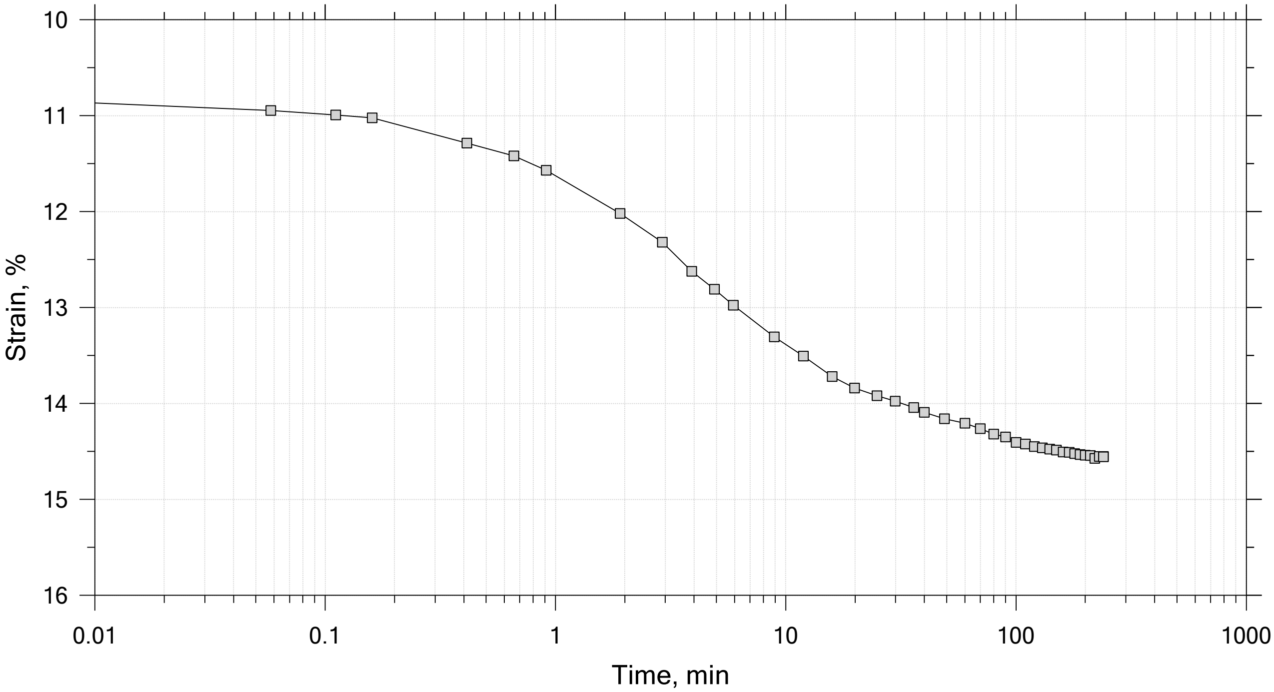
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: njh
Sample No.: 27	Test Date: 1/17/23	Depth: 53'9"-53'11"
Test No.: IP-4	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 10.2 kPa		

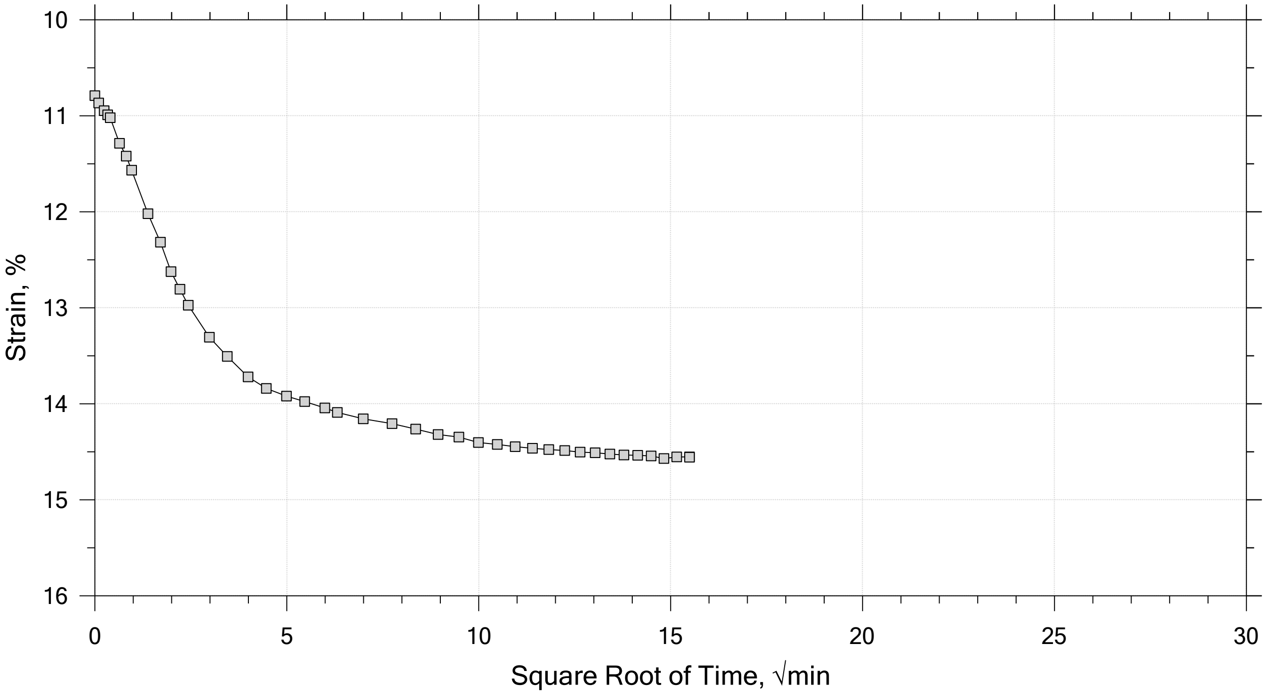
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 9 of 15

Constant Load Step

Stress: 3.2e+03 kPa





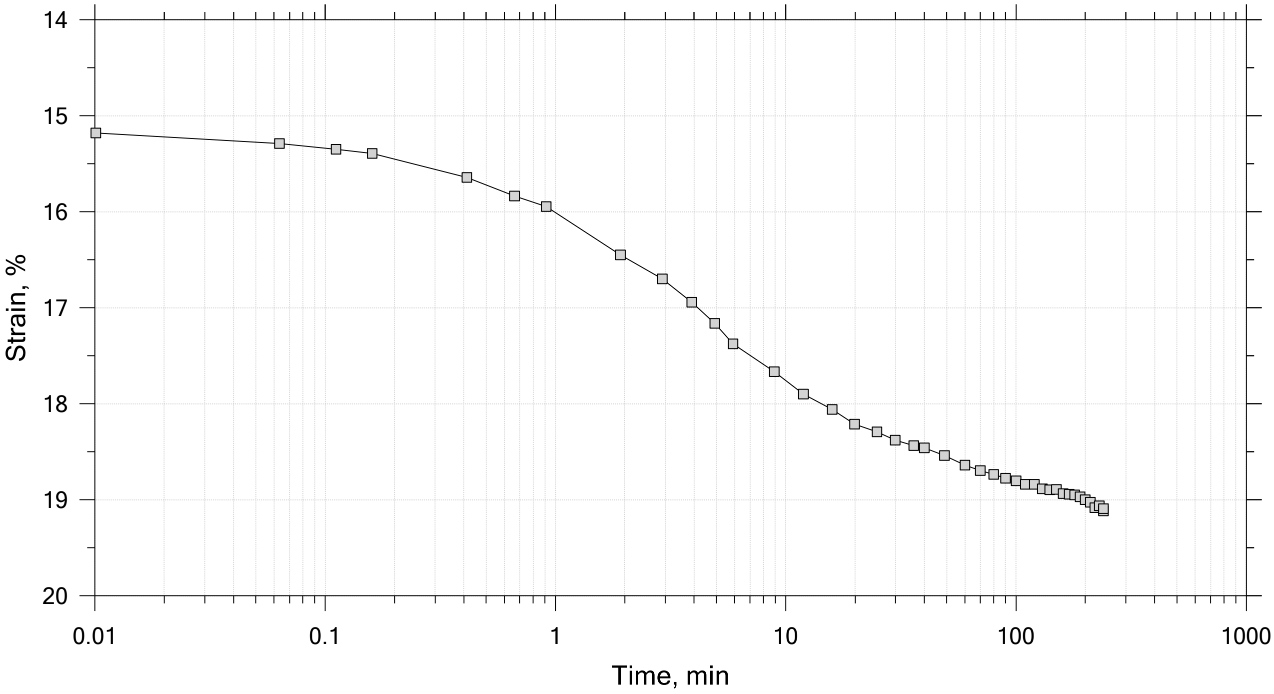
GeoTesting EXPRESS	Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: njh
	Sample No.: 27	Test Date: 1/17/23	Depth: 53'9"-53'11"
	Test No.: IP-4	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-032, Swell Pressure = 10.2 kPa		

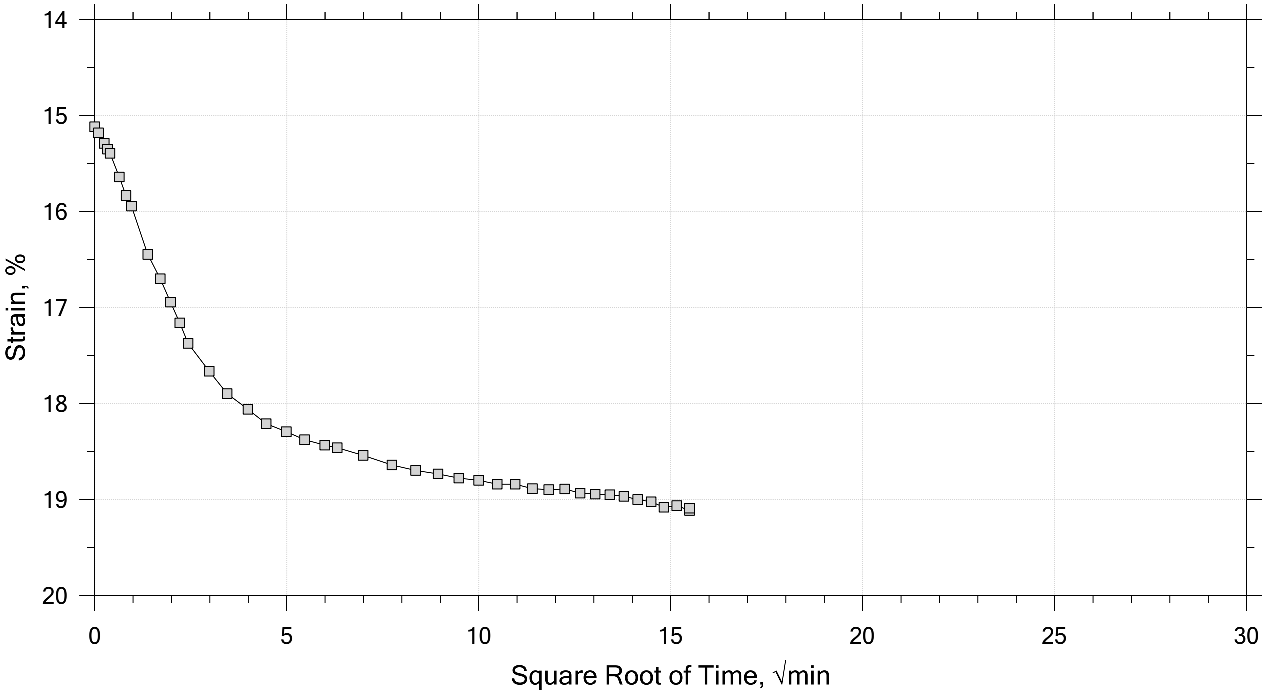
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 10 of 15

Constant Load Step

Stress: 6.4e+03 kPa

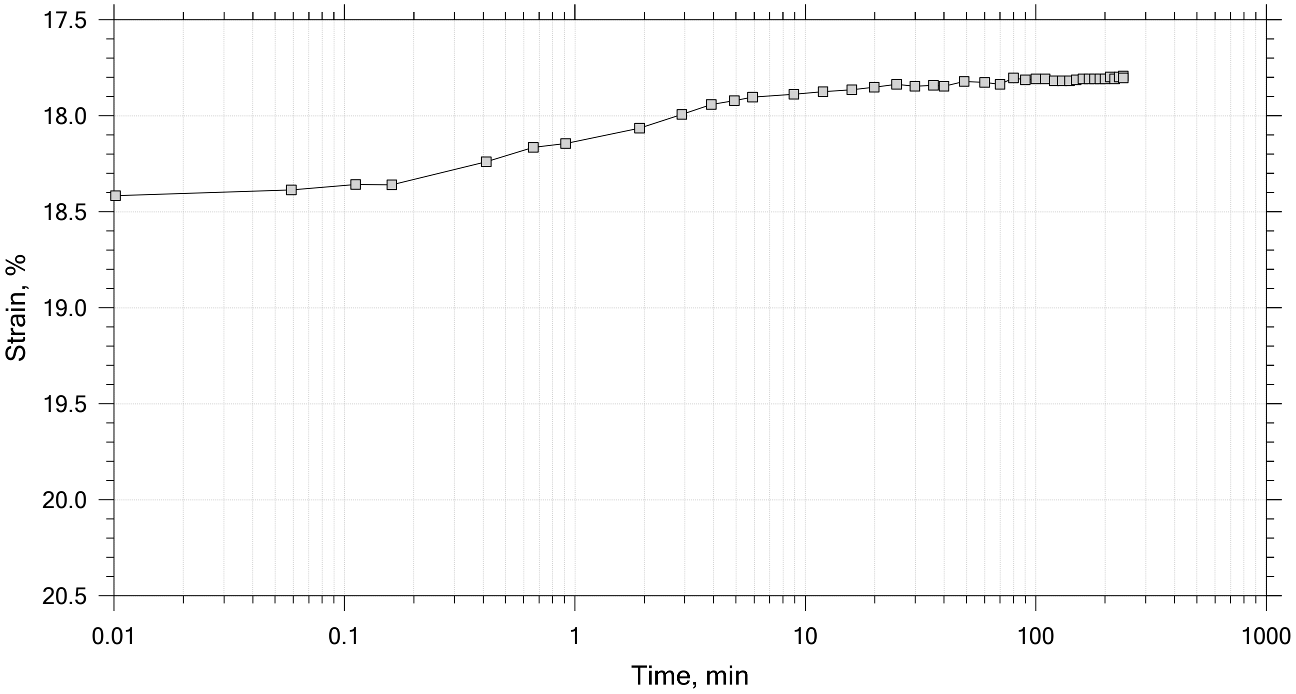


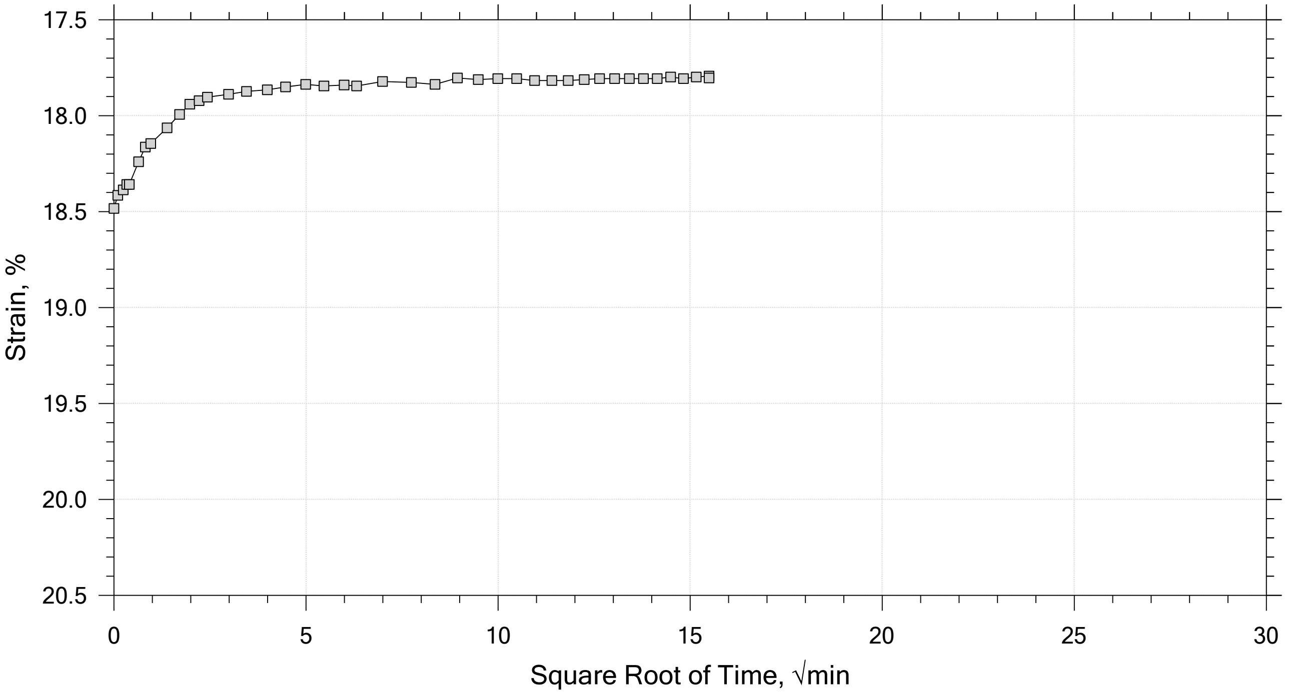


Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: njh
Sample No.: 27	Test Date: 1/17/23	Depth: 53'9"-53'11"
Test No.: IP-4	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 10.2 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 11 of 15
Constant Load Step
Stress: 1.6e+03 kPa





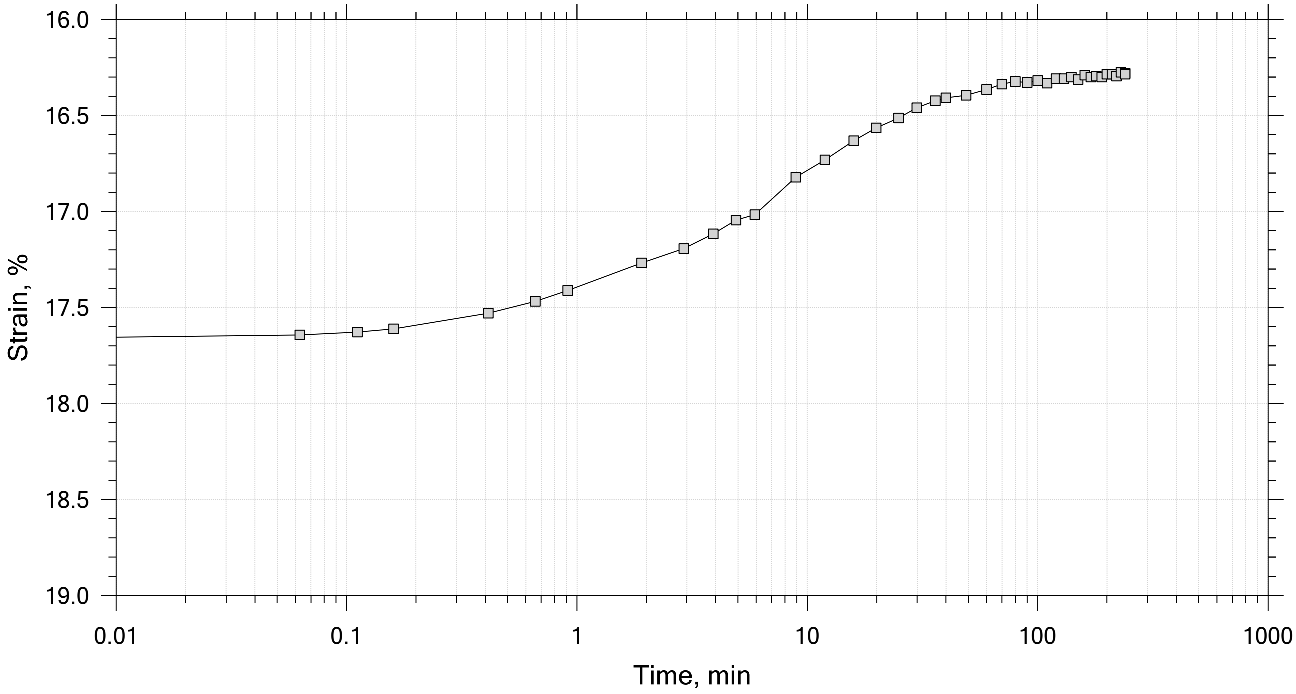
GeoTesting EXPRESS	Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: njh
	Sample No.: 27	Test Date: 1/17/23	Depth: 53'9"-53'11"
	Test No.: IP-4	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-032, Swell Pressure = 10.2 kPa		

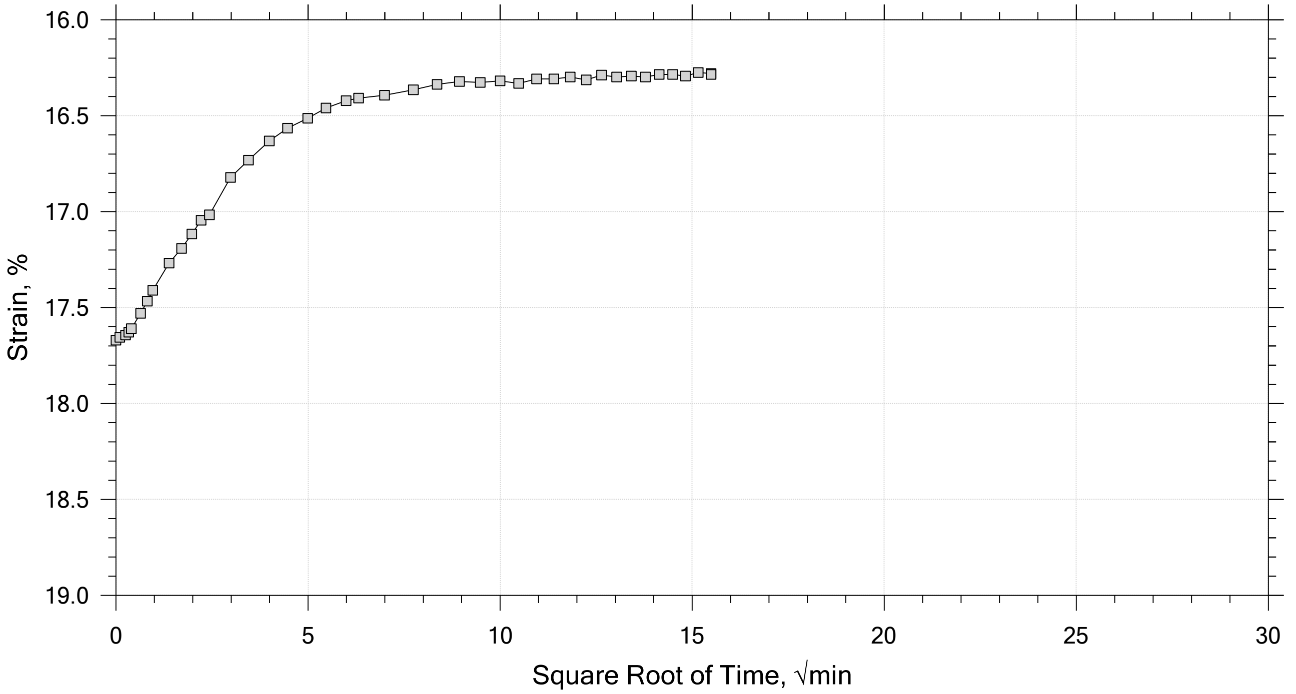
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 12 of 15

Constant Load Step

Stress: 400 kPa





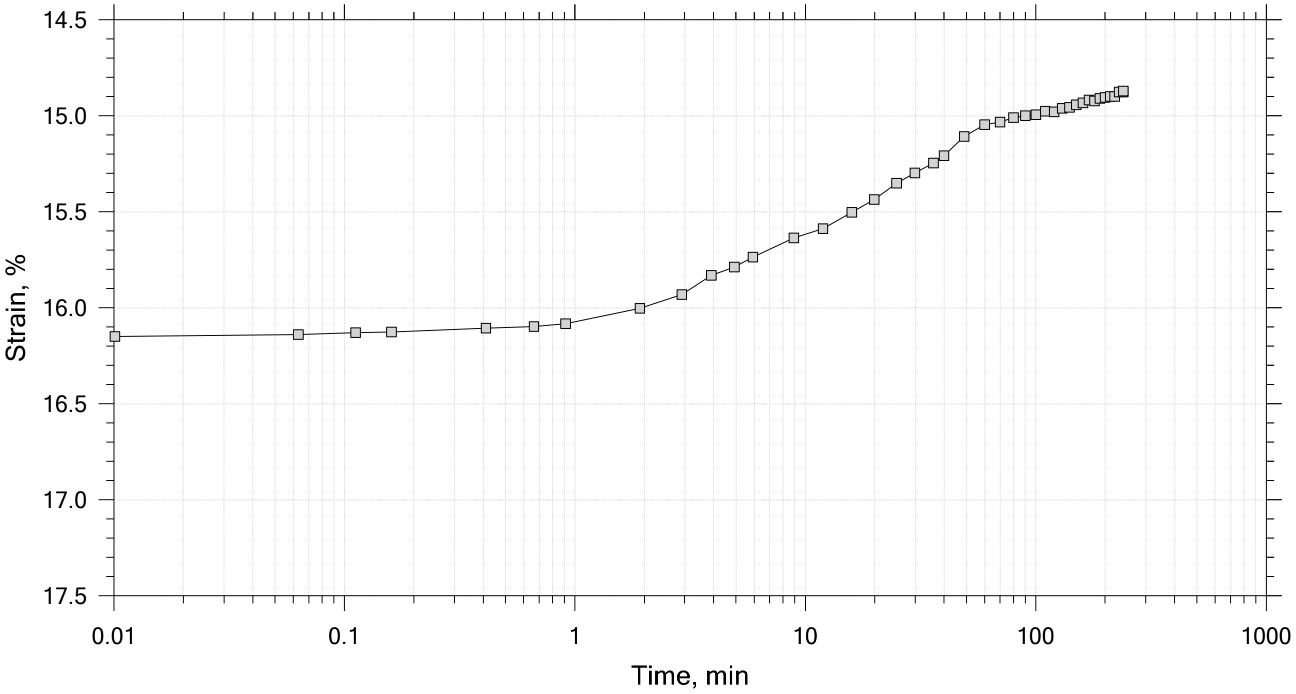
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: njh
Sample No.: 27	Test Date: 1/17/23	Depth: 53'9"-53'11"
Test No.: IP-4	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 10.2 kPa		

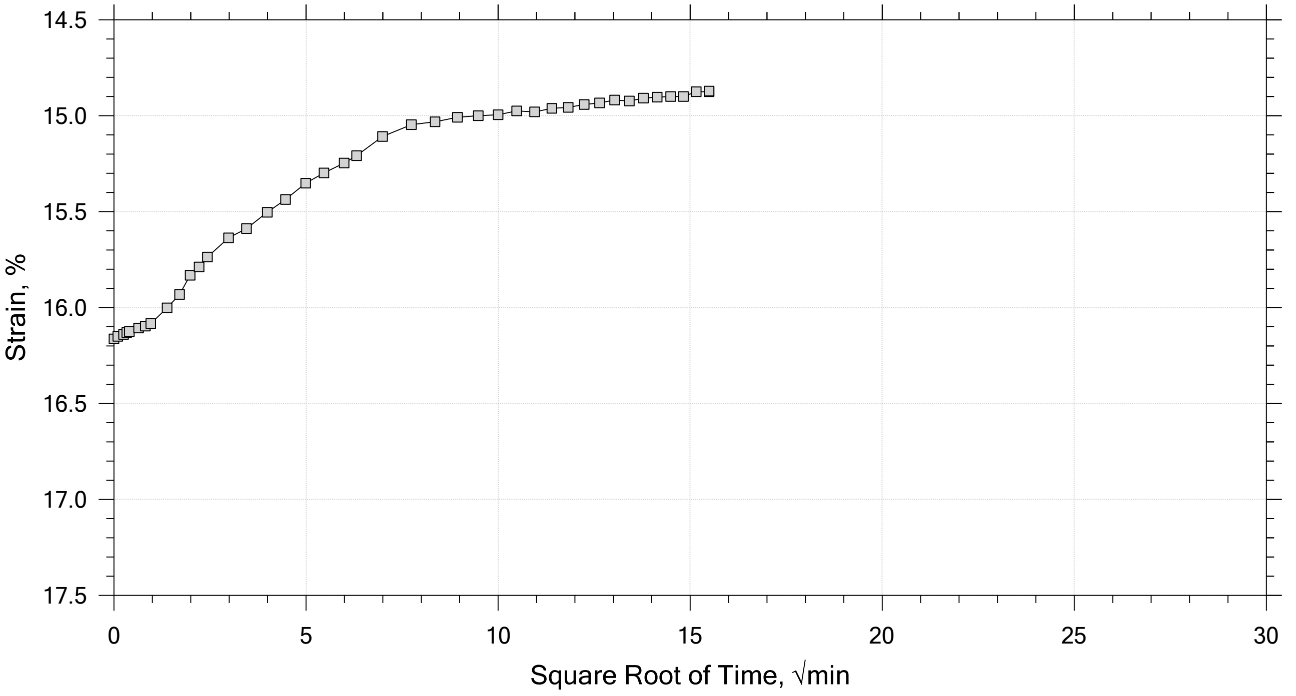
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 13 of 15

Constant Load Step

Stress: 100 kPa





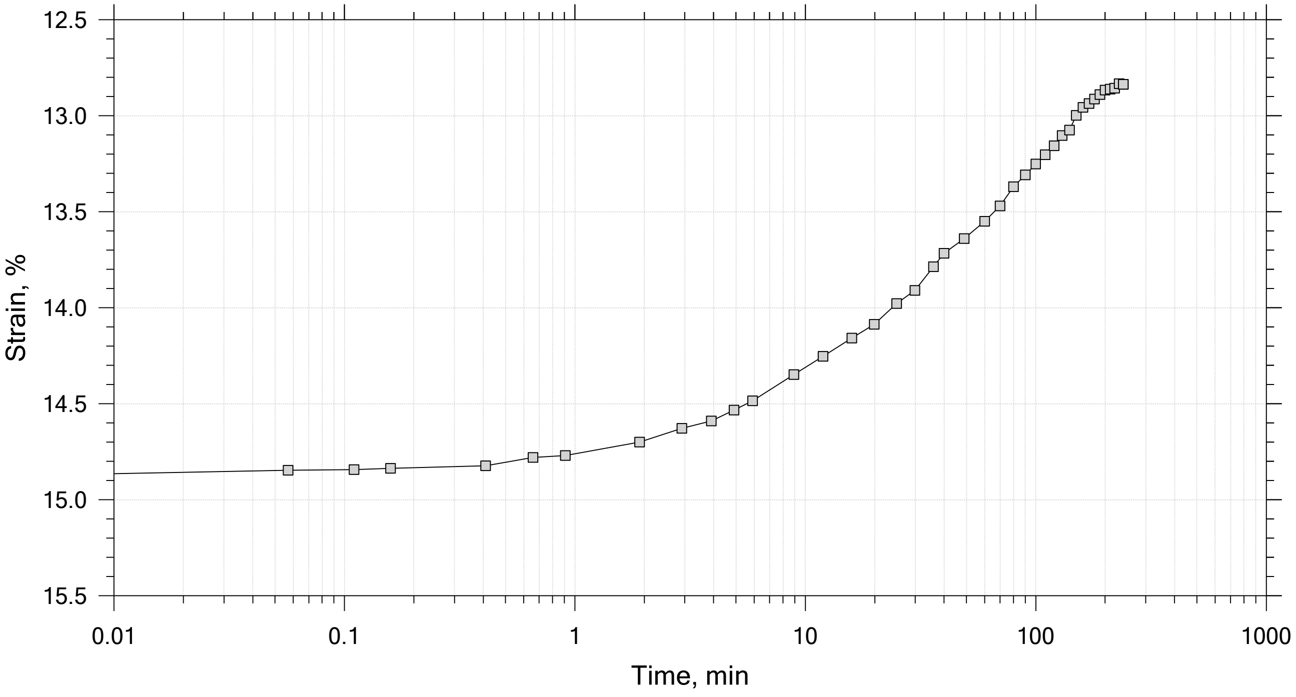
GeoTesting EXPRESS	Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: njh
	Sample No.: 27	Test Date: 1/17/23	Depth: 53'9"-53'11"
	Test No.: IP-4	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-032, Swell Pressure = 10.2 kPa		

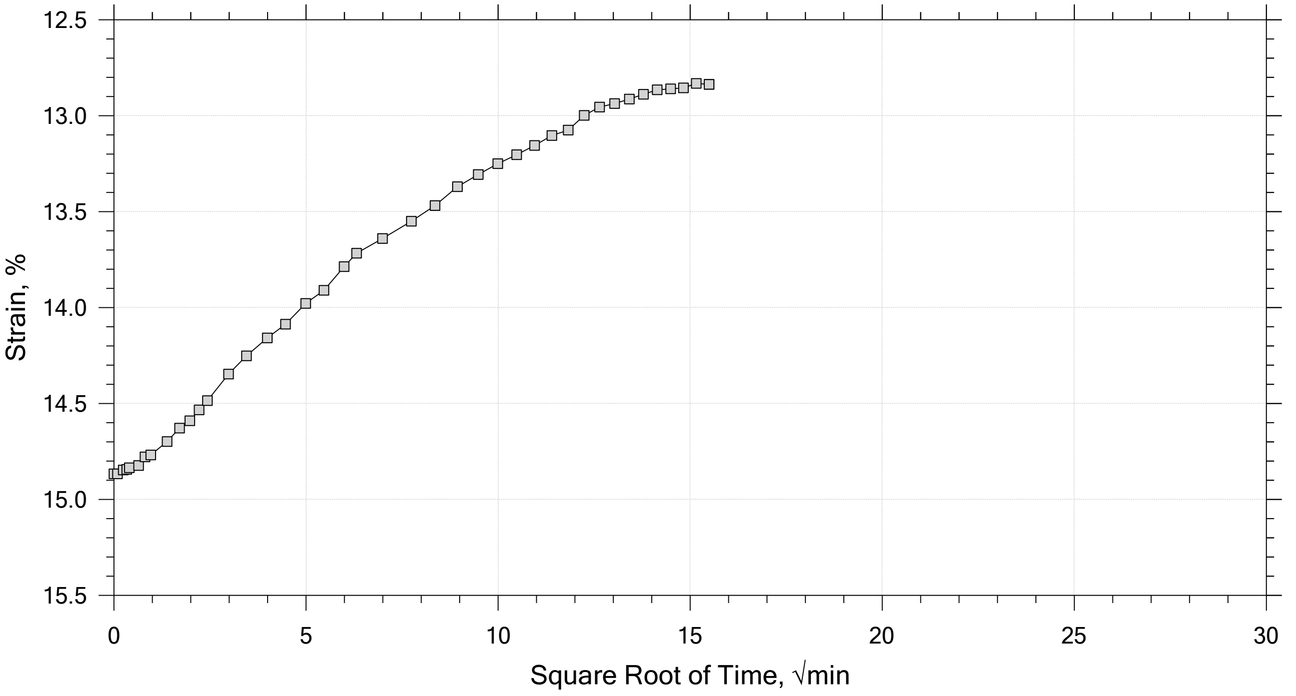
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 14 of 15

Constant Load Step

Stress: 25 kPa





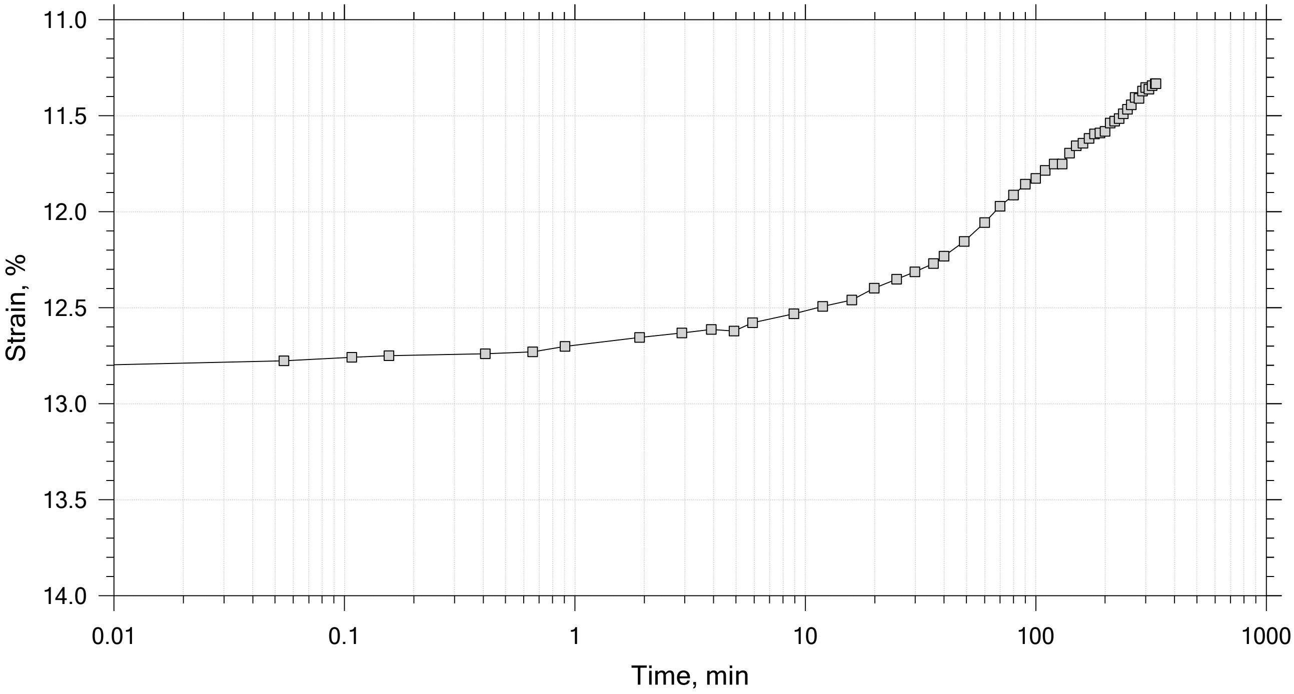
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: njh
Sample No.: 27	Test Date: 1/17/23	Depth: 53'9"-53'11"
Test No.: IP-4	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 10.2 kPa		

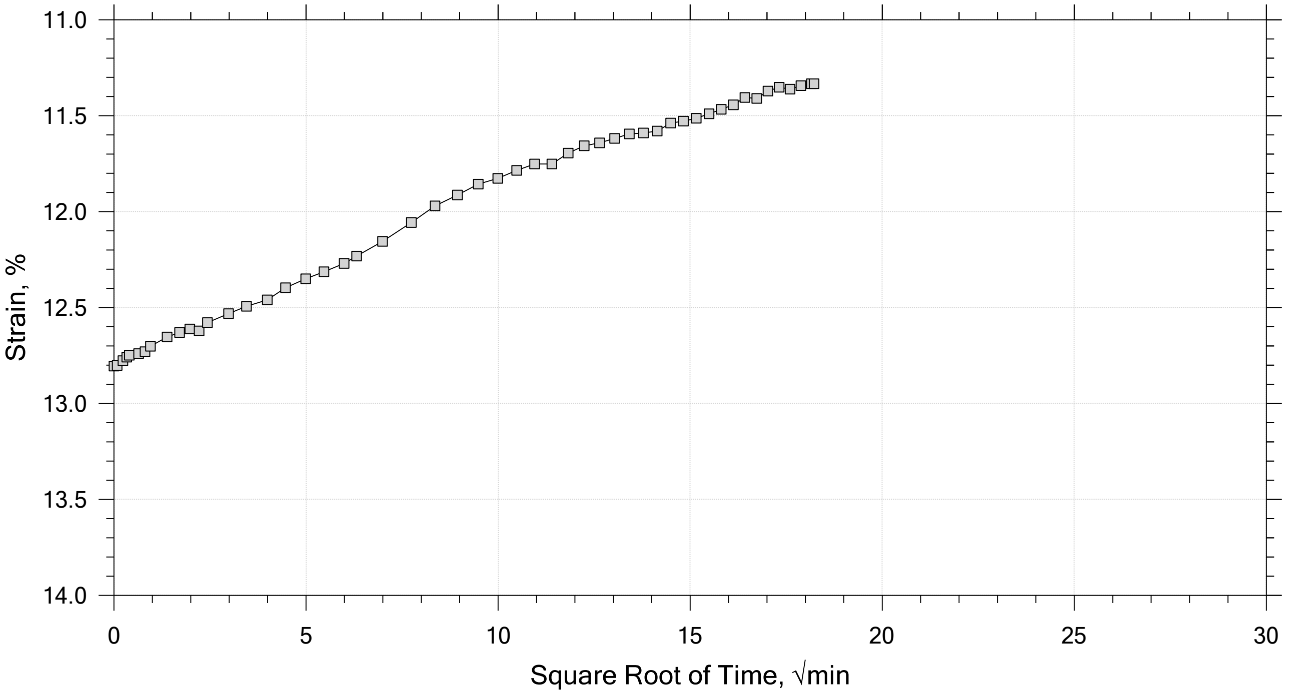
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 15 of 15

Constant Load Step

Stress: 5 kPa





Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: njh
Sample No.: 27	Test Date: 1/17/23	Depth: 53'9"-53'11"
Test No.: IP-4	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 10.2 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Specimen Diameter: 2.50 in	Estimated Specific Gravity: 2.72	Liquid Limit: ---
Initial Height: 1.00 in	Initial Void Ratio: 0.857	Plastic Limit: ---
Final Height: 0.86 in	Final Void Ratio: 0.597	Plasticity Index: ---

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	E1692	RING		E1578
Mass Container, gm	8.43	110.24	110.24	8.6
Mass Container + Wet Soil, gm	260.23	264.81	254.02	156.25
Mass Container + Dry Soil, gm	210.3	228.16	228.16	129.69
Mass Dry Soil, gm	201.87	117.92	117.92	121.09
Water Content, %	24.73	31.08	21.93	21.93
Void Ratio	---	0.86	0.60	---
Degree of Saturation, %	---	98.73	100.00	---
Dry Unit Weight, pcf	---	91.513	106.41	---

Note: Specific Gravity and Void Ratios are calculated assuming the degree of saturation equals 100% at the end of the test.
Therefore, values may not represent actual values for the specimen.

Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: njh
Sample No.: 27	Test Date: 1/17/23	Depth: 53'9"-53'11"
Test No.: IP-4	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 10.2 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

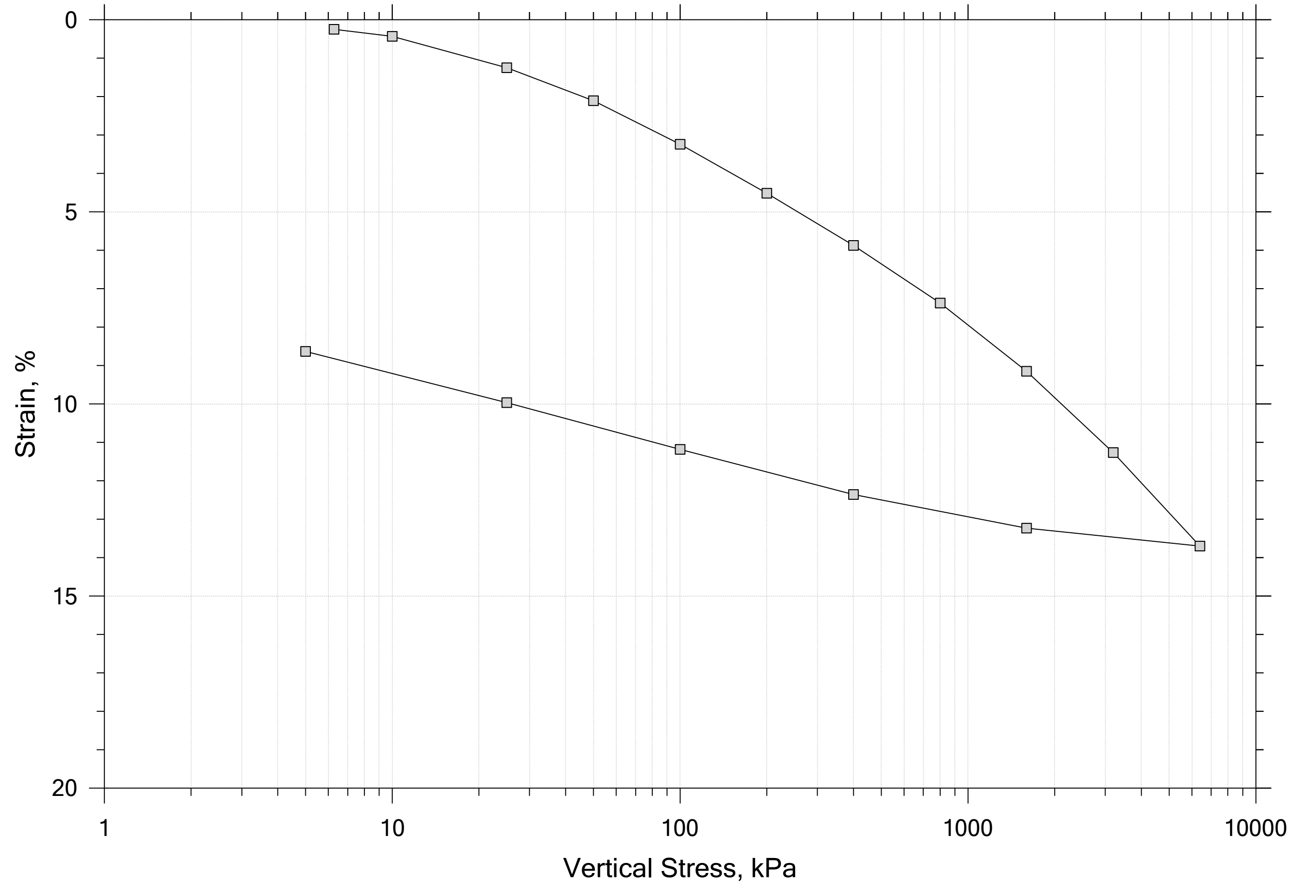
Square Root of Time Coefficients

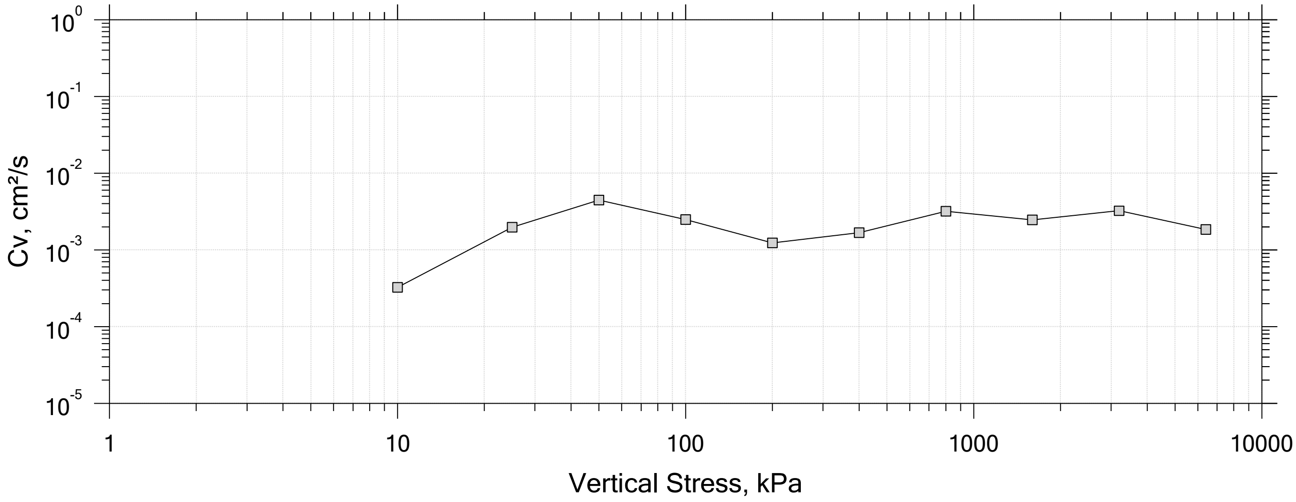
Step	Applied Stress kPa	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt. T90 min	Cv ft²/s	Mv 1/kPa	k ft/day
1	10.2	0.005027	0.848	0.503	---	---	---	---
2	25.0	0.009245	0.840	0.925	12.253	1.97e-06	2.85e-04	1.45e-04
3	50.0	0.01673	0.826	1.67	18.090	1.32e-06	2.99e-04	1.02e-04
4	100.	0.02663	0.808	2.66	8.551	2.75e-06	1.98e-04	1.40e-04
5	200.	0.04116	0.781	4.12	10.895	2.10e-06	1.45e-04	7.89e-05
6	400.	0.05479	0.755	5.48	8.792	2.53e-06	6.82e-05	4.45e-05
7	800.	0.06710	0.733	6.71	7.846	2.76e-06	3.08e-05	2.19e-05
8	1.60e+03	0.1003	0.671	10.0	56.470	3.65e-07	4.16e-05	3.91e-06
9	3.20e+03	0.1456	0.587	14.6	16.633	1.13e-06	2.83e-05	8.28e-06
10	6.40e+03	0.1909	0.503	19.1	16.083	1.06e-06	1.42e-05	3.86e-06
11	1.60e+03	0.1780	0.526	17.8	6.162	2.65e-06	2.69e-06	1.84e-06
12	400.	0.1628	0.555	16.3	25.275	6.68e-07	1.27e-05	2.18e-06
13	100.	0.1487	0.581	14.9	64.193	2.72e-07	4.71e-05	3.31e-06
14	25.0	0.1284	0.619	12.8	162.496	1.12e-07	2.71e-04	7.85e-06
15	5.00	0.1133	0.647	11.3	294.900	6.43e-08	7.52e-04	1.25e-05

Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: njh
Sample No.: 27	Test Date: 1/17/23	Depth: 53'9"-53'11"
Test No.: IP-4	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 10.2 kPa		
Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Summary Report





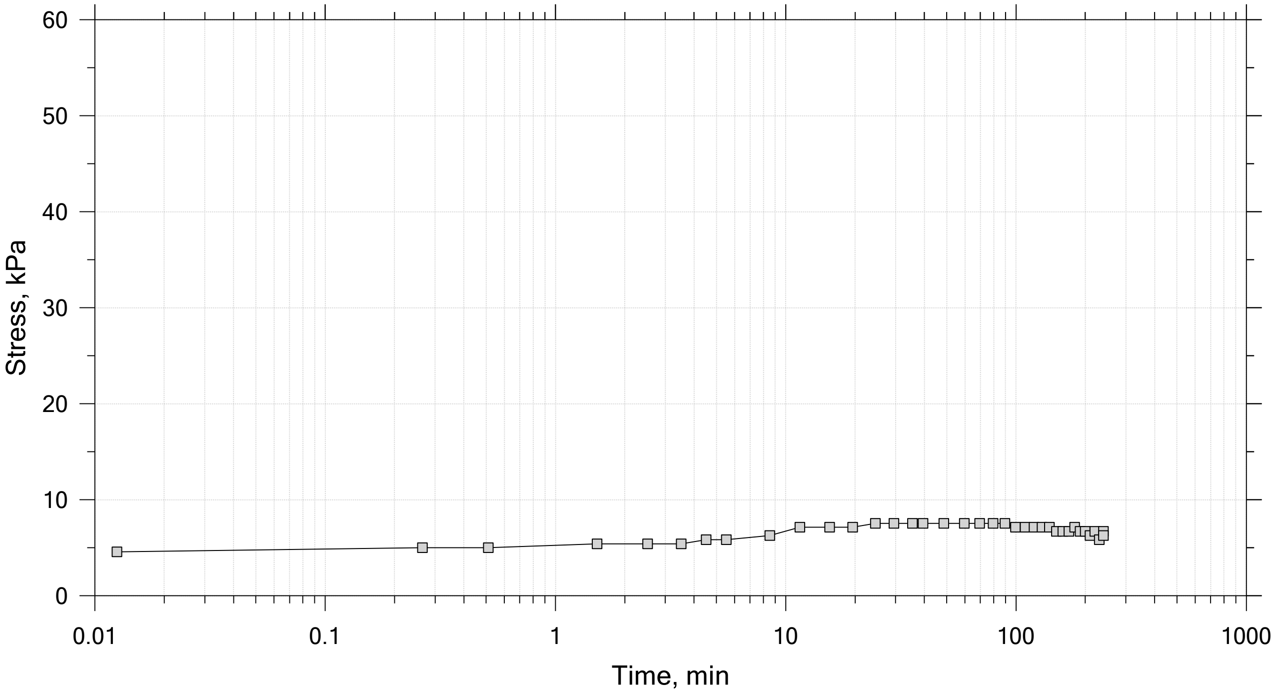
GeoTesting EXPRESS			
	Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: anm
	Sample No.: 28-1	Test Date: 12/5/22	Depth: 55'6"-55'8"
	Test No.: IP-7	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-001, Swell Pressure = 6.27 kPa		
	Displacement at End of Increment		

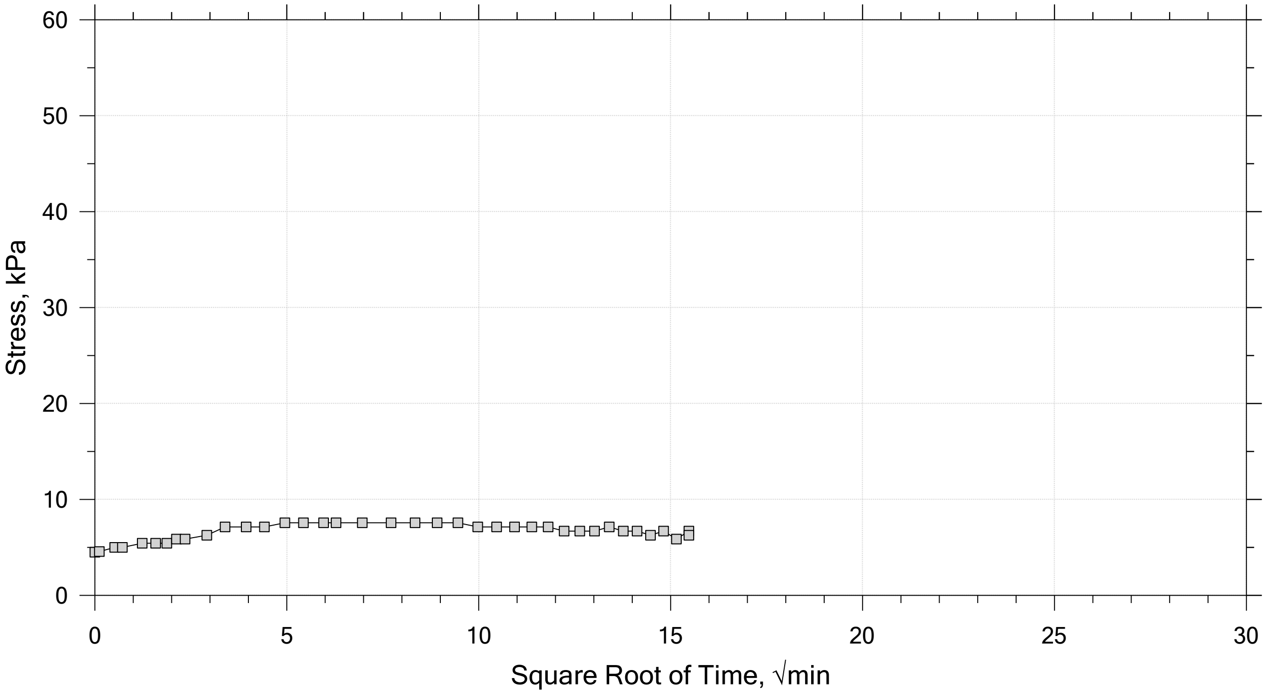
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 1 of 16

Constant Volume Step

Stress: 6.27 kPa

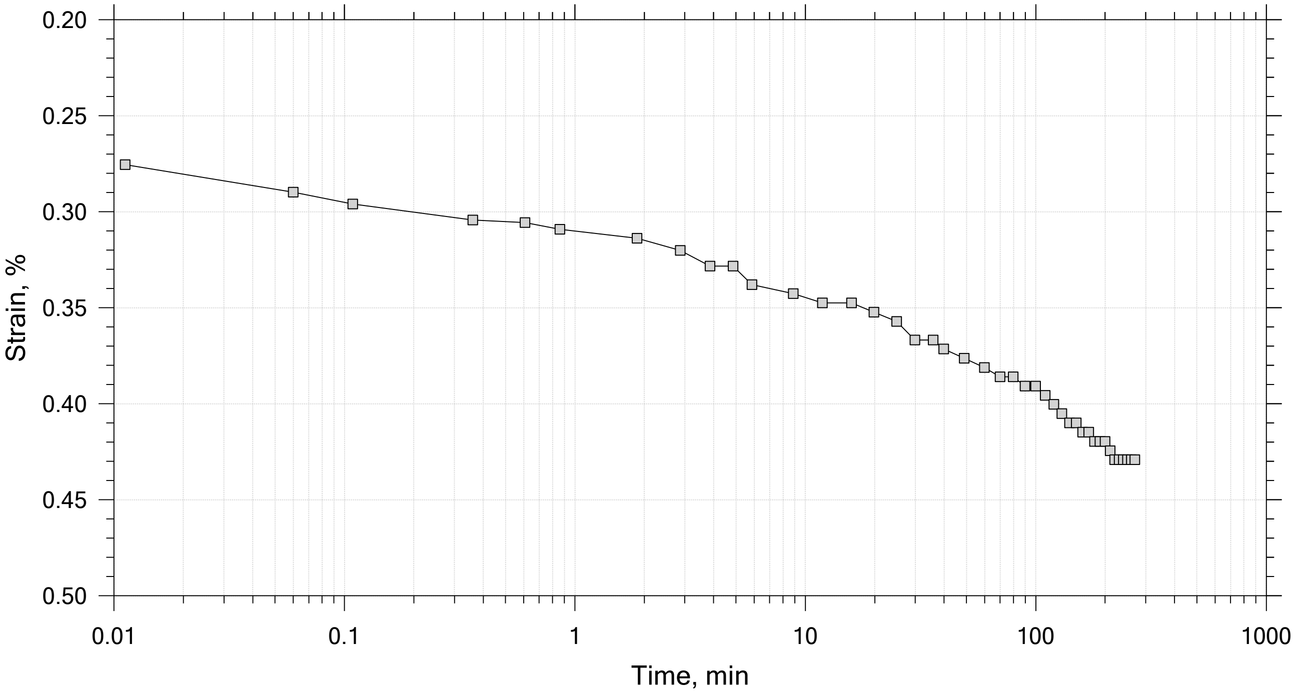


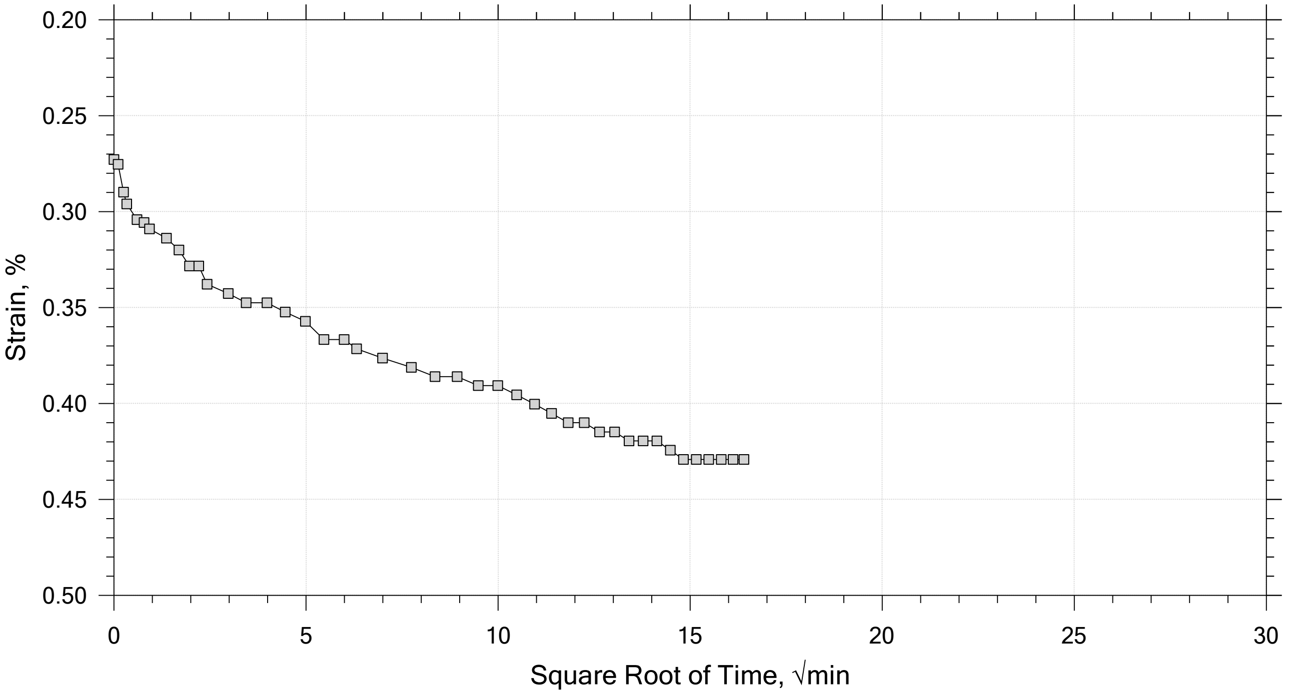


Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-1	Test Date: 12/5/22	Depth: 55'6"-55'8"
Test No.: IP-7	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 6.27 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 2 of 16
Constant Load Step
Stress: 10 kPa





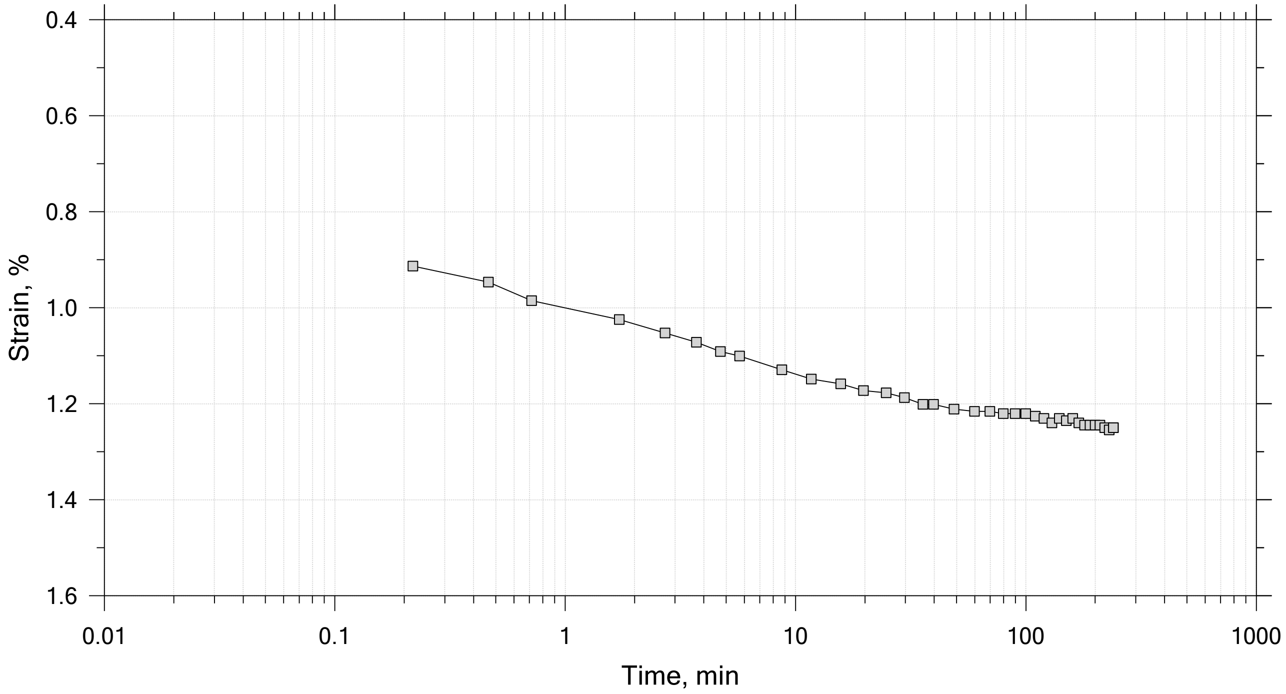
GeoTesting EXPRESS	Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: anm
	Sample No.: 28-1	Test Date: 12/5/22	Depth: 55'6"-55'8"
	Test No.: IP-7	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-001, Swell Pressure = 6.27 kPa		

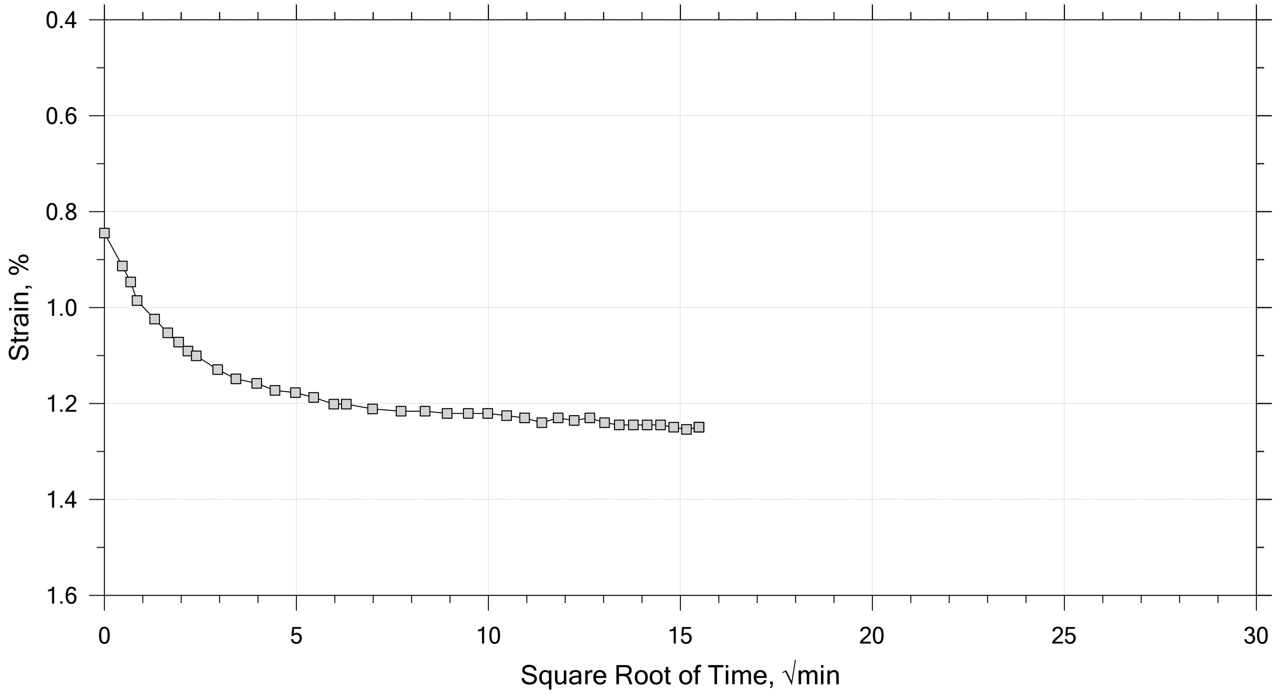
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 3 of 16

Constant Load Step

Stress: 25 kPa





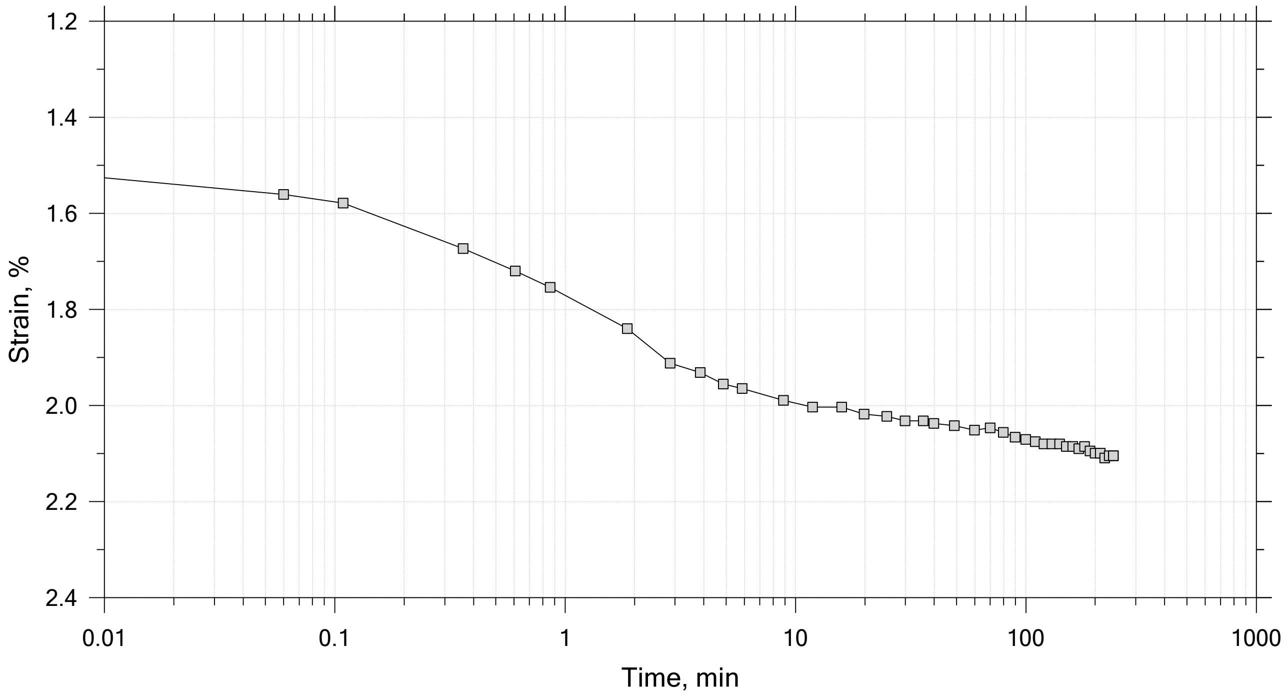
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-1	Test Date: 12/5/22	Depth: 55'6"-55'8"
Test No.: IP-7	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 6.27 kPa		

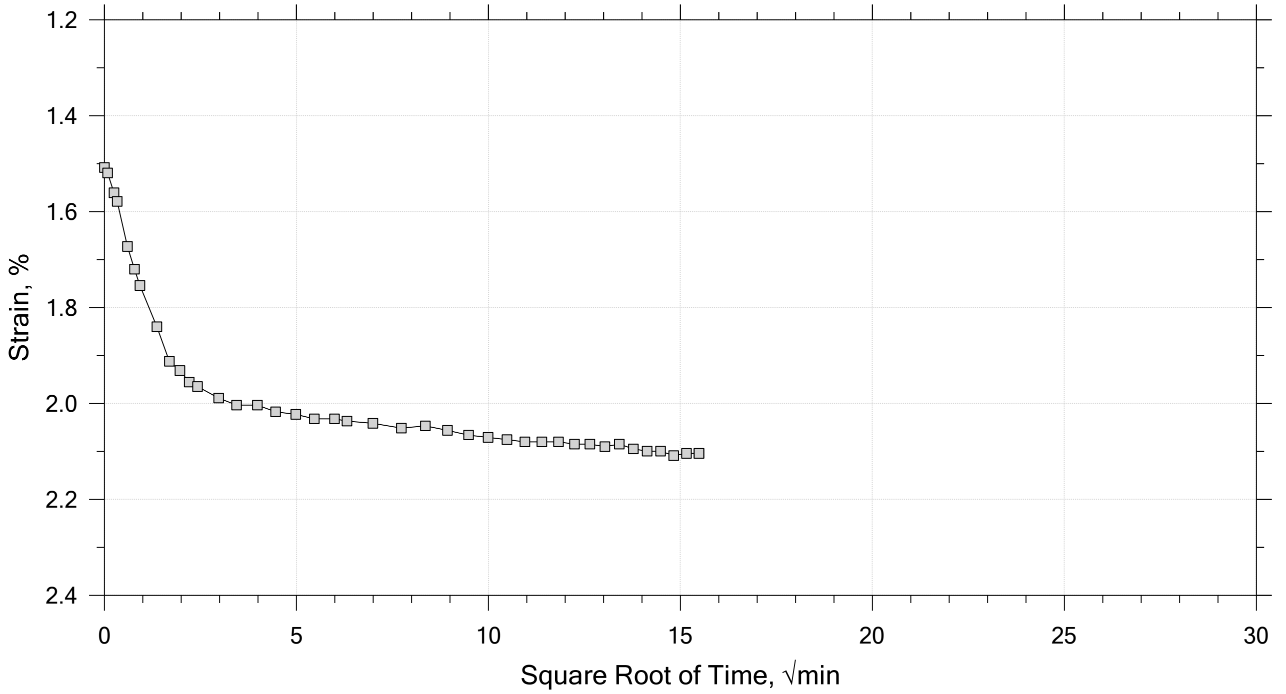
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 4 of 16

Constant Load Step

Stress: 50 kPa





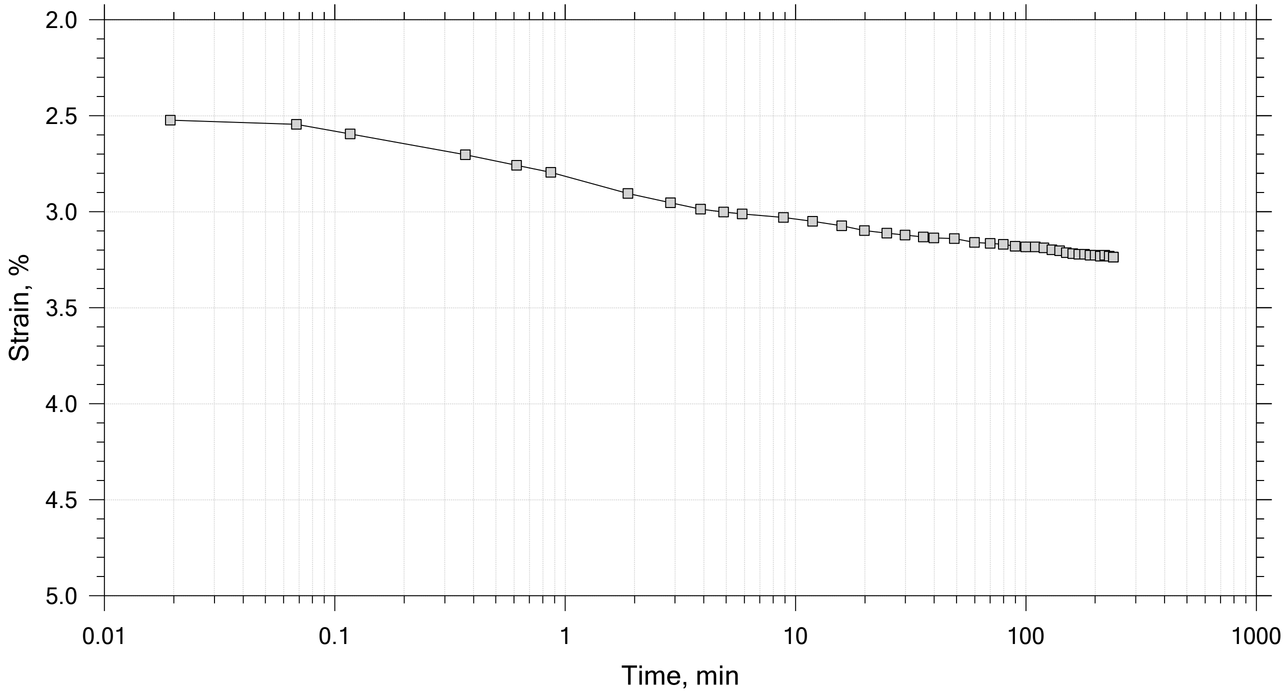
GeoTesting EXPRESS	Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: anm
	Sample No.: 28-1	Test Date: 12/5/22	Depth: 55'6"-55'8"
	Test No.: IP-7	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-001, Swell Pressure = 6.27 kPa		

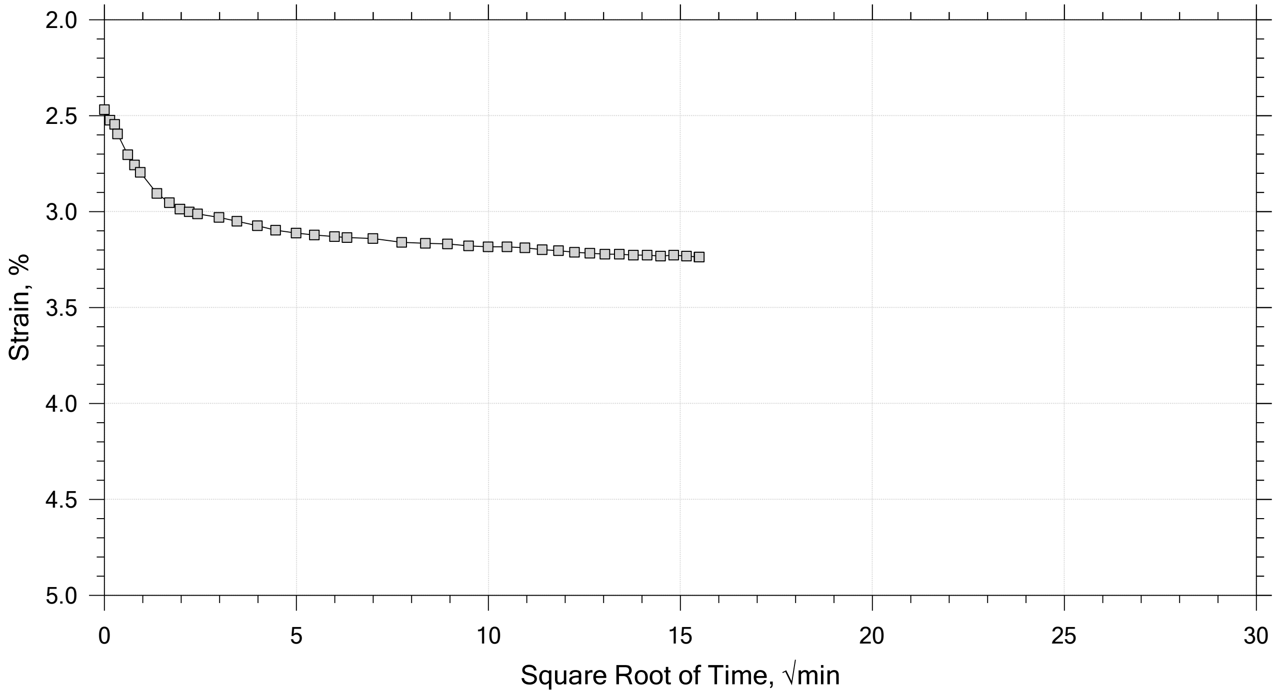
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 5 of 16

Constant Load Step

Stress: 100 kPa





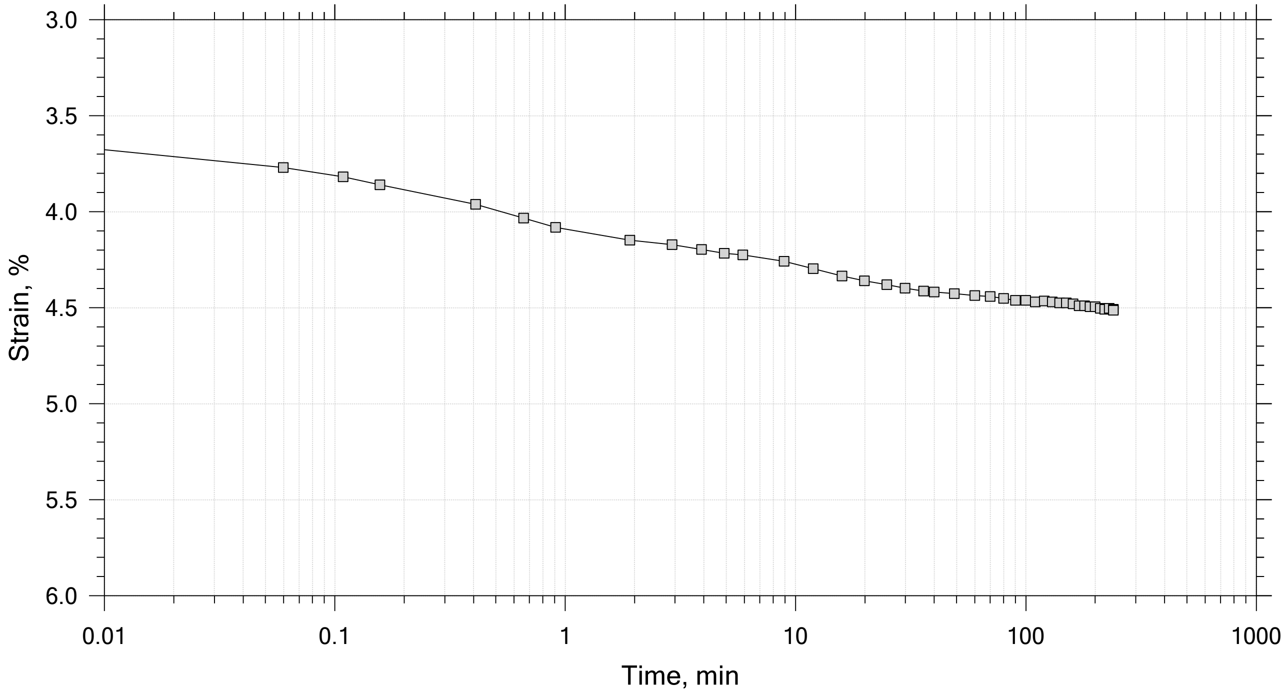
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-1	Test Date: 12/5/22	Depth: 55'6"-55'8"
Test No.: IP-7	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 6.27 kPa		

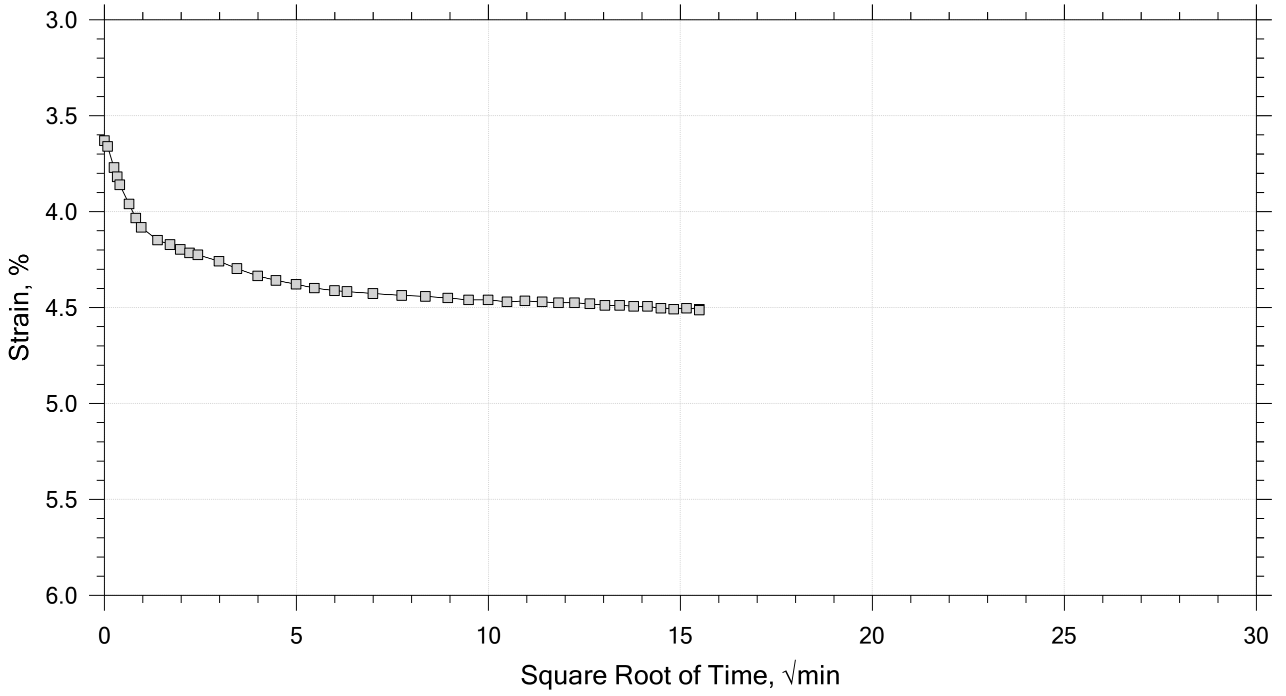
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 6 of 16

Constant Load Step

Stress: 200 kPa

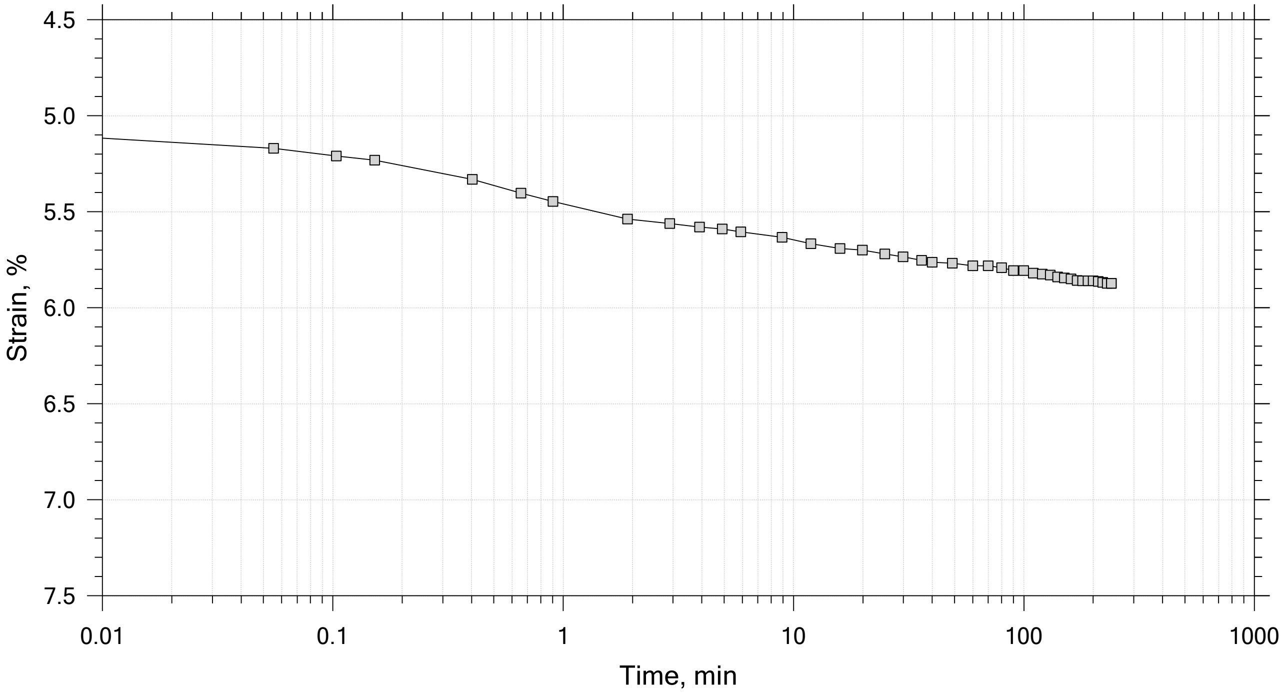


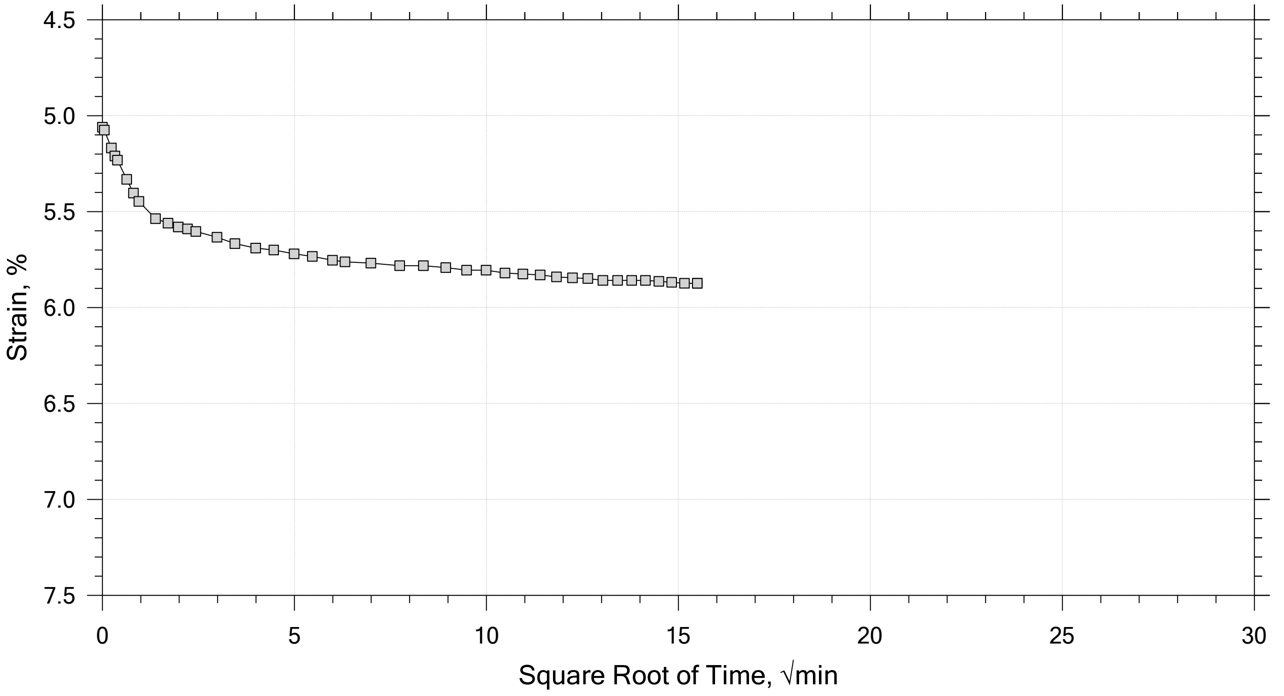


Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-1	Test Date: 12/5/22	Depth: 55'6"-55'8"
Test No.: IP-7	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 6.27 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 7 of 16
Constant Load Step
Stress: 400 kPa

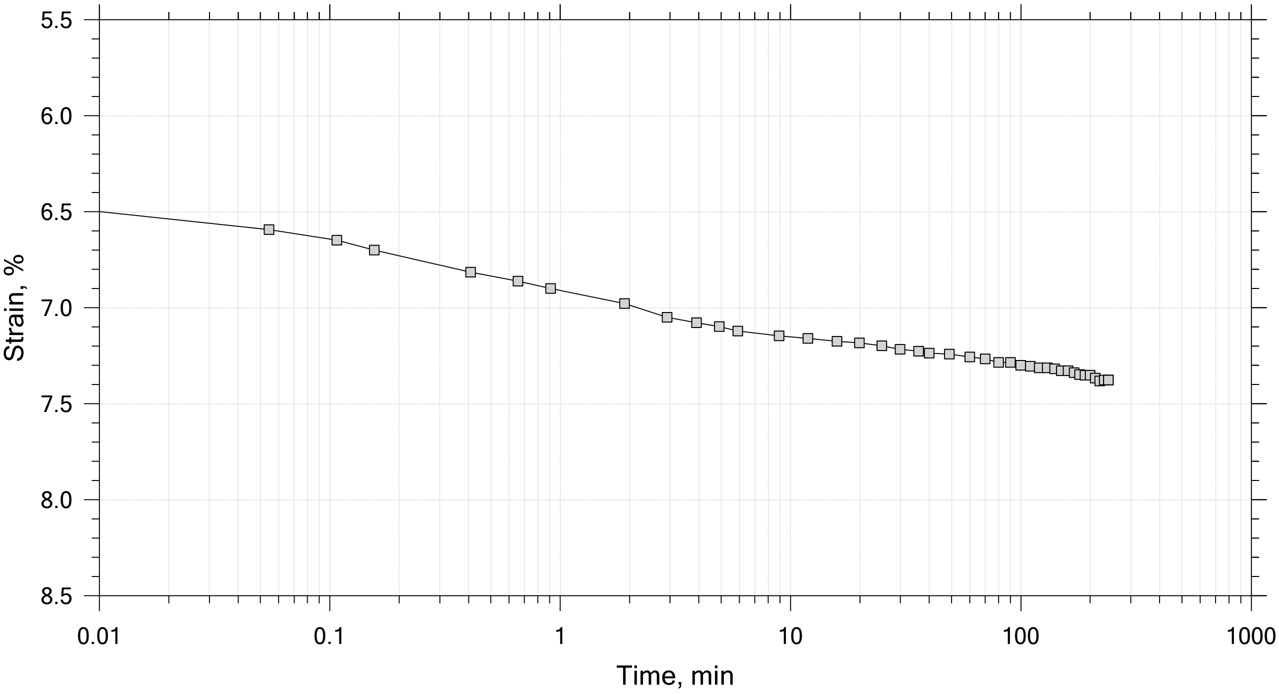


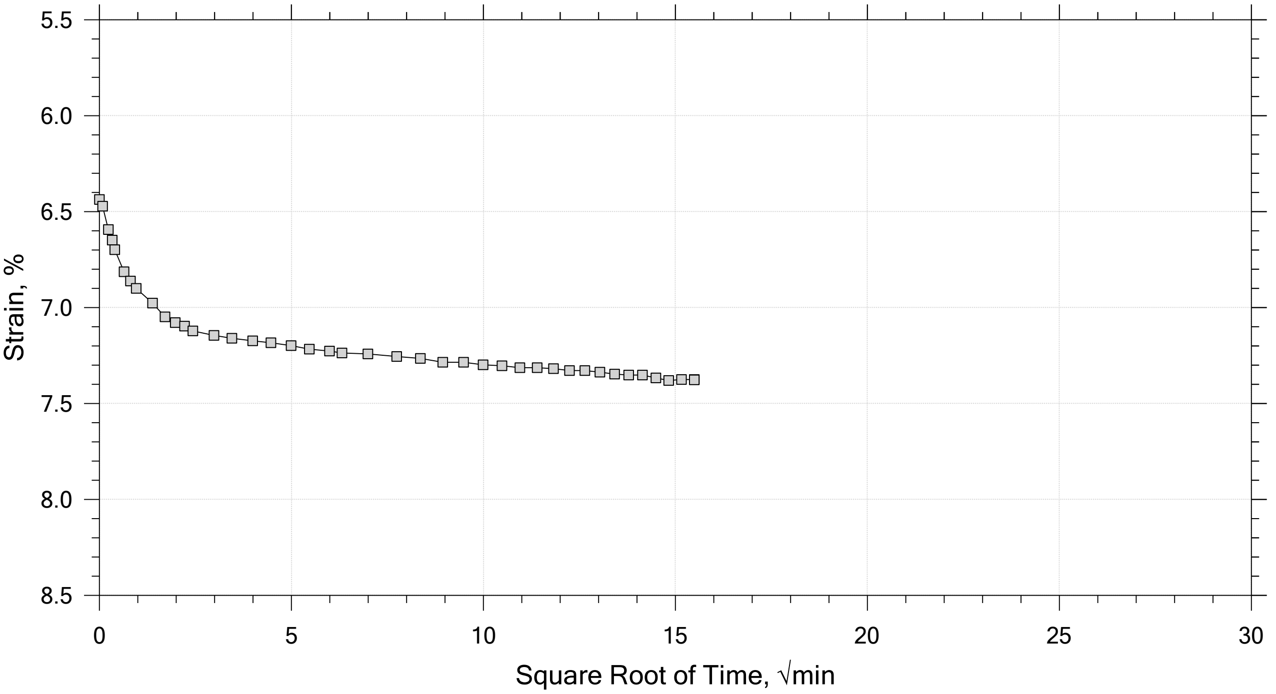


GeoTesting EXPRESS	Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: anm
	Sample No.: 28-1	Test Date: 12/5/22	Depth: 55'6"-55'8"
	Test No.: IP-7	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-001, Swell Pressure = 6.27 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 8 of 16
Constant Load Step
Stress: 800 kPa

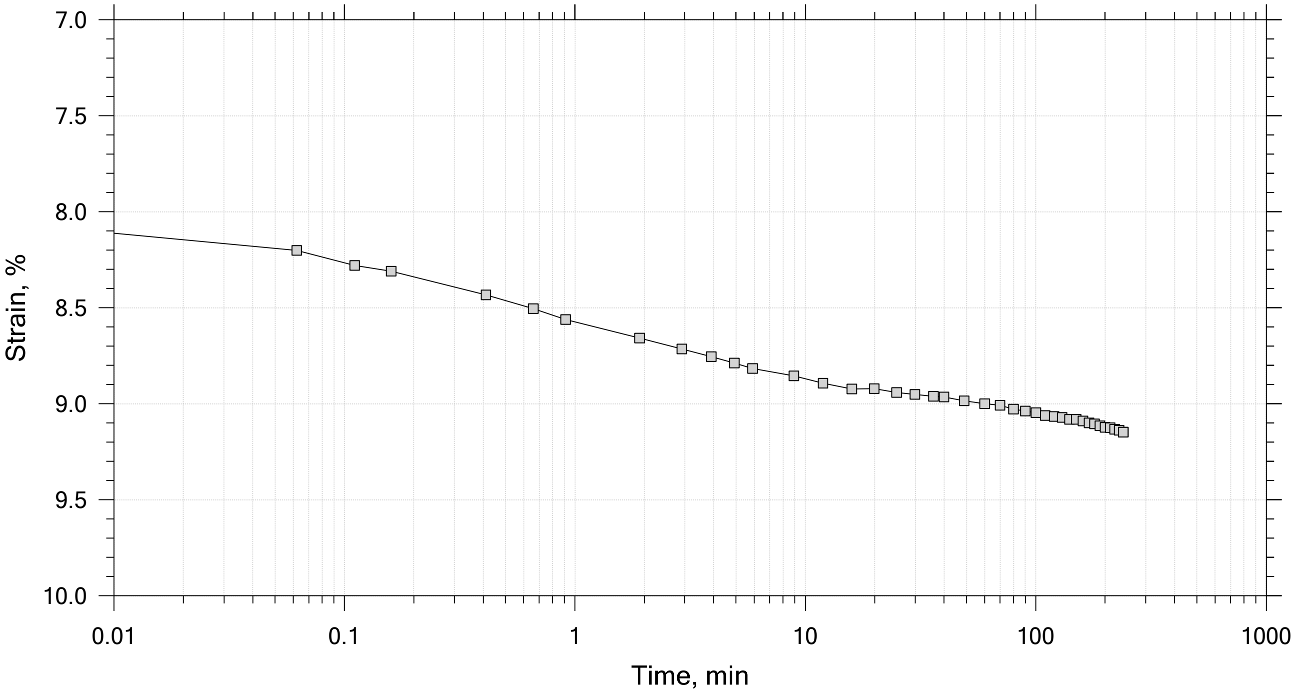


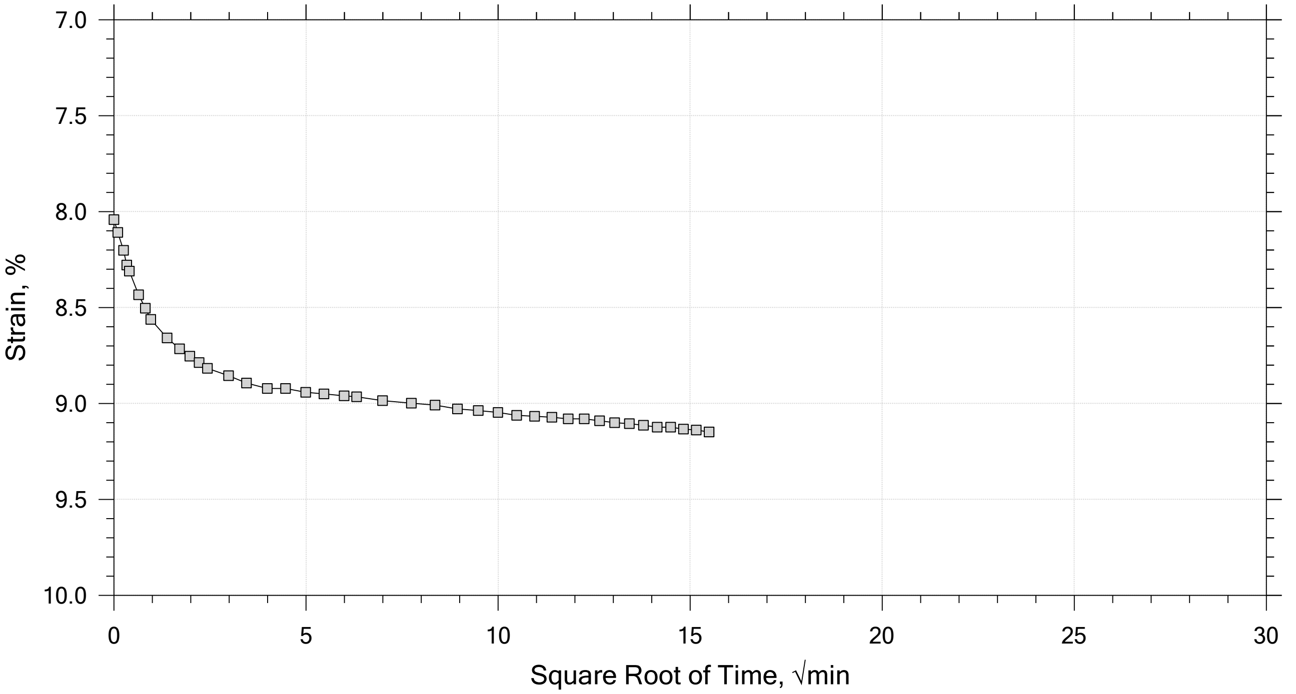


Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-1	Test Date: 12/5/22	Depth: 55'6"-55'8"
Test No.: IP-7	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 6.27 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 9 of 16
Constant Load Step
Stress: 1.6e+03 kPa

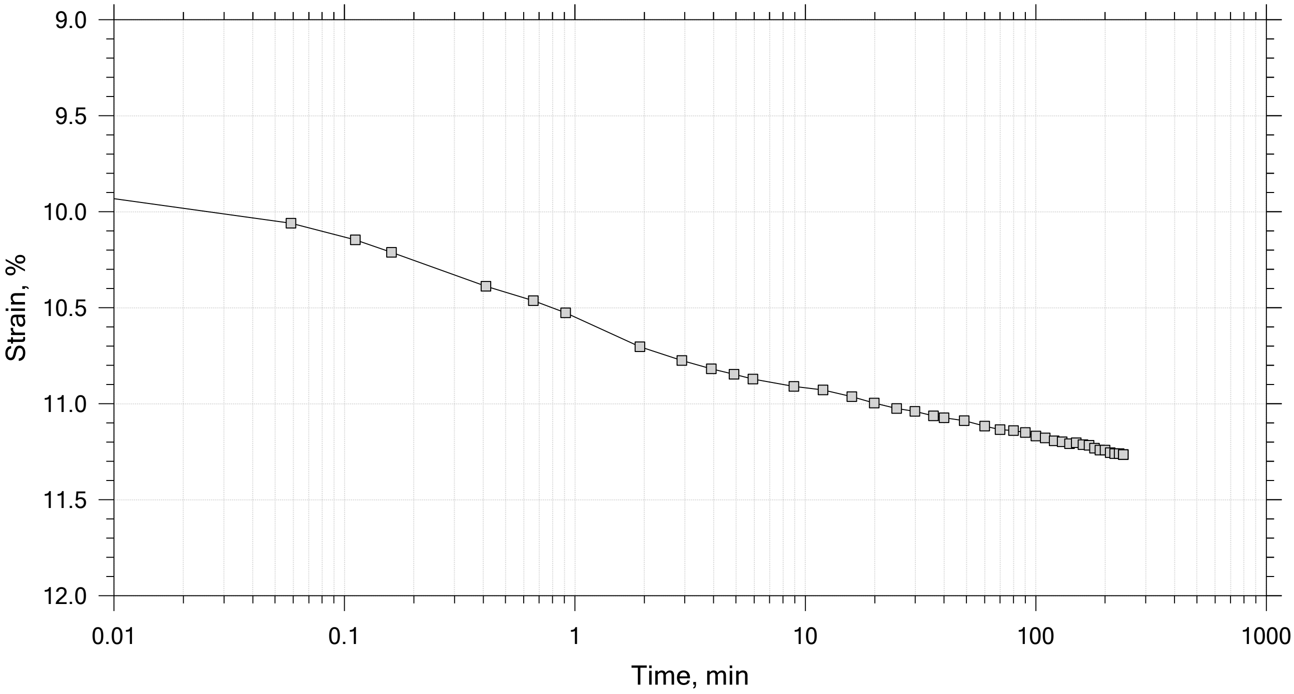


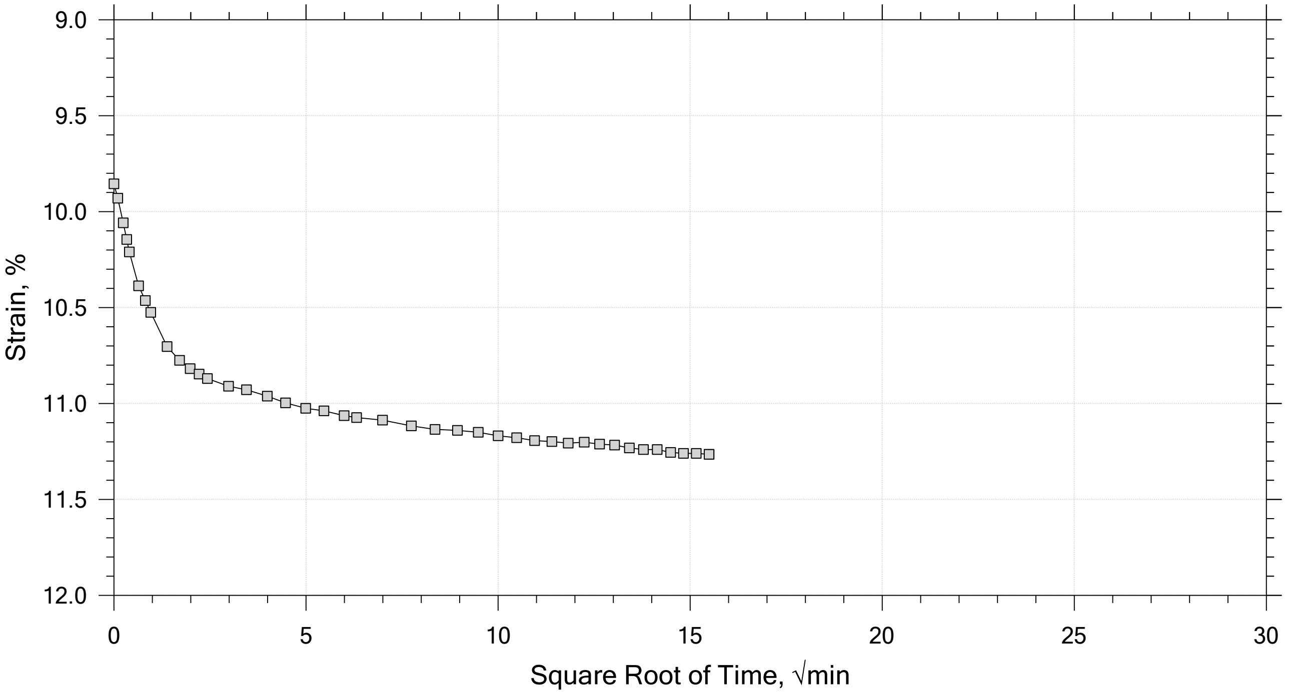


Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-1	Test Date: 12/5/22	Depth: 55'6"-55'8"
Test No.: IP-7	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 6.27 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 10 of 16
Constant Load Step
Stress: 3.2e+03 kPa

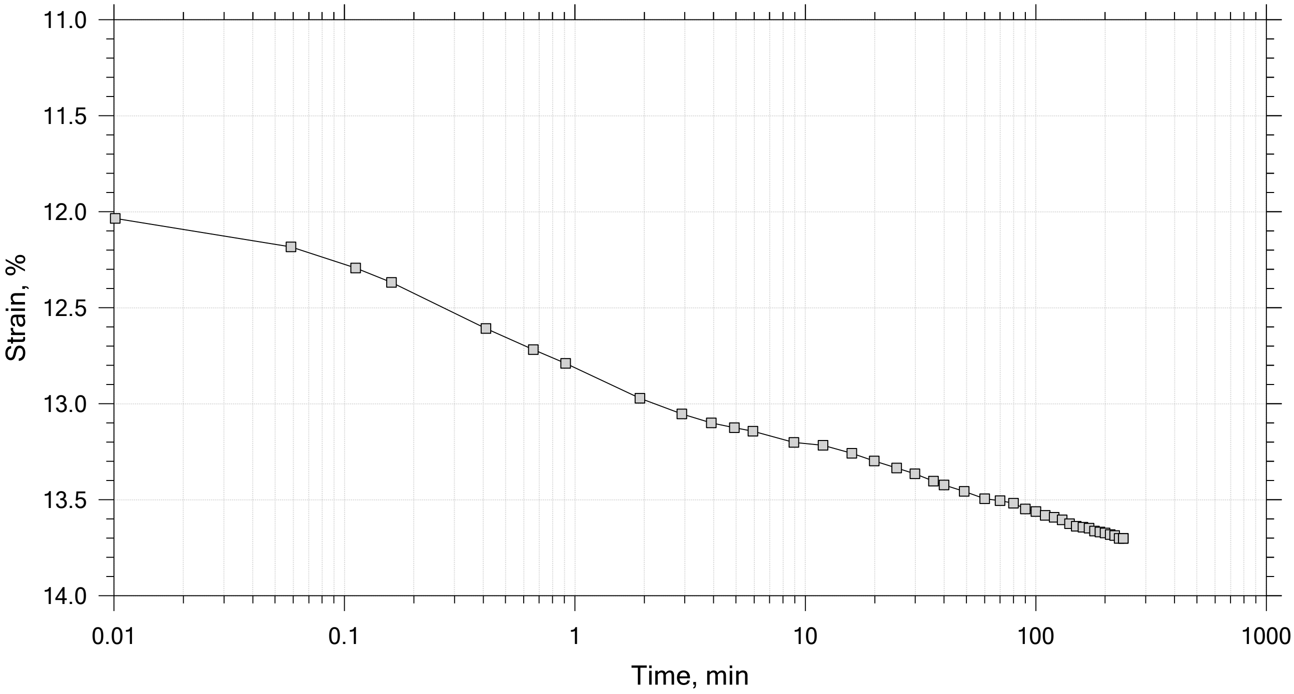


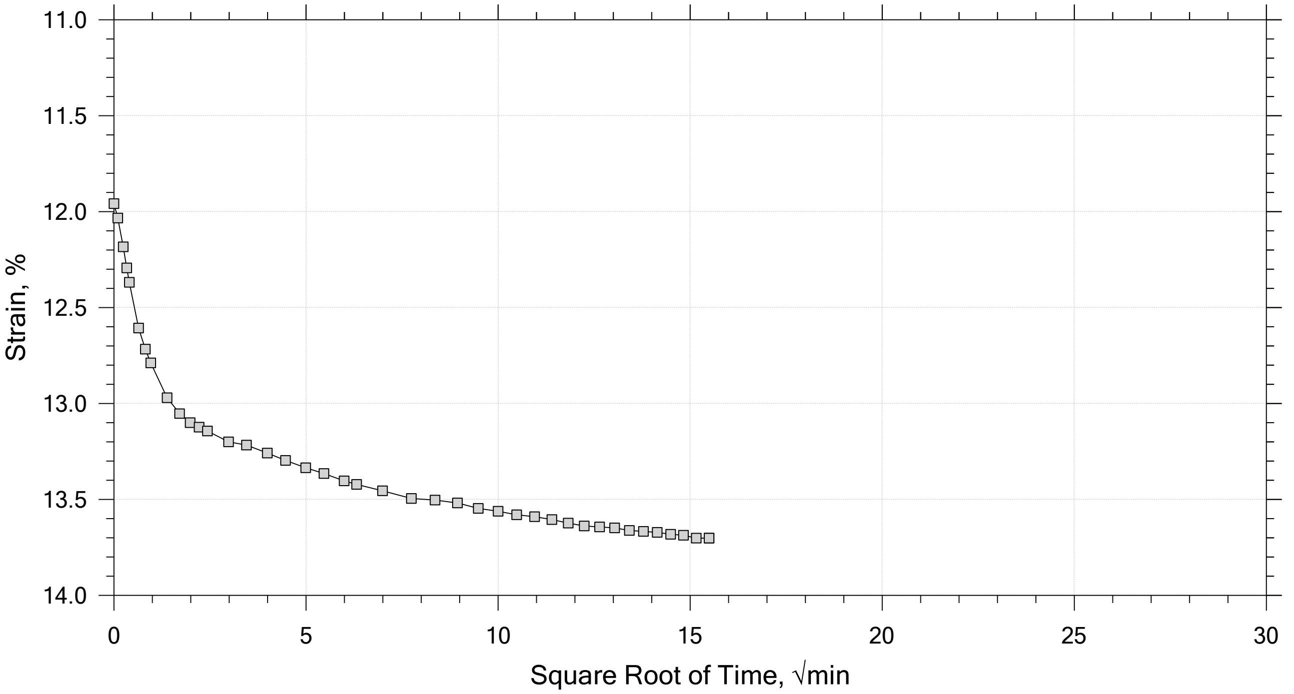


Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-1	Test Date: 12/5/22	Depth: 55'6"-55'8"
Test No.: IP-7	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 6.27 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 11 of 16
Constant Load Step
Stress: 6.4e+03 kPa





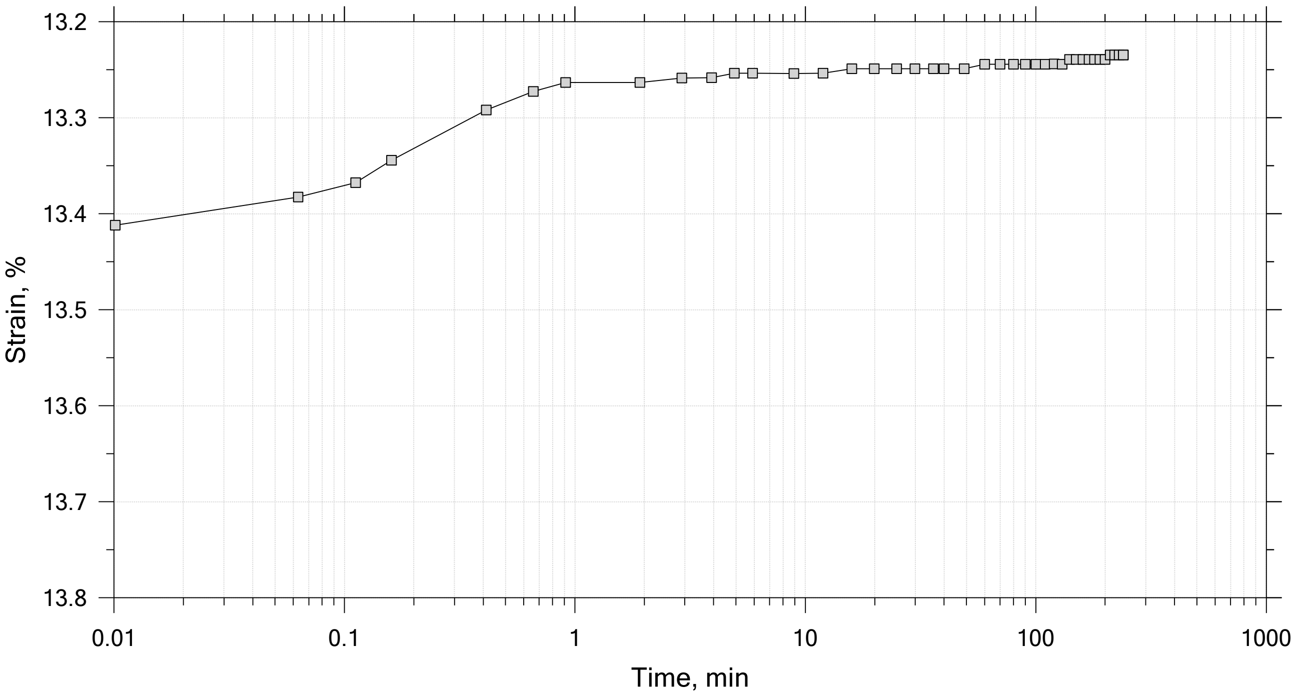
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-1	Test Date: 12/5/22	Depth: 55'6"-55'8"
Test No.: IP-7	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 6.27 kPa		

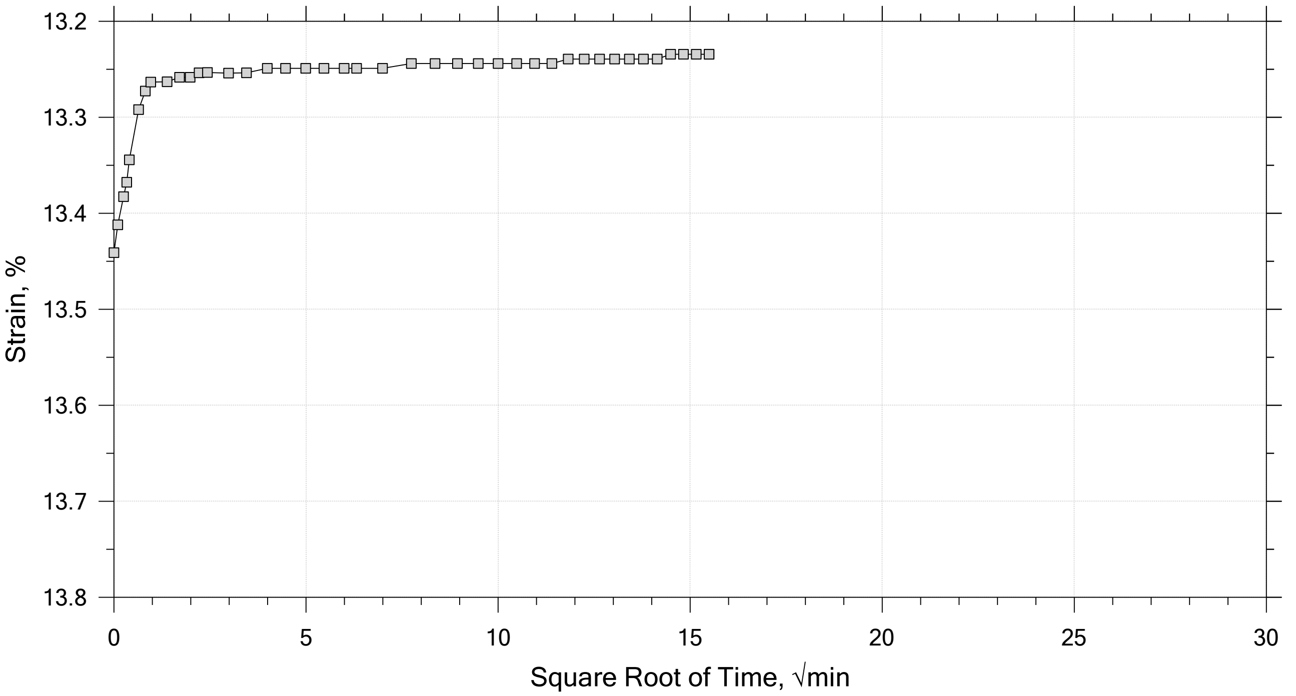
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 12 of 16

Constant Load Step

Stress: 1.6e+03 kPa

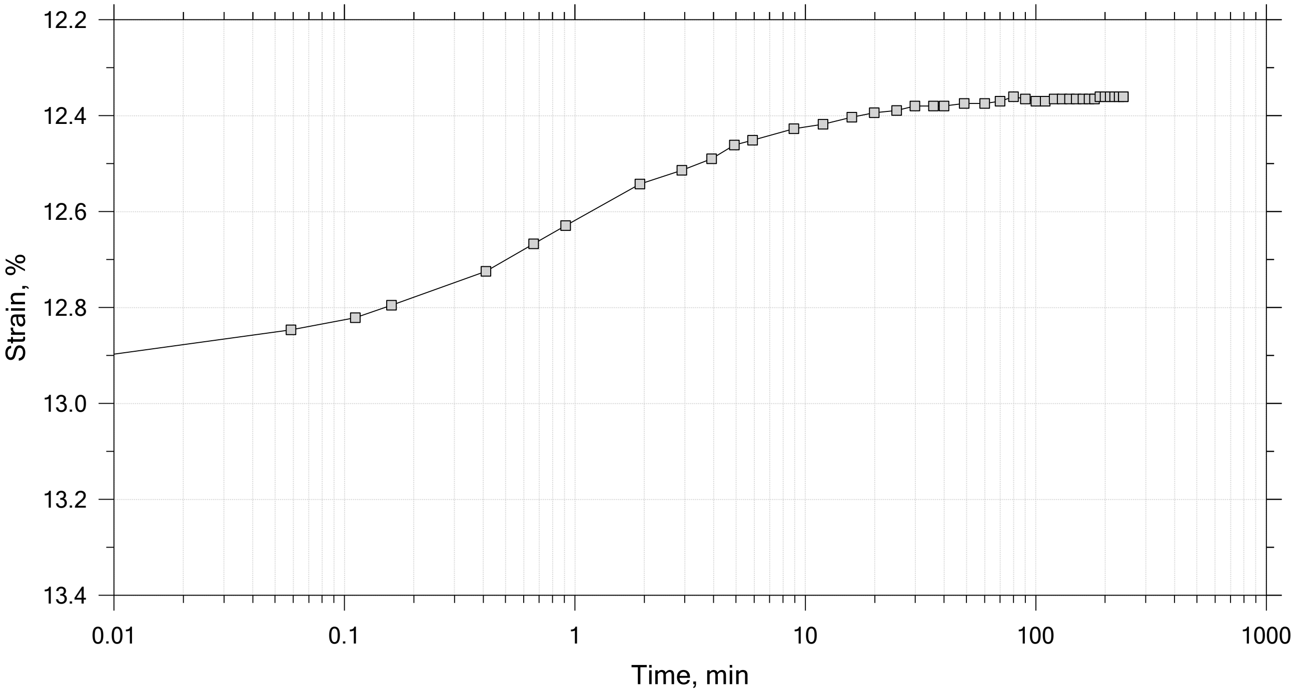


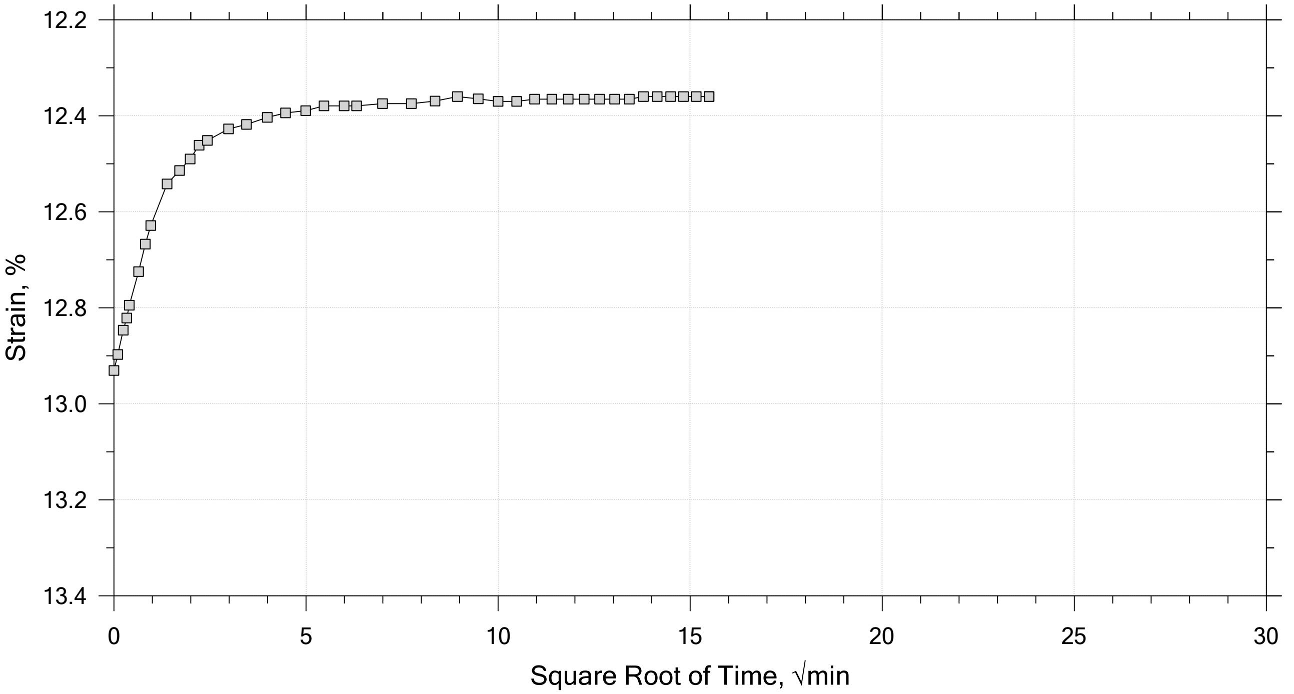


Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-1	Test Date: 12/5/22	Depth: 55'6"-55'8"
Test No.: IP-7	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 6.27 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 13 of 16
Constant Load Step
Stress: 400 kPa





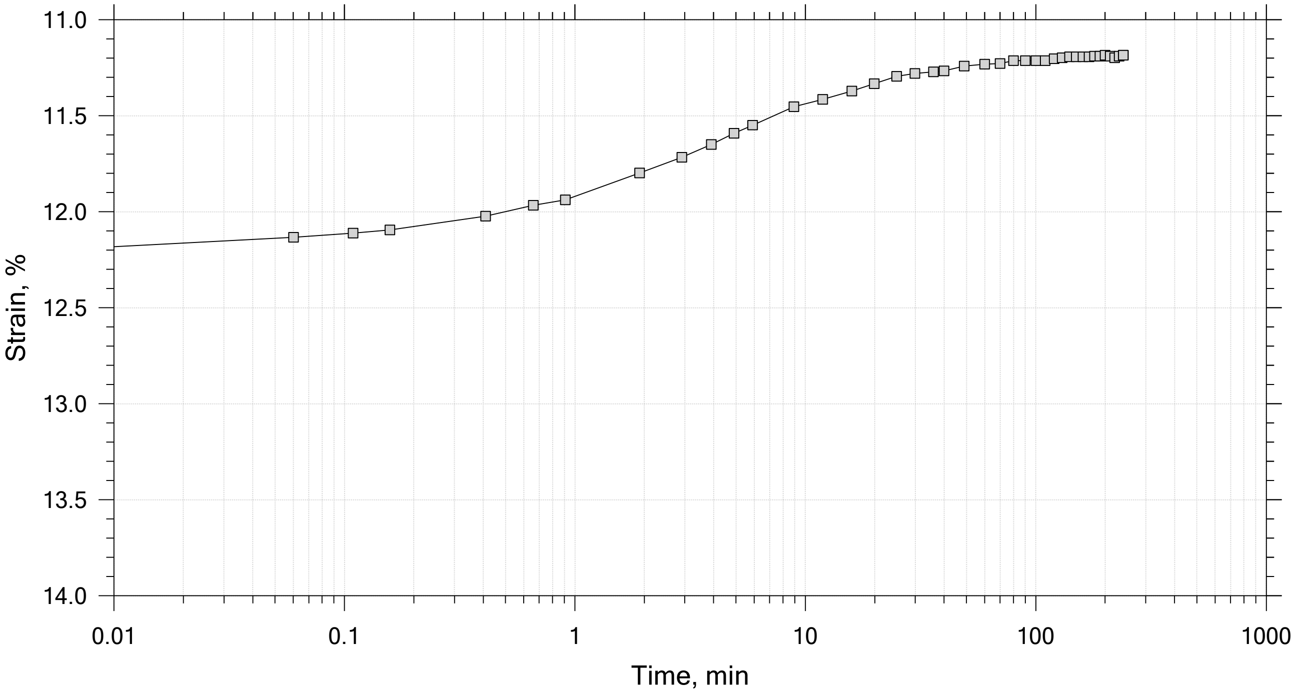
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-1	Test Date: 12/5/22	Depth: 55'6"-55'8"
Test No.: IP-7	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 6.27 kPa		

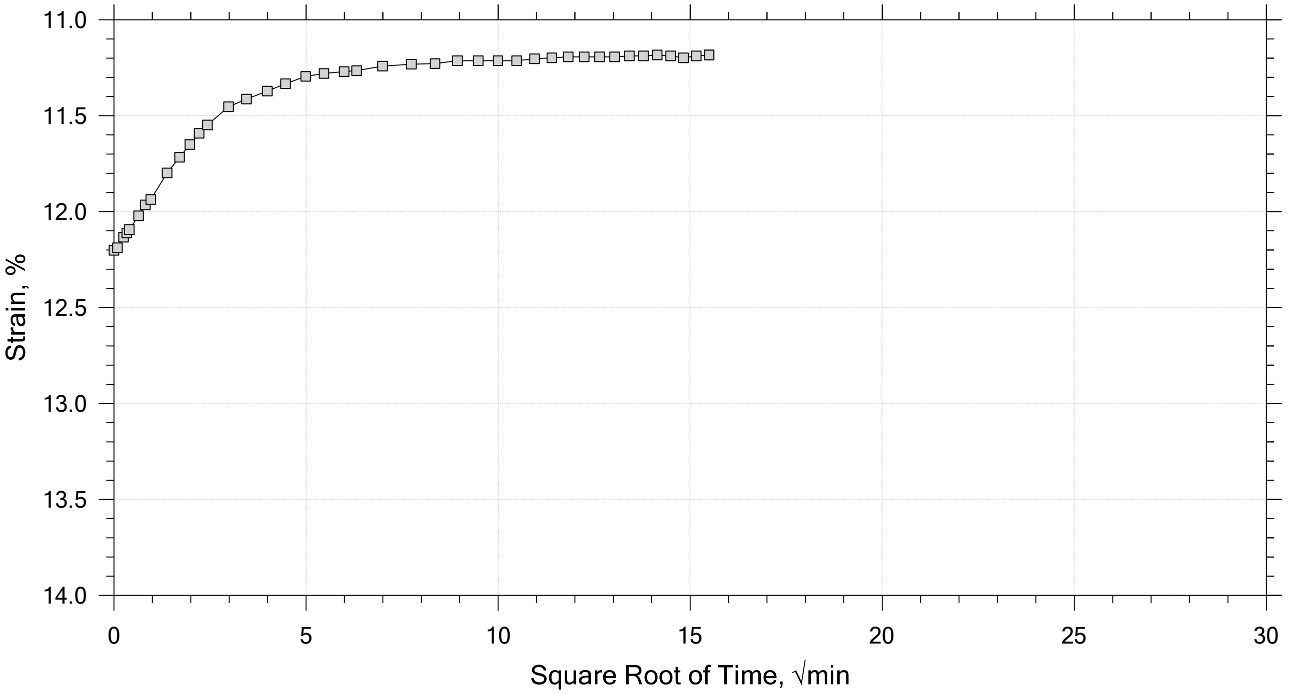
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 14 of 16

Constant Load Step

Stress: 100 kPa





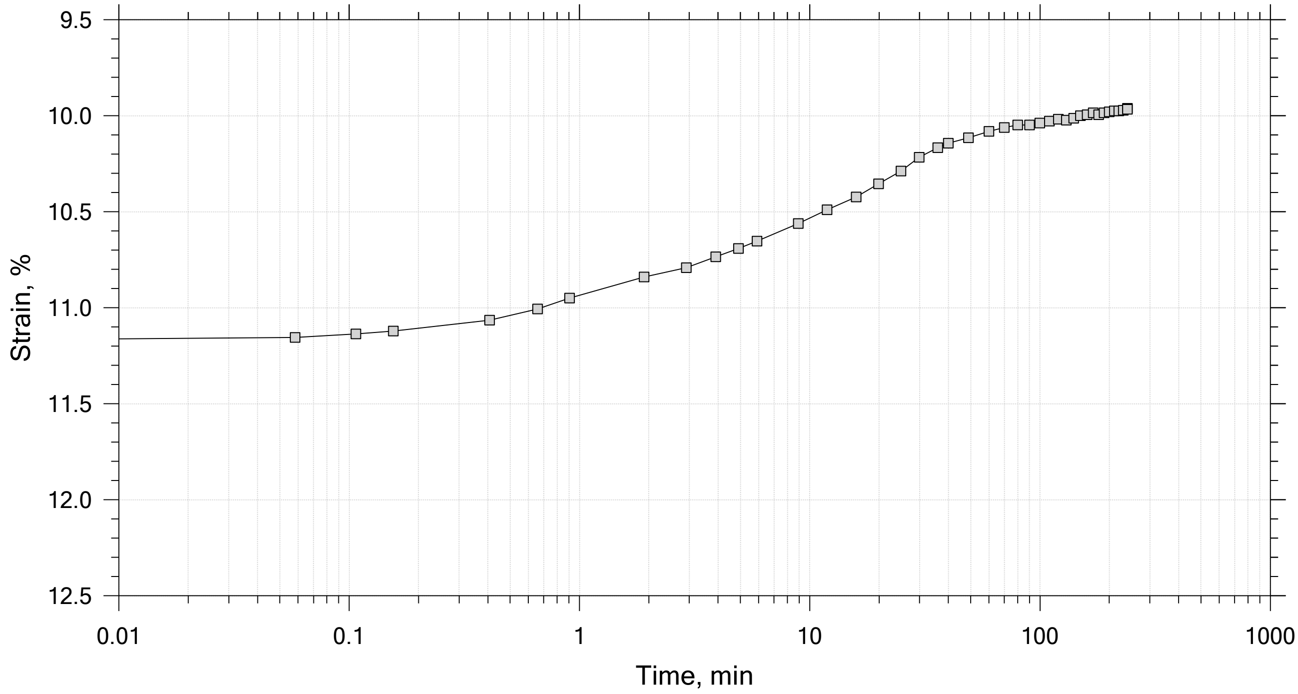
GeoTesting EXPRESS	Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: anm
	Sample No.: 28-1	Test Date: 12/5/22	Depth: 55'6"-55'8"
	Test No.: IP-7	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-001, Swell Pressure = 6.27 kPa		

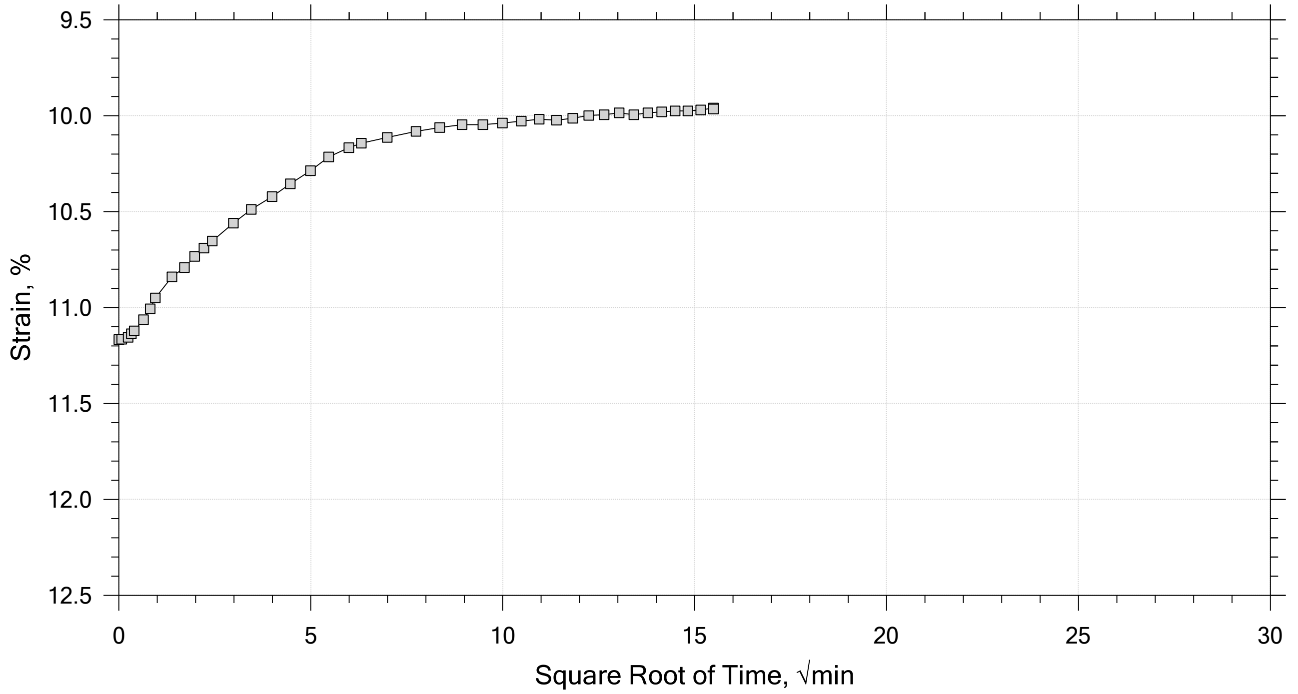
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 15 of 16

Constant Load Step

Stress: 25 kPa





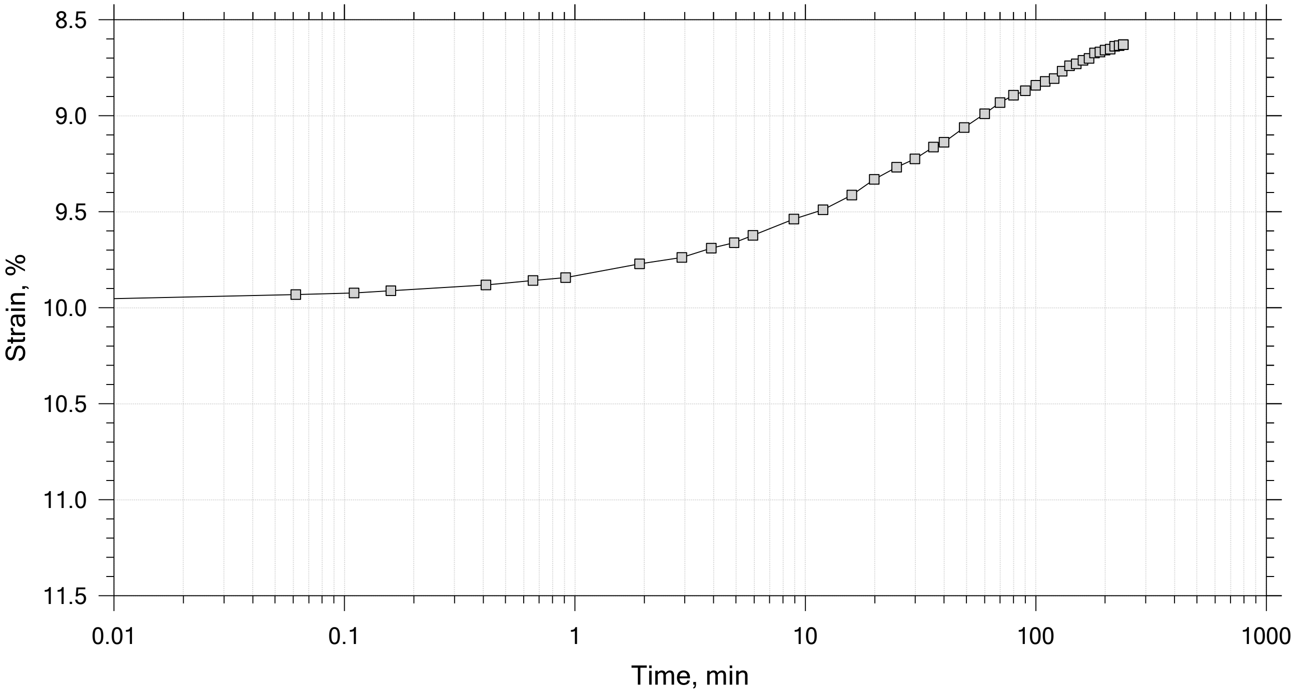
Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-1	Test Date: 12/5/22	Depth: 55'6"-55'8"
Test No.: IP-7	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 6.27 kPa		

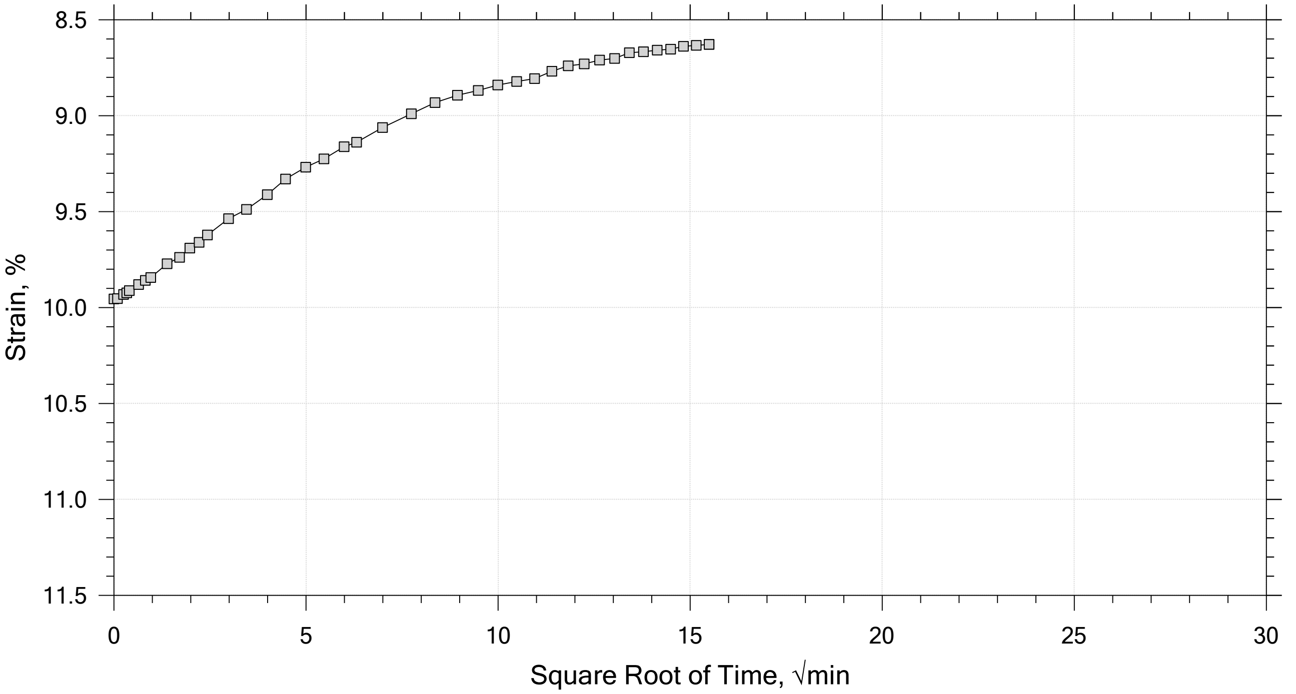
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 16 of 16

Constant Load Step

Stress: 5 kPa





GeoTesting EXPRESS	Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: anm
	Sample No.: 28-1	Test Date: 12/5/22	Depth: 55'6"-55'8"
	Test No.: IP-7	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-001, Swell Pressure = 6.27 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Specimen Diameter: 6.35 cm	Measured Specific Gravity: 2.67	Liquid Limit: ---
Initial Height: 2.54 cm	Initial Void Ratio: 0.592	Plastic Limit: ---
Final Height: 2.29 cm	Final Void Ratio: 0.433	Plasticity Index: ---

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	E4368	RING		E2782
Mass Container, gm	8.33	109.7	109.7	8.38
Mass Container + Wet Soil, gm	271.28	271.49	266.48	169.31
Mass Container + Dry Soil, gm	230.31	244.62	244.62	146.87
Mass Dry Soil, gm	221.98	134.92	134.92	138.49
Water Content, %	18.46	19.92	16.20	16.20
Void Ratio	---	0.59	0.43	---
Degree of Saturation, %	---	89.85	99.99	---
Dry Unit Weight, kN/m³	---	16.448	18.276	---

Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-1	Test Date: 12/5/22	Depth: 55'6"-55'8"
Test No.: IP-7	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 6.27 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

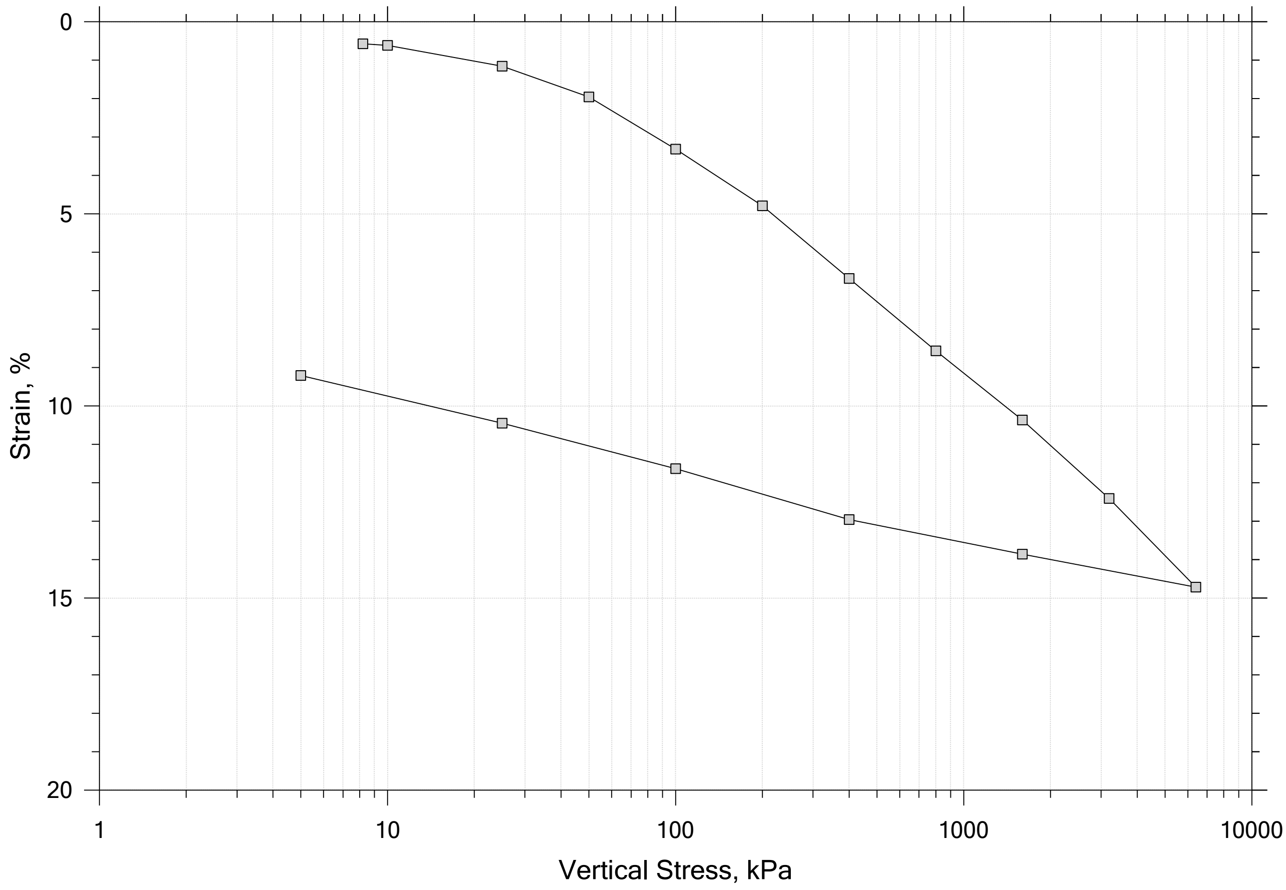
Square Root of Time Coefficients

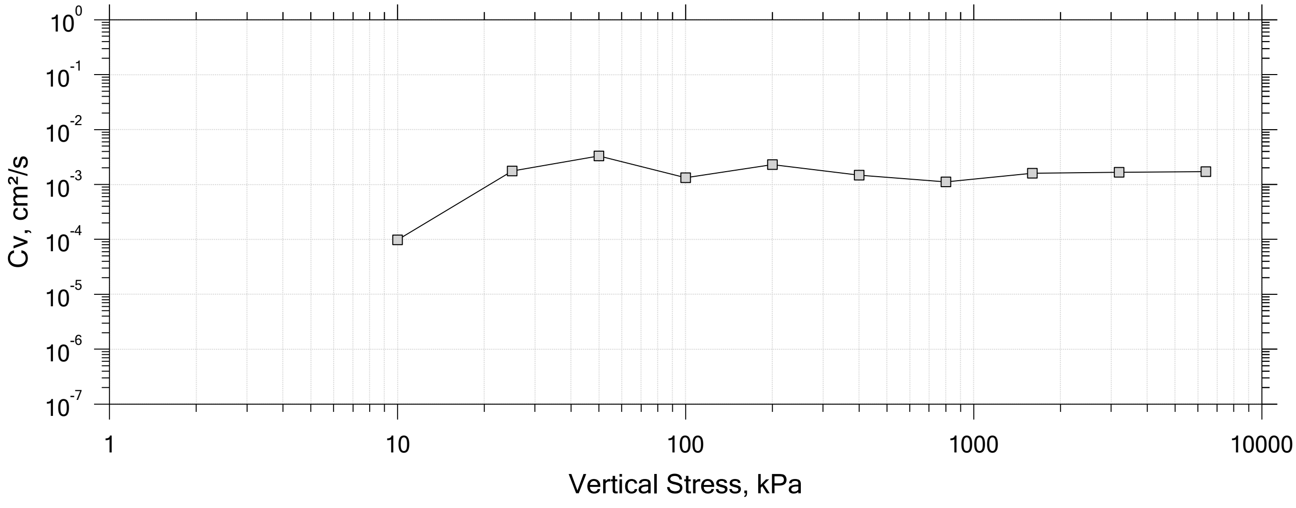
Step	Applied Stress kPa	Final Displacement cm	Void Ratio	Strain at End %	Sq.Rt. T90 min	Cv cm²/s	Mv 1/kPa	k cm/s
1	6.27	0.006254	0.588	0.246	---	---	---	---
2	10.0	0.01090	0.585	0.429	69.858	3.24e-04	4.91e-04	1.56e-08
3	25.0	0.03174	0.572	1.25	11.376	1.97e-03	5.47e-04	1.06e-07
4	50.0	0.05345	0.558	2.10	4.955	4.45e-03	3.42e-04	1.49e-07
5	100.	0.08221	0.540	3.24	8.719	2.48e-03	2.26e-04	5.50e-08
6	200.	0.1146	0.520	4.51	17.147	1.23e-03	1.28e-04	1.54e-08
7	400.	0.1492	0.498	5.87	12.216	1.68e-03	6.80e-05	1.12e-08
8	800.	0.1874	0.474	7.38	6.253	3.18e-03	3.76e-05	1.17e-08
9	1.60e+03	0.2324	0.446	9.15	7.831	2.45e-03	2.21e-05	5.32e-09
10	3.20e+03	0.2861	0.413	11.3	5.686	3.23e-03	1.32e-05	4.19e-09
11	6.40e+03	0.3480	0.374	13.7	9.427	1.85e-03	7.61e-06	1.38e-09
12	1.60e+03	0.3362	0.381	13.2	1.577	1.08e-02	9.73e-07	1.03e-09
13	400.	0.3140	0.395	12.4	3.456	5.02e-03	7.28e-06	3.58e-09
14	100.	0.2841	0.414	11.2	10.430	1.70e-03	3.92e-05	6.54e-09
15	25.0	0.2531	0.433	9.97	21.421	8.51e-04	1.62e-04	1.36e-08
16	5.00	0.2192	0.455	8.63	80.582	2.33e-04	6.68e-04	1.53e-08

Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-1	Test Date: 12/5/22	Depth: 55'6"-55'8"
Test No.: IP-7	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-001, Swell Pressure = 6.27 kPa		
Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Summary Report

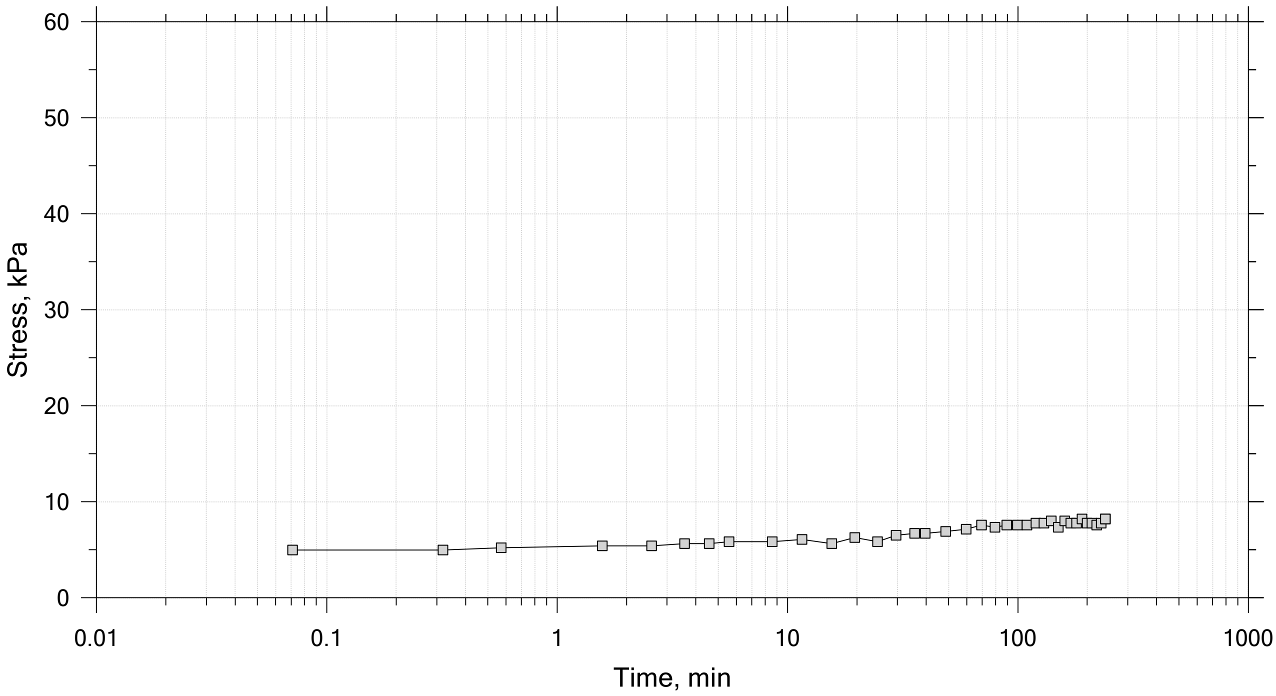


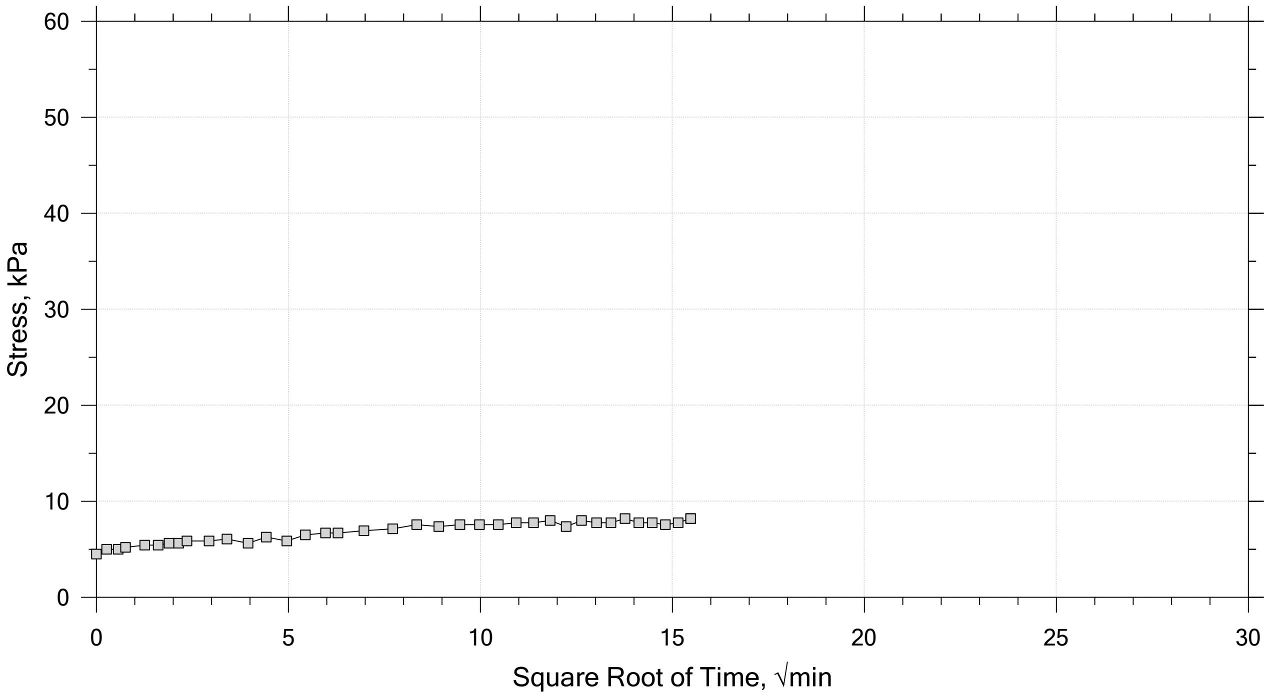


GeoTesting EXPRESS	Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: anm
	Sample No.: 28-2	Test Date: 12/5/22	Depth: 55'8"-55'10"
	Test No.: IP-8	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-032, Swell Pressure = 8.2 kPa		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 1 of 16
Constant Volume Step
Stress: 8.2 kPa





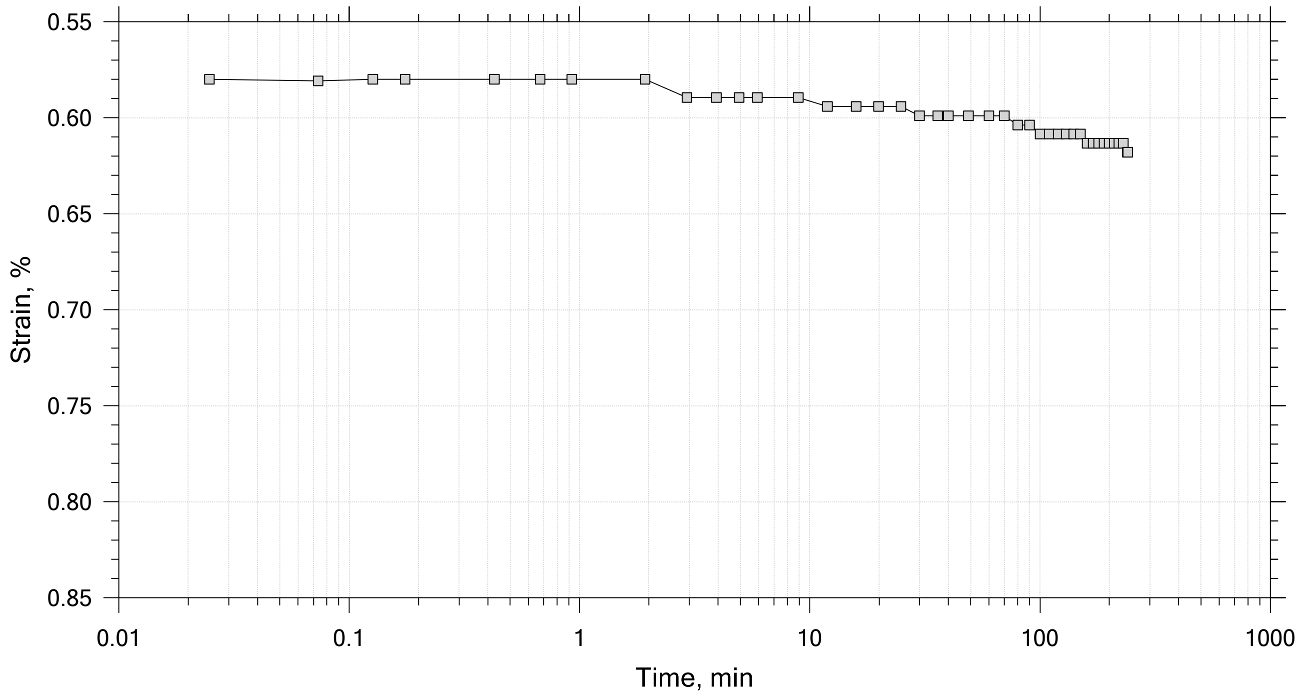
GeoTesting EXPRESS	Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: anm
	Sample No.: 28-2	Test Date: 12/5/22	Depth: 55'8"-55'10"
	Test No.: IP-8	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-032, Swell Pressure = 8.2 kPa		

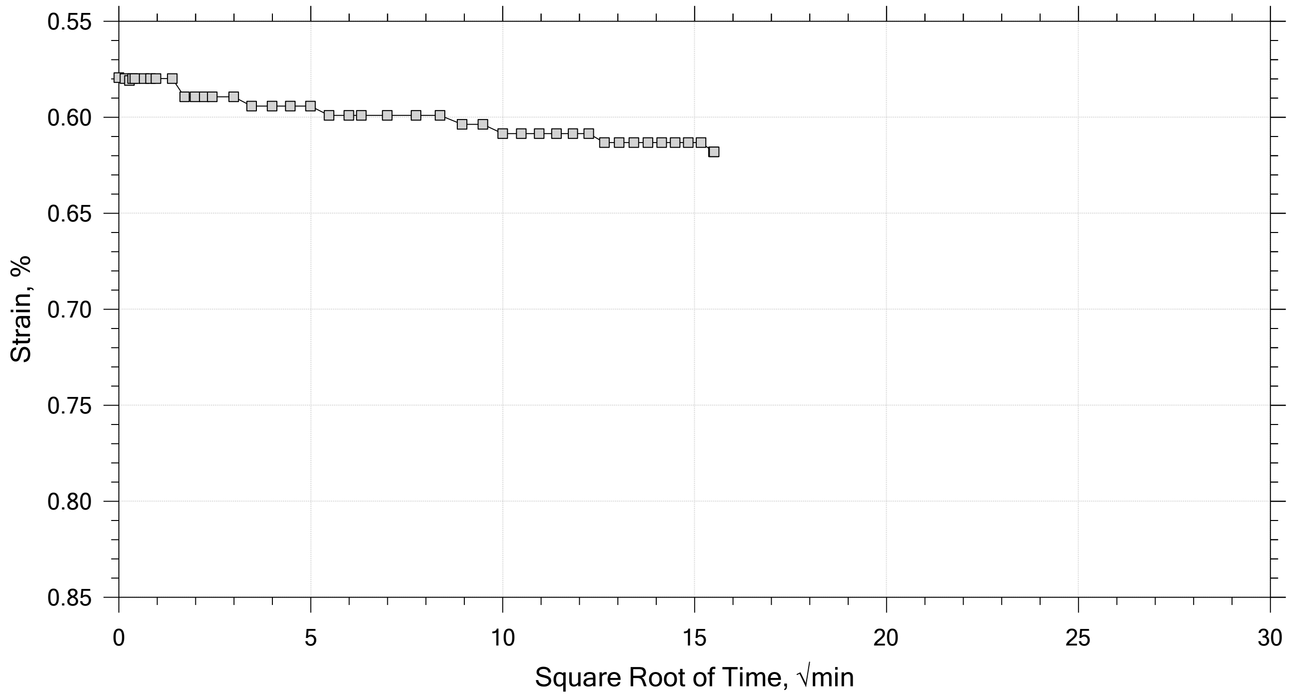
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 2 of 16

Constant Load Step

Stress: 10 kPa





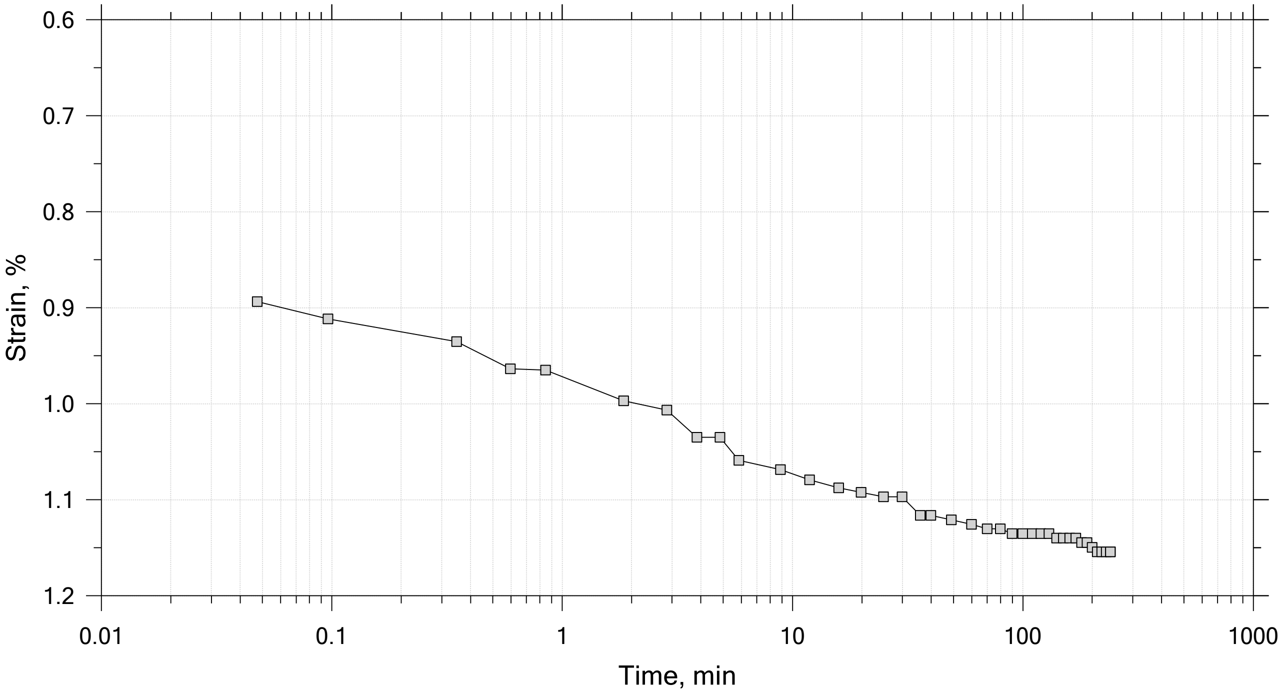
GeoTesting EXPRESS	Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: anm
	Sample No.: 28-2	Test Date: 12/5/22	Depth: 55'8"-55'10"
	Test No.: IP-8	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-032, Swell Pressure = 8.2 kPa		

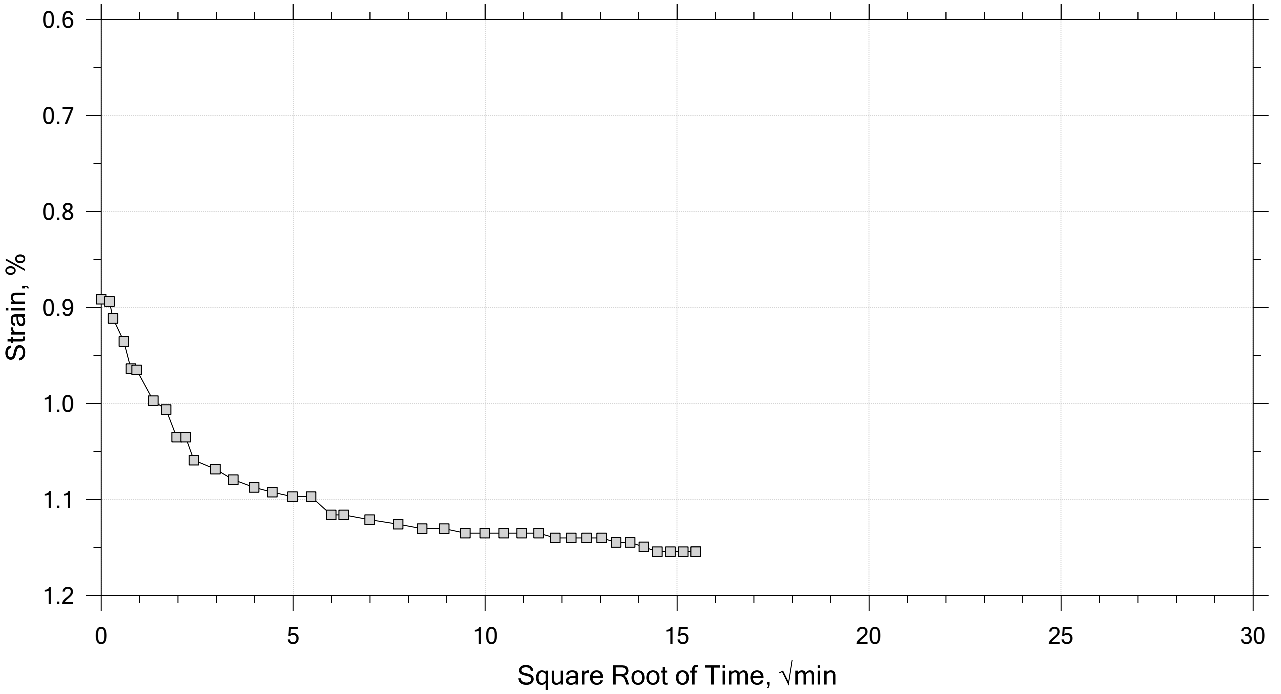
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 3 of 16

Constant Load Step

Stress: 25 kPa

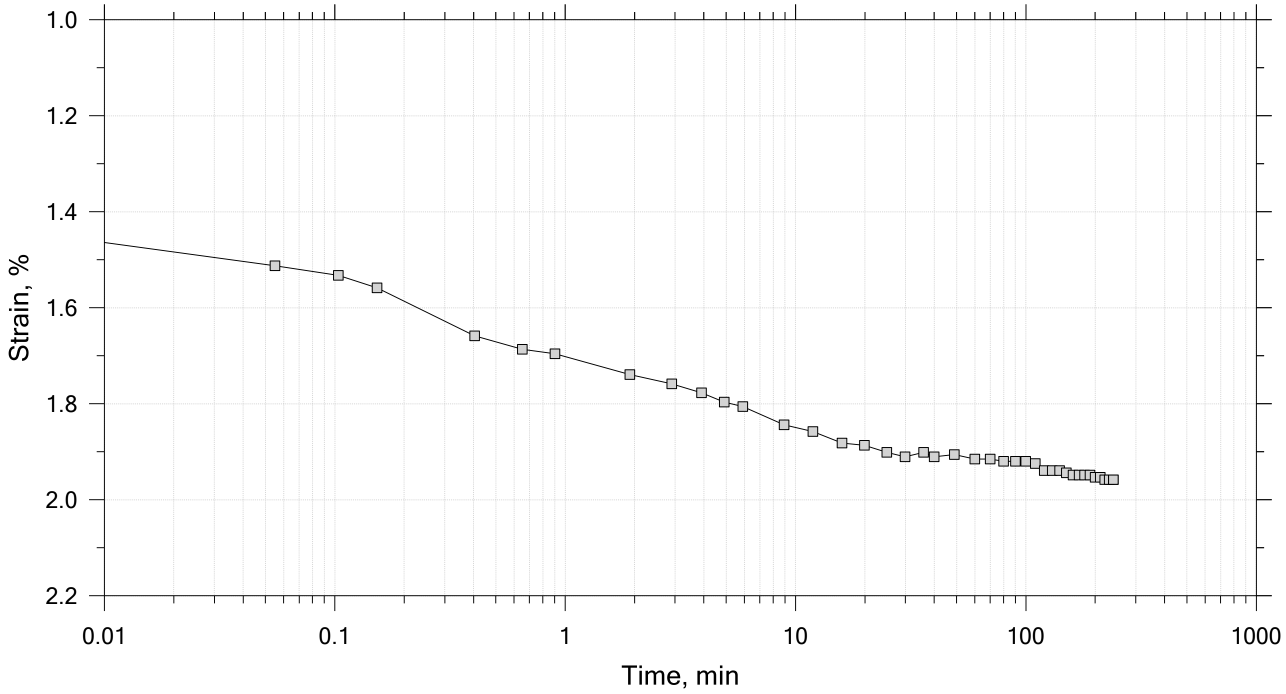


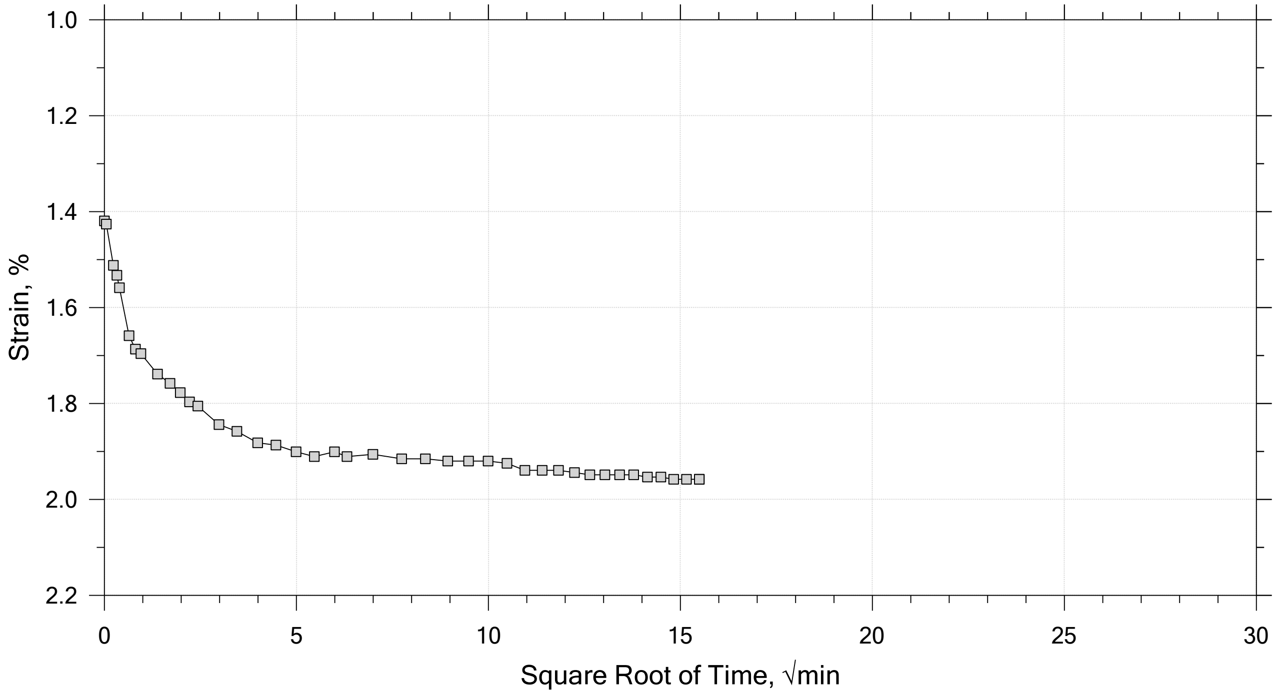


Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-2	Test Date: 12/5/22	Depth: 55'8"-55'10"
Test No.: IP-8	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 8.2 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 4 of 16
Constant Load Step
Stress: 50 kPa





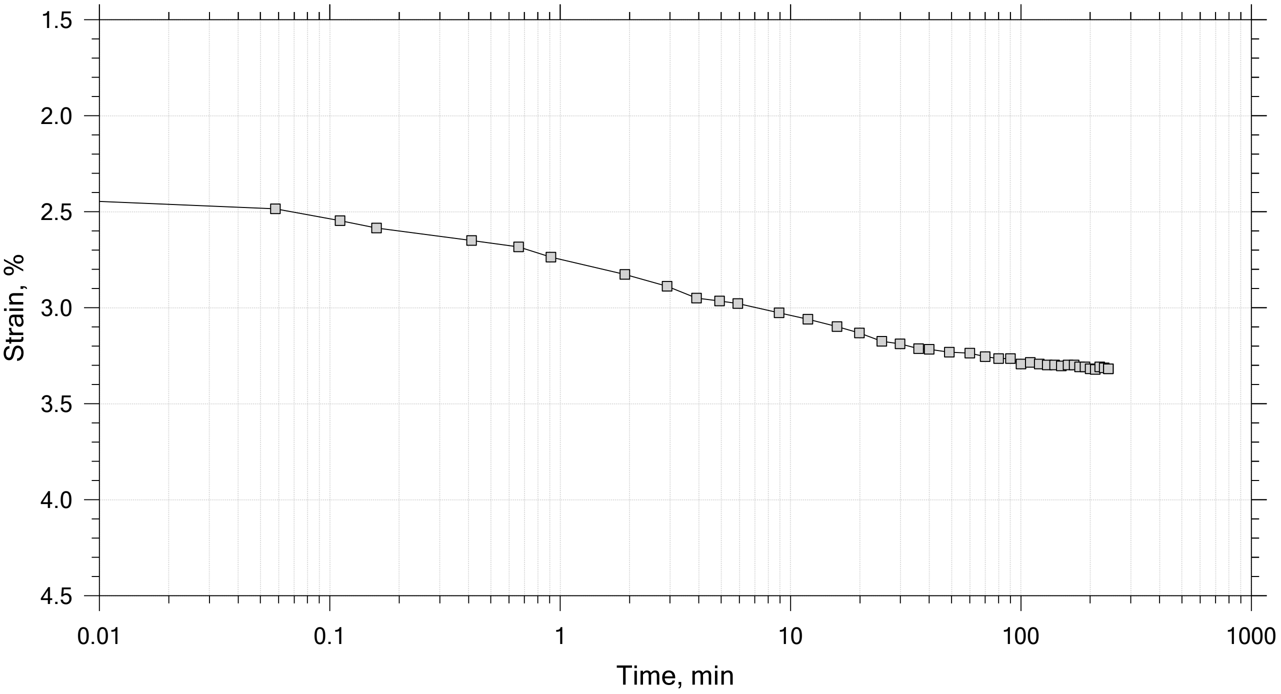
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-2	Test Date: 12/5/22	Depth: 55'8"-55'10"
Test No.: IP-8	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 8.2 kPa		

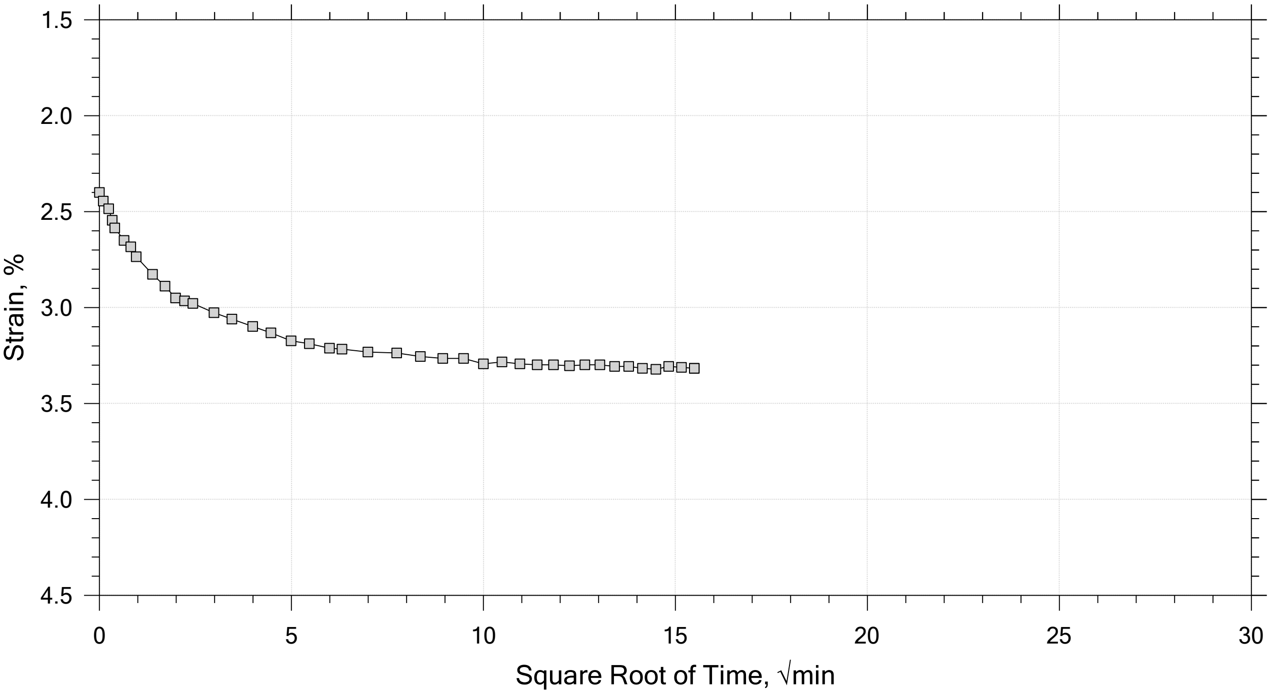
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 5 of 16

Constant Load Step

Stress: 100 kPa





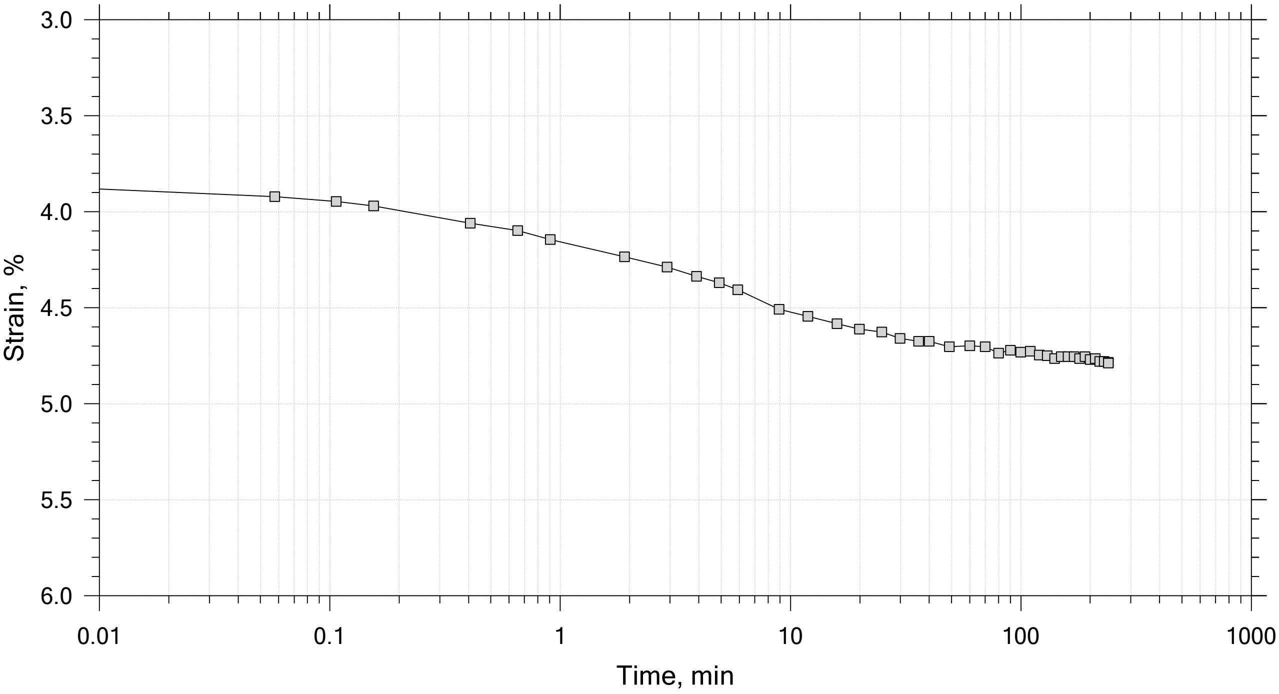
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-2	Test Date: 12/5/22	Depth: 55'8"-55'10"
Test No.: IP-8	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 8.2 kPa		

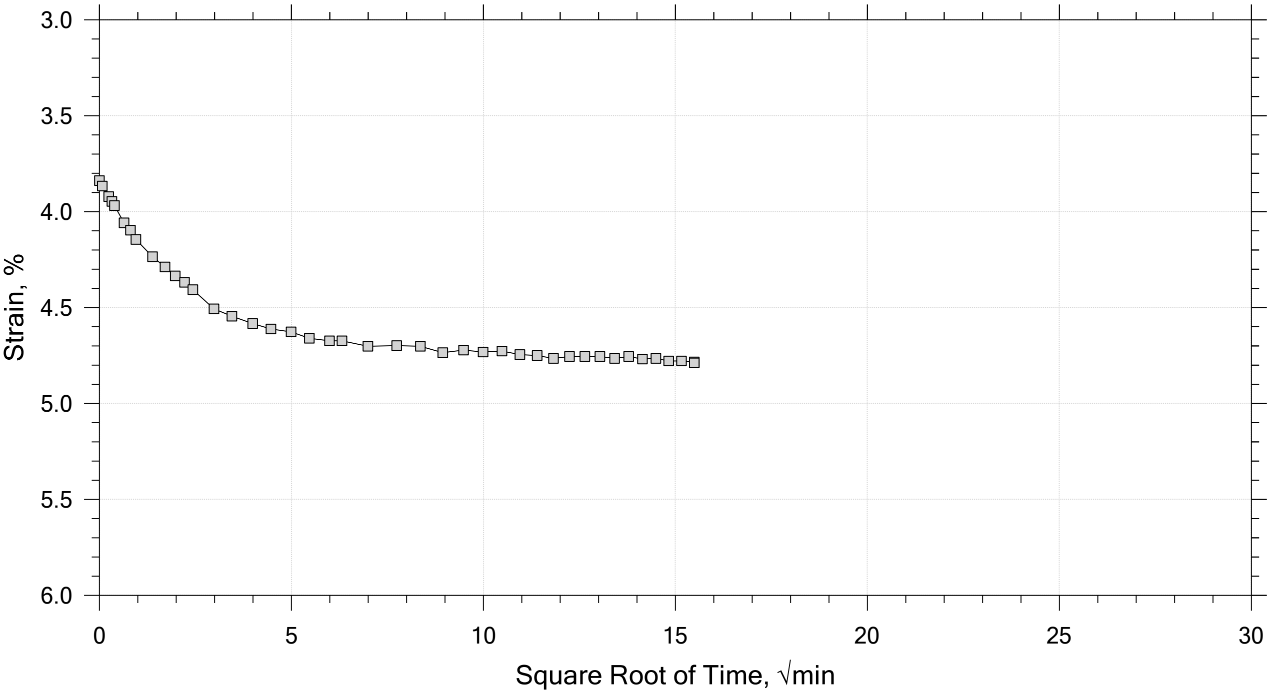
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 6 of 16

Constant Load Step

Stress: 200 kPa





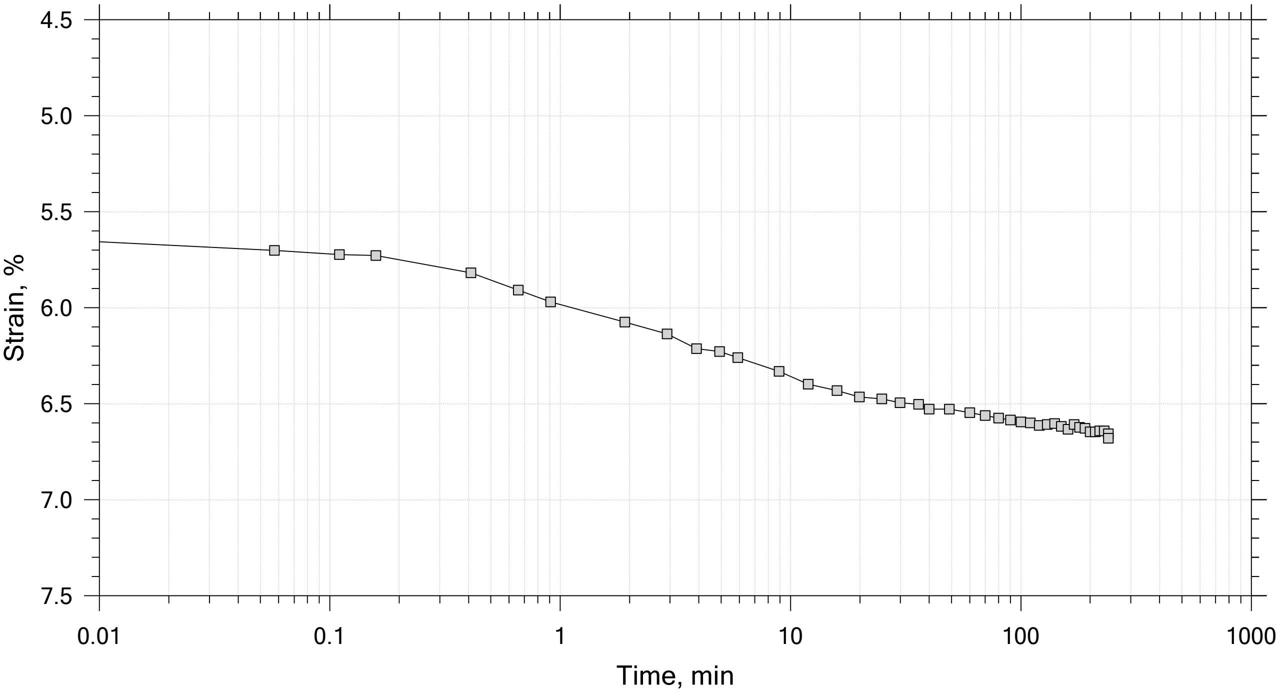
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-2	Test Date: 12/5/22	Depth: 55'8"-55'10"
Test No.: IP-8	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 8.2 kPa		

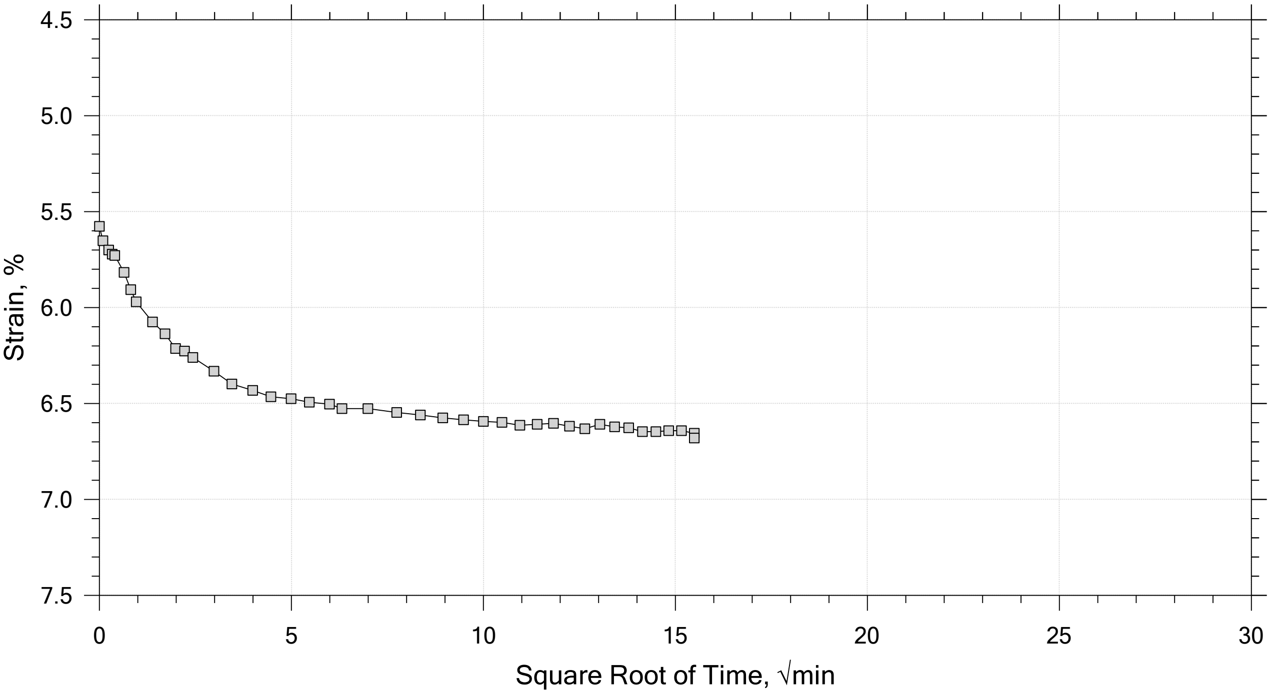
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 7 of 16

Constant Load Step

Stress: 400 kPa





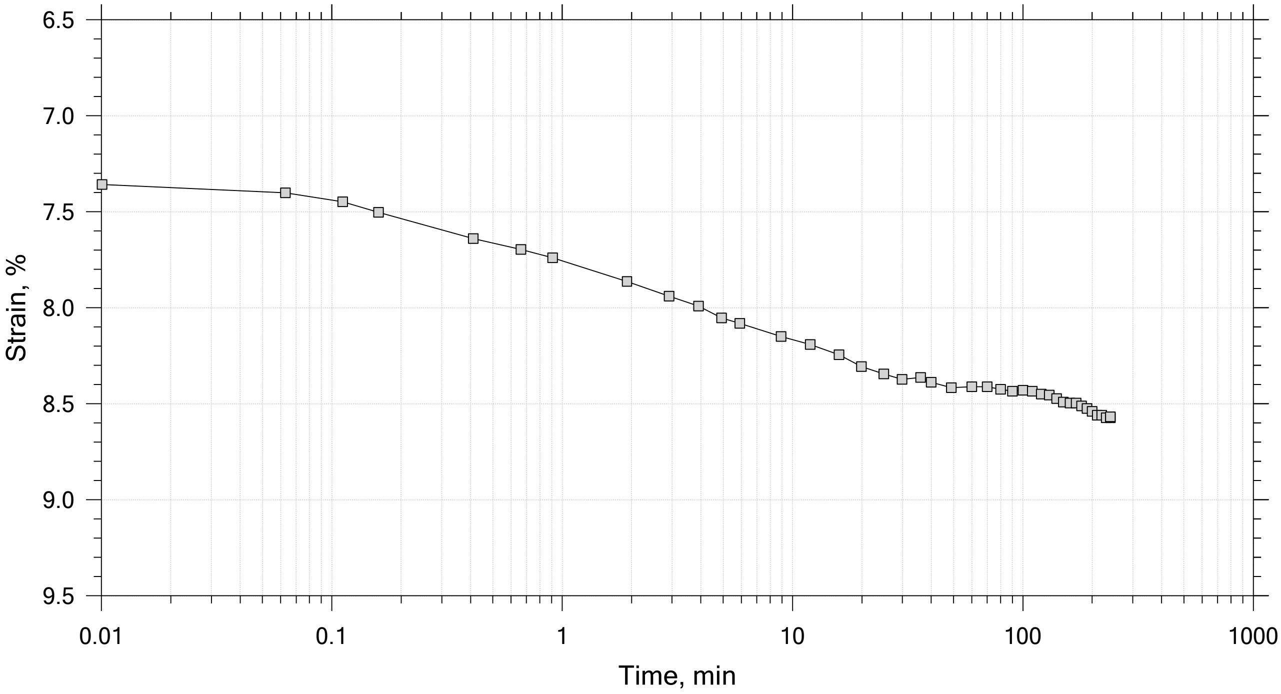
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-2	Test Date: 12/5/22	Depth: 55'8"-55'10"
Test No.: IP-8	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 8.2 kPa		

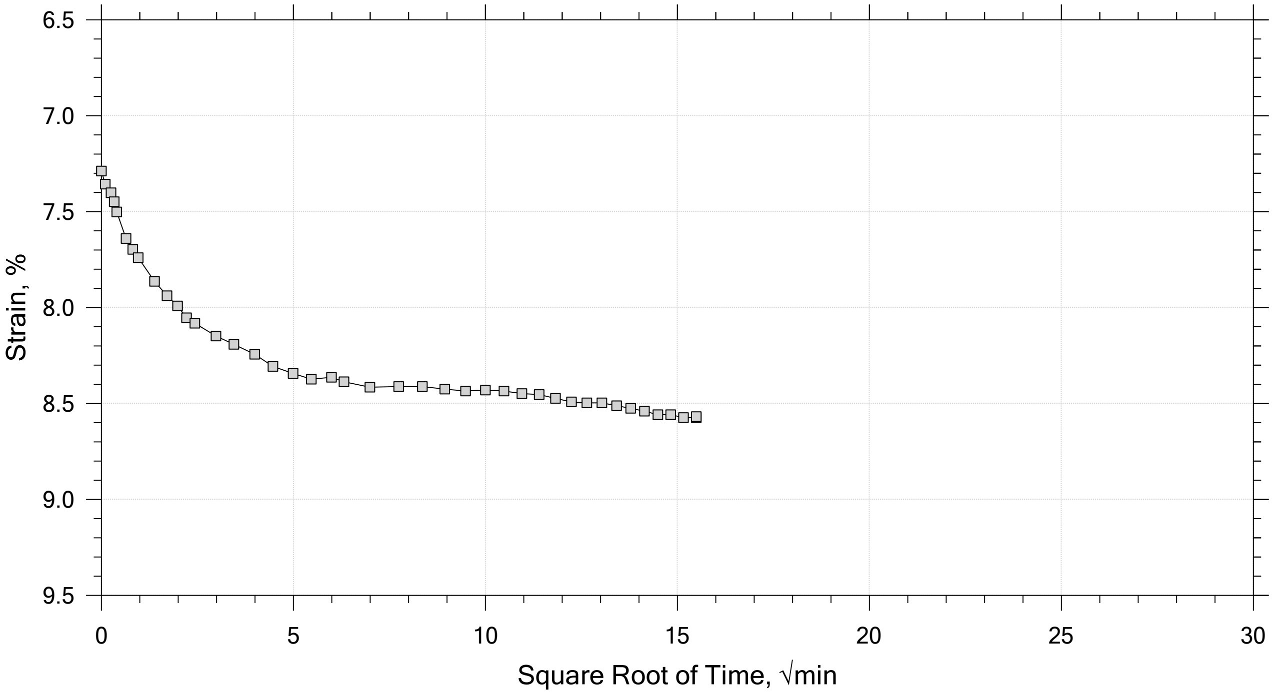
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 8 of 16

Constant Load Step

Stress: 800 kPa

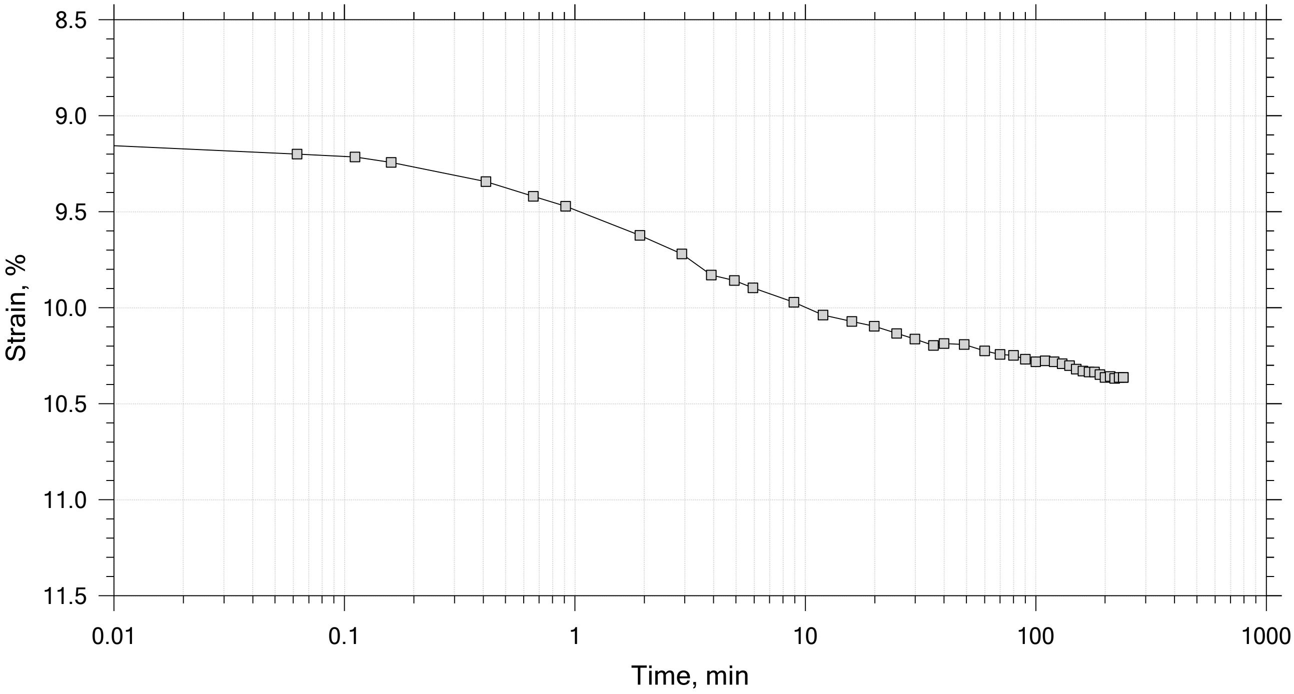


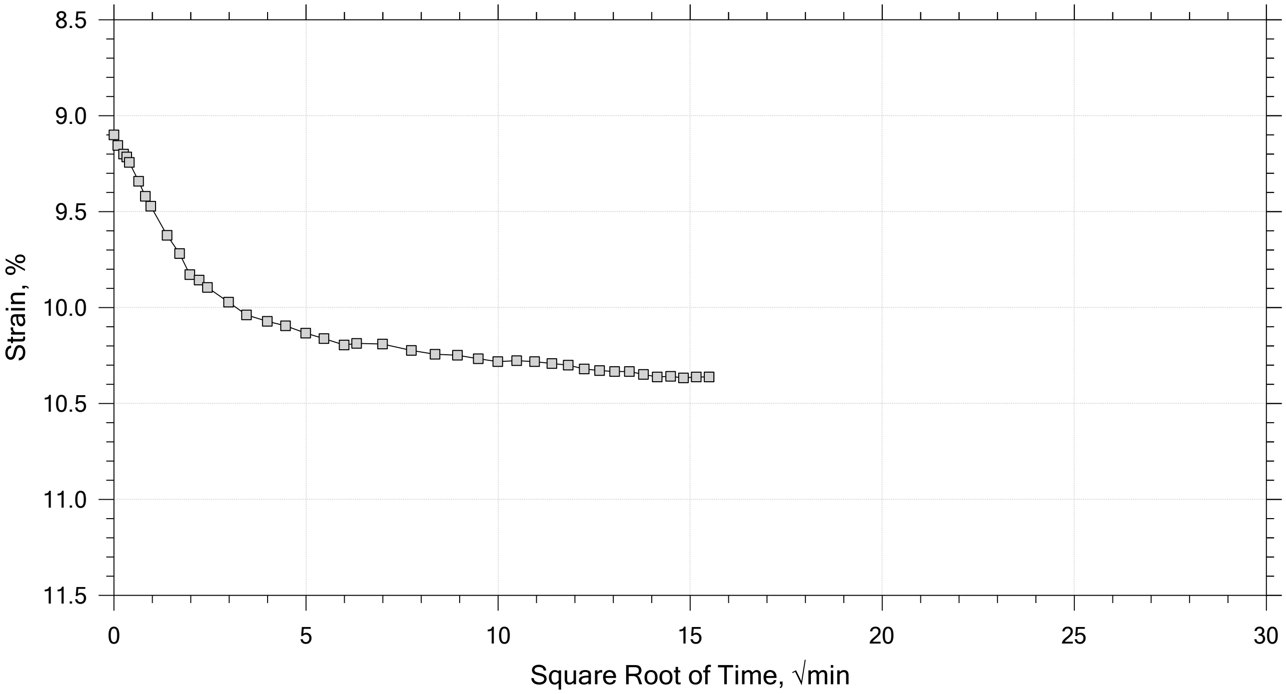


Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-2	Test Date: 12/5/22	Depth: 55'8"-55'10"
Test No.: IP-8	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 8.2 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 9 of 16
Constant Load Step
Stress: 1.6e+03 kPa





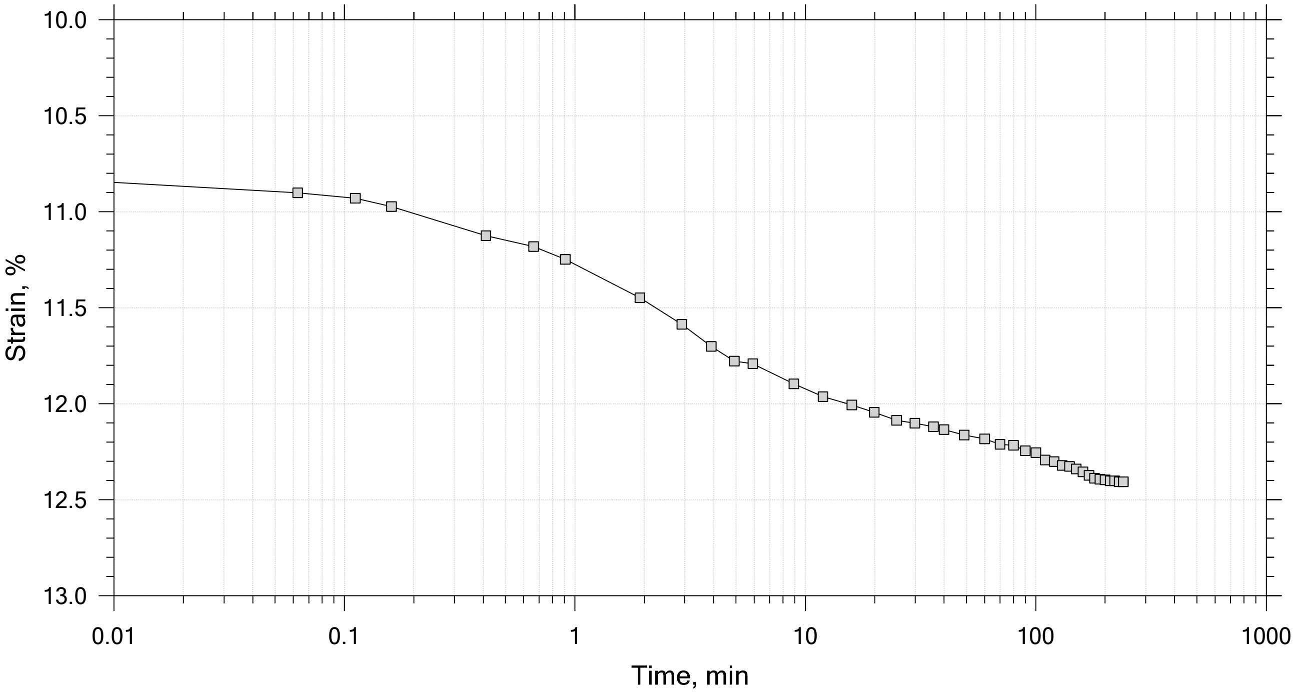
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-2	Test Date: 12/5/22	Depth: 55'8"-55'10"
Test No.: IP-8	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 8.2 kPa		

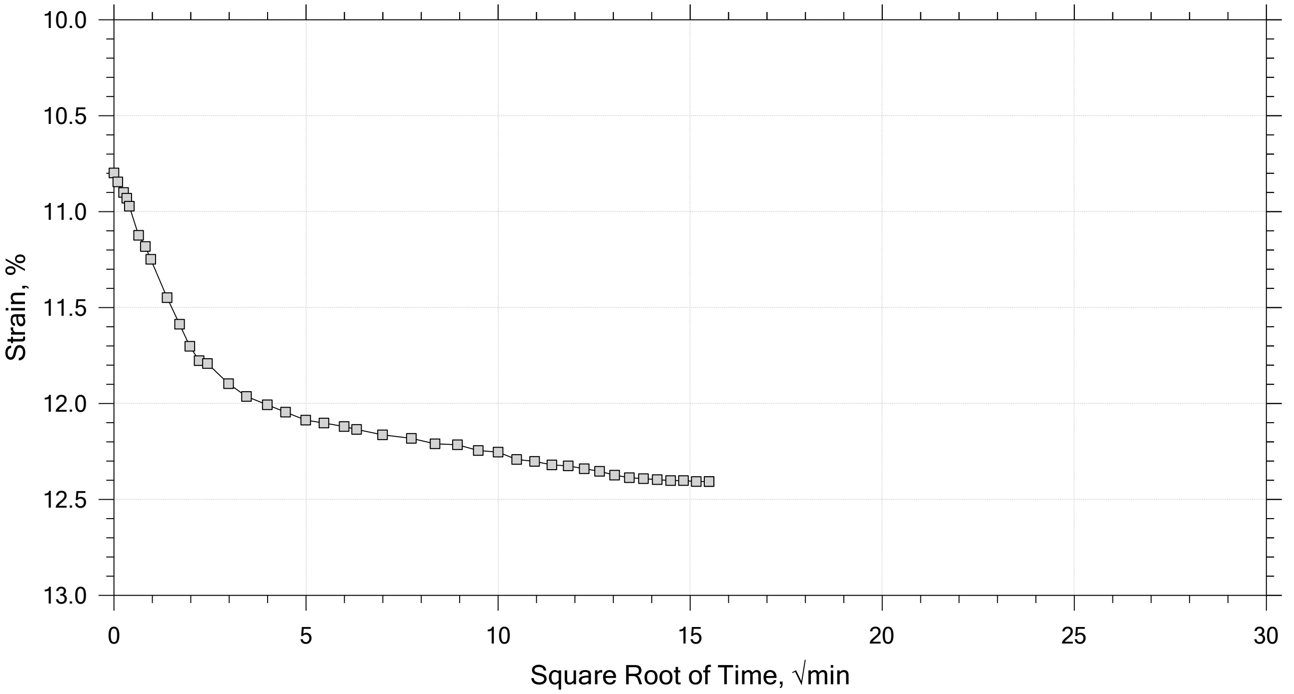
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 10 of 16

Constant Load Step

Stress: 3.2e+03 kPa

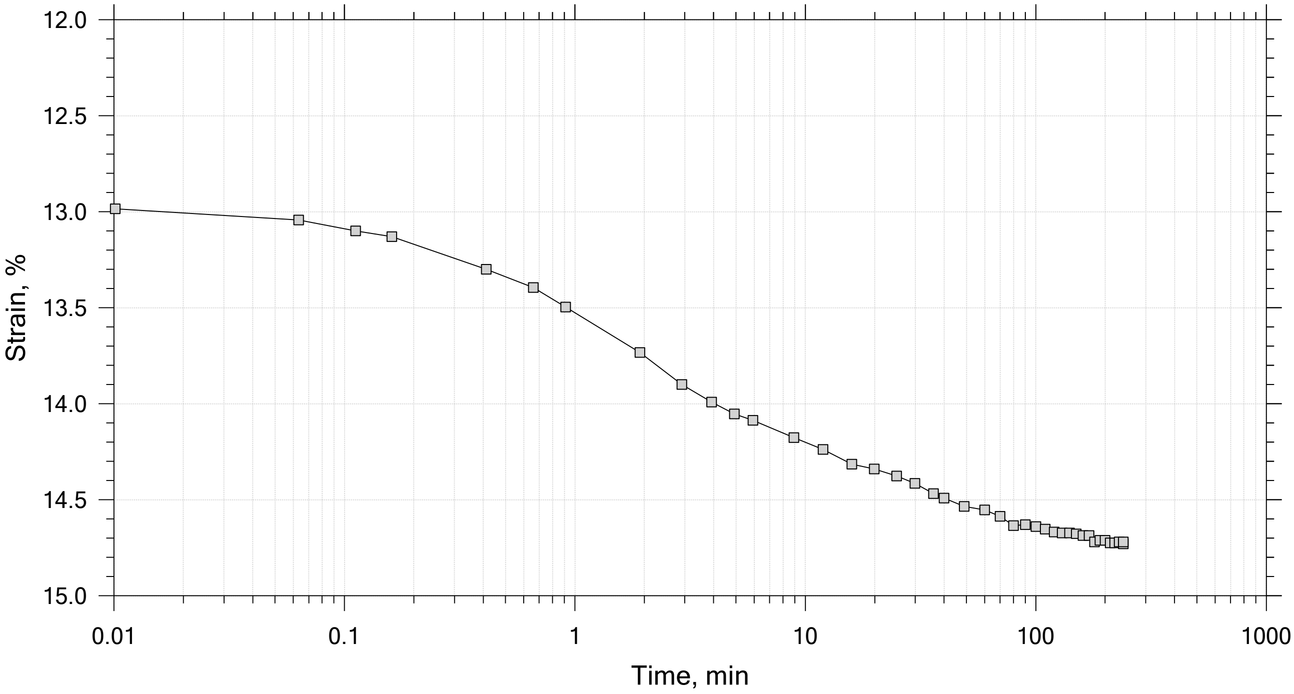


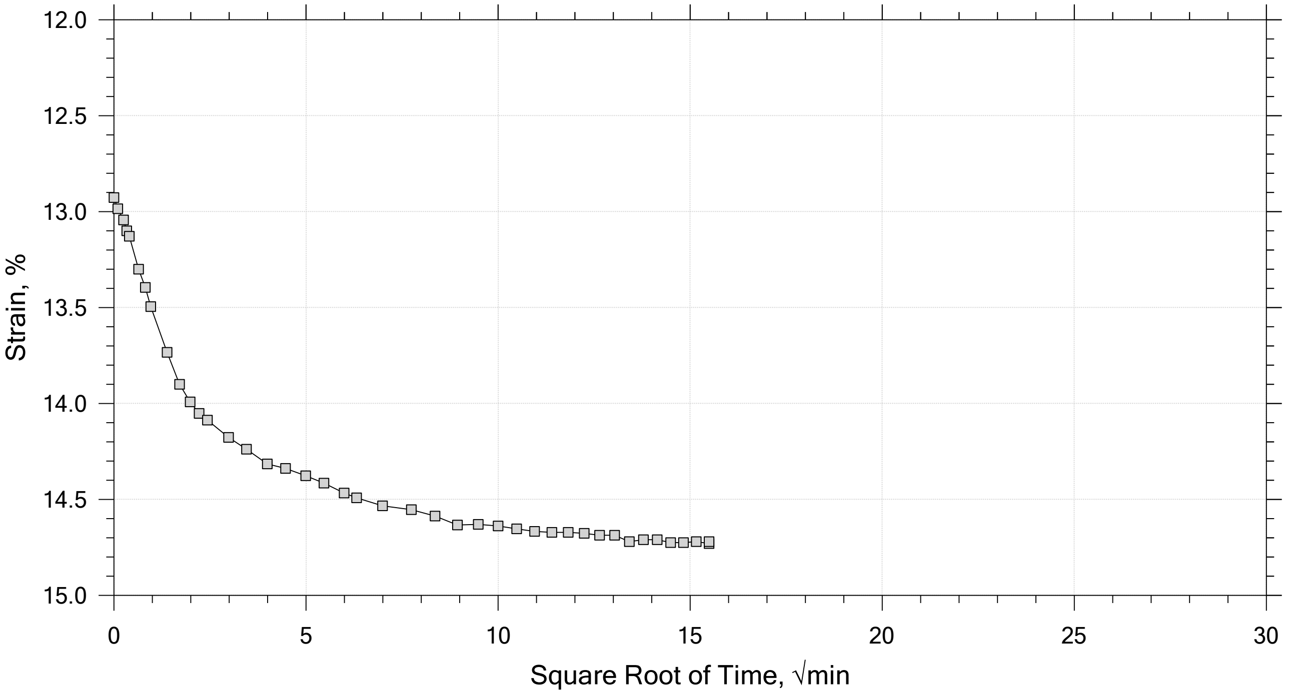


Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-2	Test Date: 12/5/22	Depth: 55'8"-55'10"
Test No.: IP-8	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 8.2 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 11 of 16
Constant Load Step
Stress: 6.4e+03 kPa





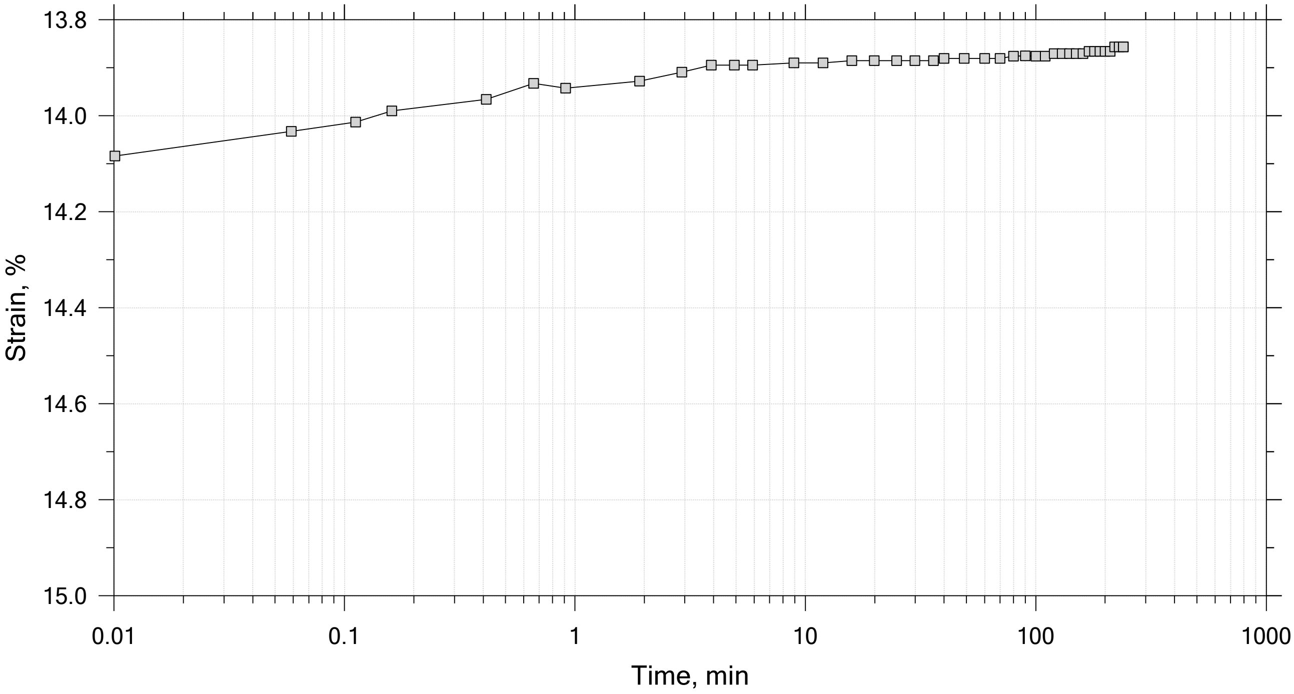
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-2	Test Date: 12/5/22	Depth: 55'8"-55'10"
Test No.: IP-8	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 8.2 kPa		

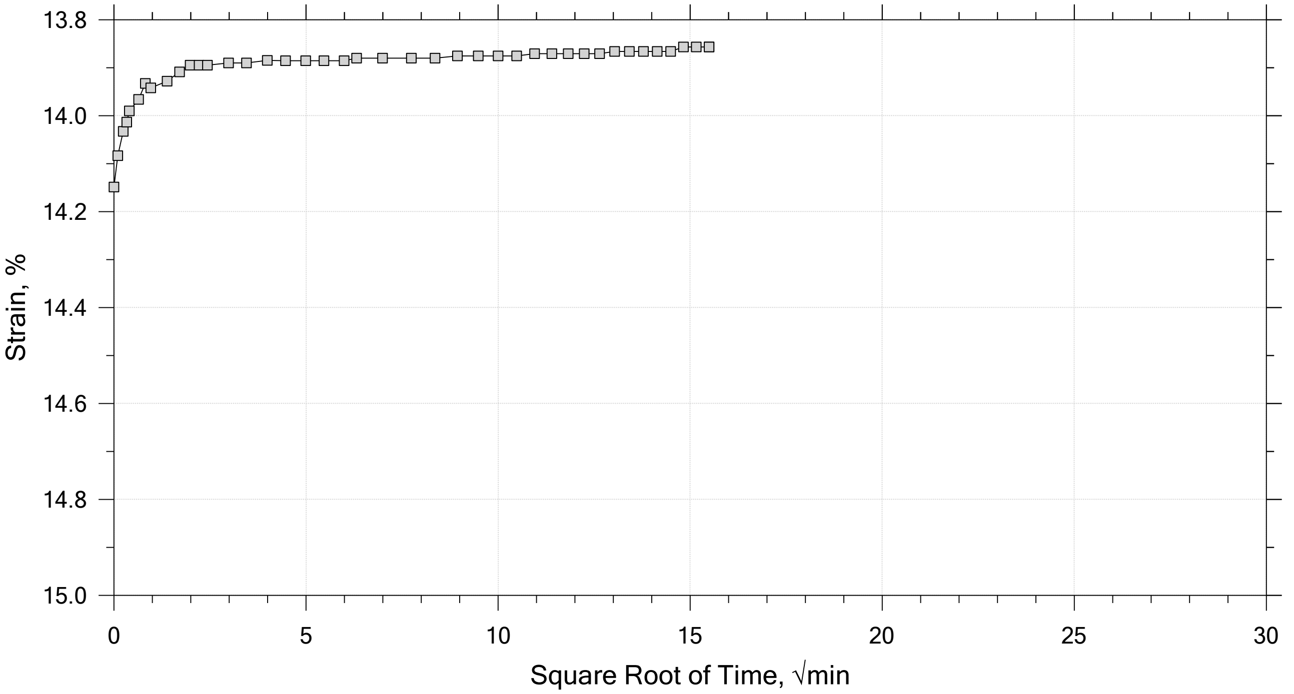
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 12 of 16

Constant Load Step

Stress: 1.6e+03 kPa





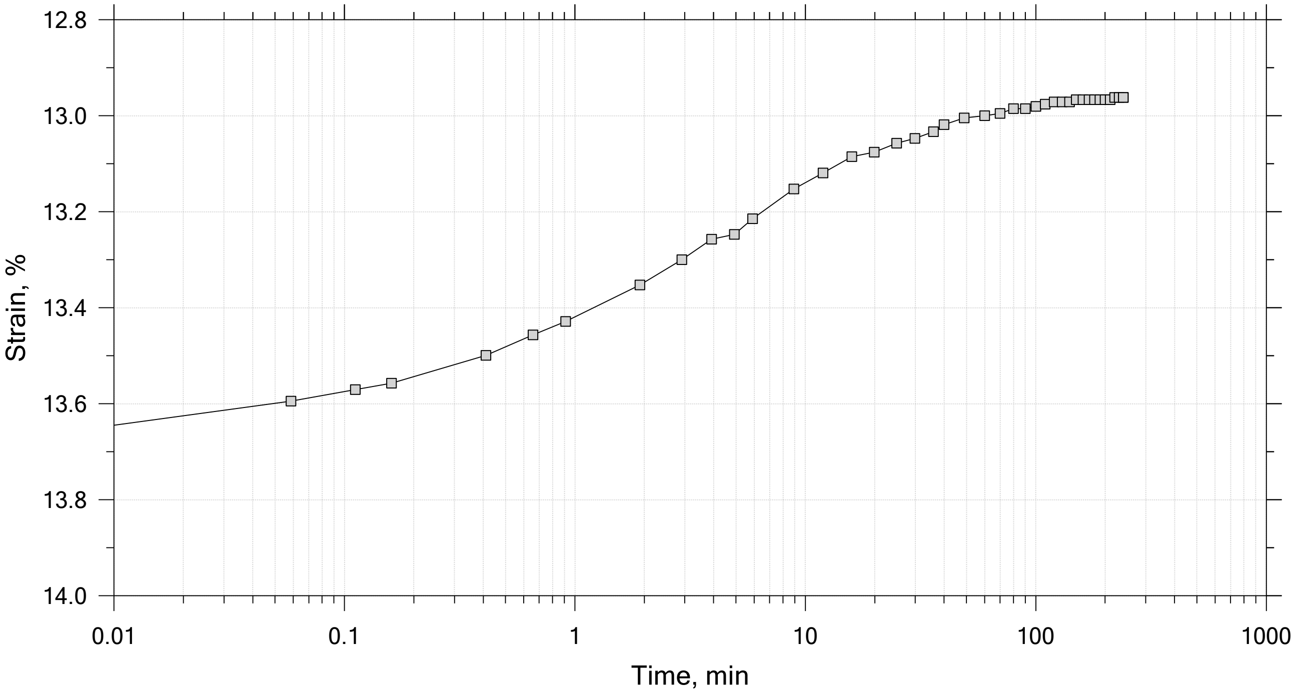
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-2	Test Date: 12/5/22	Depth: 55'8"-55'10"
Test No.: IP-8	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 8.2 kPa		

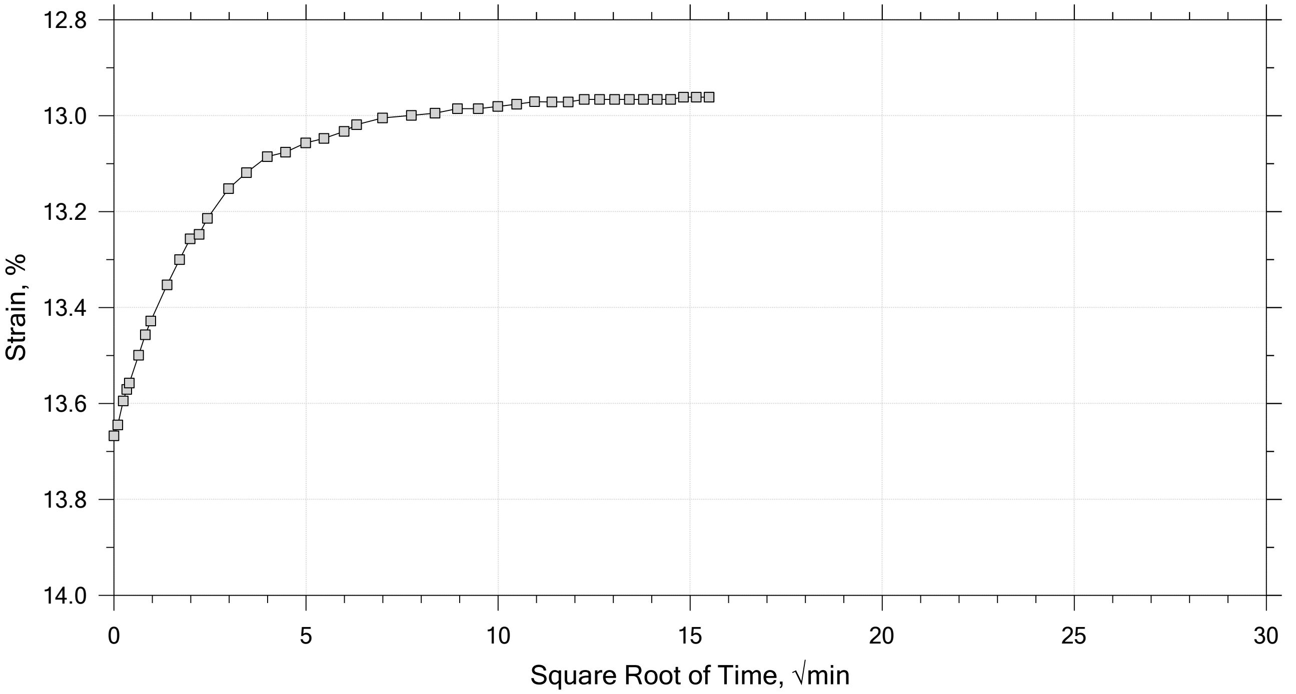
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 13 of 16

Constant Load Step

Stress: 400 kPa





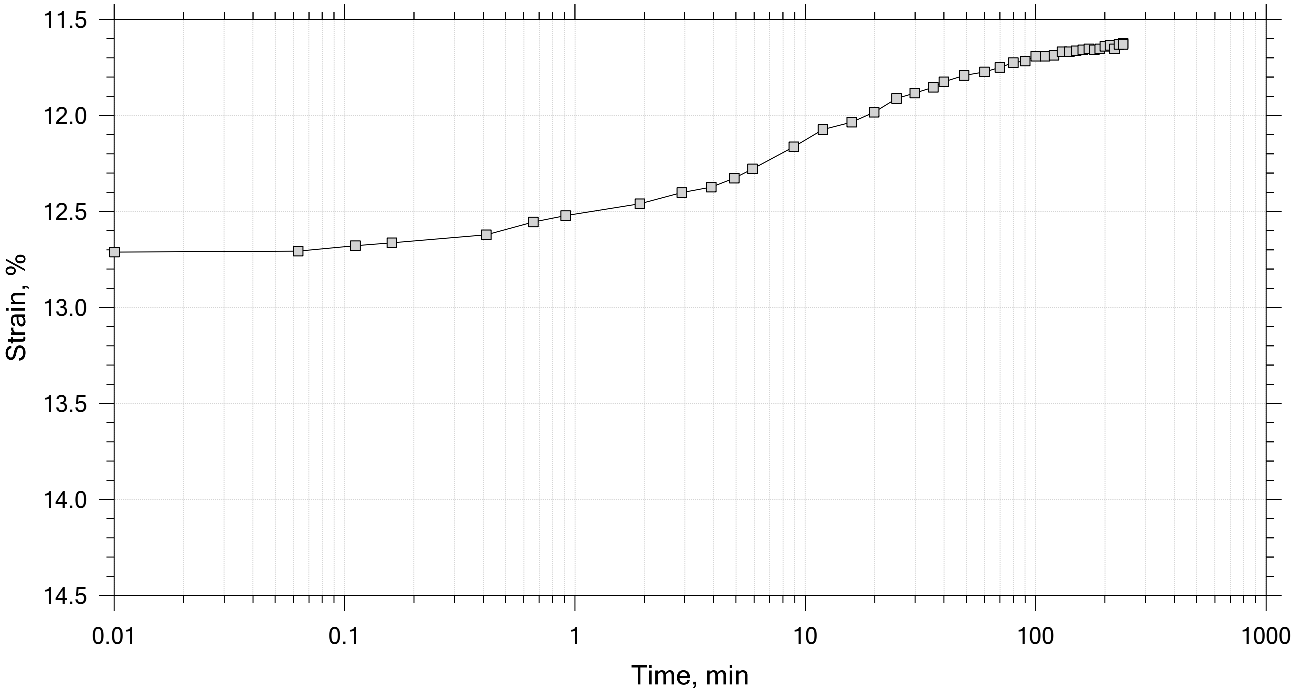
GeoTesting EXPRESS	Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: anm
	Sample No.: 28-2	Test Date: 12/5/22	Depth: 55'8"-55'10"
	Test No.: IP-8	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-032, Swell Pressure = 8.2 kPa		

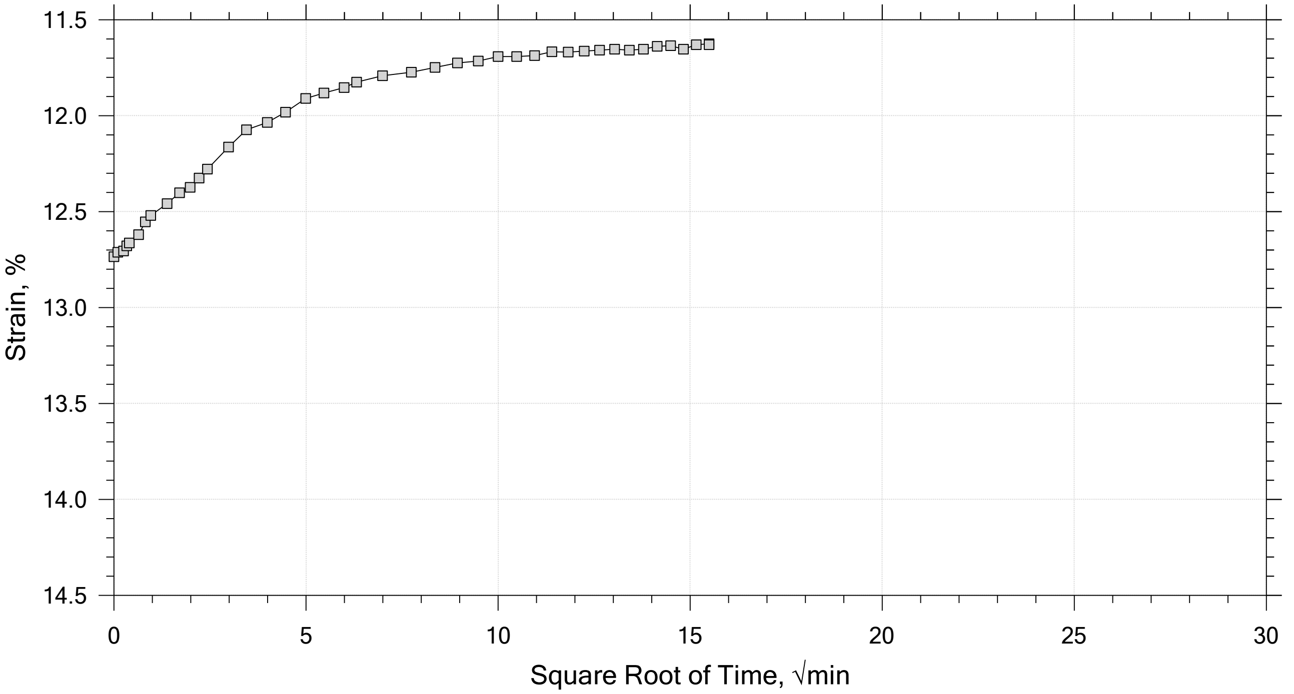
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 14 of 16

Constant Load Step

Stress: 100 kPa





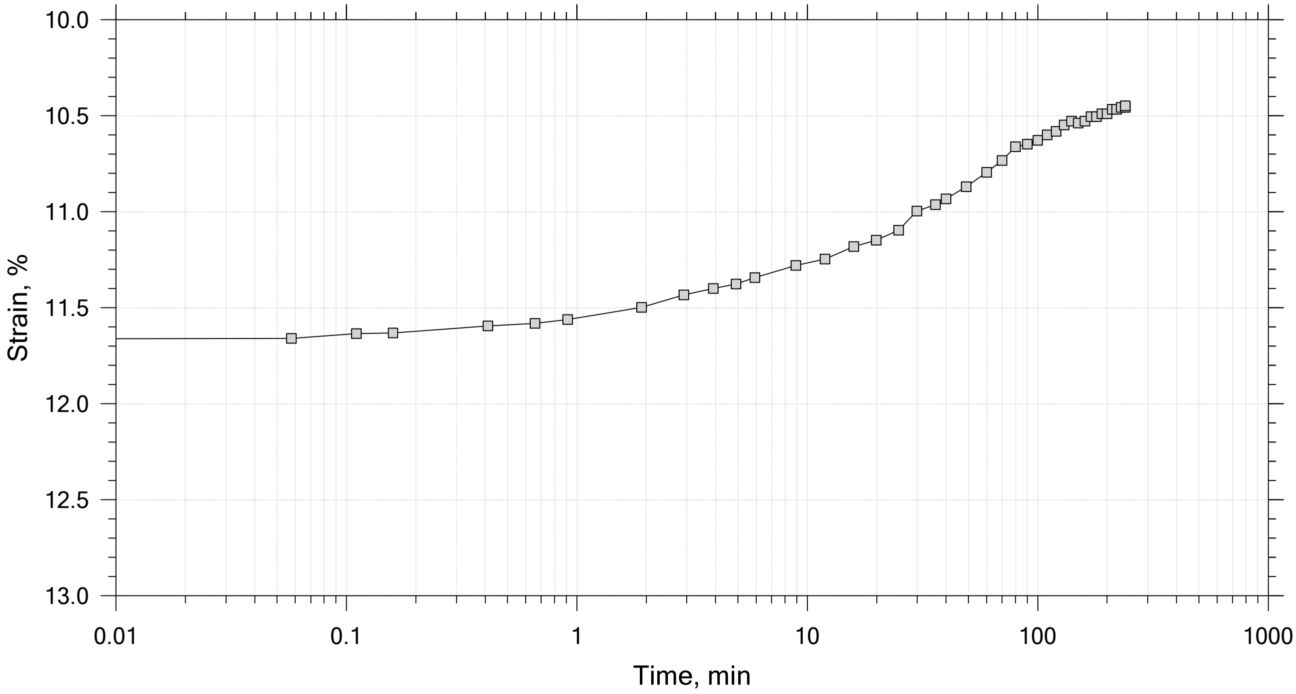
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-2	Test Date: 12/5/22	Depth: 55'8"-55'10"
Test No.: IP-8	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 8.2 kPa		

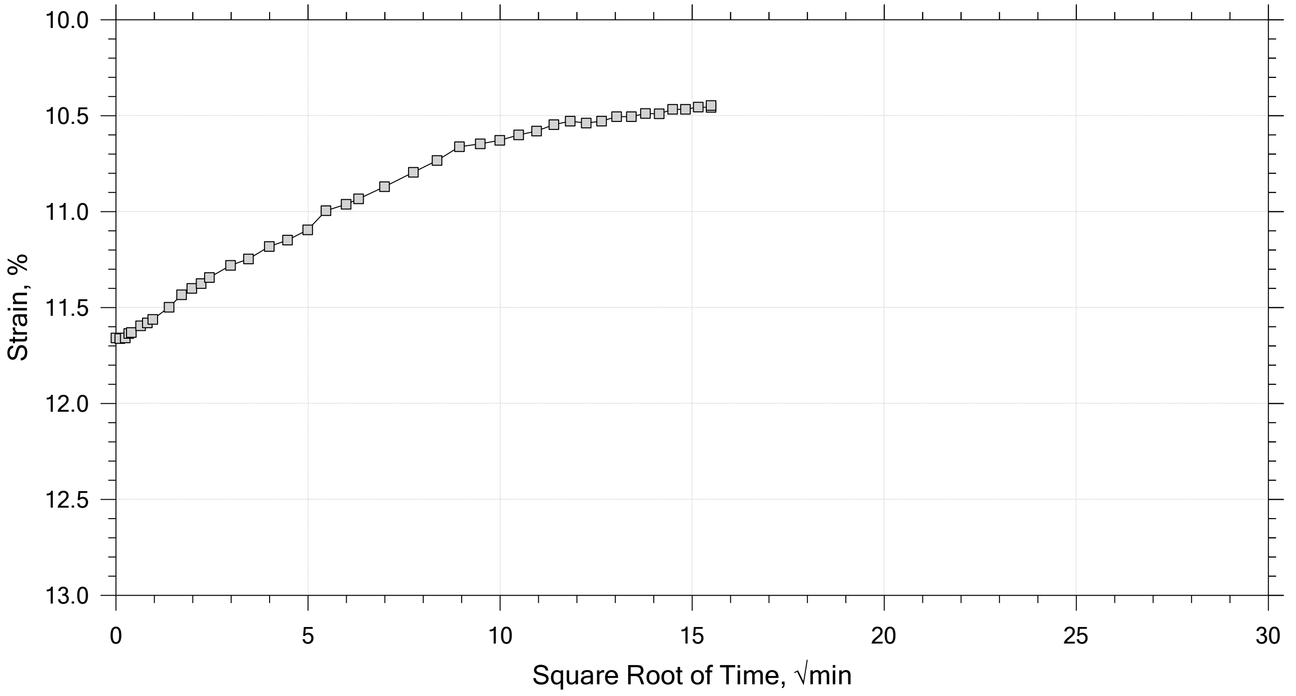
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 15 of 16

Constant Load Step

Stress: 25 kPa





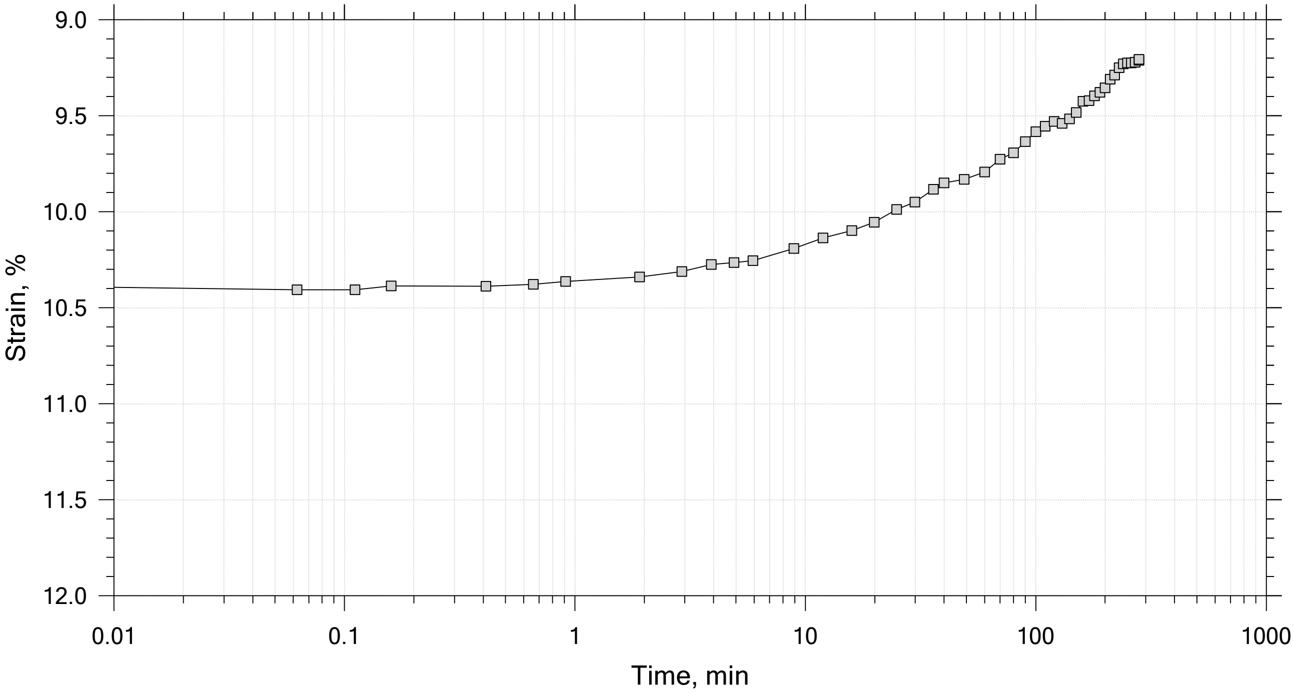
Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-2	Test Date: 12/5/22	Depth: 55'8"-55'10"
Test No.: IP-8	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 8.2 kPa		

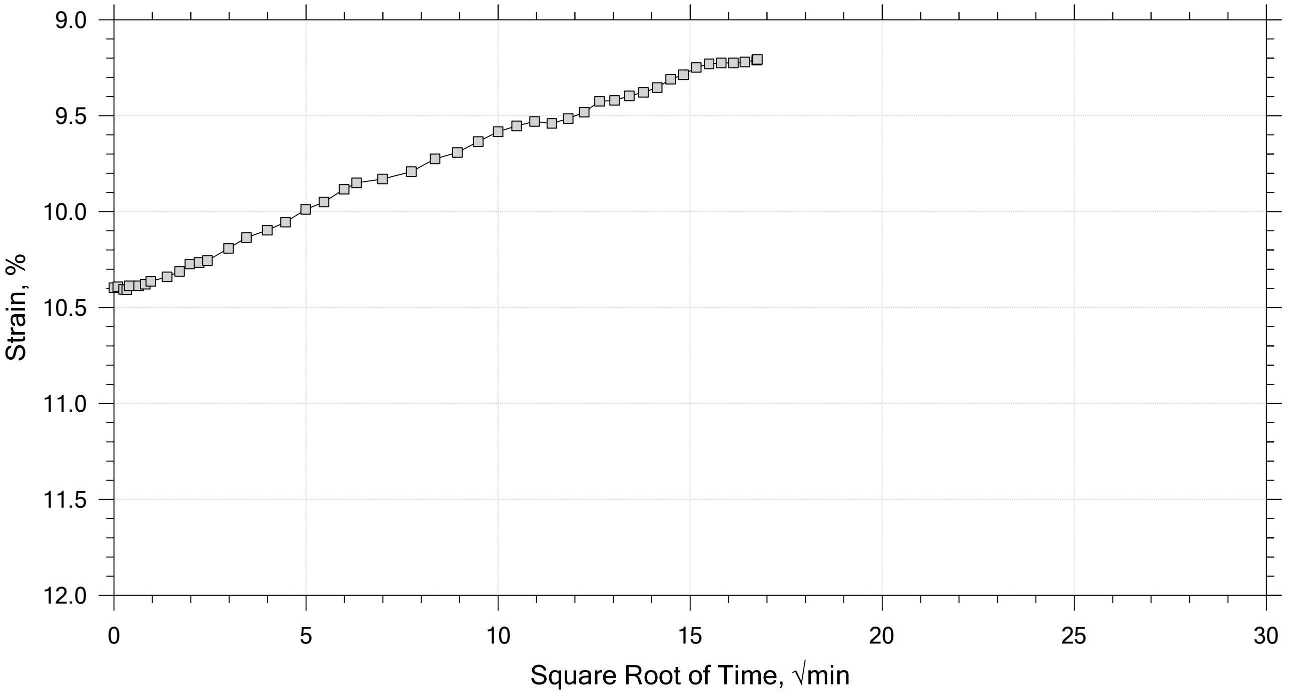
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 16 of 16

Constant Load Step

Stress: 5 kPa





Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-2	Test Date: 12/5/22	Depth: 55'8"-55'10"
Test No.: IP-8	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 8.2 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

Specimen Diameter: 6.35 cm	Measured Specific Gravity: 2.67	Liquid Limit: ---
Initial Height: 2.54 cm	Initial Void Ratio: 0.531	Plastic Limit: ---
Final Height: 2.41 cm	Final Void Ratio: 0.455	Plasticity Index: ---

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	E4184	RING		E1982
Mass Container, gm	8.39	107.7	107.7	8.28
Mass Container + Wet Soil, gm	274.21	273.75	270.62	170.55
Mass Container + Dry Soil, gm	233.86	247.95	247.95	147.97
Mass Dry Soil, gm	225.47	140.25	140.25	139.69
Water Content, %	17.90	18.40	16.16	16.16
Void Ratio	---	0.53	0.45	---
Degree of Saturation, %	---	92.44	94.90	---
Dry Unit Weight, kN/m³	---	17.098	17.998	---

GeoTesting EXPRESS	Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
	Boring No.: BH26	Tested By: trm	Checked By: anm
	Sample No.: 28-2	Test Date: 12/5/22	Depth: 55'8"-55'10"
	Test No.: IP-8	Sample Type: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-032, Swell Pressure = 8.2 kPa		

One-Dimensional Consolidation by ASTM D2435 - Method B

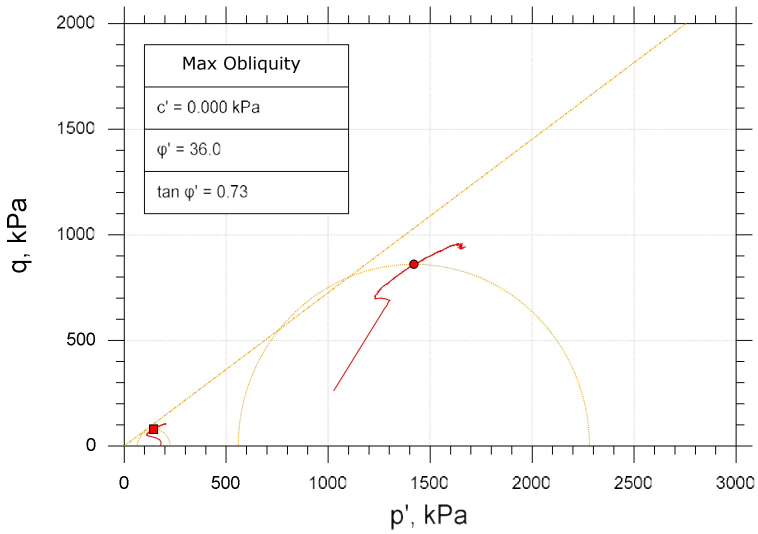
Square Root of Time Coefficients

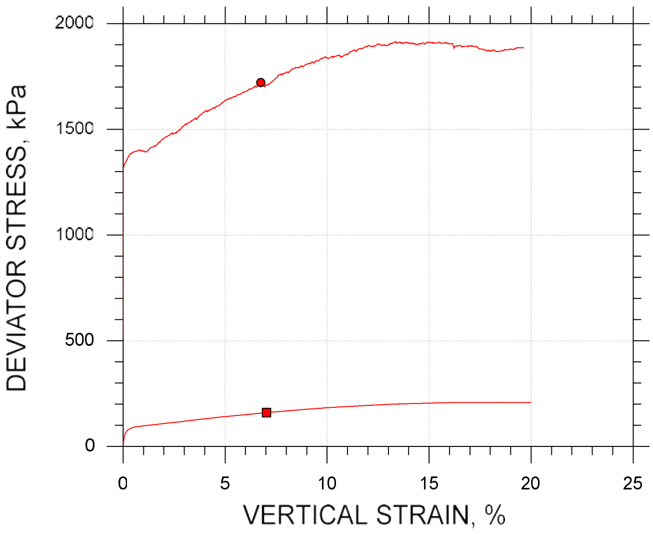
Step	Applied Stress kPa	Final Displacement cm	Void Ratio	Strain at End %	Sq.Rt. T90 min	Cv cm²/s	Mv 1/kPa	k cm/s
1	8.20	0.01455	0.523	0.573	---	---	---	---
2	10.0	0.01570	0.522	0.618	229.970	9.79e-05	2.51e-04	2.41e-09
3	25.0	0.02932	0.514	1.15	12.739	1.76e-03	3.58e-04	6.16e-08
4	50.0	0.04974	0.501	1.96	6.660	3.32e-03	3.22e-04	1.05e-07
5	100.	0.08426	0.481	3.32	16.351	1.32e-03	2.72e-04	3.52e-08
6	200.	0.1216	0.458	4.79	9.153	2.29e-03	1.47e-04	3.31e-08
7	400.	0.1697	0.429	6.68	13.719	1.48e-03	9.46e-05	1.37e-08
8	800.	0.2176	0.400	8.57	17.360	1.12e-03	4.72e-05	5.19e-09
9	1.60e+03	0.2632	0.373	10.4	11.724	1.59e-03	2.24e-05	3.51e-09
10	3.20e+03	0.3151	0.341	12.4	10.723	1.67e-03	1.28e-05	2.09e-09
11	6.40e+03	0.3739	0.306	14.7	9.911	1.72e-03	7.23e-06	1.22e-09
12	1.60e+03	0.3520	0.319	13.9	3.674	4.56e-03	1.80e-06	8.04e-10
13	400.	0.3292	0.333	13.0	9.224	1.85e-03	7.46e-06	1.36e-09
14	100.	0.2954	0.353	11.6	28.874	6.07e-04	4.44e-05	2.64e-09
15	25.0	0.2654	0.371	10.4	101.275	1.78e-04	1.58e-04	2.75e-09
16	5.00	0.2338	0.390	9.21	209.582	8.84e-05	6.21e-04	5.38e-09

Project: Darlington NPP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Tested By: trm	Checked By: anm
Sample No.: 28-2	Test Date: 12/5/22	Depth: 55'8"-55'10"
Test No.: IP-8	Sample Type: intact	Elevation: ---
Description: Moist, gray clay		
Remarks: TX-032, Swell Pressure = 8.2 kPa		
Displacement at End of Increment		

Client: WSP Canada Inc.	
Project Name: Darlington NNP Phase II	
Project Location: Ontario, Canada	
Project Number: GTX-316444	
Tested By: trm	Checked By: njh
Boring ID: BH26	
Preparation: intact	
Description: Moist, gray clay	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.7

CONSOLIDATED UNDRAINED TRIAXIAL TEST - Ko CONSOLIDATION

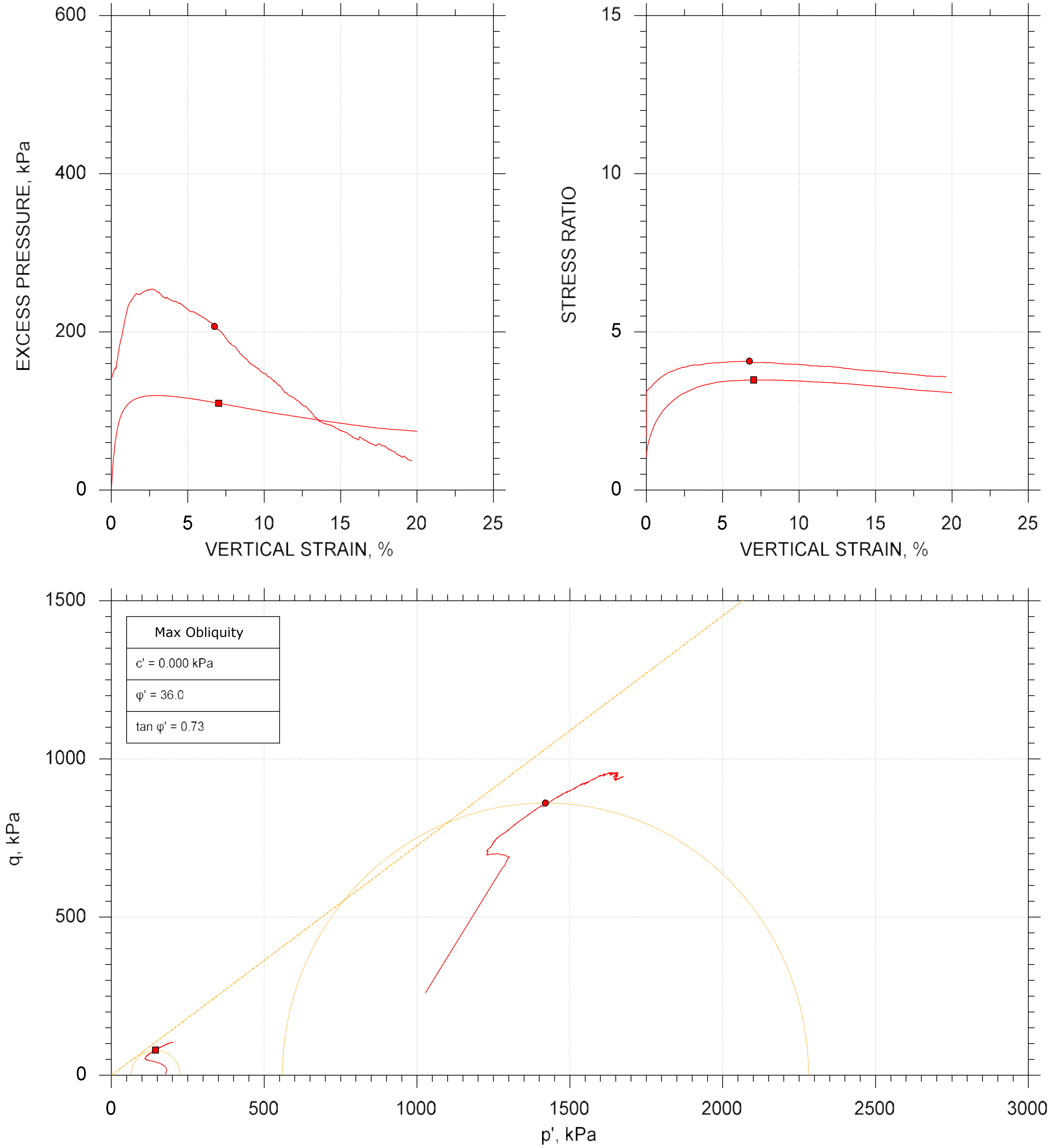




Symbol		■	●		
Sample ID		24-3	24-4		
Depth, ft		46'2"-46'8"	47'1"-47'7"		
Test Number		CKoUc-2-1	CKoUc-2-2R		
Initial	Height, cm	15.49	10.67		
	Diameter, cm	7.137	5.207		
	Moisture Content (from Cuttings), %	22.0	21.3		
	Dry Density, kN/m³	15.8	15.9		
	Saturation (Wet Method), %	88.1	86.7		
	Void Ratio	0.673	0.662		
Before Shear	Moisture Content, %	24.7	21.2		
	Dry Density, kN/m³	15.9	16.8		
	Cross-sectional Area (Method A), cm²	39.92	21.79		
	Saturation, %	100.0	100.0		
	Void Ratio	0.667	0.572		
	Back Pressure, kPa	668.8	916.0		
Vertical Effective Consolidation Stress, kPa		179.8	1283		
Horizontal Effective Consolidation Stress, kPa		174.3	766.3		
Vertical Strain after Consolidation, %		0.2329	7.765		
Volumetric Strain after Consolidation, %		0.7077	5.973		
Time to 50% Consolidation, min		---	---		
Shear Strength, kPa		80.10	860.9		
Strain at Failure, %		7.03	6.74		
Strain Rate, %/min		0.01600	0.01600		
Deviator Stress at Failure, kPa		160.2	1722		
Effective Minor Principal Stress at Failure, kPa		64.45	559.2		
Effective Major Principal Stress at Failure, kPa		224.7	2281		
B-Value		0.95	0.99		
Notes: - Before Shear Saturation set to 100% for phase calculation. - Moisture Content determined by ASTM D2216. - Deviator Stress includes membrane correction. - Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions. Remarks:					

TX-001, Test 2-1: Ko = 0. 97 Test 2-2R: Ko= 0.59

CONSOLIDATED UNDRAINED TRIAXIAL TEST
Ko CONSOLIDATION



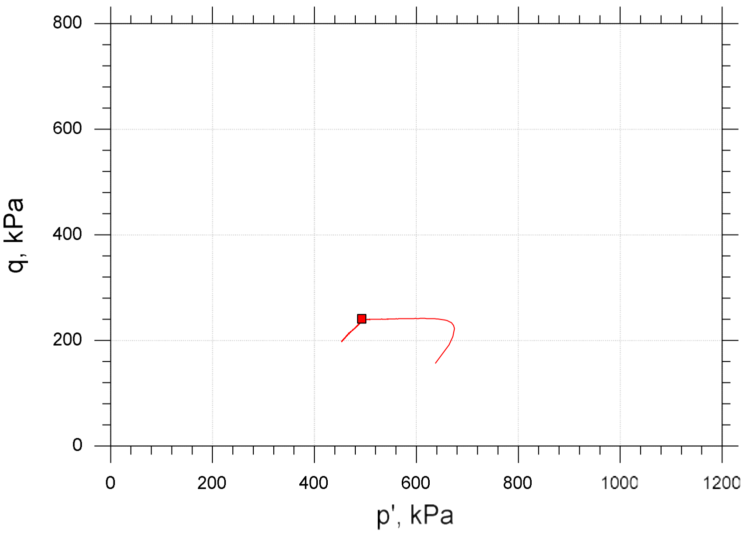
	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
■	24-3	CKoUc-2-1	46'2"-46'8"	trm	1/10/23	njh	1/26/23	316444-CKOUc-2-1n.dat
●	24-4	CKoUc-2-2R	47'1"-47'7"	trm	1/17/23	njh	1/26/23	316444-CKOUc-2-2Rn.dat

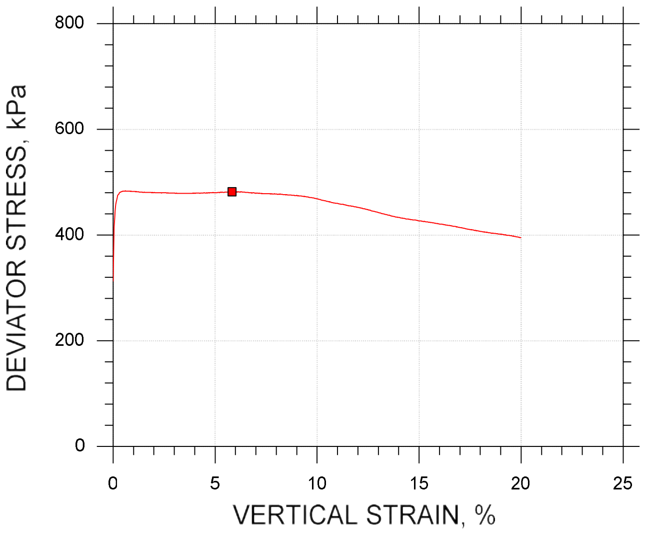
GeoTesting EXPRESS

Project: Darlington NNP Phase II	Location: Ontario, Canada	Project No.: GTX-316444
Boring No.: BH26	Sample Type: intact	
Description: Moist, gray clay		
Remarks: TX-001, Test 2-1: Ko = 0. 97 Test 2-2R: Ko= 0.59		

Client: WSP Canada Inc.	
Project Name: Darlington NNP Phase II	
Project Location: Ontario, Cananda	
Project Number: GTX-316444	
Tested By: trm	Checked By: njh
Boring ID: BH26	
Preparation: intact	
Description: Moist, gray clay	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Measured Specific Gravity: 2.67

CONSOLIDATED UNDRAINED TRIAXIAL TEST - Ko CONSOLIDATION

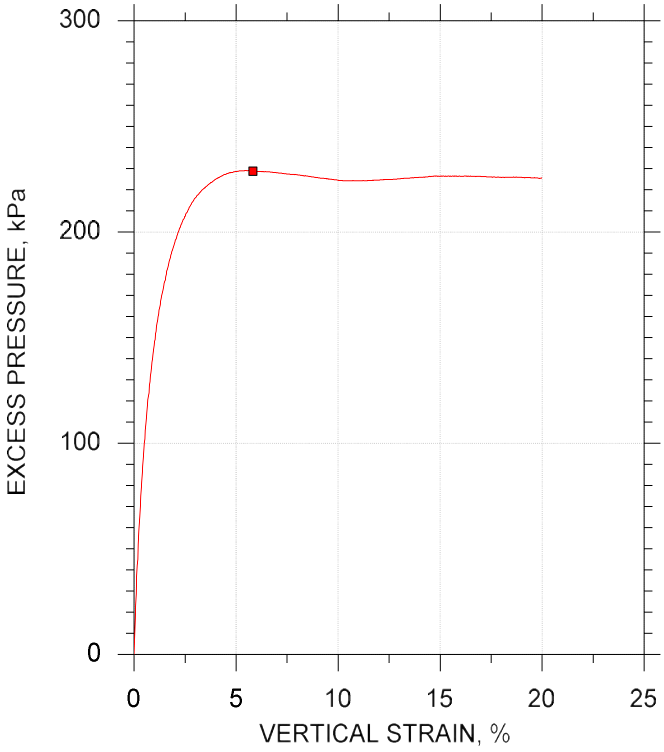


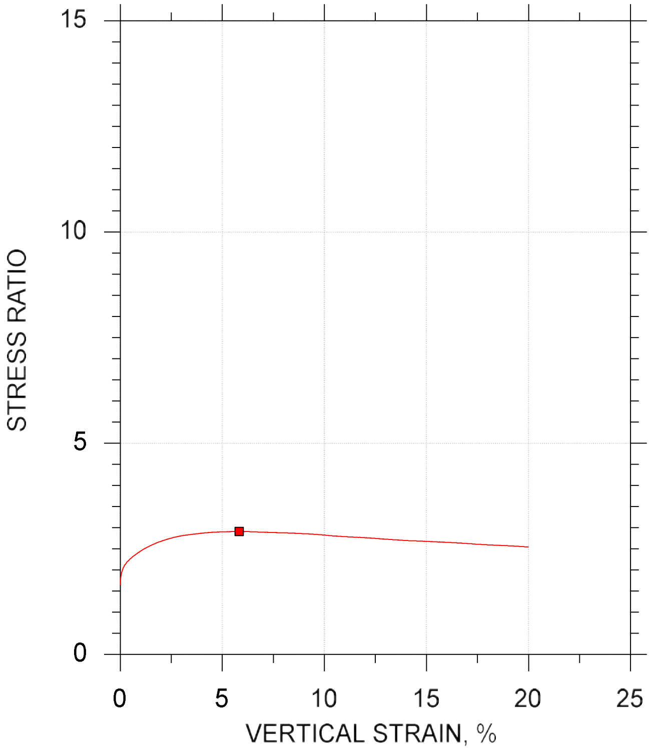


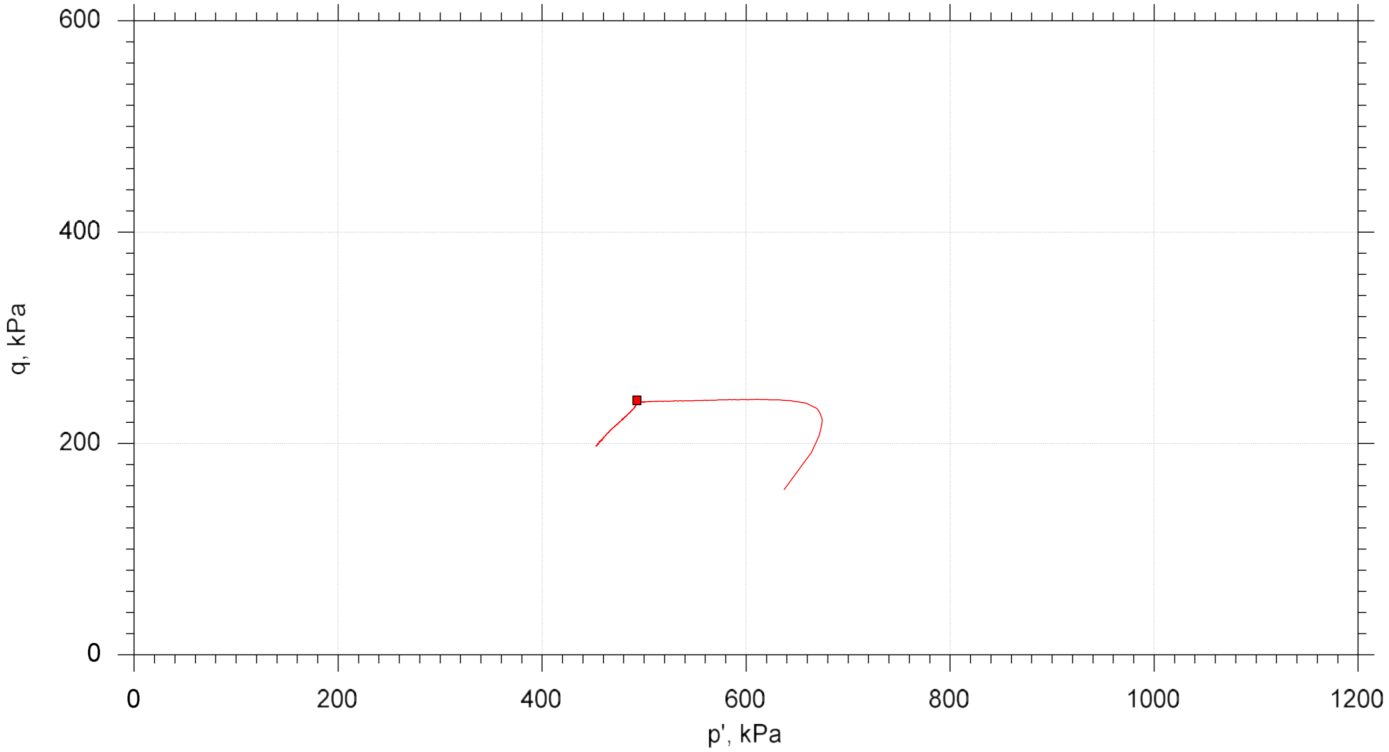
Symbol		🟥			
Sample ID		28-3			
Depth, ft		54'3"-54'9"			
Test Number		CKoUc-3-1R			
Initial	Height, cm	15.19			
	Diameter, cm	7.188			
	Moisture Content (from Cuttings), %	28.1			
	Dry Density, kN/m³	14.9			
	Saturation (Wet Method), %	99.9			
	Void Ratio	0.752			
Before Shear	Moisture Content, %	25.4			
	Dry Density, kN/m³	15.6			
	Cross-sectional Area (Method A), cm²	41.46			
	Saturation, %	100.0			
	Void Ratio	0.678			
	Back Pressure, kPa	461.8			
Vertical Effective Consolidation Stress, kPa		790.1			
Horizontal Effective Consolidation Stress, kPa		480.9			
Vertical Strain after Consolidation, %		7.546			
Volumetric Strain after Consolidation, %		8.151			
Time to 50% Consolidation, min		---			
Shear Strength, kPa		240.9			
Strain at Failure, %		5.83			
Strain Rate, %/min		0.01600			
Deviator Stress at Failure, kPa		481.9			
Effective Minor Principal Stress at Failure, kPa		251.9			
Effective Major Principal Stress at Failure, kPa		733.8			
B-Value		0.95			
Notes: - Before Shear Saturation set to 100% for phase calculation. - Moisture Content determined by ASTM D2216. - Specific Gravity determined by ASTM D854. - Deviator Stress includes membrane correction. - Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions. Remarks:					

TX-014, Ko = 0.60

CONSOLIDATED UNDRAINED TRIAXIAL TEST
Ko CONSOLIDATION







	Sample No	Test No	Depth	Tested By	Test Date	Checked By	Check Date	Test File
🟥	28-3	CKoUc-3-1R	54'3"-54'9"	trm	2/10/23	njh	2/16/23	316444-CKoUc-3-1R.dat

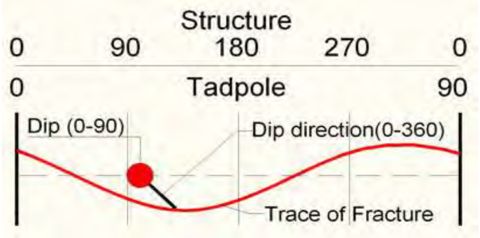
GeoTesting EXPRESS

Project: Darlington NNP Phase II	Location: Ontario, Cananda	Project No.: GTX-316444
Boring No.: BH26	Sample Type: intact	
Description: Moist, gray clay		
Remarks: TX-014, Ko = 0.60		

Geophysical Record of Borehole: BH26

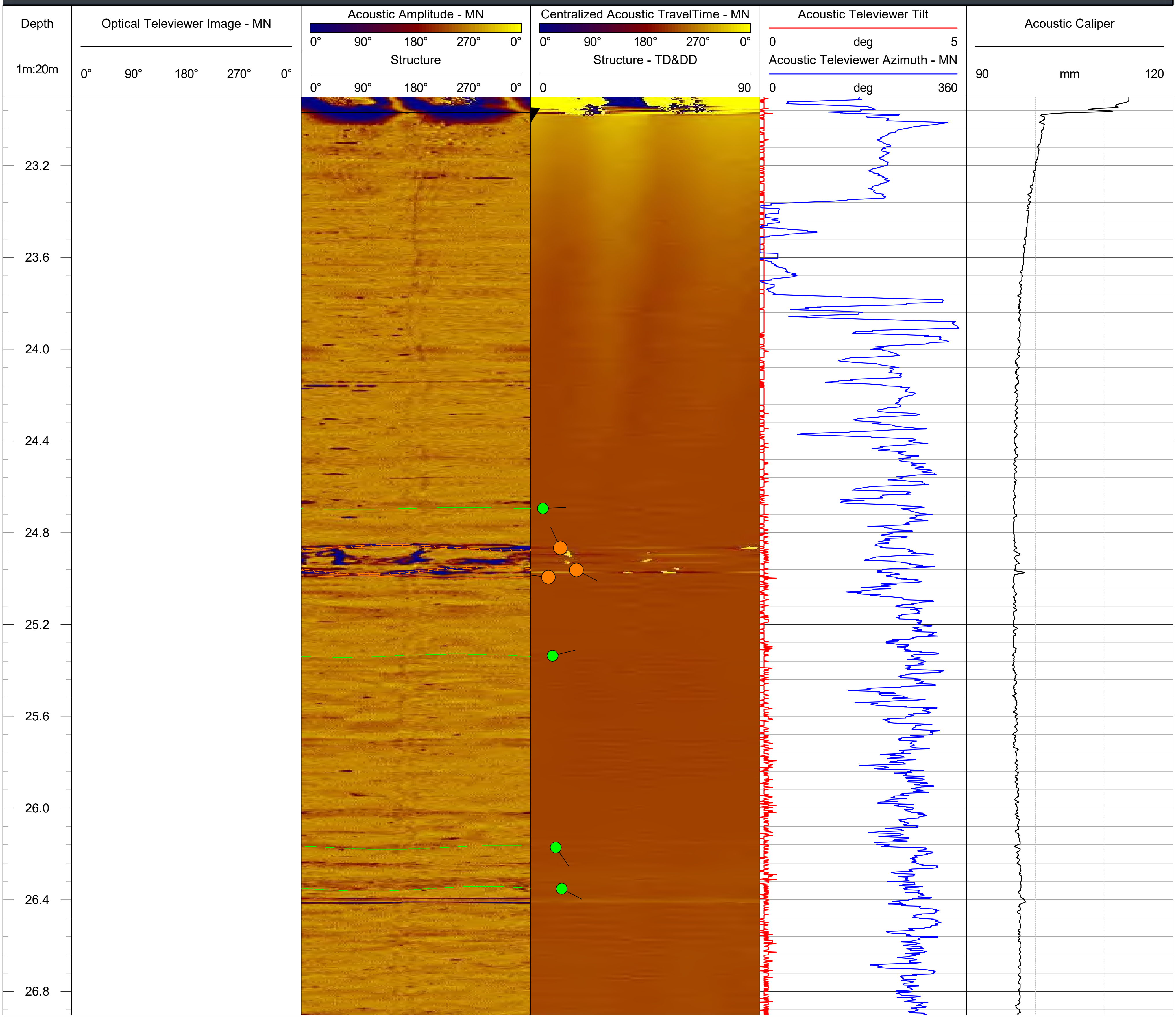
Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2022

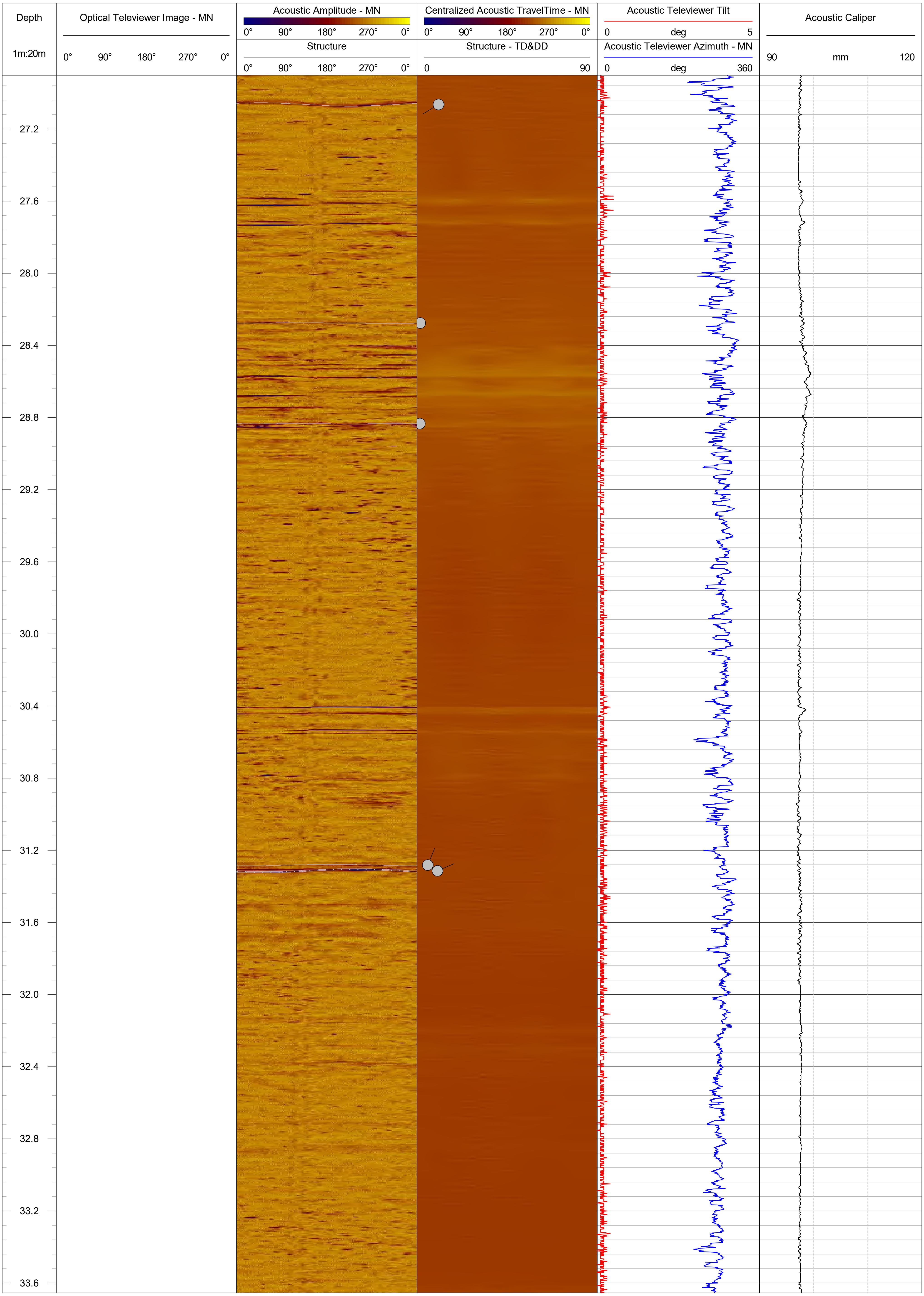
Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at ground	**Casing Depth:**	23 m bgs	**Location:**	Darlington, Ontario
Easting:	683911.61 m	**Drilled Depth:**	75 m bgs	**Water Level:**	10 m bgs	**Log Date:**	Aug-8-2022
Northing:	4859836.89 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	84.12 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	C. Phillips



🔴 Major Open Joint / Fracture
🟠 Partially Open Joint / Fracture
⚪ Filled Fracture / Joint
🟢 Bedding / Banding / Foliation
◀ Casing

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)

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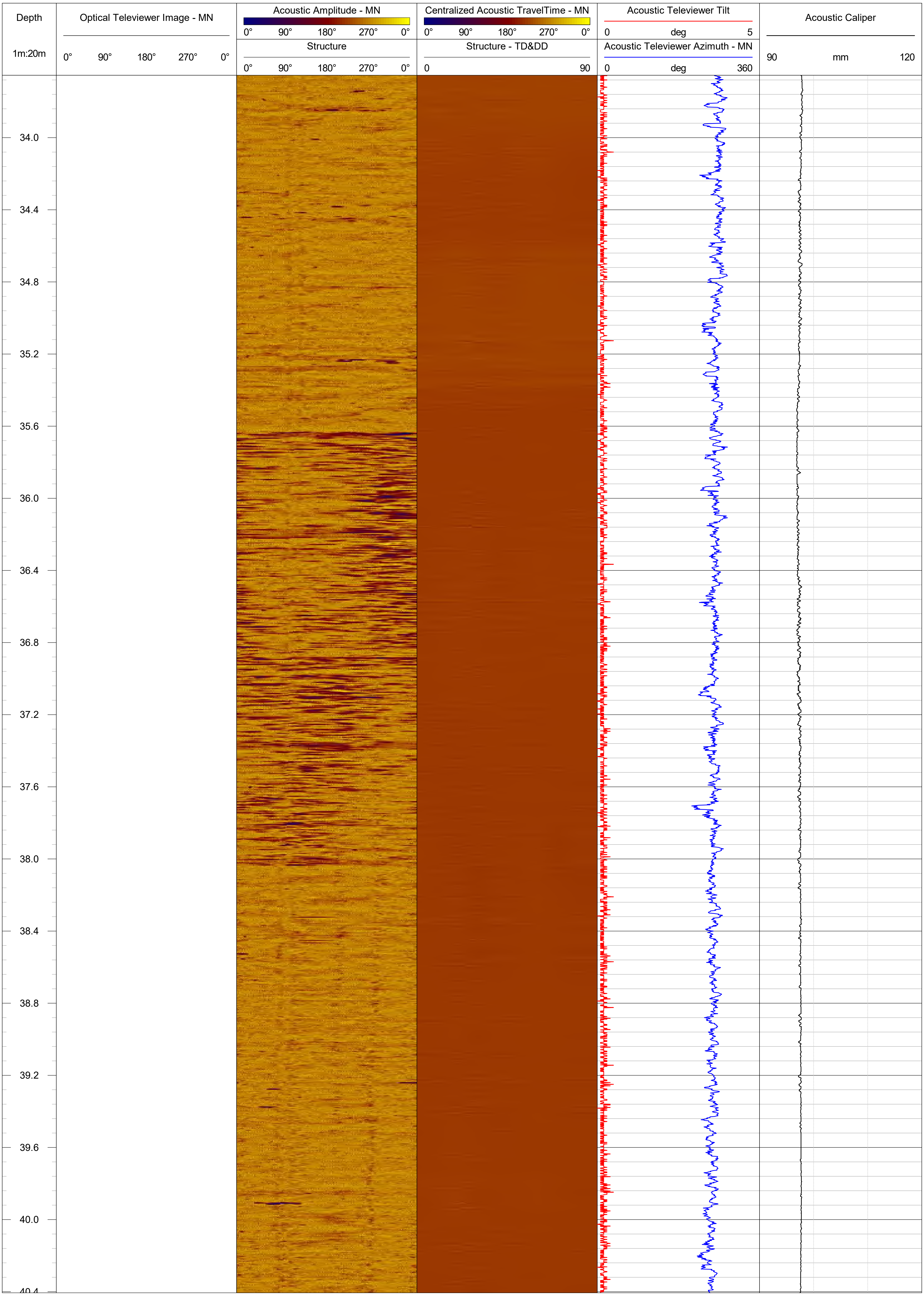
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
27.2
27.6
28.0
28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0
32.4
32.8
33.2
33.6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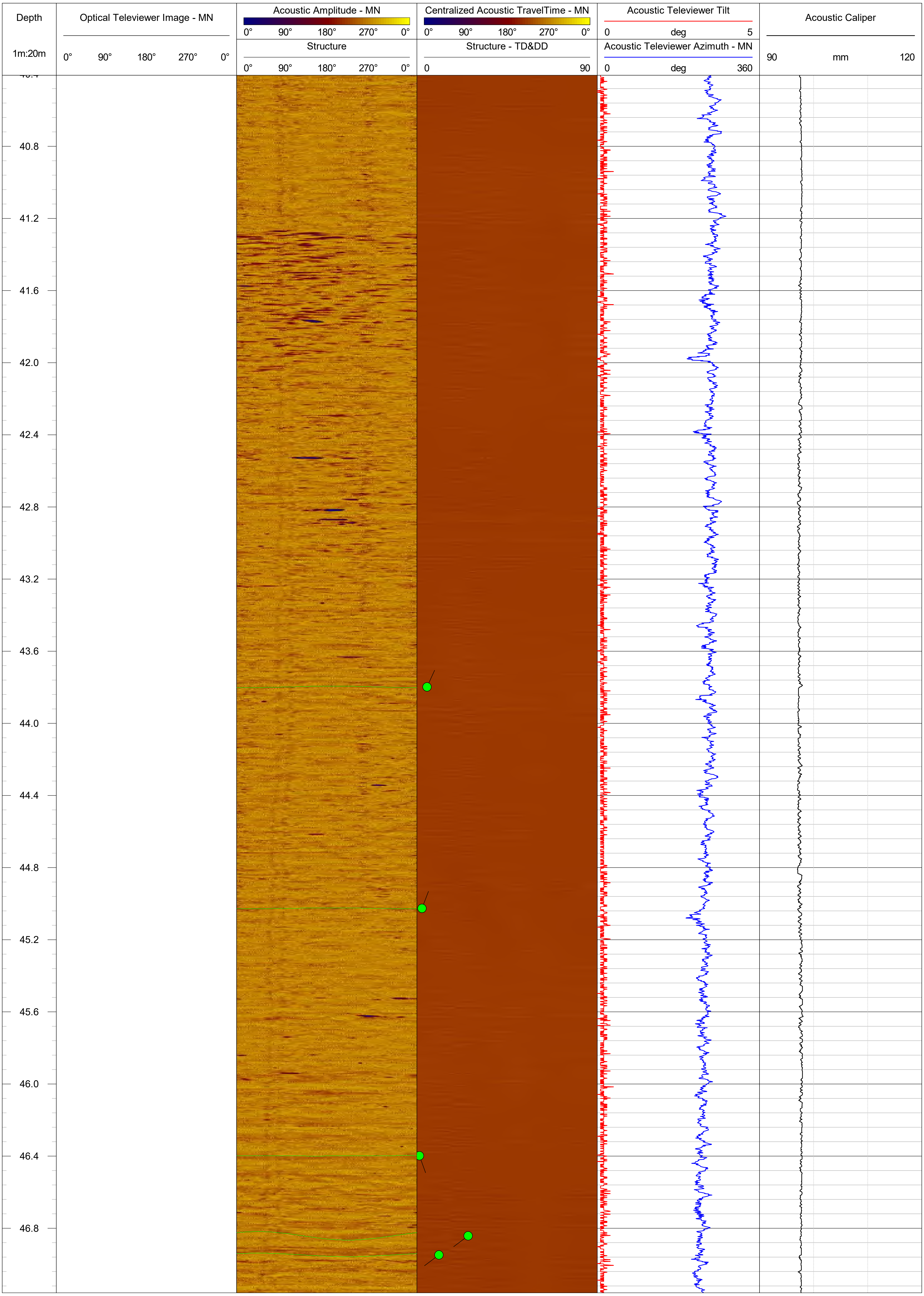
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8
37.2
37.6
38.0
38.4
38.8
39.2
39.6
40.0
40.4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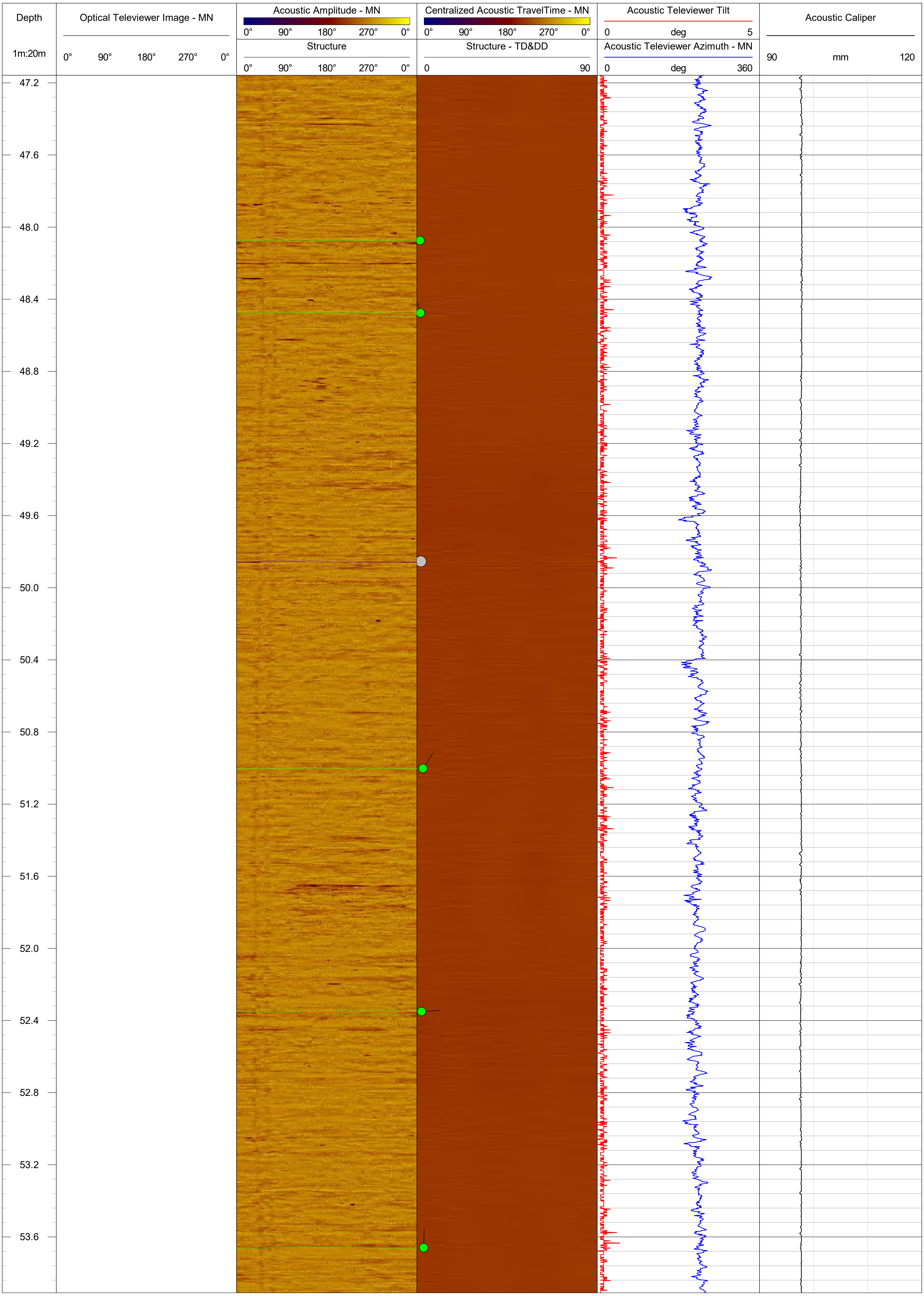
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
40.8
41.2
41.6
42.0
42.4
42.8
43.2
43.6
44.0
44.4
44.8
45.2
45.6
46.0
46.4
46.8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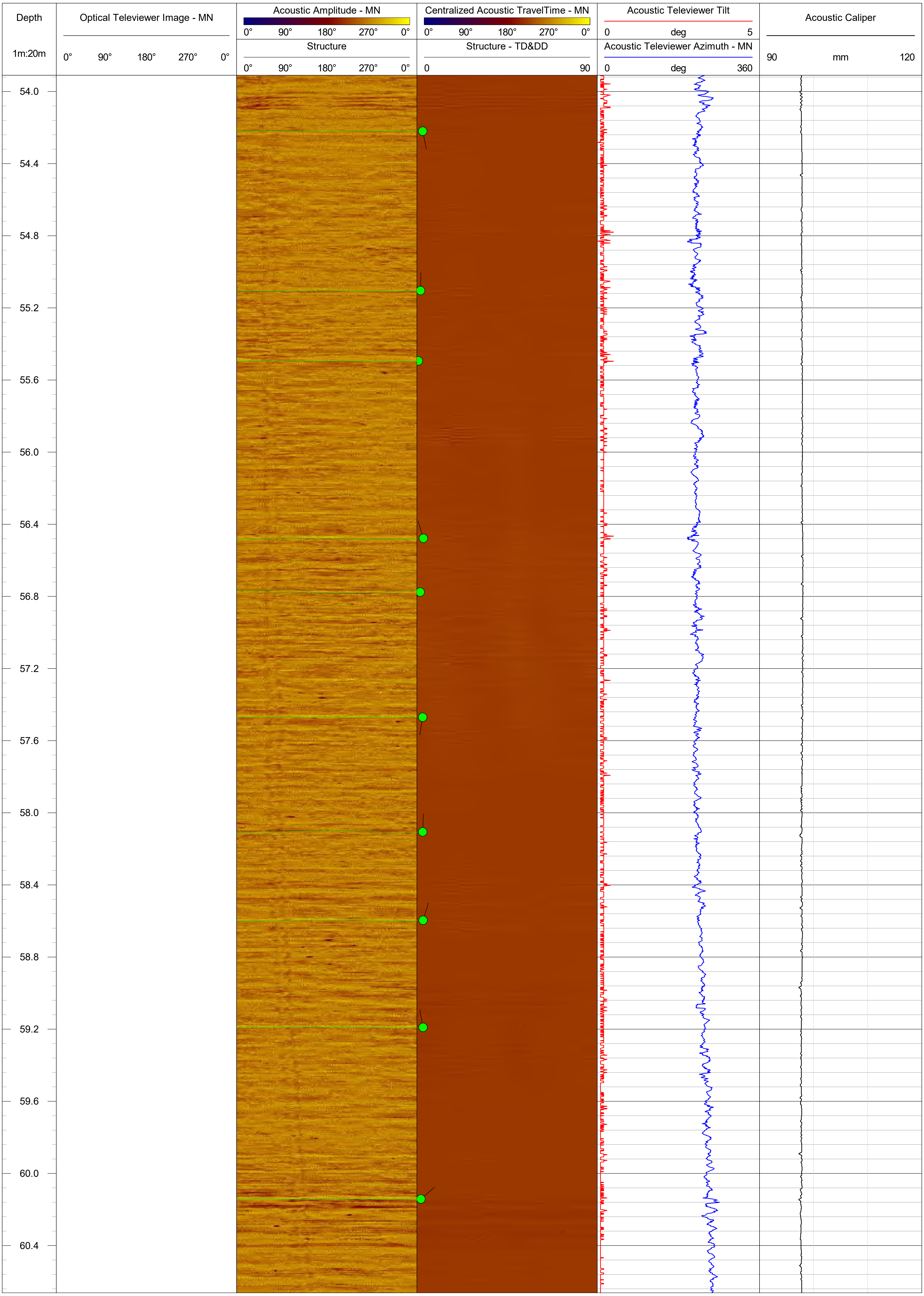
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
47.2
47.6
48.0
48.4
48.8
49.2
49.6
50.0
50.4
50.8
51.2
51.6
52.0
52.4
52.8
53.2
53.6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Optical Televiewer Image - MN
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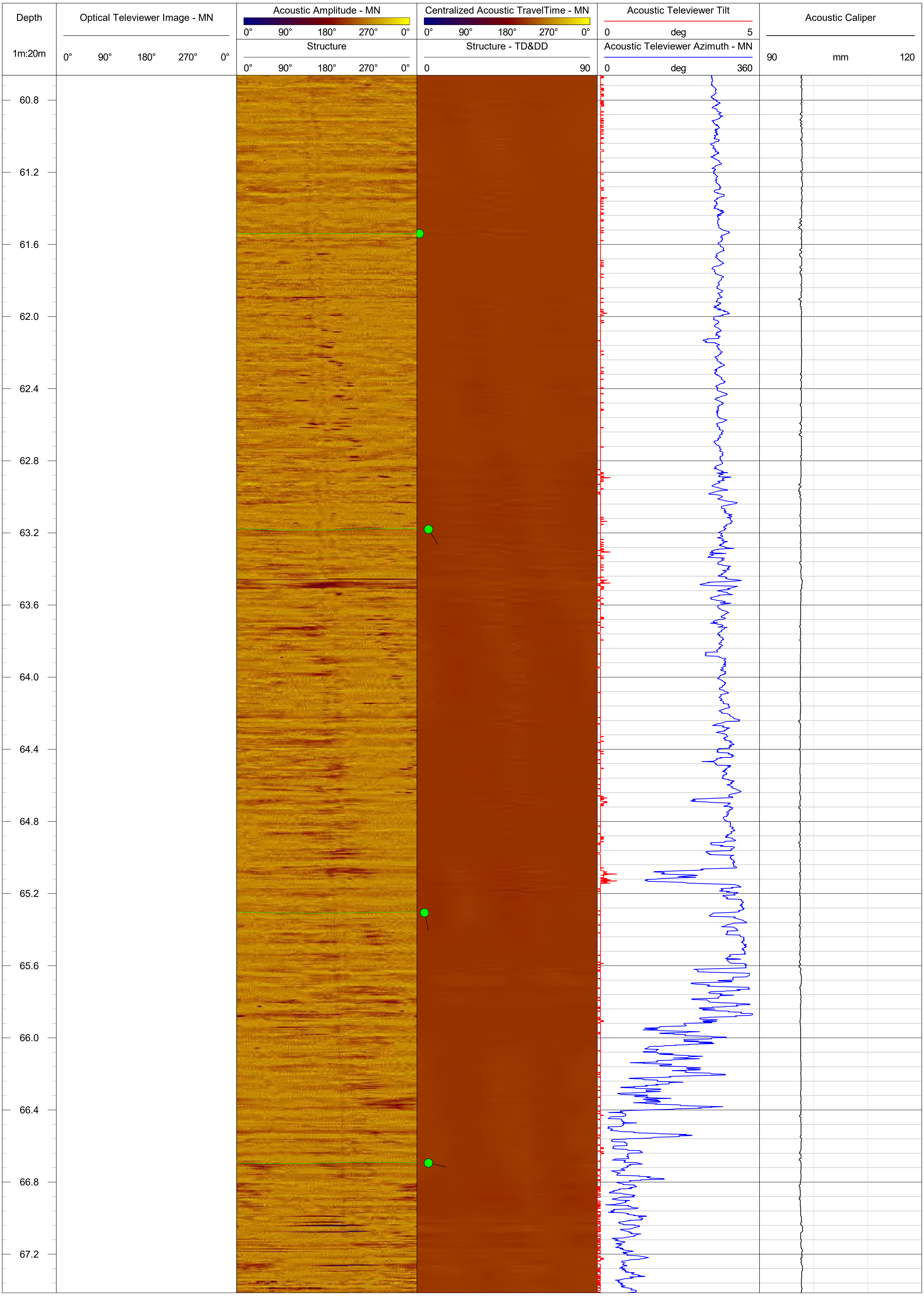
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
54.0
54.4
54.8
55.2
55.6
56.0
56.4
56.8
57.2
57.6
58.0
58.4
58.8
59.2
59.6
60.0
60.4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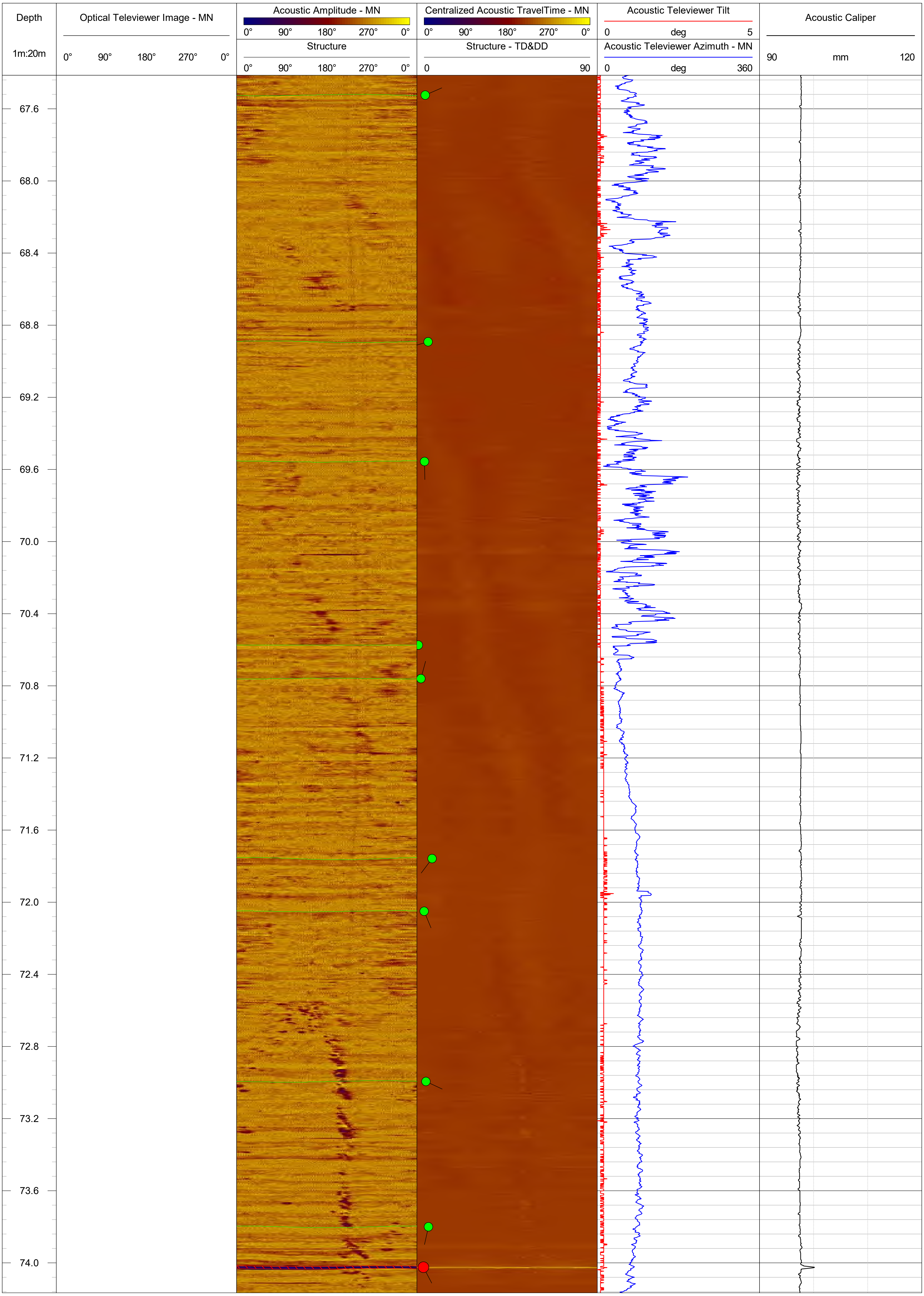
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
60.8
61.2
61.6
62.0
62.4
62.8
63.2
63.6
64.0
64.4
64.8
65.2
65.6
66.0
66.4
66.8
67.2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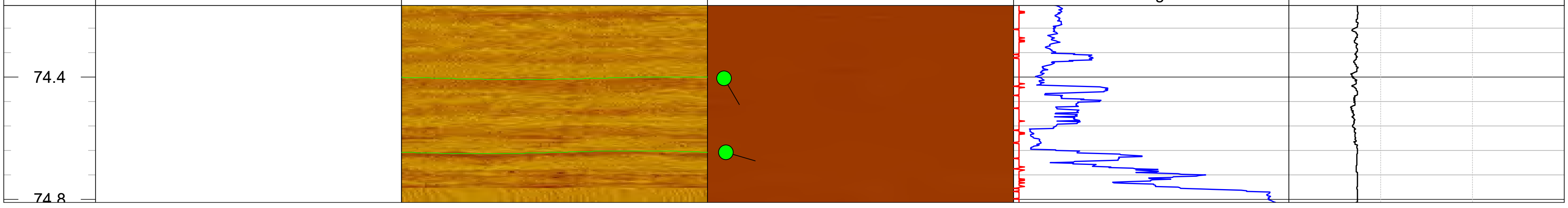
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
67.6
68.0
68.4
68.8
69.2
69.6
70.0
70.4
70.8
71.2
71.6
72.0
72.4
72.8
73.2
73.6
74.0

Depth	Optical Televiewer Image - MN	Acoustic Amplitude - MN	Centralized Acoustic TravelTime - MN	Acoustic Televiewer Tilt	Acoustic Caliper
		0° 90° 180° 270° 0°	0° 90° 180° 270° 0°	0 deg 5	
1m:20m	0° 90° 180° 270° 0°	Structure	Structure - TD&DD	Acoustic Televiewer Azimuth - MN	90 mm 120
		0° 90° 180° 270° 0°	0 90	0 deg 360	



Geophysical Record of Borehole: BH26

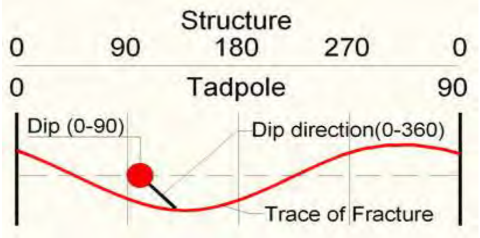
Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2022

Datum: NAD83, UTM Zone 17N
Easting: 683911.61 m
Northing: 4859836.89 m
Elevation: 84.12 m

Depth Reference: "0" at ground
Drilled Depth: 75 m bgs
Borehole Diameter: 96 mm
Casing Diameter: HQ

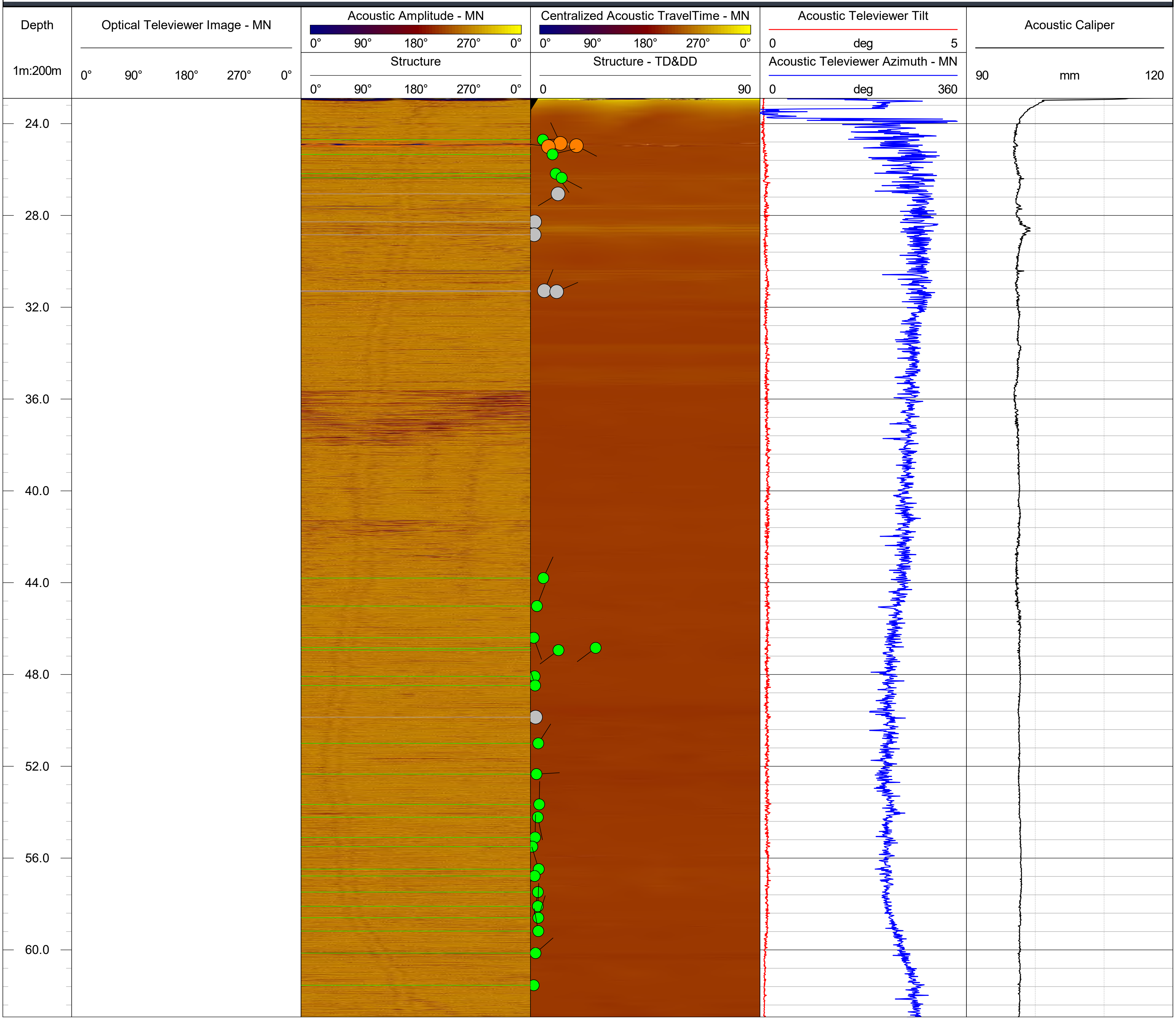
Casing Depth: 23 m bgs
Water Level: 10 m bgs
Borehole Inclination: Vertical
Borehole Azimuth: N/A

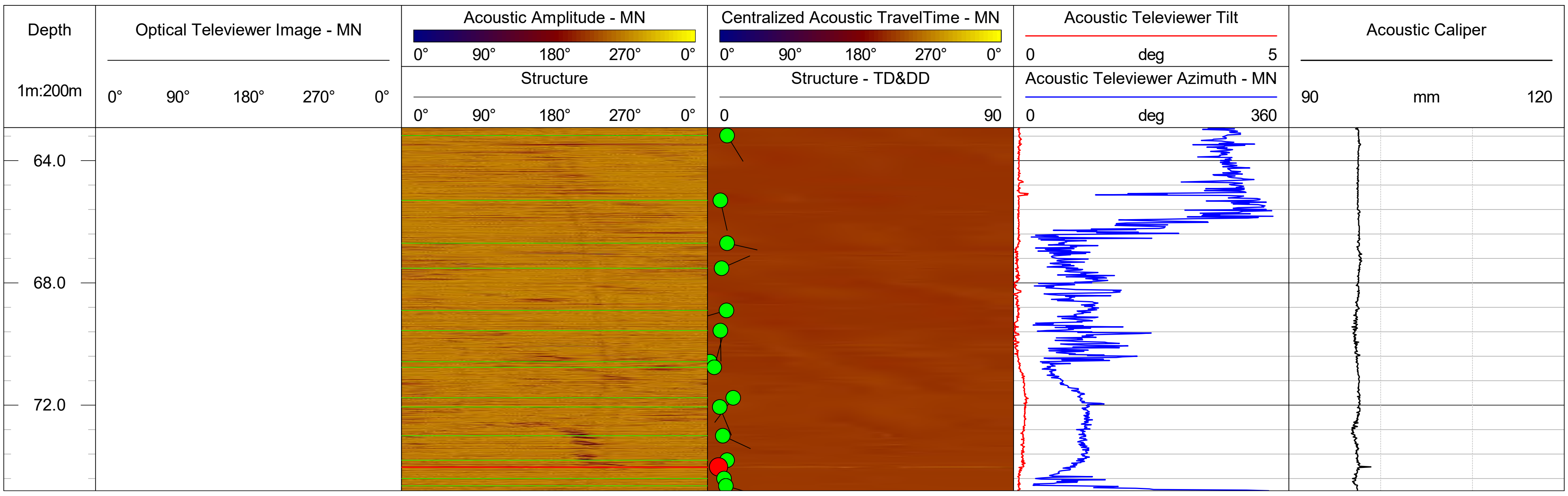
Location: Darlington, Ontario
Log Date: Aug-8-2022
Logged By: C. Phillips



- ● Major Open Joint / Fracture
- ● Partially Open Joint / Fracture
- ● Filled Fracture / Joint
- ● Bedding / Banding / Foliation
- ◀ Casing

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)




Depth
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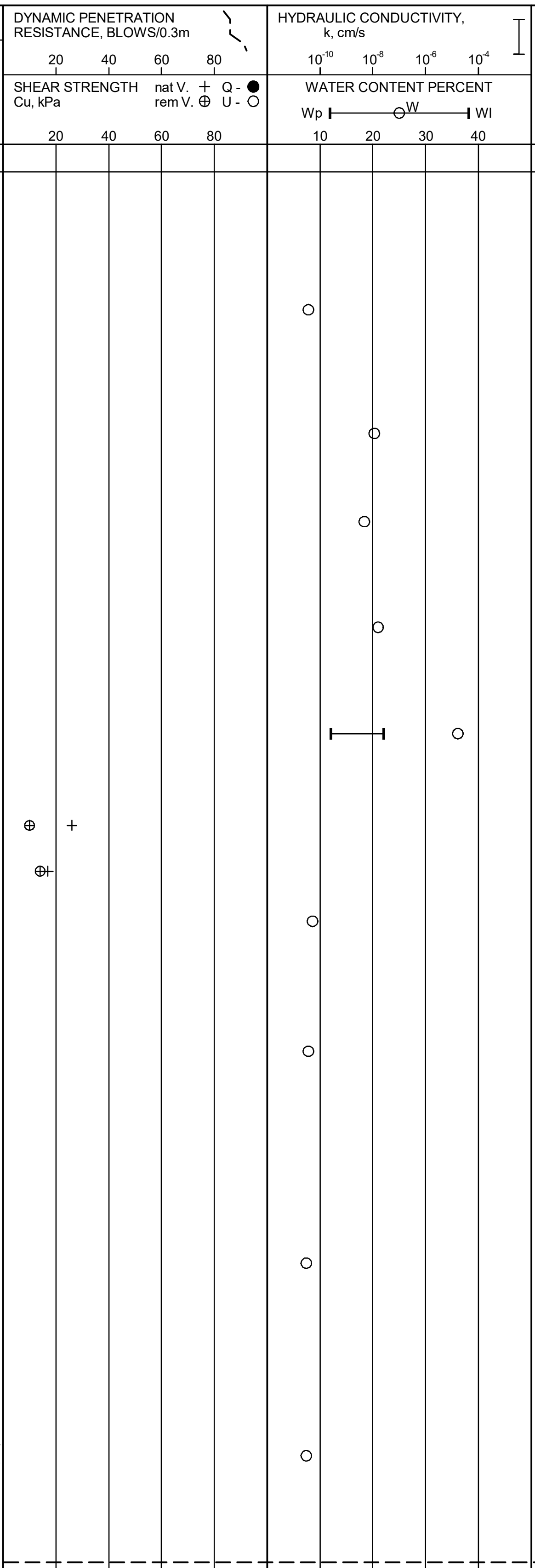
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
64.0
68.0
72.0

A07-BH82

RECORD OF BOREHOLE: BH82

PROJECT: 21451329
LOCATION: N 4860165.38; E 683719.13
BORING DATE: June 20 to 23, 2022
DRILL RIG: Diedrich 120 Track Mounted
SHEET 1 OF 4
DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		GROUND SURFACE	89.26					
0	Power Augering 210 mm O.D./110 mm I.D. Hollow Stem Augers	**Silty Sand with Sand (SM)**, dark brown, moist, fine to coarse sand, subangular fine to coarse gravel (Fill) (Unit 1) - Topsoil inclusions in Spoon Sample 2	0.00	1	SS	32		
1				2	SS	40		
		- Fine to medium Silty Sand below 1.22 m -Rootlets in Spoon Sample 3A		3A	SS	21		
		Lean Clay with Sand (CL), very stiff to medium stiff, brown, fine to coarse sand, trace of subangular fine gravel to 2.9 m, low to medium plasticity (Glaciolacustrine) (Unit 2a)	87.48 1.78	3B				
2				4	SS	16		
3	Mud Rotary Wash Boring HWT Casing			5	SS	16		
4		- Turning grey at 3.66 m depth - No recovery in first Spoon attempt at Sample 6		6	SS	7		2 25 39 34
5		**Silty Sand with Gravel (SM)**, medium dense, grey, moist, fine to coarse sand, subangular to angular fine to coarse gravel (Glaciolacustrine) (Unit 2b) - Shelby tube Sample 7 not successful	84.16 5.10	7	TO	-		
6				8	SS	25	NP	15 41 32 12
7		**Silty Sand (SM)**, very dense, grey, moist, fine to coarse sand, subangular to angular fine to coarse gravel (Till) (Unit 3)	82.17 7.09					
8				9	SS	151		
9				10	SS	100/ 0.46	NP	8 44 37 12
10			79.28					



PIEZOMETER OR STANDPIPE INSTALLATION

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: JS
CHECKED: SEMP

RECORD OF BOREHOLE: BH82

PROJECT: 21451329
LOCATION: N 4860165.38; E 683719.13

BORING DATE: June 20 to 23, 2022
DRILL RIG: Diedrich 120 Track Mounted

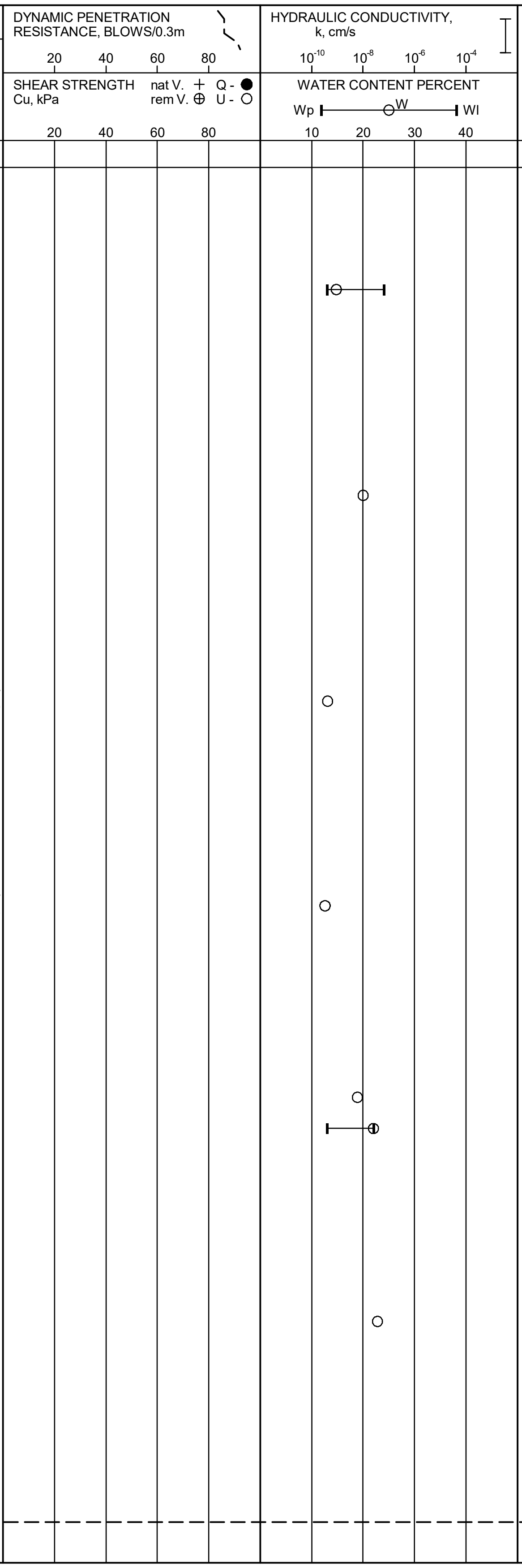
SHEET 2 OF 4
DATUM: Geodetic

BORING METHOD: Mud Rotary Wash Boring; HWT Casing

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)
9.98	**Lean Clay with Sand (CL)**, hard, grey, moist, fine to coarse sand, low to medium plasticity (Glaciolacustrine) (Unit 4b)	9.98
11.66	**Sandy Silt (ML) to Silty Sand (SM)**, very dense, grey, moist, fine to medium sand (Glaciolacustrine) (Unit 4a) - Lean Clay interlayers below 16.21 m	77.60 11.66
16.97	**Lean Clay (CL)**, hard, grey, moist, fine sand to 17.75 m , low to medium plasticity (Glaciolacustrine) (Unit 4b)	72.29 16.97
19.28	**Sandy Silty Clay (CL-ML)**, hard, grey, moist, fine to coarse sand, trace of angular fine gravel, low plasticity (Till) (Unit 5)	69.98 19.28

NUMBER	TYPE	BLOWS/0.3m	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
11	SS	73	0 16 55 29
12	SS	98	
13	SS	182/0.29	
14	SS	181/0.26	0 62 33 5
15A	SS	74	
15B			0 5 58 37
16	SS	32	
17	SS	34	3 33 42 22



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: JS
CHECKED: SEMP

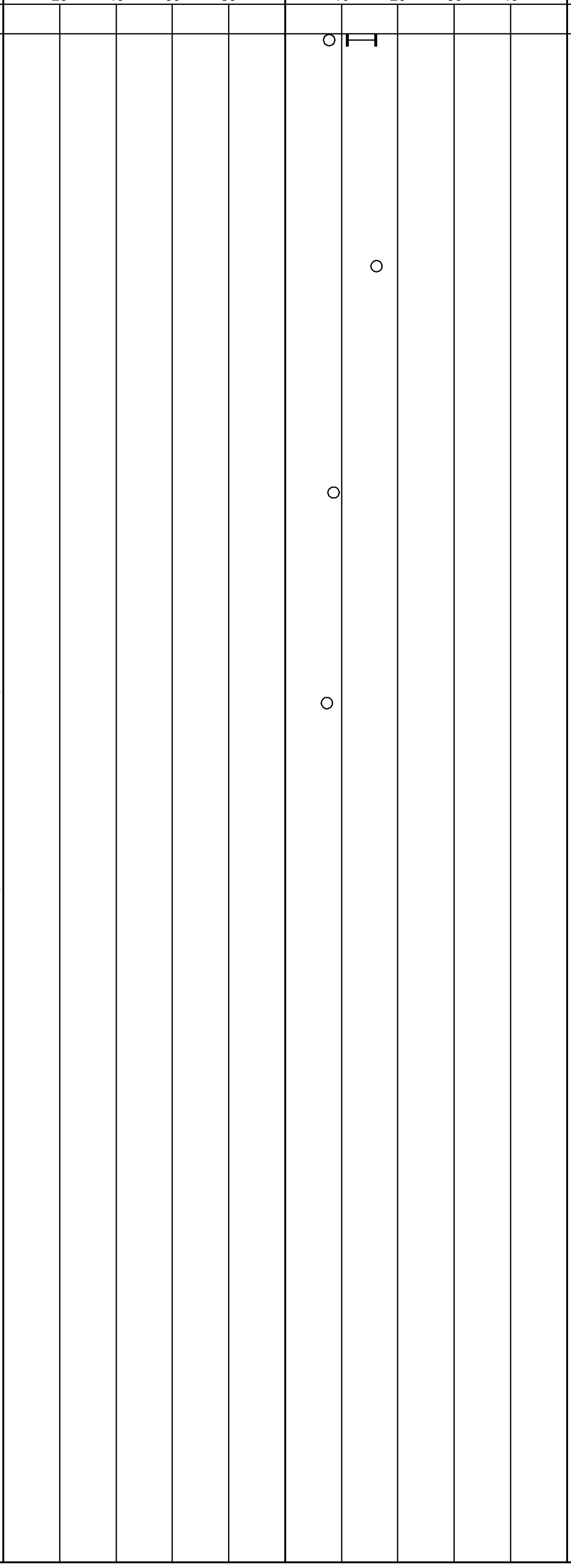
PROJECT: 21451329
LOCATION: N 4860165.38; E 683719.13

RECORD OF BOREHOLE: BH82

BORING DATE: June 20 to 23, 2022
DRILL RIG: Diedrich 120 Track Mounted

SHEET 3 OF 4
DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		--- CONTINUED FROM PREVIOUS PAGE ---						
20	Mud Rotary Wash Boring HWT Casing	**Sandy Silty Clay (CL-ML)**, hard, grey, moist, fine to coarse sand, trace of angular fine gravel, low plasticity (Till) (Unit 5)	68.53 20.73	17	SS	34		3 33 42 22
21		**Sandy Silt (ML)**, very dense, grey, wet, fine to medium sand (Glaciolacustrine) (Unit 4a)	66.93 22.33	18	SS	117		0 61 32 7
22–25		**Sandy Silt (ML)**, very dense, grey, moist, fine to coarse sand, subangular to angular fine to coarse gravel (Till) (Unit 5)		19	SS	57		
		- Less plasticity below 23.85 m depth		20	SS	100/ 0.10	NP	6 39 42 14
		- Spoon sample 21 bouncing	63.46 25.80	21	SS	100/ 0.07		
26		**Shale Bedrock Fragments** (Unit 6a) - Bedrock cored from 25.80 m to 28.81 m depth - Refer to Record of Drillhole BH82						



PIEZOMETER OR STANDPIPE INSTALLATION

Notes:

1. Water level in open borehole could not be measured upon completion of soil drilling due to use of mud-rotary technique.

2. Efficiency of the SPT hammer utilized was 76.5 %.

DEPTH SCALE
1 : 50

LOGGED: JS
CHECKED: SEMP

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4860165.38; E 683719.13
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

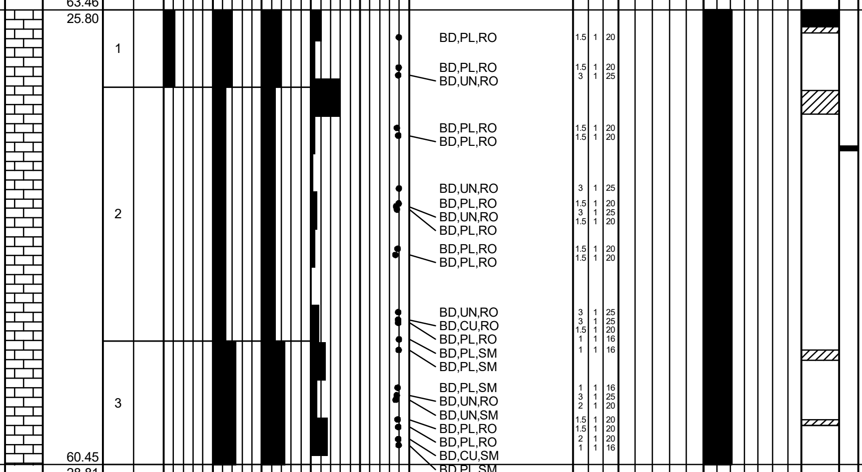
RECORD OF DRILLHOLE: BH82

DRILLING DATE: June 23, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 4 OF 4
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (m)	RUN No.
		TOP OF BEDROCK	63.46	
26 27 28	Rotary Drill HQ3 Core	Slightly weathered, very thinly to medium bedded, grey, fine grained, faintly porous, slightly reactive to HCl, very weak to weak LIMESTONE (Lindsay Formation) with dark grey fine grained laminated shale interbeds Slake Durability Sample	25.80	1 2 3
			60.45	
29		END OF DRILLHOLE	28.81	



DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,UN,RO	3	1	25
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,UN,RO	3	1	25
BD,PL,RO	1.5	1	20
BD,UN,RO	3	1	25
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,UN,RO	3	1	25
BD,CU,RO	3	1	25
BD,PL,RO	1.5	1	20
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,UN,RO	3	1	25
BD,UN,SM	2	1	20
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,CU,SM	2	1	20
BD,PL,SM	1	1	16

30
31
32
33
34
35

DEPTH SCALE
1 : 50

LOGGED: JS
CHECKED: AC

Water Content Summary
ASTM D2216

Test Request #	21451329-21600-610 BH82	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville		

Sample Location	Sample				Soil Description	Water Content %	Method	Remarks
	Ref	Top (m)	Base (m)	Type				
BH82	2	0.76	1.22	SS		7.8	B	
BH82	3B	1.77	1.98	SS		20.3	B	
BH82	4	2.29	2.74	SS		18.4	B	
BH82	5	3.05	3.51	SS		21.0	B	
BH82	6	3.81	4.27	SS		36.1	B	
BH82	7	5.18	5.64	GS		8.6	B	
BH82	8	6.10	6.55	SS		7.8	B	
BH82	9	7.62	8.08	SS		7.4	B	
BH82	10	9.14	9.34	SS		7.4	B	
BH82	11	10.67	11.13	SS		14.8	B	
BH82	12	12.19	12.65	SS		20.0	B	
BH82	13	13.72	14.16	SS		13.1	B	
BH82	14	15.24	15.66	SS		12.6	B	
BH82	15A	16.76	16.97	SS		18.9	B	
BH82	15B	16.97	17.22	SS		22.0	B	
BH82	16	18.29	18.75	SS		22.8	B	
BH82	17	19.81	20.27	SS		7.8	B	
BH82	18	21.34	21.79	SS		16.2	B	
BH82	19	22.86	23.32	SS		8.6	B	
BH82	20	24.38	24.64	SS		7.4	B	

Notes:

Tested by: JTimms **Date:** 12 Oct 2022
Checked by: MRuck **Date:** 27 Oct 2022

Disclaimer:

Reviewed by: JoNorris **Date:** 09 Nov 2022

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PARTICLE SIZE DISTRIBUTION

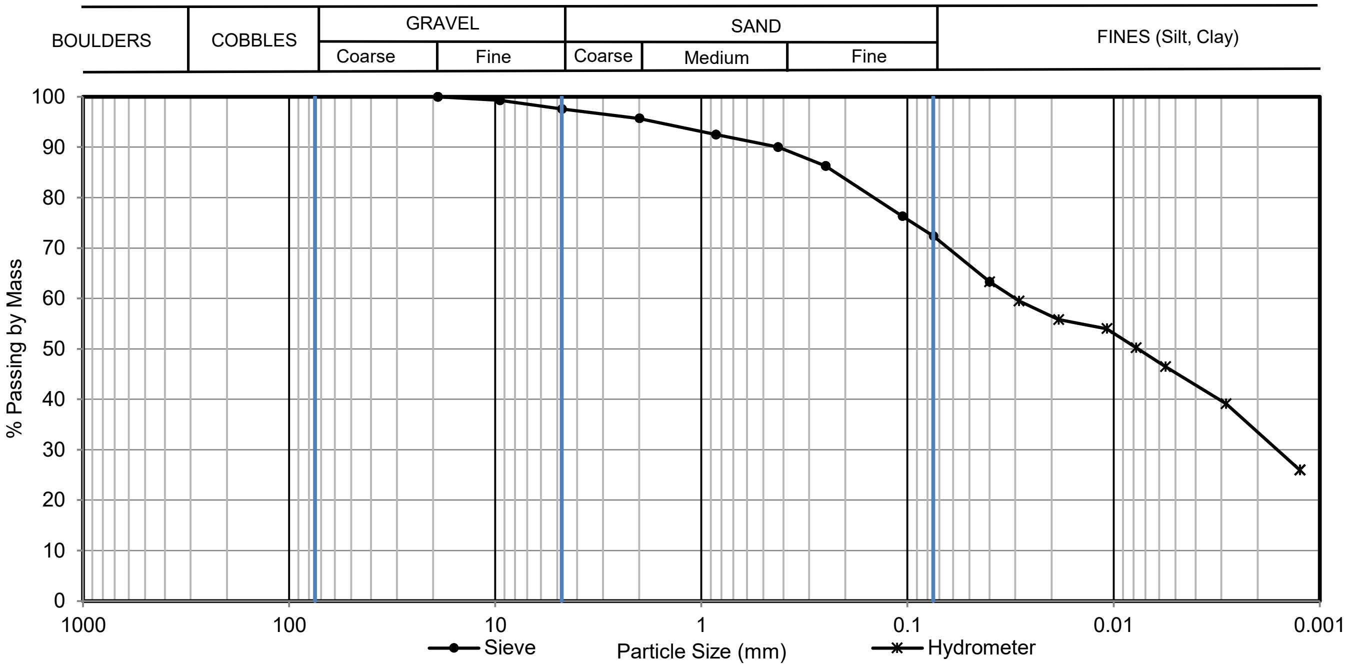
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH82	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH82
Source:		Sample No.:	6
		Type:	SS
Soil Description:		Depth (m):	3.81 - 4.27

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	20 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)	GRAVEL	SAND	FINES (Silt, Clay)
	2.4	25.2	72.4



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0400	63.3
3/8"	9.5	99.3	0.0288	59.5
#4	4.75	97.6	0.0185	55.8
#10	2	95.7	0.0108	54.0
#20	0.85	92.5	0.0078	50.2
#40	0.425	90.0	0.0056	46.5
#60	0.25	86.3	0.0029	39.1
#140	0.106	76.3	0.0013	26.0
#200	0.075	72.4		
			0.005 mm	45.24
			0.002 mm	33.47
			D60	0.03
			D30	0.00
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

Tested by: JTimms **Date:** 20 Oct 2022 **Checked by:** MRuck **Date:** 27 Oct 2022 **Reviewed by:** JoNorris **Date:** 09 Nov 2022

Golder Associates
100 Scotia Court Whitby, ON L1N 8Y6 Canada
[+1] 905-723-2727

PARTICLE SIZE DISTRIBUTION

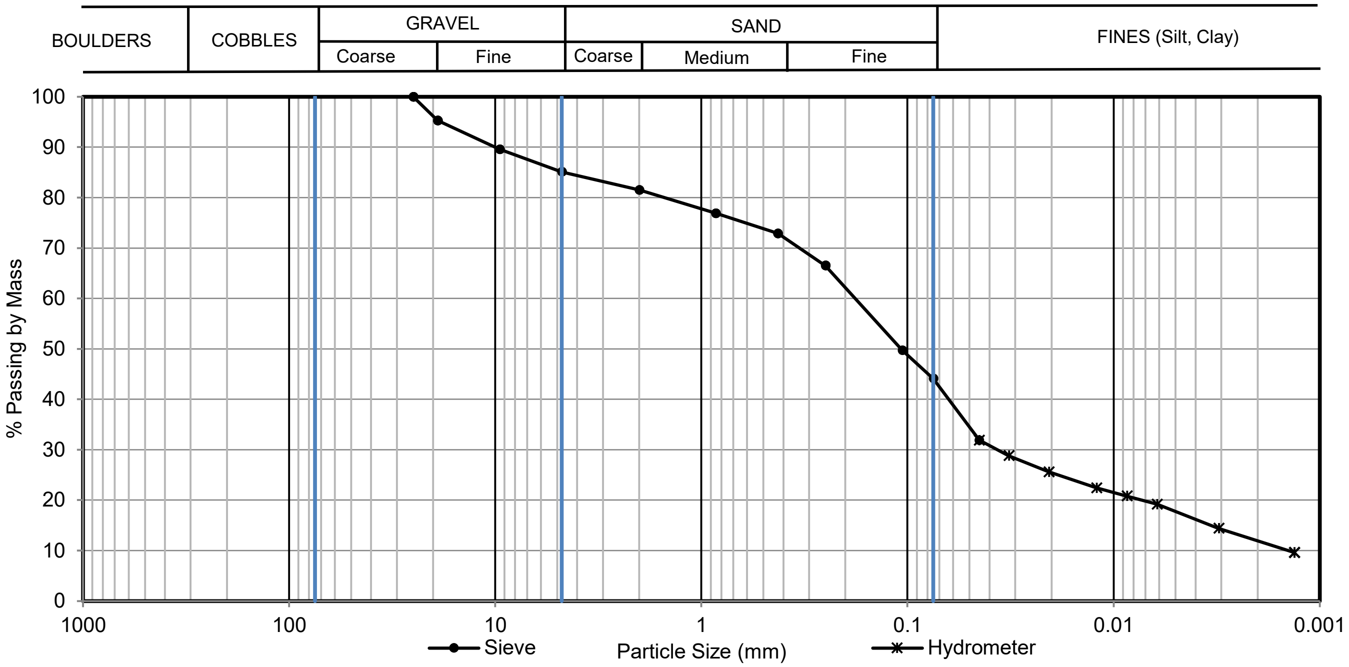
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH82	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH82
Source:		Sample No.:	8
		Type:	SS
Soil Description:		Depth (m):	6.10 - 6.55

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	20 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%) 14.9 41.0 44.1



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1"	25	100.0	0.0449	31.9
3/4"	19	95.3	0.0322	28.8
3/8"	9.5	89.6	0.0206	25.6
#4	4.75	85.1	0.0121	22.4
#10	2	81.5	0.0086	20.8
#20	0.85	76.9	0.0062	19.2
#40	0.425	72.9	0.0031	14.4
#60	0.25	66.5	0.0013	9.6
#140	0.106	49.7		
#200	0.075	44.1		
			0.005 mm	17.75
			0.002 mm	11.92
			D60	0.18
			D30	0.04
			D10	0.00
			Cu	130.00
			Cc	5.20

Notes:

Disclaimer:

Tested by: JTimms **Date:** 20 Oct 2022 **Checked by:** MRuck **Date:** 27 Oct 2022 **Reviewed by:** JoNorris **Date:** 09 Nov 2022

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PARTICLE SIZE DISTRIBUTION

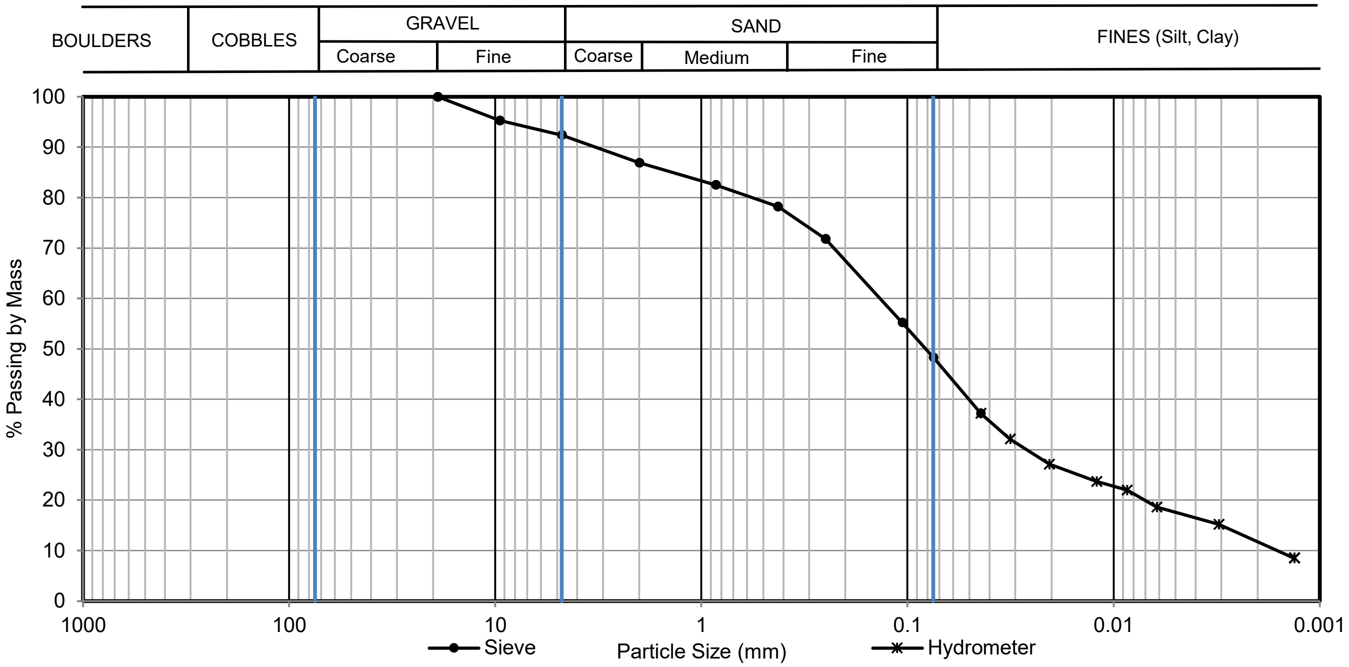
ASTM D6913 and ASTM D422
Method B

Test Request #: 21451329-21600-610 BH82
Client: E.S. Fox Limited
Project Name: ES Fox/DNNP Invest/Bowmanville
Source:
Soil Description:

Project Number: 21451329-21600-610
Project Location:
Sample Location: BH82
Sample No.: 10
Type: SS
Depth (m): 9.14 - 9.34

Specimen Reference: NA
Specimen Depth (m): NA
Date of Test: 19 Oct 2022
Specimen Description: NA

Grain Size Distribution (%)	7.6	44.1	48.3



Sieve			**Hydrometer Sedimentation**	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0441	37.2
3/8"	9.5	95.3	0.0318	32.1
#4	4.75	92.4	0.0205	27.1
#10	2	86.9	0.0121	23.7
#20	0.85	82.5	0.0086	22.0
#40	0.425	78.2	0.0062	18.6
#60	0.25	71.8	0.0031	15.2
#140	0.106	55.2	0.0013	8.5
#200	0.075	48.3		
			0.005 mm	17.56
			0.002 mm	11.74
			D60	0.14
			D30	0.03
			D10	0.00
			Cu	85.00
			Cc	3.20

Notes:

Disclaimer:

Tested by: MKMarren **Date:** 19 Oct 2022 **Checked by:** MRuck **Date:** 27 Oct 2022 **Reviewed by:** JoNorris **Date:** 09 Nov 2022

PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422

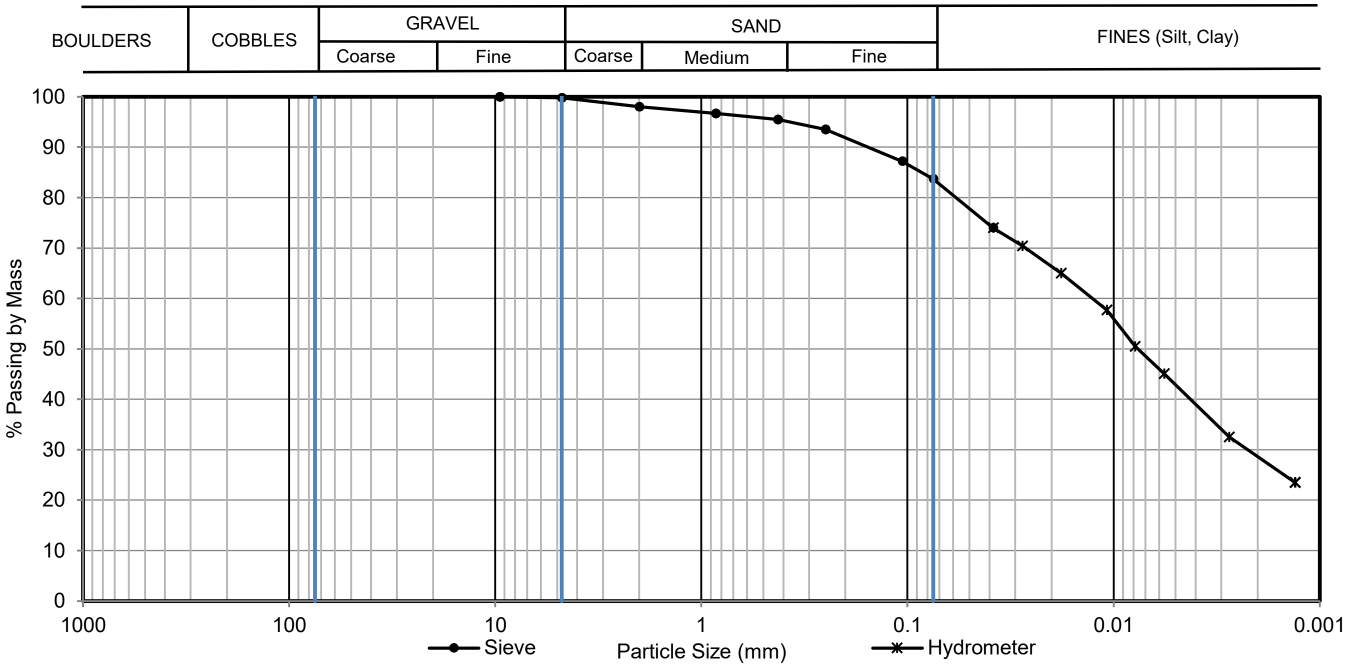
Method B

Test Request #	21451329-21600-610 BH82	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH82
Source:		Sample No.:	11
		Type:	SS
Soil Description:		Depth (m):	10.67 - 11.13

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	20 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)

BOULDERS	COBBLES	GRAVEL	SAND	FINES (Silt, Clay)
		0.2	16.1	83.7



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/8"	9.5	100.0	0.0384	74.0
#4	4.75	99.8	0.0277	70.4
#10	2	98.0	0.0180	65.0
#20	0.85	96.7	0.0108	57.7
#40	0.425	95.5	0.0079	50.5
#60	0.25	93.5	0.0057	45.1
#140	0.106	87.2	0.0028	32.5
#200	0.075	83.7	0.0013	23.5
			0.005 mm	42.86
			0.002 mm	28.60
			D60	0.01
			D30	0.00
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

Tested by: KGill **Date:** 20 Oct 2022 **Checked by:** MRuck **Date:** 09 Nov 2022 **Reviewed by:** JoNorris **Date:** 10 Nov 2022

PARTICLE SIZE DISTRIBUTION

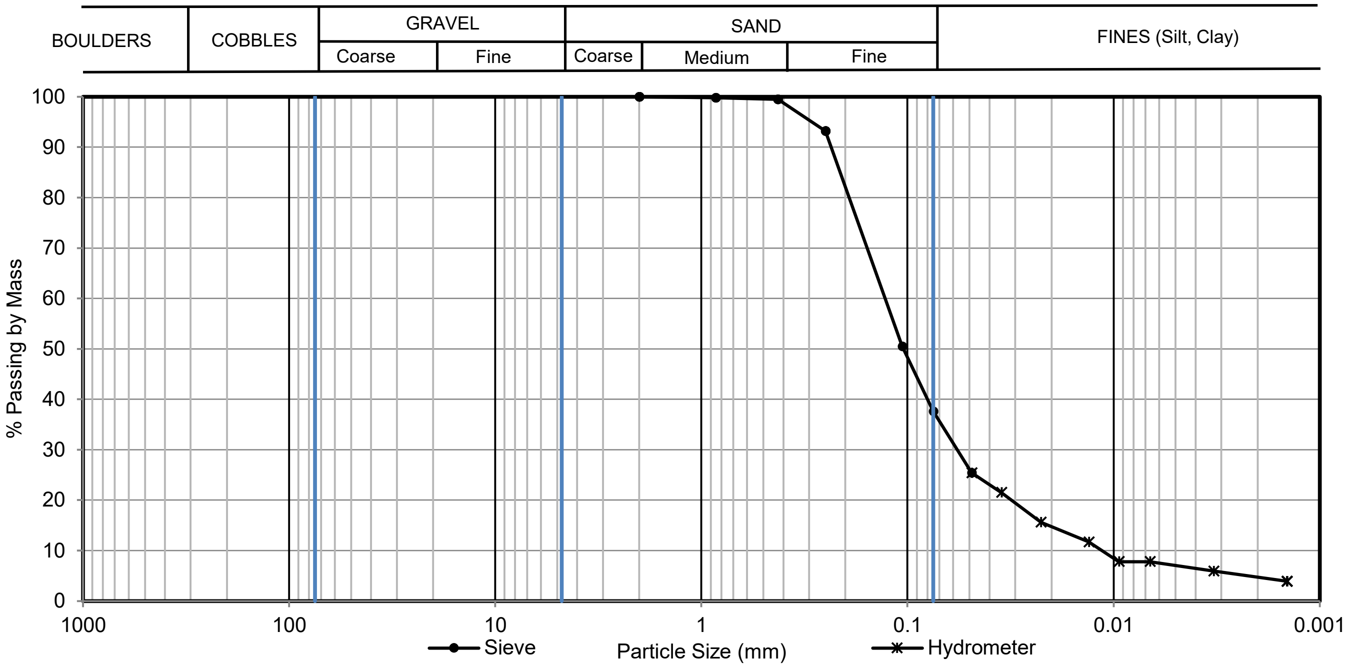
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH82	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH82
Source:		Sample No.:	14
		Type:	SS
Soil Description:		Depth (m):	15.24 - 15.66

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	19 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)	Gravel	Sand	Fines
	0.0	62.4	37.6



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
#10	2	100.0	0.0488	25.4
#20	0.85	99.8	0.0350	21.5
#40	0.425	99.5	0.0225	15.6
#60	0.25	93.2	0.0132	11.7
#140	0.106	50.5	0.0094	7.8
#200	0.075	37.6	0.0067	7.8
			0.0033	5.9
			0.0014	3.9
			0.005 mm	7.03
			0.002 mm	4.70
			D60	0.13
			D30	0.06
			D10	0.01
			Cu	11.00
			Cc	2.30

Notes:

Disclaimer:

Tested by: JTimms **Date:** 19 Oct 2022 **Checked by:** MRuck **Date:** 27 Oct 2022 **Reviewed by:** JoNorris **Date:** 09 Nov 2022

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PARTICLE SIZE DISTRIBUTION

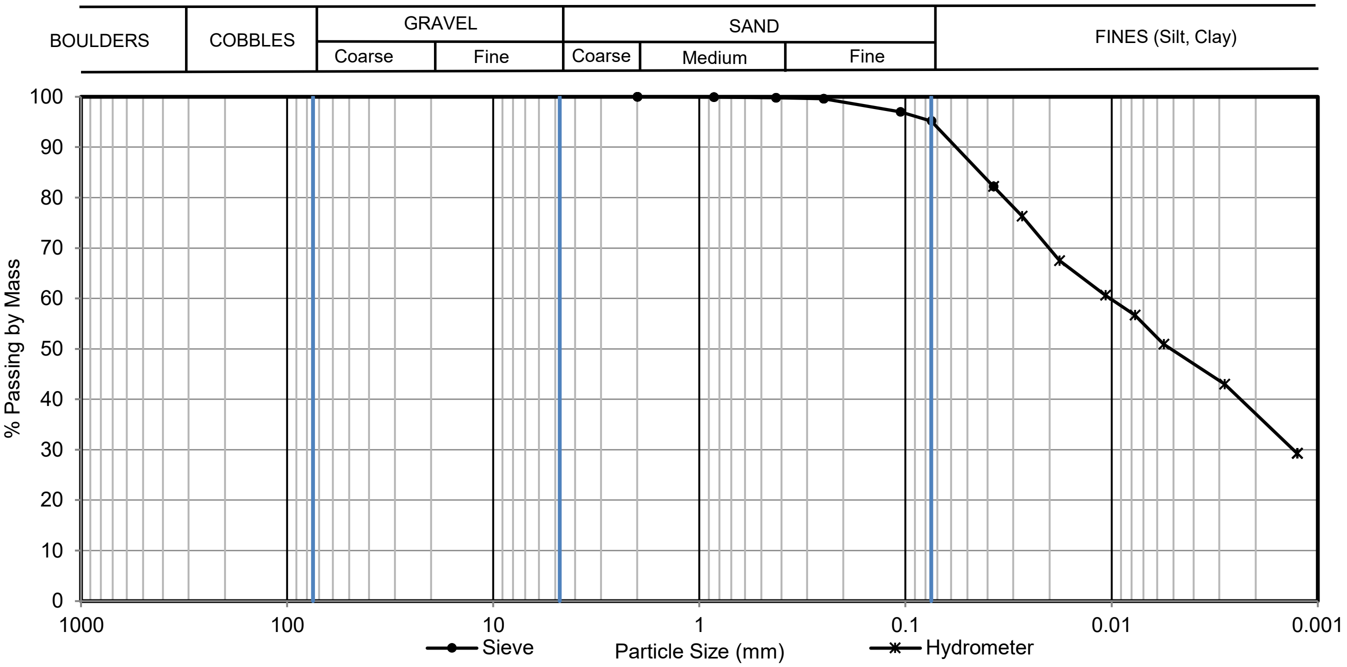
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH82	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH82
Source:		Sample No.:	15B
		Type:	SS
Soil Description:		Depth (m):	16.97 - 17.22

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	19 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%) 0.0 4.8 95.2



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
#10	2	100.0	0.0374	82.2
#20	0.85	99.9	0.0272	76.3
#40	0.425	99.8	0.0179	67.5
#60	0.25	99.6	0.0107	60.6
#140	0.106	97.0	0.0077	56.7
#200	0.075	95.2	0.0056	50.9
			0.0028	43.0
			0.0013	29.3
			0.005 mm	49.61
			0.002 mm	37.12
			D60	0.01
			D30	0.00
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

Tested by: MKMarren **Date:** 19 Oct 2022 **Checked by:** MRuck **Date:** 27 Oct 2022 **Reviewed by:** JoNorris **Date:** 09 Nov 2022

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PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422

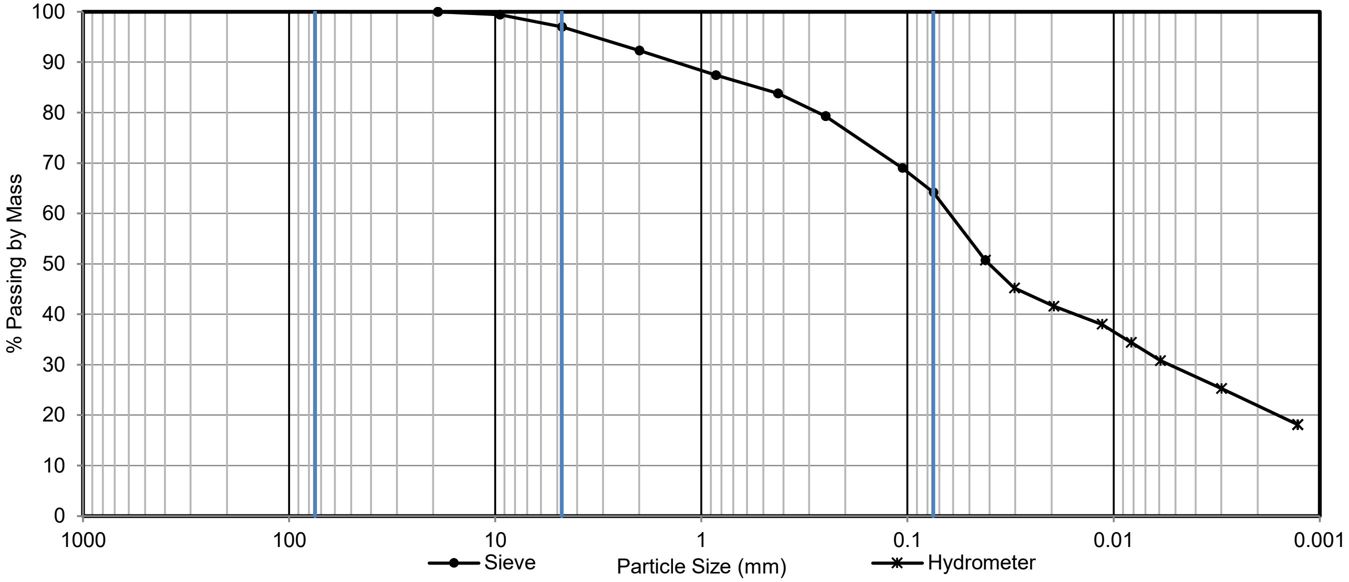
Method B

Test Request #	21451329-21600-610 BH82	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH82
Source:		Sample No.:	17
Soil Description:		Type:	SS
		Depth (m):	19.81 - 20.27

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	20 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)

BOULDERS	COBBLES	GRAVEL Coarse	GRAVEL Fine	SAND Coarse	SAND Medium	SAND Fine	FINES (Silt, Clay)
		3.0		32.8			64.2



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0419	50.7
3/8"	9.5	99.4	0.0303	45.2
#4	4.75	97.0	0.0195	41.6
#10	2	92.3	0.0114	38.0
#20	0.85	87.4	0.0082	34.4
#40	0.425	83.8	0.0059	30.8
#60	0.25	79.3	0.0030	25.3
#140	0.106	69.0	0.0013	18.1
#200	0.075	64.2		
			0.005 mm	29.42
			0.002 mm	21.87
			D60	0.06
			D30	0.01
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

The laboratory testing services reported herein have been performed in accordance with the terms of a contract with Golder's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of Golder's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Tested by: JTimms **Date:** 20 Oct 2022 **Checked by:** MRuck **Date:** 27 Oct 2022 **Reviewed by:** JoNorris **Date:** 09 Nov 2022

GOLDER
MEMBER OF WSP

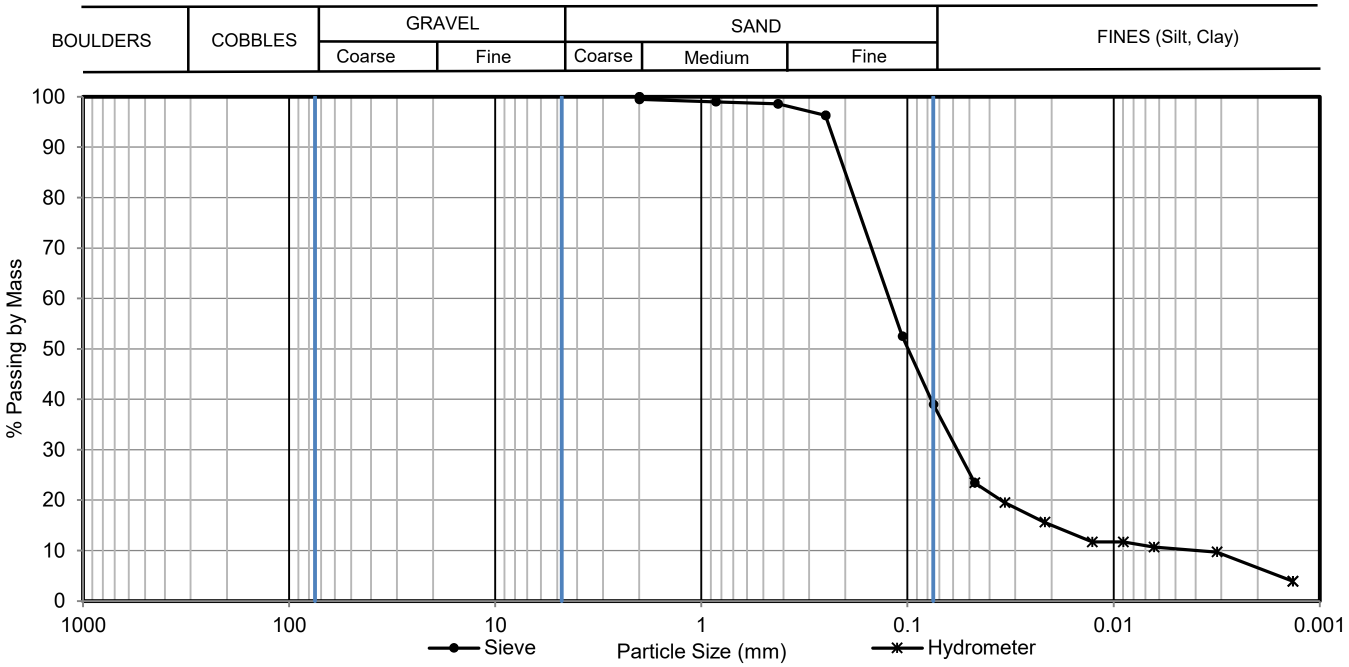
PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422
Method B

Test Request #	21451329-21600-610 BH82	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH82
Source:		Sample No.:	18
Soil Description:		Type:	SS
		Depth (m):	21.34 - 21.79

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	19 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)	Gravel	Sand	Fines
	0.0	61.0	39.0



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
#10	2	99.5	0.0472	23.4
#20	0.85	99.0	0.0338	19.5
#40	0.425	98.6	0.0216	15.6
#60	0.25	96.3	0.0127	11.7
#140	0.106	52.5	0.0090	11.7
#200	0.075	39.0	0.0064	10.7
			0.0032	9.7
			0.0014	3.9
			0.005 mm	10.35
			0.002 mm	6.58
			D60	0.12
			D30	0.06
			D10	0.00
			Cu	31.00
			Cc	6.90

Notes:

Disclaimer:

Tested by: MKMarren **Date:** 19 Oct 2022 **Checked by:** MRuck **Date:** 27 Oct 2022 **Reviewed by:** JoNorris **Date:** 09 Nov 2022

PARTICLE SIZE DISTRIBUTION

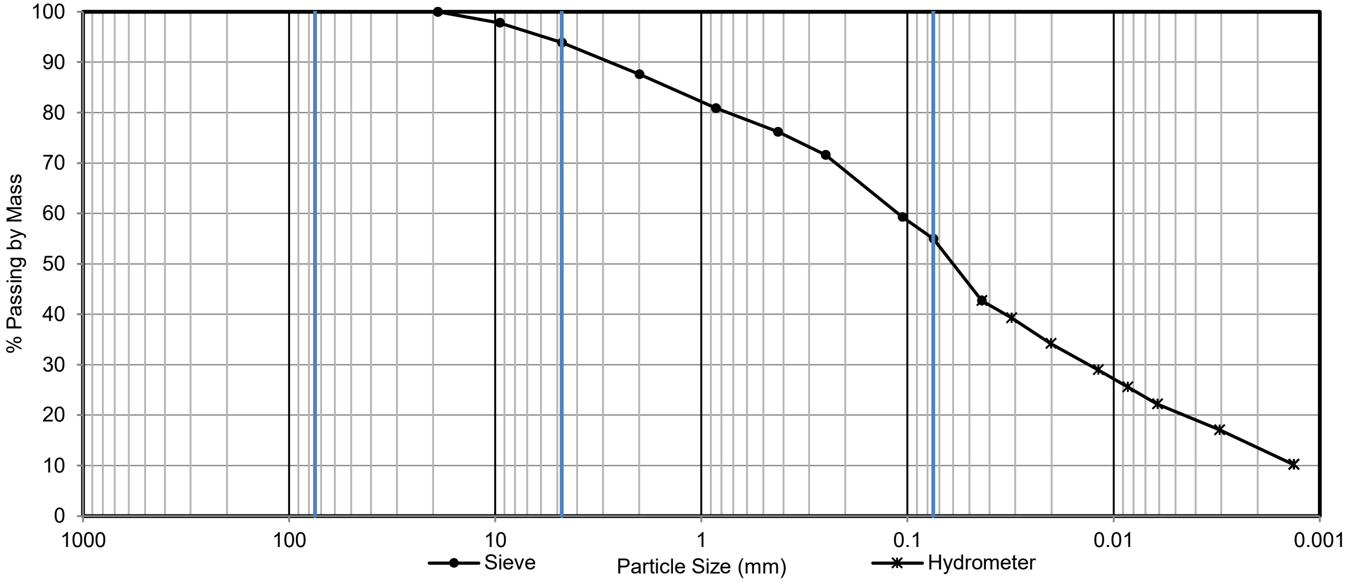
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH82		Project Number:	21451329-21600-610
Client:	E.S. Fox Limited		Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville		Sample Location:	BH82
Source:			Sample No.:	20
			Type:	SS
Soil Description:			Depth (m):	24.38 - 24.64

Specimen Reference	NA	Specimen Depth (m):	NA		Date of Test	20 Oct 2022
Specimen Description	NA					

Grain Size Distribution (%)			6.1		38.9			55.0
	BOULDERS	COBBLES	GRAVEL		SAND			FINES (Silt, Clay)
			Coarse	Fine	Coarse	Medium	Fine	



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0436	42.7
3/8"	9.5	97.8	0.0313	39.3
#4	4.75	93.9	0.0202	34.2
#10	2	87.6	0.0119	29.0
#20	0.85	80.9	0.0086	25.6
#40	0.425	76.2	0.0061	22.2
#60	0.25	71.6	0.0031	17.1
#140	0.106	59.3	0.0013	10.2
#200	0.075	55.0		
			0.005 mm	20.69
			0.002 mm	13.53
			D60	0.11
			D30	0.01
			D10	
			Cu	
			Cc	

Notes:

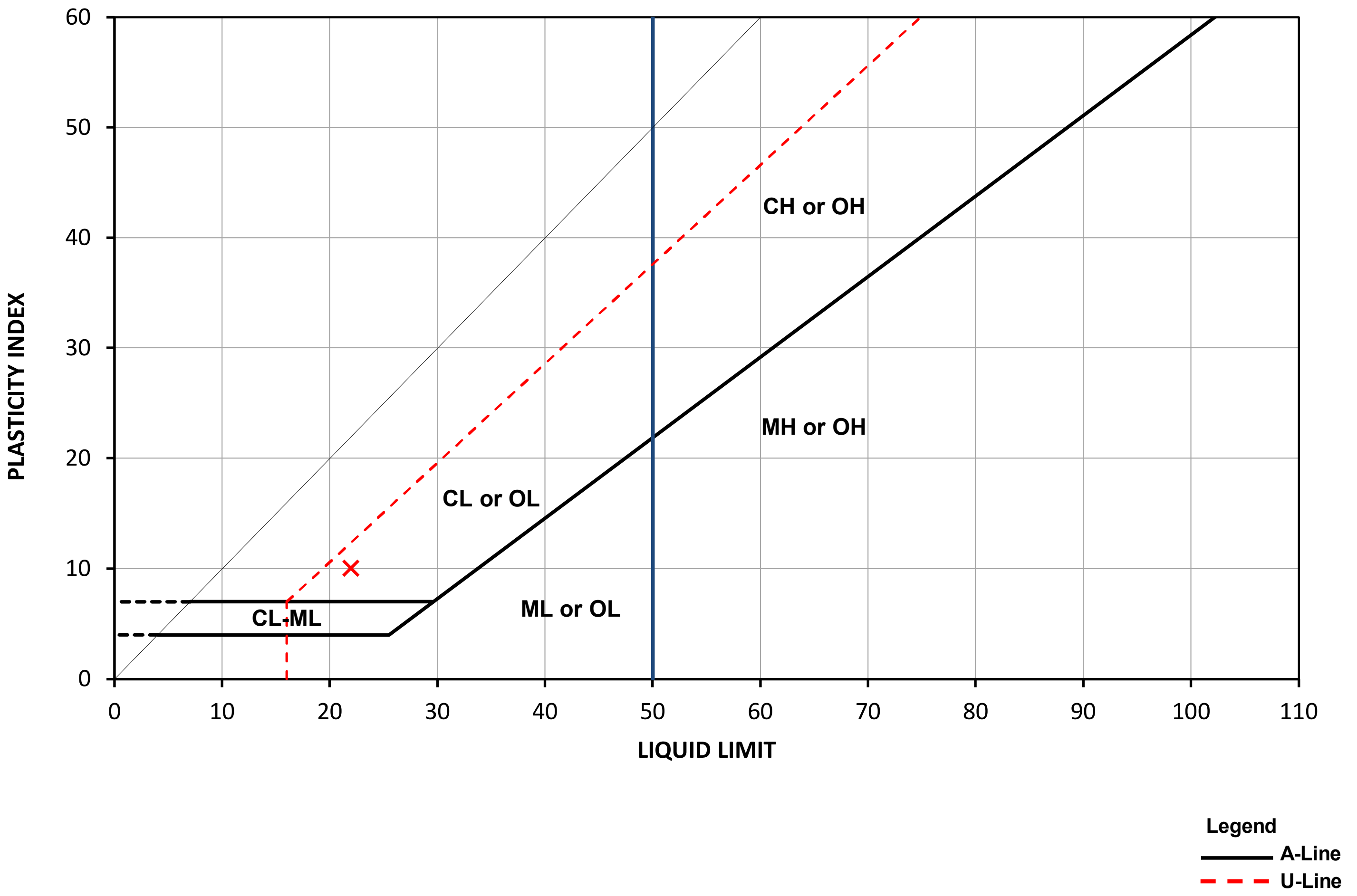
Disclaimer:

Tested by: JTimms **Date:** 20 Oct 2022 **Checked by:** MRuck **Date:** 27 Oct 2022 **Reviewed by:** JoNorris **Date:** 09 Nov 2022

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318
Method A - Multipoint Test

Test Request #	21451329-21600-610 BH82	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH82
Source:		Sample No.:	6
Soil Description:		Type:	SS
		Depth (m):	3.81 - 4.27

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	25 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH82	6	3.81	4.27	83	36.1	22	12	10	2.41

NP = Non-Plastic
ND = Not Determined

Test Preparation
Wet Preparation Tested after >425um removed

Notes:

Tested by: JTimms **Date:** 25 Oct 2022
Checked by: MRuck **Date:** 27 Oct 2022

Disclaimer:

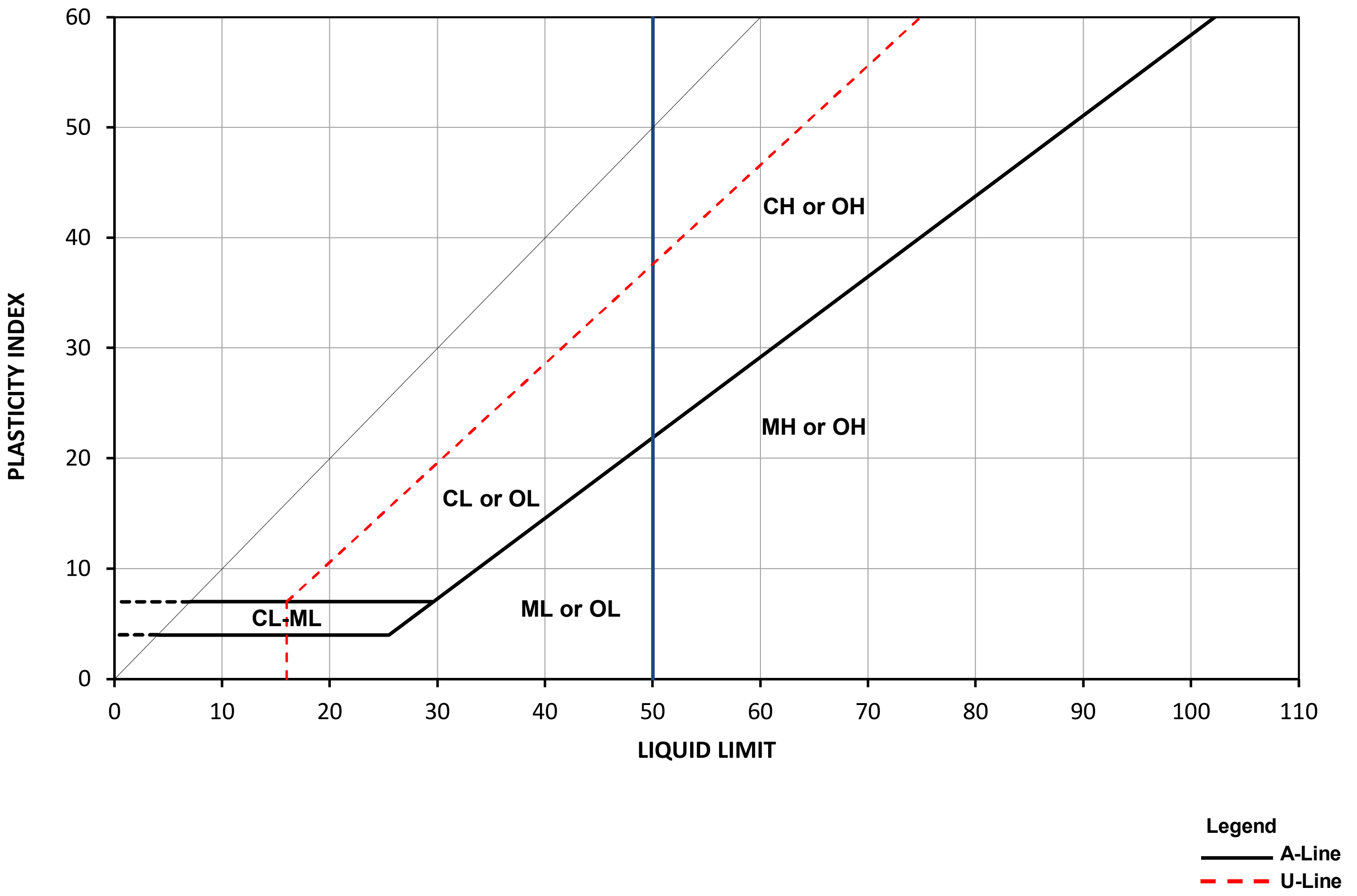
Reviewed by: JoNorris **Date:** 09 Nov 2022

GOLDER
MEMBER OF WSP

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318

Test Request #	21451329-21600-610 BH82	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH82
Source:		Sample No.:	8
Soil Description:		Type:	SS
		Depth (m):	6.10 - 6.55

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	25 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH82	8	6.10	6.55	90	7.8		NP		

NP = Non-Plastic
ND = Not Determined

Test Preparation
Wet Preparation Tested after >425um removed

Notes:

Tested by: JTimms **Date:** 25 Oct 2022
Checked by: MRuck **Date:** 27 Oct 2022

Disclaimer:

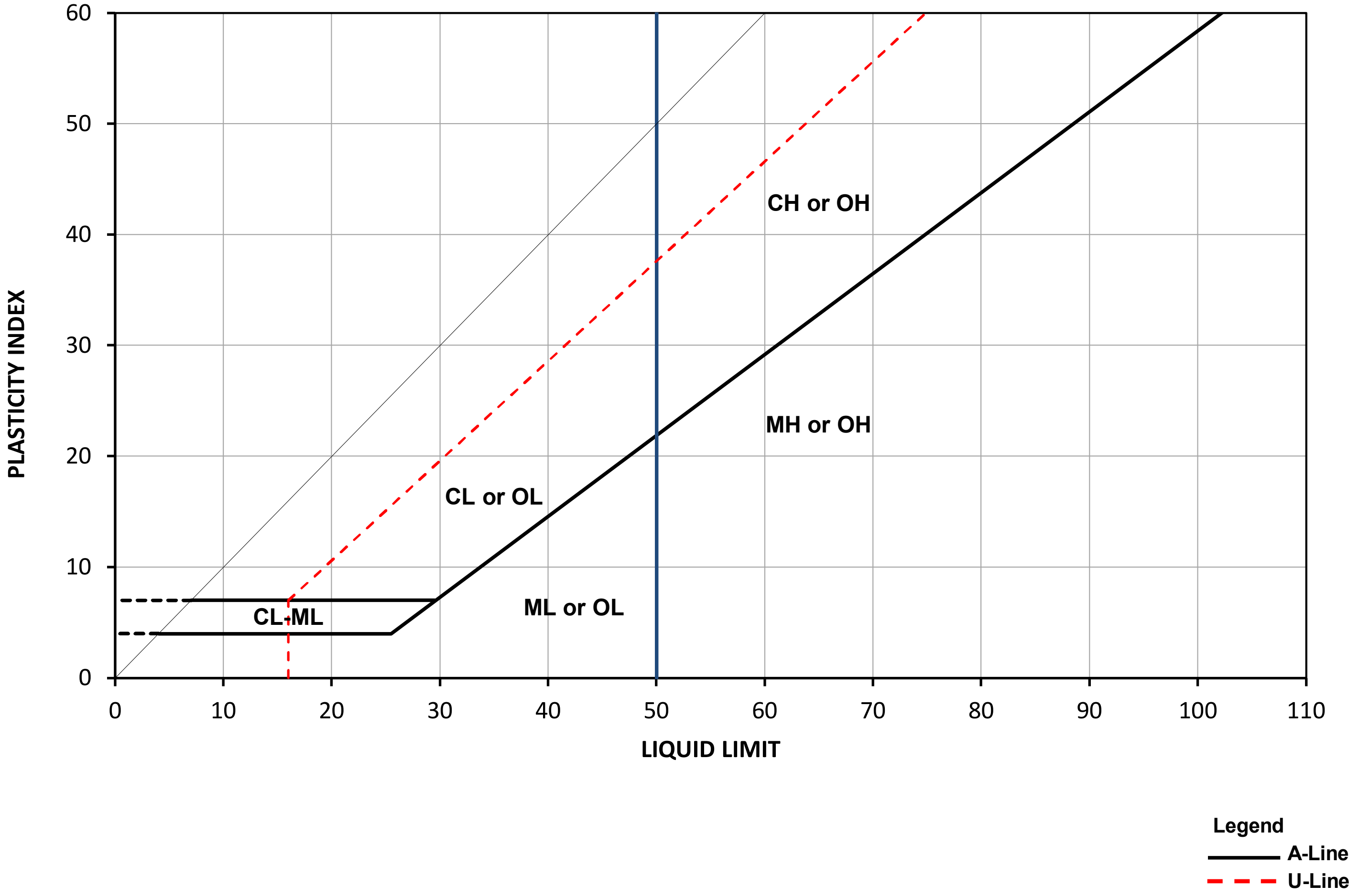
Reviewed by: JoNorris **Date:** 09 Nov 2022

GOLDER
MEMBER OF WSP

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318

Test Request #	21451329-21600-610 BH82	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH82
Source:		Sample No.:	10
Soil Description:		Type:	SS
		Depth (m):	9.14 - 9.34

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	25 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH82	10	9.14	9.34	85	7.4		NP		

NP = Non-Plastic
ND = Not Determined

Test Preparation
Wet Preparation Tested after >425um removed

Notes:

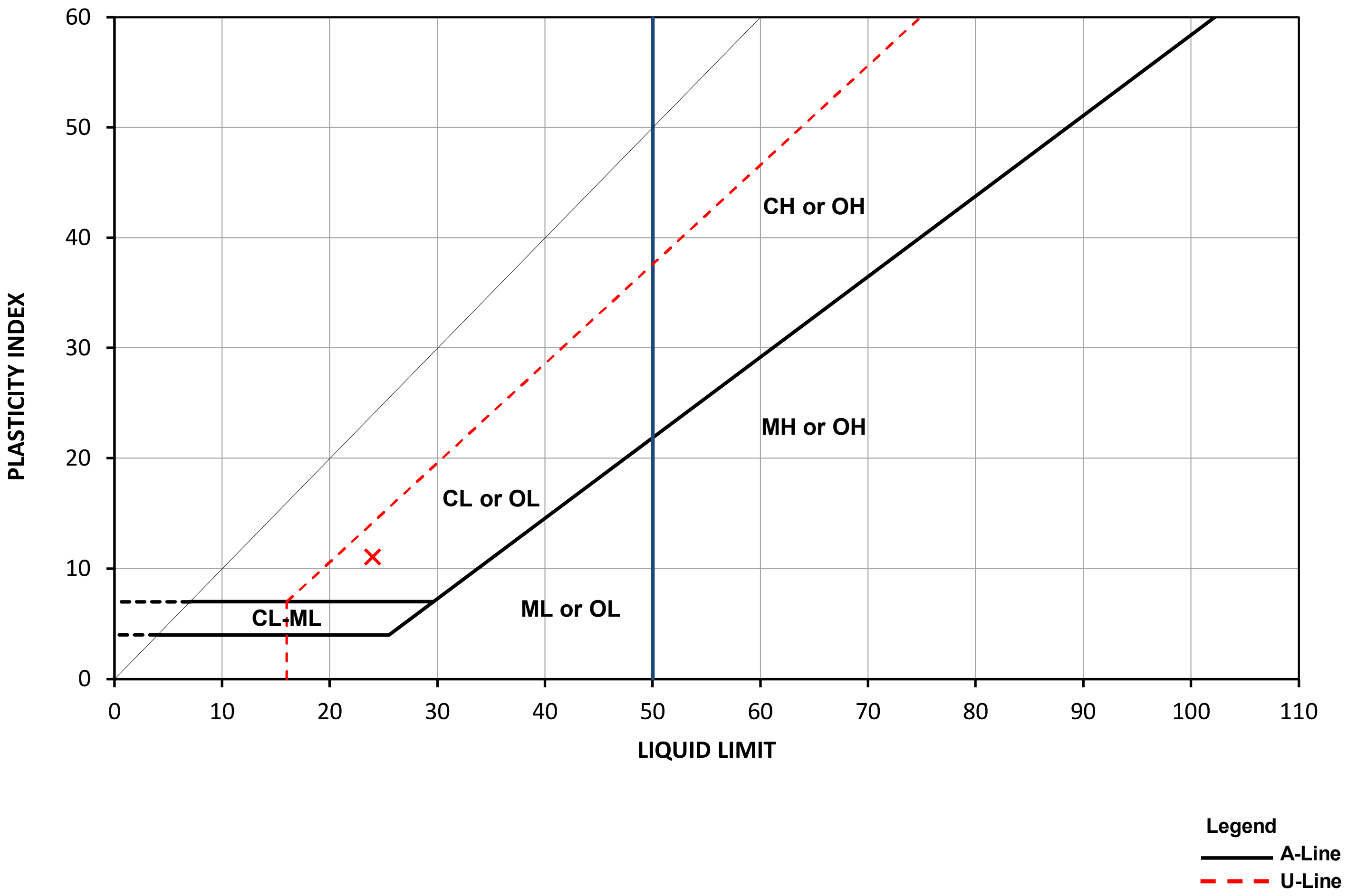
Disclaimer:

Tested by: JTimms **Date:** 25 Oct 2022
Checked by: MRuck **Date:** 27 Oct 2022
Reviewed by: JoNorris **Date:** 09 Nov 2022

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318
Method B - One-point Test

Test Request #	21451329-21600-610 BH82	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH82
Source:		Sample No.:	11
Soil Description:		Type:	SS
		Depth (m):	10.67 - 11.13

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	27 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH82	11	10.67	11.13	ND	14.8	24	13	11	0.16

NP = Non-Plastic
ND = Not Determined

Test Preparation

Notes:

Tested by: XMeng **Date:** 27 Oct 2022
Checked by: MRuck **Date:** 08 Nov 2022

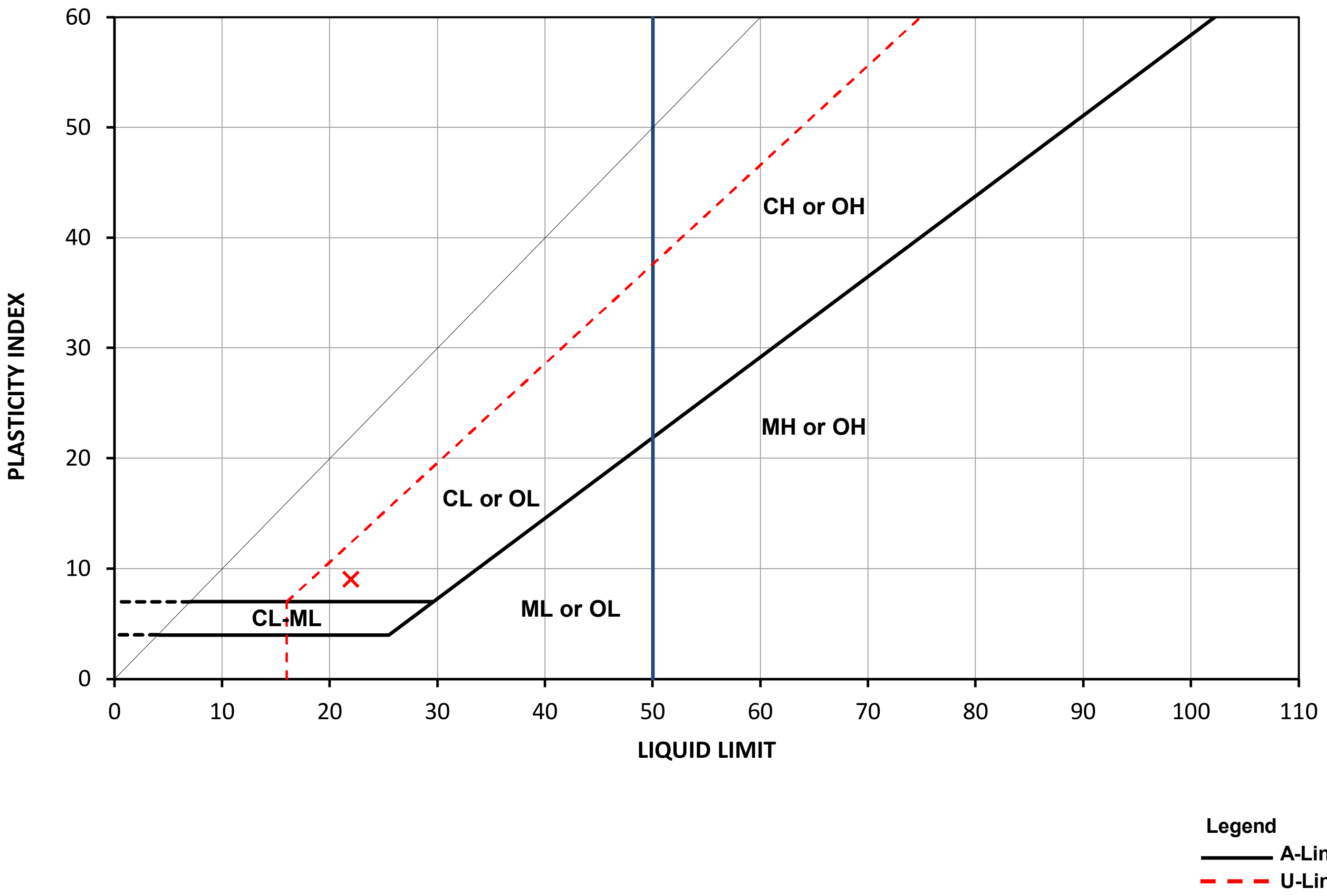
Disclaimer:

Reviewed by: JoNorris **Date:** 09 Nov 2022

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318
Method A - Multipoint Test

Test Request #	21451329-21600-610 BH82	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH82
Source:		Sample No.:	15B
Soil Description:		Type:	SS
		Depth (m):	16.97 - 17.22

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	25 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH82	15B	16.97	17.22	100	22.0	22	13	9	1.00

NP = Non-Plastic
ND = Not Determined

Test Preparation
Wet Preparation Tested after >425um removed

Notes:

Tested by: JTimms **Date:** 25 Oct 2022
Checked by: MRuck **Date:** 27 Oct 2022

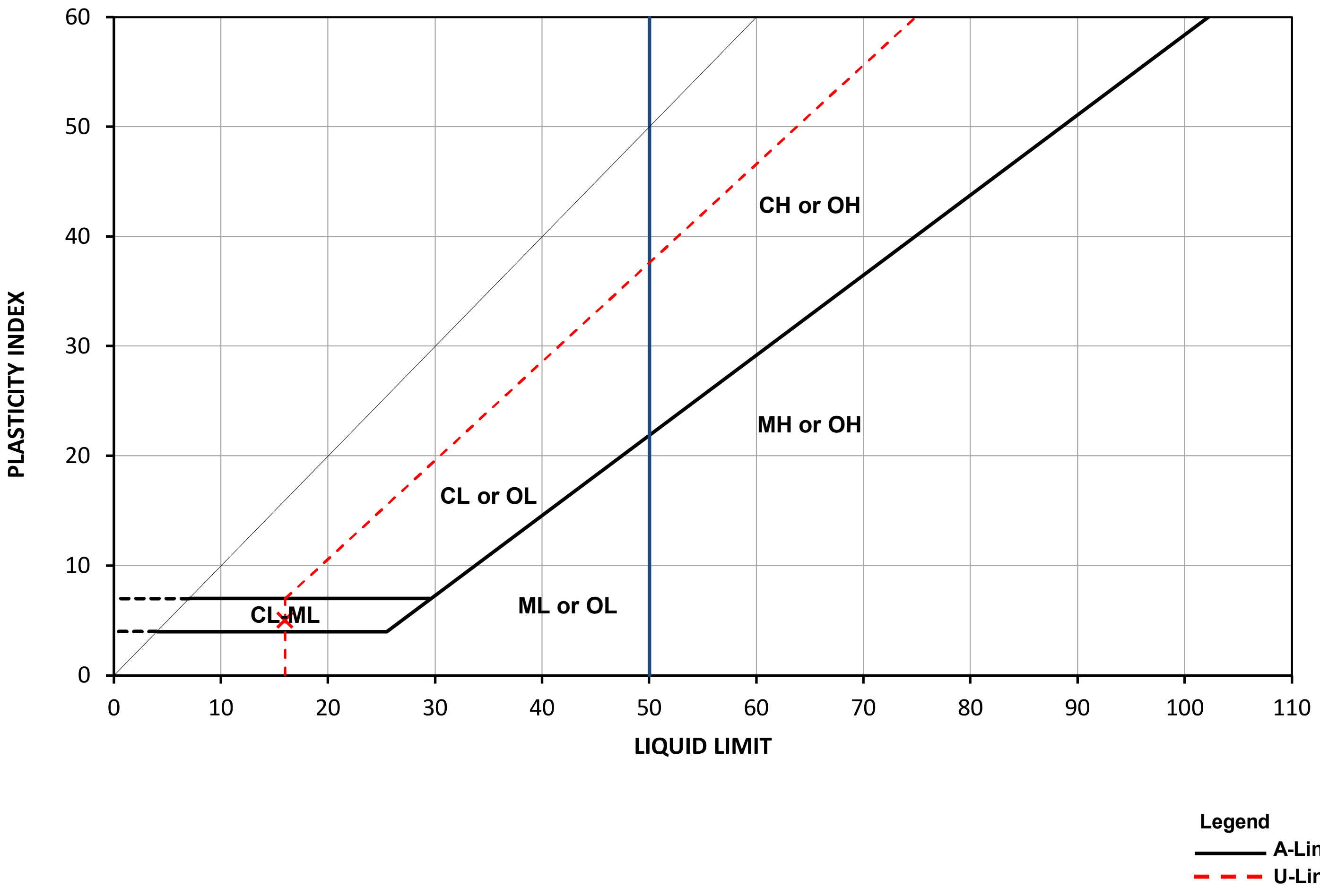
Disclaimer:

Reviewed by: JoNorris **Date:** 09 Nov 2022

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318
Method A - Multipoint Test

Test Request #	21451329-21600-610 BH82	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH82
Source:		Sample No.:	17
Soil Description:		Type:	SS
		Depth (m):	19.81 - 20.27

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	25 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH82	17	19.81	20.27	91	7.8	16	11	5	-0.64

NP = Non-Plastic
ND = Not Determined

Test Preparation
Wet Preparation Tested after >425um removed

Notes:

Tested by: JTimms **Date:** 25 Oct 2022
Checked by: MRuck **Date:** 27 Oct 2022

Disclaimer:
The laboratory testing services reported herein have been performed in accordance with the terms of a contract with Golder's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of Golder's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

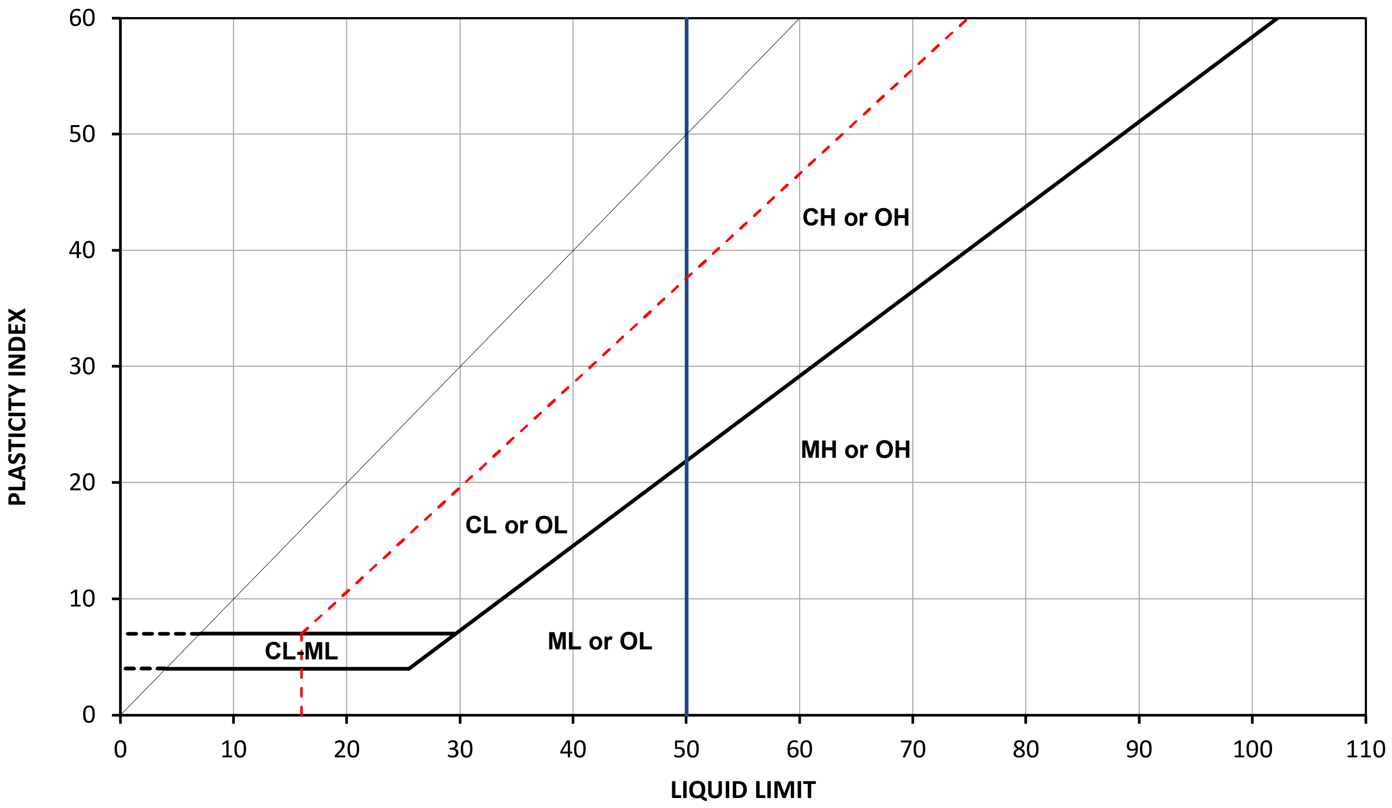
Reviewed by: JoNorris **Date:** 09 Nov 2022

GOLDER
MEMBER OF WSP

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318

Test Request #	21451329-21600-610 BH82	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH82
Source:		Sample No.:	20
Soil Description:		Type:	SS
		Depth (m):	24.38 - 24.64

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	25 Oct 2022
Specimen Description	NA				



Legend
- A-Line
- U-Line

Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH82	20	24.38	24.64	86	7.4		NP		

NP = Non-Plastic
ND = Not Determined

Test Preparation
Wet Preparation Tested after >425um removed

Notes:

Disclaimer:
The laboratory testing services reported herein have been performed in accordance with the terms of a contract with Golder's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of Golder's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Tested by: JTimms **Date:** 25 Oct 2022
Checked by: MRuck **Date:** 27 Oct 2022
Reviewed by: JoNorris **Date:** 09 Nov 2022

GOLDER
MEMBER OF WSP

SPECIFIC GRAVITY OF SOIL SOLIDS
ASTM D854
Pycnometer Method B

Test Request #	21451329-21600-610 BH82	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	NA
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH82
Source:		Sample No.:	11
Soil Description:		Type:	SS
		Depth (m)	10.67 - 11.13

Specimen Reference	NA	Specimen Depth	NA	Date of Test	27 Oct 2022
Specimen Description	NA				

Proportions		
Percentage Passing (4.75 mm)		%
Percentage Retained (4.75 mm)		%

Fine Fraction (D854)		
Calibrated Mass of Pycnometer		g
Calibrated Volume of Pycnometer	249.65	mL
Mass of Pycnometer	94.42	g
Test Temperature	17.8	oC
Mass of Pycnometer, soil and water	369.26	g
Mass of Container (or tare)	3.55	g
Mass of dry soil and container	44.12	g
Dry mass of soil solids	40.57	g
Specific Gravity at 20oC	**2.70**	

Coarse Fraction (C127)		
Mass of Oven Dry Sample		g
Mass of saturated-surface-dry in air		g
Apparent mass of saturated test sample in water		g
Specific Gravity Oven Dry		
Specific Gravity Saturated Surface Dry		
Specific Gravity with Weighted Average	**2.70**	

Notes:

Tested by: ShKhan **Date:** 27 Oct 2022
Checked by: MRuck **Date:** 08 Nov 2022

Disclaimer:

Reviewed by: JoNorris **Date:** 09 Nov 2022

GOLDER
MEMBER OF WSP

SPECIFIC GRAVITY OF SOIL SOLIDS
ASTM D854
Pycnometer Method B

Test Request #	21451329-21600-610 BH82	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	NA
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH82
Source:		Sample No.:	13
Soil Description:		Type:	SS
		Depth (m)	13.72 - 14.16

Specimen Reference	NA	Specimen Depth	NA	Date of Test	NA
Specimen Description	NA				

Proportions		
Percentage Passing (4.75 mm)		%
Percentage Retained (4.75 mm)		%

Fine Fraction (D854)		
Calibrated Mass of Pycnometer		g
Calibrated Volume of Pycnometer	249.54	mL
Mass of Pycnometer	92.05	g
Test Temperature	19.4	oC
Mass of Pycnometer, soil and water	366.57	g
Mass of Container (or tare)	92.05	g
Mass of dry soil and container	132.29	g
Dry mass of soil solids	40.24	g
Specific Gravity at 20oC	**2.71**	

Coarse Fraction (C127)		
Mass of Oven Dry Sample		g
Mass of saturated-surface-dry in air		g
Apparent mass of saturated test sample in water		g
Specific Gravity Oven Dry		
Specific Gravity Saturated Surface Dry		
Specific Gravity with Weighted Average	**2.71**	

Notes:

Disclaimer:

Tested by: ShKhan **Date:**

Checked by: MRuck **Date:** 08 Nov 2022 **Reviewed by:** JoNorris **Date:** 09 Nov 2022

WSP GOLDER

Water (Moisture) Content, Ash Content, and Organic Material of Soils
ASTM D2974 Method A

Test Request #	21451329-21600-610 BH82	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH82
Source:		Sample No.:	2
Soil Description:		Type:	SS
		Depth (m):	0.76 - 1.22

Specimen Reference	NA	Specimen Depth	NA	Date of Test	12 Oct 2022
Specimen Description	NA				

Furnace Temperature During Test (°C)	440
Duration of Test (nearest 15 minutes)	5850
Mass of Crucible With Lid (g)	61.16
Moist Mass of Specimen Plus Crucible With Lid (g)	149.68
Oven Dry Mass of Specimen Plus Crucible With Lid (g)	143.93
Mass of Crucible With Lid Plus Ash (g)	143.24
Water Content (%)	7
Ash Content (%)	99.2
Organic Material (%)	0.8

Test Preparation

Notes:

Disclaimer:

Tested by: JTimms **Date:** 12 Oct 2022

Checked by: MRuck **Date:** 27 Oct 2022

Reviewed by: JoNorris **Date:** 09 Nov 2022

SOIL RESISTIVITY USING THE WENNER FOUR ELECTRODE METHOD (ASTM G57-20)

November 3, 2022
Golder Project Number: 21451329-21600-610

Attention: Sarah Poot

Sample Description: **BH82, SA16, 18.29-18.75m**

Date Scheduled:	October 3, 2022	Sampled By:	Golder Associates Ltd.
Date Received:	October 12, 2022	Golder Lab No.:	G-22-267
Date Tested:	October 12, 2022	Tested By:	E. Shallhorn

Resistivity Meter Model Number	Miller 400D
Soil Box Factor	0.976377953
Temperature of Sample (°C)	23.5
Measured Resistance (ohm)	4520.0
Resistivity (ohm•cm)	4413.2
Temperature Corrected Resistivity (ohm•cm)	**5295.8**

Data Input By: M. Ruck

Reviewed by:

Jodi Norris, Technical and Quality Coordinator

SOIL RESISTIVITY USING THE WENNER FOUR ELECTRODE METHOD (ASTM G57-20)

November 3, 2022
Golder Project Number: 21451329-21600-610

Attention: Sarah Poot

Sample Description: **BH82, SA19, 22.86-23.32m**

Date Scheduled:	October 3, 2022	Sampled By:	Golder Associates Ltd.
Date Received:	October 12, 2022	Golder Lab No.:	G-22-268
Date Tested:	October 12, 2022	Tested By:	E. Shallhorn

Resistivity Meter Model Number	Miller 400D
Soil Box Factor	0.976377953
Temperature of Sample (°C)	23.5
Measured Resistance (ohm)	3120.0
Resistivity (ohm•cm)	3046.3
Temperature Corrected Resistivity (ohm•cm)	**3655.6**

Data Input By: M. Ruck

Reviewed by:

Jodi Norris, Technical and Quality Coordinator

A08-BH202

PROJECT: 21451329

RECORD OF BOREHOLE: BH202

SHEET 1 OF 7

LOCATION: N 4859648.42; E 684020.72

BORING DATE: August 7 to 9, 2022

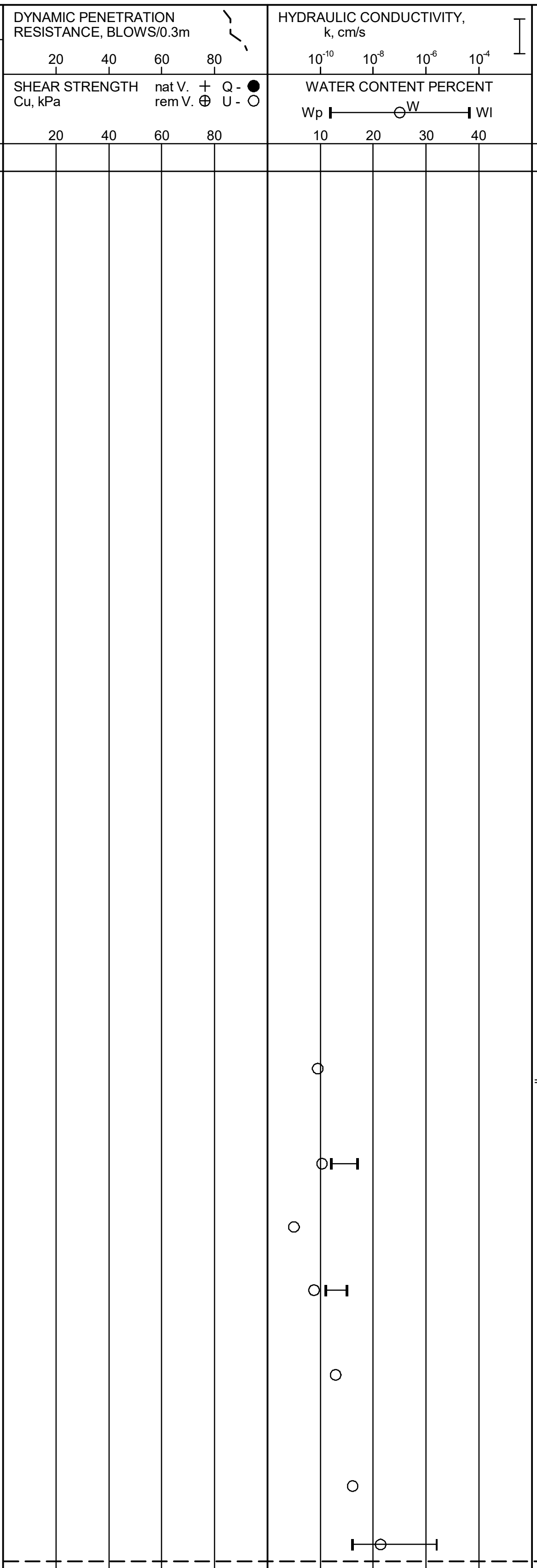
DATUM: Geodetic

DRILL RIG: Diedrich 120 Track Mounted

DEPTH SCALE METRES | BORING METHOD | SOIL PROFILE | SAMPLES | DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m | HYDRAULIC CONDUCTIVITY, k, cm/s | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

BORING METHOD: Mud Rotary Wash Boring (Tricone); UW Casing (0 to approx. 8.8 m); Open (below)

ELEV. DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
78.30 0.00	BARGE DECK						
74.85 3.45	WATER						
72.15 6.15	**Silty Clay with Sand to Sandy Silty Clay (CL-ML)**, stiff to hard, grey, moist, fine to coarse sand, angular fine to coarse gravel, low plasticity (Till) (Unit 3)		1	SS	18	γ =24.60 kN/m³	
			2	SS	11		1 22 55 22
	- Rock fragments in spoon sample 3		3	SS	123		
			4	SS	28		9 26 49 16
69.94 8.36	**Sandy Lean Clay (CL)**, stiff, grey, moist, fine to medium sand, trace of angular coarse gravel, low to medium plasticity (Glaciolacustrine) (Unit 4b)		5	SS	12		
69.33 8.97	**Silty Sand (SM)**, very dense, grey, wet, fine to medium sand (Glaciolacustrine) (Unit 4a)		6A	SS	60		
68.88 9.42	- Lean Clay layers		6B				
			7	SS	40		1 6 44 50



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DEPTH SCALE

1 : 50

LOGGED: PKS

CHECKED: SEMP

PROJECT: 21451329

LOCATION: N 4859648.42; E 684020.72

RECORD OF BOREHOLE: BH202

SHEET 2 OF 7

BORING DATE: August 7 to 9, 2022

DRILL RIG: Diedrich 120 Track Mounted

DATUM: Geodetic

BORING METHOD: Mud Rotary Wash Boring (Tricone) — Open

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-10} 10^{-8} 10^{-6} 10^{-4}

WATER CONTENT PERCENT: Wp ⊢ W ○ ⊣ Wl 10 20 30 40

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE METRES	DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---						
10	**Lean Clay (CL)**, hard to very stiff, grey, moist, fine to medium sand, low to medium plasticity (Glaciolacustrine) (Unit 4b)	67.84 10.46	7	SS	40		1 6 44 50
	Sandy Lean Clay (CL), very stiff, grey, moist, fine to coarse sand, trace of angular fine gravel, low to medium plasticity (Till) (Unit 5)	67.50 10.80	8A 8B	SS	18		
11	**Sandy Silt (ML)**, very dense, grey, wet, fine to medium sand (Glaciolacustrine) (Unit 4a)		9	SS	108		
			10	SS	131	γ=23.14 kN/m³	
12			11	SS	88	NP	3 38 57 3
13			12	SS	81		
		64.46 13.84	13A 13B	SS	65		
14	**Lean Clay with Sand (CL)**, very stiff, grey, moist, fine to coarse sand, low to medium plasticity (Glaciolacustrine) (Unit 4b)	63.67 14.63	14	SS	23	γ=21.28 kN/m³	
15	**Sandy Silty Clay with Sand (CL-ML)**, hard, grey, moist, fine to coarse sand, angular fine to coarse gravel, low plasticity (Till) (Unit 5)		15	SS	38		
			16	SS	51		20 31 34 15
16	- Gravel and sand increase below 15.67 m	61.92 16.38	17 18	SS SS	164 100/0.10		
	Shale Bedrock						
17							
18							
19							
20							

Notes:

1. Bedrock cored from 16.38 m to 62.00 m depth

2. Refer to Record of Drillhole BH202

3. Water level in open borehole could not be measured upon completion of soil drilling due to use of mud-rotary technique.

4- Efficiency of the SPT hammer utilized was 75.2 %.

DEPTH SCALE

1 : 50

LOGGED: PKS

CHECKED: SEMP

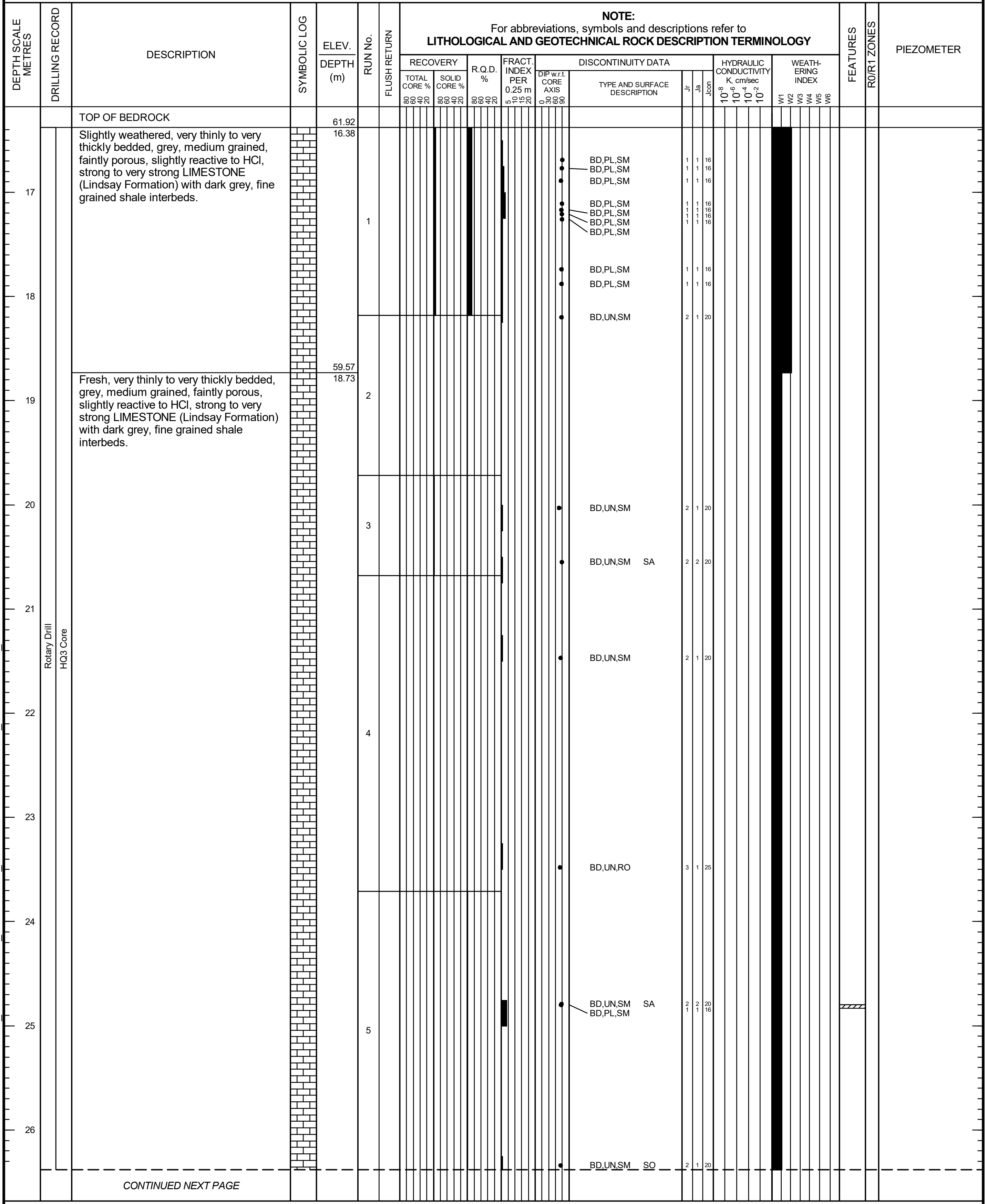
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859648.42; E 684020.72
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH202

DRILLING DATE: August 9 to 17, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 3 OF 7
DATUM: Geodetic

NOTE: For abbreviations, symbols and descriptions refer to **LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY**



ELEV. DEPTH (m)	DESCRIPTION
61.92	TOP OF BEDROCK
16.38	Slightly weathered, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey, fine grained shale interbeds.
59.57 18.73	Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey, fine grained shale interbeds.

TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,PL,SM			
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,UN,SM	2	1	20
BD,UN,SM	2	1	20
BD,UN,SM SA	2	2	20
BD,UN,SM	2	1	20
BD,UN,RO	3	1	25
BD,UN,SM SA	2	2	20
BD,PL,SM	1	1	16
BD,UN,SM SO	2	1	20

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: PKS/KL
CHECKED: AKV

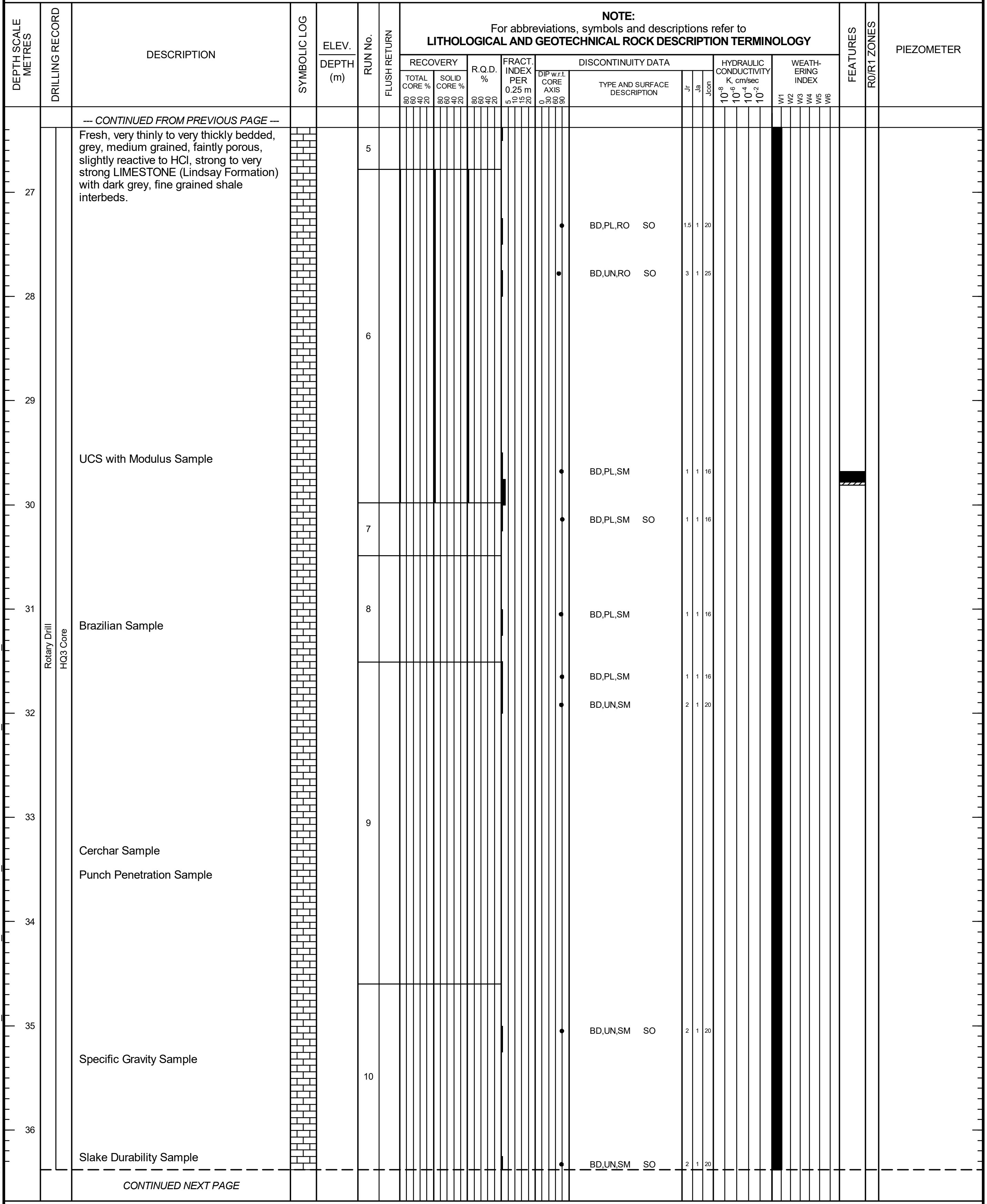
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859648.42; E 684020.72
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH202

DRILLING DATE: August 9 to 17, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 4 OF 7
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



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Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey, fine grained shale interbeds.

UCS with Modulus Sample

Brazilian Sample

Cerchar Sample

Punch Penetration Sample

Specific Gravity Sample

Slake Durability Sample

TYPE AND SURFACE DESCRIPTION		Jr	Ja	Jcon
BD,PL,RO	SO	1.5	1	20
BD,UN,RO	SO	3	1	25
BD,PL,SM		1	1	16
BD,PL,SM	SO	1	1	16
BD,PL,SM		1	1	16
BD,PL,SM		1	1	16
BD,UN,SM		2	1	20
BD,UN,SM	SO	2	1	20
BD,UN,SM	SO	2	1	20

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: PKS/KL
CHECKED: AKV

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859648.42; E 684020.72
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH202

DRILLING DATE: August 9 to 17, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 5 OF 7
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE % 80 60 40 20	RECOVERY SOLID CORE % 80 60 40 20	R.Q.D. % 80 60 40 20	FRACT. INDEX PER 0.25 m 5 10 15 20	DISCONTINUITY DATA DIP w.r.t. CORE AXIS 0 30 60 90	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2}	WEATHERING INDEX W1 W2 W3 W4 W5 W6	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
	Rotary Drill HQ3 Core	Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey, fine grained shale interbeds.																		
37					10															
		UCS with Modulus Sample																		
38																				
39					11															
40												BD,PL,RO	1.5	1	20					
												BD,PL,SM	1	1	16					
												BD,PL,SM	1	1	16					
		Brazilian Sample																		
41					12															
												BD,UN,SM	2	1	20					
42		Cerchar Sample										BD,UN,RO	3	1	25					
												BD,UN,SM	2	1	20					
					13															
43																				
		Slake Durability Sample																		
44												BD,UN,SM	2	1	20					
		Direct Shear Sample										BD,UN,SM SO	2	1	20					
45												BD,UN,RO SO	3	1	25					
					14															
46												BD,UN,SM	2	1	20					
		CONTINUED NEXT PAGE																		

DEPTH SCALE
1 : 50

LOGGED: PKS/KL
CHECKED: AKV

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859648.42; E 684020.72
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH202

DRILLING DATE: August 9 to 17, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (m) | RUN No. | FLUSH RETURN | RECOVERY (TOTAL CORE % 80 60 40 20; SOLID CORE % 80 60 40 20) | R.Q.D. % 80 60 40 20 | FRACT. INDEX PER 0.25 m 5 10 15 20 | DISCONTINUITY DATA (DIP w.r.t. CORE AXIS 0 30 60 90; TYPE AND SURFACE DESCRIPTION; Jr; Ja; Jcon) | HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2} | WEATHERING INDEX W1 W2 W3 W4 W5 W6 | FEATURES | R0/R1 ZONES | PIEZOMETER

--- CONTINUED FROM PREVIOUS PAGE ---

Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey, fine grained shale interbeds.

Specific Gravity Sample

Punch Penetration Sample

Drilling record: Rotary Drill, HQ3 Core

Depth scale (m): 47, 48, 49, 50, 51, 52, 53, 54, 55, 56

Run No.: 14, 15, 16, 17, 18, 19

TYPE AND SURFACE DESCRIPTION		Jr	Ja	Jcon
BD,UN,SM		2	1	20
BD,UN,SM		2	1	20
BD,UN,RO		3	1	25
BD,UN,RO		3	1	25
BD,UN,RO	SO	3	1	25
BD,UN,SM		2	1	20
BD,PL,SM		1	1	16
BD,PL,SM		1	1	16
BD,CU,RO	SA	3	2	22
BD,PL,SM		1	1	16
BD,UN,SM		2	1	20
BD,UN,SM		2	1	20
BD,ST,SM		2	1	20
BD,UN,RO	SA	3	2	22
BD,UN,RO	SA	3	2	22

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

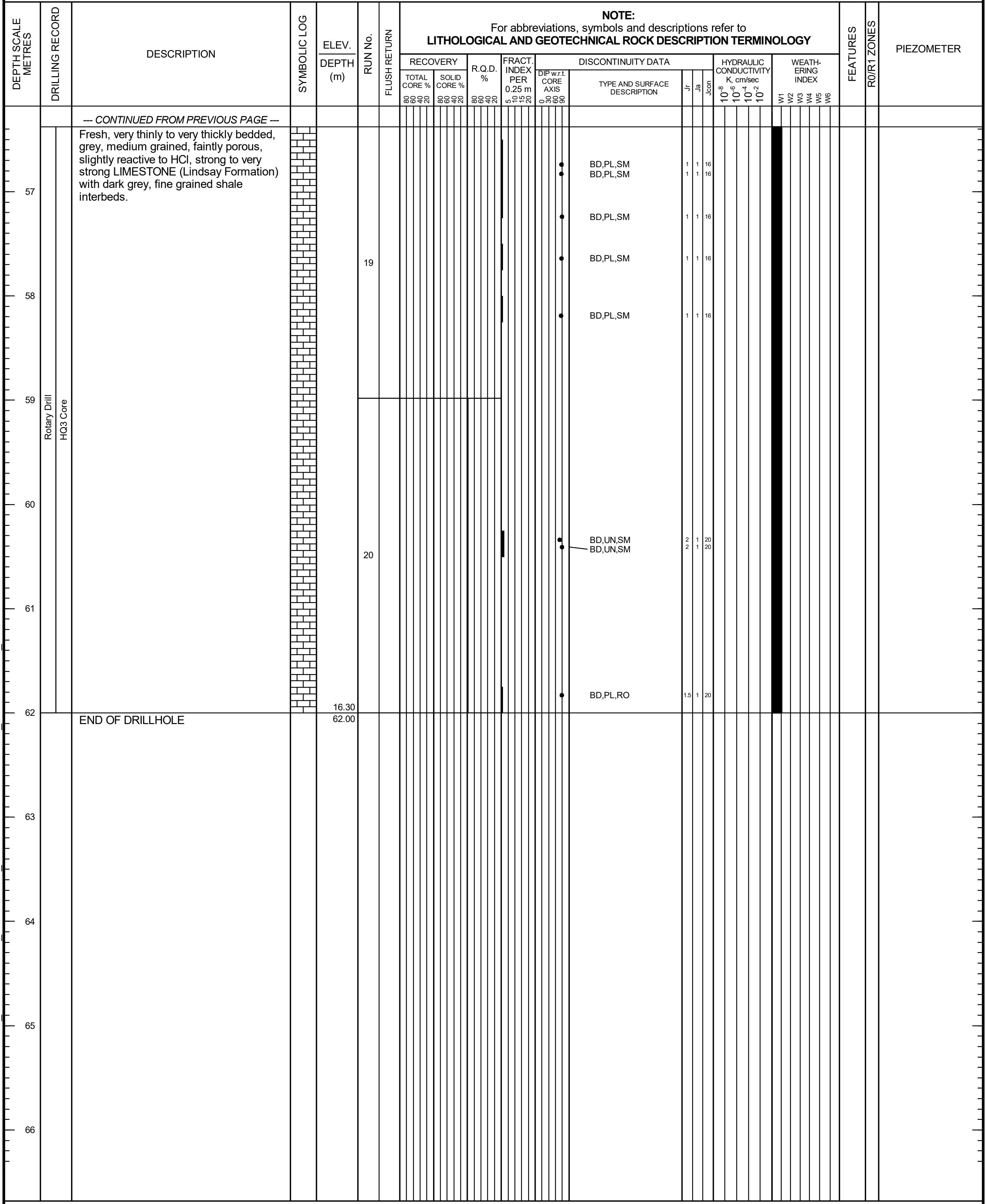
LOGGED: PKS/KL
CHECKED: AKV

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859648.42; E 684020.72
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH202

DRILLING DATE: August 9 to 17, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 7 OF 7
DATUM: Geodetic



NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

--- CONTINUED FROM PREVIOUS PAGE ---

Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey, fine grained shale interbeds.

ELEV. DEPTH (m)	DESCRIPTION
16.30 62.00	END OF DRILLHOLE

DISCONTINUITY DATA

TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,UN,SM	2	1	20
BD,UN,SM	2	1	20
BD,PL,RO	1.5	1	20

DEPTH SCALE
1 : 50

LOGGED: PKS/KL
CHECKED: AKV

Water Content Summary
ASTM D2216

Test Request #	21451329-21600-610 BH202	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville		

Sample Location	Sample				Soil Description	Water Content %	Method	Remarks
	Ref	Top (m)	Base (m)	Type				
BH202	1	6.15	6.76	SS		9.5	B	
BH202	2	6.91	7.37	SS		10.3	B	
BH202	3	7.37	7.82	SS		5.0	B	
BH202	4	7.82	8.28	SS		8.8	B	
BH202	5	8.43	8.89	SS		12.9	B	
BH202	6B	9.42	9.50	SS		16.1	B	
BH202	7	9.65	10.11	SS		21.4	B	
BH202	9	10.87	11.33	SS		12.5	B	
BH202	10	11.48	11.94	SS		18.6	B	
BH202	11	12.09	12.55	SS		18.9	B	
BH202	12	12.70	13.16	SS		20.1	B	
BH202	14	13.92	14.38	SS		18.4	B	
BH202	16	15.14	15.60	SS		8.3	B	

Notes:

Tested by: JTimms **Date:** 05 Oct 2022
Checked by: MRuck **Date:** 26 Oct 2022

Disclaimer:

Reviewed by: JoNorris **Date:** 09 Nov 2022

GOLDER
MEMBER OF WSP

PARTICLE SIZE DISTRIBUTION

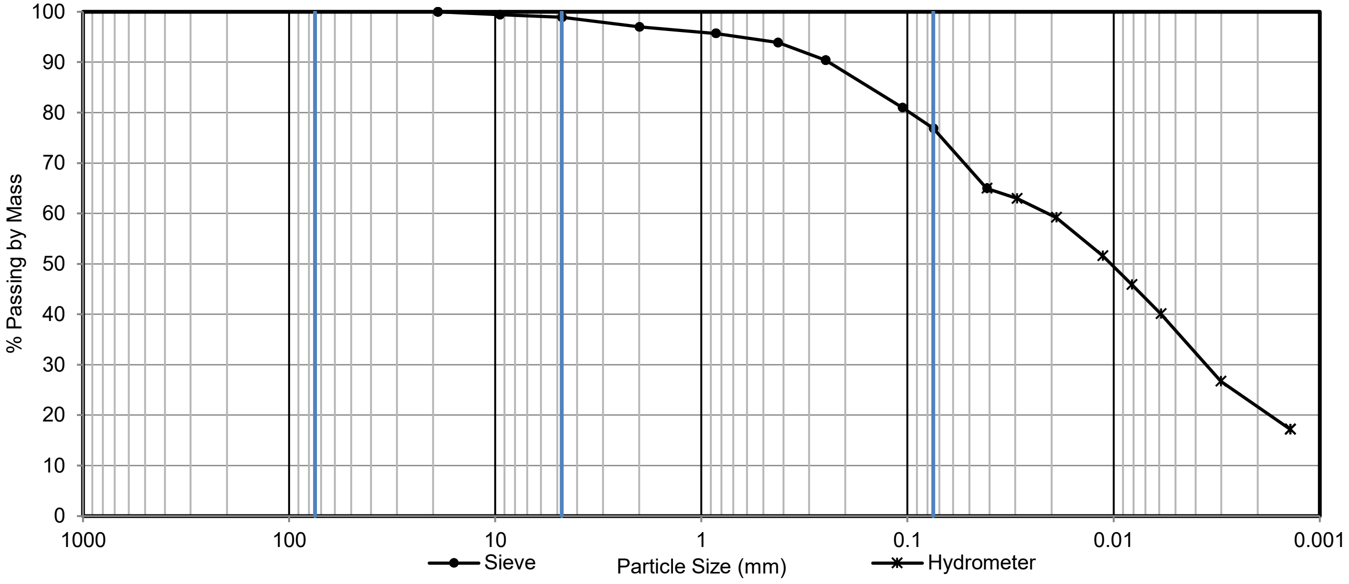
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH202	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH202
Source:		Sample No.:	2
		Type:	SS
Soil Description:		Depth (m):	6.91 - 7.37

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	14 Oct 2022
Specimen Description	NA				

	BOULDERS	COBBLES	GRAVEL		SAND			FINES (Silt, Clay)
			Coarse	Fine	Coarse	Medium	Fine	
Grain Size Distribution (%)			1.1		22.0			76.9



Sieve			**Hydrometer Sedimentation**	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0413	65.0
3/8"	9.5	99.4	0.0295	63.0
#4	4.75	98.9	0.0190	59.2
#10	2	97.0	0.0113	51.6
#20	0.85	95.7	0.0082	45.9
#40	0.425	93.9	0.0059	40.1
#60	0.25	90.4	0.0030	26.7
#140	0.106	81.0	0.0014	17.2
#200	0.075	76.9		
			0.005 mm	36.79
			0.002 mm	21.65
			D60	0.02
			D30	0.00
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

The laboratory testing services reported herein have been performed in accordance with the terms of a contract with Golder's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of Golder's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Tested by: MKMarren **Date:** 14 Oct 2022 **Checked by:** MRuck **Date:** 26 Oct 2022 **Reviewed by:** JoNorris **Date:** 09 Nov 2022

PARTICLE SIZE DISTRIBUTION

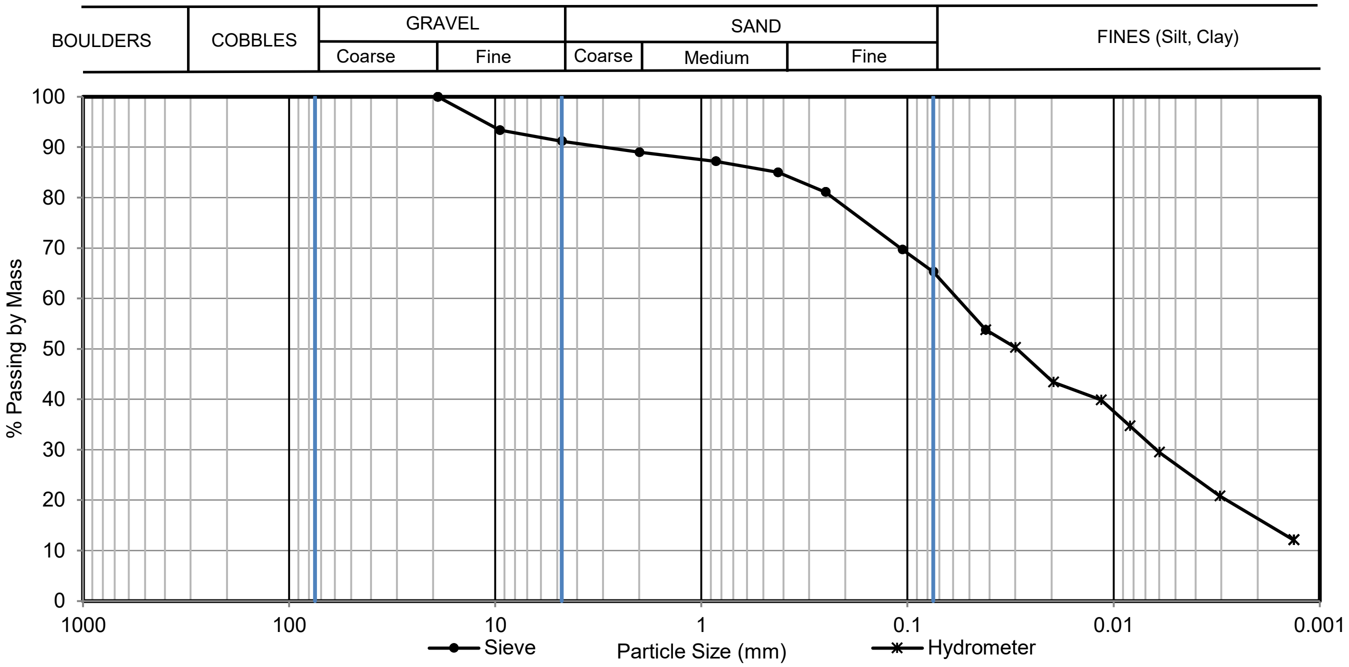
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH202	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH202
Source:		Sample No.:	4
Soil Description:		Type:	SS
		Depth (m):	7.82 - 8.28

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	13 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%) 8.8 25.9 65.3



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0418	53.8
3/8"	9.5	93.4	0.0300	50.3
#4	4.75	91.2	0.0196	43.4
#10	2	89.0	0.0115	39.9
#20	0.85	87.2	0.0083	34.7
#40	0.425	85.0	0.0060	29.5
#60	0.25	81.1	0.0031	20.8
#140	0.106	69.7	0.0013	12.1
#200	0.075	65.3		
			0.005 mm	27.14
			0.002 mm	16.34
			D60	0.06
			D30	0.01
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

Tested by: MKMarren **Date:** 13 Oct 2022 **Checked by:** MRuck **Date:** 26 Oct 2022 **Reviewed by:** JoNorris **Date:** 09 Nov 2022

PARTICLE SIZE DISTRIBUTION

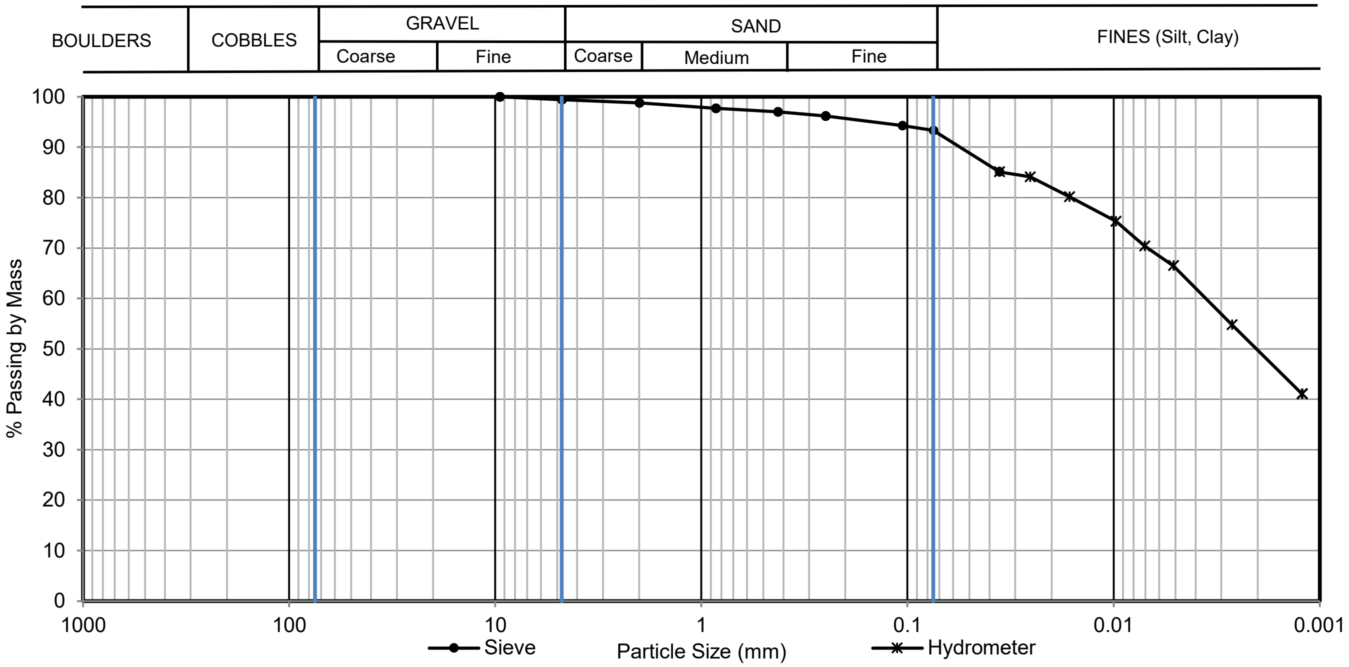
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH202	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH202
Source:		Sample No.:	7
		Type:	SS
Soil Description:		Depth (m):	9.65 - 10.11

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	14 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%) 0.6 6.1 93.3



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/8"	9.5	100.0	0.0358	85.1
#4	4.75	99.4	0.0254	84.1
#10	2	98.8	0.0164	80.2
#20	0.85	97.7	0.0098	75.3
#40	0.425	97.0	0.0071	70.4
#60	0.25	96.2	0.0051	66.5
#140	0.106	94.3	0.0027	54.8
#200	0.075	93.3	0.0012	41.1
			0.005 mm	66.04
			0.002 mm	49.75
			D60	0.00
			D30	
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

Tested by: MKMarren **Date:** 14 Oct 2022 **Checked by:** MRuck **Date:** 26 Oct 2022 **Reviewed by:** JoNorris **Date:** 09 Nov 2022

GOLDER
MEMBER OF WSP

PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422

Method B

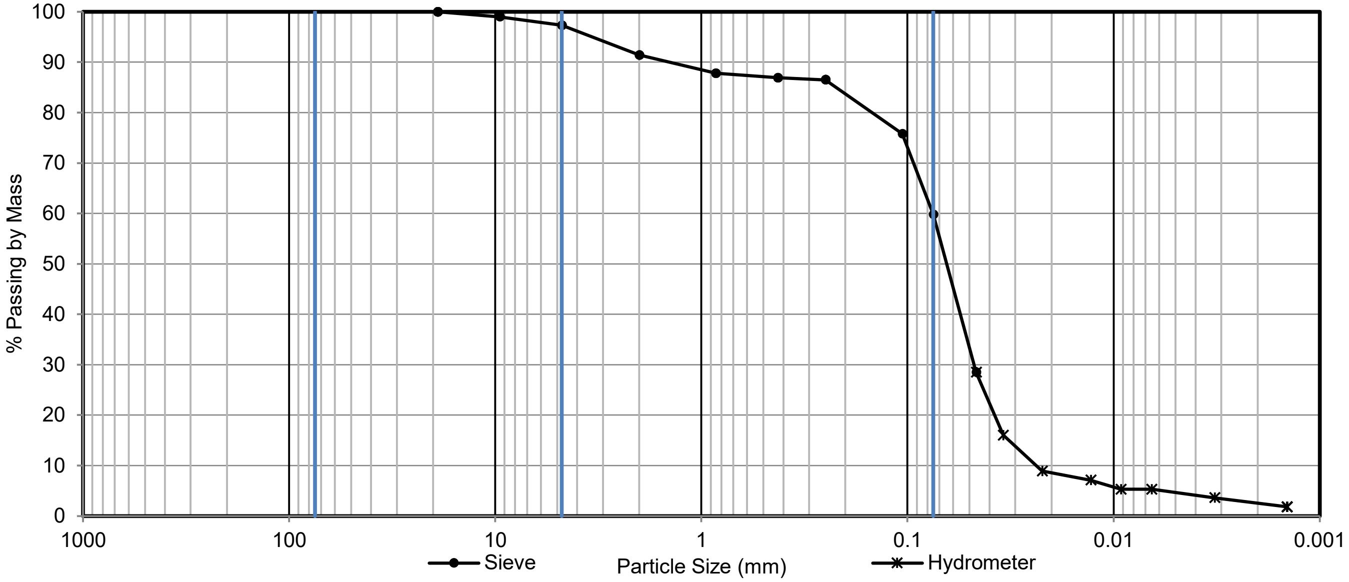
Test Request #: 21451329-21600-610 BH202
Client: E.S. Fox Limited
Project Name: ES Fox/DNNP Invest/Bowmanville
Source:
Soil Description:

Project Number: 21451329-21600-610
Project Location:
Sample Location: BH202
Sample No.: 11
Type: SS
Depth (m): 12.09 - 12.55

Specimen Reference: NA
Specimen Depth (m): NA
Date of Test: 14 Oct 2022
Specimen Description: NA

Grain Size Distribution (%)

BOULDERS	COBBLES	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	
		2.7		37.5			59.8



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0464	28.5
3/8"	9.5	99.0	0.0343	16.0
#4	4.75	97.3	0.0222	8.9
#10	2	91.4	0.0129	7.1
#20	0.85	87.8	0.0092	5.3
#40	0.425	86.9	0.0065	5.3
#60	0.25	86.5	0.0032	3.6
#140	0.106	75.8	0.0014	1.8
#200	0.075	59.8		
			0.005 mm	4.65
			0.002 mm	2.53
			D60	0.08
			D30	0.05
			D10	0.02
			Cu	3.20
			Cc	1.30

Notes:

Disclaimer:

Tested by: MKMarren **Date:** 14 Oct 2022

Checked by: MRuck **Date:** 26 Oct 2022

Reviewed by: JoNorris **Date:** 09 Nov 2022

PARTICLE SIZE DISTRIBUTION

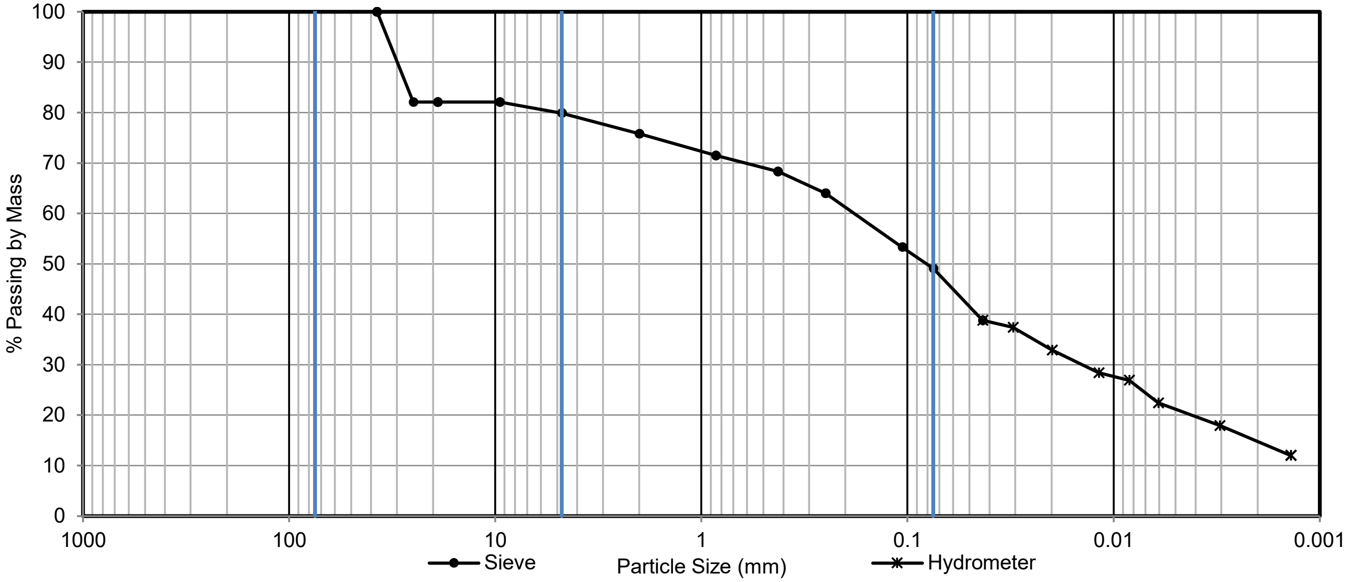
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH202	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH202
Source:		Sample No.:	16
		Type:	SS
Soil Description:		Depth (m):	15.14 - 15.60

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	14 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)				20.1		30.8		49.1
BOULDERS	COBBLES	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1 1/2"	37.5	100.0	0.0432	38.8
1"	25	82.1	0.0308	37.4
3/4"	19	82.1	0.0199	32.9
3/8"	9.5	82.1	0.0118	28.4
#4	4.75	79.9	0.0084	26.9
#10	2	75.8	0.0061	22.4
#20	0.85	71.5	0.0031	17.9
#40	0.425	68.3	0.0014	12.0
#60	0.25	64.0		
#140	0.106	53.3		
#200	0.075	49.1		
			0.005 mm	21.13
			0.002 mm	14.76
			D60	0.18
			D30	0.01
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

Tested by: MKMarren **Date:** 14 Oct 2022 **Checked by:** MRuck **Date:** 26 Oct 2022 **Reviewed by:** JoNorris **Date:** 09 Nov 2022

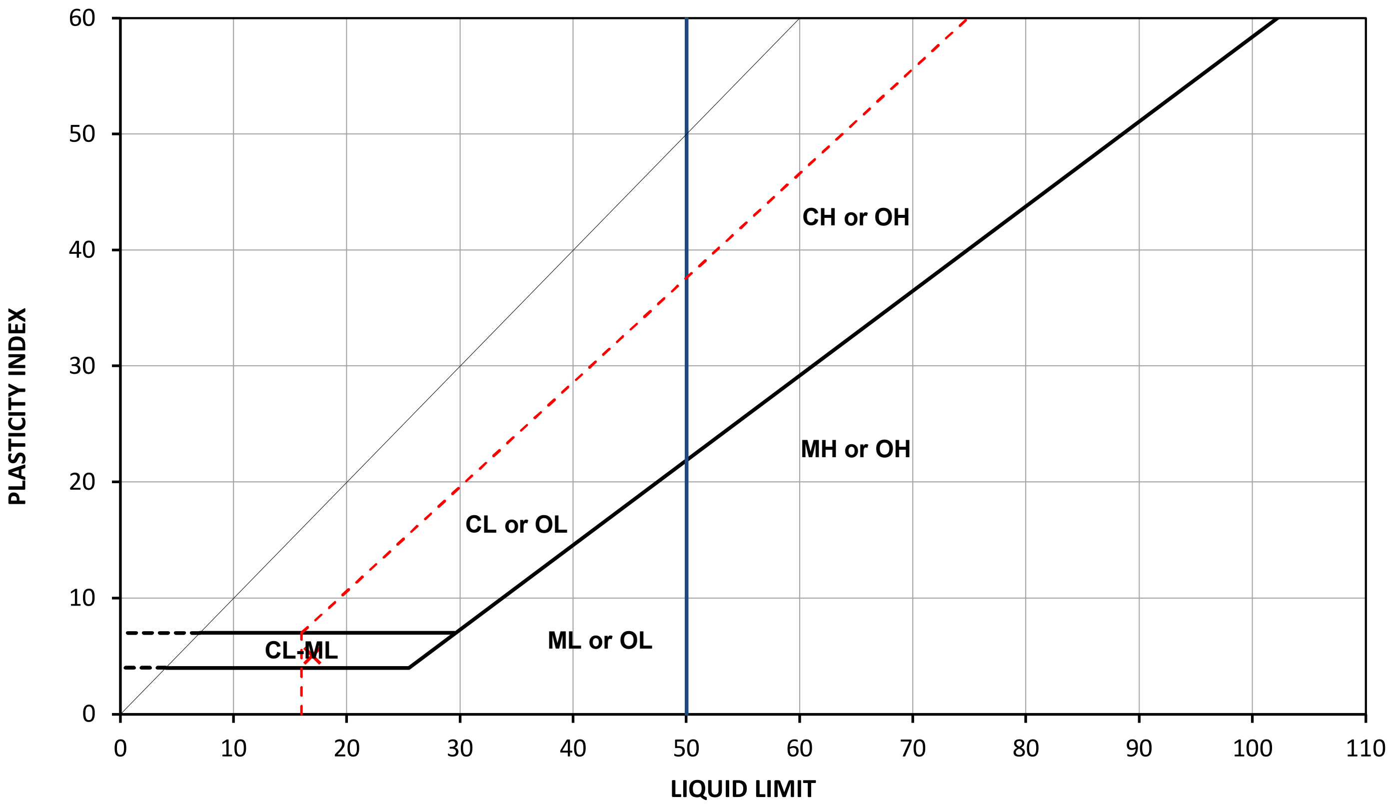
LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

ASTM D4318

Method A - Multipoint Test

Test Request #	21451329-21600-610 BH202	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH202
Source:		Sample No.:	2
Soil Description:		Type:	SS
		Depth (m):	6.91 - 7.37

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	17 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH202	2	6.91	7.37	94	10.3	17	12	5	-0.34

NP = Non-Plastic
ND = Not Determined

Test Preparation
Dry Preparation Tested after >425um removed

Notes:

Disclaimer:

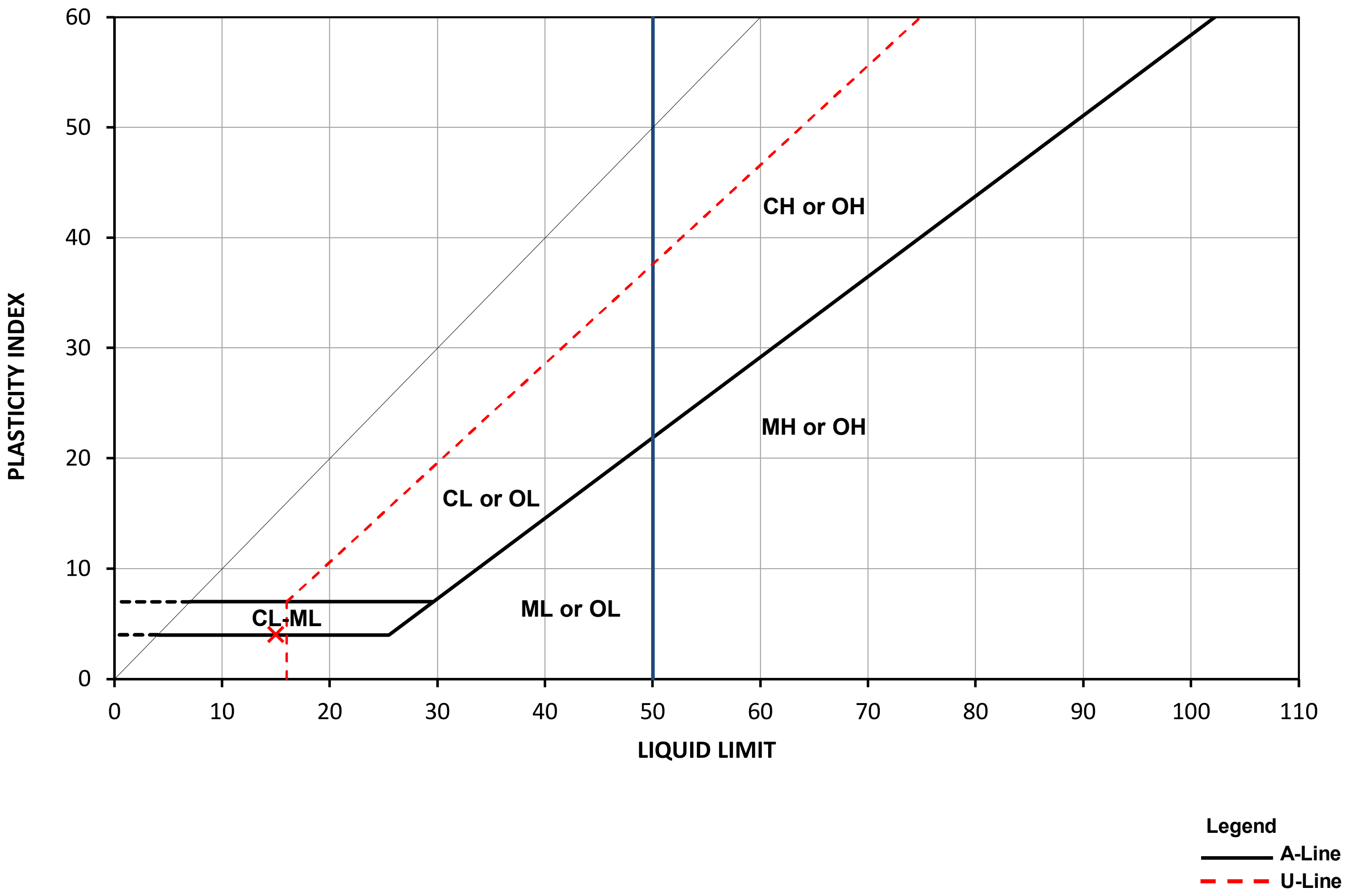
Tested by: JTimms **Date:** 17 Oct 2022
Checked by: MRuck **Date:** 26 Oct 2022
Reviewed by: JoNorris **Date:** 09 Nov 2022

GOLDER
MEMBER OF WSP

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318
Method A - Multipoint Test

Test Request #	21451329-21600-610 BH202	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH202
Source:		Sample No.:	4
Soil Description:		Type:	SS
		Depth (m):	7.82 - 8.28

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	17 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH202	4	7.82	8.28	93	8.8	15	11	4	-0.55

NP = Non-Plastic
ND = Not Determined

Test Preparation
Dry Preparation Tested after >425um removed

Notes:

Tested by: JTimms **Date:** 17 Oct 2022
Checked by: MRuck **Date:** 26 Oct 2022

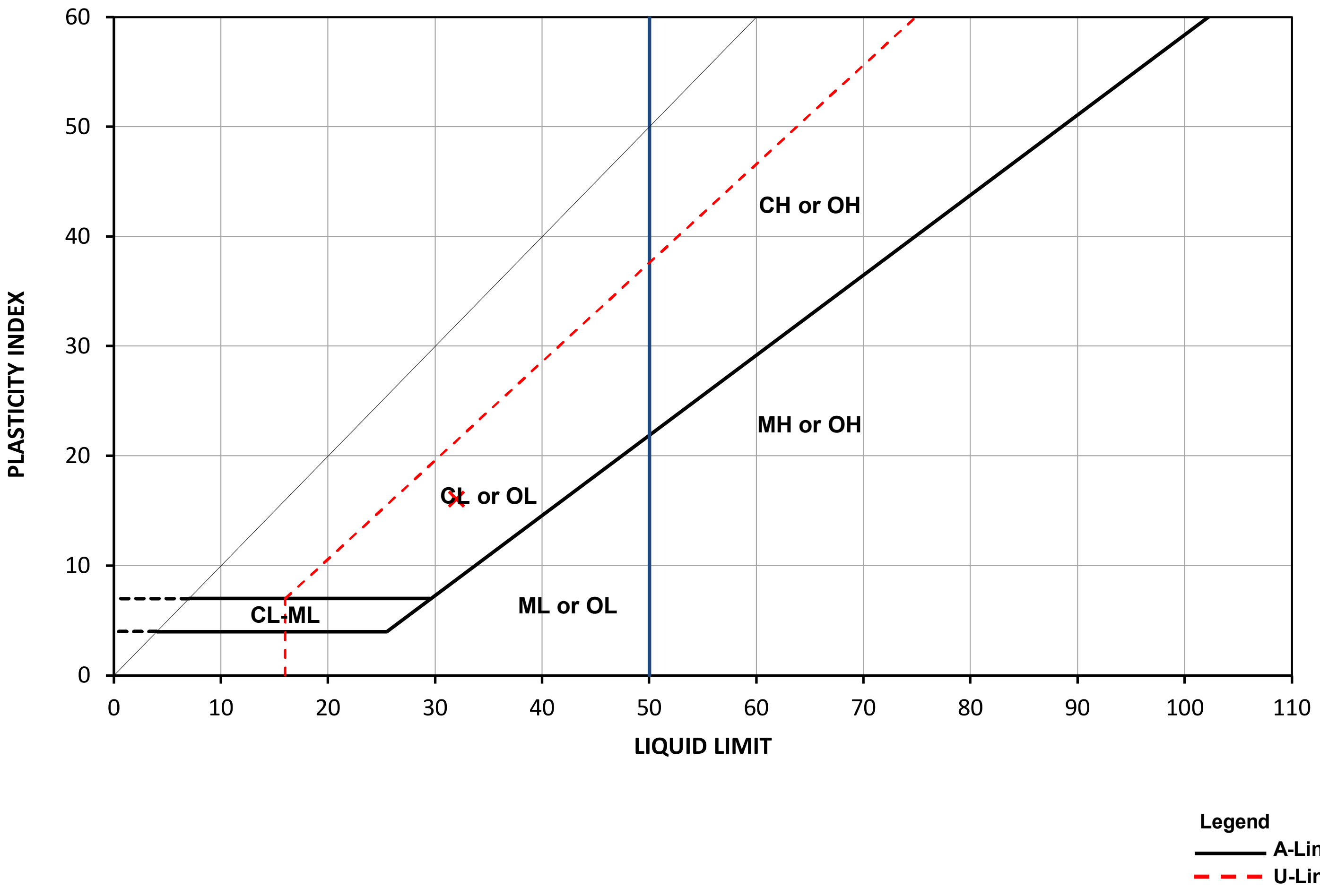
Disclaimer:
The laboratory testing services reported herein have been performed in accordance with the terms of a contract with Golder's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of Golder's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Reviewed by: JoNorris **Date:** 09 Nov 2022

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318
Method A - Multipoint Test

Test Request #	21451329-21600-610 BH202	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH202
Source:		Sample No.:	7
Soil Description:		Type:	SS
		Depth (m):	9.65 - 10.11

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	17 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH202	7	9.65	10.11	92	21.4	32	16	16	0.34

NP = Non-Plastic
ND = Not Determined

Test Preparation

Dry Preparation Tested after >425um removed

Notes:

Tested by: JTimms **Date:** 17 Oct 2022
Checked by: MRuck **Date:** 26 Oct 2022

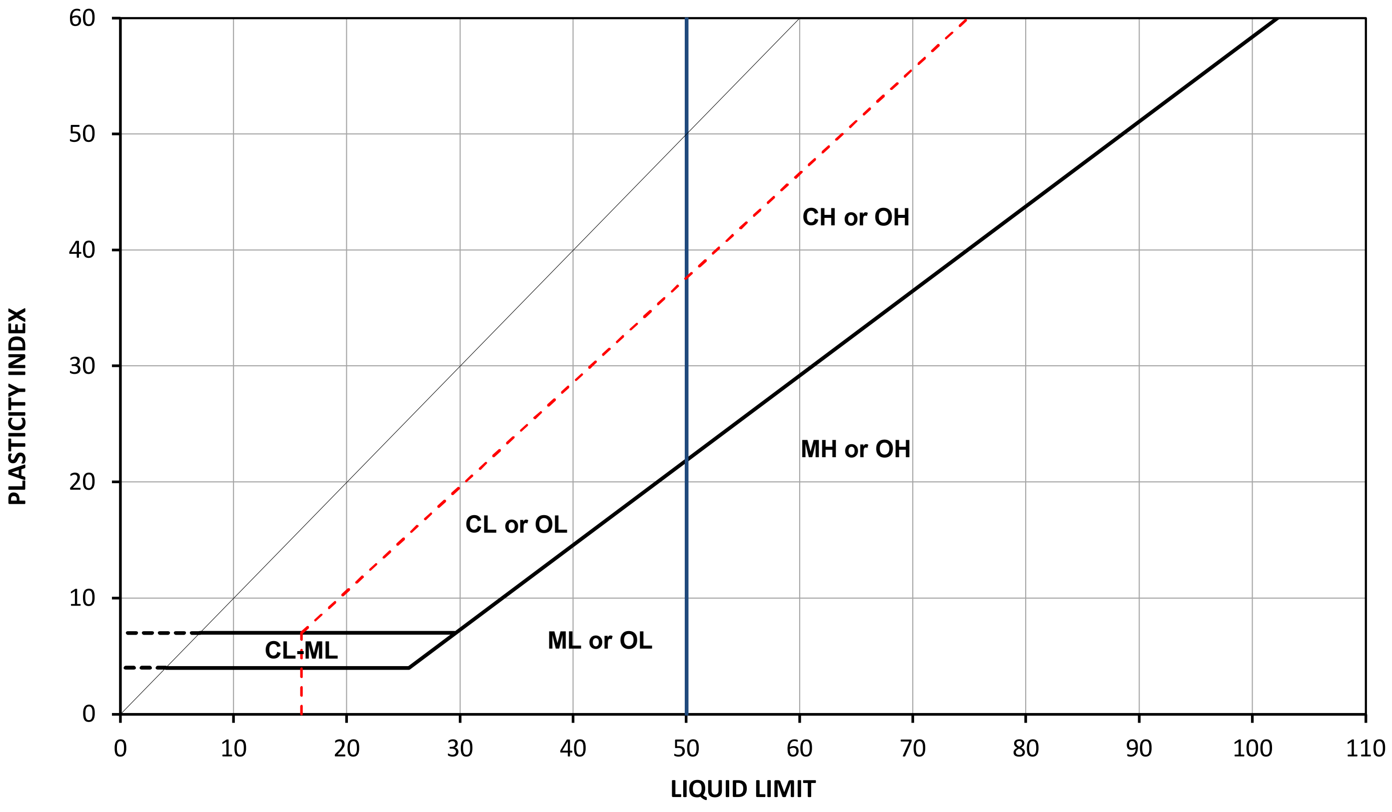
Disclaimer:

Reviewed by: JoNorris **Date:** 09 Nov 2022

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318

Test Request #	21451329-21600-610 BH202	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH202
Source:		Sample No.:	11
Soil Description:		Type:	SS
		Depth (m):	12.09 - 12.55

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	17 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH202	11	12.09	12.55	95	18.9		NP		

NP = Non-Plastic
ND = Not Determined

Test Preparation
Wet Preparation Tested after >425um removed

Notes:

Tested by: JTimms **Date:** 17 Oct 2022
Checked by: MRuck **Date:** 26 Oct 2022

Disclaimer:

Reviewed by: JoNorris **Date:** 09 Nov 2022

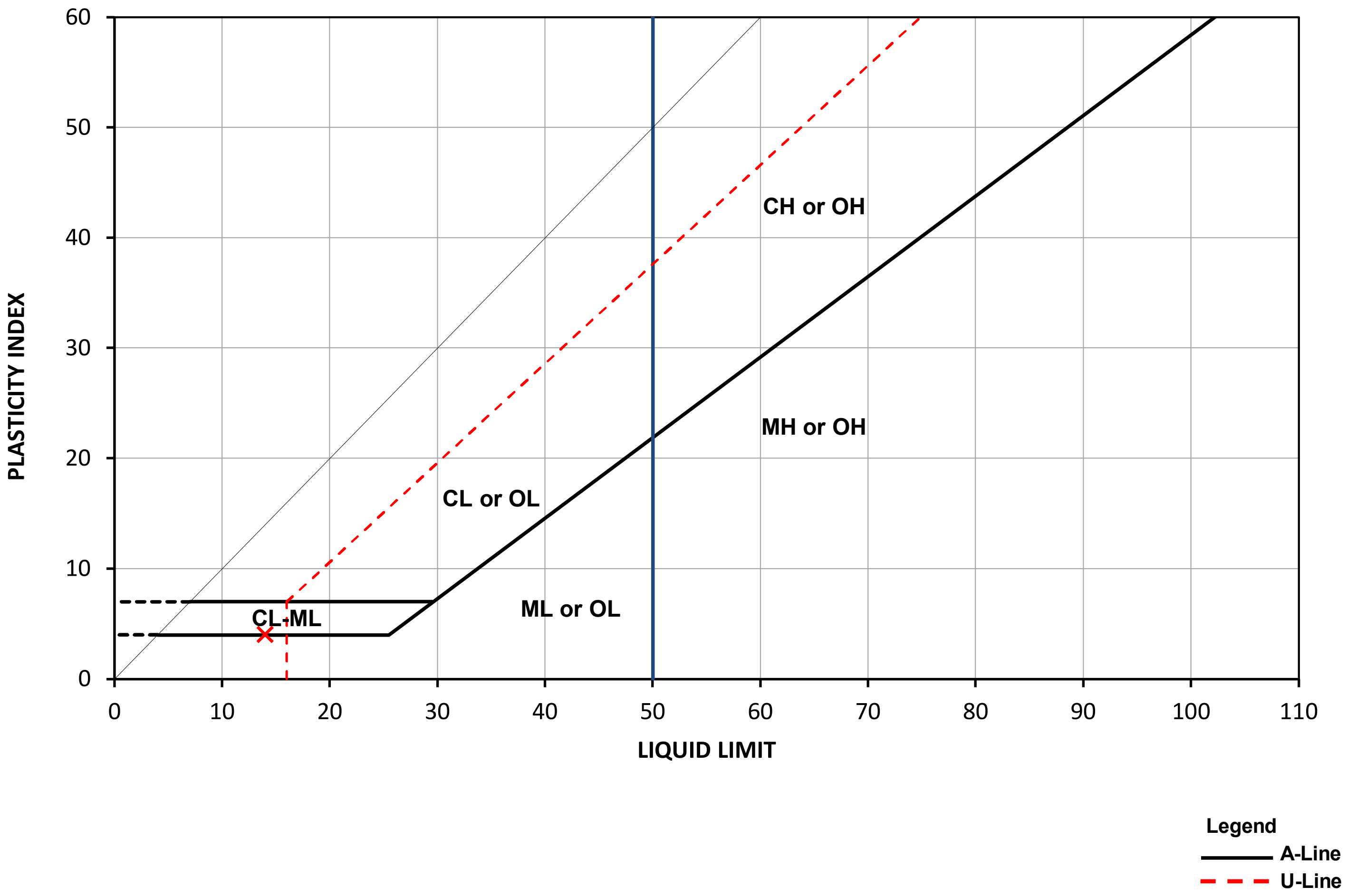
LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

ASTM D4318

Method A - Multipoint Test

Test Request #	21451329-21600-610 BH202	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH202
Source:		Sample No.:	16
Soil Description:		Type:	SS
		Depth (m):	15.14 - 15.60

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	17 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH202	16	15.14	15.60	80	8.3	14	10	4	-0.43

NP = Non-Plastic
ND = Not Determined

Test Preparation

Dry Preparation Tested after >425um removed

Notes:

Tested by: JTimms **Date:** 17 Oct 2022
Checked by: MRuck **Date:** 26 Oct 2022

Disclaimer:

Reviewed by: JoNorris **Date:** 09 Nov 2022

GOLDER
MEMBER OF WSP

SPECIFIC GRAVITY OF SOIL SOLIDS
ASTM D854
Pycnometer Method B

Test Request #	21451329-21600-610 BH202	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	NA
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH202
Source:		Sample No.:	14
Soil Description:		Type:	SS
		Depth (m)	13.92 - 14.38

Specimen Reference	NA	Specimen Depth	NA	Date of Test	26 Oct 2022
Specimen Description	NA				

Proportions		
Percentage Passing (4.75 mm)		%
Percentage Retained (4.75 mm)		%

Fine Fraction (D854)		
Calibrated Mass of Pycnometer		g
Calibrated Volume of Pycnometer	249.58	mL
Mass of Pycnometer	91.74	g
Test Temperature	19.4	oC
Mass of Pycnometer, soil and water	366.31	g
Mass of Container (or tare)	91.74	g
Mass of dry soil and container	131.90	g
Dry mass of soil solids	40.16	g
Specific Gravity at 20oC	**2.72**	

Coarse Fraction (C127)		
Mass of Oven Dry Sample		g
Mass of saturated-surface-dry in air		g
Apparent mass of saturated test sample in water		g
Specific Gravity Oven Dry		
Specific Gravity Saturated Surface Dry		
Specific Gravity with Weighted Average	**2.72**	

Notes:

Disclaimer:

Tested by: DPatel **Date:** 26 Oct 2022
Checked by: MRuck **Date:** 09 Nov 2022
Reviewed by: JoNorris **Date:** 10 Nov 2022

GOLDER

DENSITY (UNIT WEIGHT) OF SOIL SPECIMENS

ASTM D 7263 Method B

Borehole Number	BH202	BH202	BH202		
Sample Number	1	10	14		
Sample Depth, m	6.15-6.76	11.48-11.94	13.92-14.38		
Weight of Soil, g	170.12	191.0	168.1		
Diameter of Sample, cm	3.413	3.605	3.956		
Length of Sample, cm	7.414	7.928	6.302		
Volume of Sample, cc	67.83	80.92	77.46		
Water Content, %	9.691	13.99	18.01		
Wet Density, g/cm^3	2.508	2.360	2.170		
Dry Density, g/cm^3	2.286	2.070	1.839		
Unit Weight, kN/m^3	24.60	23.14	21.28		

Notes:

- Water contents determined from tested specimens
- Specimen was intact

Project Number	21451329-21600-610	Tested By	S. Khan
Date Tested	October 26, 2022	Checked By	LH

Water (Moisture) Content, Ash Content, and Organic Material of Soils
ASTM D2974 Method A

Test Request # 21451329-21600-610 BH202		Project Number: 21451329-21600-610
Client: E.S. Fox Limited		Project Location:
Project Name: ES Fox/DNNP Invest/Bowmanville		Sample Location: BH202
Source:		Sample No.: 1
Soil Description:		Type: SS
		Depth (m): 6.15 - 6.76
Specimen Reference NA	Specimen Depth NA	Date of Test 05 Oct 2022
Specimen Description NA		

Furnace Temperature During Test (°C)	440
Duration of Test (nearest 15 minutes)	15705
Mass of Crucible With Lid (g)	57.80
Moist Mass of Specimen Plus Crucible With Lid (g)	160.85
Oven Dry Mass of Specimen Plus Crucible With Lid (g)	152.06
Mass of Crucible With Lid Plus Ash (g)	151.57
Water Content (%)	9
Ash Content (%)	99.5
Organic Material (%)	0.5

Test Preparation

Notes:

Disclaimer:

Tested by: JTimms **Date:** 05 Oct 2022

Checked by: MRuck **Date:** 26 Oct 2022 **Reviewed by:** JoNorris **Date:** 09 Nov 2022

SOIL RESISTIVITY USING THE WENNER FOUR ELECTRODE METHOD (ASTM G57-20)

October 5, 2022
Golder Project Number: 21451329-21600-610

Attention: Sarah Poot

Sample Description: **BH202, SA7, 9.65-10.11m**

Date Scheduled:	October 3, 2022	Sampled By:	Golder Associates Ltd.
Date Received:	October 4, 2022	Golder Lab No.:	G-22-254
Date Tested:	October 5, 2022	Tested By:	E. Shallhorn

Resistivity Meter Model Number	Miller 400D
Soil Box Factor	0.976377953
Temperature of Sample (°C)	22.0
Measured Resistance (ohm)	1290.0
Resistivity (ohm•cm)	1259.5
Temperature Corrected Resistivity (ohm•cm)	**1464.2**

Data Input By: E.Shallhorn

Reviewed by:

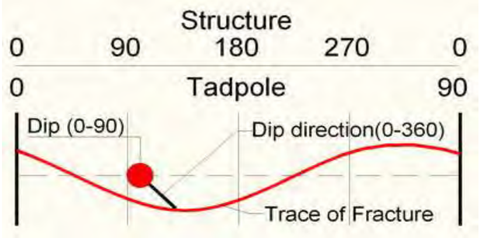
Jodi Norris, Technical and Quality Coordinator

CCIL
The Voice Of Independent Canadian Laboratories
La voix des laboratoires indépendants canadiens

Geophysical Record of Borehole: BH202

Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	20.6 m bgs	**Location:**	Darlington, Ontario
Easting:	684020.72 m	**Drilled Depth:**	61.7 m bgs	**Water Level:**	N/A	**Log Date:**	Aug-18-2022
Northing:	4859648.42 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	78.30 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	C. Phillips

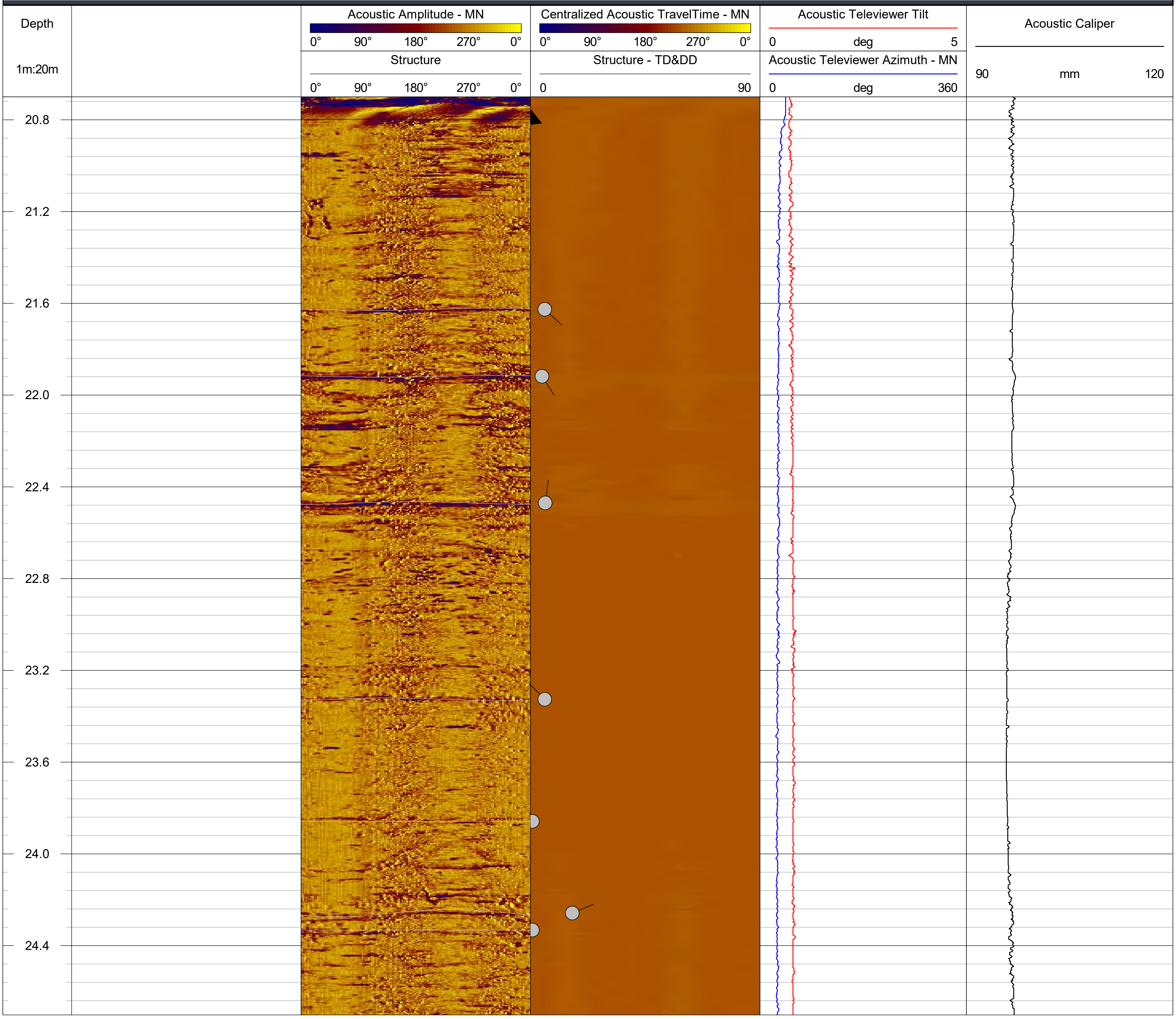


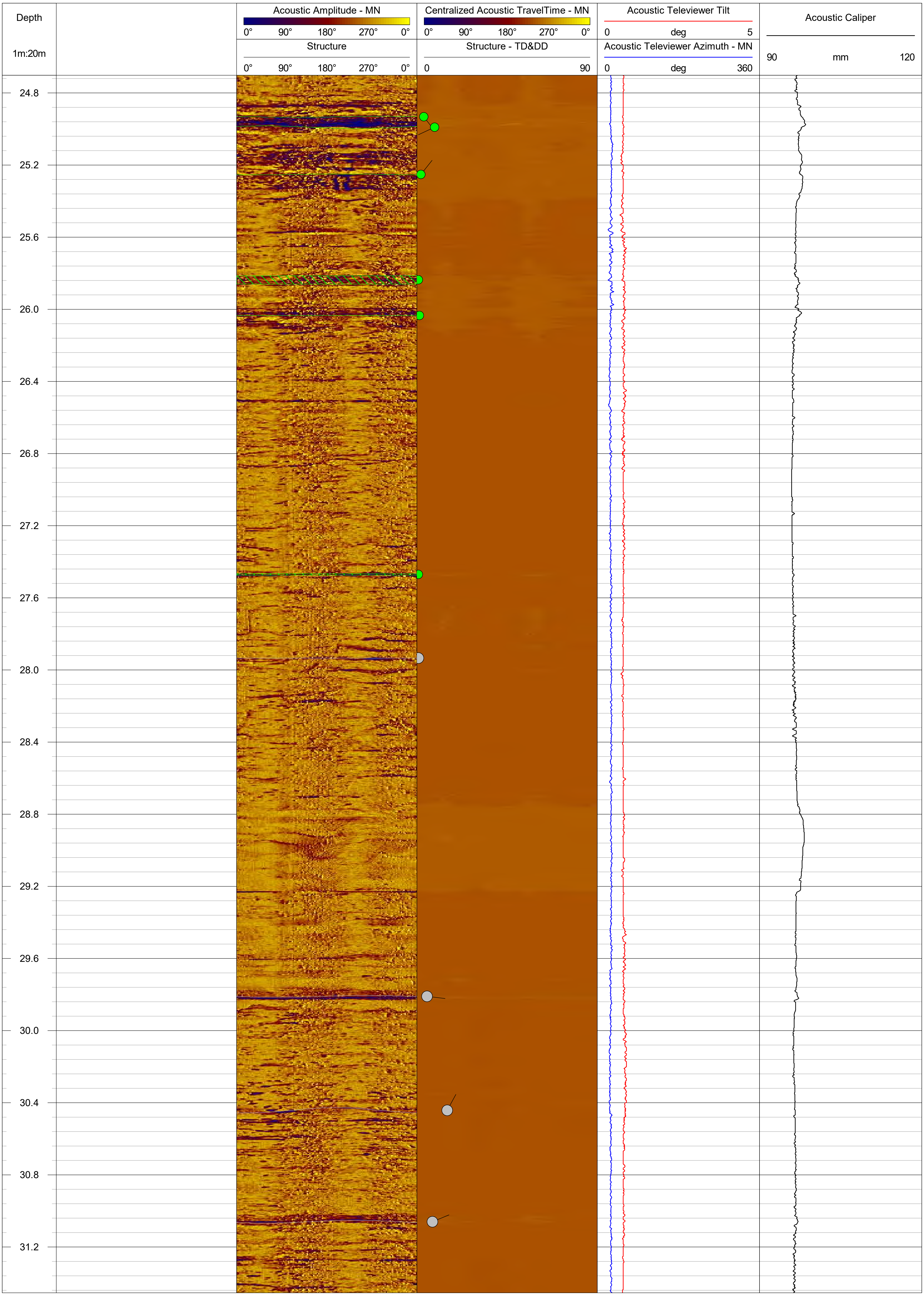
Filled Fracture / Joint

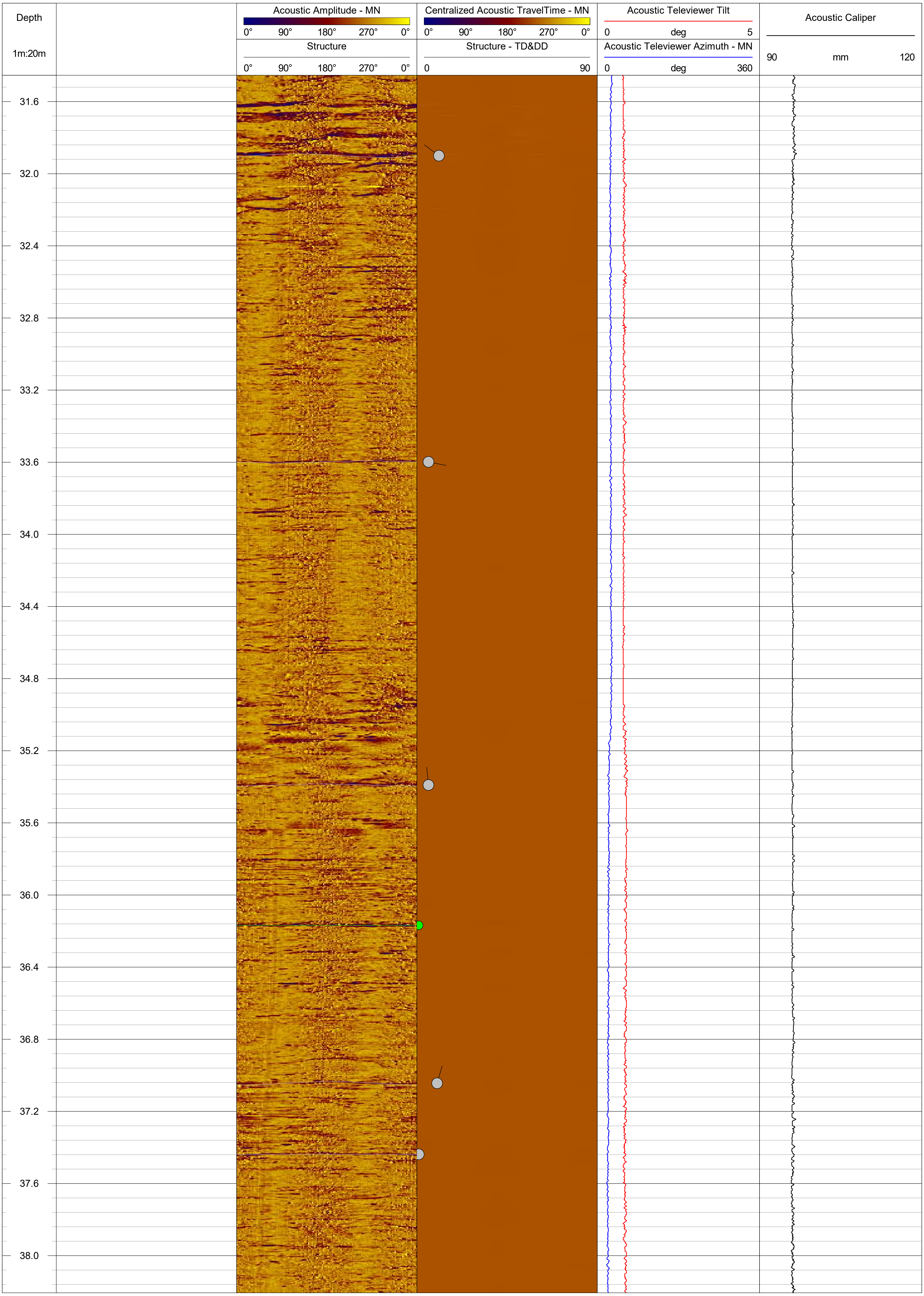
Bedding / Banding / Foliation

Casing

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)




Depth
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
24.8
25.2
25.6
26.0
26.4
26.8
27.2
27.6
28.0
28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2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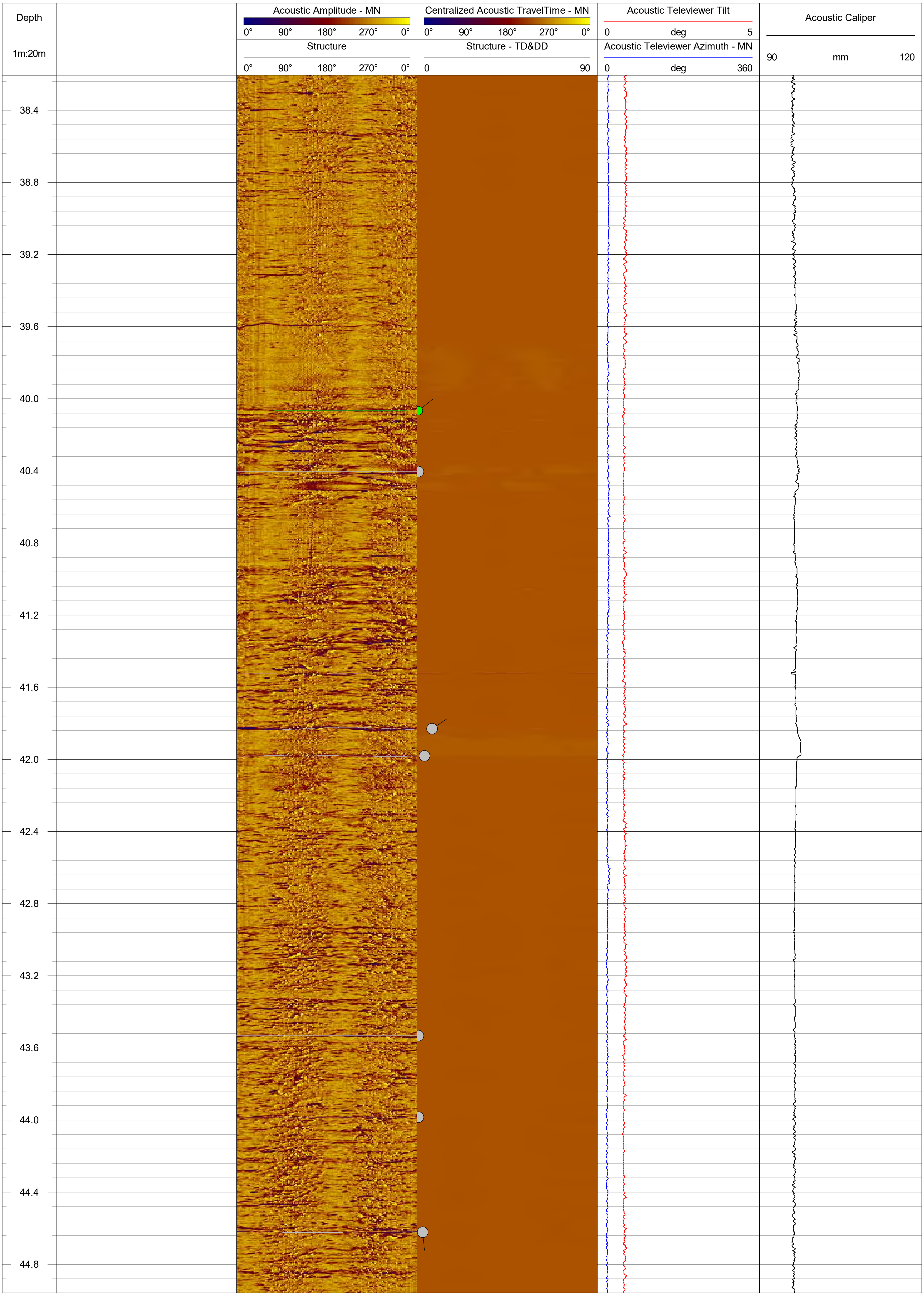
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
31.6
32.0
32.4
32.8
33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8
37.2
37.6
38.0


Depth
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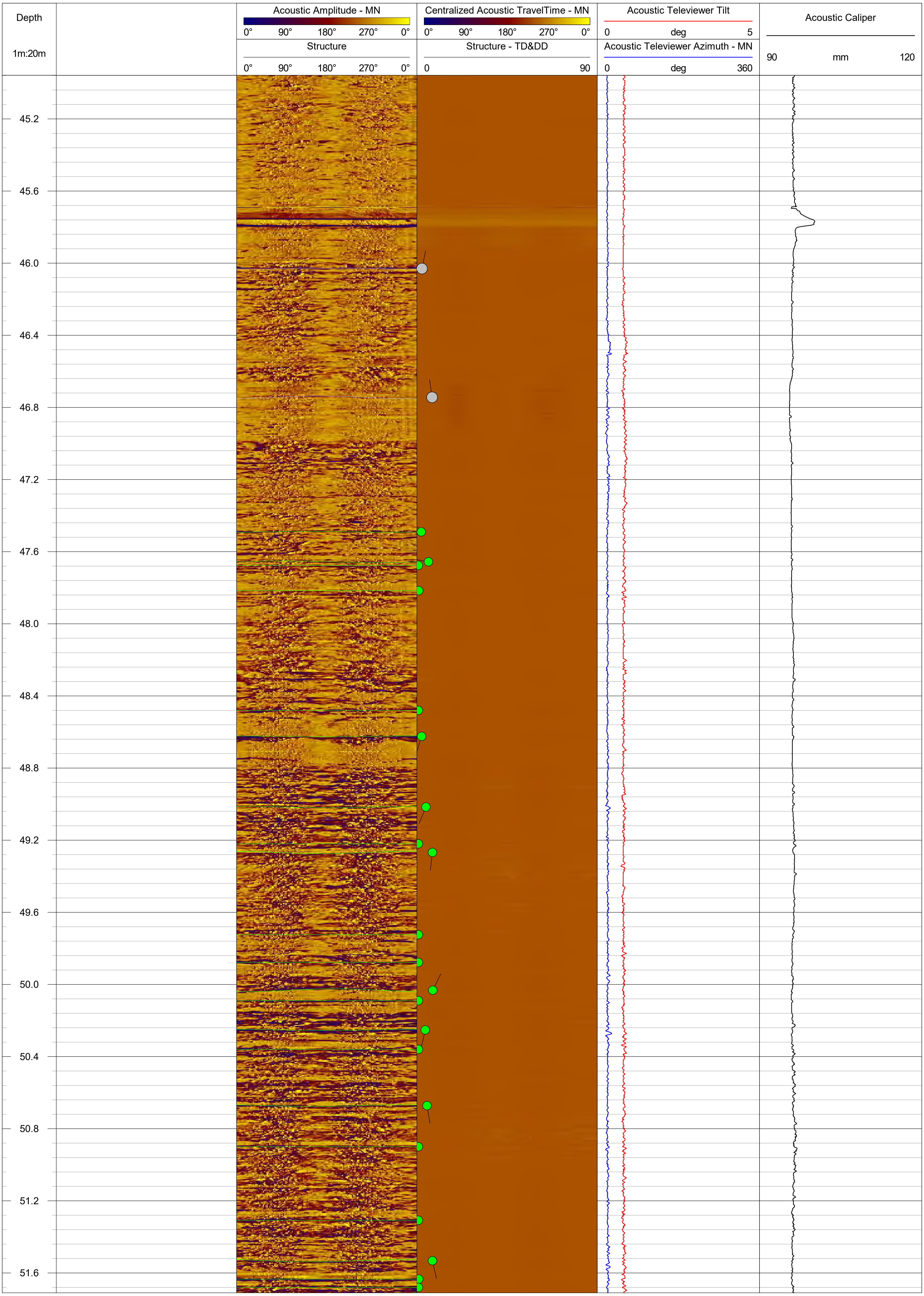
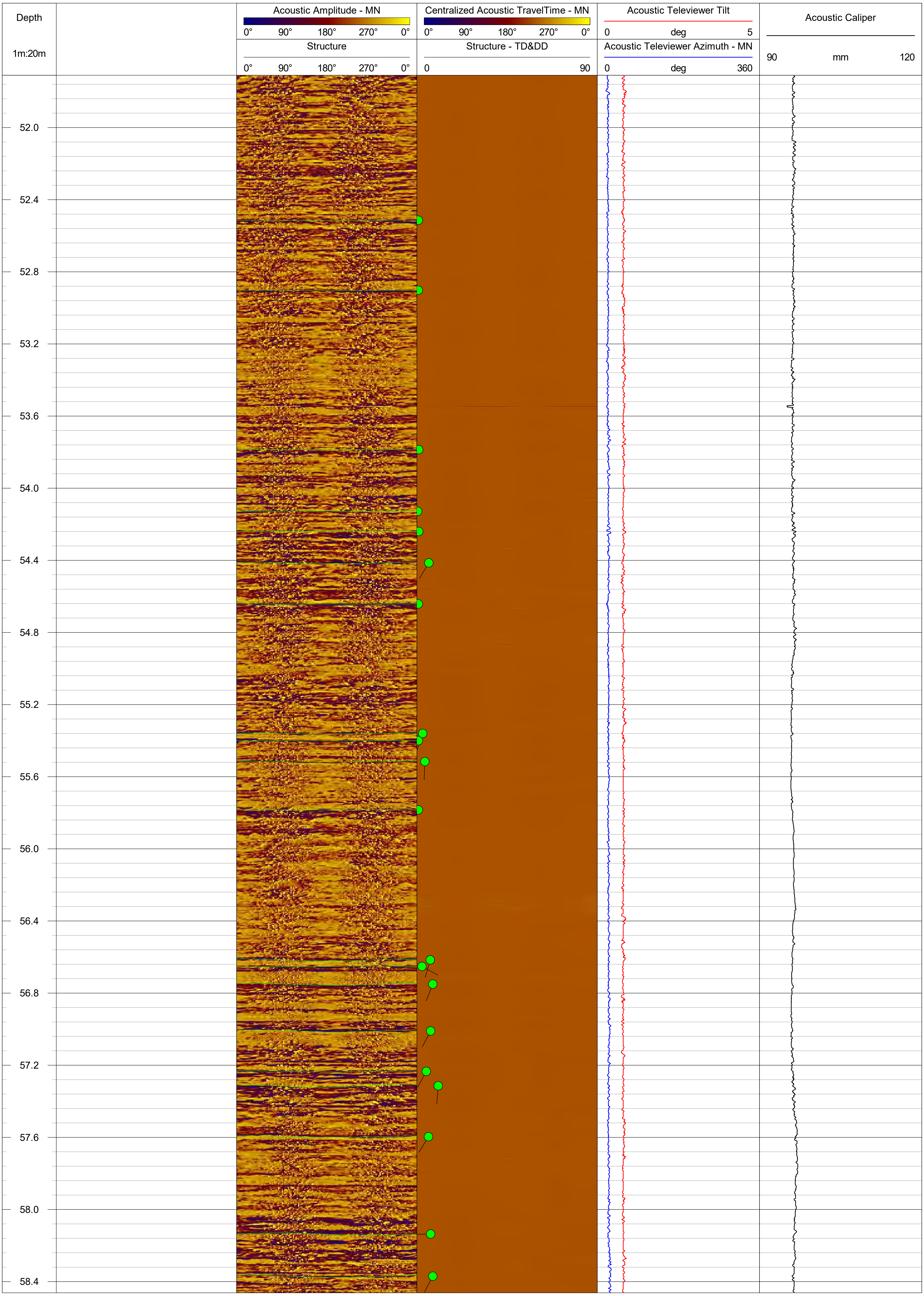
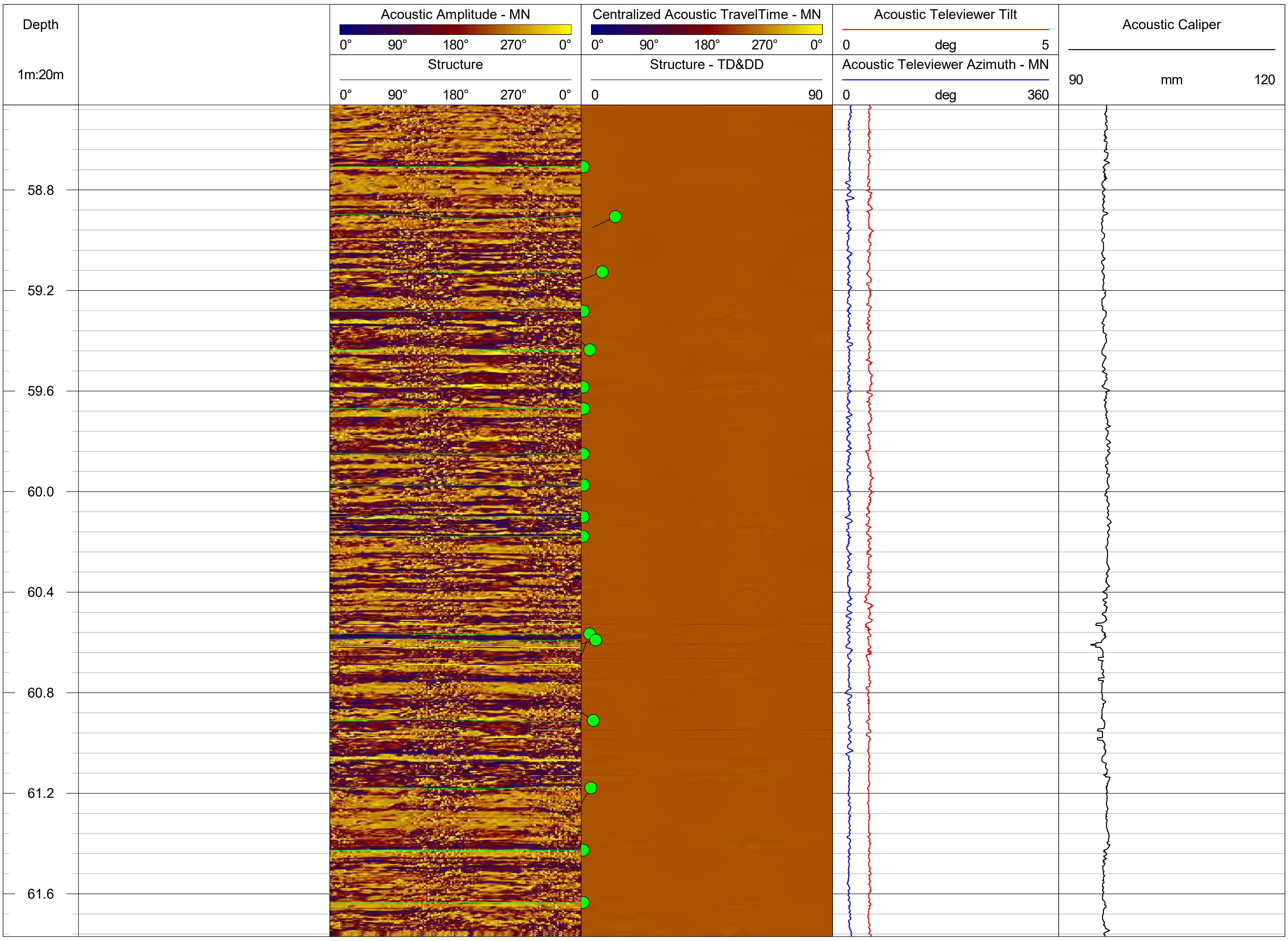
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
38.4
38.8
39.2
39.6
40.0
40.4
40.8
41.2
41.6
42.0
42.4
42.8
43.2
43.6
44.0
44.4
44.8


Depth
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
45.2
45.6
46.0
46.4
46.8
47.2
47.6
48.0
48.4
48.8
49.2
49.6
50.0
50.4
50.8
51.2
51.6

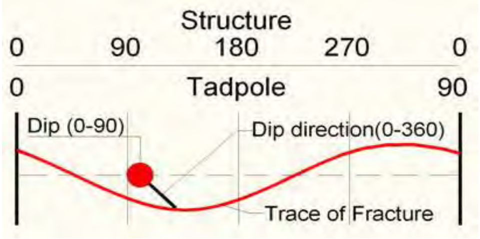

Depth
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
52.0
52.4
52.8
53.2
53.6
54.0
54.4
54.8
55.2
55.6
56.0
56.4
56.8
57.2
57.6
58.0
58.4


Depth
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
58.8
59.2
59.6
60.0
60.4
60.8
61.2
61.6

Geophysical Record of Borehole: BH202

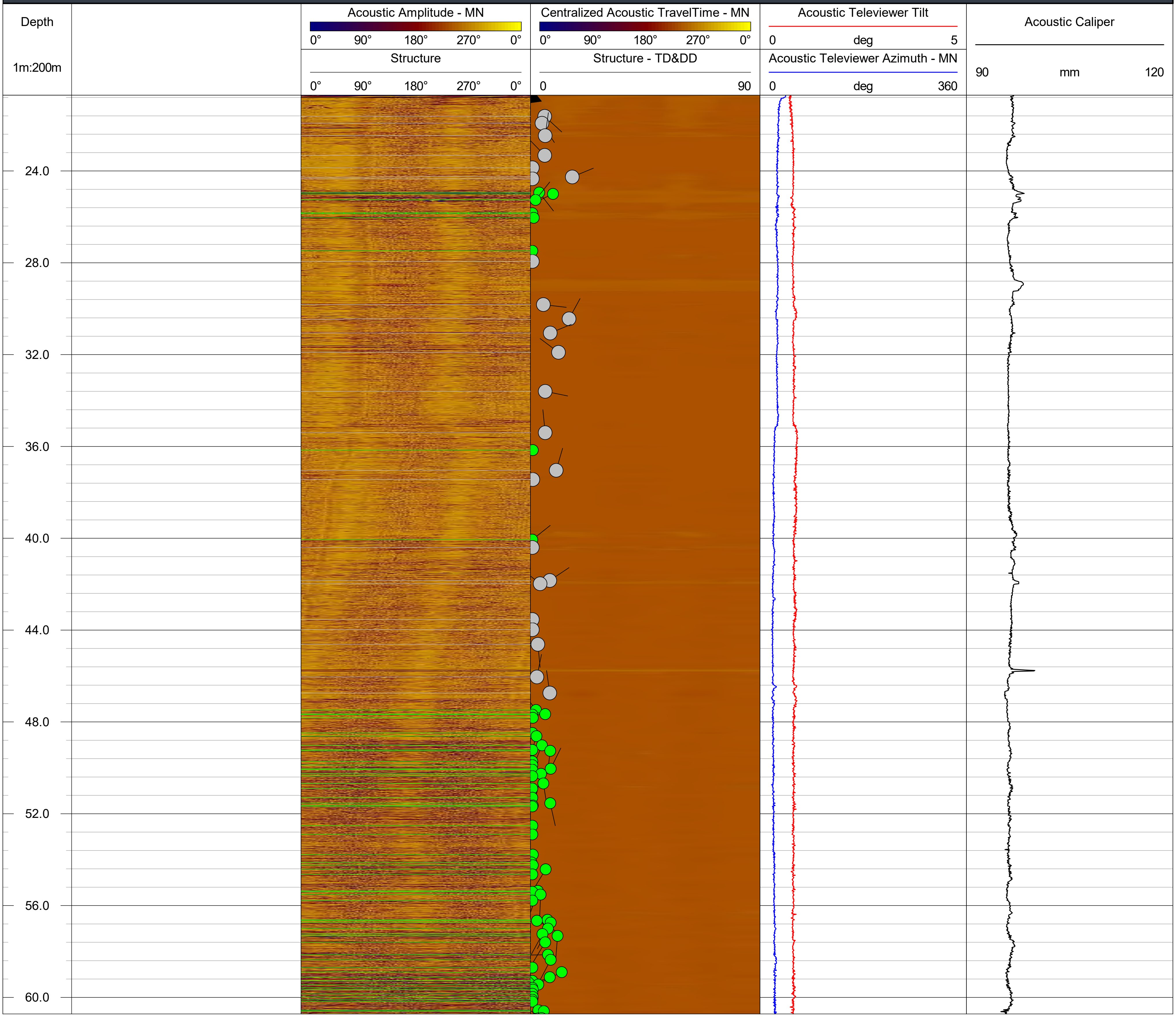
Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	20.6 m bgs	**Location:**	Darlington, Ontario
Easting:	684020.72 m	**Drilled Depth:**	61.7 m bgs	**Water Level:**	N/A	**Log Date:**	Aug-18-2022
Northing:	4859648.42 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	78.30 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	C. Phillips



● Filled Fracture / Joint
🟢 Bedding / Banding / Foliation
◀ Casing

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)



Depth		Acoustic Amplitude - MN 0° 90° 180° 270° 0°	Centralized Acoustic TravelTime - MN 0° 90° 180° 270° 0°	Acoustic Televiewer Tilt 0 deg 5	Acoustic Caliper
1m:200m		Structure 0° 90° 180° 270° 0°	Structure - TD&DD 0 90	Acoustic Televiewer Azimuth - MN 0 deg 360	90 mm 120

A09-BH203

PROJECT: 21451329

LOCATION: N 4859488.56; E 684015.94

RECORD OF BOREHOLE: BH203

SHEET 1 OF 8

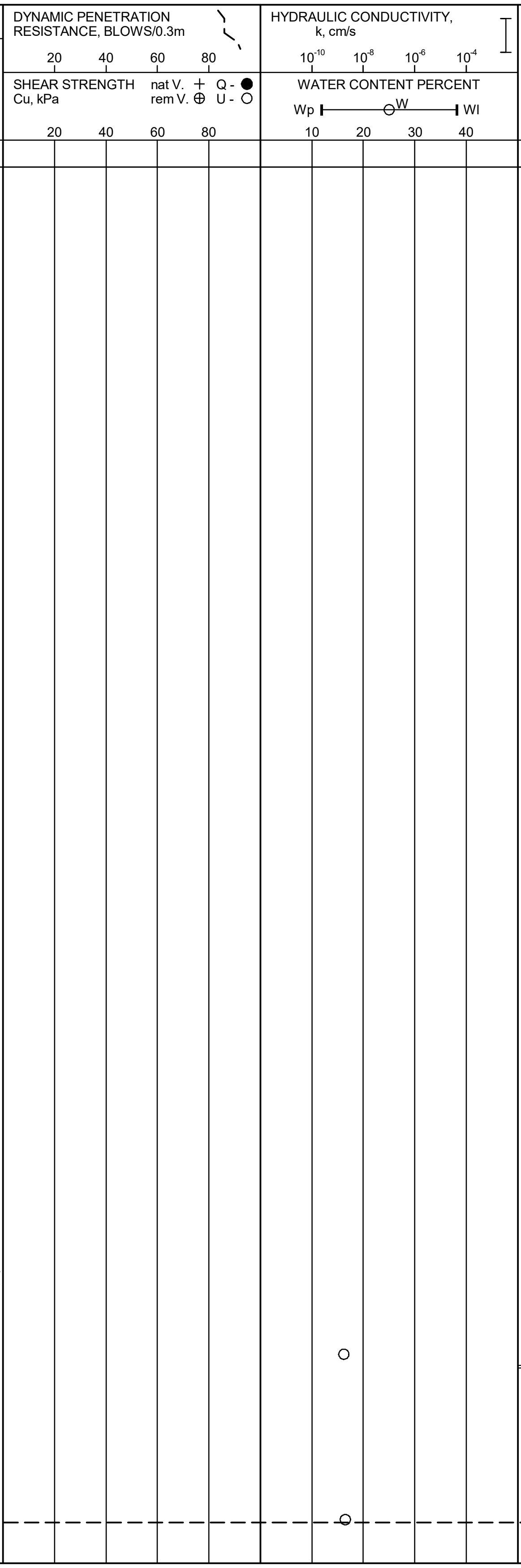
BORING DATE: July 20 and 21,2022

DATUM: Geodetic

DRILL RIG: Diedrich 120 Track Mounted

BORING METHOD: Mud Rotary Wash Boring (Tricone) / UW Casing

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
	BARGE DECK		78.62 0.00				
0							
1							
2							
3							
	WATER		75.07 3.55				
4							
5							
6							
7							
	Poorly graded Sand (SP), very dense, brown, wet, fine to coarse sand (Glaciolacustrine) (Unit 4a)		70.77 7.85	1A			
8	**Sandy Silt (ML) to Silty Sand (SM)**, very dense, grey, moist to wet, fine to medium sand (Glaciolacustrine) (Unit 4a)		70.39 8.23	1B	SS	100/ 0.07	
				2		107	γ=23.14kN/m³
9	- Rock fragments in Spoon Sample 2						
				3		107	
				4		98	
10							



PIEZOMETER OR STANDPIPE INSTALLATION

GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

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DEPTH SCALE

1 : 50

LOGGED: SC

CHECKED: SEMP

PROJECT: 21451329

RECORD OF BOREHOLE: BH203

SHEET 2 OF 8

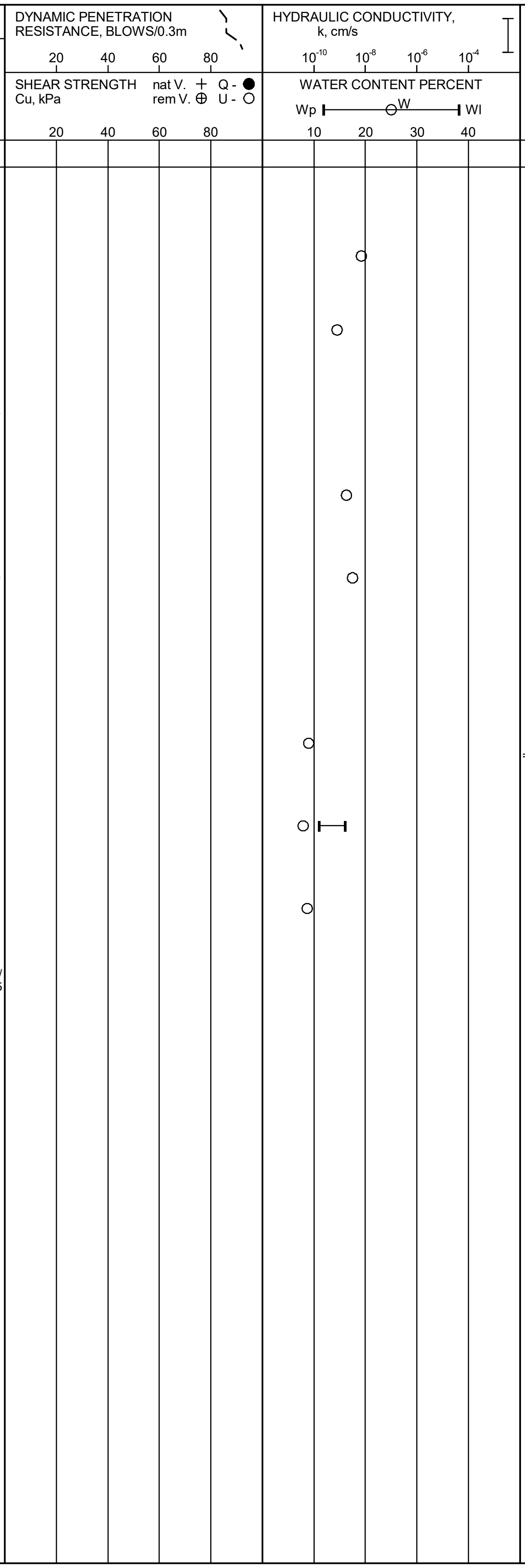
LOCATION: N 4859488.56; E 684015.94

BORING DATE: July 20 and 21,2022

DATUM: Geodetic

DRILL RIG: Diedrich 120 Track Mounted

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		--- CONTINUED FROM PREVIOUS PAGE ---						
10	Mud Rotary Wash Boring (Tricone) UW Casing	**Sandy Silt (ML) to Silty Sand (SM)**, very dense, grey, moist to wet, fine to medium sand (Glaciolacustrine) (Unit 4a)		4		98		
			68.13 10.49	5A	SS	54		
		Lean Clay with Sand (CL), hard, grey, moist, fine to medium sand, low to medium plasticity (Glaciolacustrine) (Unit 4b)		5B				
11				6		35		
			67.11 11.51					
	Mud Rotary Wash Boring (Tricone) Open	**Sandy Silt (ML)** , very dense, grey, moist, fine to coarse sand, angular to subangular fine to coarse gravel (Till) (Unit 5)		7		106		
12			66.50 12.12					
		Silt (ML), very dense, grey, wet, fine to medium sand (Glaciolacustrine) (Unit 4a)		8		191	NP	0 13 80 7
13				9		170		
				10A	SS	141		
			64.88 13.74					
14		**Sandy Silty Clay (CL-ML)**, hard, grey, moist, fine to coarse sand, angular to subangular fine to coarse gravel, low plasticity (Till) (Unit 5)		10B				
				11		152	γ =24.20 kN/m³	
15				12		81		5 27 49 20
				13		89		
16				14		110/ 0.15		
			62.47 16.15					
		Shale Bedrock Fragments (Unit 6a) - Bedrock cored from 16.76 m to 69.65 m depth						
			61.86 16.76					
17		- Refer to Record of Drillhole BH203 **Shale Bedrock**						
18								
19								
20								



PIEZOMETER OR STANDPIPE INSTALLATION

Notes:

1. Water level in open borehole could not be measured upon completion of soil drilling due to use of mud-rotary technique.

2. Efficiency of the SPT hammer utilized was 75.2 %.

DEPTH SCALE

1 : 50

LOGGED: SC

CHECKED: SEMP

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859488.56; E 684015.94
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

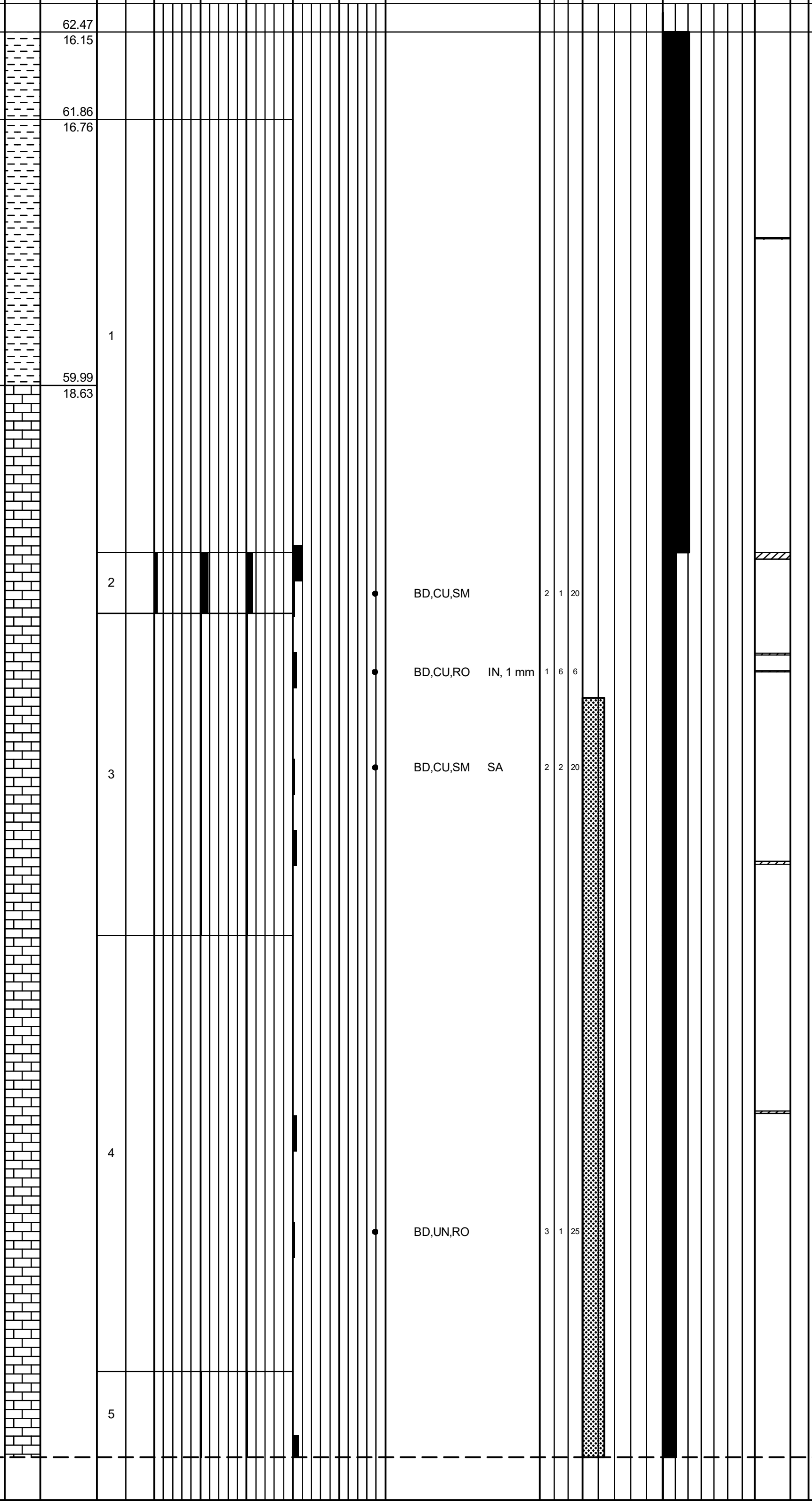
RECORD OF DRILLHOLE: BH203

DRILLING DATE: July 22 to August 12, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 3 OF 8
DATUM: Geodetic

NOTE: For abbreviations, symbols and descriptions refer to **LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY**

DRILLING RECORD	DESCRIPTION	ELEV. / DEPTH (m)	RUN No.
	TOP OF BEDROCK	62.47 16.15	
Rotary Drill HQ3 Core	Shale Bedrock Fragments	61.86 16.76	
	Slightly weathered, thickly bedded, dark brownish grey, fine grained, faintly porous, slightly reactive to HCl, medium strong SHALE (Blue Mountain Formation) with very thin to thin, grey, fine to medium grained limestone interbeds Swell Sample Swell Sample Swell Sample	59.99 18.63	1
	Slightly weathered to fresh, thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey, fine grained shale interbeds.		2 3 4 5



DISCONTINUITY DATA

TYPE AND SURFACE DESCRIPTION		Jr	Ja	Jcon
BD,CU,SM		2	1	20
BD,CU,RO	IN, 1 mm	1	6	6
BD,CU,SM	SA	2	2	20
BD,UN,RO		3	1	25

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: SC/PKS
CHECKED: PKS

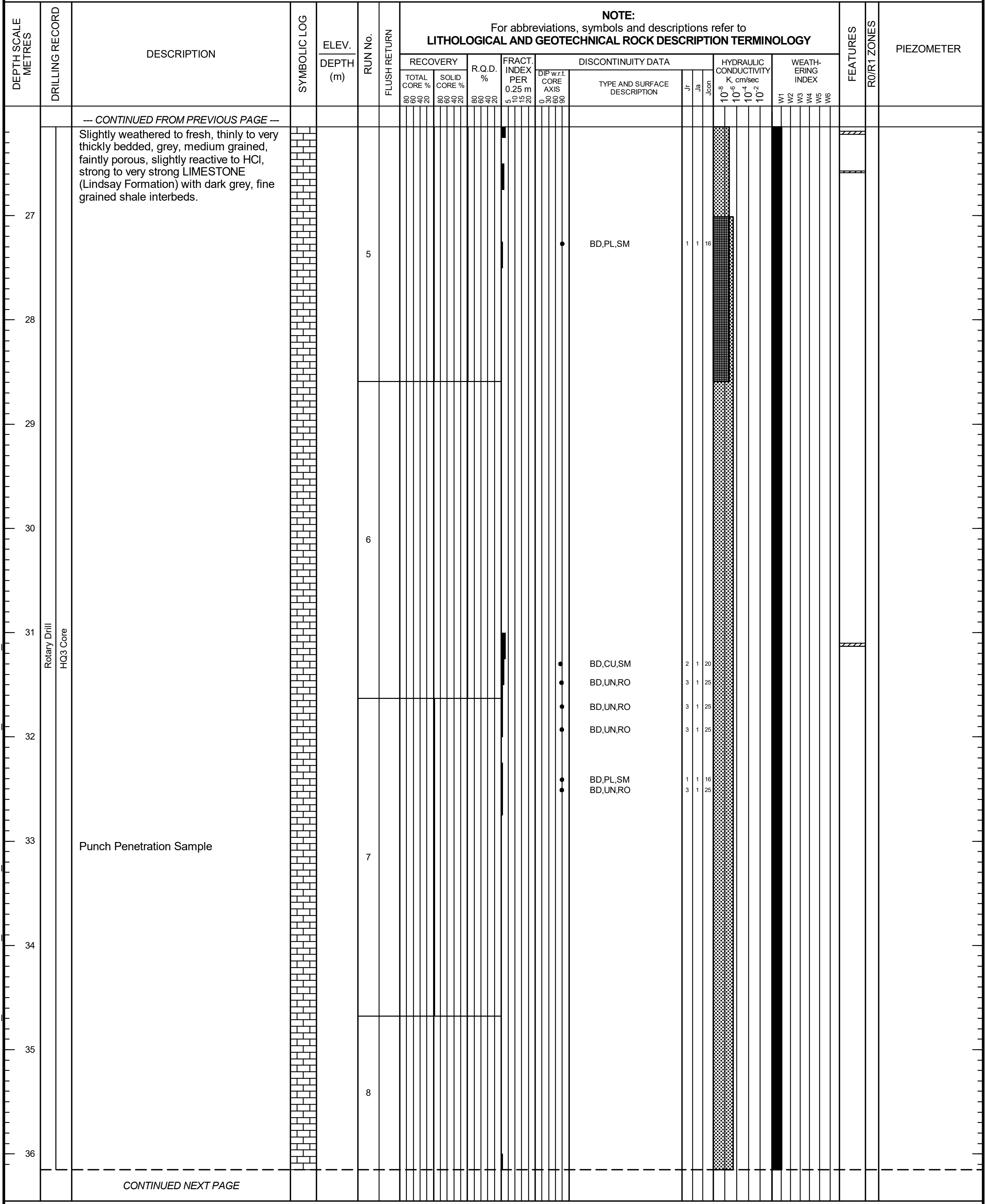
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859488.56; E 684015.94
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH203

DRILLING DATE: July 22 to August 12, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 4 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



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Slightly weathered to fresh, thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey, fine grained shale interbeds.

Punch Penetration Sample

TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,PL,SM	1	1	16
BD,CU,SM	2	1	20
BD,UN,RO	3	1	25
BD,UN,RO	3	1	25
BD,UN,RO	3	1	25
BD,PL,SM	1	1	16
BD,UN,RO	3	1	25

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: SC/PKS
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859488.56; E 684015.94
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH203

DRILLING DATE: July 22 to August 12, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 5 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

Column headings: DEPTH SCALE METRES | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (m) | RUN No. | FLUSH RETURN | RECOVERY (TOTAL CORE % 80 60 40 20; SOLID CORE % 80 60 40 20) | R.Q.D. % 80 60 40 20 | FRACT. INDEX PER 0.25 m 5 10 15 20 | DISCONTINUITY DATA (DIP w.r.t. CORE AXIS 0 30 60 90; TYPE AND SURFACE DESCRIPTION; Jr; Ja; Jcon) | HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2} | WEATHERING INDEX W1 W2 W3 W4 W5 W6 | FEATURES | R0/R1 ZONES | PIEZOMETER

--- CONTINUED FROM PREVIOUS PAGE ---

Drilling record: Rotary Drill, HQ3 Core

Direct Shear Sample
Slightly weathered to fresh, thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey, fine grained shale interbeds.

Cerchar Sample

UCS with Modulus Sample

Brazilian Sample

Depth scale (m)	Run No.
37	8
38	
39	9
40	
41	
42	10
43	
44	
45	11
46	

Type and surface description	Jr	Ja	Jcon
BD,UN,SM	2	1	20
BD,UN,RO	3	1	25
BD,UN,SM	2	1	20
BD,UN,SM	2	1	20
BD,UN,RO	3	1	25
BD,UN,SM	2	1	20

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: SC/PKS
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859488.56; E 684015.94
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH203

DRILLING DATE: July 22 to August 12, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 6 OF 8
DATUM: Geodetic

DEPTH SCALE METRES | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (m) | RUN No. | FLUSH RETURN | RECOVERY (TOTAL CORE % 80 60 40 20; SOLID CORE % 80 60 40 20) | R.Q.D. % 80 60 40 20 | FRACT. INDEX PER 0.25 m 5 10 15 20 | DISCONTINUITY DATA (DIP w.r.t. CORE AXIS 0 30 60 90; TYPE AND SURFACE DESCRIPTION; Jr; Ja; Jcon) | HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2} | WEATHERING INDEX W1 W2 W3 W4 W5 W6 | FEATURES | R0/R1 ZONES | PIEZOMETER

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

--- CONTINUED FROM PREVIOUS PAGE ---

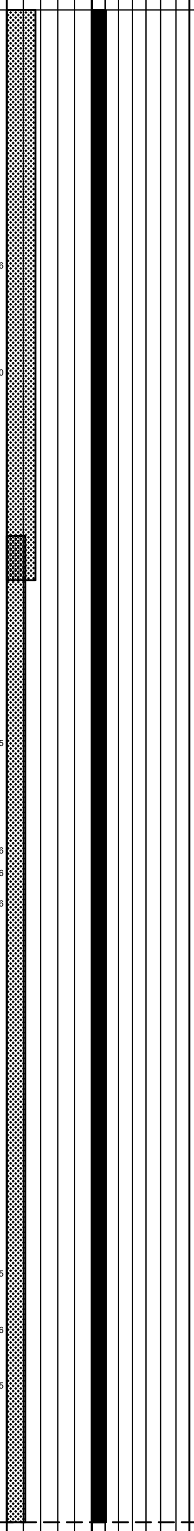
Slightly weathered to fresh, thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey, fine grained shale interbeds.

Drilling record: Rotary Drill, HQ3 Core

Depth scale: 47, 48, 49, 50, 51, 52, 53, 54, 55, 56

Run No.: 11, 12, 13, 14, 15

Run No.	Type and Surface Description	Jr	Ja	Jcon
12	BD,PL,SM	1	1	16
12	BD,UN,SM	2	1	20
13	BD,UN,RO	3	1	25
13	BD,PL,SM	1	1	16
13	BD,PL,SM	1	1	16
13	BD,PL,SM	1	1	16
14	BD,UN,RO	3	1	25
14	BD,PL,SM	1	1	16
14	BD,UN,RO	3	1	25



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DEPTH SCALE
1 : 50

LOGGED: SC/PKS
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859488.56; E 684015.94
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH203

DRILLING DATE: July 22 to August 12, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 7 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES: 57, 58, 59, 60, 61, 62, 63, 64, 65, 66

DRILLING RECORD: Rotary Drill, HQ3 Core

DESCRIPTION: Slightly weathered to fresh, thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey, fine grained shale interbeds.

RUN No.: 15, 16, 17, 18

DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,UN,RO	3	1	25
BD,PL,SM	1	1	16
BD,UN,RO	3	1	25
BD,PL,SM	1	1	16

Column headings: DEPTH SCALE METRES; DRILLING RECORD; DESCRIPTION; SYMBOLIC LOG; ELEV. DEPTH (m); RUN No.; FLUSH RETURN; RECOVERY (TOTAL CORE % 80 60 40 20; SOLID CORE % 80 60 40 20); R.Q.D. % 80 60 40 20; FRACT. INDEX PER 0.25 m 5 10 15 20; DISCONTINUITY DATA (DIP w.r.t. CORE AXIS 0 30 60 90; TYPE AND SURFACE DESCRIPTION; Jr; Ja; Jcon); HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2}; WEATH-ERING INDEX W1 W2 W3 W4 W5 W6; FEATURES; R0/R1 ZONES; PIEZOMETER

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: SC/PKS
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859488.56; E 684015.94
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH203

DRILLING DATE: July 22 to August 12, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 8 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (m)	RUN No.	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
		--- CONTINUED FROM PREVIOUS PAGE ---						
	Rotary Drill HQ3 Core	Slightly weathered to fresh, thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey, fine grained shale interbeds.			BD,UN,RO	3	1	25
67				18				
68								
				19	BD,UN,SM	2	1	20
					BD,UN,SM	2	1	20
69			8.97 69.65					
		END OF DRILLHOLE						
70								
71								
72								
73								
74								
75								
76								

Other columns: SYMBOLIC LOG; FLUSH RETURN; RECOVERY (TOTAL CORE %, SOLID CORE %: 80 60 40 20); R.Q.D. % (80 60 40 20); FRACT. INDEX PER 0.25 m (5 10 15 20); DIP w.r.t. CORE AXIS (0 30 60 90); HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-8} 10^{-6} 10^{-4} 10^{-2}); WEATHERING INDEX (W1 W2 W3 W4 W5 W6); FEATURES; R0/R1 ZONES; PIEZOMETER

DEPTH SCALE
1 : 50

LOGGED: SC/PKS
CHECKED: PKS

GOLDER
MEMBER OF WSP

Water Content Summary
ASTM D2216

Test Request #	21451329-21600-610 BH203
Client:	E.S. Fox Limited
Project Name:	ES Fox/DNNP Invest/Bowmanville
Project Number:	21451329-21600-610
Project Location:	

Sample Location	Sample				Soil Description	Water Content %	Method	Remarks
	Ref	Top (m)	Base (m)	Type				
BH203	2	8.53	8.99	SS		16.2	B	
BH203	4	9.75	10.21	SS		16.5	B	
BH203	5B	10.49	10.82	SS		19.2	B	
BH203	6	10.97	11.43	SS		14.5	B	
BH203	8	12.19	12.65	SS		16.3	B	
BH203	9	12.80	13.26	SS		17.5	B	
BH203	11	14.02	14.48	SS		9.0	B	
BH203	12	14.63	15.09	SS		7.9	B	
BH203	13	15.24	15.70	SS		8.7	B	

Notes:

Tested by: JTimms **Date:** 04 Oct 2022
Checked by: MRuck **Date:** 26 Oct 2022

Disclaimer:

Reviewed by: JoNorris **Date:** 10 Nov 2022

PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422

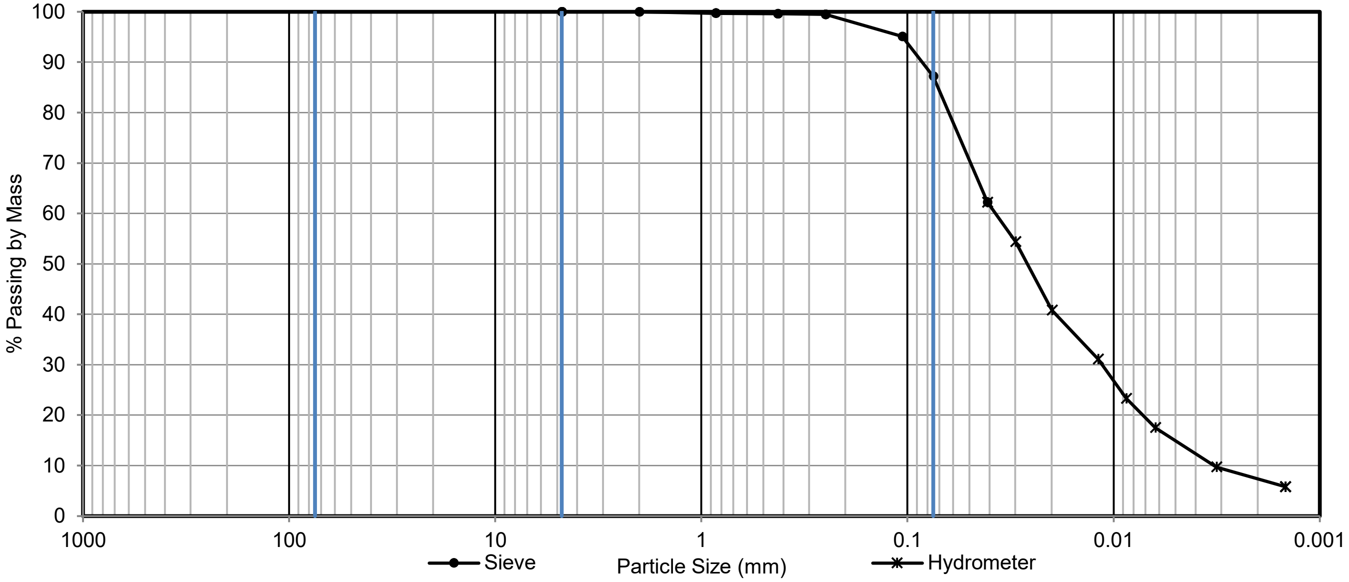
Method B

Test Request #	21451329-21600-610 BH203	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH203
Source:		Sample No.:	8
Soil Description:		Type:	SS
		Depth (m):	12.19 - 12.65

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	17 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)

BOULDERS	COBBLES	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	
		0.0		12.8			87.2



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
#4	4.75	100.0	0.0409	62.2
#10	2	100.0	0.0299	54.4
#20	0.85	99.7	0.0199	40.8
#40	0.425	99.6	0.0119	31.1
#60	0.25	99.5	0.0087	23.3
#140	0.106	95.1	0.0063	17.5
#200	0.075	87.2	0.0032	9.7
			0.0015	5.8
			0.005 mm	14.91
			0.002 mm	7.36
			D60	0.04
			D30	0.01
			D10	0.00
			Cu	12.00
			Cc	1.10

Notes:

Disclaimer:

Tested by: MKMarren **Date:** 17 Oct 2022 **Checked by:** MRuck **Date:** 26 Oct 2022 **Reviewed by:** JoNorris **Date:** 10 Nov 2022

PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422

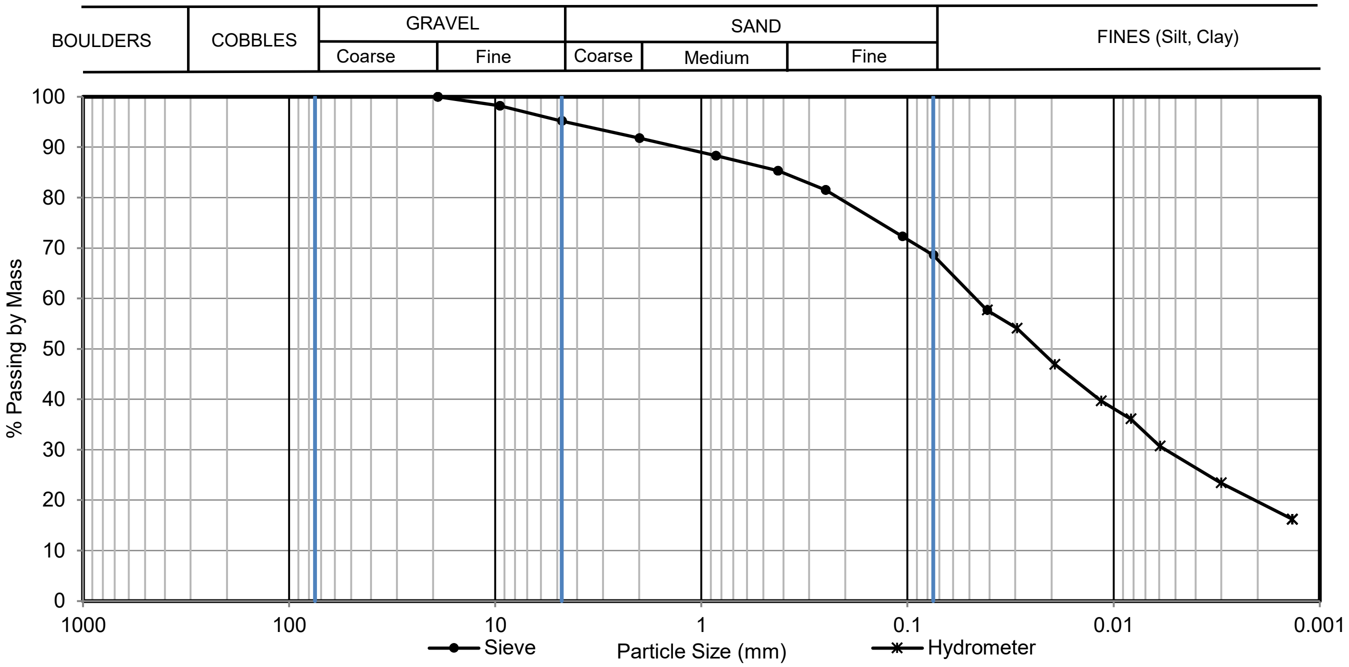
Method B

Test Request #	21451329-21600-610 BH203	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH203
Source:		Sample No.:	12
Soil Description:		Type:	SS
		Depth (m):	14.63 - 15.09

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	17 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)

GRAVEL	SAND	FINES (Silt, Clay)
4.8	26.6	68.6



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0411	57.7
3/8"	9.5	98.2	0.0295	54.1
#4	4.75	95.2	0.0193	46.9
#10	2	91.8	0.0115	39.7
#20	0.85	88.3	0.0083	36.1
#40	0.425	85.3	0.0060	30.7
#60	0.25	81.5	0.0030	23.4
#140	0.106	72.3	0.0014	16.2
#200	0.075	68.6		
			0.005 mm	28.82
			0.002 mm	19.70
			D60	0.05
			D30	0.01
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

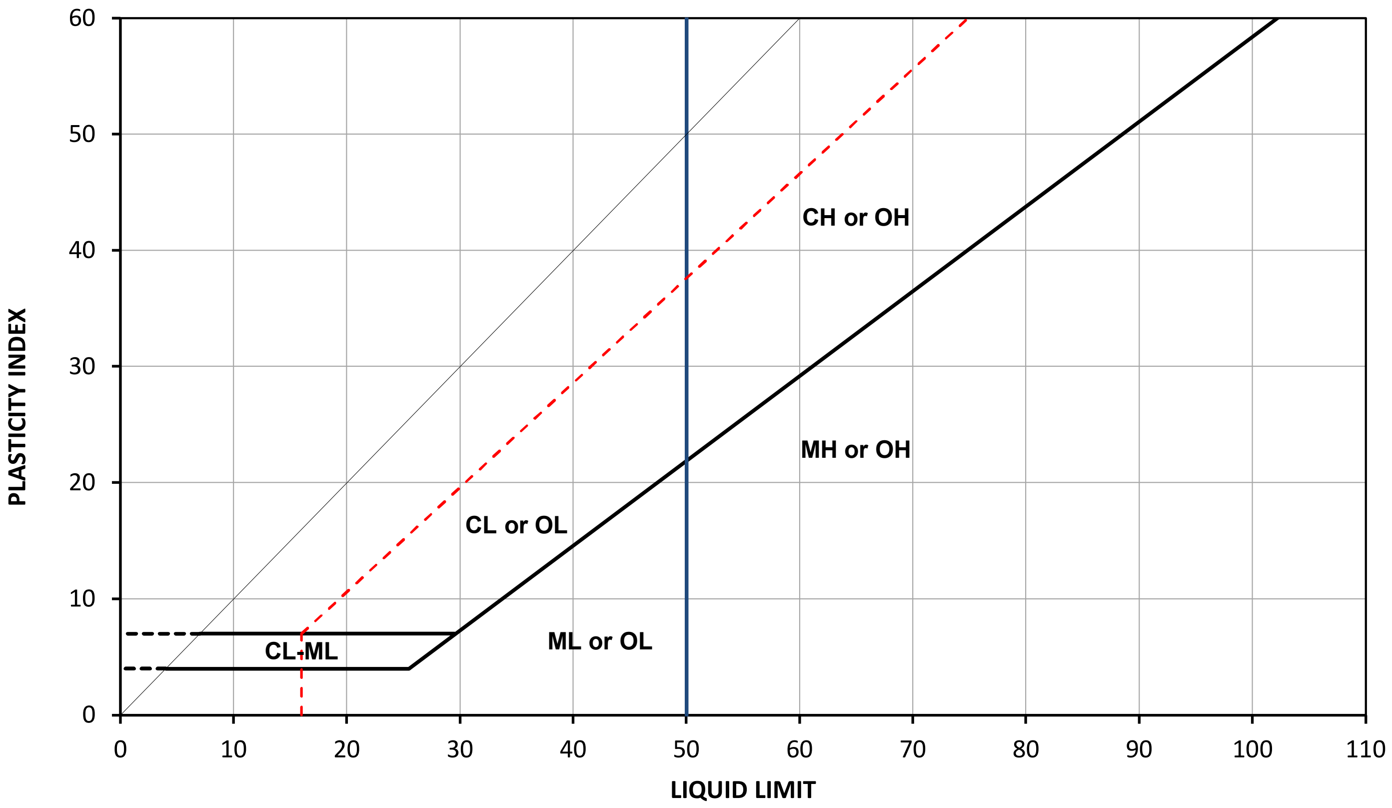
Tested by: MKMarren **Date:** 17 Oct 2022 **Checked by:** MRuck **Date:** 26 Oct 2022 **Reviewed by:** JoNorris **Date:** 10 Nov 2022

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318

Test Request #	21451329-21600-610 BH203	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH203
Source:		Sample No.:	8
Soil Description:		Type:	SS
		Depth (m):	12.19 - 12.65

Specimen Reference NA   Specimen Depth (m): NA   Date of Test 19 Oct 2022

Specimen Description NA



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH203	8	12.19	12.65	96	16.3		NP		

NP = Non-Plastic
ND = Not Determined

Test Preparation

Notes:

Tested by: JTimms **Date:** 19 Oct 2022
Checked by: MRuck **Date:** 26 Oct 2022

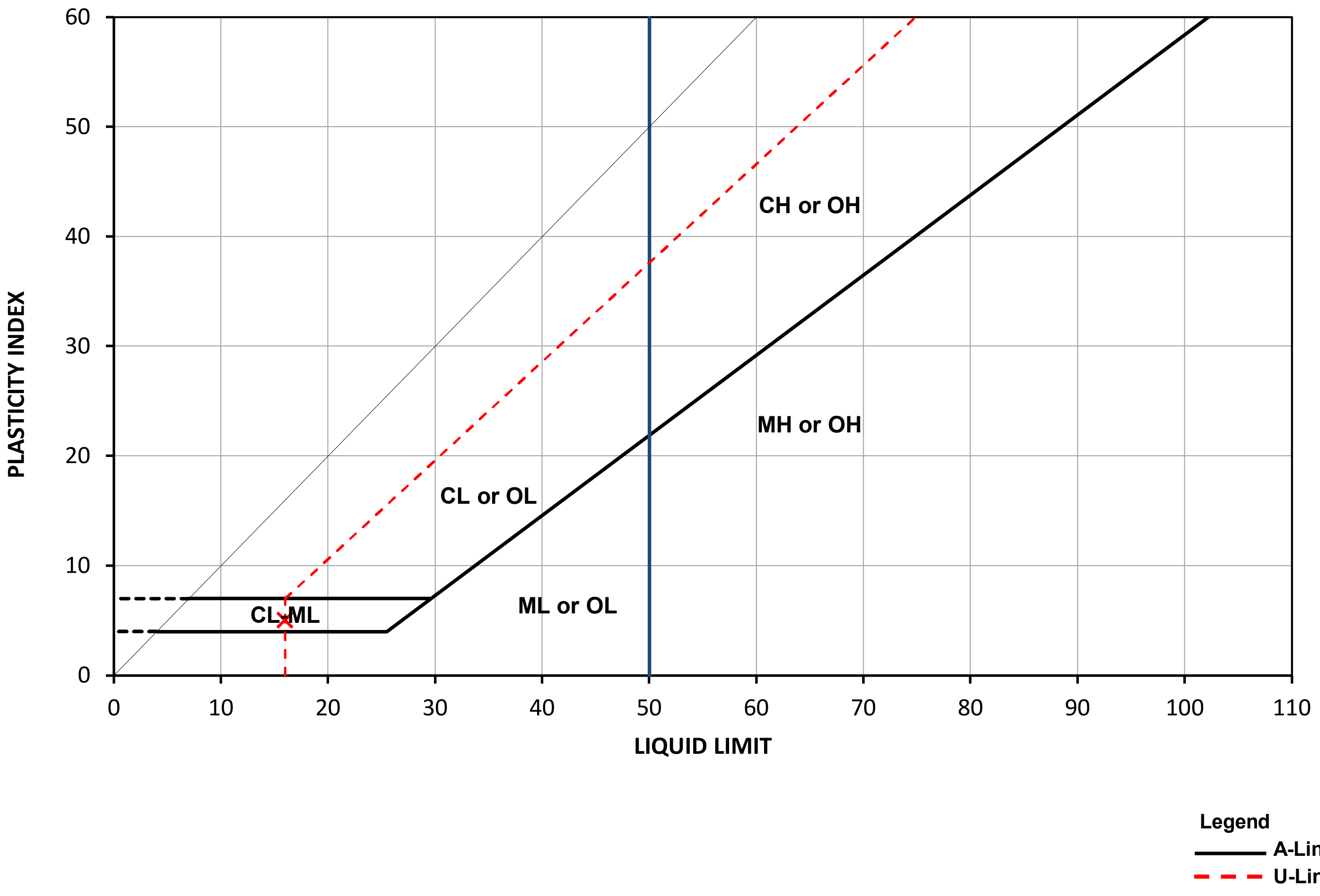
Disclaimer:
The laboratory testing services reported herein have been performed in accordance with the terms of a contract with Golder's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of Golder's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Reviewed by: JoNorris **Date:** 09 Nov 2022

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318
Method A - Multipoint Test

Test Request #	21451329-21600-610 BH203	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH203
Source:		Sample No.:	12
Soil Description:		Type:	SS
		Depth (m):	14.63 - 15.09

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	19 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH203	12	14.63	15.09	81	7.9	16	11	5	-0.62

NP = Non-Plastic
ND = Not Determined

Test Preparation
Dry Preparation Tested after >425um removed

Notes:

Tested by: JTimms **Date:** 19 Oct 2022
Checked by: MRuck **Date:** 26 Oct 2022

Disclaimer:

Reviewed by: JoNorris **Date:** 09 Nov 2022

SPECIFIC GRAVITY OF SOIL SOLIDS
ASTM D854
Pycnometer Method B

Test Request #	21451329-21600-610 BH203	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	NA
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH203
Source:		Sample No.:	3
Soil Description:		Type:	SS
		Depth (m)	9.14 - 9.60

Specimen Reference	NA	Specimen Depth	NA	Date of Test	27 Oct 2022
Specimen Description	NA				

Proportions		
Percentage Passing (4.75 mm)		%
Percentage Retained (4.75 mm)		%

Fine Fraction (D854)		
Calibrated Mass of Pycnometer		g
Calibrated Volume of Pycnometer	249.64	mL
Mass of Pycnometer	90.49	g
Test Temperature	19.4	oC
Mass of Pycnometer, soil and water	365.02	g
Mass of Container (or tare)	90.49	g
Mass of dry soil and container	130.70	g
Dry mass of soil solids	40.21	g
Specific Gravity at 20oC	**2.70**	

Coarse Fraction (C127)		
Mass of Oven Dry Sample		g
Mass of saturated-surface-dry in air		g
Apparent mass of saturated test sample in water		g
Specific Gravity Oven Dry		
Specific Gravity Saturated Surface Dry		
Specific Gravity with Weighted Average	**2.70**	

Notes:

Disclaimer:

Tested by: DPatel **Date:** 27 Oct 2022

Checked by: MRuck **Date:** 09 Nov 2022

Reviewed by: JoNorris **Date:** 10 Nov 2022

DENSITY (UNIT WEIGHT) OF SOIL SPECIMENS

ASTM D 7263 Method B

Borehole Number	BH203	BH203			
Sample Number	2	11			
Sample Depth, m	8.53-8.99	14.02-14.48			
Weight of Soil, g	188.3	170.0			
Diameter of Sample, cm	3.710	3.572			
Length of Sample, cm	7.380	6.874			
Volume of Sample, cc	79.78	68.88			
Water Content, %	12.99	9.360			
Wet Density, g/cm^3	2.360	2.468			
Dry Density, g/cm^3	2.088	2.257			
Unit Weight, kN/m^3	23.14	24.20			

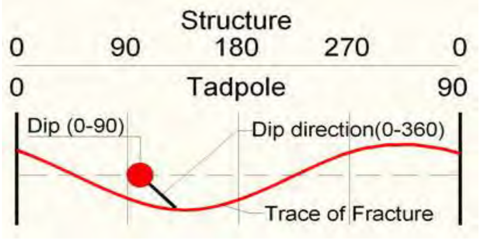
Notes:
- Water contents determined from tested specimens
- Specimen was intact

Project Number	21451329-21600-610	Tested By	S. Khan
Date Tested	October 26, 2022	Checked By	LH

Geophysical Record of Borehole: BH203

Log Title:	Darlington DNNP Geophysical Log
Project Number:	21451329
Client:	Ontario Power Generation
Date:	January 2023

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	~19 m bgs	**Location:**	Darlington, ON
Easting:	684015.94 m	**Drilled Depth:**	69.7 m bgs	**Water Level:**	N/A	**Log Date:**	Aug-04-2022
Northing:	4859488.56 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	78.62 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	P. Leith

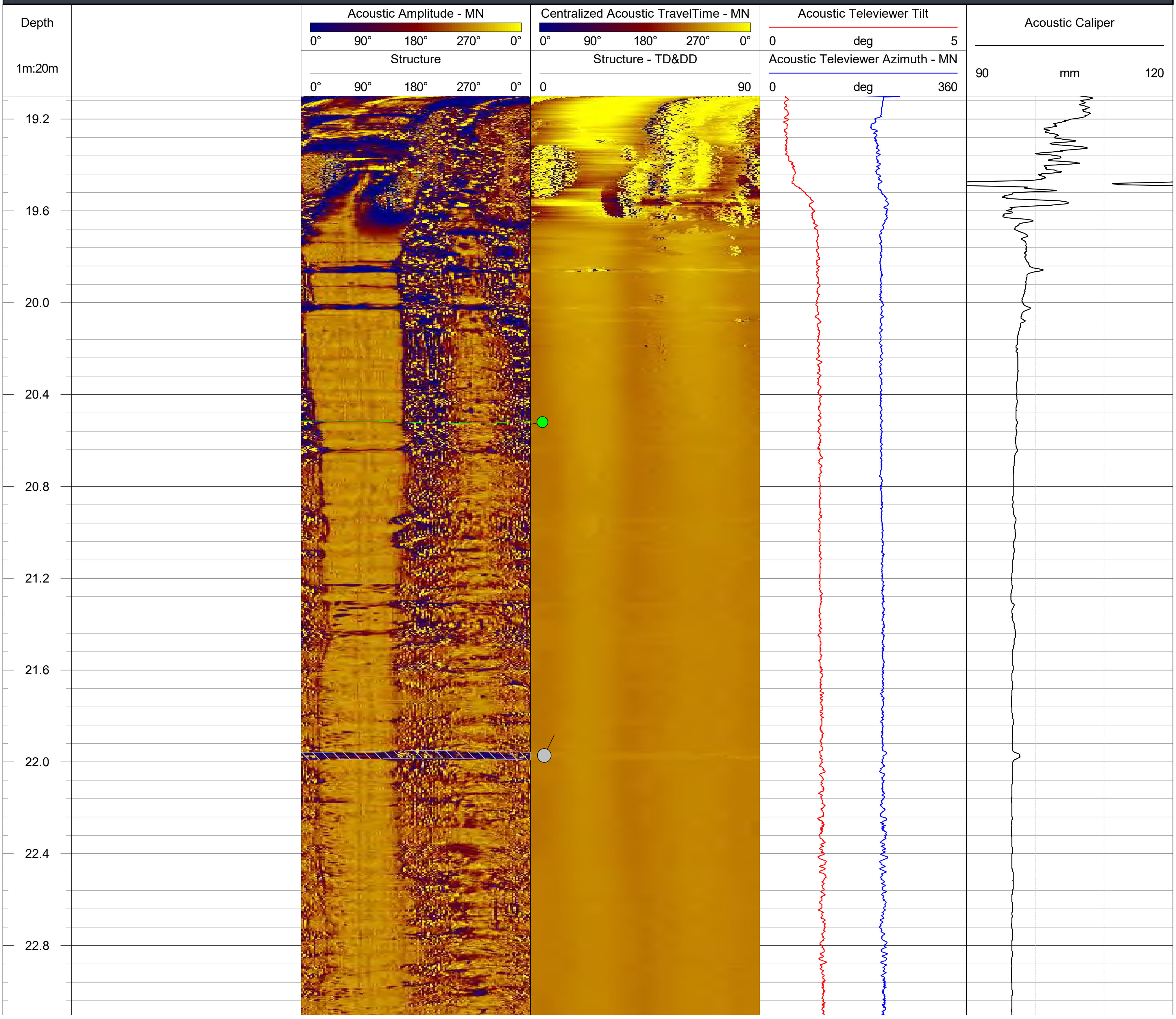


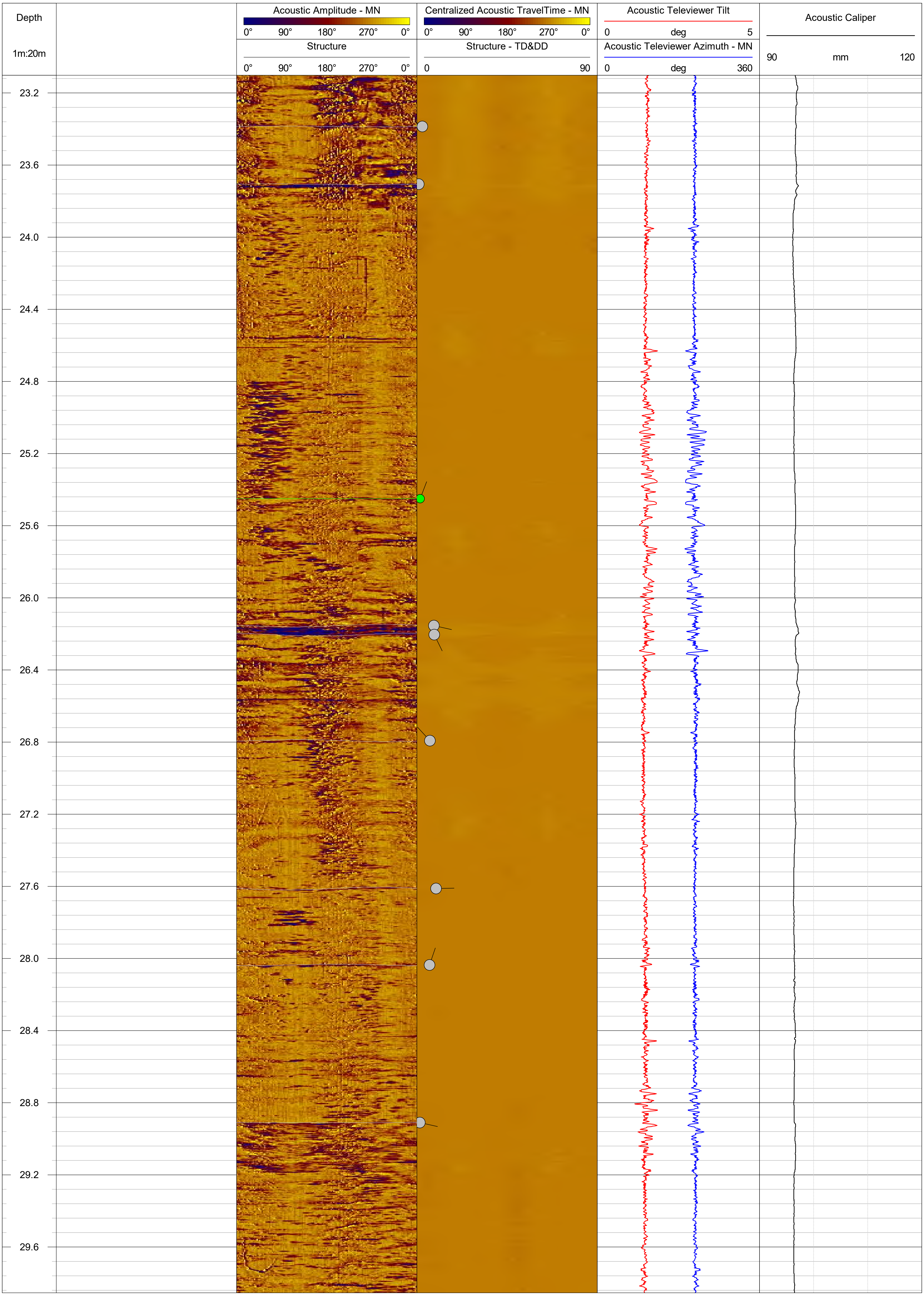
● Partially Open Joint / Fracture

● Filled Fracture / Joint

● Bedding / Banding / Foliation

Notes: Magentic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)

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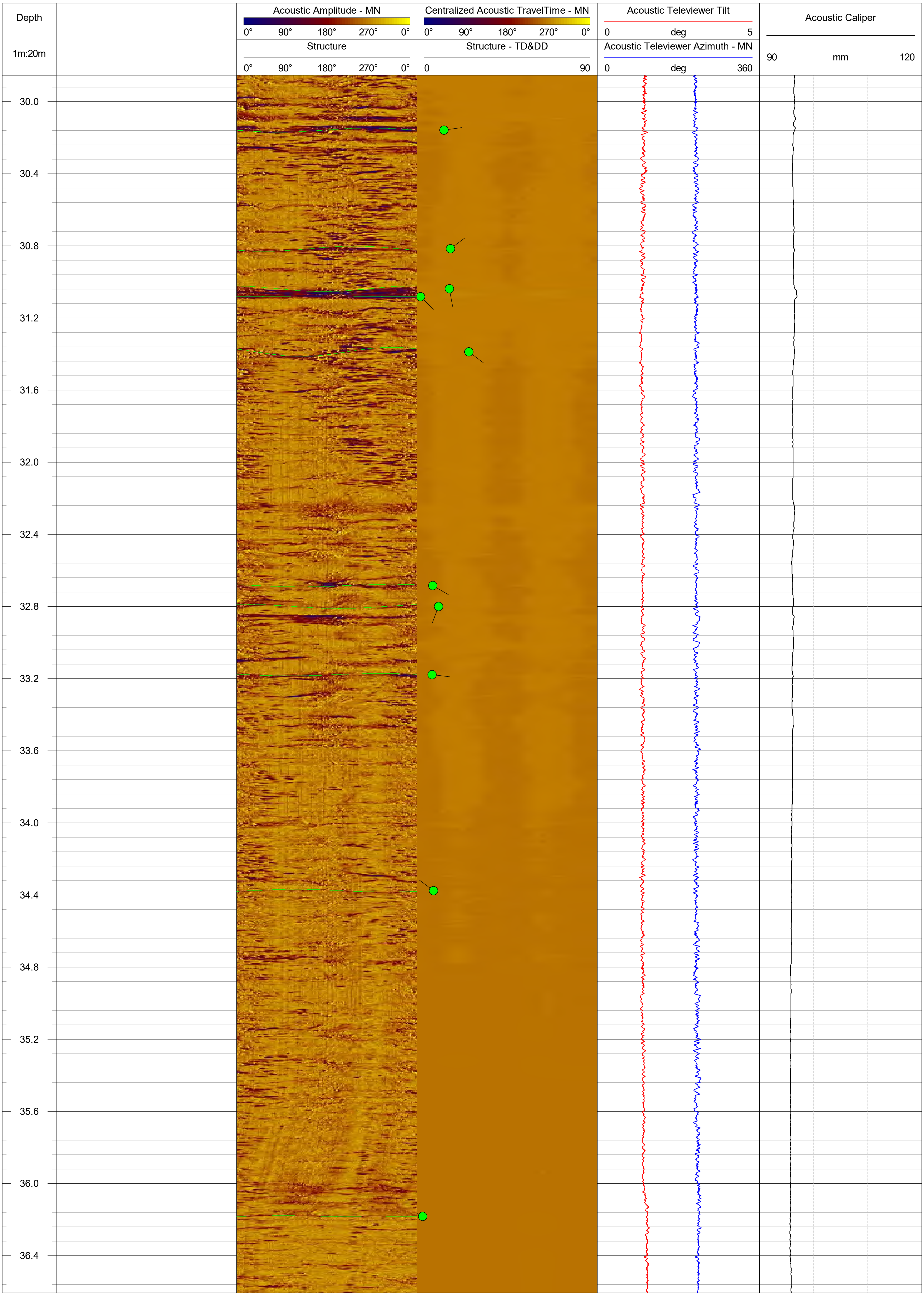
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
23.2
23.6
24.0
24.4
24.8
25.2
25.6
26.0
26.4
26.8
27.2
27.6
28.0
28.4
28.8
29.2
29.6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Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
30.0
30.4
30.8
31.2
31.6
32.0
32.4
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33.2
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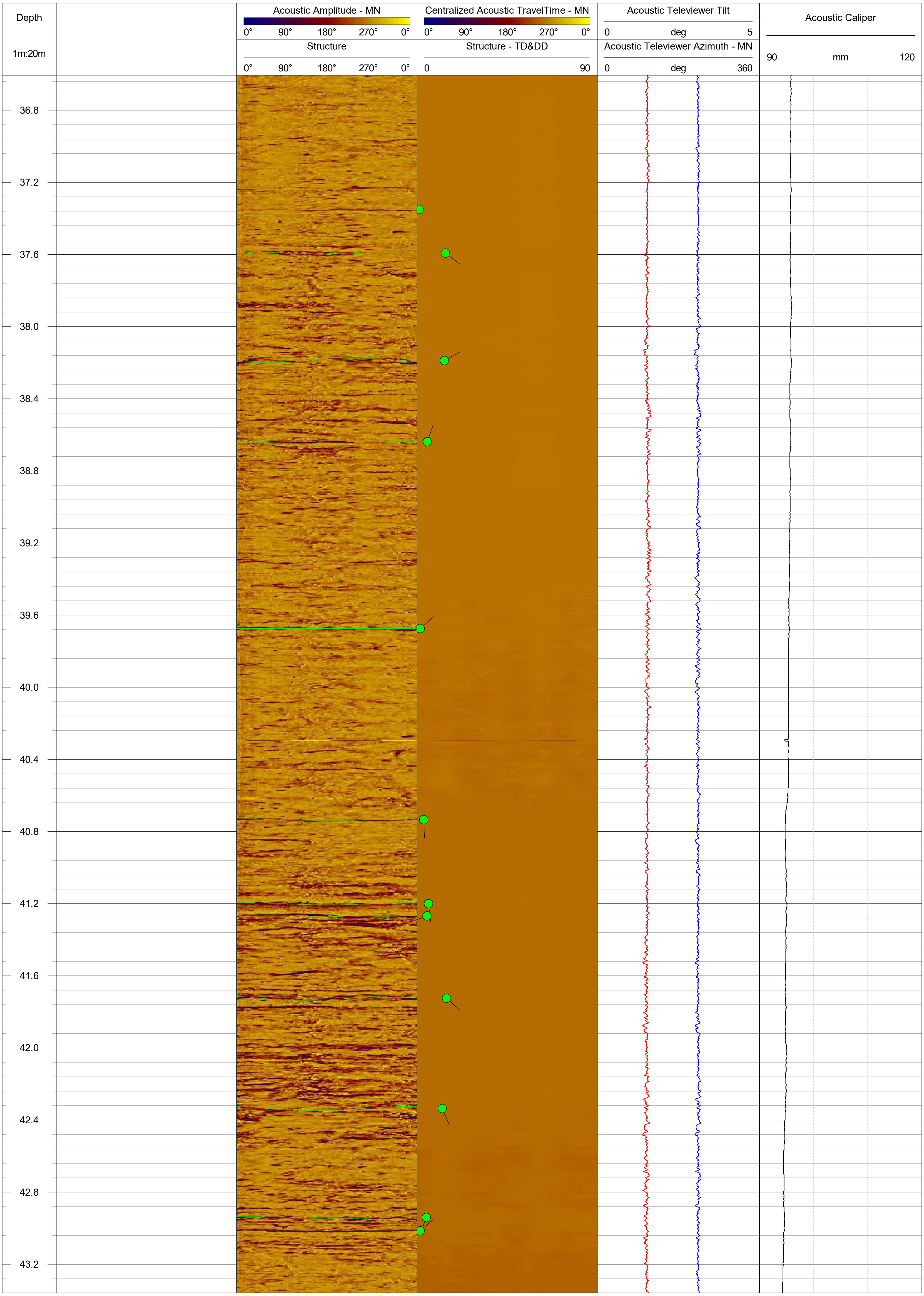
34.0
34.4
34.8
35.2
35.6
36.0
36.4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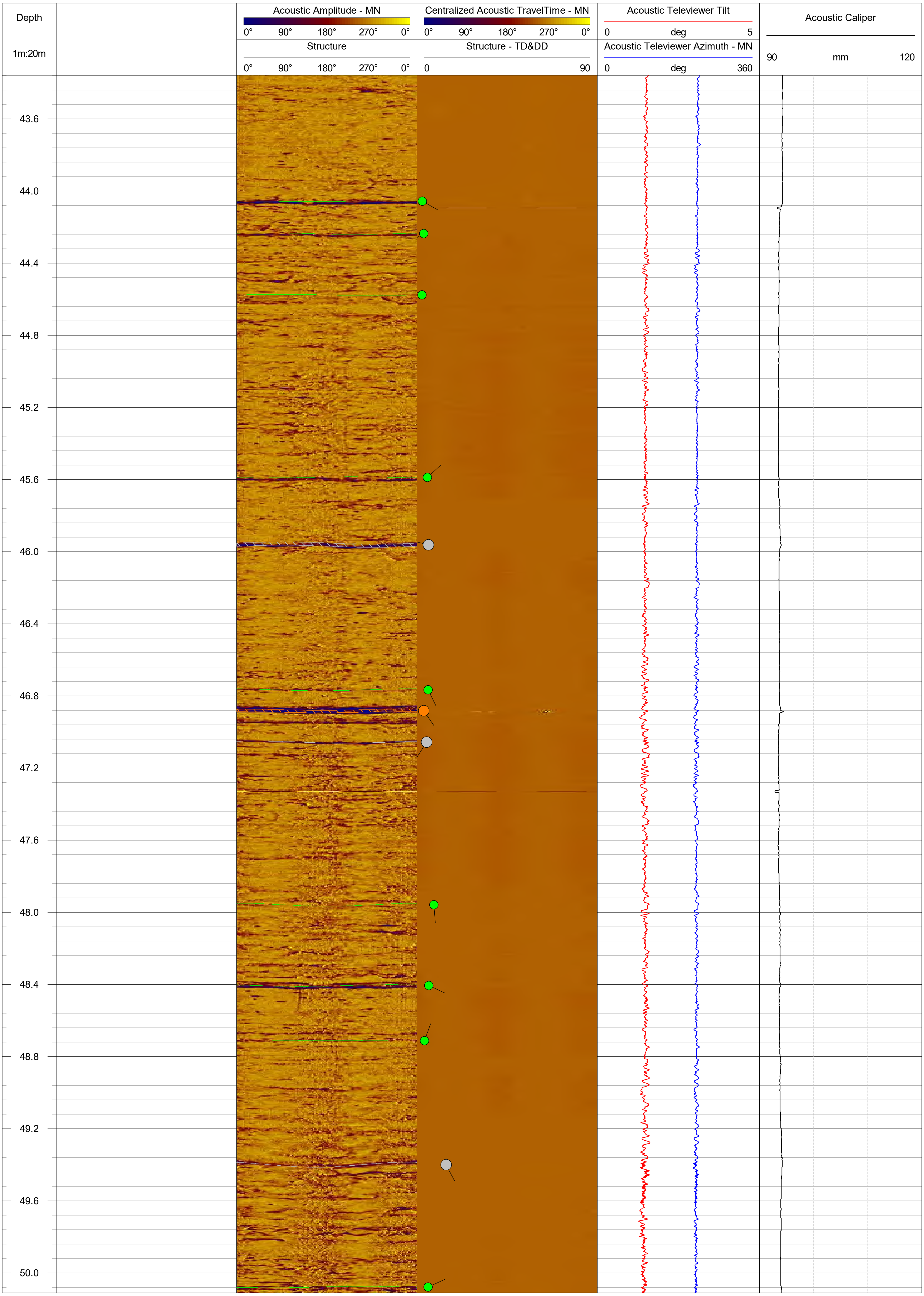
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
36.8
37.2
37.6
38.0
38.4
38.8
39.2
39.6
40.0
40.4
40.8
41.2
41.6
42.0
42.4
42.8
43.2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Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
43.6
44.0
44.4
44.8
45.2
45.6
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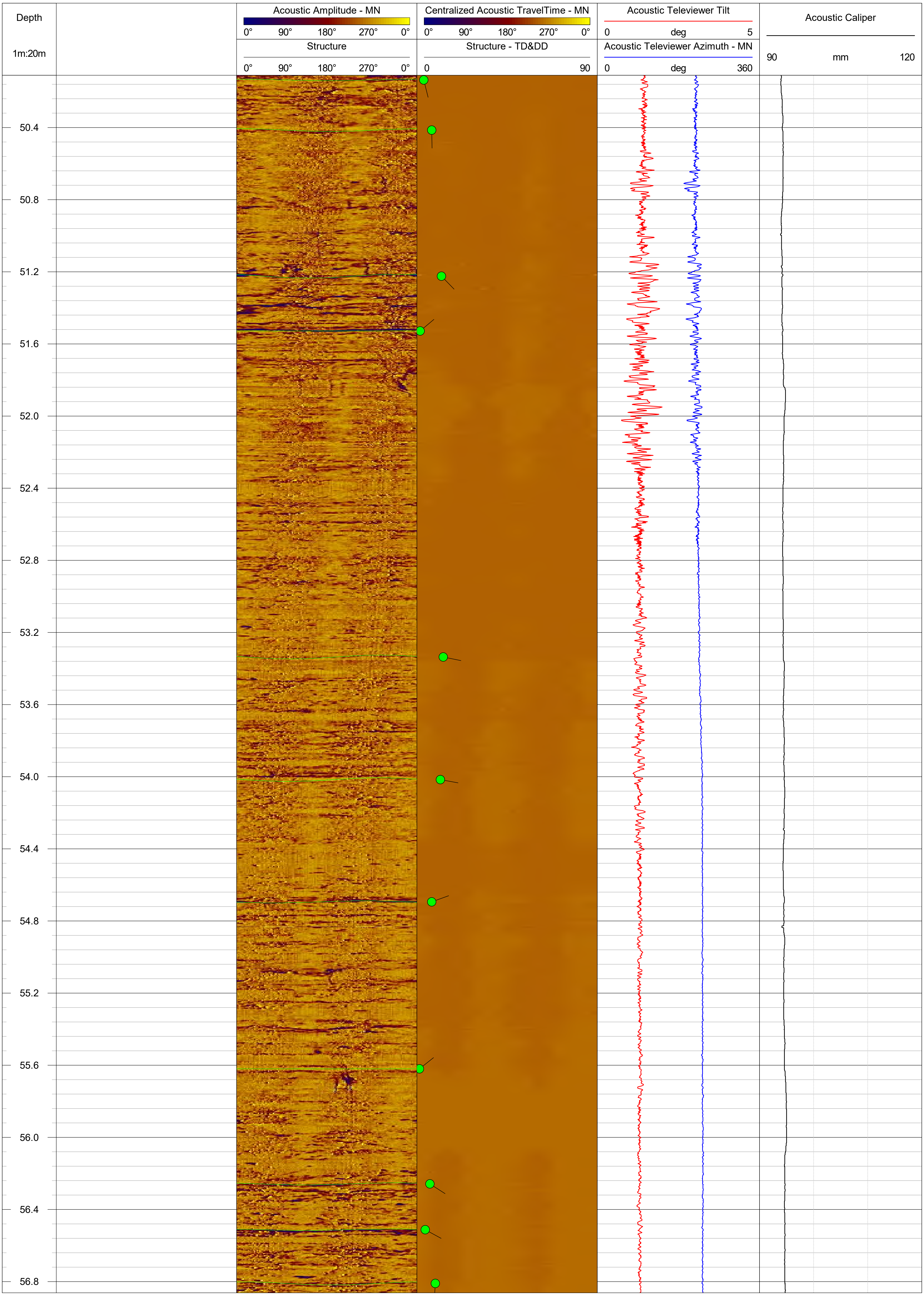
47.2
47.6
48.0
48.4
48.8
49.2
49.6
50.0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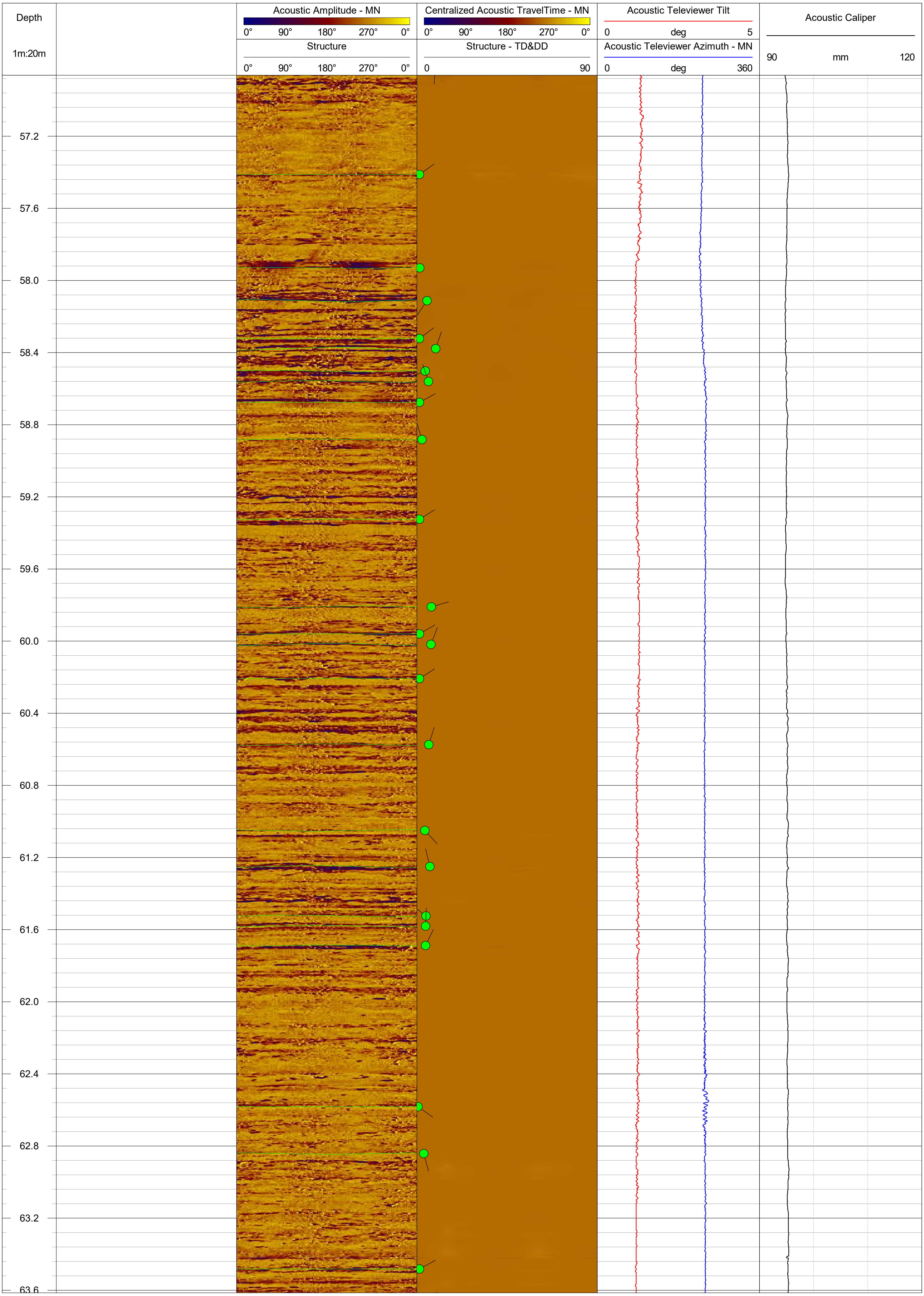
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
50.4
50.8
51.2
51.6
52.0
52.4
52.8
53.2
53.6
54.0
54.4
54.8
55.2
55.6
56.0
56.4
56.8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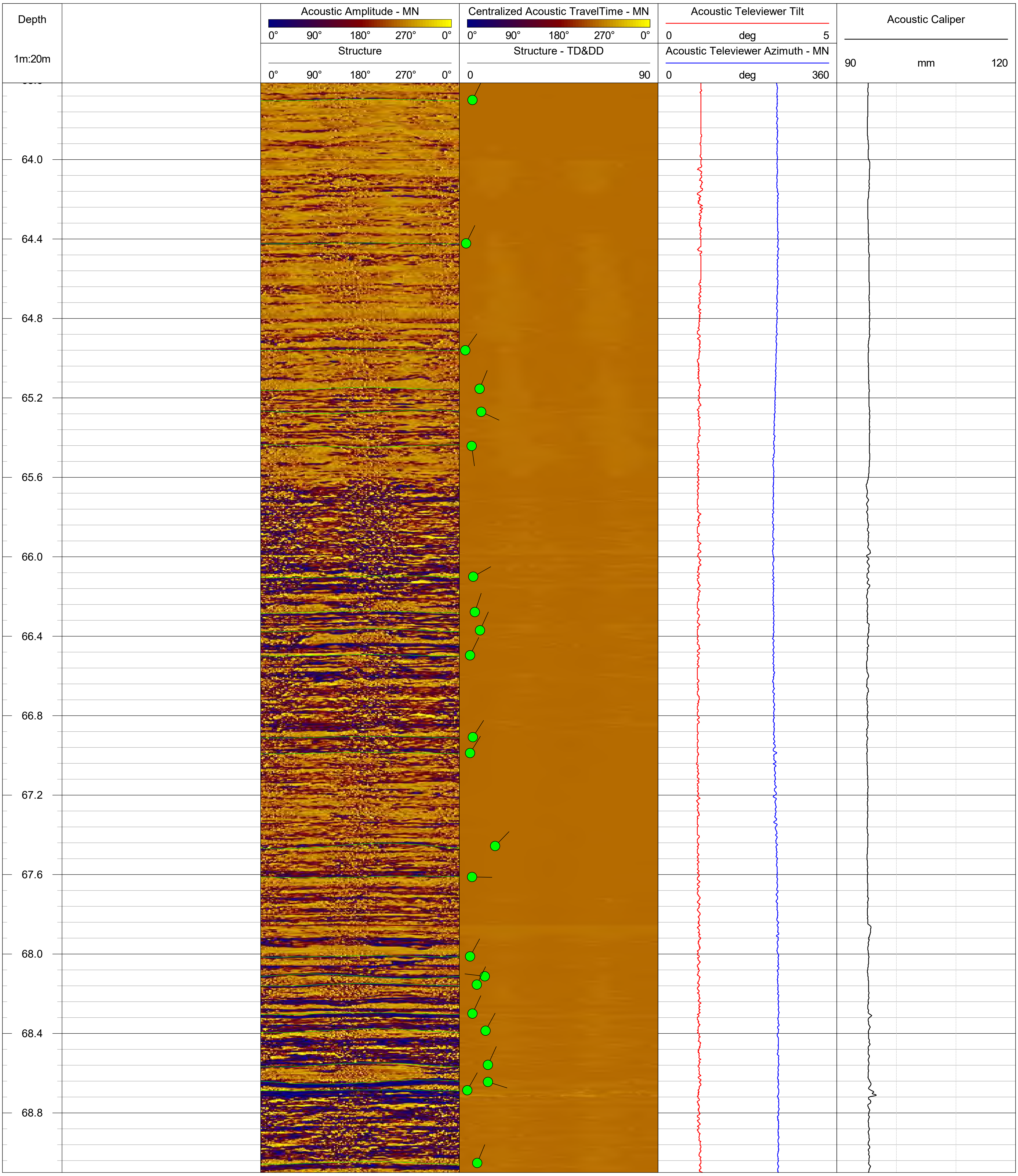
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
57.2
57.6
58.0
58.4
58.8
59.2
59.6
60.0
60.4
60.8
61.2
61.6
62.0
62.4
62.8
63.2
63.6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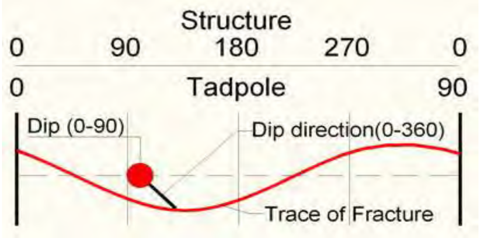
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
64.0
64.4
64.8
65.2
65.6
66.0
66.4
66.8
67.2
67.6
68.0
68.4
68.8

Geophysical Record of Borehole: BH203

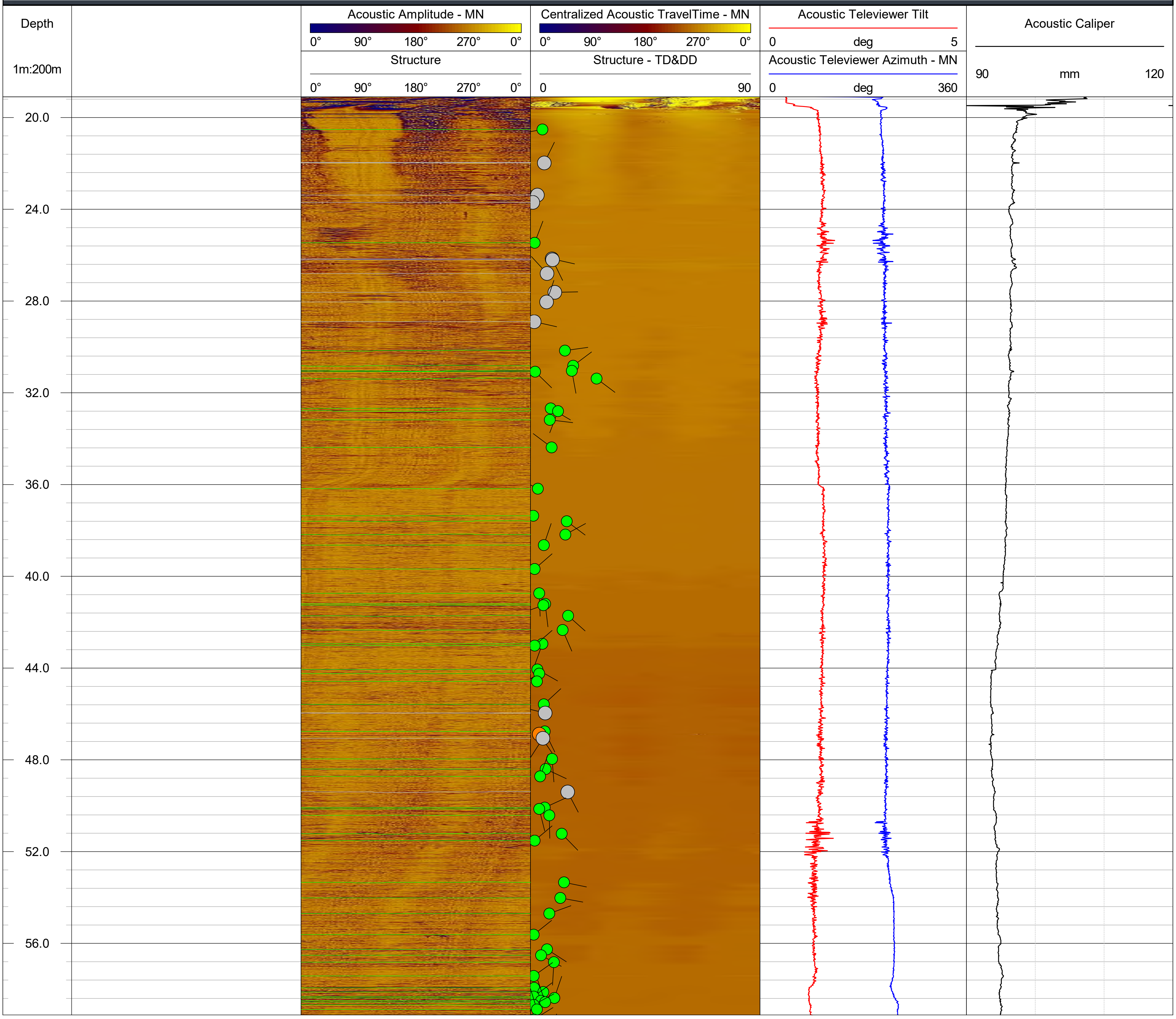
Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

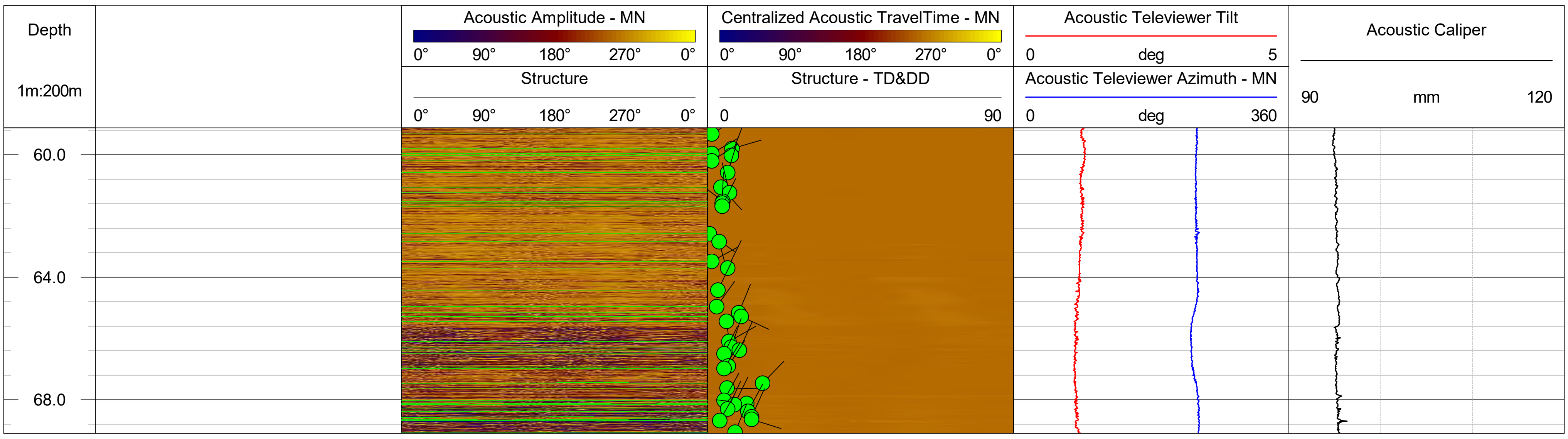
Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	~19 m bgs	**Location:**	Darlington, ON
Easting:	684015.94 m	**Drilled Depth:**	69.7 m bgs	**Water Level:**	N/A	**Log Date:**	Aug-04-2022
Northing:	4859488.56 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	78.62 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	P. Leith



● Partially Open Joint / Fracture
● Filled Fracture / Joint
● Bedding / Banding / Foliation

Notes: Magentic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)




Depth
1m:200m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
60.0
64.0
68.0

A10-BH204

PROJECT: 21451329

LOCATION: N 4859404.61; E 684127.45

RECORD OF BOREHOLE: BH204

BORING DATE: May 18, 2021

DRILL RIG: Diedrich 120 Track Mounted

SHEET 1 OF 7

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-10} 10^{-8} 10^{-6} 10^{-4}) WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		BARGE DECK		79.39							
0	Mud Rotary Wash Boring (Tricone) UW Casing			0.00							
5		WATER		74.38 5.01							
10											

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

LOGGED: JD

CHECKED: SEMP

PROJECT: 21451329

RECORD OF BOREHOLE: BH204

SHEET 2 OF 7

LOCATION: N 4859404.61; E 684127.45

BORING DATE: May 18, 2021

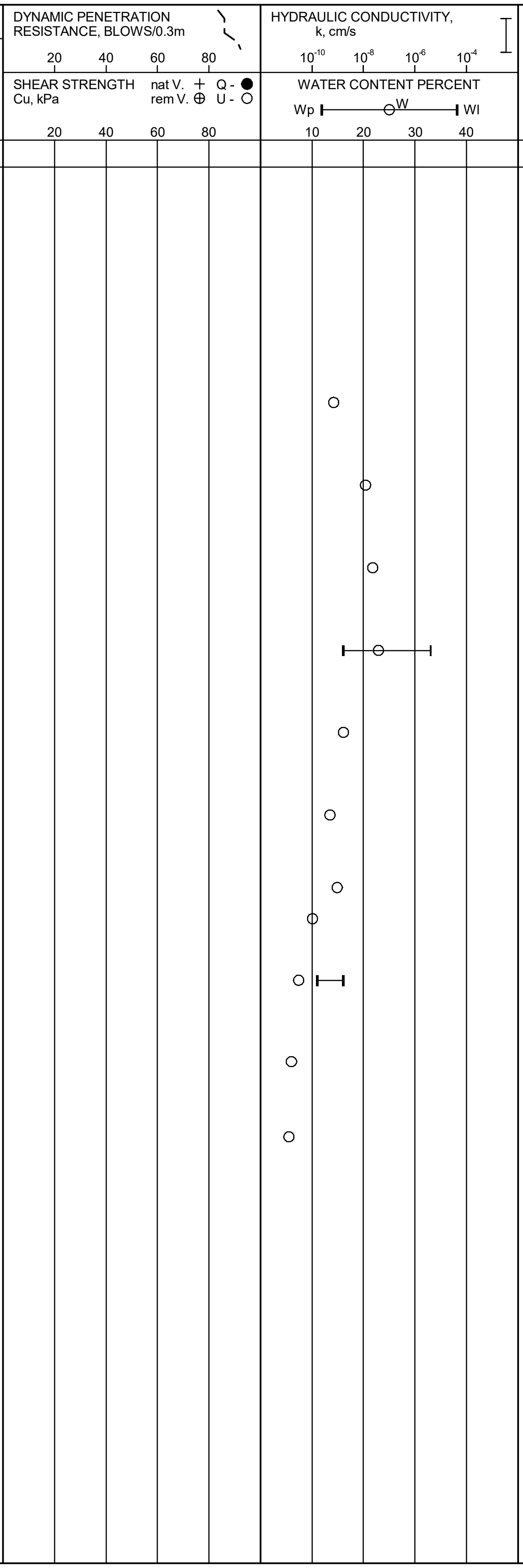
DATUM: Geodetic

DRILL RIG: Diedrich 120 Track Mounted

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
10	Mud Rotary Wash Boring (Tricone) UW Casing	WATER	69.03 10.36
		Poorly Graded Sand with Silt (SP-SM), dense, brown, wet, medium to coarse sand, trace of angular to subangular fine to coarse gravel (Glaciolacustrine) (Unit 4a)	68.49 10.90
11		**Silt with Sand (ML)**, medium dense, grey, moist to wet, fine to medium sand, trace of angular to subangular fine to coarse gravel (Glaciolacustrine) (Unit 4a)	66.74 12.65
13		**Lean Clay (CL)**, very stiff to hard, grey, trace of fine to medium sand, low to medium plasticity (Glaciolacustrine) (Unit 4b)	64.30 15.09
15	Mud Rotary Wash Boring (Tricone) Open	**Silty Sand (SM)**, very dense, grey, moist, fine to medium sand (Glaciolacustrine) (Unit 4a)	64.05 15.34
		Sandy Silty Clay (CL-ML), hard, grey, moist, fine to coarse sand, angular to subangular fine to coarse gravel, low plasticity (Till) (Unit 5)	62.02 17.37
17		**Shale Bedrock Fragments** (Unit 6a)	17.50
		- Bedrock cored from 17.50 m to 63.38 m depth - Refer to Record of Drillhole BH204	

SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1A 1B	SS	42		
2	SS	28	NP	1 17 69 13
3	SS	25		
4	SS	28		
5	SS	32		0 4 48 49
6	SS	39		
7	SS	30		
8A 8B	SS	81		
9	SS	161		7 29 44 20
10	SS	195		
11A 11B	SS	191		



PIEZOMETER OR STANDPIPE INSTALLATION

Notes:

1. Water level in open borehole could not be measured upon completion of soil drilling due to use of mud-rotary technique.

2. Efficiency of the SPT hammer utilized was 75.2 %.

GTA-BHS 005 S:\CLIENTS\OPG\DARLINGTON_GENERATING_STATION\02_DATA\GINT\DARLINGTON_GENERATING_STATION.GPJ GAL-MIS.GDT 3/14/23

DEPTH SCALE

1 : 50

LOGGED: JD

CHECKED: SEMP

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859404.61; E 684127.45
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH204

DRILLING DATE: May 22 to 27, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 3 OF 7
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.
		TOP OF BEDROCK		62.02	
	Rotary Drill HQ3 Core	Shale Bedrock Fragments		17.37	
18		Slightly weathered to fresh, thinly bedded, dark brownish grey, fine grained, faintly porous, slightly reactive to HCl, strong SHALE (Blue Mountain Formation) with very thin to thin, grey, fine to medium grained limestone interbeds		17.50	1
19				59.94 19.45	2
20–27		Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong LIMESTONE (Lindsay Formation) with dark grey shale interbeds			3 4 5 6

FLUSH RETURN | RECOVERY: TOTAL CORE % (80 60 40 20), SOLID CORE % (80 60 40 20) | R.Q.D. % (80 60 40 20) | FRACT. INDEX PER 0.25 m (5 10 15 20) | DIP w.r.t. CORE AXIS (0 30 60 90)

DISCONTINUITY DATA

TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,UN,SM	2	1	20
BD,UN,SM	2	1	20
BD,UN,RO	3	1	25
BD,UN,RO	3	1	25
BD,UN,RO	3	1	25
BD,PL,SM	1	1	16
BD,UN,SM	2	1	20
BD,UN,RO	3	1	25

HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-8} 10^{-6} 10^{-4} 10^{-2}) | WEATHERING INDEX (W1 W2 W3 W4 W5 W6) | FEATURES | R0/R1 ZONES | PIEZOMETER

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: SC
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859404.61; E 684127.45
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH204

DRILLING DATE: May 22 to 27, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 4 OF 7
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE % 80 60 40 20	RECOVERY SOLID CORE % 80 60 40 20	R.Q.D. % 80 60 40 20	FRACT. INDEX PER 0.25 m 5 10 15 20	DIP w.r.t. CORE AXIS 0 30 60 90	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2}	WEATHERING INDEX W1 W2 W3 W4 W5 W6	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
	Rotary Drill HQ3 Core	Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong LIMESTONE (Lindsay Formation) with dark grey shale interbeds										BD,UN,SM SA BD,CU,SM SA	2 2	2 2	20 20					
28																				
					6															
29																				
30																				
31												BD,PL,RO	1.5	1	20					
		Petrographic Analysis Sample																		
					7															
32																				
												BD,PL,RO	1.5	1	20					
33																				
												BD,PL,SM	1	1	16					
34																				
		Cerchar Sample																		
					8															
35																				
36																				
		Punch Penetration Sample																		
					9															
37																				
		UCS with Modulus Sample																		
		CONTINUED NEXT PAGE																		

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DEPTH SCALE
1 : 50

LOGGED: SC
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859404.61; E 684127.45
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH204

DRILLING DATE: May 22 to 27, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 5 OF 7
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE % (80 60 40 20)	RECOVERY SOLID CORE % (80 60 40 20)	R.Q.D. % (80 60 40 20)	FRACT. INDEX PER 0.25 m (5 10 15 20)	DISCONTINUITY DATA DIP w.r.t. CORE AXIS (0 30 60 90)	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-8} 10^{-6} 10^{-4} 10^{-2})	WEATHERING INDEX (W1 W2 W3 W4 W5 W6)	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
	Rotary Drill HQ3 Core	Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong LIMESTONE (Lindsay Formation) with dark grey shale interbeds																		
38					9															
39		Brazilian Sample																		
		Slake Durability Sample																		
40																				
41					10															
42																				
		Direct Shear Sample									●	BD,PL,SM	1	1	16					
43																				
44					11															
		UCS with Modulus Sample																		
45																				
46					12															
47																				
		CONTINUED NEXT PAGE																		

DEPTH SCALE
1 : 50

LOGGED: SC
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859404.61; E 684127.45
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH204

DRILLING DATE: May 22 to 27, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 6 OF 7
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE % 80 60 40 20	RECOVERY SOLID CORE % 80 60 40 20	R.Q.D. % 80 60 40 20	FRACT. INDEX PER 0.25 m 5 10 15 20	DISCONTINUITY DATA DIP w.r.t. CORE AXIS 0 30 60 90	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2}	WEATH-ERING INDEX W1 W2 W3 W4 W5 W6	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
		Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong LIMESTONE (Lindsay Formation) with dark grey shale interbeds																		
48					12															
49		Petrographic Analysis Sample																		
50					13															
51																				
52	Rotary Drill HQ3 Core																			
53					14															
54																				
55																				
56					15															
57																				
		CONTINUED NEXT PAGE																		

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DEPTH SCALE
1 : 50

LOGGED: SC
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859404.61; E 684127.45
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH204

DRILLING DATE: May 22 to 27, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 7 OF 7
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (m)	RUN No.	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	WEATHERING INDEX
		--- CONTINUED FROM PREVIOUS PAGE ---							
58	Rotary Drill HQ3 Core	Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong LIMESTONE (Lindsay Formation) with dark grey shale interbeds		15					W1
59				16					
60					BD,UN,SM SA	2	2	20	
61									
62				17					
63			16.01 63.38						
		END OF DRILLHOLE							
64									
65									
66									
67									

DEPTH SCALE
1 : 50

LOGGED: SC
CHECKED: PKS

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GOLDER
MEMBER OF WSP

Water Content Summary
ASTM D2216

Test Request # 21451329-21600-610 BH204
Client: E.S. Fox Limited
Project Name: ES Fox/DNNP Invest/Bowmanville
Project Number: 21451329-21600-610
Project Location:

Sample Location	Sample				Soil Description	Water Content %	Method	Remarks
	Ref	Top (m)	Base (m)	Type				
BH204	2	11.51	11.96	SS		14.2	B	
BH204	3	12.12	12.57	SS		20.4	B	
BH204	4	12.73	13.18	SS		21.8	B	
BH204	5	13.34	13.79	SS		22.9	B	
BH204	6	13.94	14.40	SS		16.1	B	
BH204	7	14.55	15.01	SS		13.5	B	
BH204	8A	15.16	15.47	SS		14.9	B	
BH204	8B	15.47	15.62	SS		10.1	B	
BH204	9	15.77	16.23	SS		7.4	B	
BH204	10	16.38	16.82	SS		6.0	B	
BH204	11A	16.99	17.32	SS		5.5	B	

Notes:

Tested by: JTimms **Date:** 12 Oct 2022
Checked by: MRuck **Date:** 24 Oct 2022

Disclaimer:

Reviewed by: JoNorris **Date:** 06 Nov 2022

GOLDER
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PARTICLE SIZE DISTRIBUTION

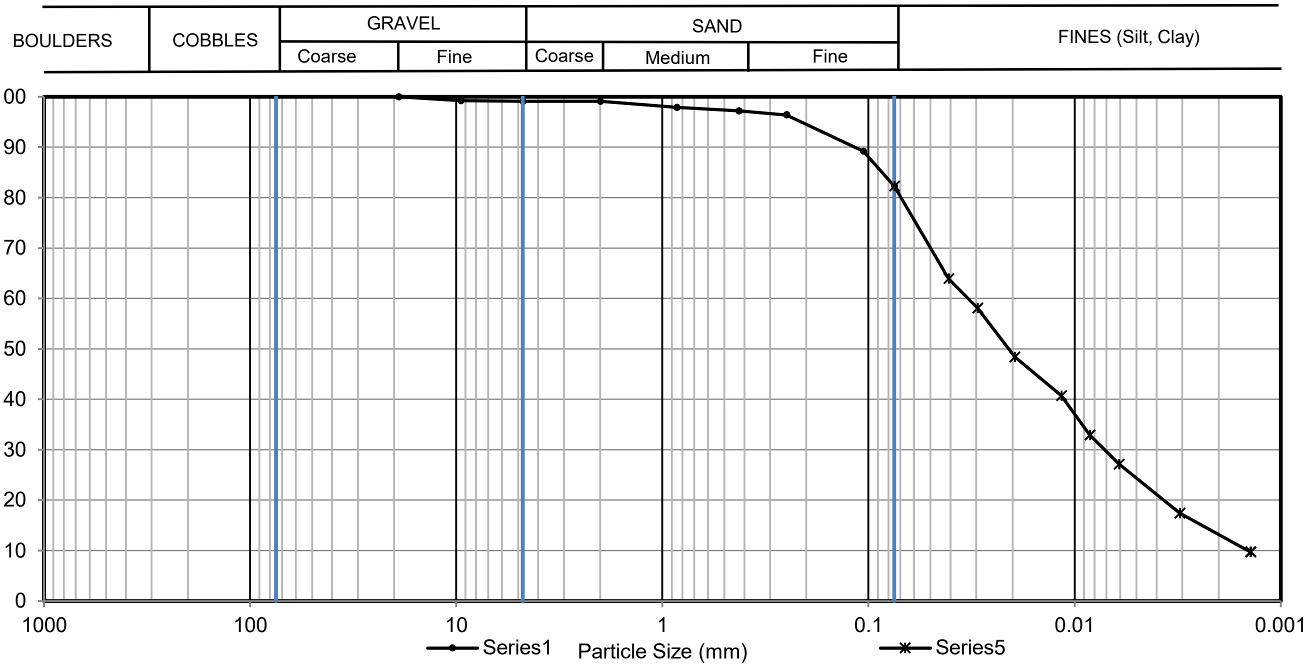
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH204	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH204
Source:		Sample No.:	2
Soil Description:		Type:	SS
		Depth (m):	11.51 - 11.96

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	18 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%) 0.9 16.8 82.3



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0408	63.9
3/8"	9.5	99.2	0.0296	58.1
#4	4.75	99.1	0.0195	48.4
#10	2	99.1	0.0116	40.7
#20	0.85	97.9	0.0084	32.9
#40	0.425	97.2	0.0061	27.1
#60	0.25	96.4	0.0031	17.4
#140	0.106	89.2	0.0014	9.7
#200	0.075	82.3		
			0.005 mm	24.30
			0.002 mm	13.17
			D60	0.03
			D30	0.01
			D10	0.00
			Cu	23.00
			Cc	1.10

Notes:

Disclaimer:

Tested by: JTimms **Date:** 18 Oct 2022 **Checked by:** MRuck **Date:** 24 Oct 2022 **Reviewed by:** JoNorris **Date:** 06 Nov 2022

Golder Associates
100 Scotia Court Whitby, ON L1N 8Y6 Canada
[+1] 905-723-2727

PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422

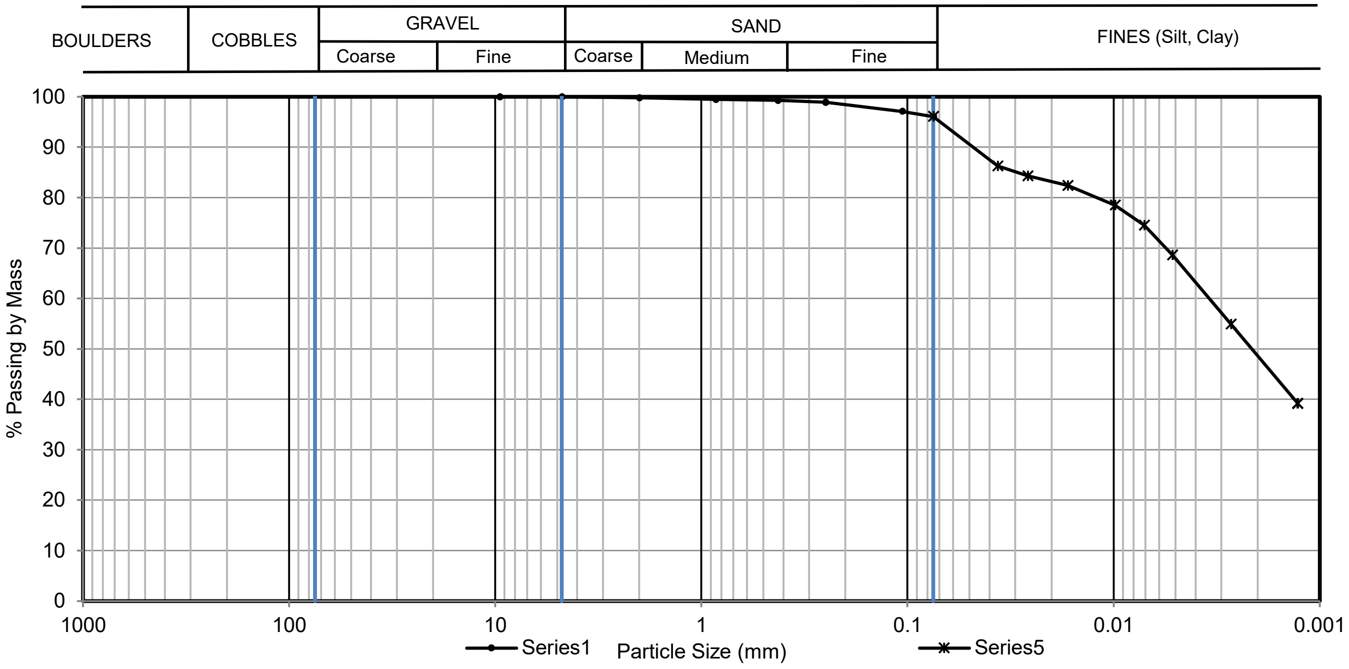
Method B

Test Request #	21451329-21600-610 BH204	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH204
Source:		Sample No.:	5
Soil Description:		Type:	SS
		Depth (m):	13.34 - 13.79

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	18 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)

BOULDERS	COBBLES	GRAVEL	SAND	FINES (Silt, Clay)
		0.0	3.9	96.1



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/8"	9.5	100.0	0.0365	86.3
#4	4.75	100.0	0.0261	84.3
#10	2	99.8	0.0167	82.4
#20	0.85	99.5	0.0098	78.5
#40	0.425	99.3	0.0071	74.5
#60	0.25	98.9	0.0052	68.6
#140	0.106	97.1	0.0027	54.9
#200	0.075	96.1	0.0013	39.2
			0.005 mm	67.86
			0.002 mm	48.59
			D60	0.00
			D30	
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

Tested by: JTimms **Date:** 18 Oct 2022 **Checked by:** MRuck **Date:** 24 Oct 2022 **Reviewed by:** JoNorris **Date:** 06 Nov 2022

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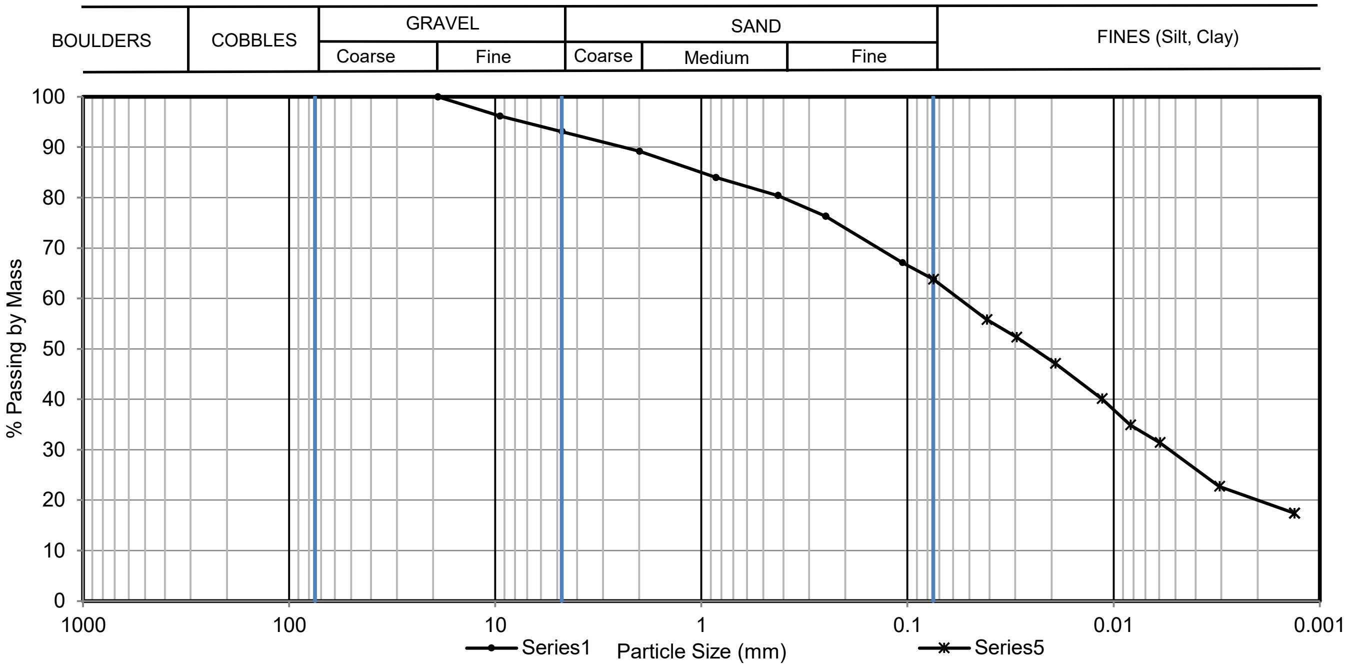
PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422
Method B

Test Request #	21451329-21600-610 BH204	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH204
Source:		Sample No.:	9
		Type:	SS
Soil Description:		Depth (m):	15.77 - 16.23

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	18 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%) 6.9 29.3 63.8



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0412	55.8
3/8"	9.5	96.2	0.0296	52.3
#4	4.75	93.1	0.0192	47.1
#10	2	89.2	0.0114	40.1
#20	0.85	84.0	0.0083	34.9
#40	0.425	80.4	0.0060	31.4
#60	0.25	76.3	0.0031	22.7
#140	0.106	67.1	0.0013	17.4
#200	0.075	63.8		
			0.005 mm	29.10
			0.002 mm	19.98
			D60	0.06
			D30	0.01
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

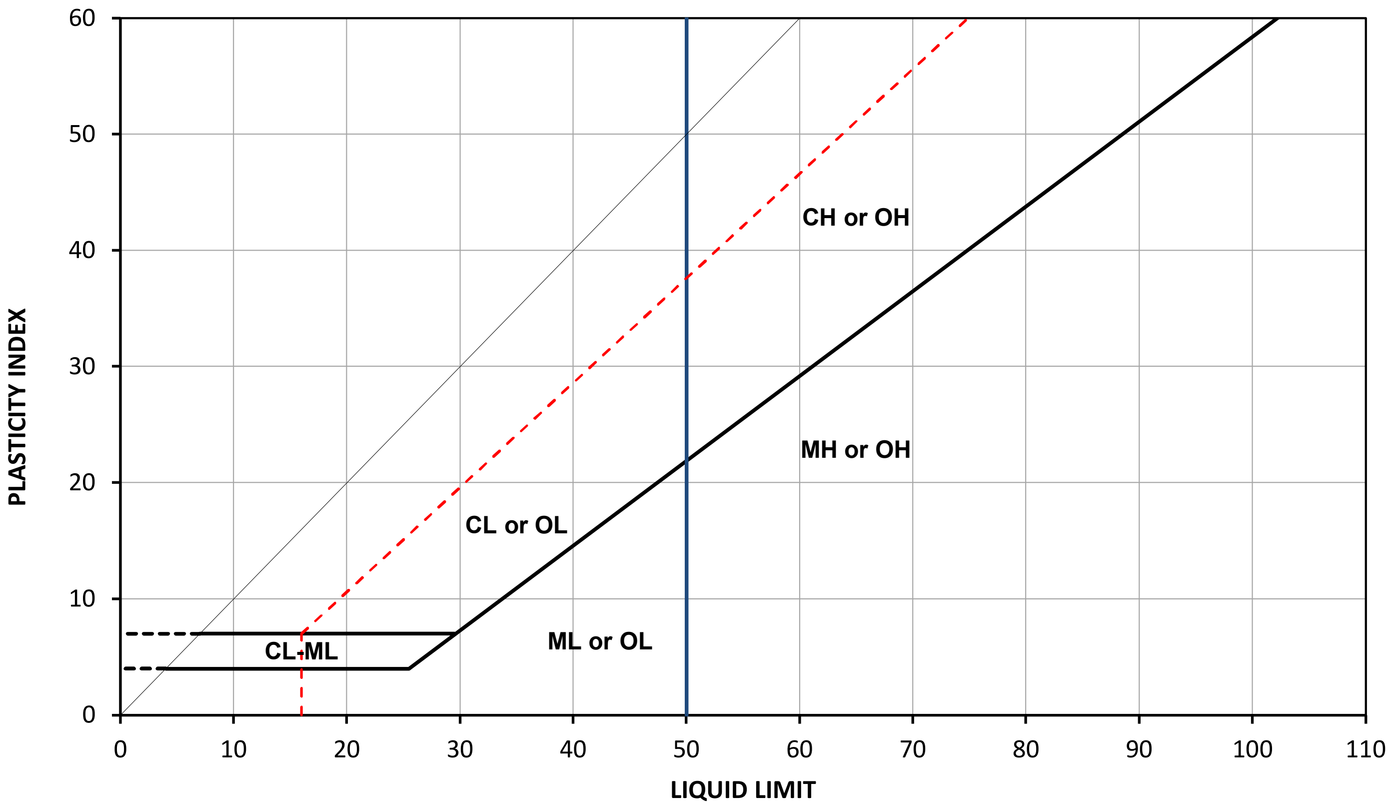
Tested by: JTimms **Date:** 18 Oct 2022 **Checked by:** MRuck **Date:** 24 Oct 2022 **Reviewed by:** JoNorris **Date:** 06 Nov 2022

GOLDER
MEMBER OF WSP

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318

Test Request #	21451329-21600-610 BH204	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH204
Source:		Sample No.:	2
Soil Description:		Type:	SS
		Depth (m):	11.51 - 11.96

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	21 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH204	2	11.51	11.96	97	14.2		NP		

NP = Non-Plastic
ND = Not Determined

Test Preparation
Dry Preparation Tested after >425um removed

Notes:

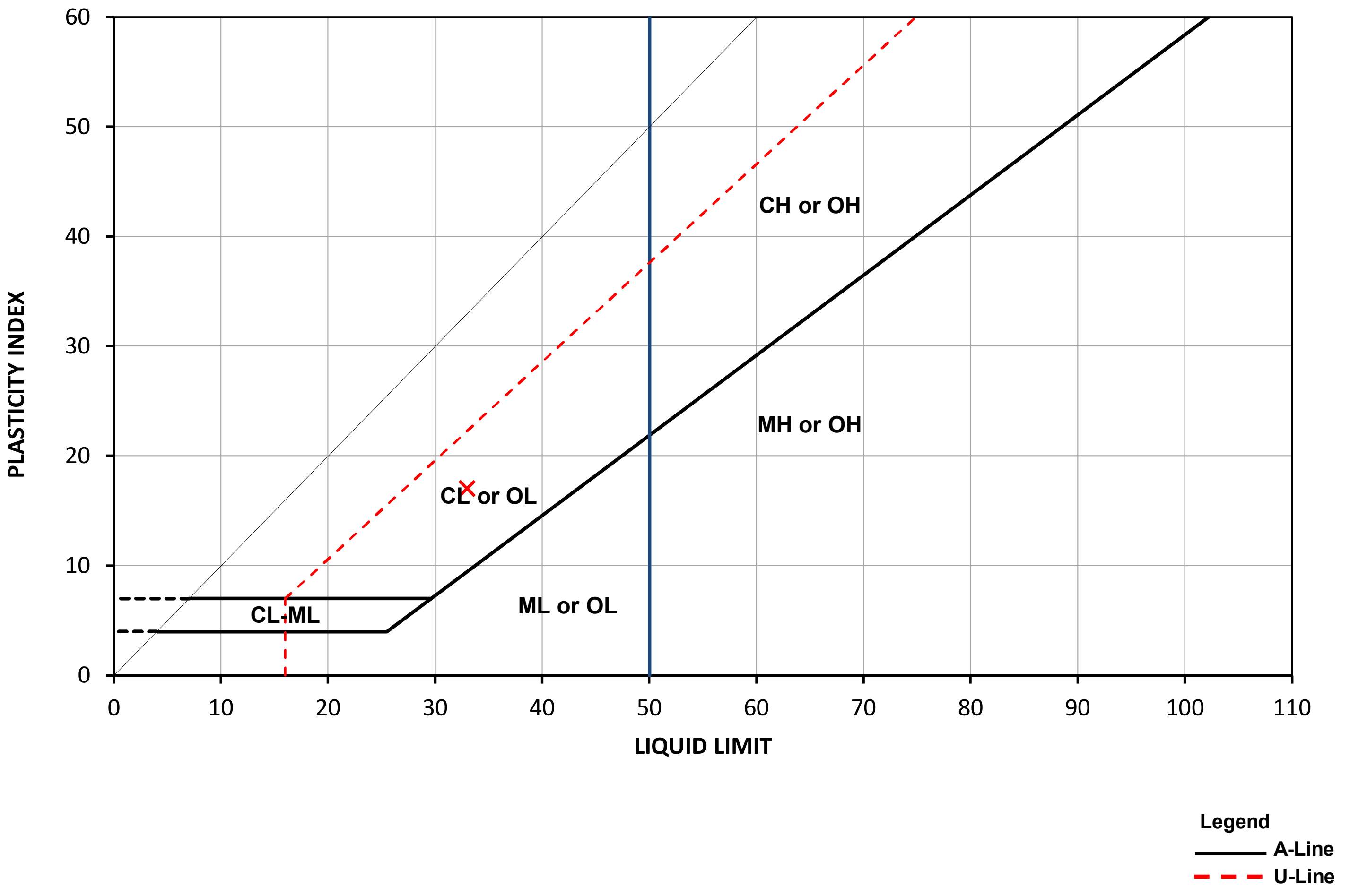
Disclaimer:
The laboratory testing services reported herein have been performed in accordance with the terms of a contract with Golder's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of Golder's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Tested by: JTimms **Date:** 21 Oct 2022
Checked by: MRuck **Date:** 24 Oct 2022
Reviewed by: JoNorris **Date:** 06 Nov 2022

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318
Method A - Multipoint Test

Test Request #	21451329-21600-610 BH204	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH204
Source:		Sample No.:	5
Soil Description:		Type:	SS
		Depth (m):	13.34 - 13.79

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	21 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH204	5	13.34	13.79	98	22.9	33	16	17	0.41

NP = Non-Plastic
ND = Not Determined

Test Preparation
Dry Preparation Tested after >425um removed

Notes:

Tested by: JTimms **Date:** 21 Oct 2022
Checked by: MRuck **Date:** 24 Oct 2022

Disclaimer:
The laboratory testing services reported herein have been performed in accordance with the terms of a contract with Golder's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of Golder's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Reviewed by: JoNorris **Date:** 06 Nov 2022

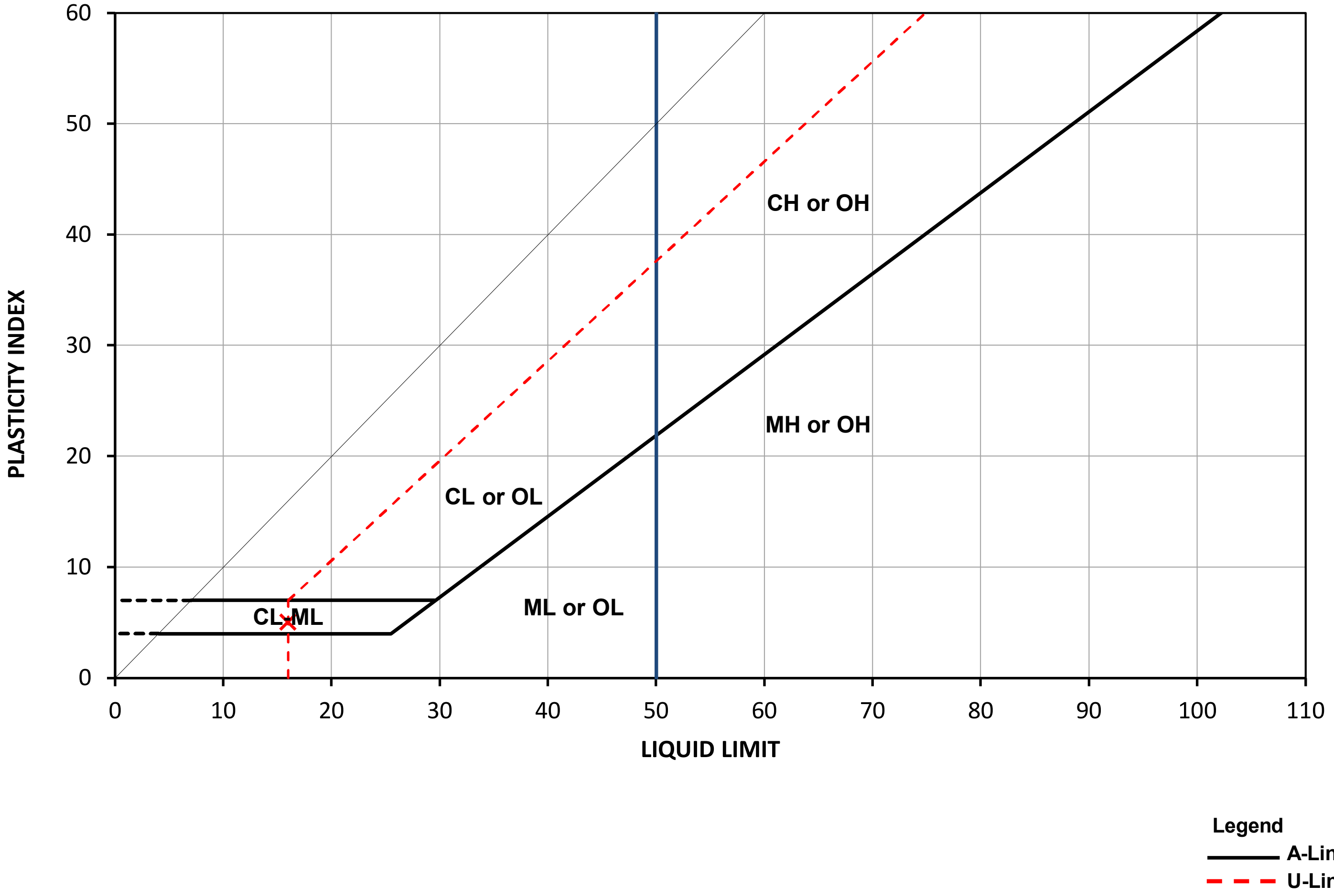
LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

ASTM D4318

Method A - Multipoint Test

Test Request #	21451329-21600-610 BH204	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH204
Source:		Sample No.:	9
Soil Description:		Type:	SS
		Depth (m):	15.77 - 16.23

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	19 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH204	9	15.77	16.23	87	7.4	16	11	5	-0.72

NP = Non-Plastic
ND = Not Determined

Test Preparation

Dry Preparation Tested after >425um removed

Notes:

Tested by: JTimms **Date:** 19 Oct 2022
Checked by: MRuck **Date:** 24 Oct 2022

Disclaimer:

Reviewed by: JoNorris **Date:** 06 Nov 2022

Water (Moisture) Content, Ash Content, and Organic Material of Soils
ASTM D2974 Method A

Test Request #	21451329-21600-610 BH204	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH204
Source:		Sample No.:	2
Soil Description:		Type:	SS
		Depth (m):	11.51 - 11.96

Specimen Reference	NA	Specimen Depth	NA	Date of Test	12 Oct 2022
Specimen Description	NA				

Furnace Temperature During Test (°C)	440
Duration of Test (nearest 15 minutes)	5850
Mass of Crucible With Lid (g)	59.89
Moist Mass of Specimen Plus Crucible With Lid (g)	111.12
Oven Dry Mass of Specimen Plus Crucible With Lid (g)	105.44
Mass of Crucible With Lid Plus Ash (g)	105.32
Water Content (%)	13
Ash Content (%)	99.7
Organic Material (%)	0.3

Test Preparation

Notes:

Disclaimer:

Tested by: JTimms **Date:** 12 Oct 2022

Checked by: MRuck **Date:** 24 Oct 2022

Reviewed by: JoNorris **Date:** 06 Nov 2022

SOIL RESISTIVITY USING THE WENNER FOUR ELECTRODE METHOD (ASTM G57-20)

November 3, 2022
Golder Project Number: 21451329-21600-610

Attention: Sarah Poot

Sample Description: **BH204, SA10, 16.38-16.82m**

Date Scheduled:	October 3, 2022	Sampled By:	Golder Associates Ltd.
Date Received:	October 12, 2022	Golder Lab No.:	G-22-269
Date Tested:	October 12, 2022	Tested By:	E. Shallhorn

Resistivity Meter Model Number	Miller 400D
Soil Box Factor	0.976377953
Temperature of Sample (°C)	23.2
Measured Resistance (ohm)	2560.0
Resistivity (ohm•cm)	2499.5
Temperature Corrected Resistivity (ohm•cm)	**2980.7**

Data Input By: M. Ruck

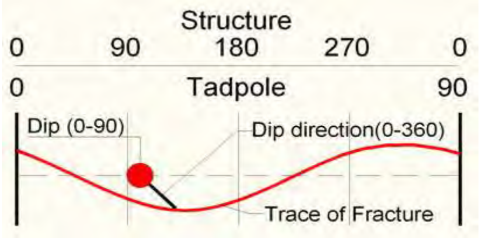
Reviewed by:

Jodi Norris, Technical and Quality Coordinator

Geophysical Record of Borehole: BH204

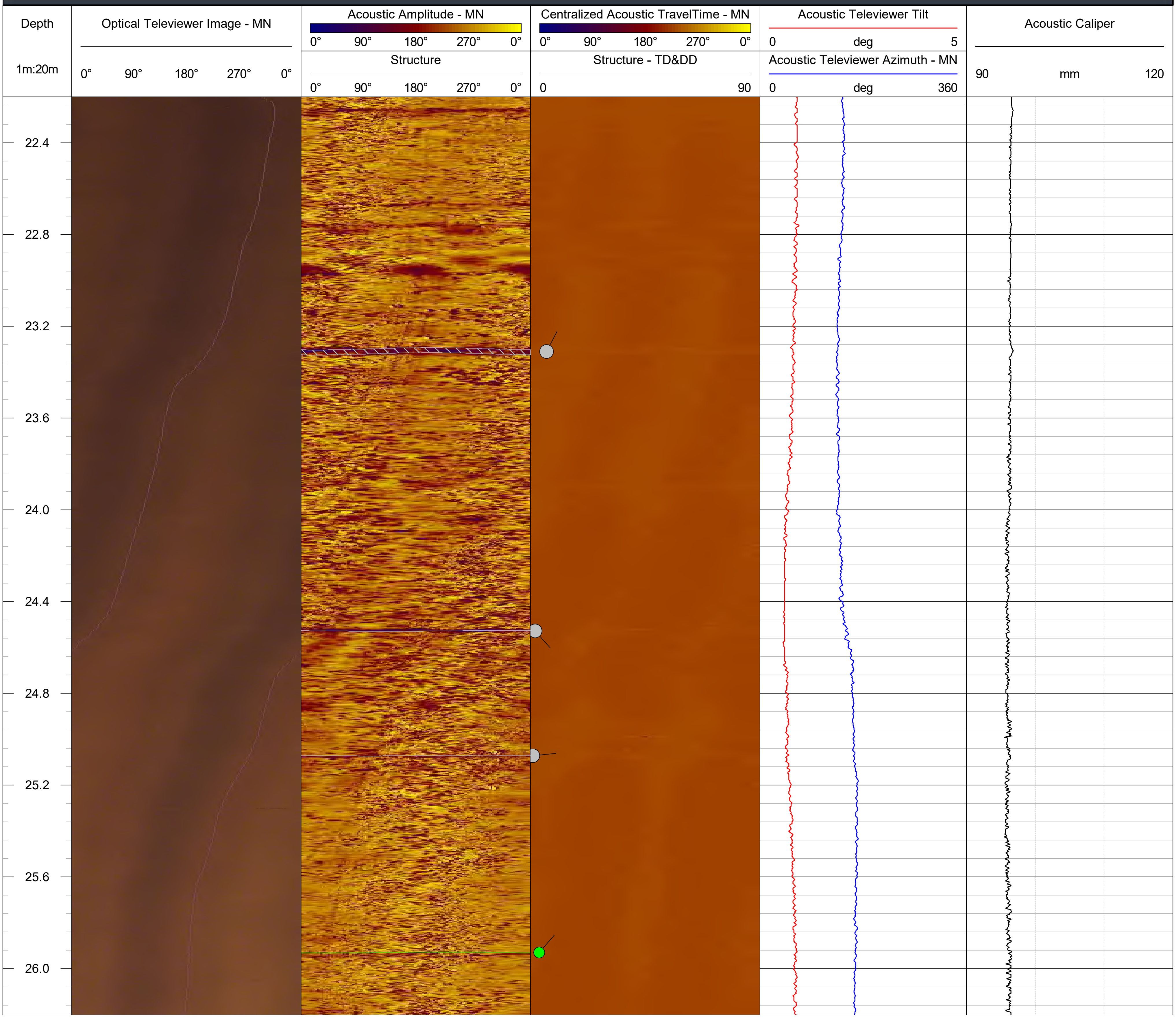
Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

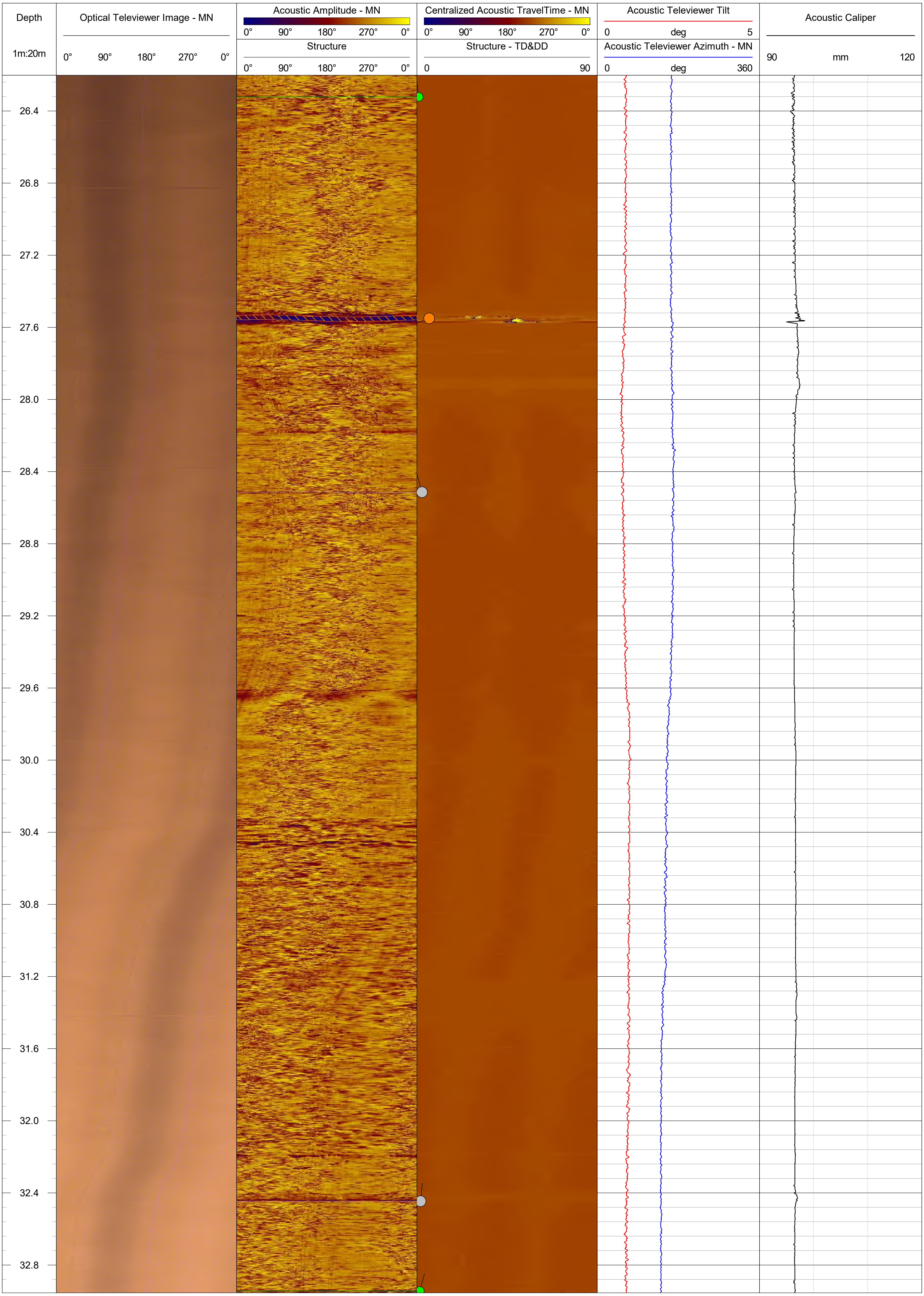
Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	23 m bgs	**Location:**	Darlington, Ontario
Easting:	684127.45 m	**Drilled Depth:**	63 m bgs	**Water Level:**	N/A	**Log Date:**	July-25-2022
Northing:	4859404.61 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	79.39 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	J. Crawford

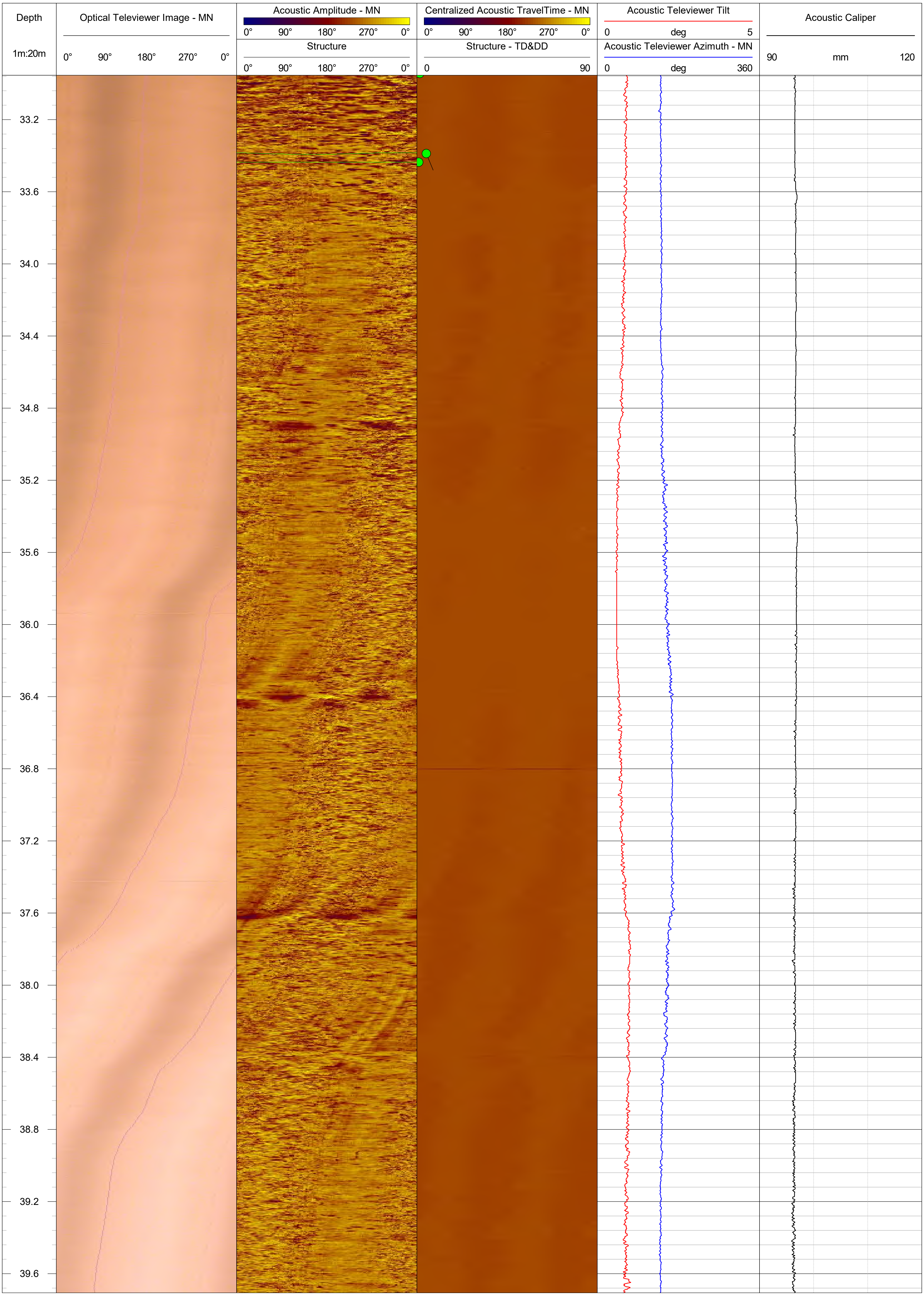


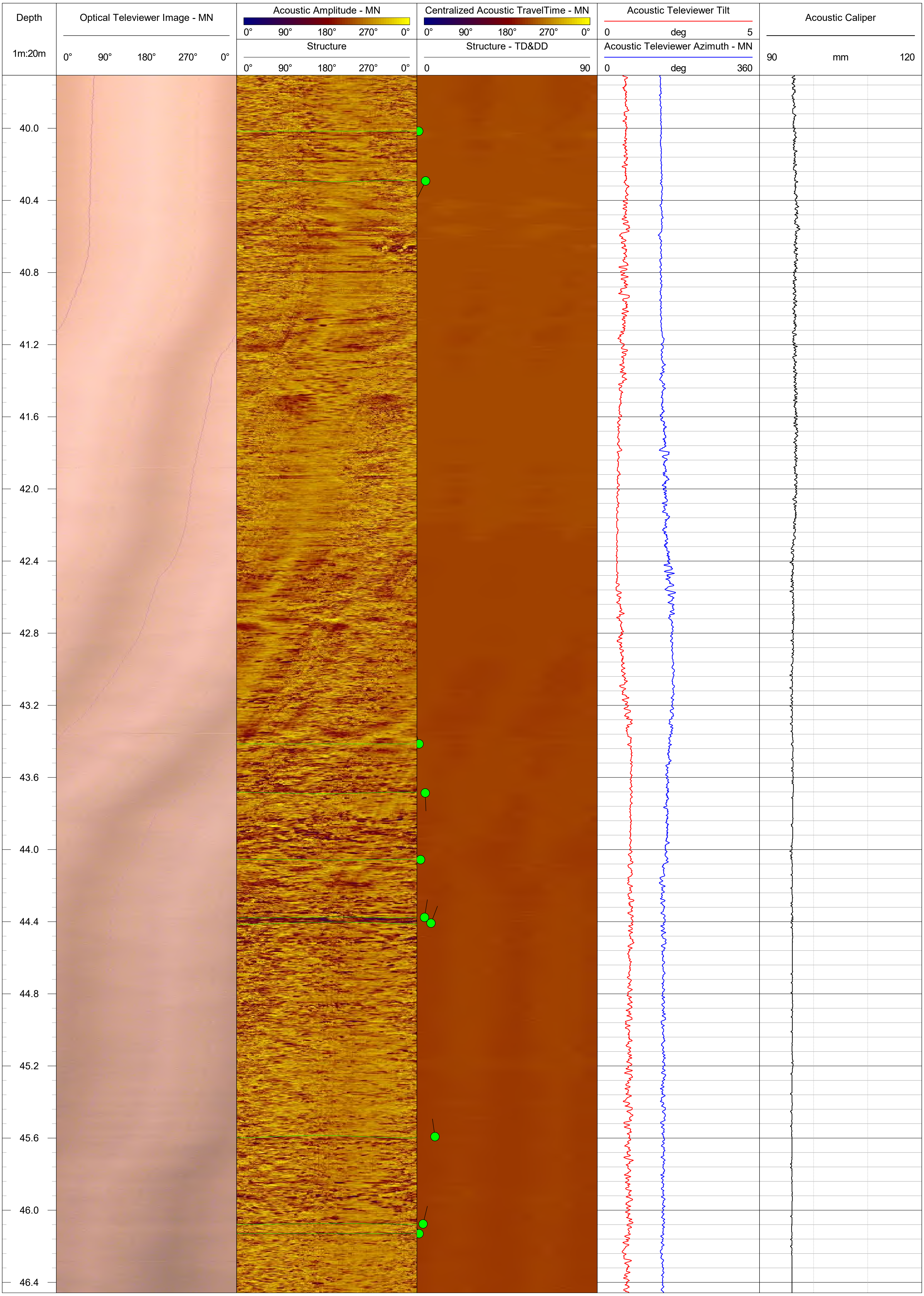
● Partially Open Joint / Fracture
● Filled Fracture / Joint
● Bedding / Banding / Foliation

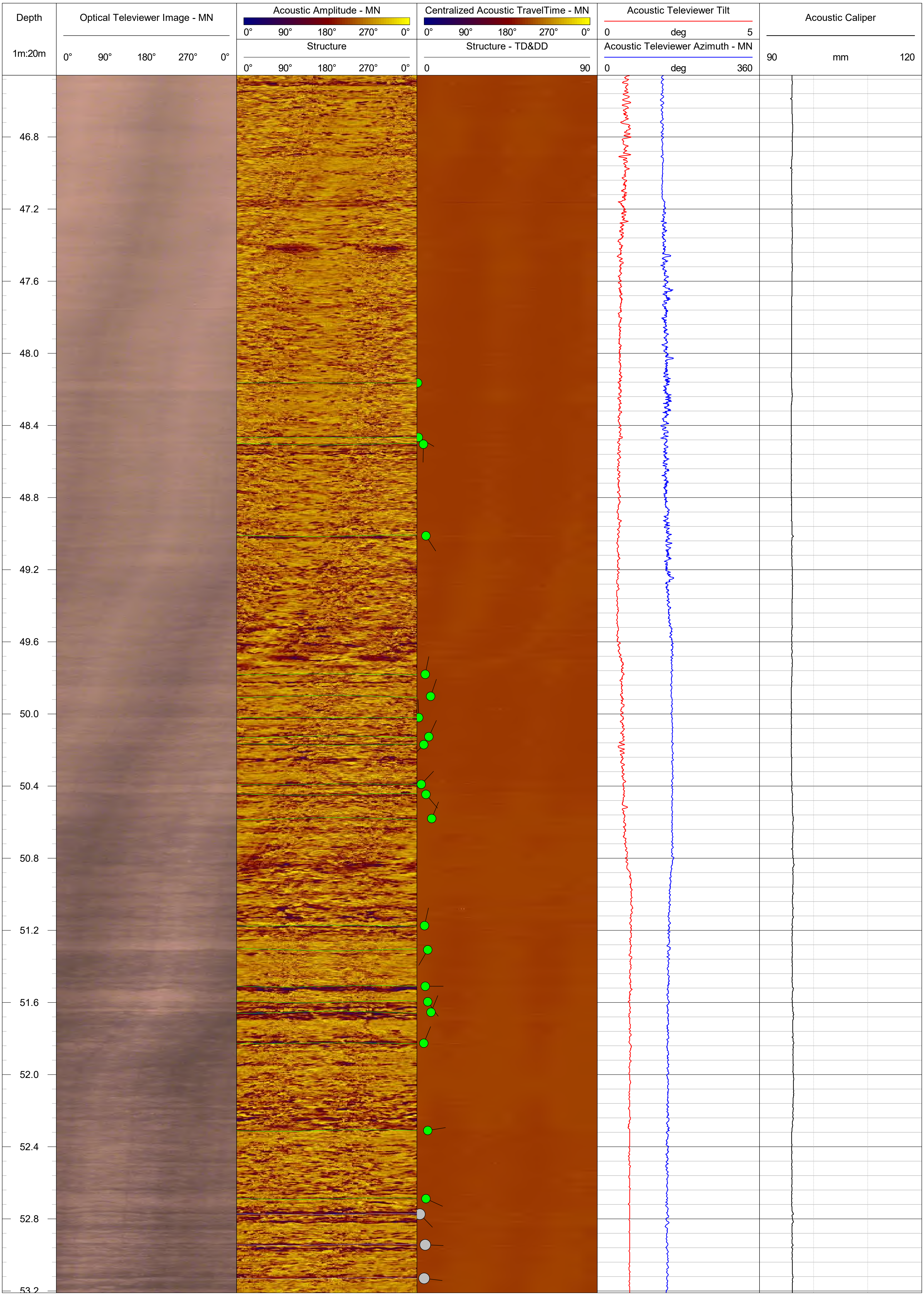
Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)

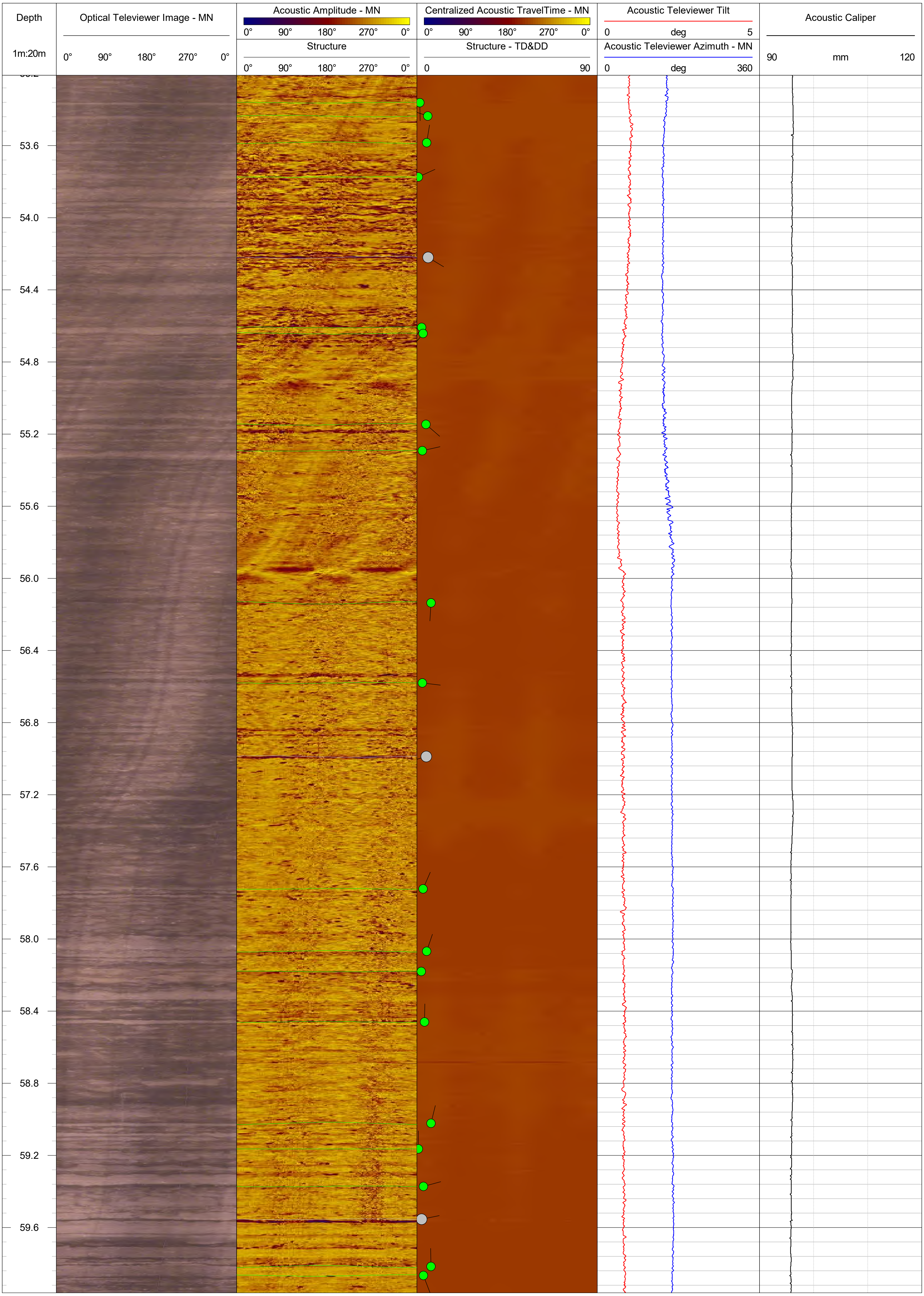


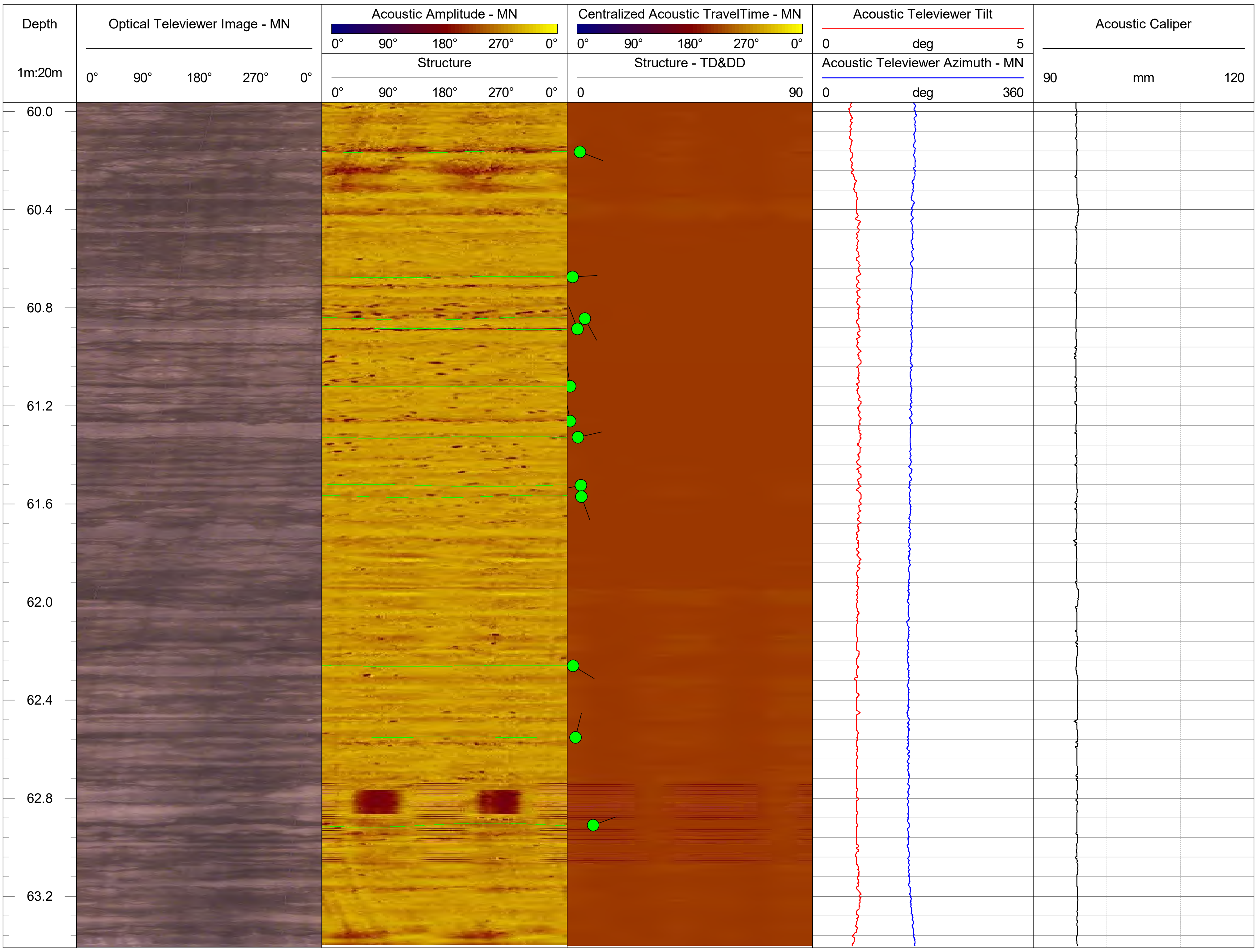

Depth
1m:20m
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
26.4
26.8
27.2
27.6
28.0
28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0
32.4
32.8


Depth
1m:20m
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8
37.2
37.6
38.0
38.4
38.8
39.2
39.6


Depth
1m:20m
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
40.0
40.4
40.8
41.2
41.6
42.0
42.4
42.8
43.2
43.6
44.0
44.4
44.8
45.2
45.6
46.0
46.4


Depth
1m:20m
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
46.8
47.2
47.6
48.0
48.4
48.8
49.2
49.6
50.0
50.4
50.8
51.2
51.6
52.0
52.4
52.8
53.2

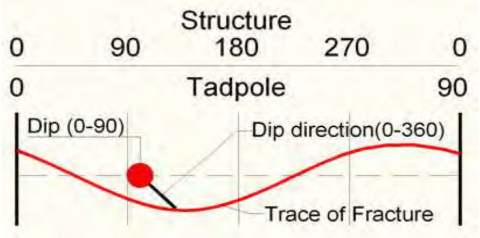

Depth
1m:20m
Optical Televiewer Image - MN
0°
90°
180°
270°
0°
Acoustic Amplitude - MN
0°
90°
180°
270°
0°
Structure
0°
90°
180°
270°
0°
Centralized Acoustic TravelTime - MN
0°
90°
180°
270°
0°
Structure - TD&DD
0
90
Acoustic Televiewer Tilt
0
deg
5
Acoustic Televiewer Azimuth - MN
0
deg
360
Acoustic Caliper
90
mm
120
53.6
54.0
54.4
54.8
55.2
55.6
56.0
56.4
56.8
57.2
57.6
58.0
58.4
58.8
59.2
59.6


Depth
1m:20m
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
60.0
60.4
60.8
61.2
61.6
62.0
62.4
62.8
63.2

Geophysical Record of Borehole: BH204

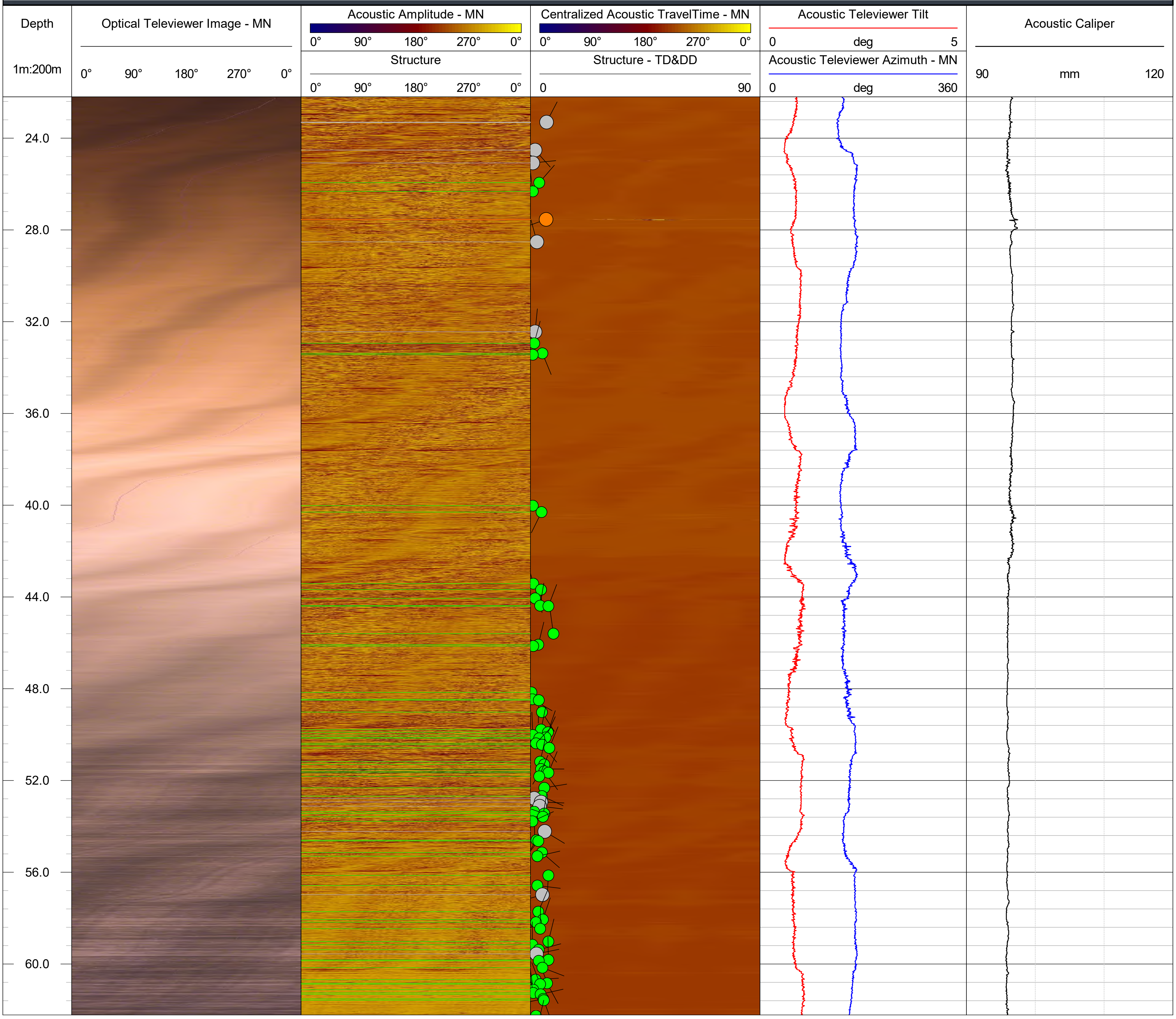
Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	23 m bgs	**Location:**	Darlington, Ontario
Easting:	684127.45 m	**Drilled Depth:**	63 m bgs	**Water Level:**	N/A	**Log Date:**	July-25-2022
Northing:	4859404.61 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	79.39 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	J. Crawford

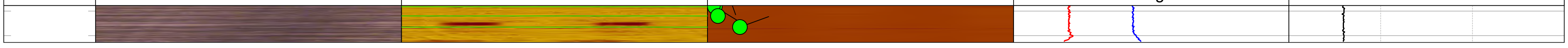


● Partially Open Joint / Fracture
● Filled Fracture / Joint
● Bedding / Banding / Foliation

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)



Depth	Optical Televiewer Image - MN	Acoustic Amplitude - MN 0° 90° 180° 270° 0°	Centralized Acoustic TravelTime - MN 0° 90° 180° 270° 0°	Acoustic Televiewer Tilt 0 deg 5	Acoustic Caliper
1m:200m	0° 90° 180° 270° 0°	Structure 0° 90° 180° 270° 0°	Structure - TD&DD 0 90	Acoustic Televiewer Azimuth - MN 0 deg 360	90 mm 120



A11-BH205

PROJECT: 21451329

LOCATION: N 4859265.57; E 684126.30

RECORD OF BOREHOLE: BH205

SHEET 1 OF 8

BORING DATE: August 24 and 25, 2022

DATUM: Geodetic

DRILL RIG: Diedrich 120 Track Mounted

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20, 40, 60, 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-10}, 10^{-8}, 10^{-6}, 10^{-4}); WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (10, 20, 30, 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION; GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		BARGE DECK		78.16							
0	Mud Rotary Wash Boring (Tricone) UW Casing			0.00							
3.61		WATER		74.55 3.61							
10											

CONTINUED NEXT PAGE

GTA-BHS 005 S:\CLIENTS\OPG\DARLINGTON_GENERATING_STATION\02_DATA\GINT\DARLINGTON_GENERATING_STATION.GPJ GAL-MIS.GDT 3/14/23

DEPTH SCALE

1 : 50

wsp

LOGGED: KL

CHECKED: SEMP

PROJECT: 21451329

LOCATION: N 4859265.57; E 684126.30

RECORD OF BOREHOLE: BH205

SHEET 2 OF 8

BORING DATE: August 24 and 25, 2022

DATUM: Geodetic

DRILL RIG: Diedrich 120 Track Mounted

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
10		*--- CONTINUED FROM PREVIOUS PAGE ---*	
10 – 11.63	Mud Rotary Wash Boring (Tricone) UW Casing	WATER	
11.63 – 13.05	Mud Rotary Wash Boring (Tricone) UW Casing	**Lean Clay (CL)**, stiff to very stiff, grey, trace of fine to coarse sand, low to medium plasticity (Glaciolacustrine) (Unit 4b)	66.53 11.63
13.05 – 14.88	Mud Rotary Wash Boring (Tricone) UW Casing / Open	**Sandy Silty Clay (CL-ML)**, very stiff to hard, grey, moist, fine to coarse sand, subangular to angular fine to coarse gravel, low plasticity (Till) (Unit 5)	65.11 13.05
14.88 – 15.57	Mud Rotary Wash Boring (Tricone) Open	**Sandy Silt (ML)**, very dense, grey, moist, fine to coarse sand, angular to subangular fine to coarse gravel (Till) (Unit 5) - Sandy Silt to Silty Sand layer between 15.47 m and 15.77 m	63.28 14.88
15.57 – 16.28	Mud Rotary Wash Boring (Tricone) Open	**Sandy Lean Clay (CL) to Sandy Silty Clay (CL-ML)**, hard, grey, moist, fine to coarse sand, angular to subangular fine to coarse gravel, low to medium plasticity (Till) (Unit 5) - Rock fragments in Spoon Sample 9	62.59 15.57
16.28		**Shale Bedrock**	61.88 16.28

Notes:

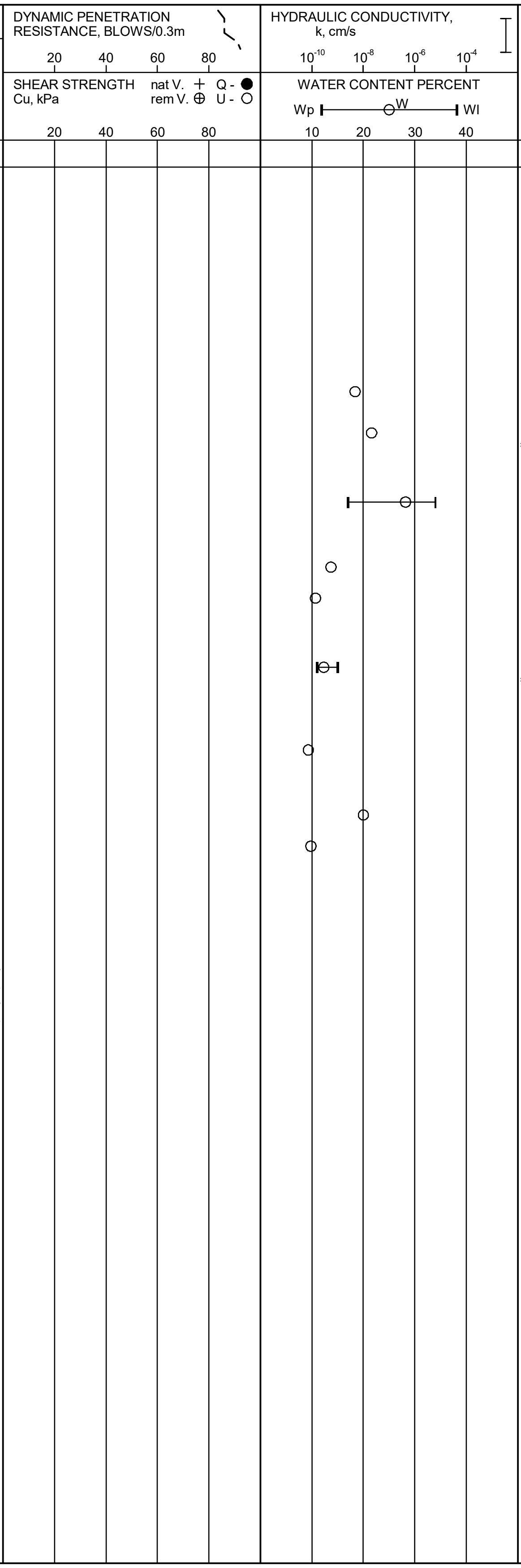
1. Bedrock cored from 16.28 m to 70.39 m depth.

2. Refer to Record of Drillhole BH205.

3. Water level in open borehole could not be measured upon completion of soil drilling due to use of mud-rotary technique.

4. Efficiency of the SPT hammer utilized was 77.9 %.

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	GRAIN SIZE DISTRIBUTION (%) GR	SA	SI	CL
1A							
1B	SS	21	γ=20.73 kN/m³				
2	SS	12		0	2	43	55
3A	SS	16					
3B							
4	SS	35	γ=24.34 kN/m³	3	27	50	20
5	SS	40					
6A	SS	63					
6B							
7A	SS	126					
7B							
7C							
8	SS	100/0.05					
9	SS	100/0.05					



PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

LOGGED: KL

CHECKED: SEMP

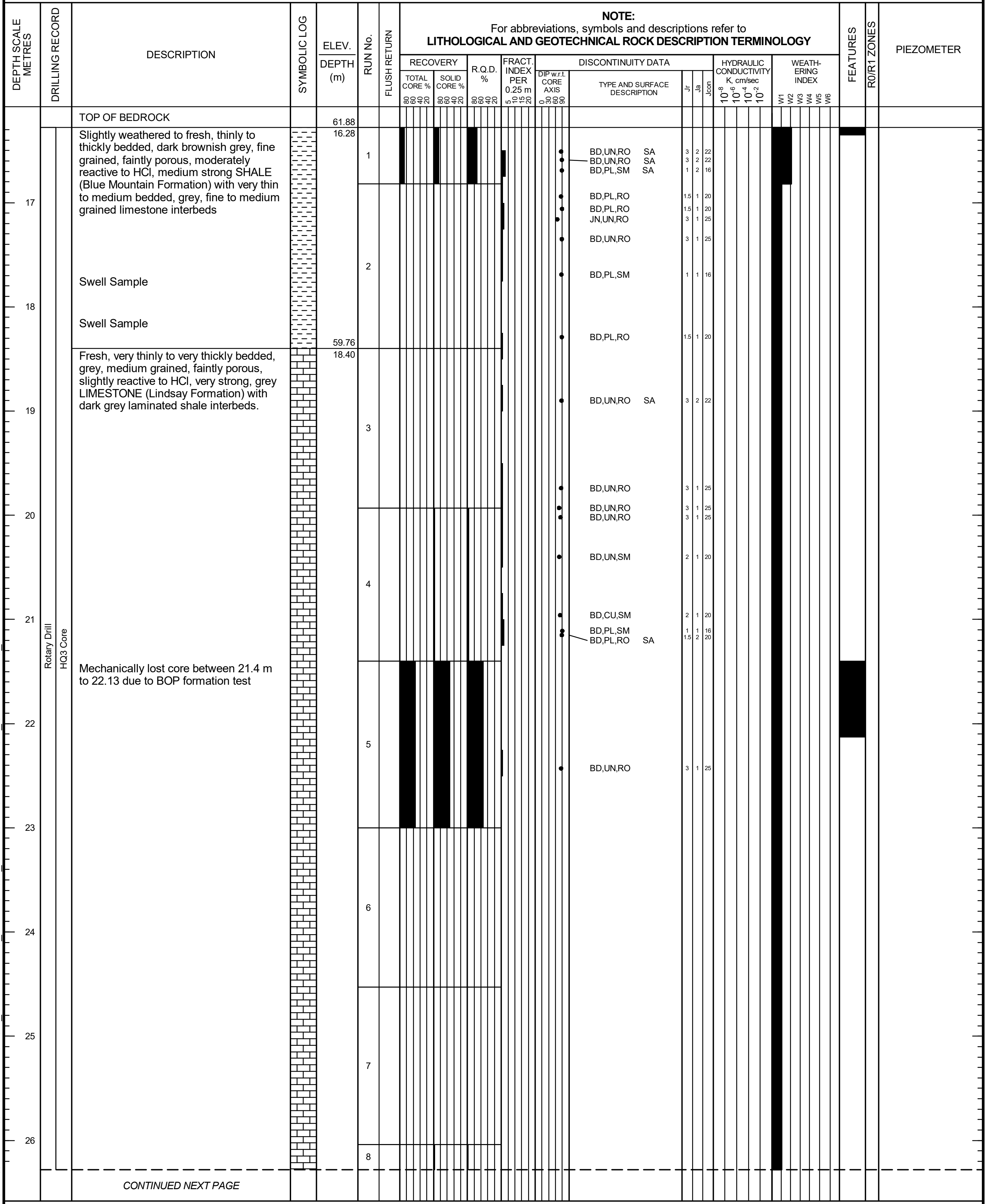
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859265.57; E 684126.3
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH205

DRILLING DATE: August 26 to September 9, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 3 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



TOP OF BEDROCK — 61.88

16.28

Slightly weathered to fresh, thinly to thickly bedded, dark brownish grey, fine grained, faintly porous, moderately reactive to HCl, medium strong SHALE (Blue Mountain Formation) with very thin to medium bedded, grey, fine to medium grained limestone interbeds

Swell Sample

Swell Sample

59.76
18.40

Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, very strong, grey LIMESTONE (Lindsay Formation) with dark grey laminated shale interbeds.

Mechanically lost core between 21.4 m to 22.13 due to BOP formation test

TYPE AND SURFACE DESCRIPTION		Jr	Ja	Jcon
BD,UN,RO	SA	3	2	22
BD,UN,RO	SA	3	2	22
BD,PL,SM	SA	1	2	16
BD,PL,RO		1.5	1	20
BD,PL,RO		1.5	1	20
JN,UN,RO		3	1	25
BD,UN,RO		3	1	25
BD,PL,SM		1	1	16
BD,PL,RO		1.5	1	20
BD,UN,RO	SA	3	2	22
BD,UN,RO		3	1	25
BD,UN,RO		3	1	25
BD,UN,RO		3	1	25
BD,UN,SM		2	1	20
BD,CU,SM		2	1	20
BD,PL,SM		1	1	16
BD,PL,RO	SA	1.5	2	20
BD,UN,RO		3	1	25

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: JS
CHECKED: PKS

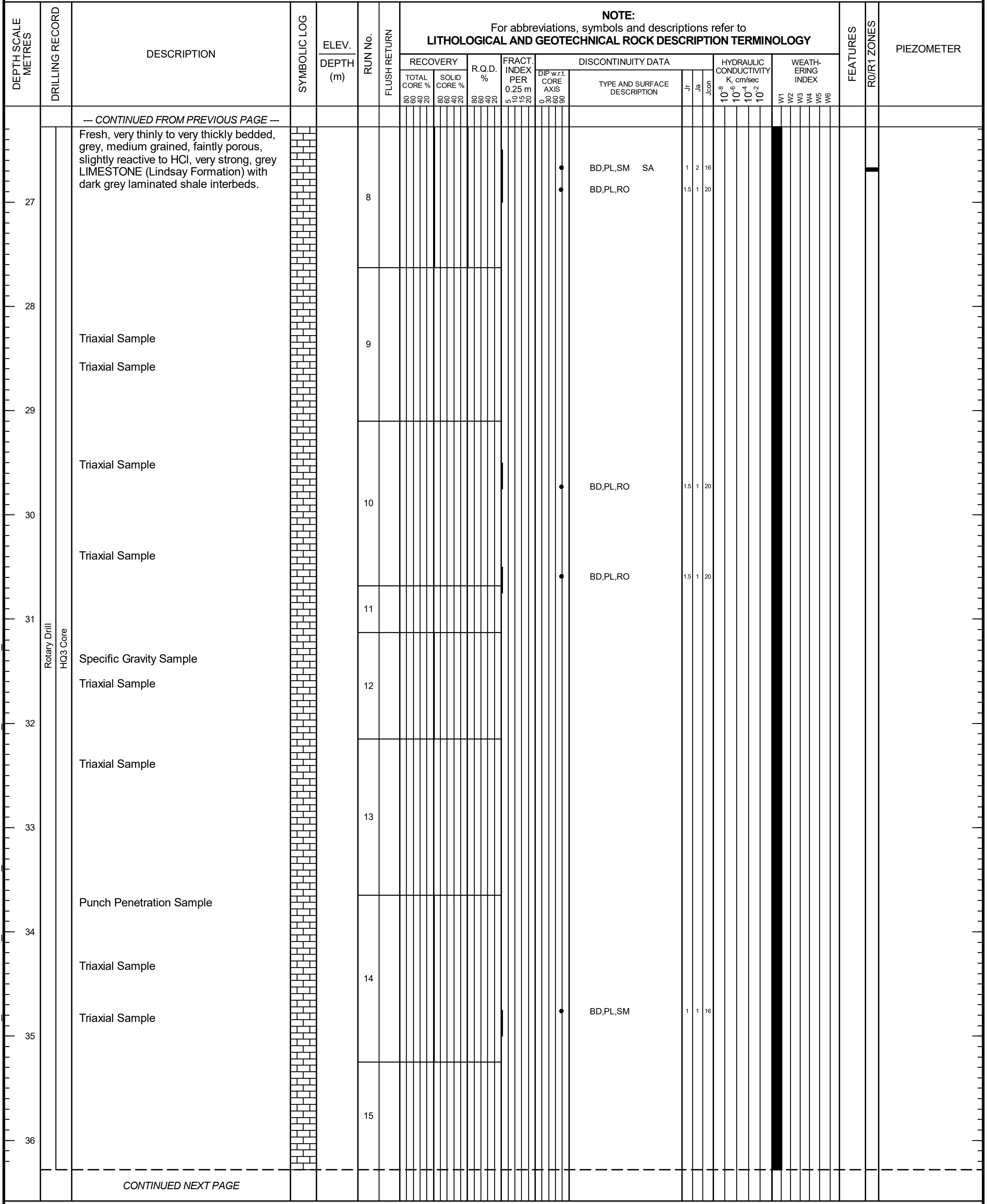
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859265.57; E 684126.3
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH205

DRILLING DATE: August 26 to September 9, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 4 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



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Depth scale (m)	Description	Run No.	Type and surface description	Jr	Ja	Jcon
	Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, very strong, grey LIMESTONE (Lindsay Formation) with dark grey laminated shale interbeds.		BD,PL,SM SA	1	2	16
			BD,PL,RO	1.5	1	20
27		8				
28						
	Triaxial Sample	9				
	Triaxial Sample					
29						
	Triaxial Sample					
			BD,PL,RO	1.5	1	20
30		10				
	Triaxial Sample					
			BD,PL,RO	1.5	1	20
31		11				
	Specific Gravity Sample					
	Triaxial Sample	12				
32						
	Triaxial Sample					
33		13				
	Punch Penetration Sample					
34						
	Triaxial Sample	14				
	Triaxial Sample		BD,PL,SM	1	1	16
35						
36		15				

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: JS
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859265.57; E 684126.3
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH205

DRILLING DATE: August 26 to September 9, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 5 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE % (80 60 40 20)	RECOVERY SOLID CORE % (80 60 40 20)	R.Q.D. % (80 60 40 20)	FRACT. INDEX PER 0.25 m (5 10 15 20)	DISCONTINUITY DATA DIP w.r.t. CORE AXIS (0 30 60 90)	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-8} 10^{-6} 10^{-4} 10^{-2})	WEATHERING INDEX (W1 W2 W3 W4 W5 W6)	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
	Rotary Drill HQ3 Core	Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, very strong, grey LIMESTONE (Lindsay Formation) with dark grey laminated shale interbeds. Cerchar Sample			15																
37					16															
					17															
38					18															
39					19															
40					20															
		UCS with Modulus Sample			21															
41					22															
42					23							BD,PL,SM	1	1	16					
		Direct Shear Sample										BD,PL,SM	1	1	16					
43		Triaxial Sample																		
44					24															
					25															
45		Brazilian Sample			26															
46					27															
		CONTINUED NEXT PAGE																		

DEPTH SCALE
1 : 50

LOGGED: JS
CHECKED: PKS

GTA-RCK 048 S:\CLIENTS\OPG\DARLINGTON_GENERATING_STATION\02_DATA\GINT\DARLINGTON_GENERATING_STATION.GPJ GAL-MISS.GDT 6/2/23

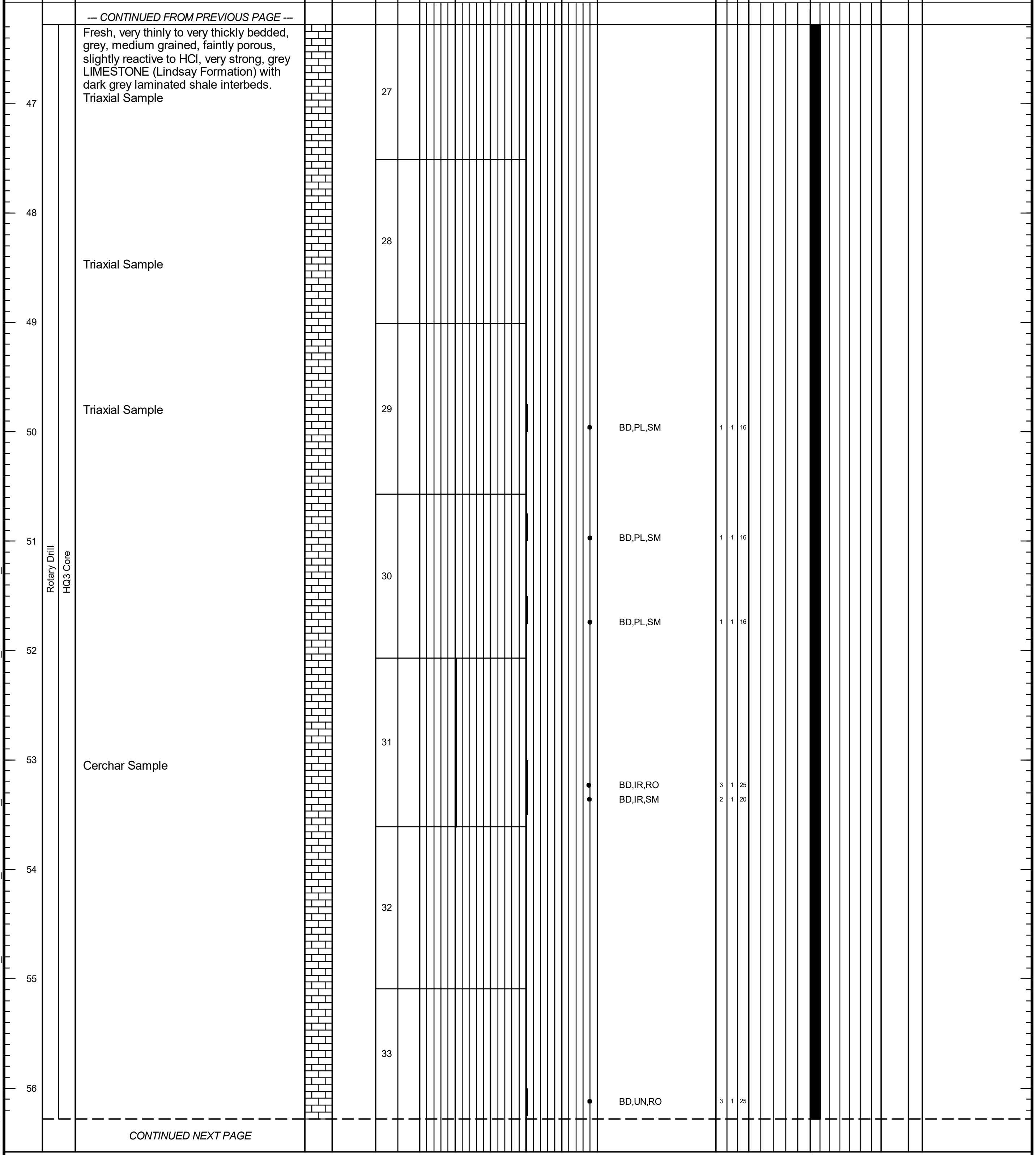
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859265.57; E 684126.3
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH205

DRILLING DATE: August 26 to September 9, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 6 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



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DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	RUN No.	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
	Rotary Drill HQ3 Core	Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, very strong, grey LIMESTONE (Lindsay Formation) with dark grey laminated shale interbeds.					
47		Triaxial Sample	27				
48			28				
		Triaxial Sample					
49							
		Triaxial Sample	29				
50				BD,PL,SM	1	1	16
51				BD,PL,SM	1	1	16
			30				
				BD,PL,SM	1	1	16
52							
			31				
53		Cerchar Sample					
				BD,IR,RO	3	1	25
				BD,IR,SM	2	1	20
54			32				
55			33				
56				BD,UN,RO	3	1	25

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: JS
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859265.57; E 684126.3
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH205

SHEET 7 OF 8

DRILLING DATE: August 26 to September 9, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

Columns: DEPTH SCALE METRES | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (m) | RUN No. | FLUSH RETURN | RECOVERY (TOTAL CORE % 80 60 40 20; SOLID CORE % 80 60 40 20) | R.Q.D. % 80 60 40 20 | FRACT. INDEX PER 0.25 m 5 10 15 20 | DISCONTINUITY DATA (DIP w.r.t. CORE AXIS 0 30 60 90; TYPE AND SURFACE DESCRIPTION; Jr; Ja; Jcon) | HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2} | WEATH-ERING INDEX W1 W2 W3 W4 W5 W6 | FEATURES | R0/R1 ZONES | PIEZOMETER

--- CONTINUED FROM PREVIOUS PAGE ---

Drilling record: Rotary Drill, HQ3 Core

Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, very strong, grey LIMESTONE (Lindsay Formation) with dark grey laminated shale interbeds.

Depth scale (m)	Run No.	Type and surface description	Jr	Ja	Jcon
	33				
57	34				
58					
	35	BD,UN,SM	2	1	20
59					
60	36				
61					
62	37				
63					
64	38				
65	39				
		BD,UN,RO	3	1	25
66	40				

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: JS
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859265.57; E 684126.3
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH205

SHEET 8 OF 8

DRILLING DATE: August 26 to September 9, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (m)	RUN No.	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
	Rotary Drill HQ3 Core	Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, very strong, grey LIMESTONE (Lindsay Formation) with dark grey laminated shale interbeds.		40				
67								
68				41				
					BD,PL,RO	1.5	1	20
69				42	BD,UN,RO IN	3	6	6
70			7.77 70.39					
		END OF DRILLHOLE						
71								
72								
73								
74								
75								
76								

Column headings: SYMBOLIC LOG; FLUSH RETURN; RECOVERY (TOTAL CORE %, SOLID CORE %: 80 60 40 20); R.Q.D. % (80 60 40 20); FRACT. INDEX PER 0.25 m (5 10 15 20); DIP w.r.t. CORE AXIS (0 30 60 90); HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-8} 10^{-6} 10^{-4} 10^{-2}); WEATHERING INDEX (W1 W2 W3 W4 W5 W6); FEATURES; R0/R1 ZONES; PIEZOMETER

DEPTH SCALE
1 : 50

LOGGED: JS
CHECKED: PKS

Water Content Summary
ASTM D2216

Test Request #	21451329-21600-610 BH205	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville		

Sample Location	Sample				Soil Description	Water Content %	Method	Remarks
	Ref	Top (m)	Base (m)	Type				
BH205	1A	11.63	11.68	SS		18.4	B	
BH205	1B	11.68	12.24	SS		21.6	B	
BH205	2	12.24	12.70	SS		28.2	B	
BH205	3A	12.85	13.05	SS		13.7	B	
BH205	3B	13.05	13.31	SS		10.7	B	
BH205	4	13.46	13.92	SS		12.3	B	
BH205	5	14.07	14.53	SS		9.3	B	
BH205	6A	14.68	14.88	SS		20.0	B	
BH205	6B	14.88	15.14	SS		9.8	B	

Notes:

Tested by: JTimms **Date:** 04 Oct 2022

Checked by: MRuck **Date:** 24 Oct 2022

Reviewed by: JoNorris **Date:** 10 Nov 2022

GOLDER
MEMBER OF WSP

PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422

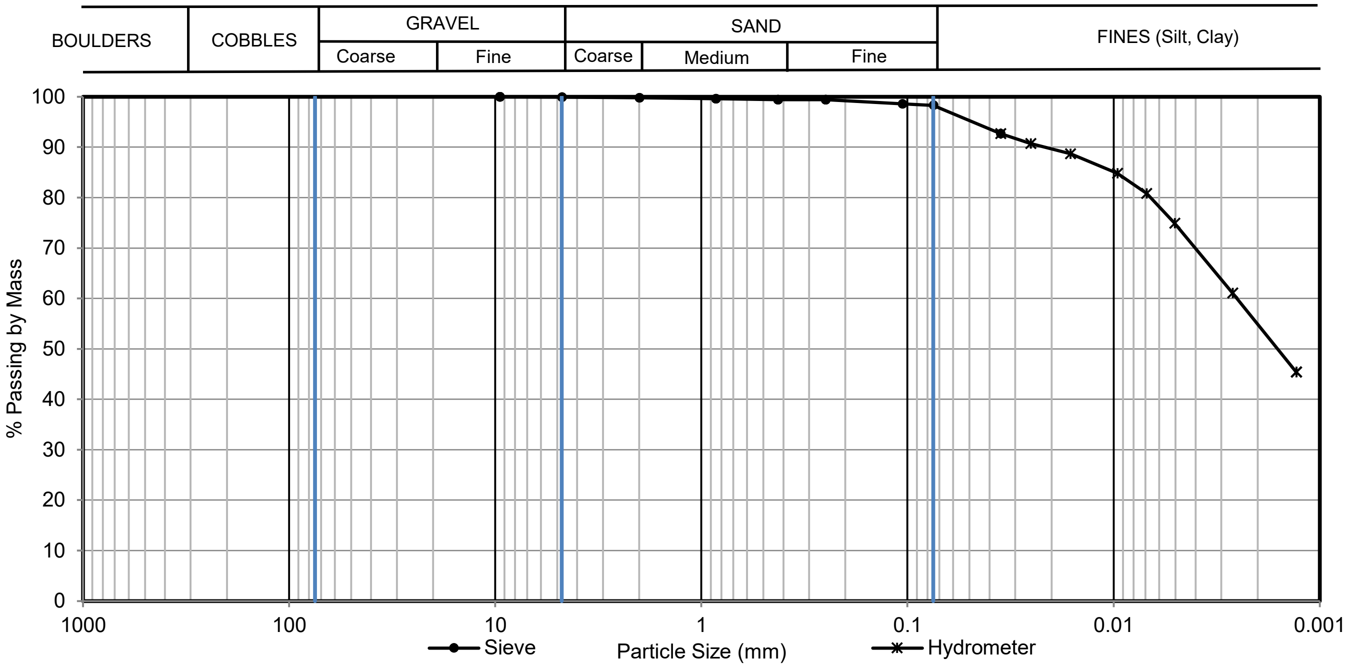
Method B

Test Request #	21451329-21600-610 BH205	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH205
Source:		Sample No.:	2
		Type:	SS
Soil Description:		Depth (m):	12.24 - 12.70

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	17 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)

BOULDERS	COBBLES	GRAVEL	SAND	FINES (Silt, Clay)
		0.1	1.6	98.3



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/8"	9.5	100.0	0.0354	92.7
#4	4.75	99.9	0.0253	90.7
#10	2	99.8	0.0162	88.7
#20	0.85	99.6	0.0096	84.8
#40	0.425	99.4	0.0069	80.8
#60	0.25	99.4	0.0051	74.9
#140	0.106	98.6	0.0027	61.1
#200	0.075	98.3	0.0013	45.4
			0.005 mm	74.65
			0.002 mm	54.90
			D60	0.00
			D30	
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

Tested by: MKMarren **Date:** 17 Oct 2022 **Checked by:** MRuck **Date:** 24 Oct 2022 **Reviewed by:** JoNorris **Date:** 10 Nov 2022

GOLDER
MEMBER OF WSP

PARTICLE SIZE DISTRIBUTION

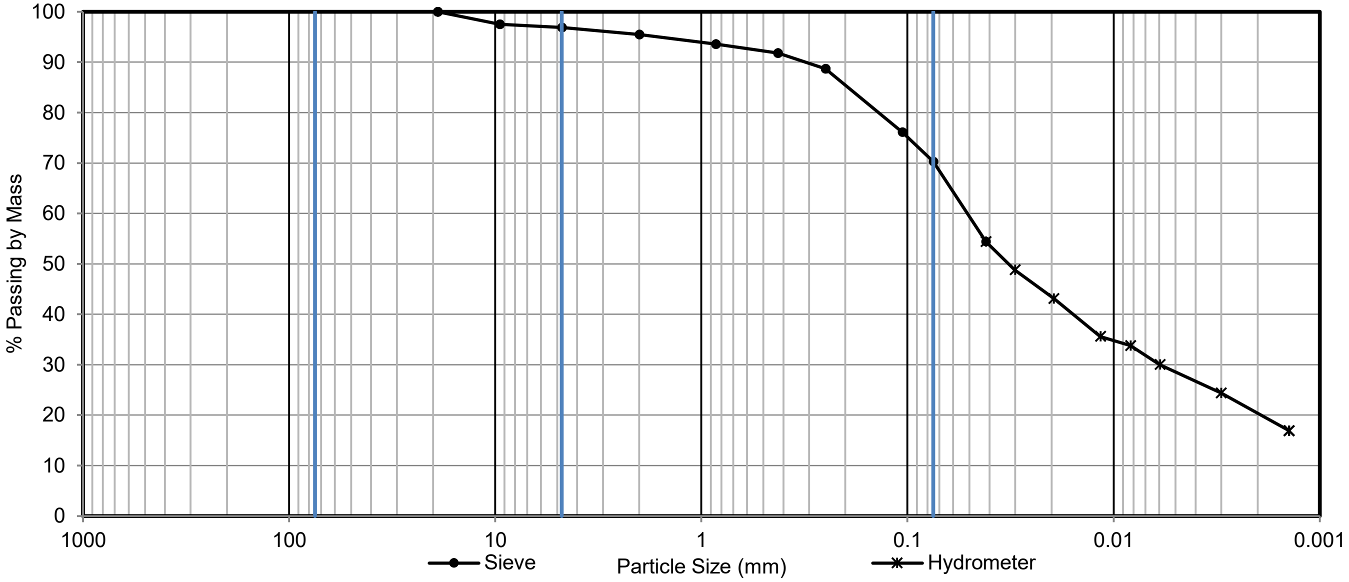
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH205	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH205
Source:		Sample No.:	4
		Type:	SS
Soil Description:		Depth (m):	13.46 - 13.92

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	17 Oct 2022
Specimen Description	NA				

	BOULDERS	COBBLES	GRAVEL		SAND			FINES (Silt, Clay)
			Coarse	Fine	Coarse	Medium	Fine	
Grain Size Distribution (%)			3.1		26.6			70.3



Sieve			**Hydrometer Sedimentation**	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0416	54.4
3/8"	9.5	97.5	0.0301	48.8
#4	4.75	96.9	0.0195	43.1
#10	2	95.5	0.0116	35.6
#20	0.85	93.6	0.0083	33.8
#40	0.425	91.8	0.0060	30.0
#60	0.25	88.7	0.0030	24.4
#140	0.106	76.1	0.0014	16.9
#200	0.075	70.3		
			0.005 mm	28.55
			0.002 mm	20.36
			D60	0.05
			D30	0.01
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

Tested by: MKMarren **Date:** 17 Oct 2022 **Checked by:** MRuck **Date:** 24 Oct 2022 **Reviewed by:** JoNorris **Date:** 10 Nov 2022

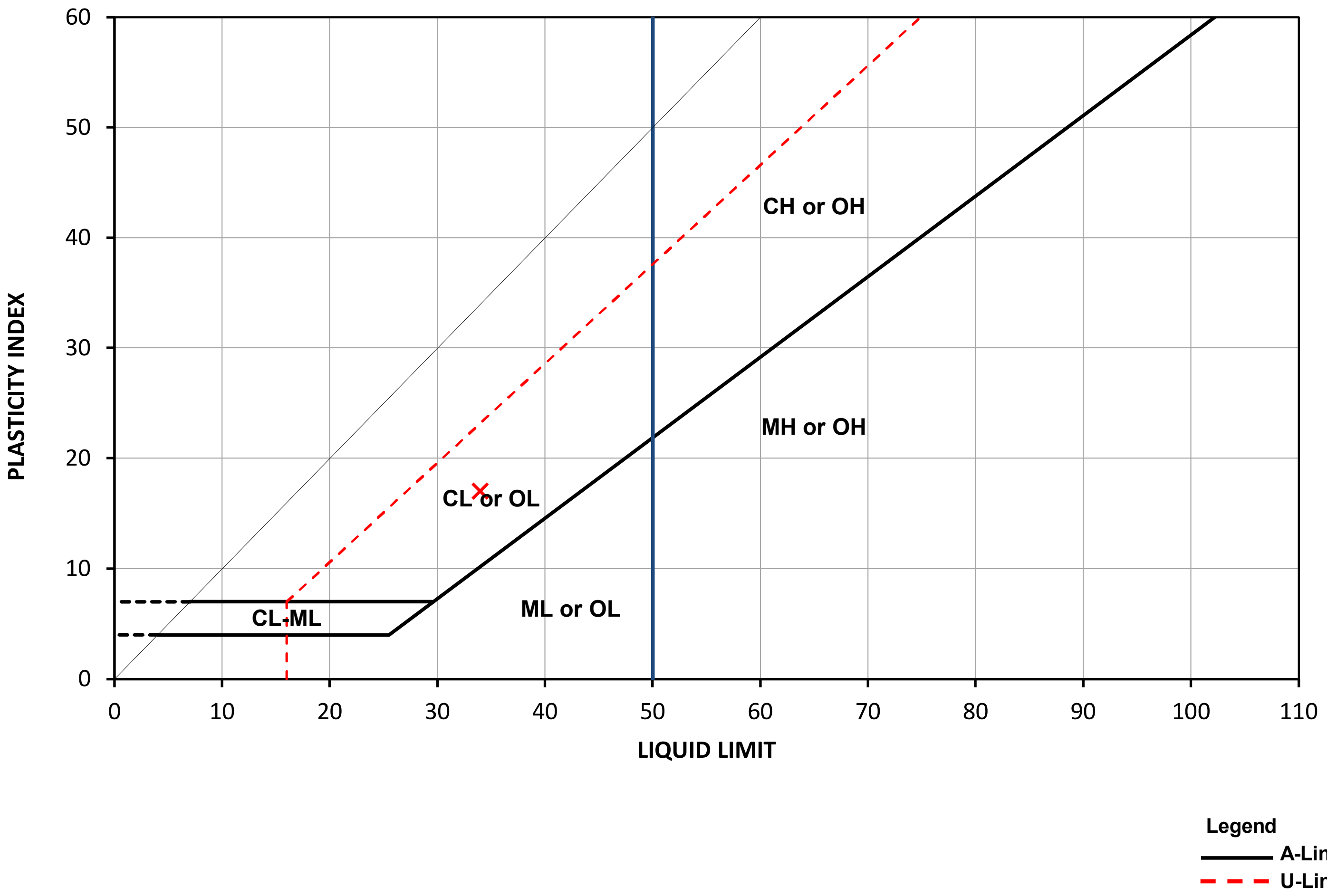
LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

ASTM D4318

Method A - Multipoint Test

Test Request #	21451329-21600-610 BH205	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH205
Source:		Sample No.:	2
Soil Description:		Type:	SS
		Depth (m):	12.24 - 12.70

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	19 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH205	2	12.24	12.70	89	28.2	34	17	17	0.66

NP = Non-Plastic
ND = Not Determined

Test Preparation

Dry Preparation Tested after >425um removed

Notes:

Disclaimer:

Tested by: JTimms **Date:** 19 Oct 2022

Checked by: MRuck **Date:** 24 Oct 2022

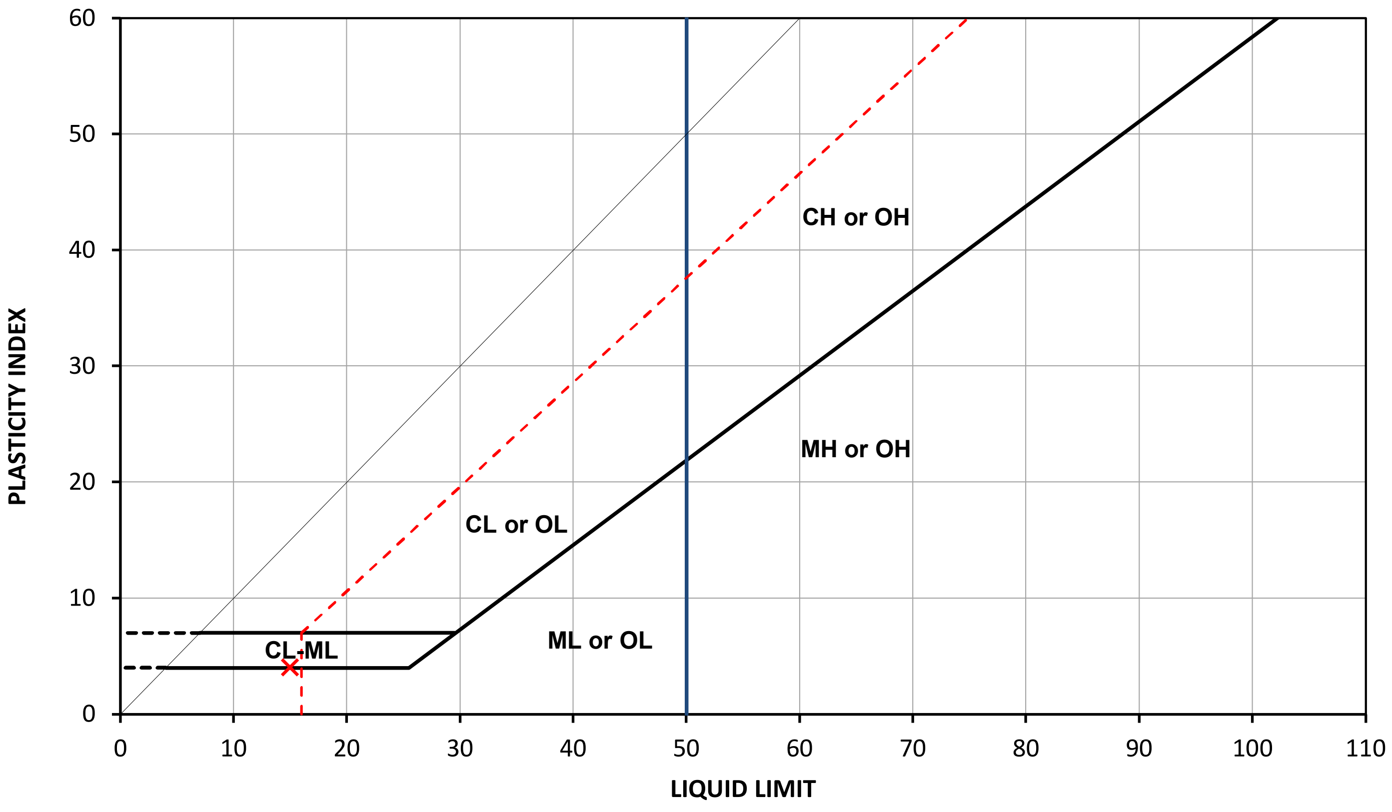
Reviewed by: JoNorris **Date:** 10 Nov 2022

GOLDER
MEMBER OF WSP

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318
Method A - Multipoint Test

Test Request #	21451329-21600-610 BH205	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH205
Source:		Sample No.:	4
Soil Description:		Type:	SS
		Depth (m):	13.46 - 13.92

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	19 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH205	4	13.46	13.92	82	12.3	15	11	4	0.33

NP = Non-Plastic
ND = Not Determined

Test Preparation
Dry Preparation Tested after >425um removed

Notes:

Disclaimer:
The laboratory testing services reported herein have been performed in accordance with the terms of a contract with Golder's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of Golder's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Tested by: JTimms **Date:** 19 Oct 2022
Checked by: MRuck **Date:** 24 Oct 2022
Reviewed by: JoNorris **Date:** 10 Nov 2022

DENSITY (UNIT WEIGHT) OF SOIL SPECIMENS

ASTM D 7263 Method B

Borehole Number	BH205	BH205			
Sample Number	1B	4			
Sample Depth, m	11.68-12.24	13.46-13.92			
Weight of Soil, g	143.32	161.1			
Diameter of Sample, cm	3.402	3.380			
Length of Sample, cm	7.460	7.235			
Volume of Sample, cc	67.81	64.92			
Water Content, %	25.23	10.310			
Wet Density, g/cm^3	2.114	2.482			
Dry Density, g/cm^3	1.688	2.250			
Unit Weight, kN/m^3	20.73	24.34			

Notes:

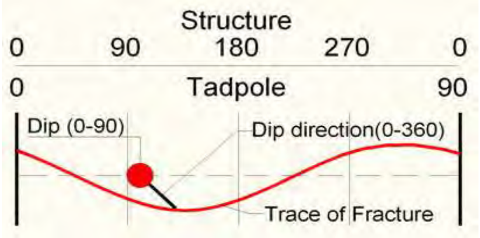
- Water contents determined from tested specimens
- Specimen was intact

Project Number	21451329-21600-610	Tested By	S. Khan
Date Tested	October 26, 2022	Checked By	LH

Geophysical Record of Borehole: BH205

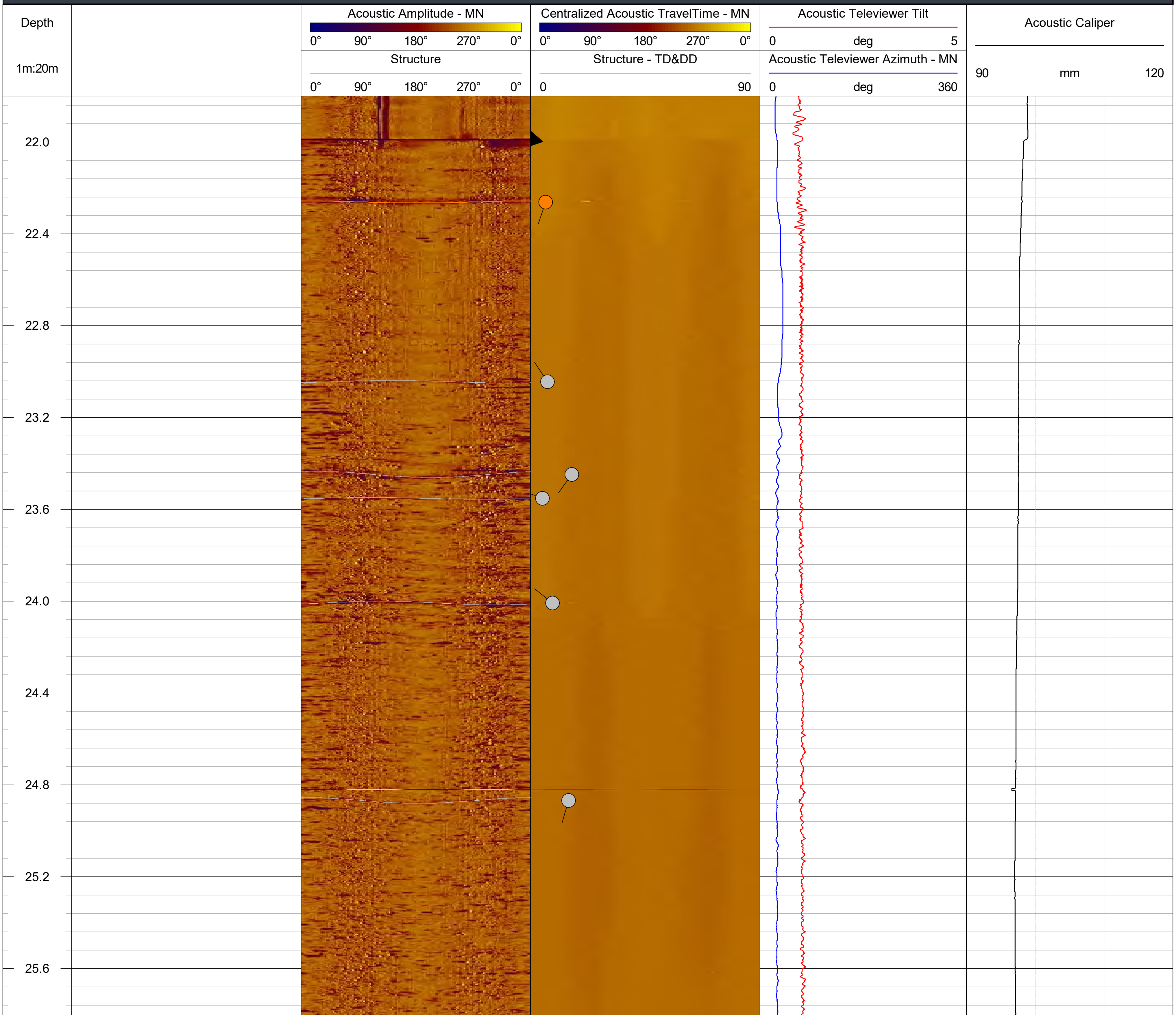
Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

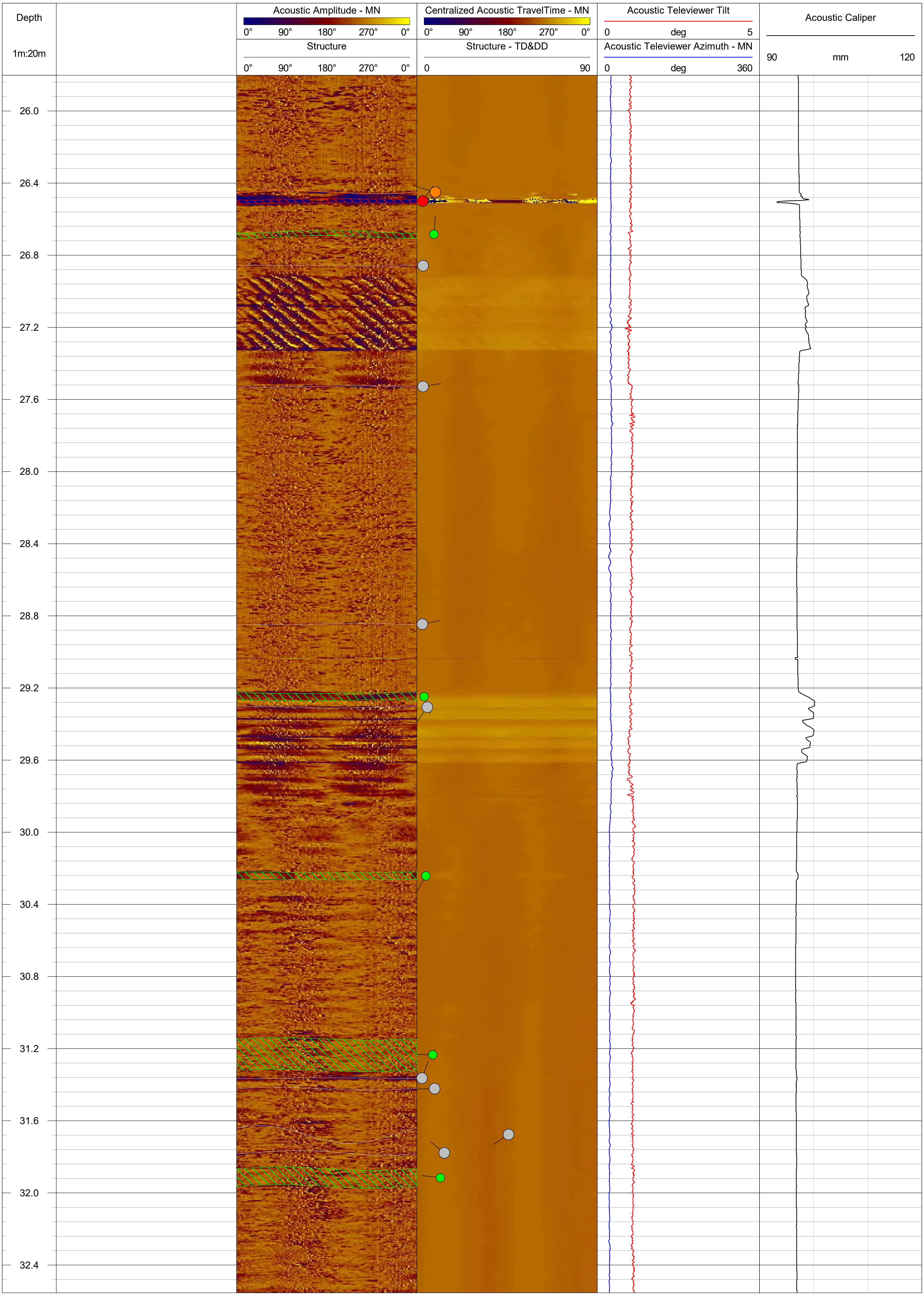
Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	~21.9 m bgs	**Location:**	Darlington, Ontario
Easting:	684126.30 m	**Drilled Depth:**	70.39 m bgs	**Water Level:**	3.16 m bgs	**Log Date:**	Sept-10-2022
Northing:	4859265.57 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	78.16 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	E. Pineda



- 🔴 Major Open Joint / Fracture
- 🟠 Partially Open Joint / Fracture
- ⚪ Filled Fracture / Joint
- 🟢 Bedding / Banding / Foliation
- ▽ Induced Fracture
- ◀ Casing

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)

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Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
26.0
26.4
26.8
27.2
27.6
28.0
28.4
28.8
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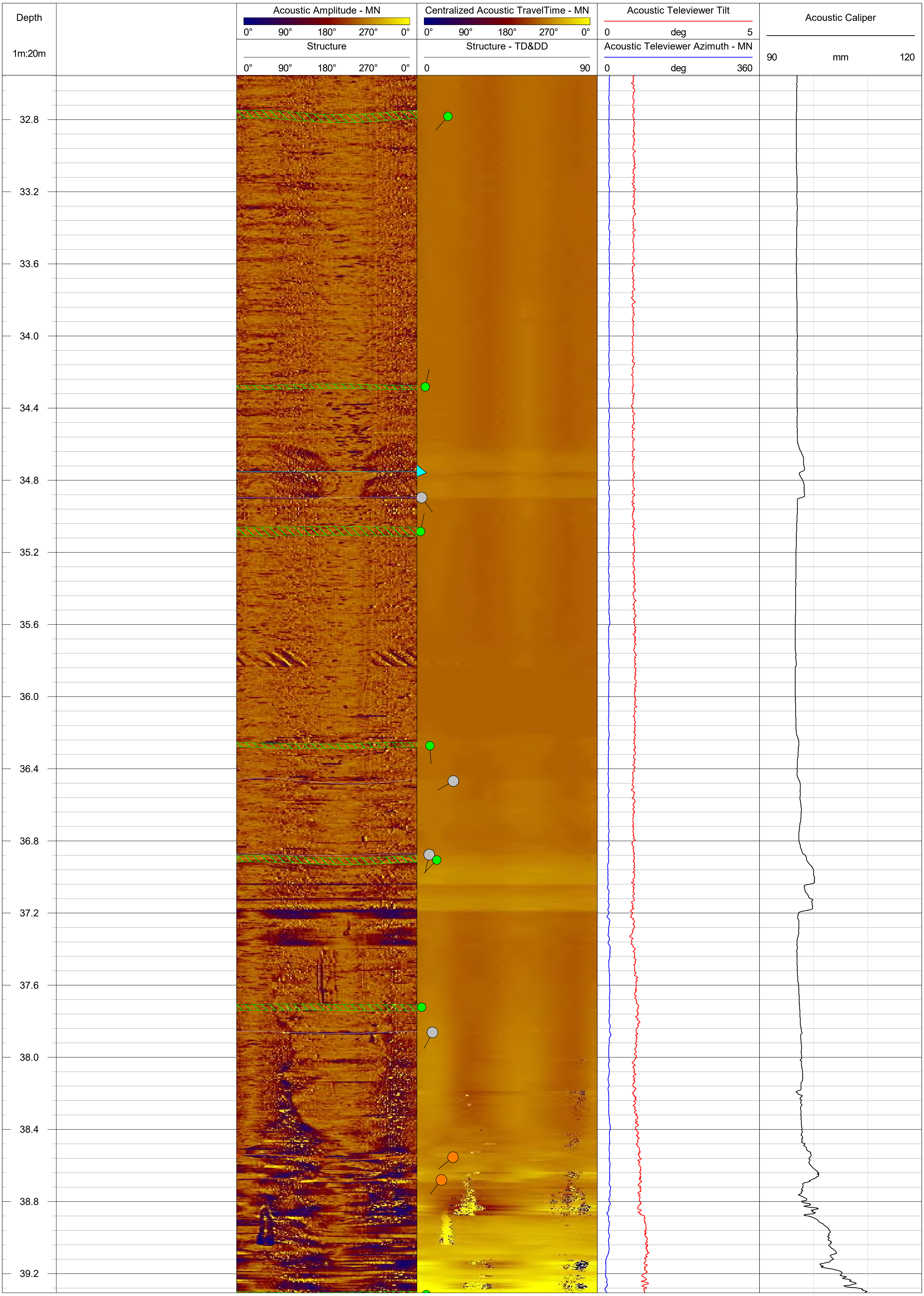
30.0
30.4
30.8
31.2
31.6
32.0
32.4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Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
32.8
33.2
33.6
34.0
34.4
34.8
35.2
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36.0
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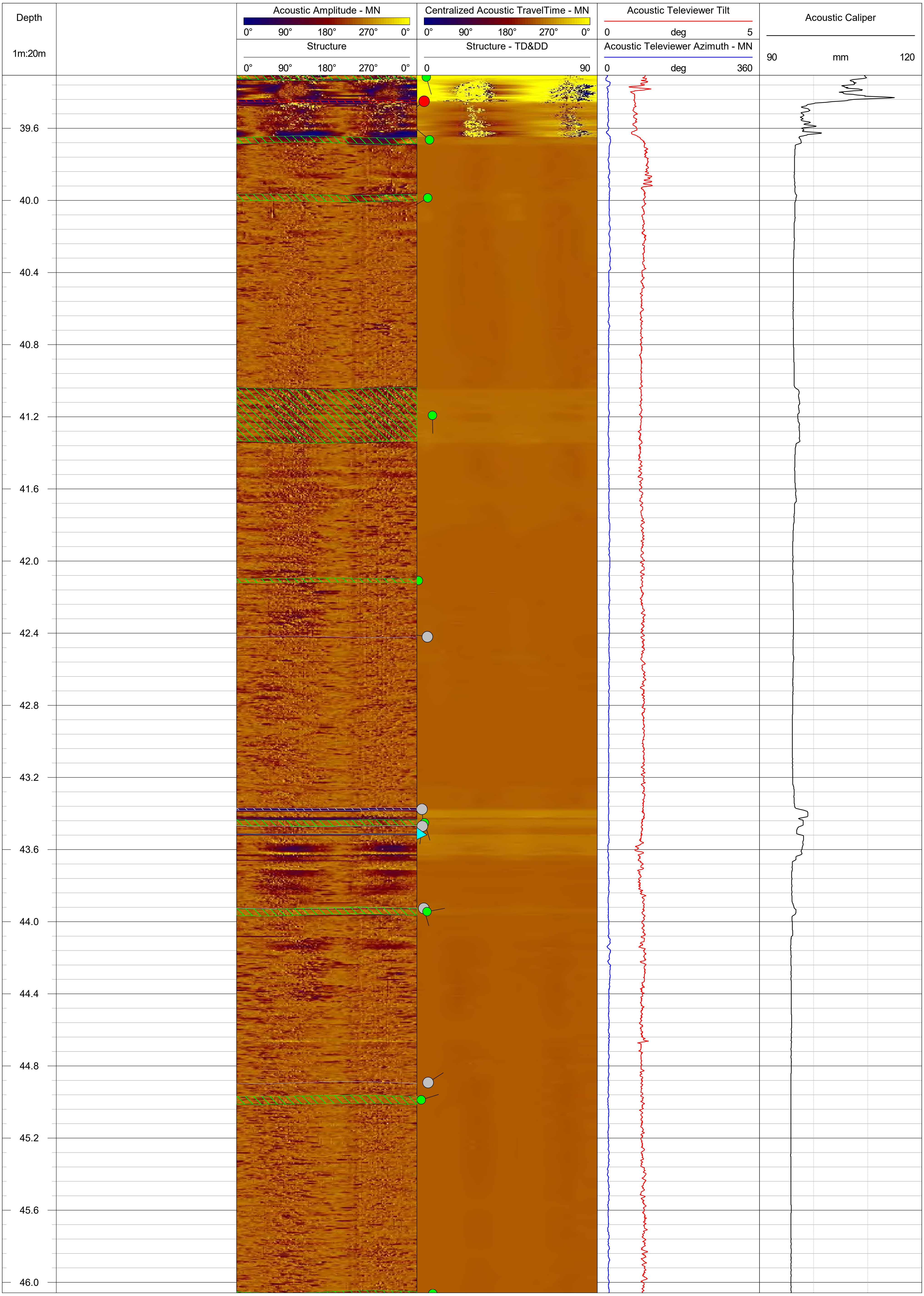
38.4
38.8
39.2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Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
39.6
40.0
40.4
40.8
41.2
41.6
42.0
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44.0
44.4
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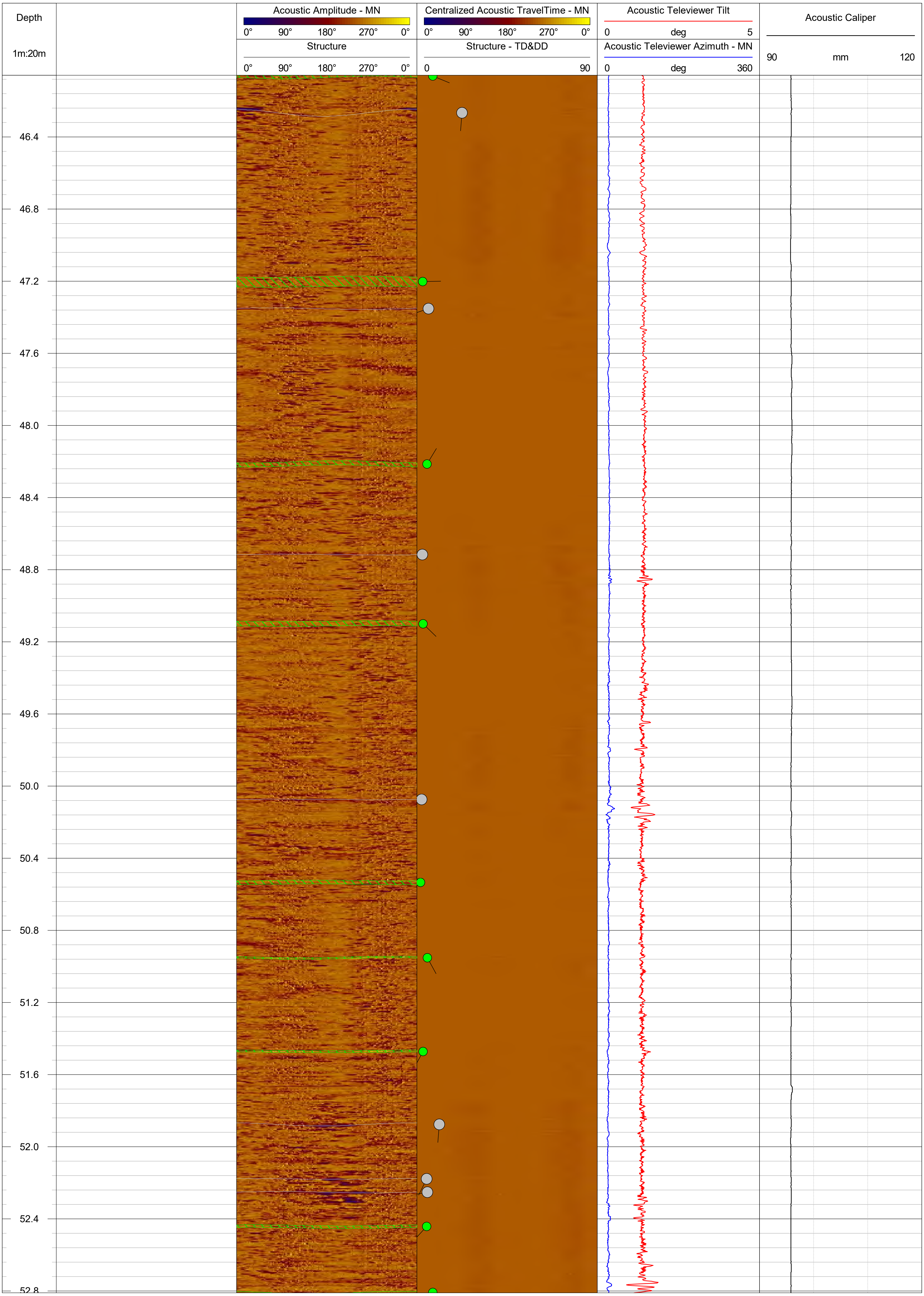
45.2
45.6
46.0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Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
46.4
46.8
47.2
47.6
48.0
48.4
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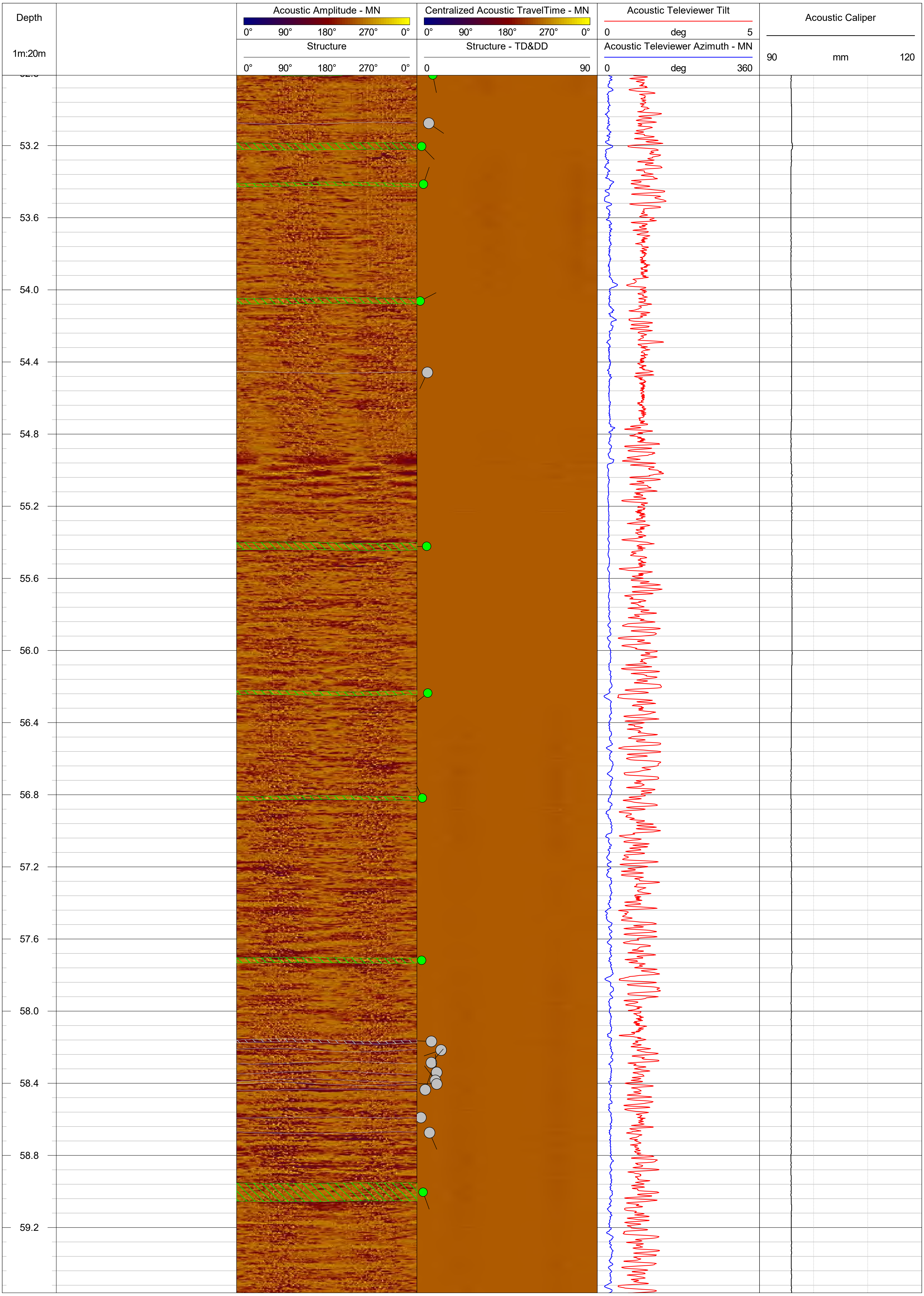
50.8
51.2
51.6
52.0
52.4
52.8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Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
53.2
53.6
54.0
54.4
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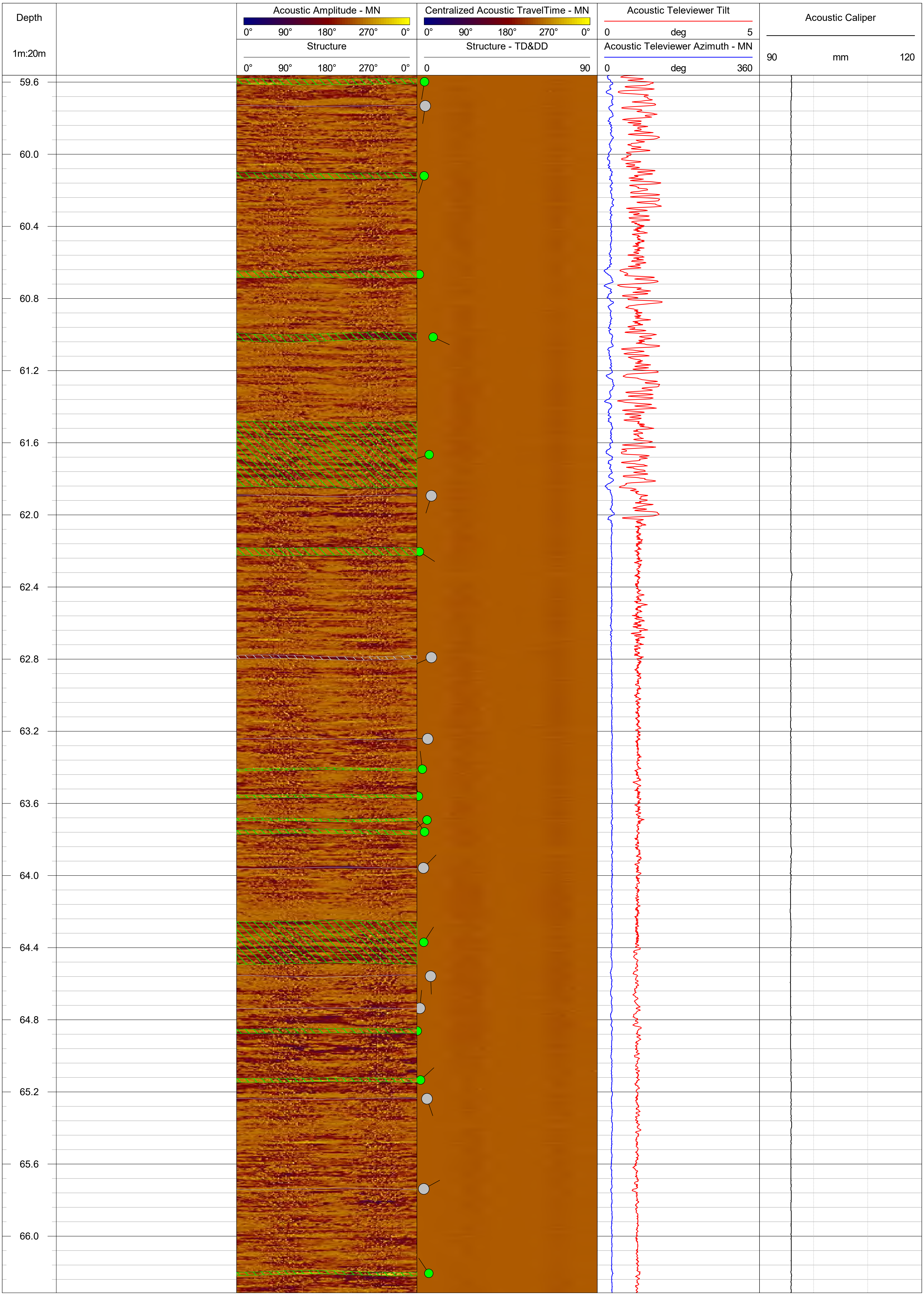
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Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
59.6
60.0
60.4
60.8
61.2
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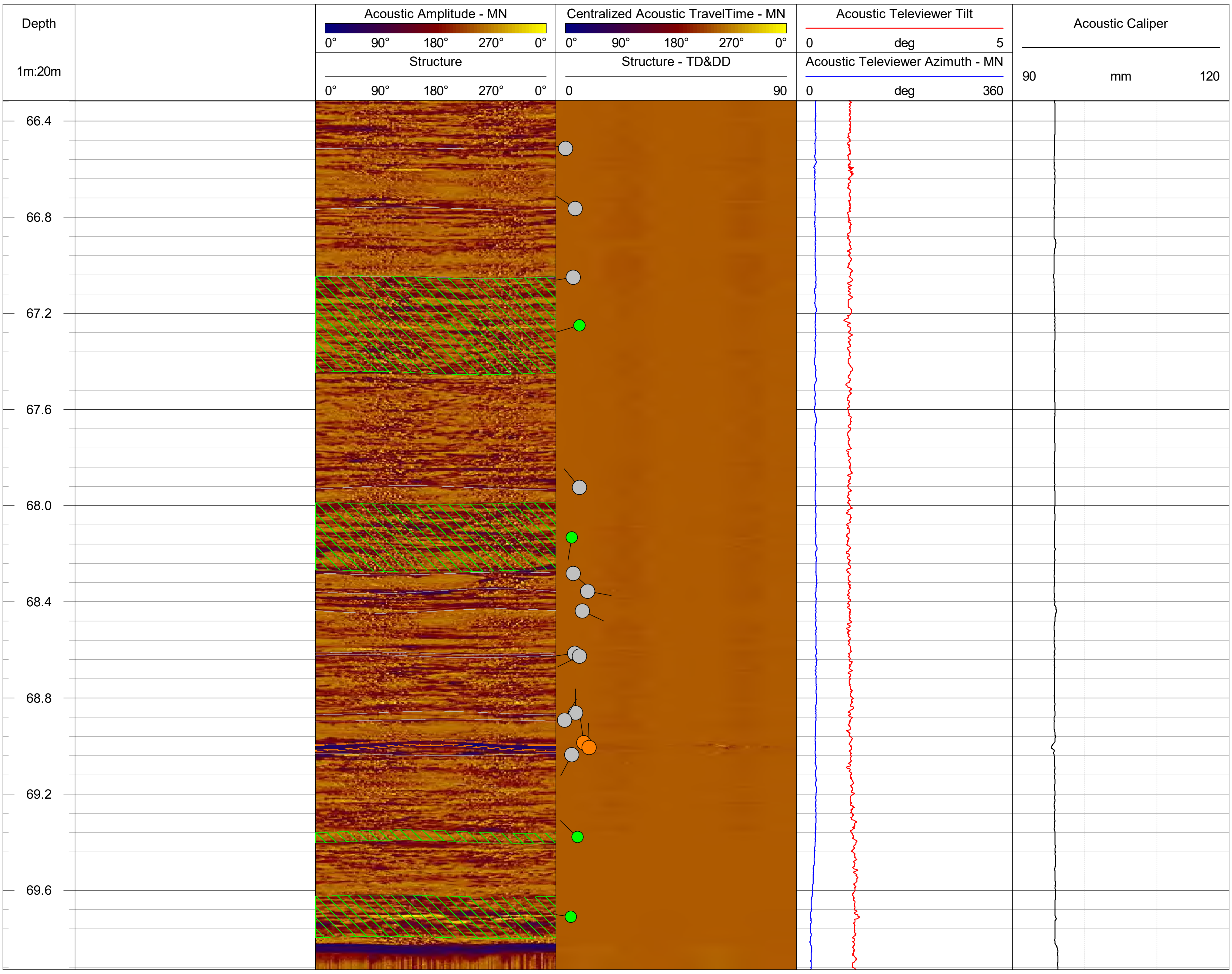
66.0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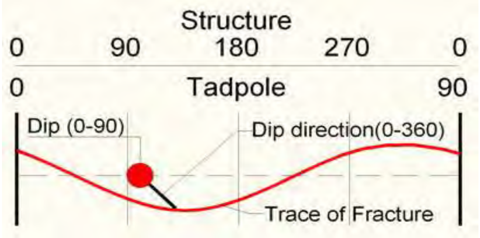
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
66.4
66.8
67.2
67.6
68.0
68.4
68.8
69.2
69.6

Geophysical Record of Borehole: BH205

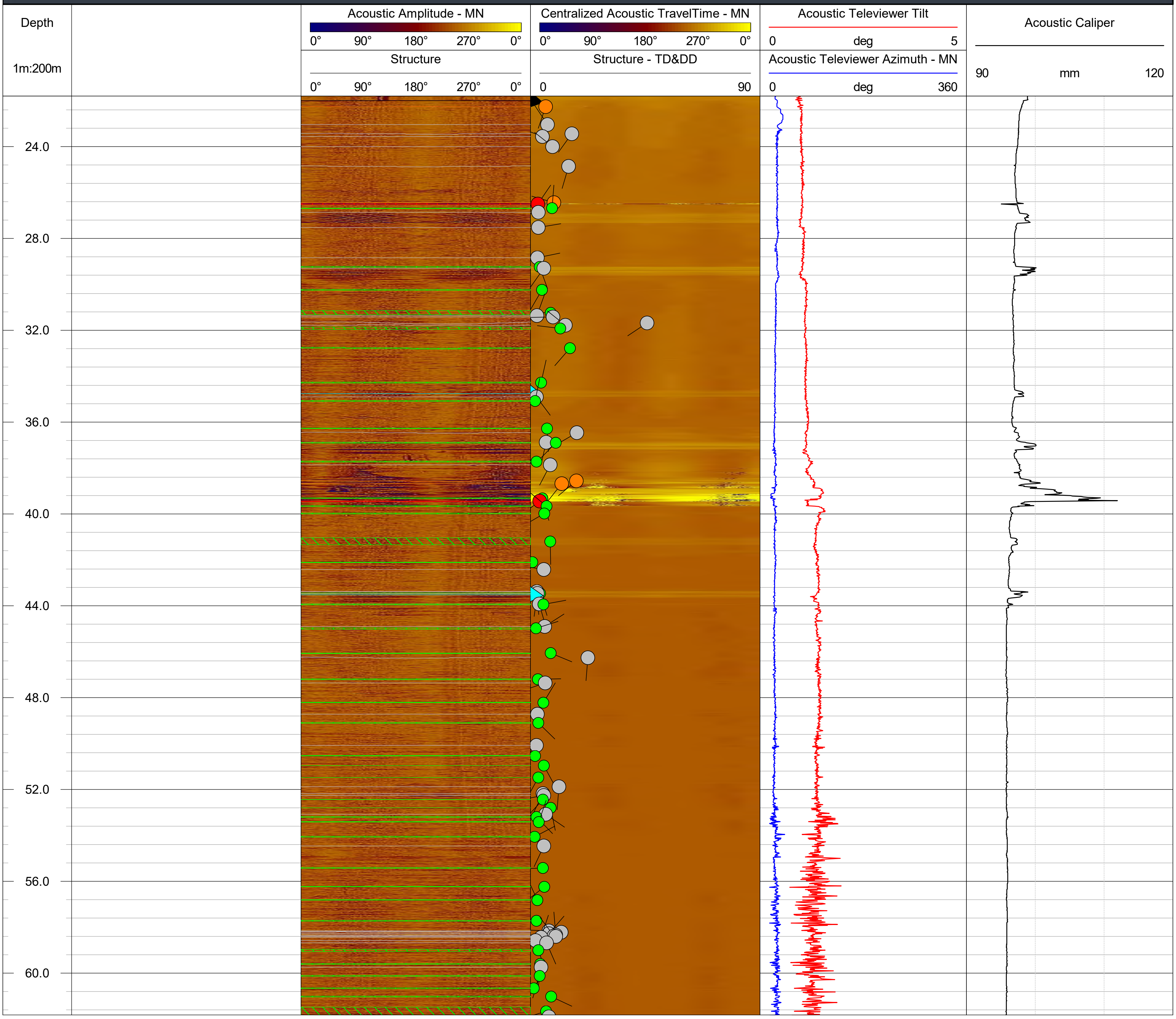
Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

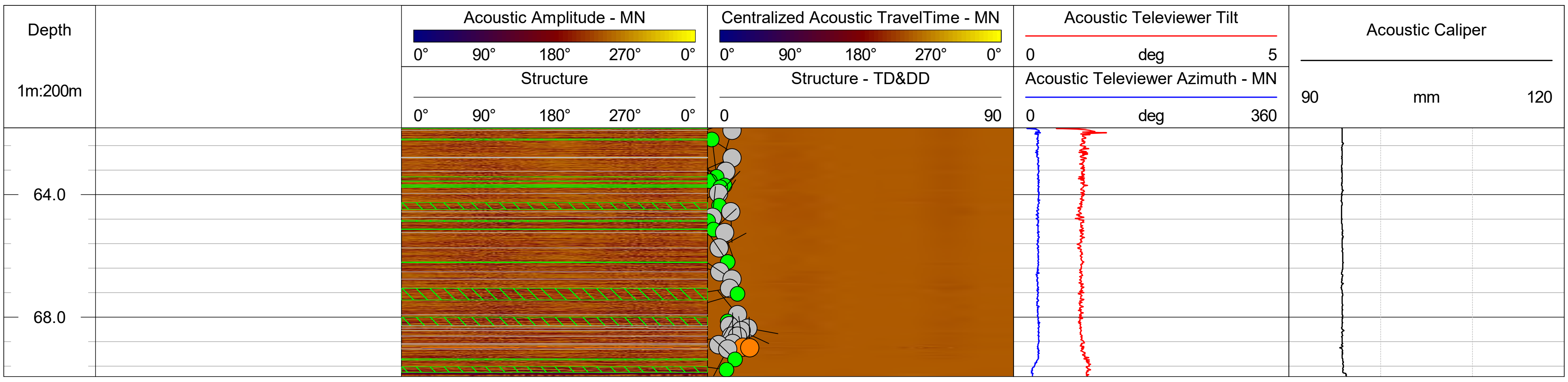
Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	~21.9 m bgs	**Location:**	Darlington, Ontario
Easting:	684126.30 m	**Drilled Depth:**	70.39 m bgs	**Water Level:**	3.16 m bgs	**Log Date:**	Sept-10-2022
Northing:	4859265.57 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	78.16 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	E. Pineda



- 🟥 Major Open Joint / Fracture
- 🟧 Partially Open Joint / Fracture
- ● Filled Fracture / Joint
- 🟩 Bedding / Banding / Foliation
- ▼ Induced Fracture
- ▼ Casing

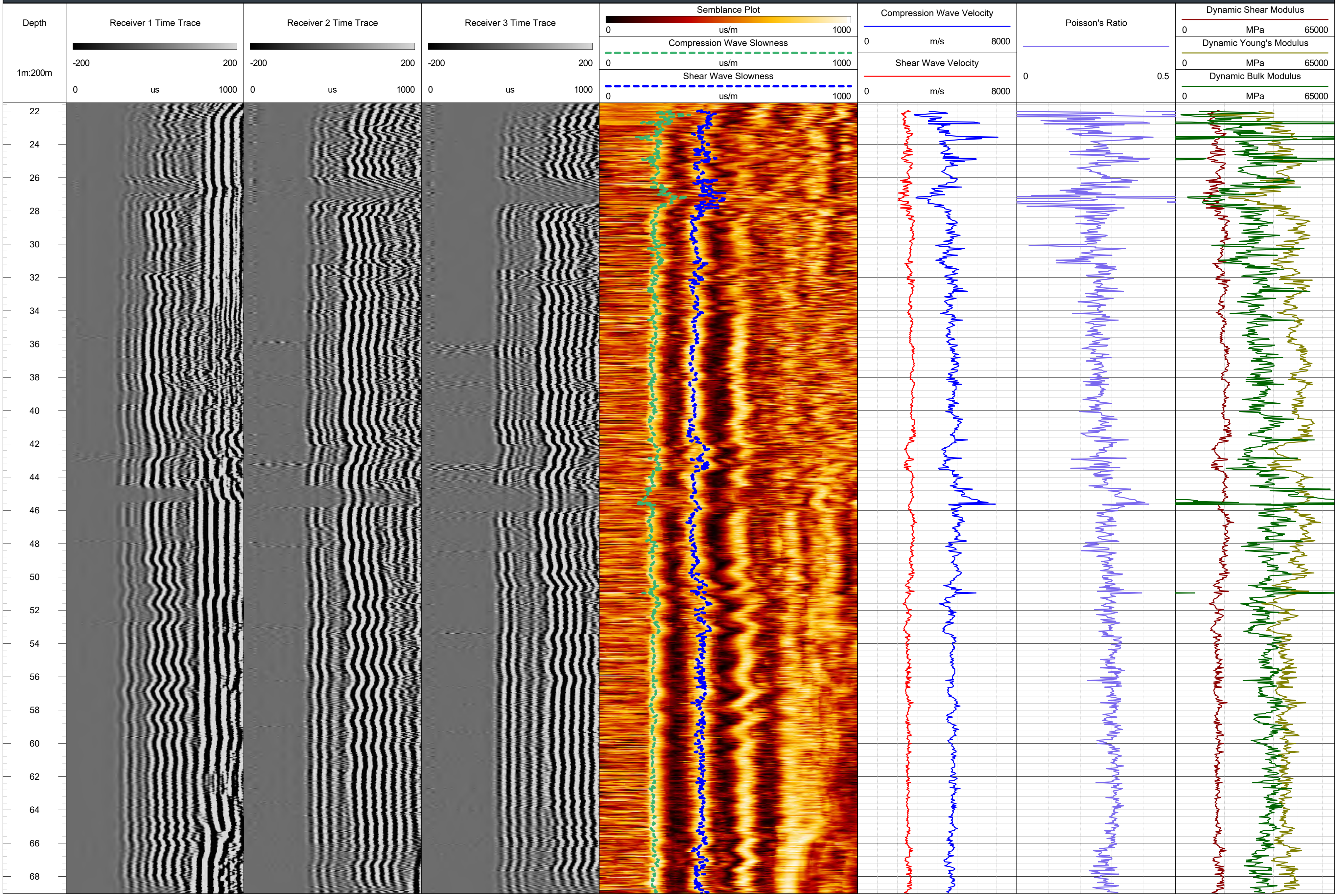
Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)




Depth
1m:200m
64.0
68.0
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120

Geophysical Record of Borehole: BH205

Log Title: Full Waveform Sonic Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023



A12-BH206

PROJECT: 21451329

LOCATION: N 4859186.99; E 684222.32

RECORD OF BOREHOLE: BH206

BORING DATE: August 3 and 4, 2022

DRILL RIG: Diedrich 120 Track Mounted

SHEET 1 OF 7

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-10} 10^{-8} 10^{-6} 10^{-4}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION; GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		BARGE DECK		78.46							
0	Mud Rotary Wash Boring (Tricone) UW Casing			0.00							
3.77		WATER	▤	74.69 3.77							
10											

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

LOGGED: LT

CHECKED: SEMP

GTA-BHS 005 S:\CLIENTS\OPG\DARLINGTON_GENERATING_STATION\02_DATA\GINT\DARLINGTON_GENERATING_STATION.GPJ GAL-MIS.GDT 6/5/23

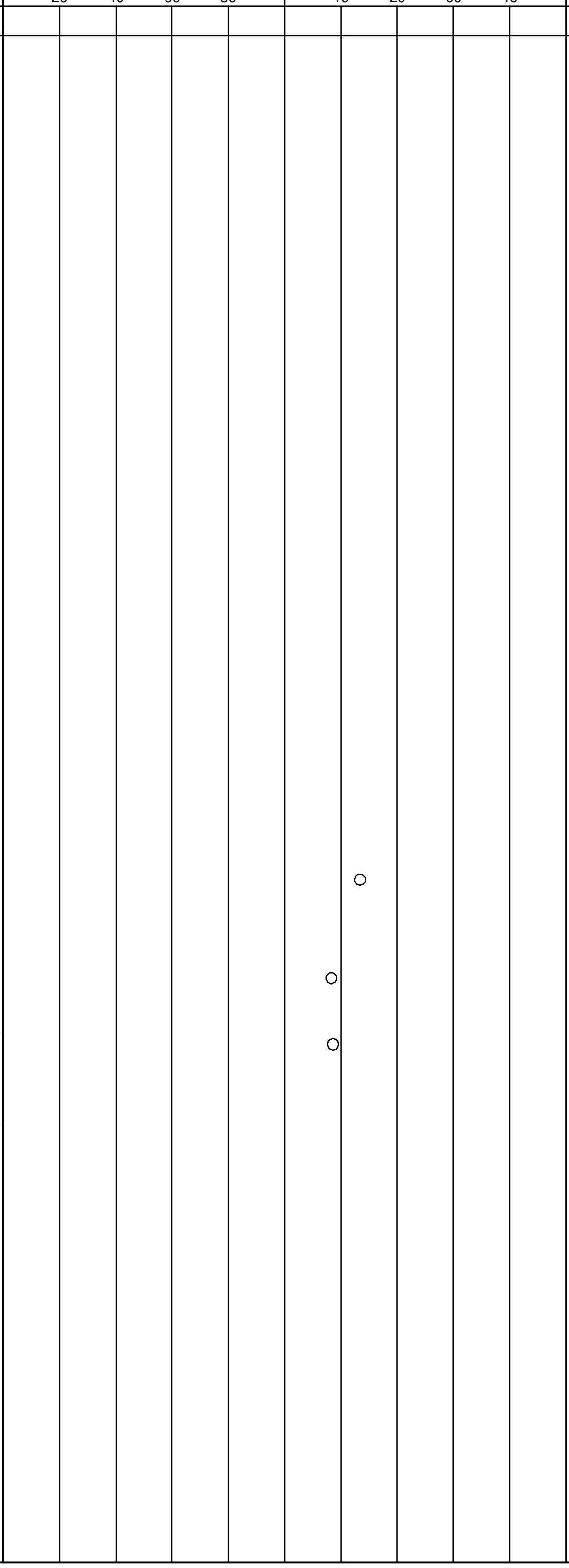
PROJECT: 21451329
LOCATION: N 4859186.99; E 684222.32

RECORD OF BOREHOLE: BH206

BORING DATE: August 3 and 4, 2022
DRILL RIG: Diedrich 120 Track Mounted

SHEET 2 OF 7
DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa (nat V. + Q - ●; rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-10} 10^{-8} 10^{-6} 10^{-4}); WATER CONTENT PERCENT (Wp ⊢ ○W ⊣ Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION; GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	Mud Rotary Wash Boring (Tricone) — UW Casing	WATER									
11											
12											
13											
14											
15				63.07 15.39							
		Silty Sand (SM), hard, grey, moist, fine to coarse sand, angular to fine gravel (Till) (Unit 5)			1	SS	97		○		
16					2	SS	189		○	NP	12 41 37 11
		- Rock fragments in Spoon Sample 3			3	SS	100/ 0.08		○		
17	Mud Rotary Wash Boring (Tricone) — Open			61.09 17.37							
		Shale Bedrock Fragments (Unit 6a)		17.49	4	SS	100/ 0.11				
		- Bedrock cored from 17.49 m to 60.87 m depth									
18		- Refer to Record of Drillhole BH206									
19											
20											



Notes:

1. Water level in open borehole could not be measured upon completion of soil drilling due to use of mud-rotary technique.

2. Efficiency of the SPT hammer utilized was 77.9 %.

DEPTH SCALE
1 : 50

LOGGED: LT
CHECKED: SEMP

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859186.99; E 684222.32
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH206

DRILLING DATE: August 4 to 7, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

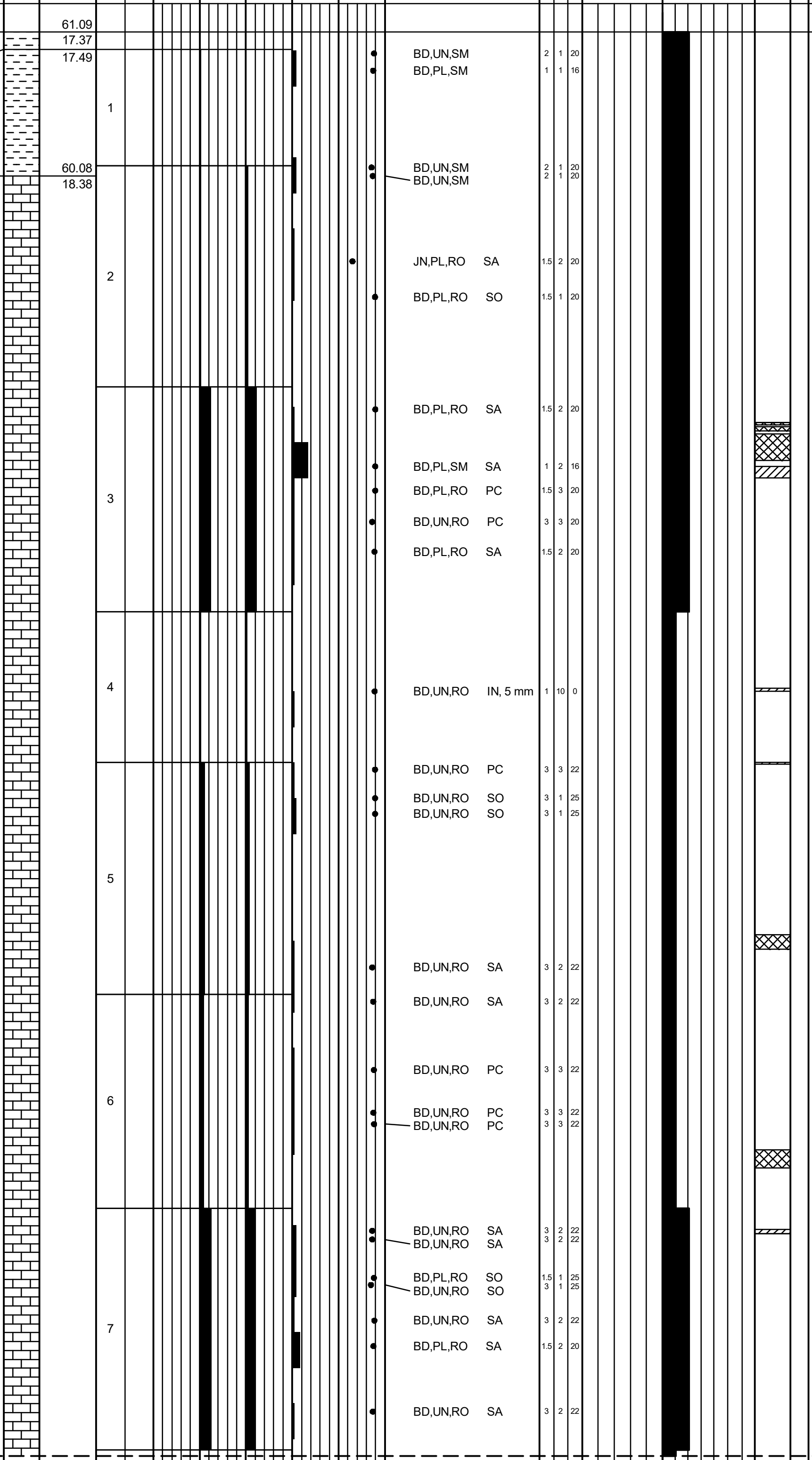
SHEET 3 OF 7

DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DRILLING RECORD: Rotary Drill, HQ3 Core

DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)	RUN No.
	TOP OF BEDROCK	61.09	
	Shale Bedrock Fragments	17.37	
18	Slightly weathered, thinly bedded, dark brownish grey, very fine grained, faintly porous, slightly reactive to HCl, weak SHALE (Blue Mountain Formation) with laminated to very thin, grey, fine to medium grained limestone interbeds	17.49	1
19 – 27	Slightly weathered to fresh, laminated to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to very strong LIMESTONE (Lindsay Formation) with dark grey shale interbeds.	60.08 18.38	2 3 4 5 6 7



DISCONTINUITY DATA

TYPE AND SURFACE DESCRIPTION		Jr	Ja	Jcon
BD,UN,SM		2	1	20
BD,PL,SM		1	1	16
BD,UN,SM		2	1	20
BD,UN,SM		2	1	20
JN,PL,RO	SA	1.5	2	20
BD,PL,RO	SO	1.5	1	20
BD,PL,RO	SA	1.5	2	20
BD,PL,SM	SA	1	2	16
BD,PL,RO	PC	1.5	3	20
BD,UN,RO	PC	3	3	20
BD,PL,RO	SA	1.5	2	20
BD,UN,RO	IN, 5 mm	1	10	0
BD,UN,RO	PC	3	3	22
BD,UN,RO	SO	3	1	25
BD,UN,RO	SO	3	1	25
BD,UN,RO	SA	3	2	22
BD,UN,RO	SA	3	2	22
BD,UN,RO	PC	3	3	22
BD,UN,RO	PC	3	3	22
BD,UN,RO	PC	3	3	22
BD,UN,RO	SA	3	2	22
BD,UN,RO	SA	3	2	22
BD,PL,RO	SO	1.5	1	25
BD,UN,RO	SO	3	1	25
BD,UN,RO	SA	3	2	22
BD,PL,RO	SA	1.5	2	20
BD,UN,RO	SA	3	2	22

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: LT
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859186.99; E 684222.32
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH206

DRILLING DATE: August 4 to 7, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (m)	RUN No.
		--- CONTINUED FROM PREVIOUS PAGE ---		
28	Rotary Drill HQ3 Core	Slightly weathered to fresh, laminated to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to very strong LIMESTONE (Lindsay Formation) with dark grey shale interbeds.		8 8
29				9
30				
31		Punch Penetration Sample		10
32				11
33				
34		Brazilian Sample		12
35				13
36				
37				14
		CONTINUED NEXT PAGE		

Column headings: FLUSH RETURN; RECOVERY (TOTAL CORE % 80 60 40 20; SOLID CORE % 80 60 40 20); R.Q.D. % 80 60 40 20; FRACT. INDEX PER 0.25 m 5 10 15 20; DISCONTINUITY DATA (DIP w.r.t. CORE AXIS 0 30 60 90; TYPE AND SURFACE DESCRIPTION; Jr; Ja; Jcon); HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2}; WEATH-ERING INDEX W1 W2 W3 W4 W5 W6; FEATURES; R0/R1 ZONES; PIEZOMETER

DEPTH SCALE METRES	TYPE AND SURFACE DESCRIPTION		Jr	Ja	Jcon
30	BD,UN,RO	PC	3	3	22
	BD,UN,RO	SA	3	2	22
31	BD,UN,RO	SA	3	2	22
	BD,UN,RO	IN, 1 mm	1	6	6
32	BD,UN,RO	SA	3	2	22
35	BD,UN,RO	SA	3	2	22
	BD,UN,RO	SA	3	2	22

DEPTH SCALE
1 : 50

LOGGED: LT
CHECKED: PKS

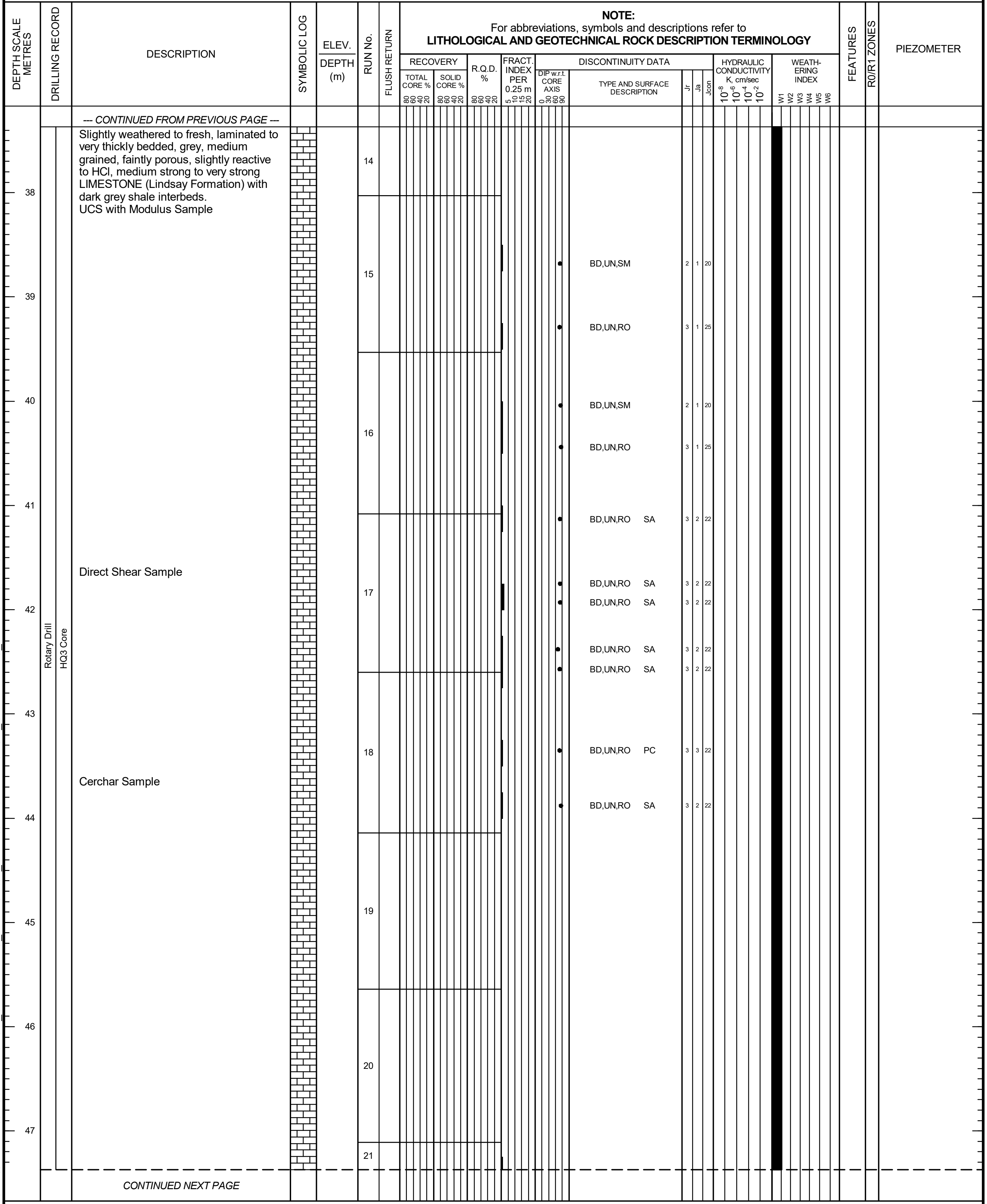
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859186.99; E 684222.32
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH206

DRILLING DATE: August 4 to 7, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



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Slightly weathered to fresh, laminated to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to very strong LIMESTONE (Lindsay Formation) with dark grey shale interbeds.
UCS with Modulus Sample

Direct Shear Sample

Cerchar Sample

TYPE AND SURFACE DESCRIPTION		Jr	Ja	Jcon
BD,UN,SM		2	1	20
BD,UN,RO		3	1	25
BD,UN,SM		2	1	20
BD,UN,RO		3	1	25
BD,UN,RO	SA	3	2	22
BD,UN,RO	SA	3	2	22
BD,UN,RO	SA	3	2	22
BD,UN,RO	SA	3	2	22
BD,UN,RO	SA	3	2	22
BD,UN,RO	PC	3	3	22
BD,UN,RO	SA	3	2	22

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: LT
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859186.99; E 684222.32
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH206

DRILLING DATE: August 4 to 7, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE % 80 60 40 20	RECOVERY SOLID CORE % 80 60 40 20	R.Q.D. % 80 60 40 20	FRACT. INDEX PER 0.25 m 5 10 15 20	DIP w.r.t. CORE AXIS 0 30 60 90	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2}	WEATHERING INDEX W1 W2 W3 W4 W5 W6	FEATURES	R0/R1 ZONES	PIEZOMETER

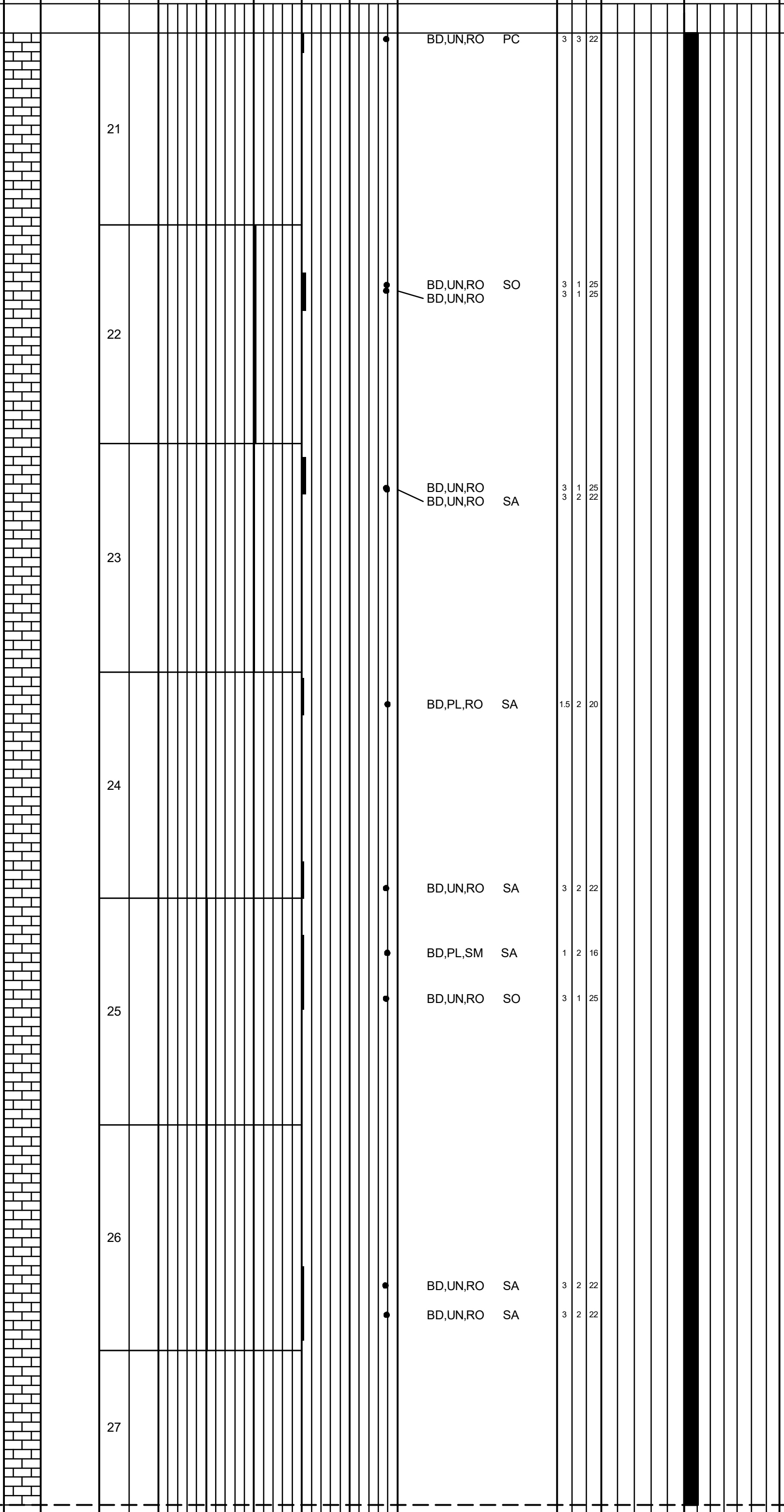
--- CONTINUED FROM PREVIOUS PAGE ---

Slightly weathered to fresh, laminated to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to very strong LIMESTONE (Lindsay Formation) with dark grey shale interbeds.

DRILLING RECORD: Rotary Drill, HQ3 Core

DEPTH SCALE: 48, 49, 50, 51, 52, 53, 54, 55, 56, 57

RUN No.: 21, 22, 23, 24, 25, 26, 27



TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,UN,RO PC	3	3	22
BD,UN,RO SO	3	1	25
BD,UN,RO	3	1	25
BD,UN,RO	3	1	25
BD,UN,RO SA	3	2	22
BD,PL,RO SA	1.5	2	20
BD,UN,RO SA	3	2	22
BD,PL,SM SA	1	2	16
BD,UN,RO SO	3	1	25
BD,UN,RO SA	3	2	22
BD,UN,RO SA	3	2	22

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

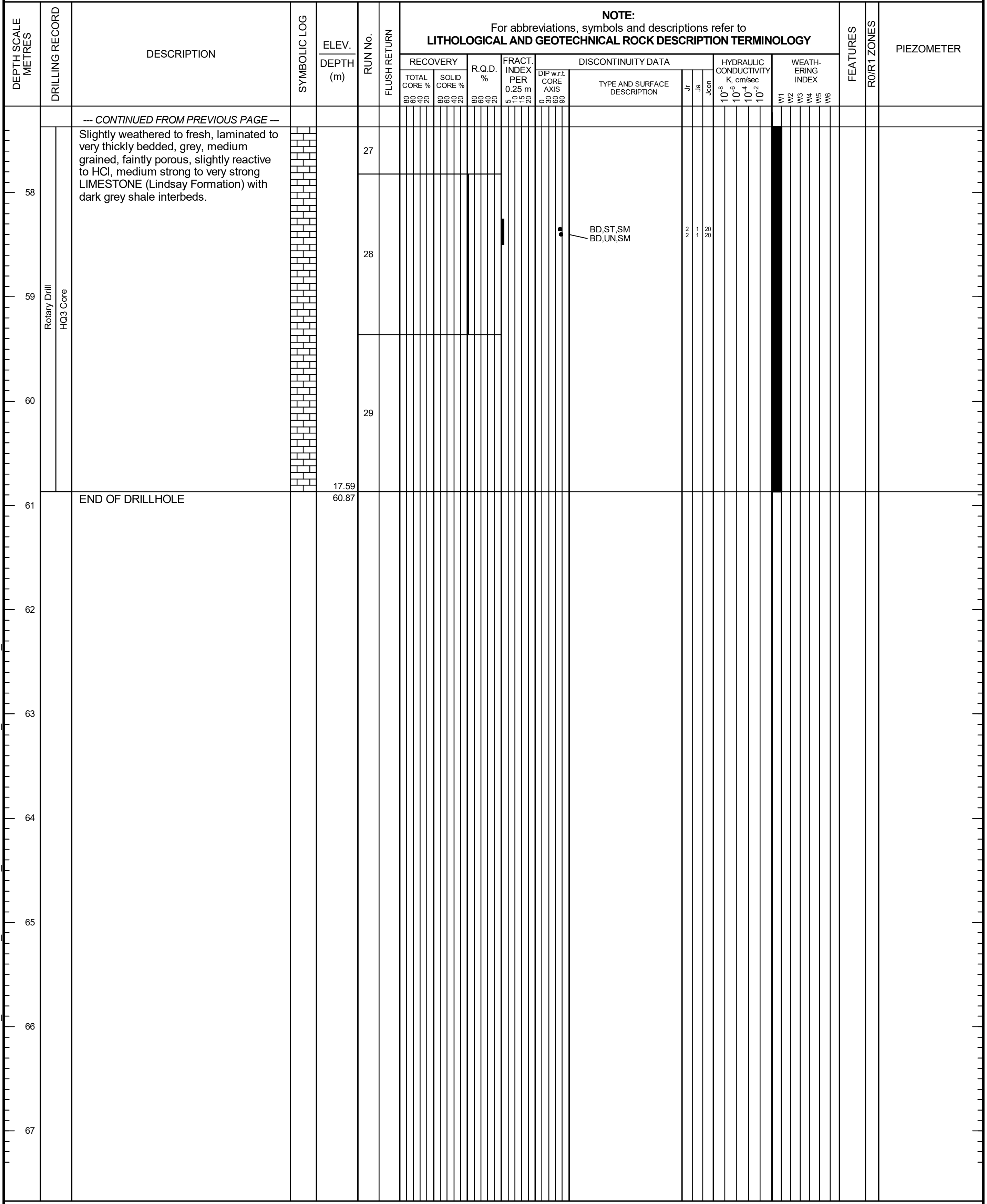
LOGGED: LT
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859186.99; E 684222.32
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH206

DRILLING DATE: August 4 to 7, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 7 OF 7
DATUM: Geodetic



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Slightly weathered to fresh, laminated to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to very strong LIMESTONE (Lindsay Formation) with dark grey shale interbeds.

ELEV.	DEPTH (m)
17.59	60.87

END OF DRILLHOLE

TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,ST,SM	2	1	20
BD,UN,SM	2	1	20

DEPTH SCALE
1 : 50

LOGGED: LT
CHECKED: PKS

GTA-RCK 048 S:\CLIENTS\OPG\DARLINGTON_GENERATING_STATION\02_DATA\GINT\DARLINGTON_GENERATING_STATION.GPJ GAL-MISS.GDT 6/2/23

Water Content Summary
ASTM D2216

Test Request # 21451329-21600-610 BH206
Client: E.S. Fox Limited
Project Name: ES Fox/DNNP Invest/Bowmanville
Project Number: 21451329-21600-610
Project Location:

Sample Location	Sample				Soil Description	Water Content %	Method	Remarks
	Ref	Top (m)	Base (m)	Type				
BH206	1	15.39	16.00	SS		13.4	B	
BH206	2	16.15	16.58	SS		8.3	B	
BH206	3	16.76	16.85	SS		8.6	B	

Notes:

Tested by: JTimms **Date:** 05 Oct 2022
Checked by: MRuck **Date:** 24 Oct 2022

Disclaimer:

Reviewed by: JoNorris **Date:** 03 Nov 2022

GOLDER
MEMBER OF WSP

PARTICLE SIZE DISTRIBUTION

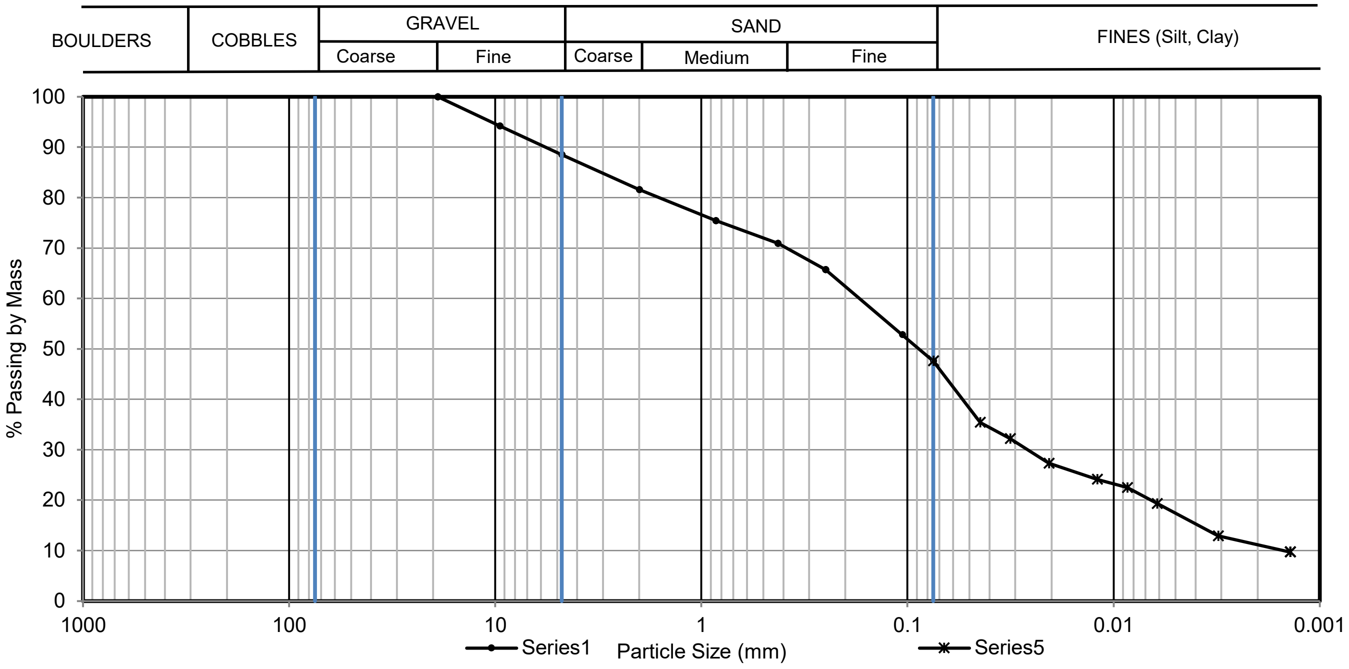
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH206	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH206
Source:		Sample No.:	2
		Type:	SS
Soil Description:		Depth (m):	16.15 - 16.58

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	17 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%) 11.5 40.9 47.6



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0444	35.4
3/8"	9.5	94.2	0.0318	32.2
#4	4.75	88.5	0.0206	27.3
#10	2	81.6	0.0120	24.1
#20	0.85	75.4	0.0086	22.5
#40	0.425	70.9	0.0062	19.3
#60	0.25	65.7	0.0031	12.9
#140	0.106	52.8	0.0014	9.7
#200	0.075	47.6		
			0.005 mm	17.36
			0.002 mm	11.15
			D60	0.17
			D30	0.03
			D10	0.00
			Cu	110.00
			Cc	2.70

Notes:

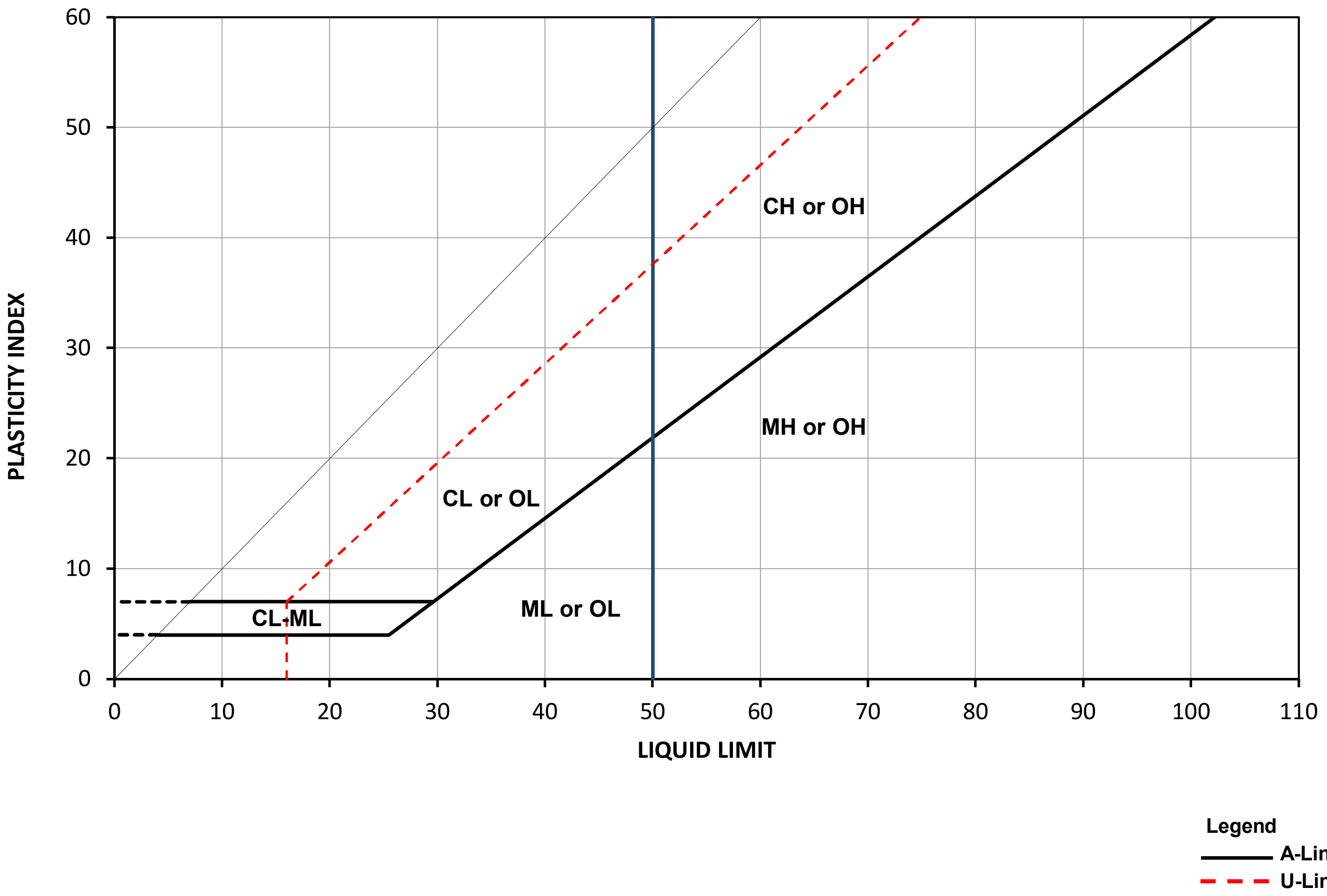
Disclaimer:

Tested by: MKMarren **Date:** 17 Oct 2022 **Checked by:** MRuck **Date:** 24 Oct 2022 **Reviewed by:** JoNorris **Date:** 03 Nov 2022

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318

Test Request #	21451329-21600-610 BH206	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH206
Source:		Sample No.:	2
Soil Description:		Type:	SS
		Depth (m):	16.15 - 16.58

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	19 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH206	2	16.15	16.58	81	8.3		NP		

NP = Non-Plastic
ND = Not Determined

Test Preparation
Dry Preparation Tested after >425um removed

Notes:

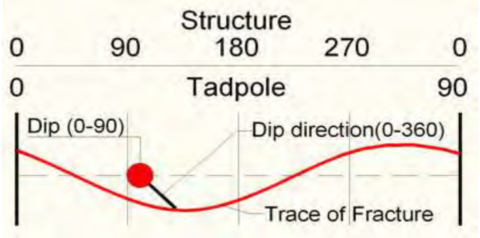
Disclaimer:
The laboratory testing services reported herein have been performed in accordance with the terms of a contract with Golder's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of Golder's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Tested by: JTimms **Date:** 19 Oct 2022
Checked by: MRuck **Date:** 24 Oct 2022
Reviewed by: JoNorris **Date:** 03 Nov 2022

Geophysical Record of Borehole: BH206

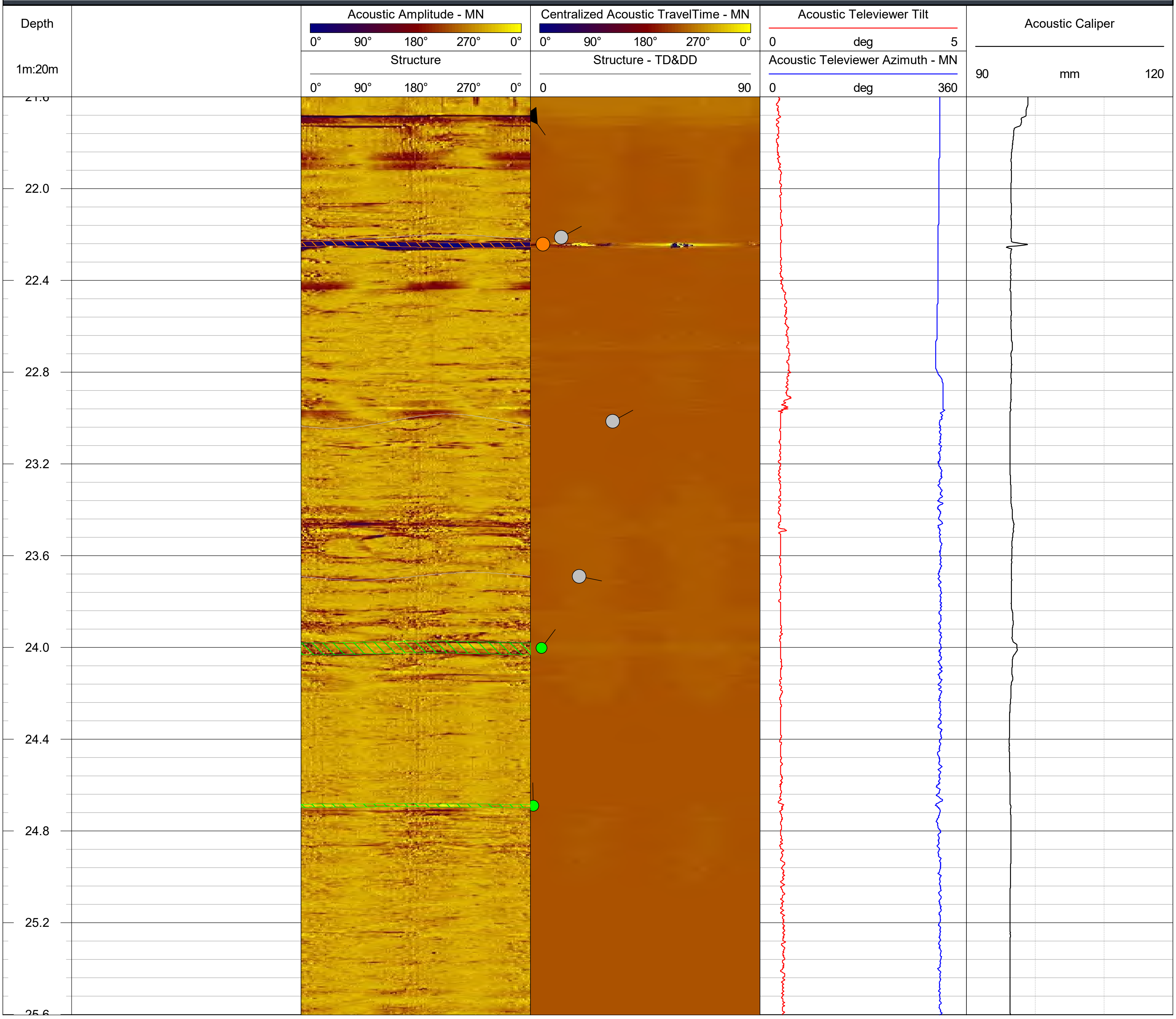
Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

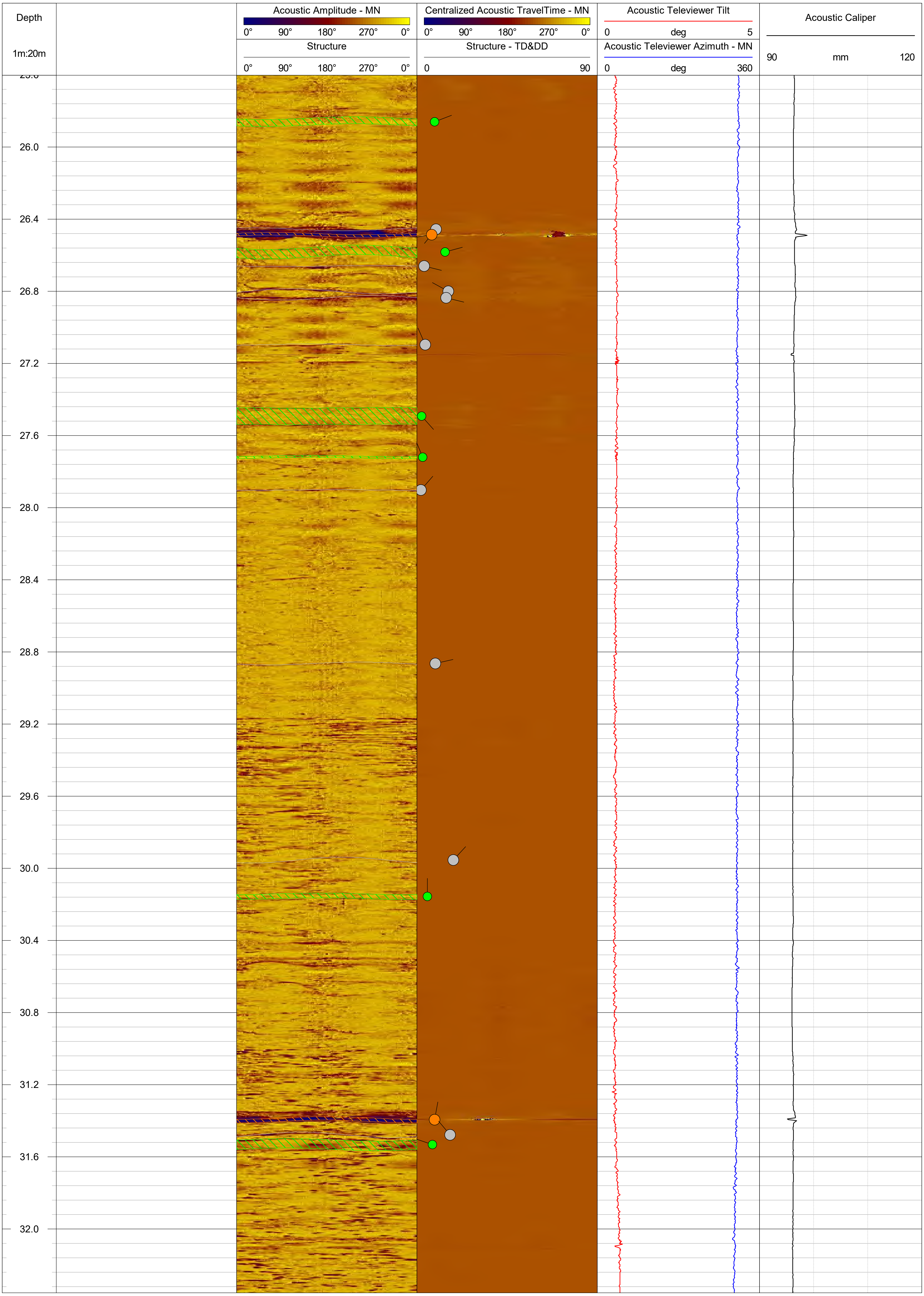
Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	~21.72 m bgs	**Location:**	Darlington, Ontario
Easting:	684222.32 m	**Drilled Depth:**	60.87 m bgs	**Water Level:**	3.7 m bgs	**Log Date:**	Aug-09-2022
Northing:	4859186.99 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	78.46 m	**Casing Diameter:**	HQ	**Casing Stickup:**	N/A	**Logged By:**	E. Pineda

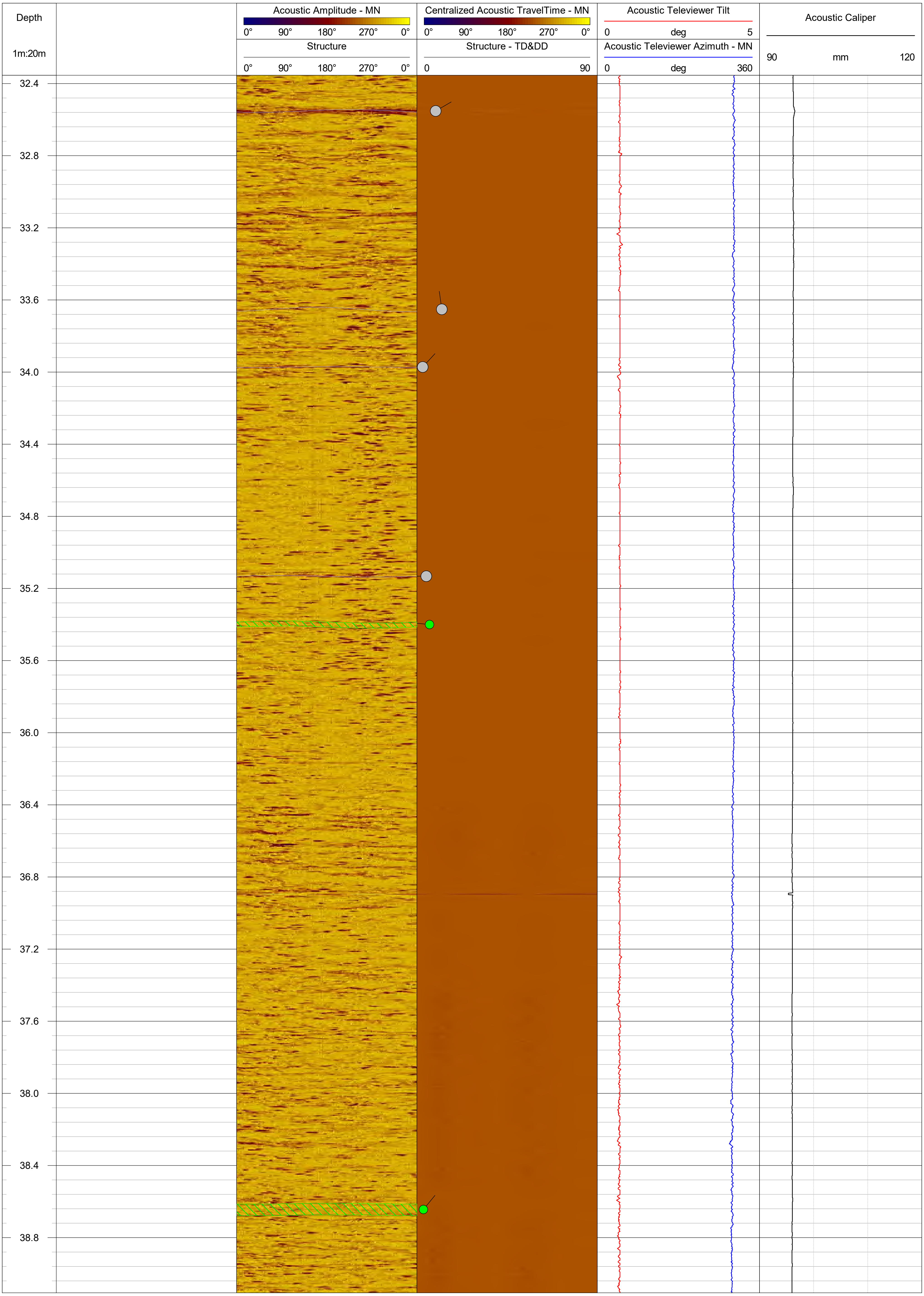


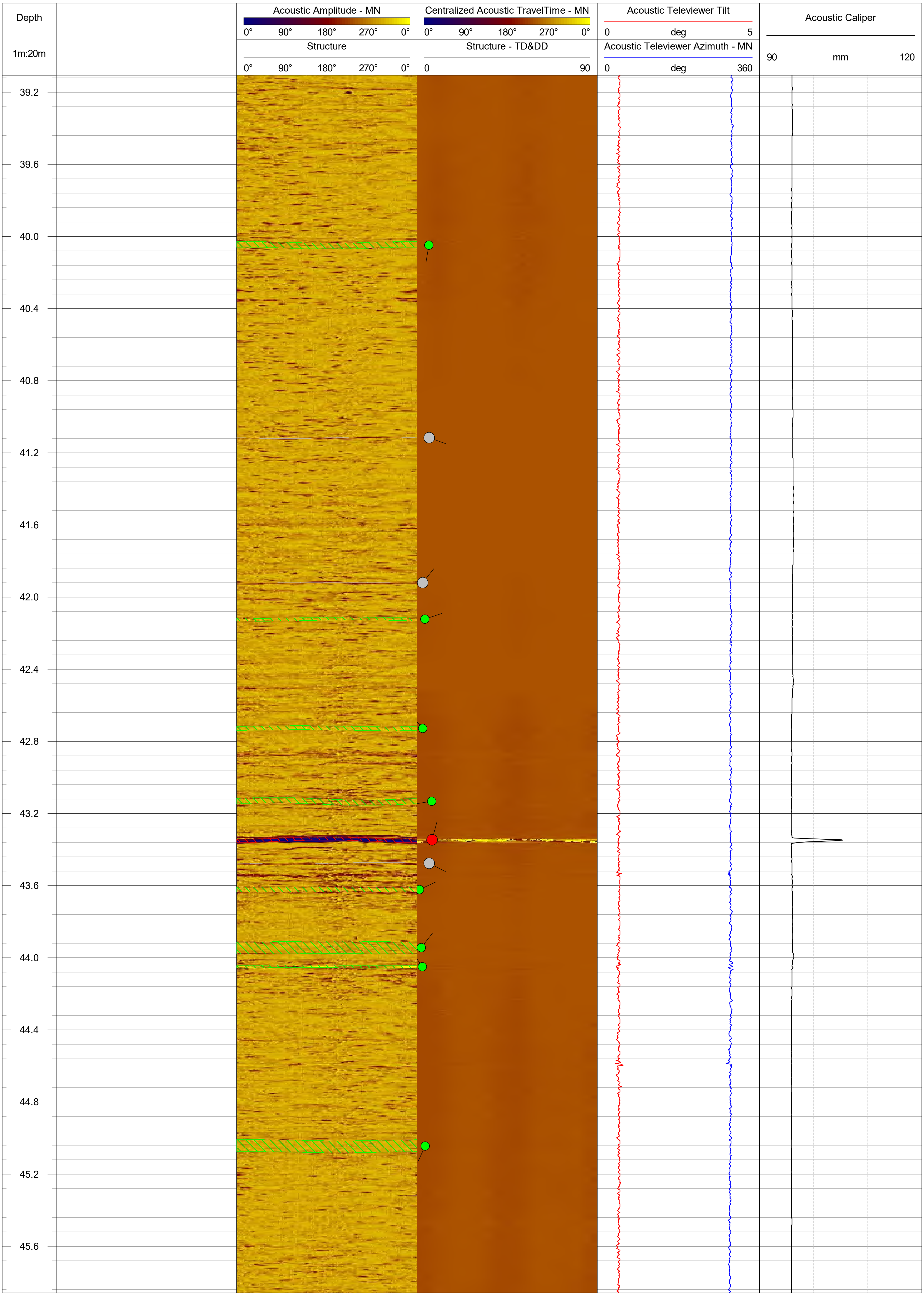
- 🔴 Major Open Joint / Fracture
- 🟠 Partially Open Joint / Fracture
- ⚪ Filled Fracture / Joint
- 🟢 Bedding / Banding / Foliation
- ◀ Casing

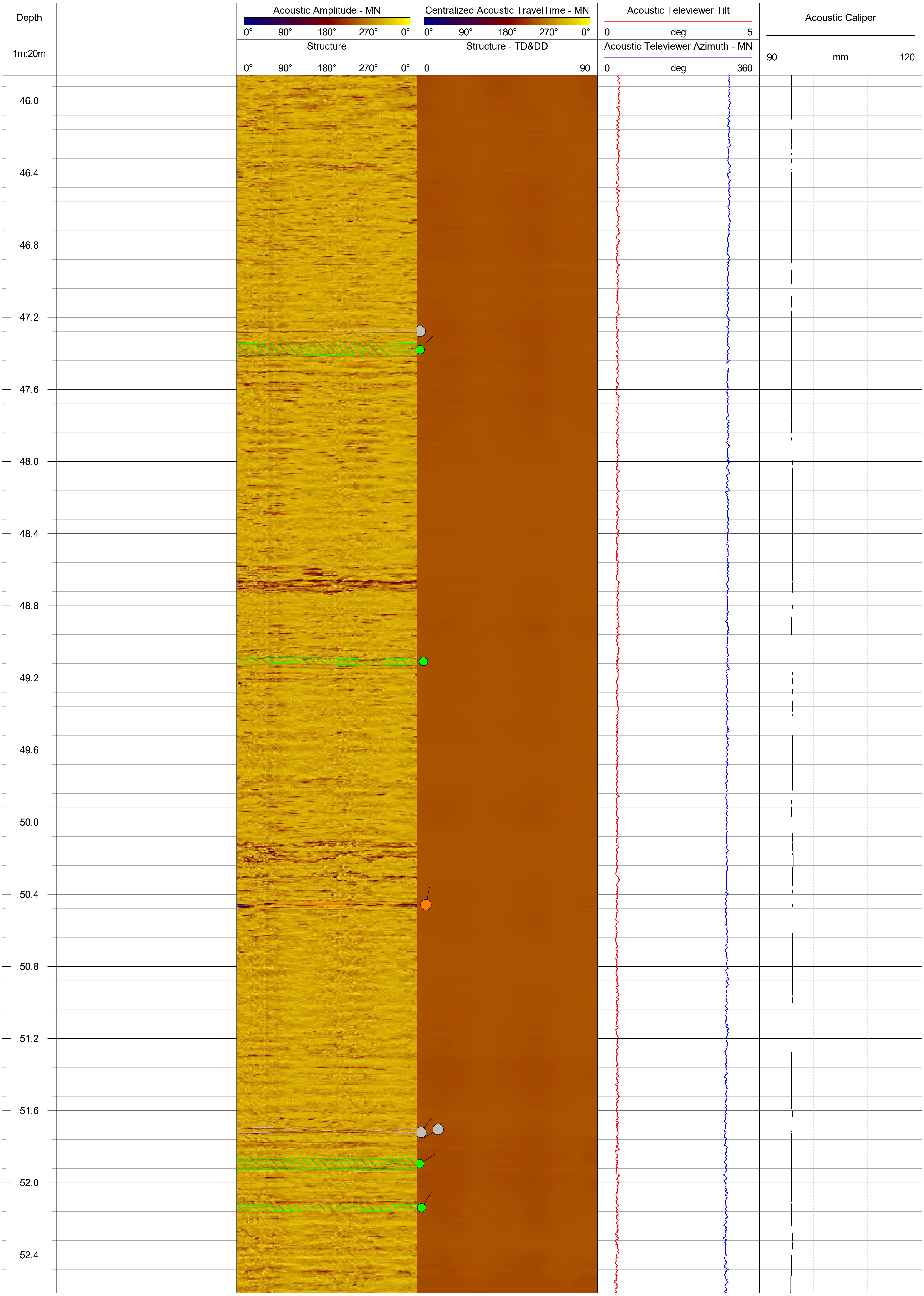
Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)

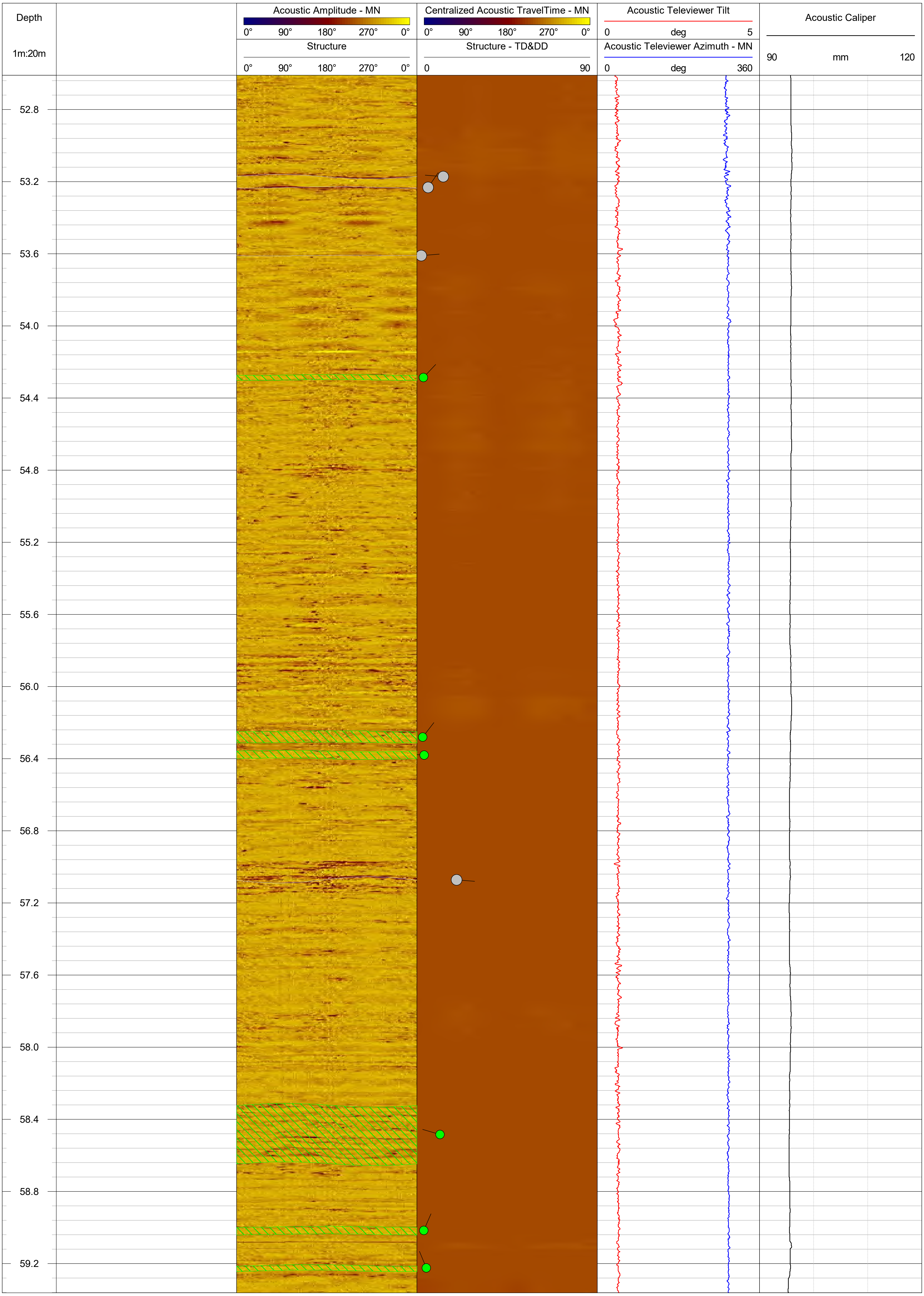


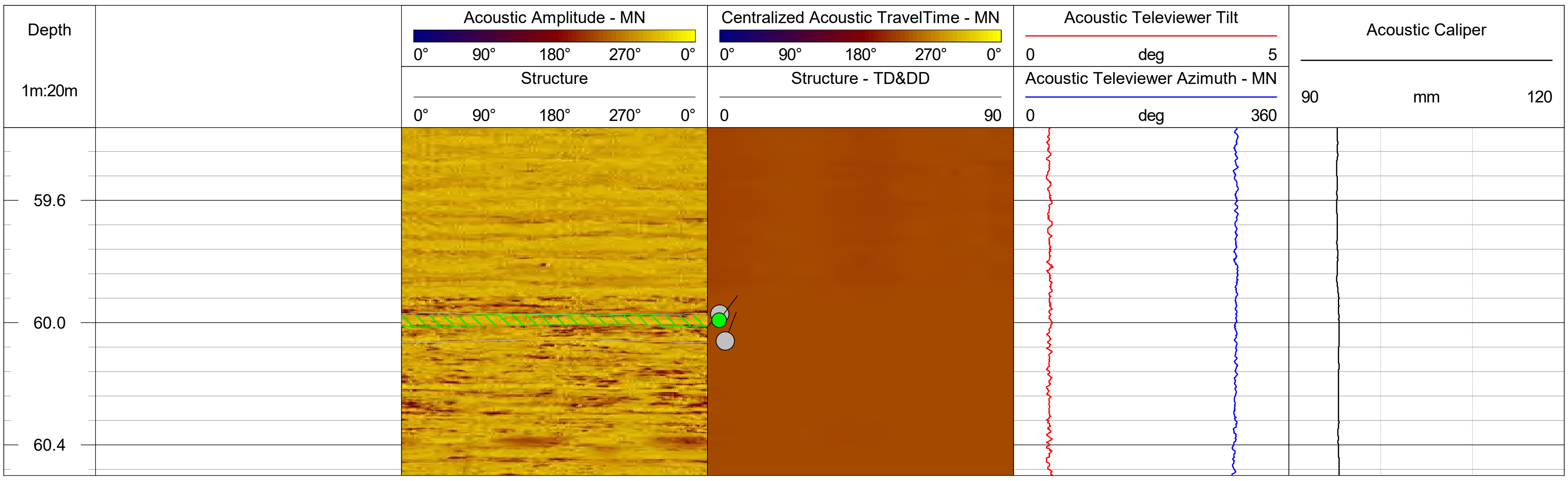

Depth
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
26.0
26.4
26.8
27.2
27.6
28.0
28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0


Depth
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
32.4
32.8
33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8
37.2
37.6
38.0
38.4
38.8


Depth
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
39.2
39.6
40.0
40.4
40.8
41.2
41.6
42.0
42.4
42.8
43.2
43.6
44.0
44.4
44.8
45.2
45.6


Depth
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
46.0
46.4
46.8
47.2
47.6
48.0
48.4
48.8
49.2
49.6
50.0
50.4
50.8
51.2
51.6
52.0
52.4

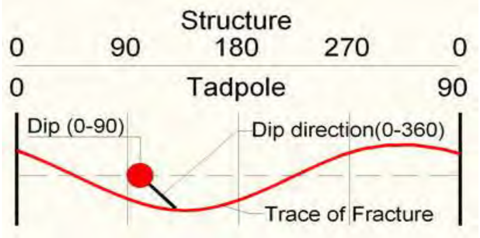

Depth
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
52.8
53.2
53.6
54.0
54.4
54.8
55.2
55.6
56.0
56.4
56.8
57.2
57.6
58.0
58.4
58.8
59.2


Depth
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
59.6
60.0
60.4

Geophysical Record of Borehole: BH206

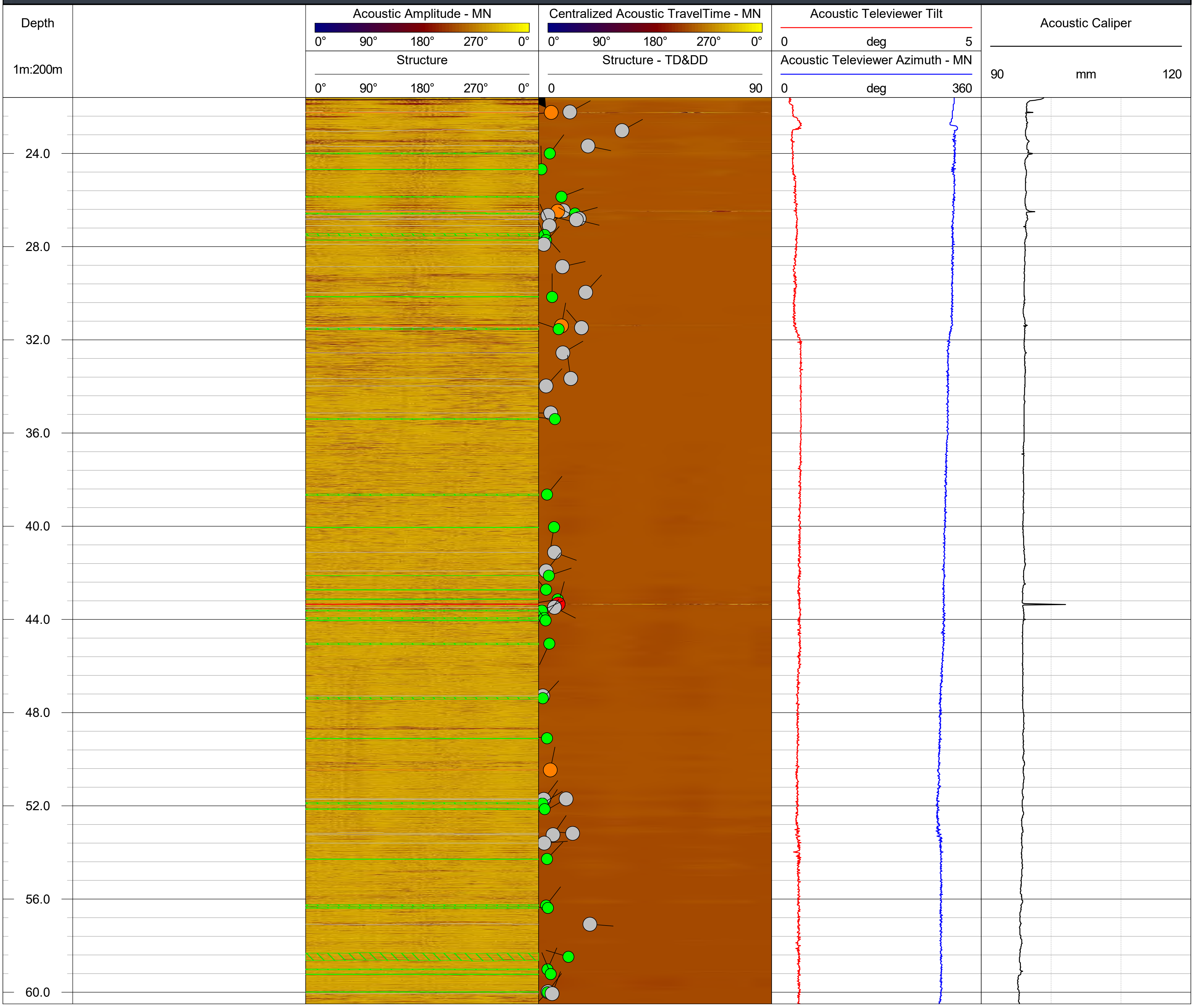
Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	~21.72 m bgs	**Location:**	Darlington, Ontario
Easting:	684222.32 m	**Drilled Depth:**	60.87 m bgs	**Water Level:**	3.7 m bgs	**Log Date:**	Aug-09-2022
Northing:	4859186.99 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	78.46 m	**Casing Diameter:**	HQ	**Casing Stickup:**	N/A	**Logged By:**	E. Pineda



🔴 Major Open Joint / Fracture
🟠 Partially Open Joint / Fracture
⚪ Filled Fracture / Joint
🟢 Bedding / Banding / Foliation
◀ Casing

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)



A13-BH207

PROJECT: 21451329

LOCATION: N 4859056.47; E 684255.27

RECORD OF BOREHOLE: BH207

SHEET 1 OF 8

BORING DATE: June 8, 2022

DATUM: Geodetic

DRILL RIG: Diedrich 120 Track Mounted

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-10} 10^{-8} 10^{-6} 10^{-4} WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0		BARGE DECK		78.85 0.00							
4	Mud Rotary Wash Boring (Tricone) UW Casing	WATER		75.07 3.78							

Depth scale marks: 0 1 2 3 4 5 6 7 8 9 10

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: ML
CHECKED: SEMP

PROJECT: 21451329

LOCATION: N 4859056.47; E 684255.27

RECORD OF BOREHOLE: BH207

SHEET 2 OF 8

BORING DATE: June 8, 2022

DATUM: Geodetic

DRILL RIG: Diedrich 120 Track Mounted

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-10} 10^{-8} 10^{-6} 10^{-4}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION; GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	Mud Rotary Wash Boring (Tricone) UW Casing	WATER									
11											
12											
13											
14											
15											
16											
		Sandy Silty Clay (CL-ML), hard, grey-brown, fine to coarse sand, trace of angular fine gravel, low plasticity (Till) (Unit 5)		62.09	1A	SS	100/0.06				
17		**Shale Bedrock Fragments** (Unit 6a) - Bedrock cored from 16.79 m to 71.38 m depth - Refer to Record of Drillhole BH207		16.82	1B						
18		Note: 1. Efficiency of the SPT hammer utilized was 77.9 %.									
19											
20											

DEPTH SCALE

1 : 50

wsp

LOGGED: ML

CHECKED: SEMP

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859056.47; E 684255.27
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH207

DRILLING DATE: June 8 to 18, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

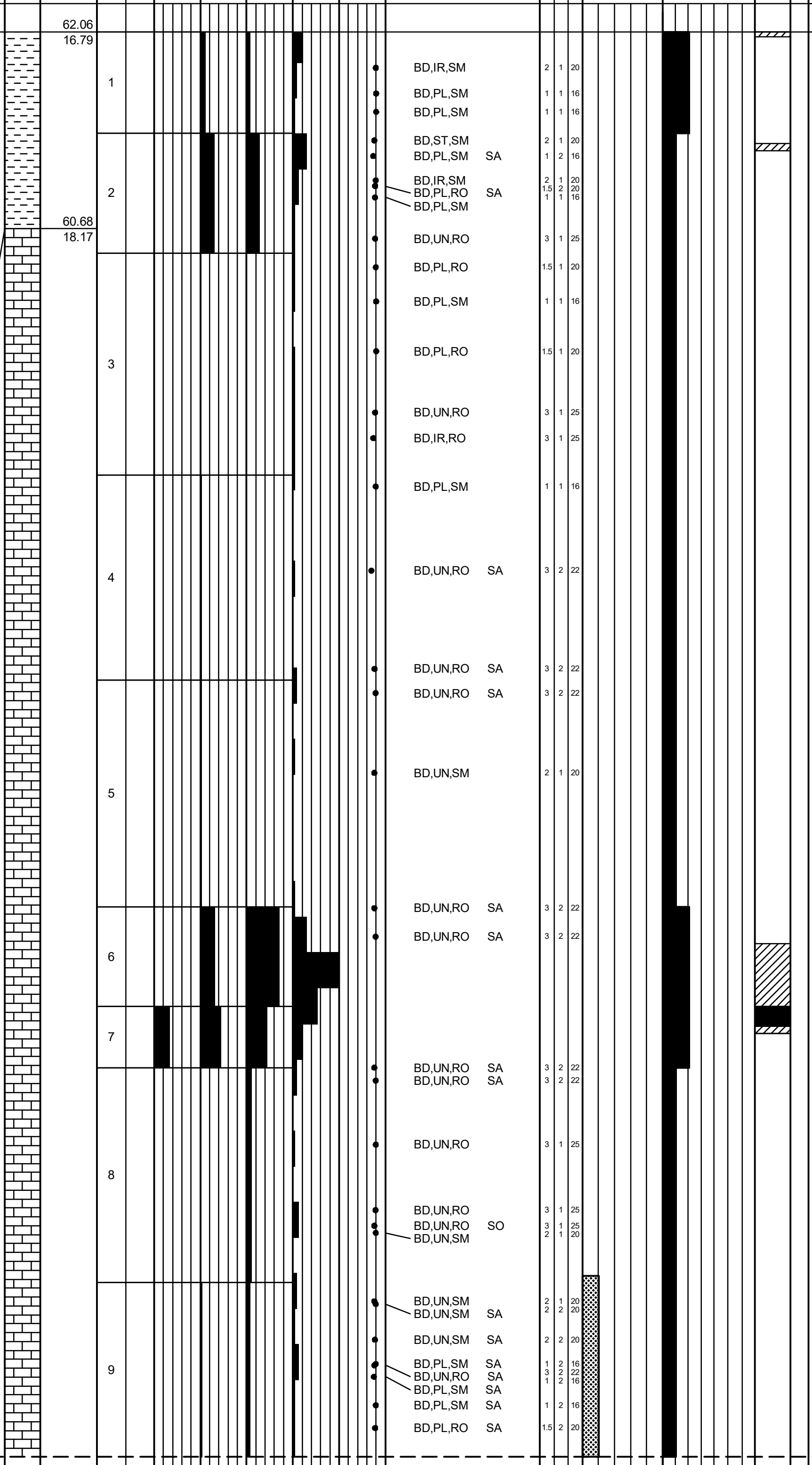
DEPTH SCALE METRES | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (m) | RUN No. | FLUSH RETURN | RECOVERY (TOTAL CORE %, SOLID CORE %) | R.Q.D. % | FRACT. INDEX PER 0.25 m | DISCONTINUITY DATA (DIP w.r.t. CORE AXIS; TYPE AND SURFACE DESCRIPTION; Jr; Ja; Jcon) | HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-8} 10^{-6} 10^{-4} 10^{-2}) | WEATHERING INDEX (W1 W2 W3 W4 W5 W6) | FEATURES | R0/R1 ZONES | PIEZOMETER

Drilling record: Rotary Drill, HQ3 Core

Elev. / Depth (m)	Description
62.06 16.79	TOP OF BEDROCK Slightly weathered to fresh, very thinly to thinly bedded, dark brownish grey, fine grained, faintly porous, slightly reactive to HCl, medium strong SHALE (Blue Mountain Formation) with very thin to thin, grey, fine to medium grained limestone interbeds Swell Sample Swell Sample Brazilian Sample Point Load Test Sample Point Load Test Sample Point Load Test Sample Point Load Test Sample Point Load Test Sample
60.68 18.17	Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey shale interbeds

Runs: 1, 2, 3, 4, 5, 6, 7, 8, 9
Depth scale (m): 17, 18, 19, 20, 21, 22, 23, 24, 25, 26

Type and surface description		Jr	Ja	Jcon
BD,IR,SM		2	1	20
BD,PL,SM		1	1	16
BD,PL,SM		1	1	16
BD,ST,SM		2	1	20
BD,PL,SM	SA	1	2	16
BD,IR,SM		2	1	20
BD,PL,RO	SA	1.5	2	20
BD,PL,SM		1	1	16
BD,UN,RO		3	1	25
BD,PL,RO		1.5	1	20
BD,PL,SM		1	1	16
BD,PL,RO		1.5	1	20
BD,UN,RO		3	1	25
BD,IR,RO		3	1	25
BD,PL,SM		1	1	16
BD,UN,RO	SA	3	2	22
BD,UN,RO	SA	3	2	22
BD,UN,RO	SA	3	2	22
BD,UN,SM		2	1	20
BD,UN,RO	SA	3	2	22
BD,UN,RO	SA	3	2	22
BD,UN,RO	SA	3	2	22
BD,UN,RO	SA	3	2	22
BD,UN,RO		3	1	25
BD,UN,RO		3	1	25
BD,UN,RO	SO	3	1	25
BD,UN,SM		2	1	20
BD,UN,SM		2	1	20
BD,UN,SM	SA	2	2	20
BD,UN,SM	SA	2	2	20
BD,PL,SM	SA	1	2	16
BD,UN,RO	SA	3	2	22
BD,PL,SM	SA	1	2	16
BD,PL,SM	SA	1	2	16
BD,PL,RO	SA	1.5	2	20



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DEPTH SCALE
1 : 50

LOGGED: KL
CHECKED: AC

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859056.47; E 684255.27
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH207

DRILLING DATE: June 8 to 18, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 4 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (m) | RUN No. | FLUSH RETURN | RECOVERY (TOTAL CORE %, SOLID CORE % 80 60 40 20) | R.Q.D. % 80 60 40 20 | FRACT. INDEX PER 0.25 m 5 10 15 20 | DISCONTINUITY DATA (DIP w.r.t. CORE AXIS 0 30 60 90; TYPE AND SURFACE DESCRIPTION; Jr; Ja; Jcon) | HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2} | WEATHERING INDEX W1 W2 W3 W4 W5 W6 | FEATURES | R0/R1 ZONES | PIEZOMETER

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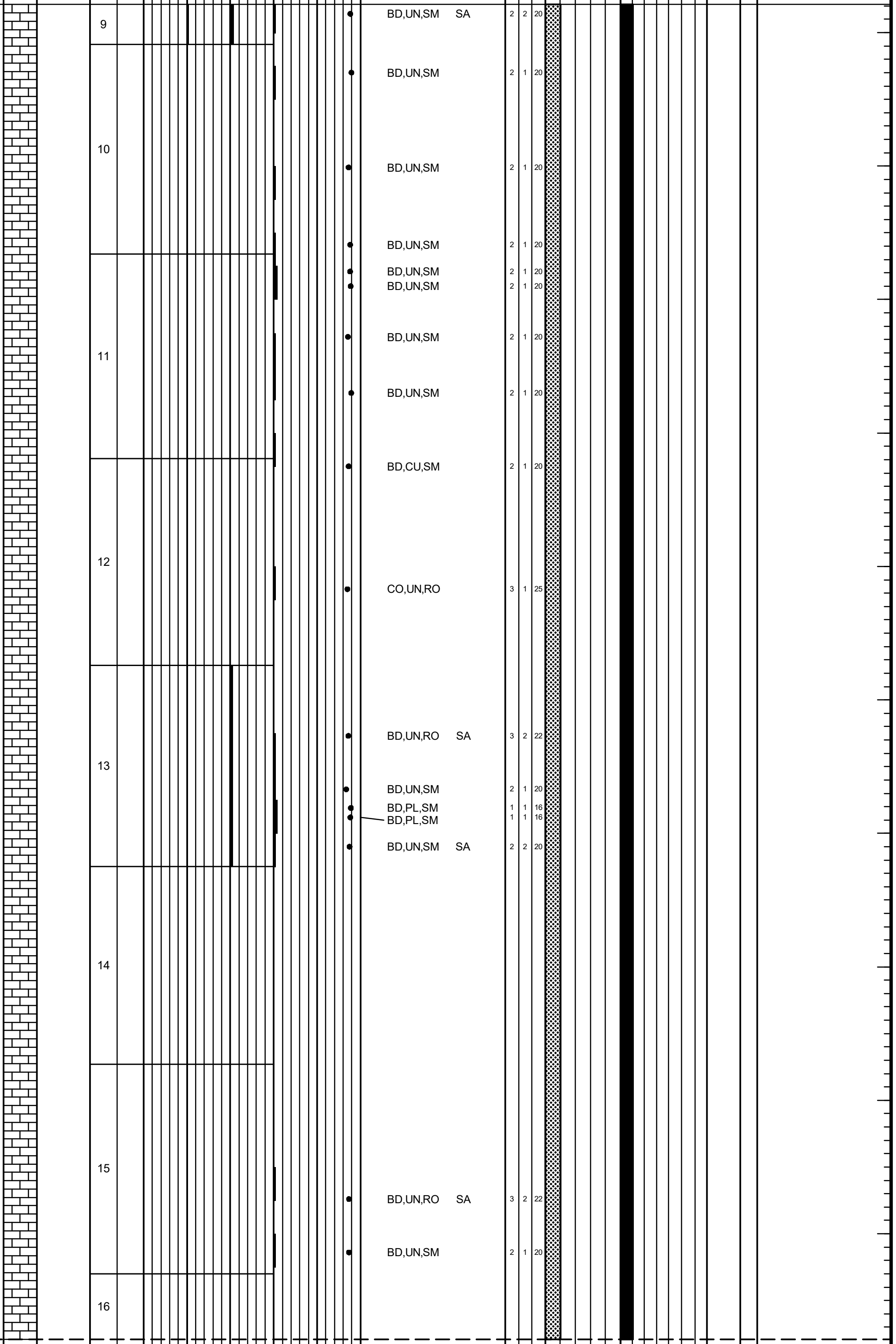


Depth scale: 27, 28, 29, 30, 31, 32, 33, 34, 35, 36

Drilling record: Rotary Drill; HQ3 Core

Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey shale interbeds

Cerchar Sample

Specific Gravity Sample

Point Load Test Sample

UCS Sample

Brazilian Sample

Run No.: 9, 10, 11, 12, 13, 14, 15, 16

Type and Surface Description		Jr	Ja	Jcon
BD,UN,SM	SA	2	2	20
BD,UN,SM		2	1	20
BD,UN,SM		2	1	20
BD,UN,SM		2	1	20
BD,UN,SM		2	1	20
BD,UN,SM		2	1	20
BD,UN,SM		2	1	20
BD,UN,SM		2	1	20
BD,CU,SM		2	1	20
CO,UN,RO		3	1	25
BD,UN,RO	SA	3	2	22
BD,UN,SM		2	1	20
BD,PL,SM		1	1	16
BD,PL,SM		1	1	16
BD,UN,SM	SA	2	2	20
BD,UN,RO	SA	3	2	22
BD,UN,SM		2	1	20

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: KL
CHECKED: AC

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859056.47; E 684255.27
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90°   AZIMUTH: ---

RECORD OF DRILLHOLE: BH207

DRILLING DATE: June 8 to 18, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

--- CONTINUED FROM PREVIOUS PAGE ---

DRILLING RECORD: Rotary Drill, HQ3 Core

DEPTH SCALE METRES	DESCRIPTION
~36.8	Petrographic Analysis Sample Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey shale interbeds Point Load Test Sample
~38.3	Punch Penetration Sample
~39.7	Point Load Test Sample
~40.5	UCS with Modulus Sample
~41.9	Slake Durability Sample
~42.4	Point Load Test Sample
~42.9	Direct Shear Sample
~44.5	Petrographic Analysis Sample
~45.5	Point Load Test Sample

RUN No.
16
17
18
19
20
21
22

DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,IR,RO SA	3	2	22
BD,UN,SM	2	1	20
BD,UN,SM	2	1	20
BD,PL,SM SA	1	2	16
BD,UN,SM	2	1	20
BD,UN,SM	2	1	20
BD,UN,SM	2	1	20
BD,IR,SM SA	2	2	20
BD,IR,RO	3	1	25

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: KL
CHECKED: AC

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859056.47; E 684255.27
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH207

DRILLING DATE: June 8 to 18, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE % (80 60 40 20)	RECOVERY SOLID CORE % (80 60 40 20)	R.Q.D. % (80 60 40 20)	FRACT. INDEX PER 0.25 m (5 10 15 20)	DIP w.r.t. CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-8} 10^{-6} 10^{-4} 10^{-2})	WEATHERING INDEX (W1 W2 W3 W4 W5 W6)	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
47	Rotary Drill HQ3 Core	Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey shale interbeds			22															
					23							BD,UN,SM	2	1	20					
48												BD,UN,SM SA	2	2	20					
					24							BD,UN,SM	2	1	20					
49												BD,UN,SM	2	1	20					
50					25															
51												BD,UN,SM	2	1	20					
					26							BD,UN,SM	2	1	20					
52												BD,UN,SM	2	1	20					
53					27															
54																				
55					28							BD,UN,SM	2	1	20					
												BD,UN,RO	3	1	25					
56					29															
		CONTINUED NEXT PAGE																		

DEPTH SCALE
1 : 50

LOGGED: KL
CHECKED: AC

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859056.47; E 684255.27
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH207

DRILLING DATE: June 8 to 18, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 7 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE % (80 60 40 20)	RECOVERY SOLID CORE % (80 60 40 20)	R.Q.D. % (80 60 40 20)	FRACT. INDEX PER 0.25 m (5 10 15 20)	DIP w.r.t. CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-8} 10^{-6} 10^{-4} 10^{-2})	WEATHERING INDEX (W1 W2 W3 W4 W5 W6)	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
57	Rotary Drill HQ3 Core	Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey shale interbeds			29						●	BD,UN,SM	2	1	20					
58					30						●	BD,UN,SM	2	1	20					
59																				
60					31						●	BD,UN,RO SA	3	2	22					
											●	BD,UN,RO SA	3	2	22					
61					32						●	BD,UN,SM	2	1	20					
62											●	BD,UN,SM	2	1	20					
											●	BD,PL,SM	1	1	16					
63					33															
64					34						●	BD,UN,SM	2	1	20					
65																				
66					35						●	BD,UN,SM	2	1	20					
		CONTINUED NEXT PAGE																		

DEPTH SCALE
1 : 50

LOGGED: KL
CHECKED: AC

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859056.47; E 684255.27
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

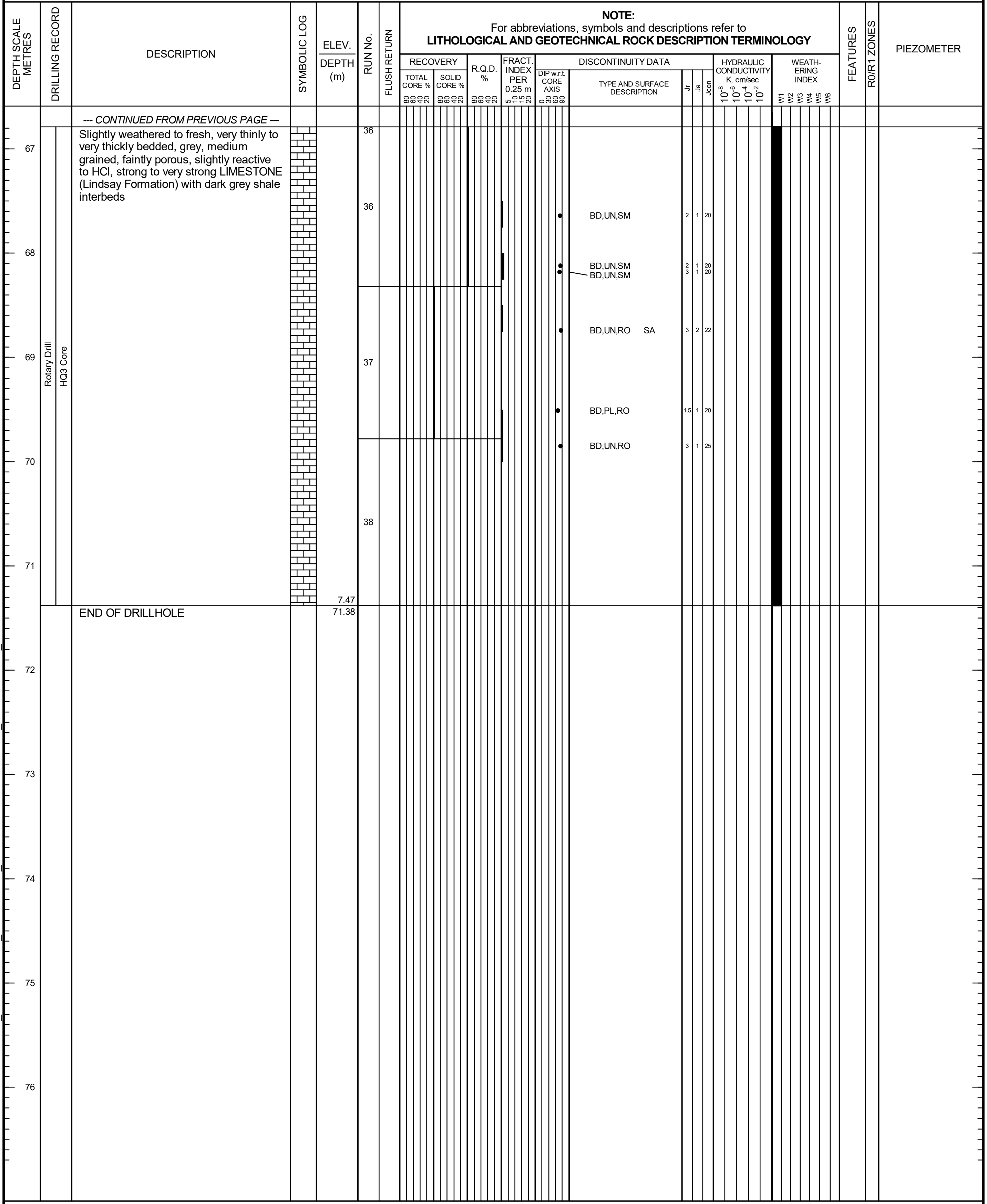
RECORD OF DRILLHOLE: BH207

SHEET 8 OF 8

DRILLING DATE: June 8 to 18, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



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Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey shale interbeds

7.47
71.38

END OF DRILLHOLE

TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,UN,SM	2	1	20
BD,UN,SM	2	1	20
BD,UN,SM	3	1	20
BD,UN,RO SA	3	2	22
BD,PL,RO	1.5	1	20
BD,UN,RO	3	1	25

DEPTH SCALE
1 : 50

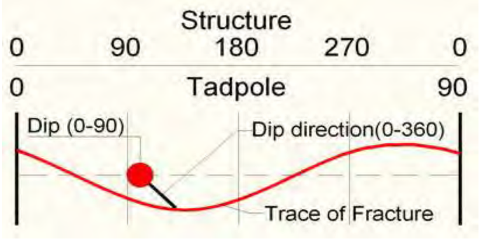
LOGGED: KL
CHECKED: AC

GTA-RCK 048 S:\CLIENTS\OPG\DARLINGTON_GENERATING_STATION\02_DATA\GINT\DARLINGTON_GENERATING_STATION.GPJ GAL-MISS.GDT 6/2/23

Geophysical Record of Borehole: BH207

Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	20.8 m bgs	**Location:**	Darlington, Ontario
Easting:	684255.27 m	**Drilled Depth:**	71.38 m bgs	**Water Level:**	N/A	**Log Date:**	June-19-2022
Northing:	4859056.47 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	78.85 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	C. Phillips



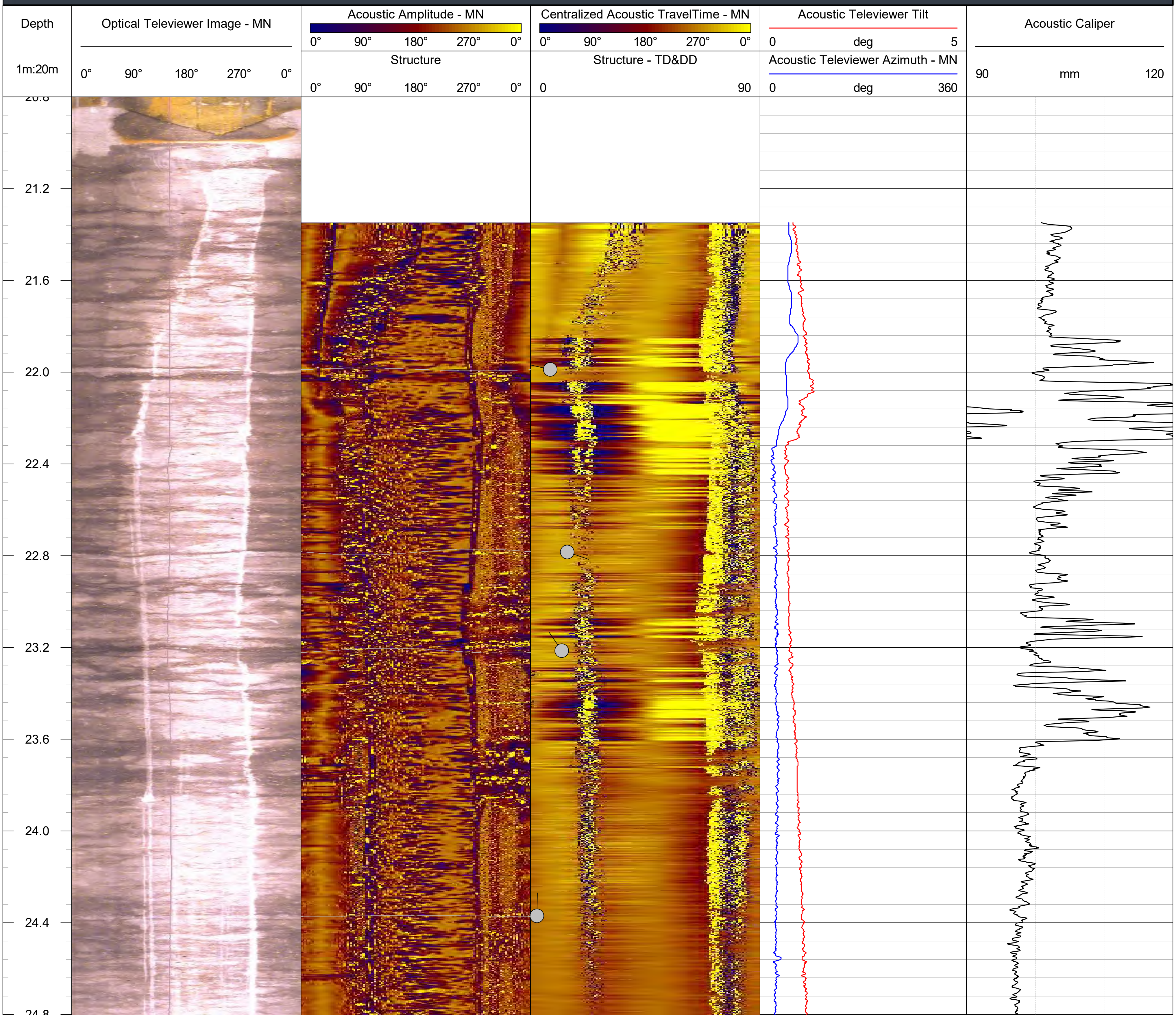
● Partially Open Joint / Fracture

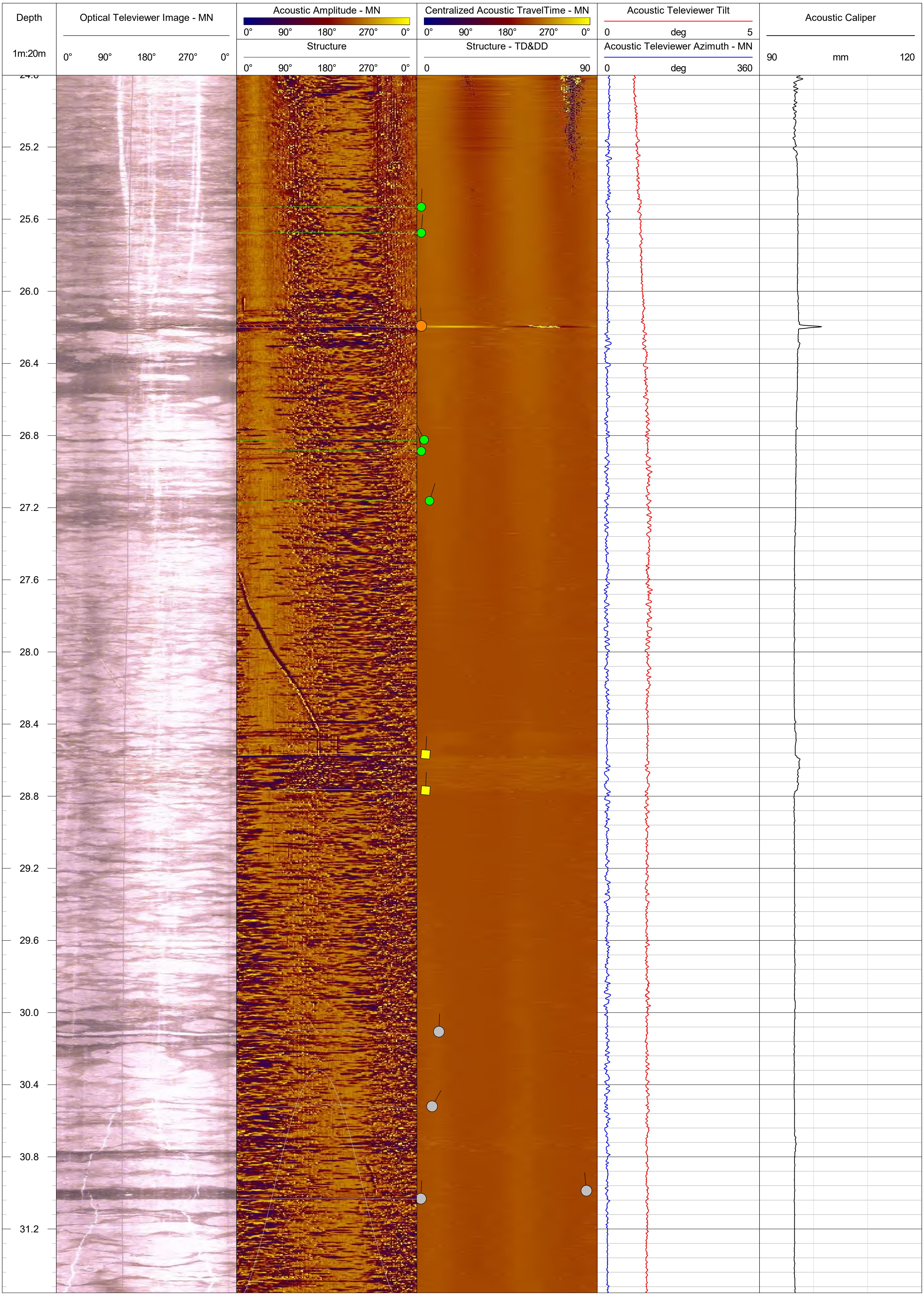
● Filled Fracture / Joint

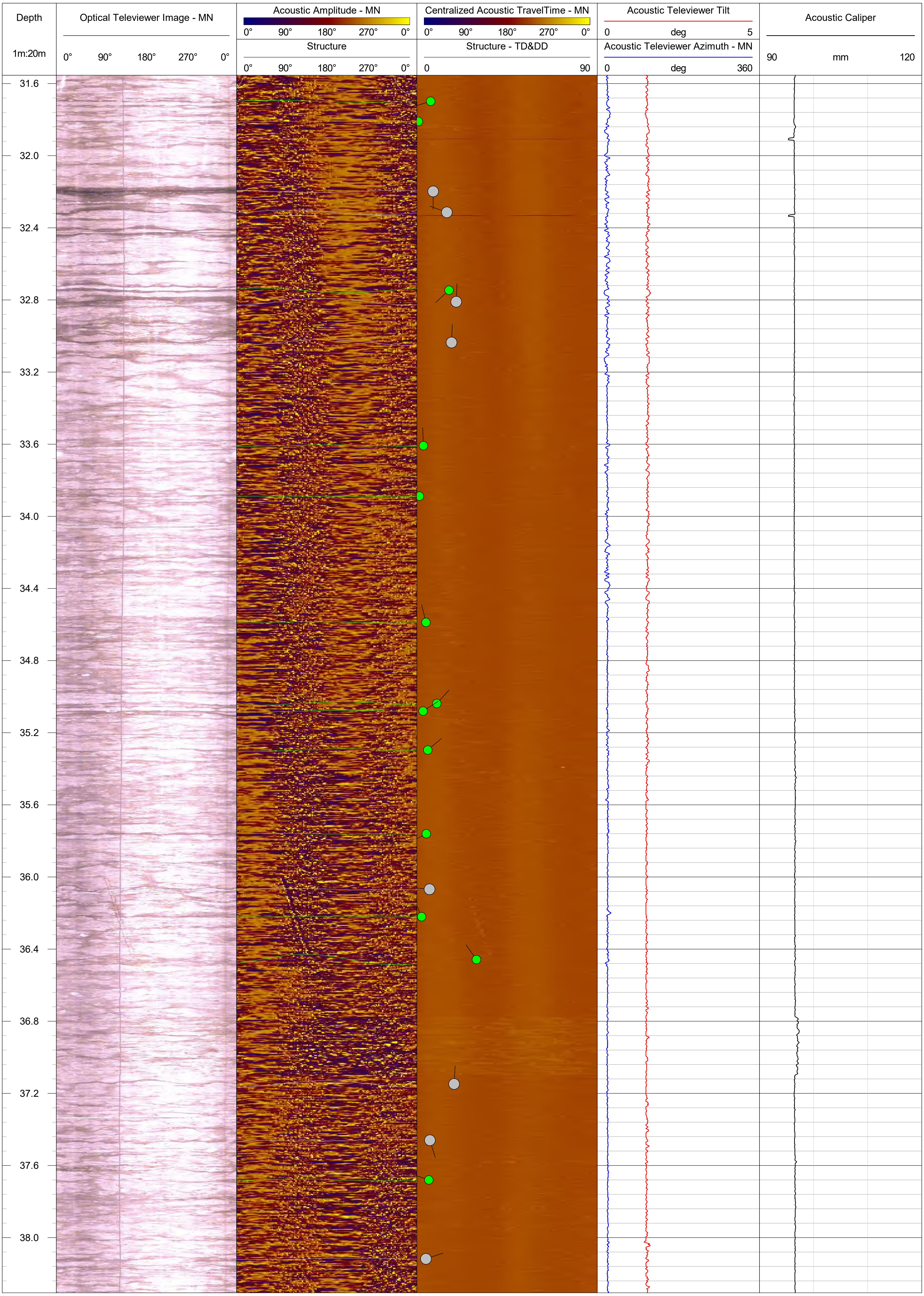
● Bedding / Banding / Foliation

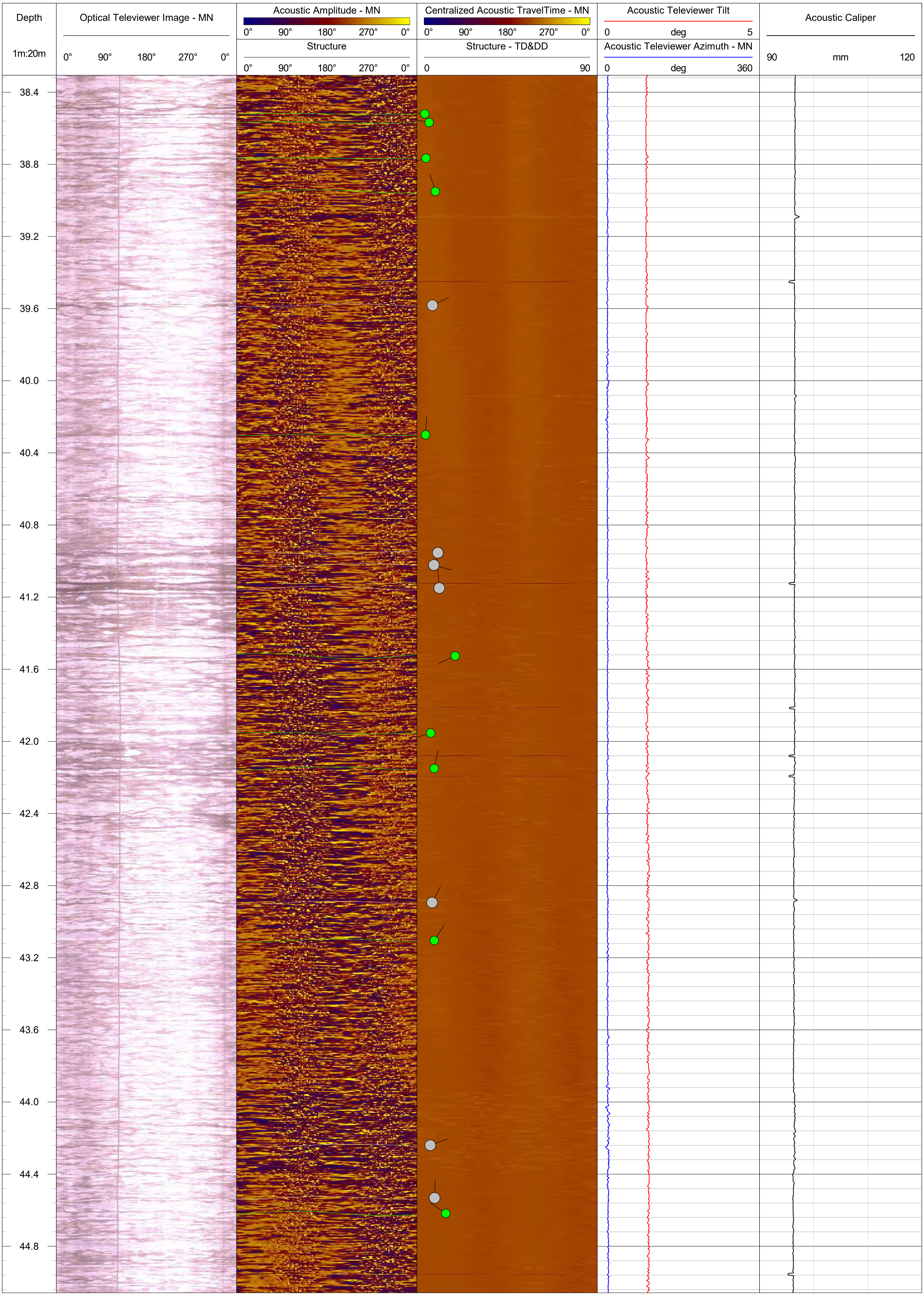
◆ Contact

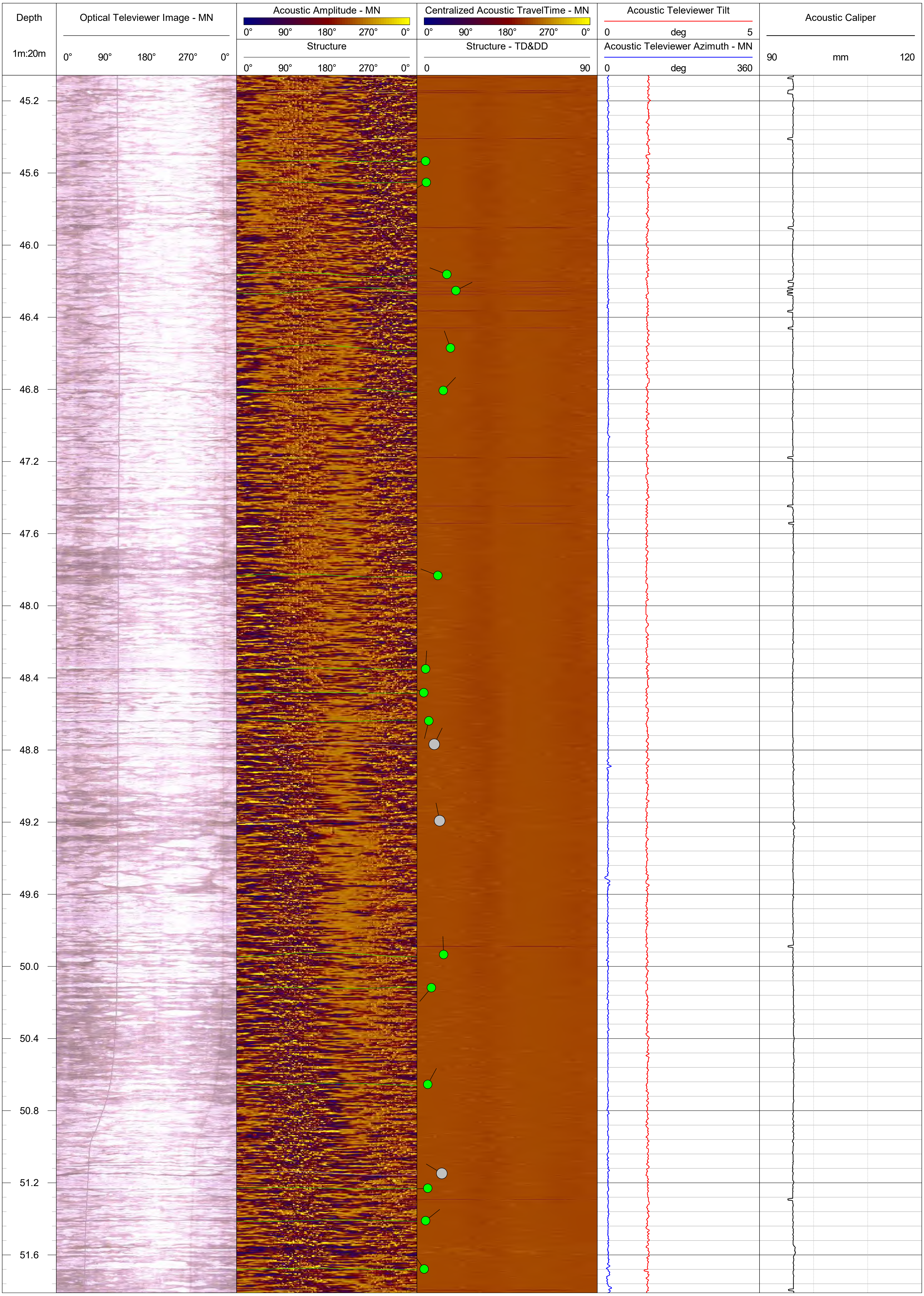
Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)




Depth
1m:20m
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
25.2
25.6
26.0
26.4
26.8
27.2
27.6
28.0
28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2


Depth
1m:20m
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
31.6
32.0
32.4
32.8
33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8
37.2
37.6
38.0


Depth
1m:20m
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
38.4
38.8
39.2
39.6
40.0
40.4
40.8
41.2
41.6
42.0
42.4
42.8
43.2
43.6
44.0
44.4
44.8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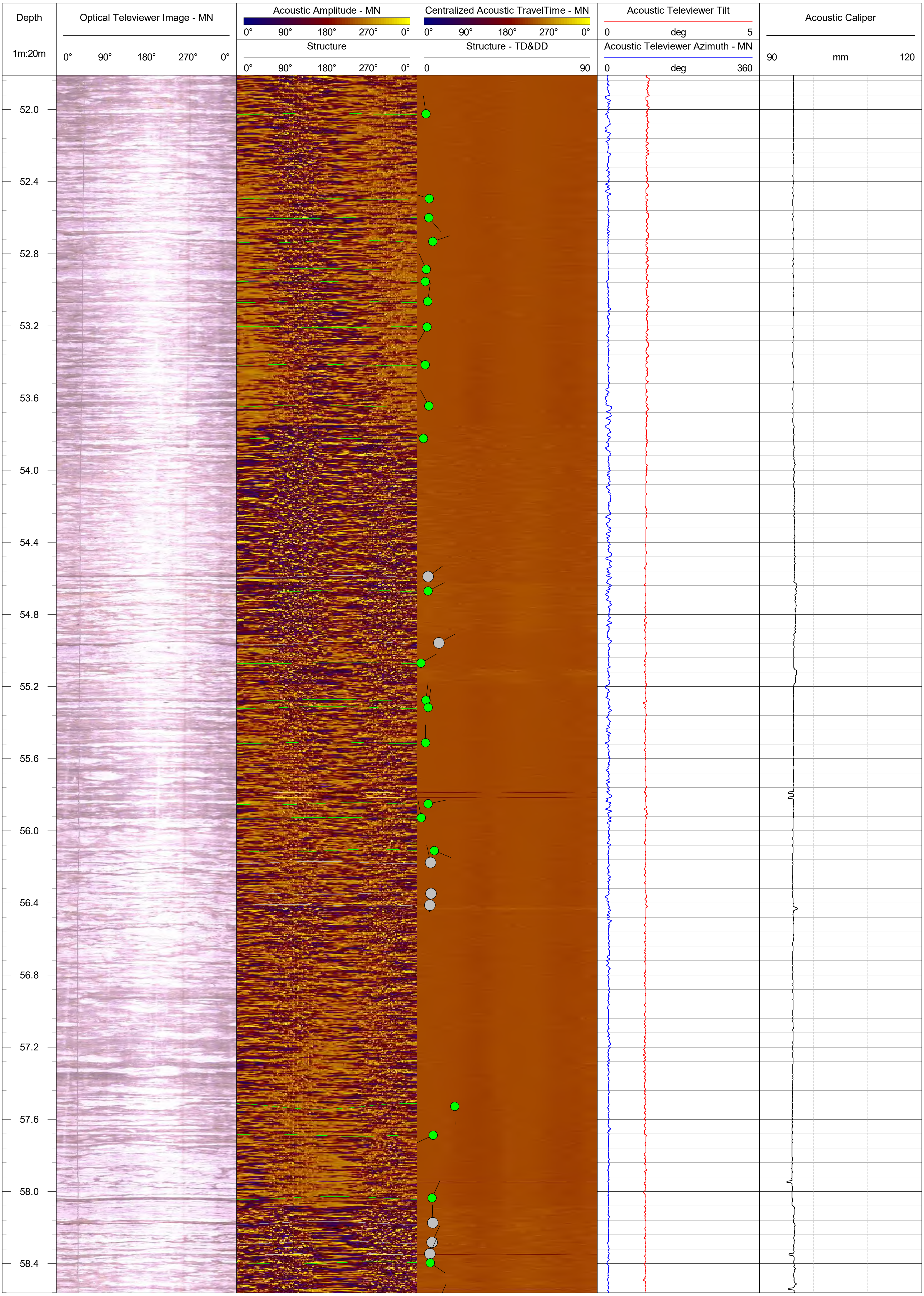
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
45.2
45.6
46.0
46.4
46.8
47.2
47.6
48.0
48.4
48.8
49.2
49.6
50.0
50.4
50.8
51.2
51.6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Optical Televiewer Image - MN
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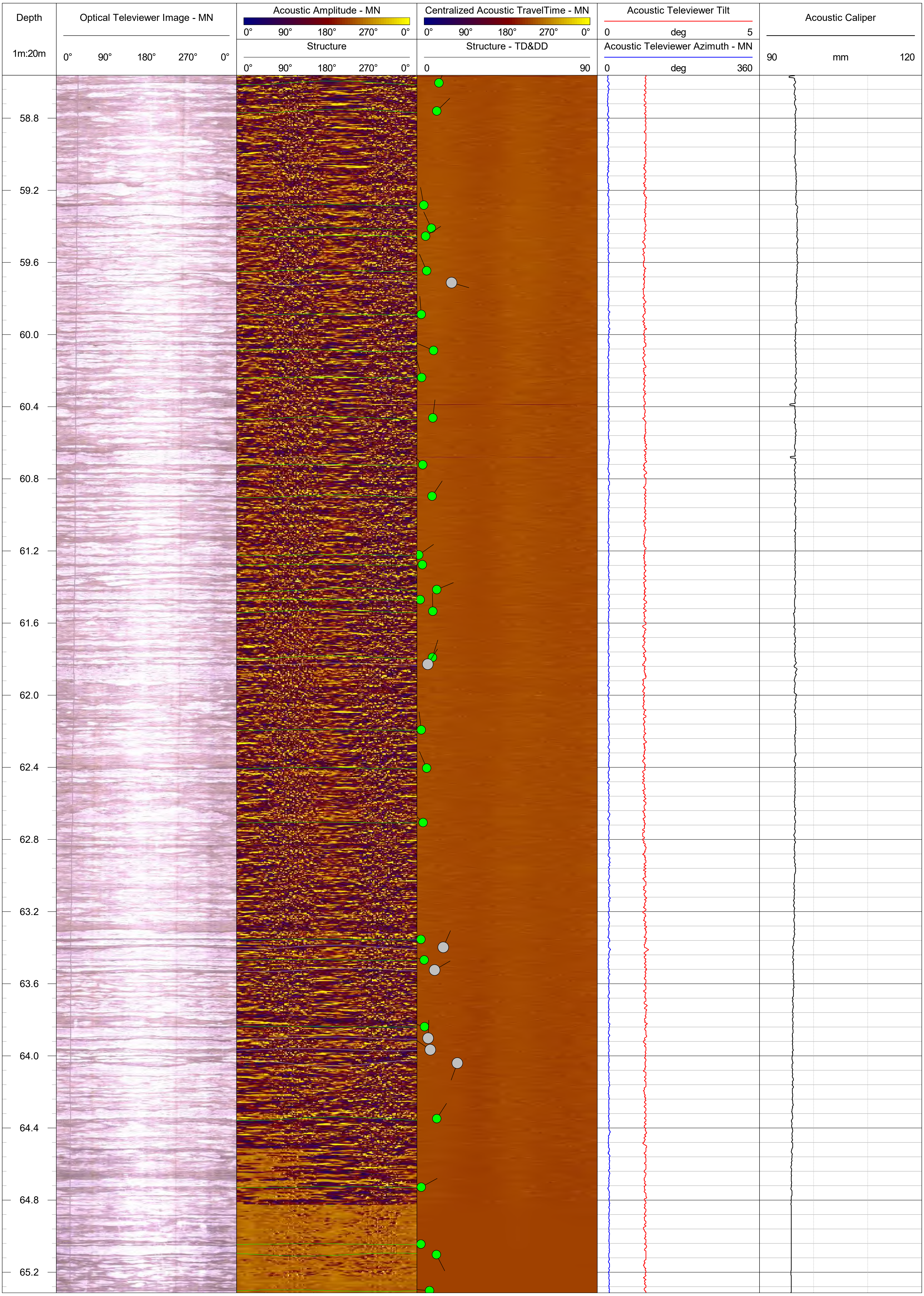
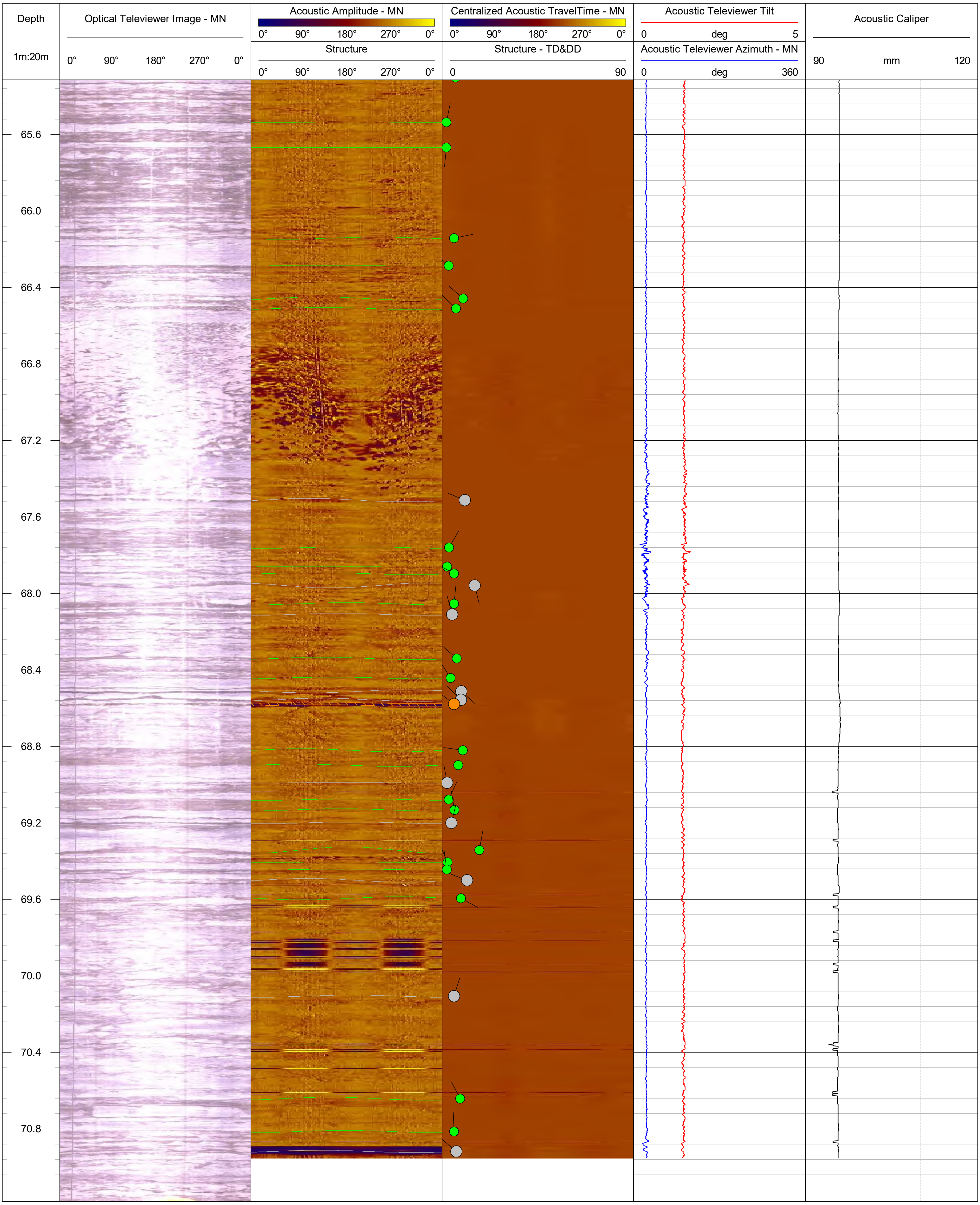
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
52.0
52.4
52.8
53.2
53.6
54.0
54.4
54.8
55.2
55.6
56.0
56.4
56.8
57.2
57.6
58.0
58.4

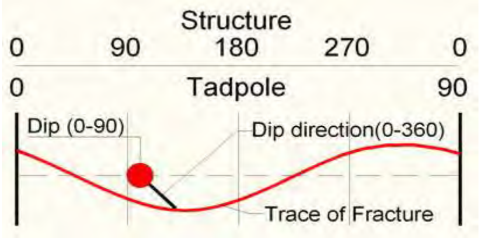

Depth
1m:20m
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
58.8
59.2
59.6
60.0
60.4
60.8
61.2
61.6
62.0
62.4
62.8
63.2
63.6
64.0
64.4
64.8
65.2


Depth
1m:20m
Optical Televiewer Image - MN
0°
90°
180°
270°
0°
Acoustic Amplitude - MN
0°
90°
180°
270°
0°
Structure
0°
90°
180°
270°
0°
Centralized Acoustic TravelTime - MN
0°
90°
180°
270°
0°
Structure - TD&DD
0
90
Acoustic Televiewer Tilt
0
deg
5
Acoustic Televiewer Azimuth - MN
0
deg
360
Acoustic Caliper
90
mm
120
65.6
66.0
66.4
66.8
67.2
67.6
68.0
68.4
68.8
69.2
69.6
70.0
70.4
70.8

Geophysical Record of Borehole: BH207

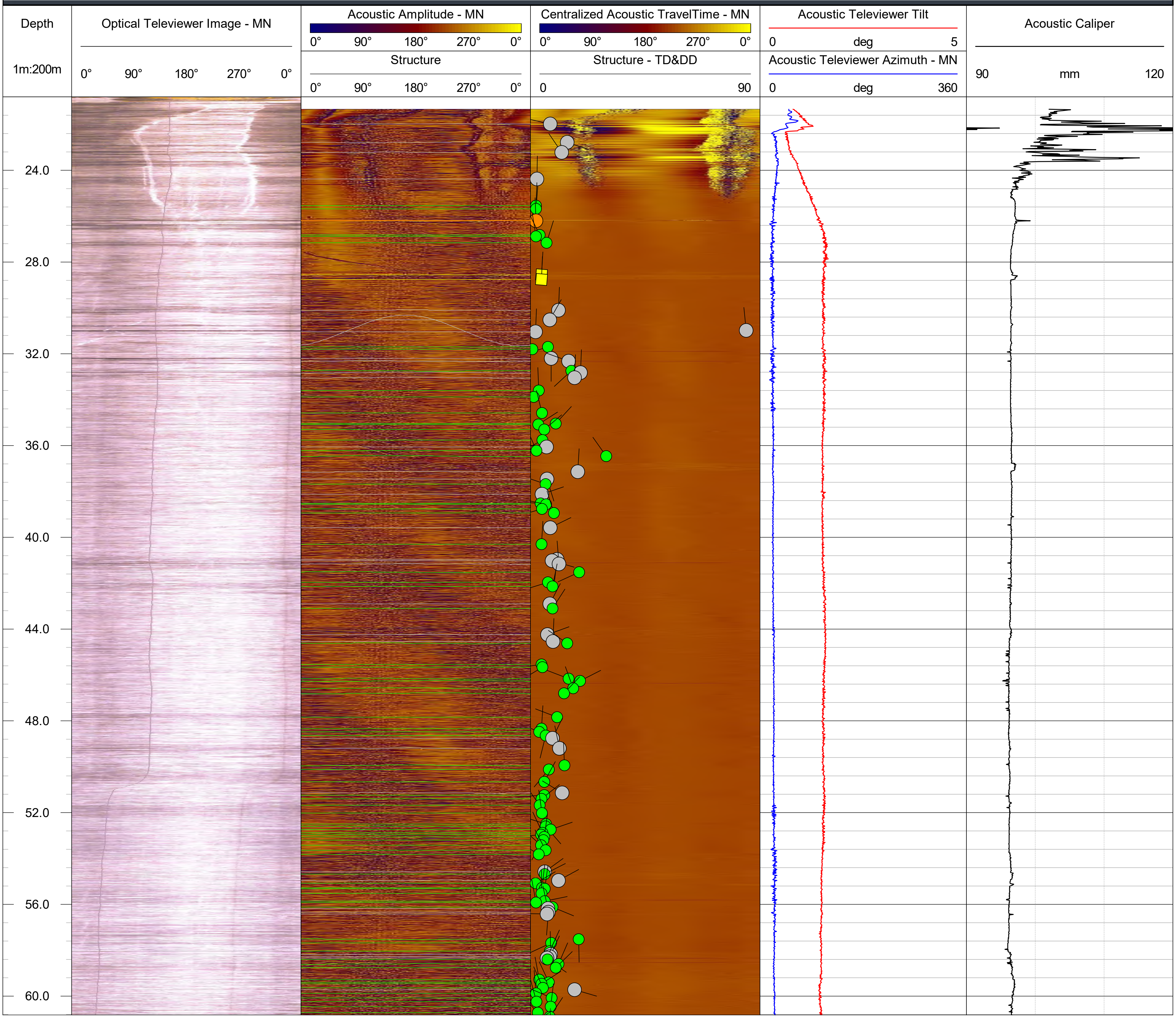
Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

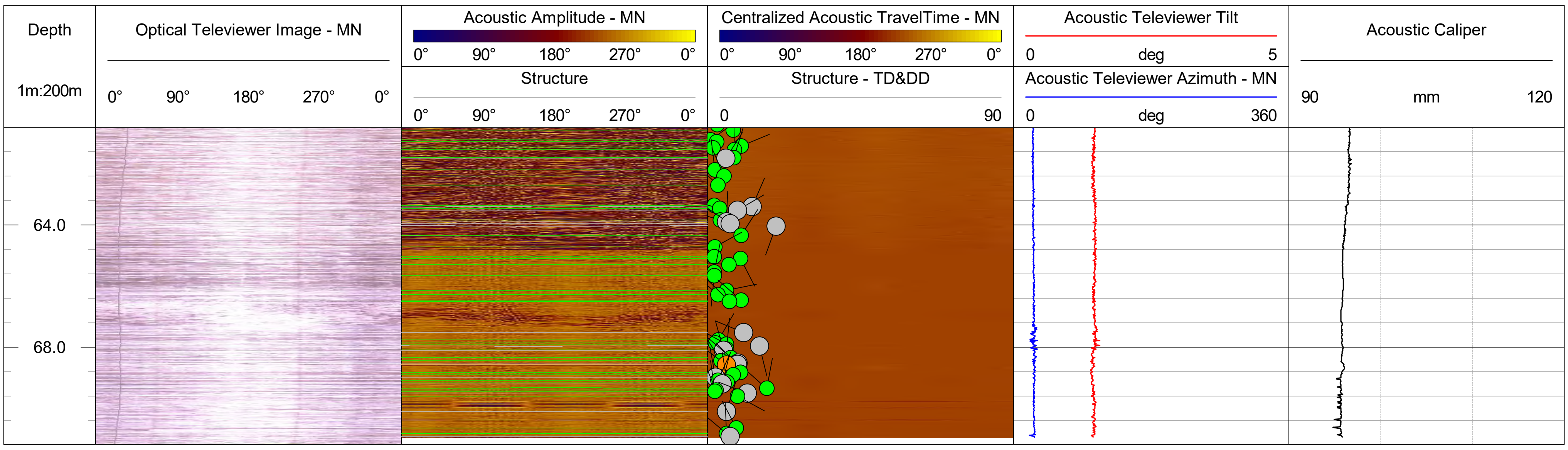
Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	20.8 m bgs	**Location:**	Darlington, Ontario
Easting:	684255.27 m	**Drilled Depth:**	71.38 m bgs	**Water Level:**	N/A	**Log Date:**	June-19-2022
Northing:	4859056.47 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	78.85 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	C. Phillips



● Partially Open Joint / Fracture
● Filled Fracture / Joint
● Bedding / Banding / Foliation
◆ Contact

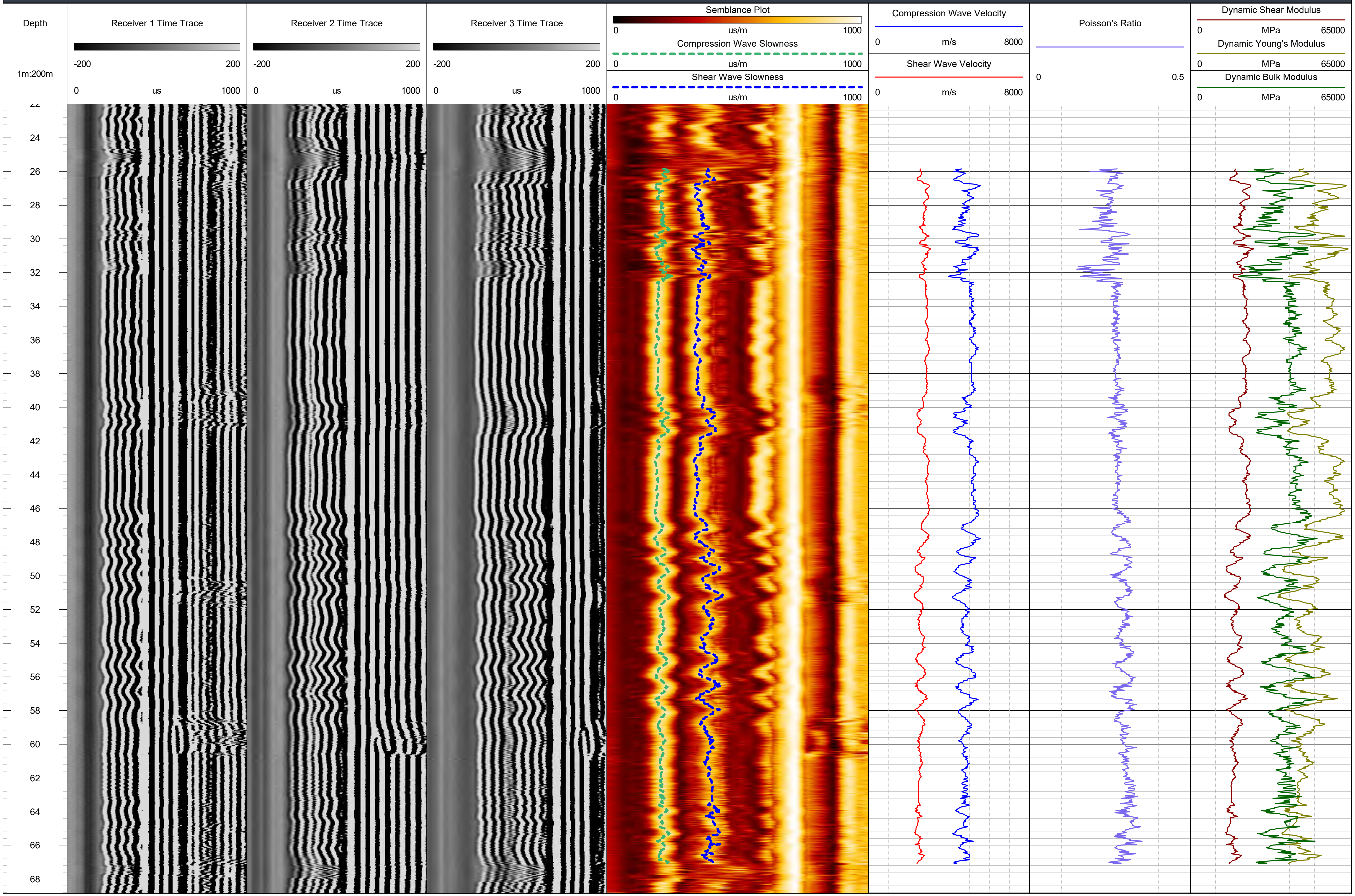
Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)




Depth
1m:200m
64.0
68.0
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120

Geophysical Record of Borehole: BH207

Log Title: Full Waveform Sonic Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023



A14-BH301

PROJECT: 21451329

LOCATION: N 4859780.93; E 684079.19

RECORD OF BOREHOLE: BH301

SHEET 1 OF 7

BORING DATE: August 23 to 25, 2022

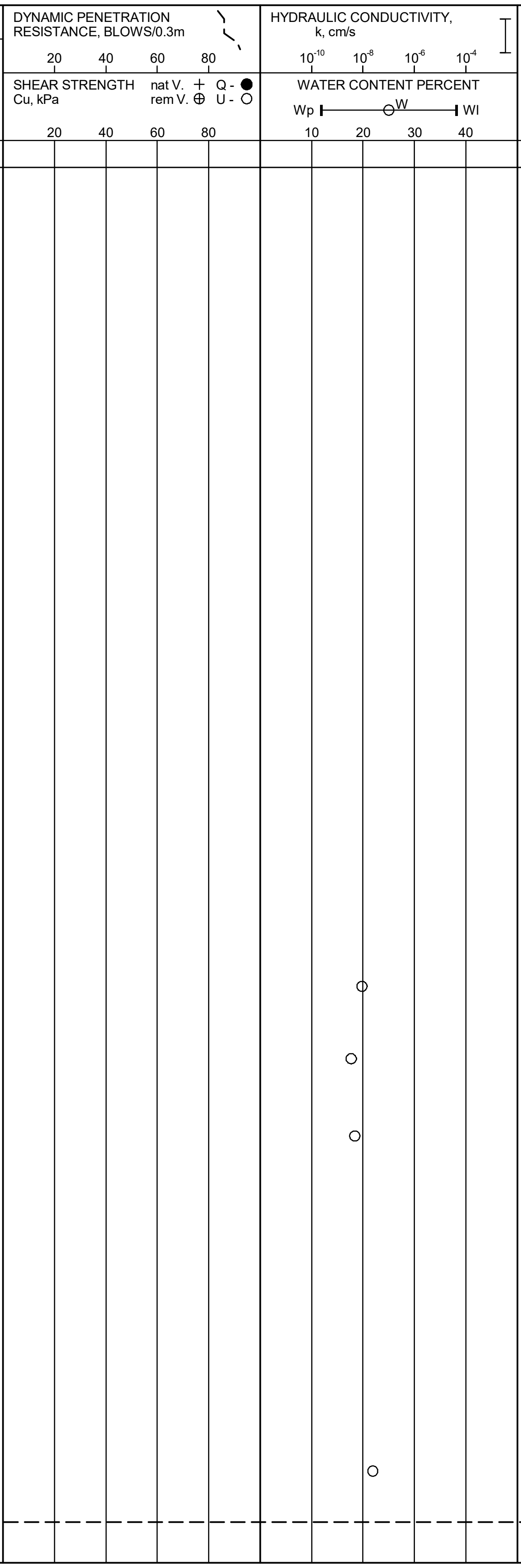
DRILL RIG: Diedrich 120 Track Mounted

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)
		BARGE DECK		78.09 0.00
0 – 3.57	Mud Rotary Wash Boring (Tricone) UW Casing	WATER		74.52 3.57
5.74		**Silty Sand (SM)**, loose to very dense, grey, wet, fine to medium sand (Glaciolacustrine) (Unit 4a) - Lean Clay layers in Spoon Sample 5		72.35 5.74
9.32	Mud Rotary Wash Boring (Tricone) Open	**Lean Clay with Sand (CL)**, hard to very stiff, grey, moist, trace of fine to medium sand, low to medium plasticity (Glaciolacustrine) (Unit 4b)		68.77 9.32

CONTINUED NEXT PAGE

NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1	SS	9		
2	SS	34	NP	1 71 25 3
3	SS	47		
4	SS	47		
5	SS	59		
6	SS	59		
7	SS	45		



PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

LOGGED: JD/BD

CHECKED: SEMP

PROJECT: 21451329
LOCATION: N 4859780.93; E 684079.19

RECORD OF BOREHOLE: BH301

SHEET 2 OF 7

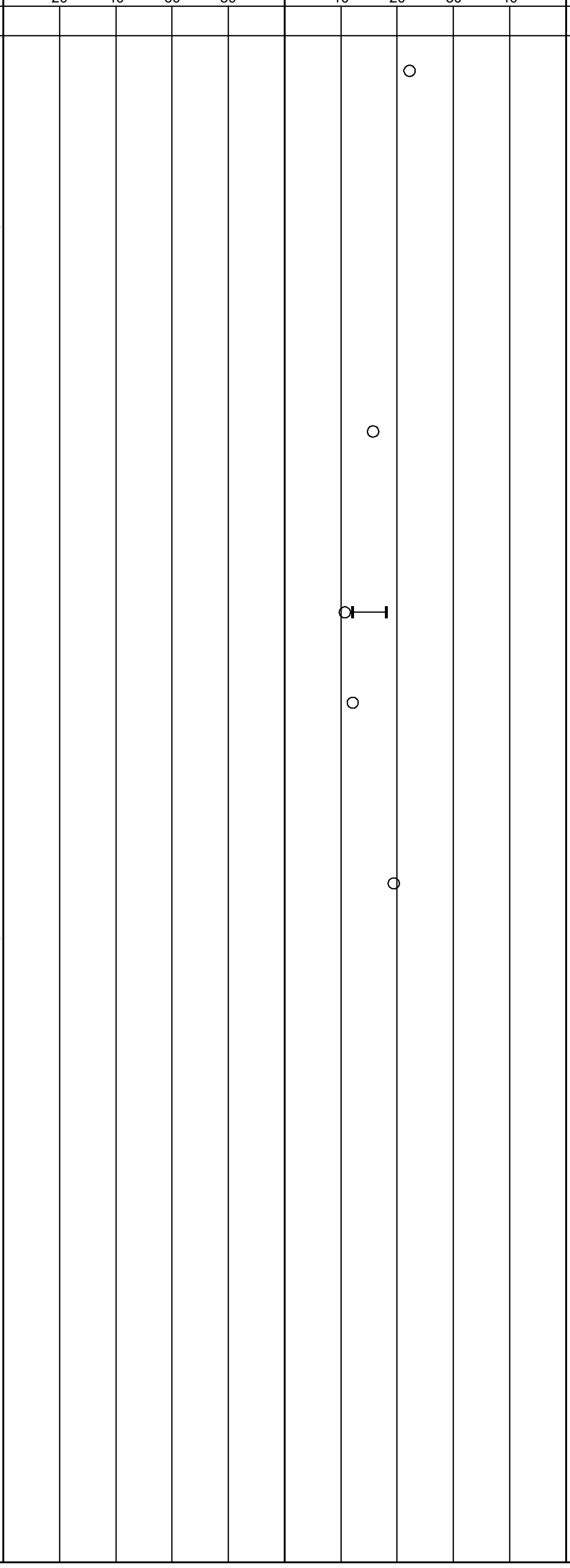
BORING DATE: August 23 to 25, 2022

DRILL RIG: Diedrich 120 Track Mounted

DATUM: Geodetic

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	PIEZOMETER OR STANDPIPE INSTALLATION
10	Mud Rotary Wash Boring (Tricone)	**Lean Clay with Sand (CL)**, hard to very stiff, grey, moist, trace of fine to medium sand, low to medium plasticity (Glaciolacustrine) (Unit 4b) - Trace of fine to coarse sand in Spoon Sample 9	67.09 11.00	8	SS	24			Open
				9	SS	34			
11		**Sandy Silt (ML)**, very dense, grey, moist, fine to medium sand (Glaciolacustrine) (Unit 4a)	64.50 13.59	10	SS	100/ 0.13			
12				11	SS	174			
				12	SS	153	NP	2 47 38 13	
13				13	SS	195			
14		**Lean Clay with Sand (CL)**, hard, grey, moist, fine to coarse sand, trace of fine subangular fine gravel, low to medium plasticity (Till) (Unit 5)	63.89 14.20	14	SS	60		3 21 51 26	
		Sandy Lean Clay (CL), very stiff, grey, wet, fine to coarse sand, low to medium plasticity (Glaciolacustrine) (Unit 4b)	63.28 14.81	15	SS	17			
15		**Sandy Silty Clay (CL-ML)**, hard, grey, moist, fine to coarse sand, angular fine gravel, low plasticity (Till) (Unit 5)		16	SS	80			
				17	SS	-			
16		- Shale Bedrock in tip of Spoon Sample 18	61.83 16.26	18A 18B	SS	100/ 0.0			
17		**Shale Bedrock**							
18									
19									
20									



Notes:

1. Bedrock cored from 16.26 m to 60.64 m depth

2. Refer to Record of Drillhole BH301

3. Water level in open borehole could not be measured upon completion of soil drilling due to use of mud-rotary technique.

4. Efficiency of the SPT hammer utilized was 75.2 %.

5. Methane (CH4) was detected at surface on barge deck by a portable gas monitor(GX-6000) during drilling of BH301 between elevations of approximately 61.8 m and 58.4 m.

DEPTH SCALE
1 : 50

LOGGED: JD/BD
CHECKED: SEMP

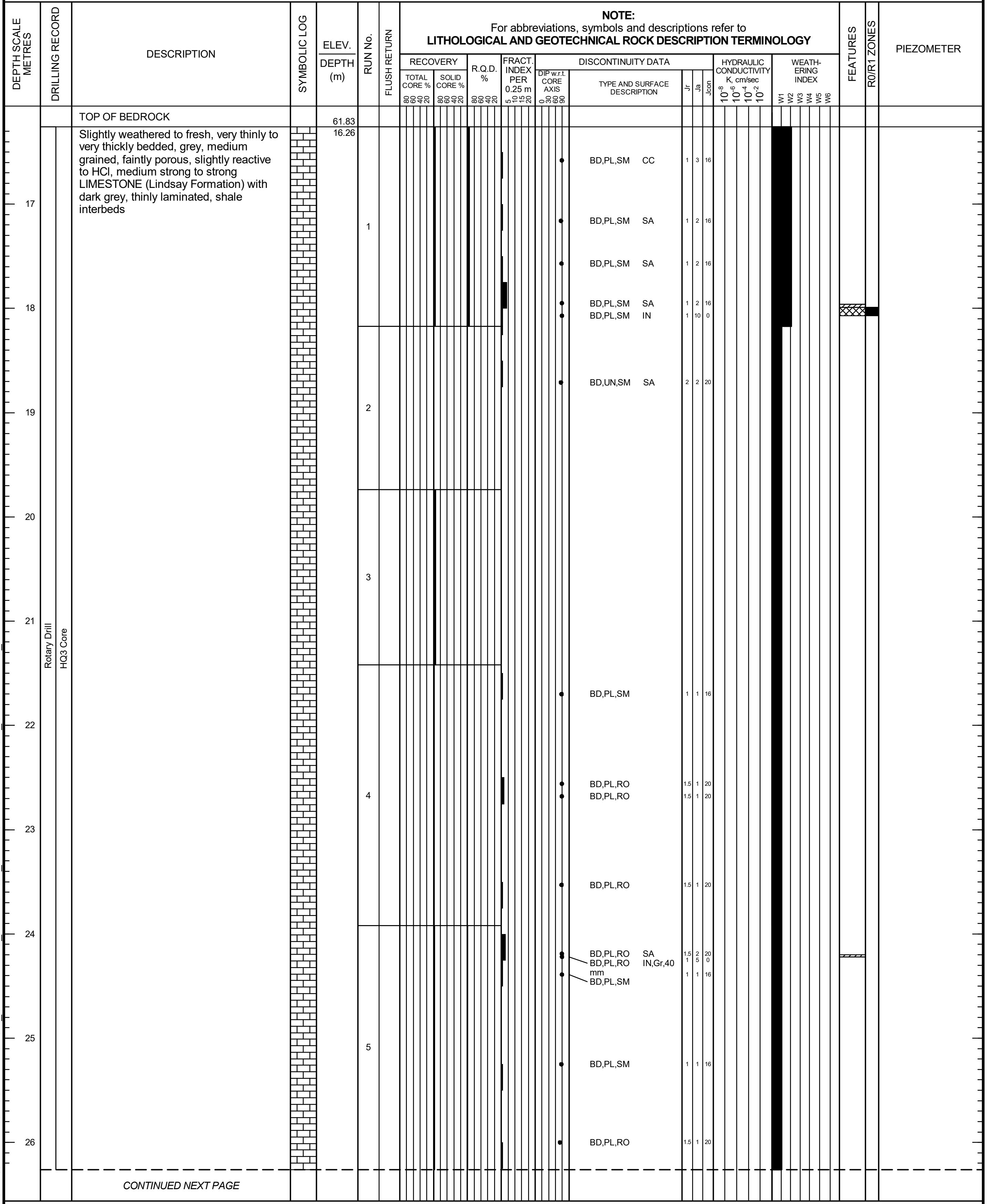
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859780.93; E 684079.19
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH301

SHEET 3 OF 7
DATUM: Geodetic

DRILLING DATE: August 25 to September 1, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



TOP OF BEDROCK — 61.83 / 16.26

Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with dark grey, thinly laminated, shale interbeds

Type and Surface Description		Jr	Ja	Jcon
BD,PL,SM	CC	1	3	16
BD,PL,SM	SA	1	2	16
BD,PL,SM	SA	1	2	16
BD,PL,SM	SA	1	2	16
BD,PL,SM	IN	1	10	0
BD,UN,SM	SA	2	2	20
BD,PL,SM		1	1	16
BD,PL,RO		1.5	1	20
BD,PL,RO		1.5	1	20
BD,PL,RO		1.5	1	20
BD,PL,RO	SA	1.5	2	20
BD,PL,RO	IN,Gr,40 mm	1	5	0
BD,PL,SM		1	1	16
BD,PL,SM		1	1	16
BD,PL,RO		1.5	1	20

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: JD
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859780.93; E 684079.19
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH301

SHEET 4 OF 7

DRILLING DATE: August 25 to September 1, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec	WEATHERING INDEX	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
	Rotary Drill HQ3 Core	Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with dark grey, thinly laminated, shale interbeds			5															
27																				
												BD,PL,RO SA	1.5	2	20					
												BD,UN,RO	3	1	25					
28																				
					6															
												BD,PL,RO	1.5	1	20					
29																				
30																				
31												BD,PL,RO	1.5	1	20					
												BD,PL,SM	1	1	16					
					7															
32																				
33		Punch Penetration Sample										BD,UN,SM	2	1	20					
34												BD,ST,RO	3	1	25					
					8															
35																				
36																				
					9															
		CONTINUED NEXT PAGE																		

Recovery scales: 80 60 40 20 | 80 60 40 20; R.Q.D.: 80 60 40 20; Fract. index: 5 10 15 20; Dip: 0 30 60 90; Hydraulic conductivity: 10^{-8} 10^{-6} 10^{-4} 10^{-2}; Weathering: W1 W2 W3 W4 W5 W6

DEPTH SCALE
1 : 50

LOGGED: JD
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859780.93; E 684079.19
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH301

DRILLING DATE: August 25 to September 1, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 5 OF 7
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY: TOTAL CORE % 80 60 40 20	RECOVERY: SOLID CORE % 80 60 40 20	R.Q.D. % 80 60 40 20	FRACT. INDEX PER 0.25 m 5 10 15 20	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS 0 30 60 90	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2}	WEATH-ERING INDEX W1 W2 W3 W4 W5 W6	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
	Rotary Drill HQ3 Core	Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with dark grey, thinly laminated, shale interbeds									●	BD,ST,RO	3	1	25					
37																				
		UCS with Modulus Sample			9															
38																				
39											●	BD,PL,SM	1	1	16					
40		Cerchar Sample									●	BD,UN,RO	3	1	25					
					10															
41											●	BD,PL,RO	1.5	1	20					
42																				
											●	BD,UN,RO	3	1	25					
43		Brazilian Sample									●	BD,UN,RO	3	1	25					
					11															
44											●	BD,PL,RO	1.5	1	20					
45		Specific Gravity Sample																		
					12															
46																				
		CONTINUED NEXT PAGE																		

DEPTH SCALE
1 : 50

LOGGED: JD
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859780.93; E 684079.19
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH301

DRILLING DATE: August 25 to September 1, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

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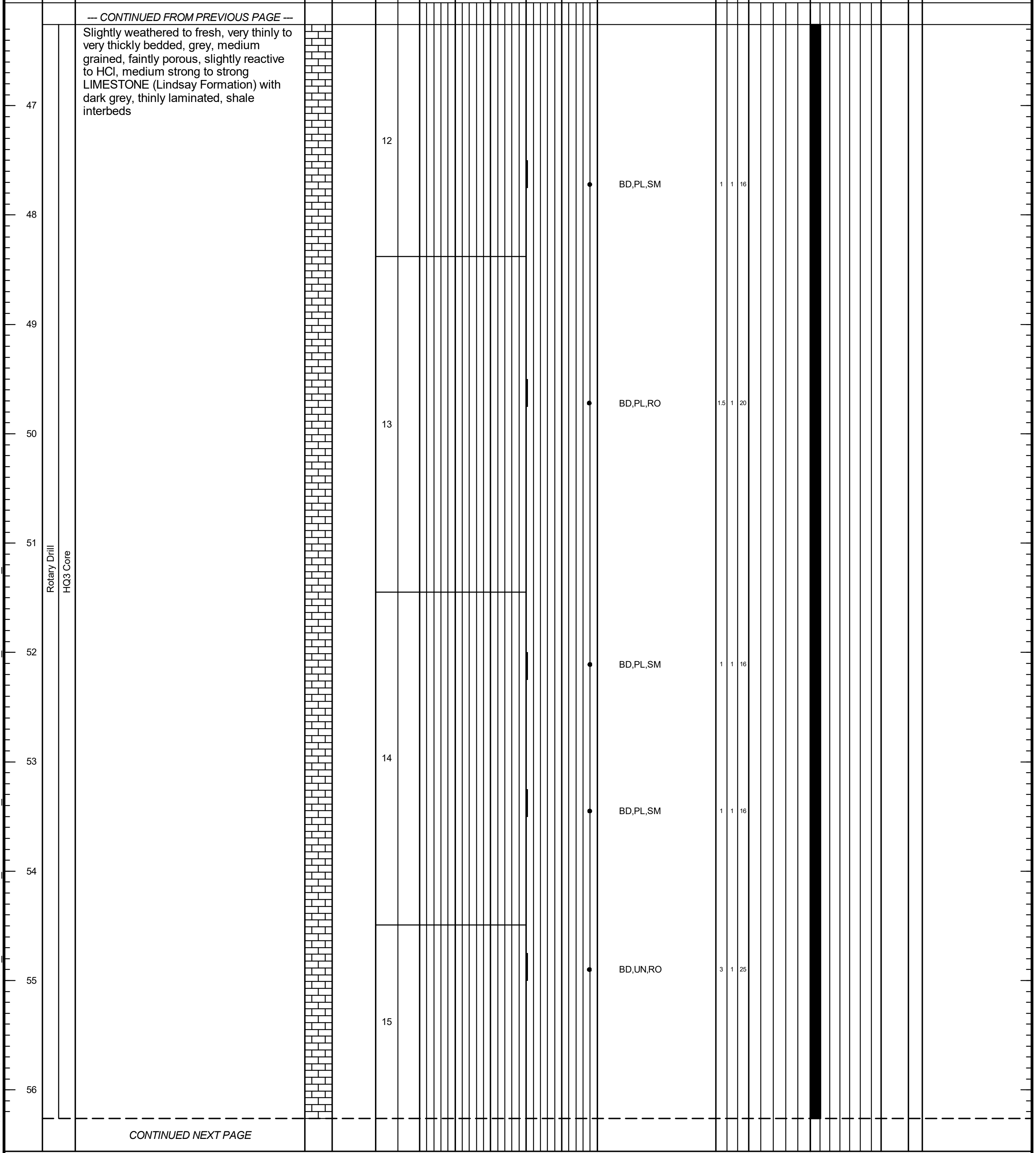


Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with dark grey, thinly laminated, shale interbeds

TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,PL,SM	1	1	16
BD,PL,RO	1.5	1	20
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,UN,RO	3	1	25

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: JD
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859780.93; E 684079.19
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH301

DRILLING DATE: August 25 to September 1, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 7 OF 7
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE % (80 60 40 20)	RECOVERY SOLID CORE % (80 60 40 20)	R.Q.D. % (80 60 40 20)	FRACT. INDEX PER 0.25 m (5 10 15 20)	DISCONTINUITY DATA DIP w.r.t. CORE AXIS (0 30 60 90)	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-8} 10^{-6} 10^{-4} 10^{-2})	WEATHERING INDEX (W1 W2 W3 W4 W5 W6)	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
57 58 59 60	Rotary Drill HQ3 Core	Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with dark grey, thinly laminated, shale interbeds	▦	17.45 60.64	15 16												W1 ■			
61 62 63 64 65 66		END OF DRILLHOLE																		

DEPTH SCALE
1 : 50

LOGGED: JD
CHECKED: PKS

Water Content Summary
ASTM D2216

Test Request #	21451329-21600-610 BH301	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville		

Sample Location	Sample Ref	Top (m)	Base (m)	Type	Soil Description	Water Content %	Method	Remarks
BH301	1	5.74	6.35	SS		19.8	B	
BH301	2	6.35	6.81	SS		17.7	B	
BH301	3	6.96	7.42	SS		18.4	B	
BH301	7	9.40	9.85	SS		21.9	B	
BH301	8	10.01	10.46	SS		22.2	B	
BH301	12	12.44	12.90	SS		15.7	B	
BH301	14	13.66	14.12	SS		10.7	B	
BH301	15	14.27	14.73	SS		12.1	B	
BH301	17	15.49	15.95	SS		19.4	B	

Notes:

Disclaimer:

Tested by: JTimms **Date:** 05 Oct 2022
Checked by: MRuck **Date:** 27 Oct 2022
Reviewed by: JoNorris **Date:** 10 Nov 2022

PARTICLE SIZE DISTRIBUTION

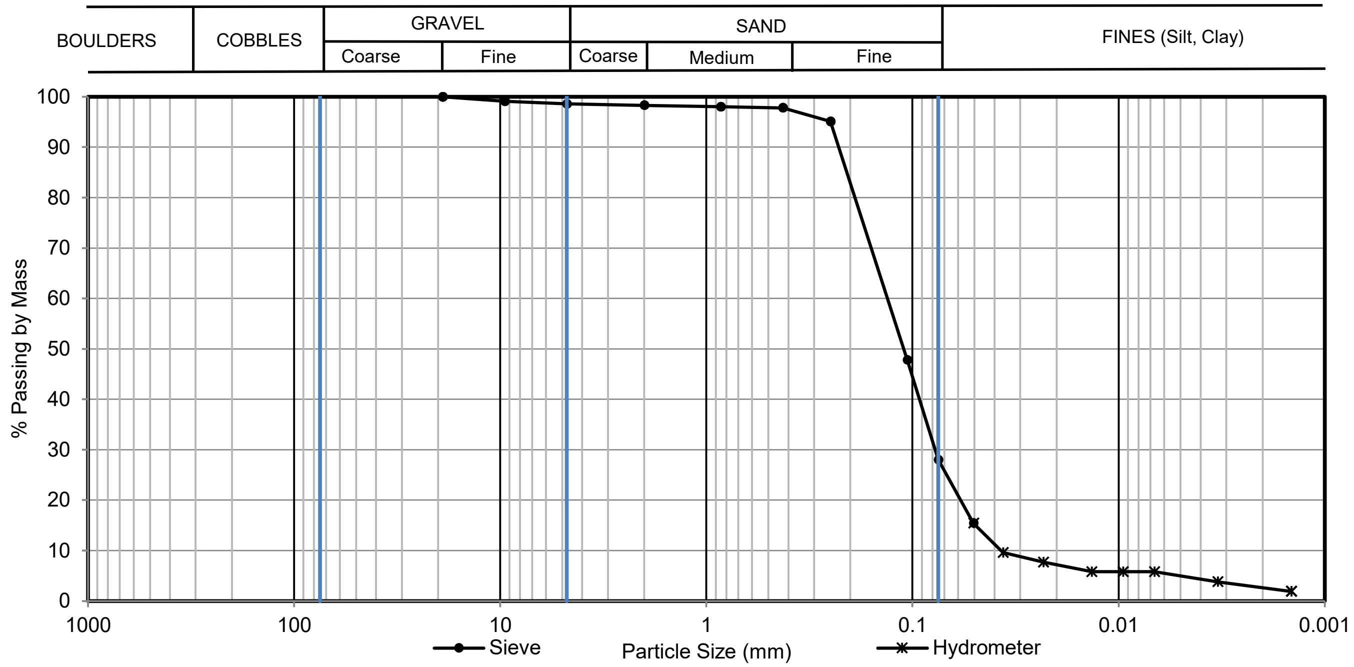
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH301	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH301
Source:		Sample No.:	2
		Type:	SS
Soil Description:		Depth (m):	6.35 - 6.81

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	18 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%) 1.4 70.6 28.0



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0506	15.4
3/8"	9.5	99.1	0.0364	9.6
#4	4.75	98.6	0.0232	7.7
#10	2	98.3	0.0135	5.8
#20	0.85	98.0	0.0095	5.8
#40	0.425	97.8	0.0067	5.8
#60	0.25	95.1	0.0033	3.8
#140	0.106	47.8	0.0015	1.9
#200	0.075	28.0		
			0.005 mm	4.97
			0.002 mm	2.64
			D60	0.13
			D30	0.08
			D10	0.04
			Cu	3.60
			Cc	1.20

Notes:

Disclaimer:

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Tested by: JTimms **Date:** 18 Oct 2022 **Checked by:** MRuck **Date:** 27 Oct 2022 **Reviewed by:** JoNorris **Date:** 10 Nov 2022

GOLDER
MEMBER OF WSP

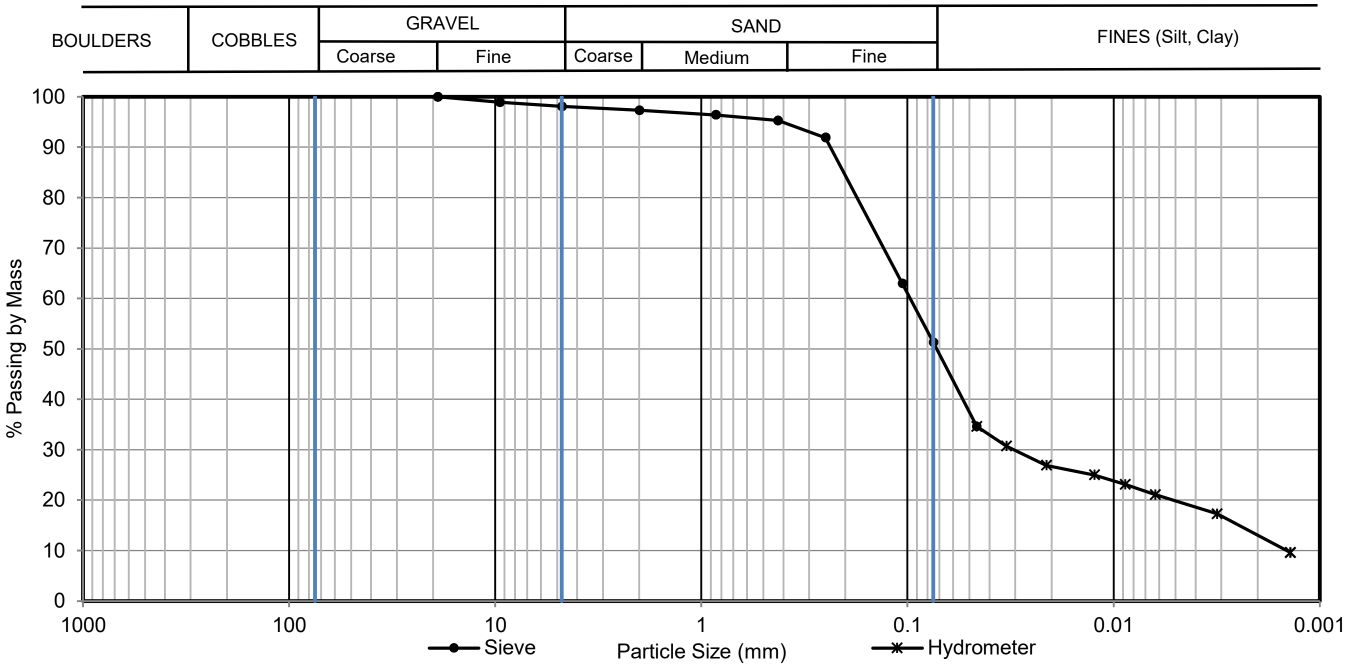
PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422
Method B

Test Request #	21451329-21600-610 BH301	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH301
Source:		Sample No.:	12
		Type:	SS
Soil Description:		Depth (m):	12.44 - 12.90

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	18 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%) 1.9 46.8 51.3



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0462	34.6
3/8"	9.5	98.9	0.0331	30.7
#4	4.75	98.1	0.0212	26.9
#10	2	97.3	0.0124	25.0
#20	0.85	96.4	0.0088	23.1
#40	0.425	95.3	0.0063	21.1
#60	0.25	91.9	0.0032	17.3
#140	0.106	63.0	0.0014	9.6
#200	0.075	51.3		
			0.005 mm	19.84
			0.002 mm	13.02
			D60	0.10
			D30	0.03
			D10	0.00
			Cu	67.00
			Cc	6.60

Notes:

Disclaimer:

Tested by: JTimms **Date:** 18 Oct 2022 **Checked by:** MRuck **Date:** 27 Oct 2022 **Reviewed by:** JoNorris **Date:** 10 Nov 2022

Golder Associates
100 Scotia Court Whitby, ON L1N 8Y6 Canada
[+1] 905-723-2727

PARTICLE SIZE DISTRIBUTION

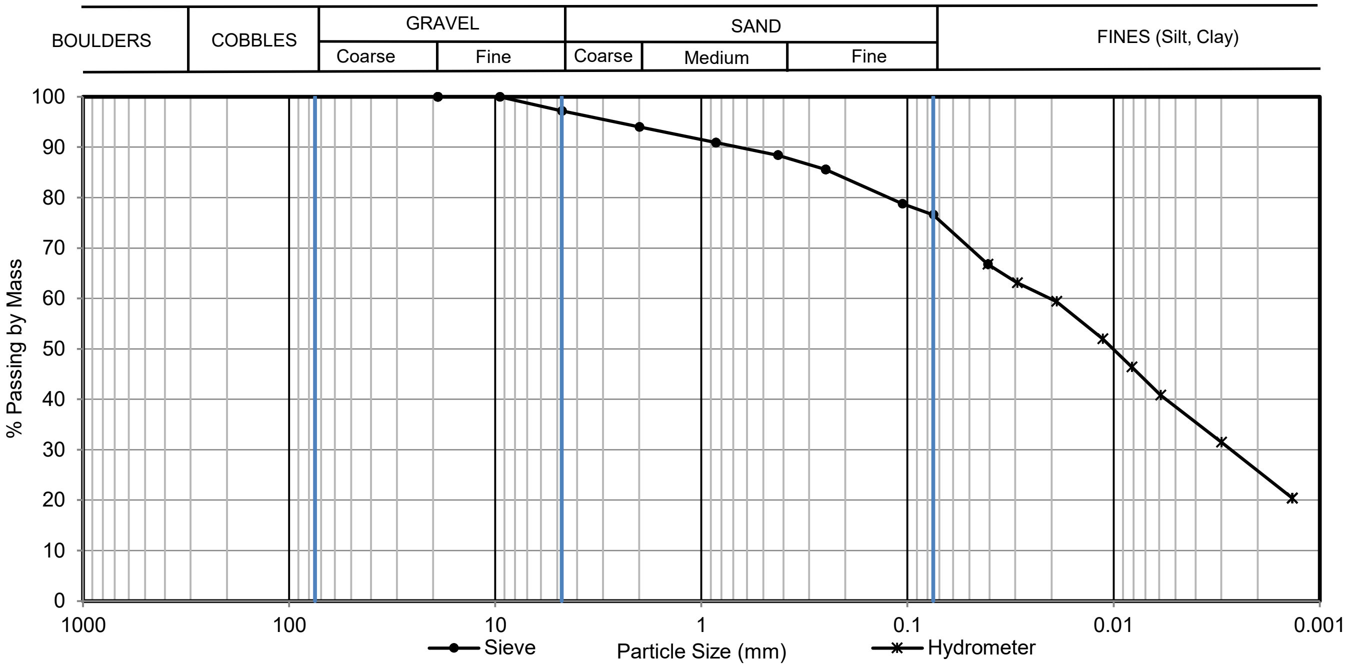
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH301	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH301
Source:		Sample No.:	14
Soil Description:		Type:	SS
		Depth (m):	13.66 - 14.12

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	19 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%) 2.8 20.6 76.6



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0408	66.8
3/8"	9.5	100.0	0.0294	63.1
#4	4.75	97.2	0.0189	59.4
#10	2	94.0	0.0113	52.0
#20	0.85	90.9	0.0082	46.4
#40	0.425	88.4	0.0059	40.8
#60	0.25	85.6	0.0030	31.5
#140	0.106	78.8	0.0014	20.4
#200	0.075	76.6		
			0.005 mm	38.51
			0.002 mm	25.81
			D60	0.02
			D30	0.00
			D10	
			Cu	
			Cc	

Notes:

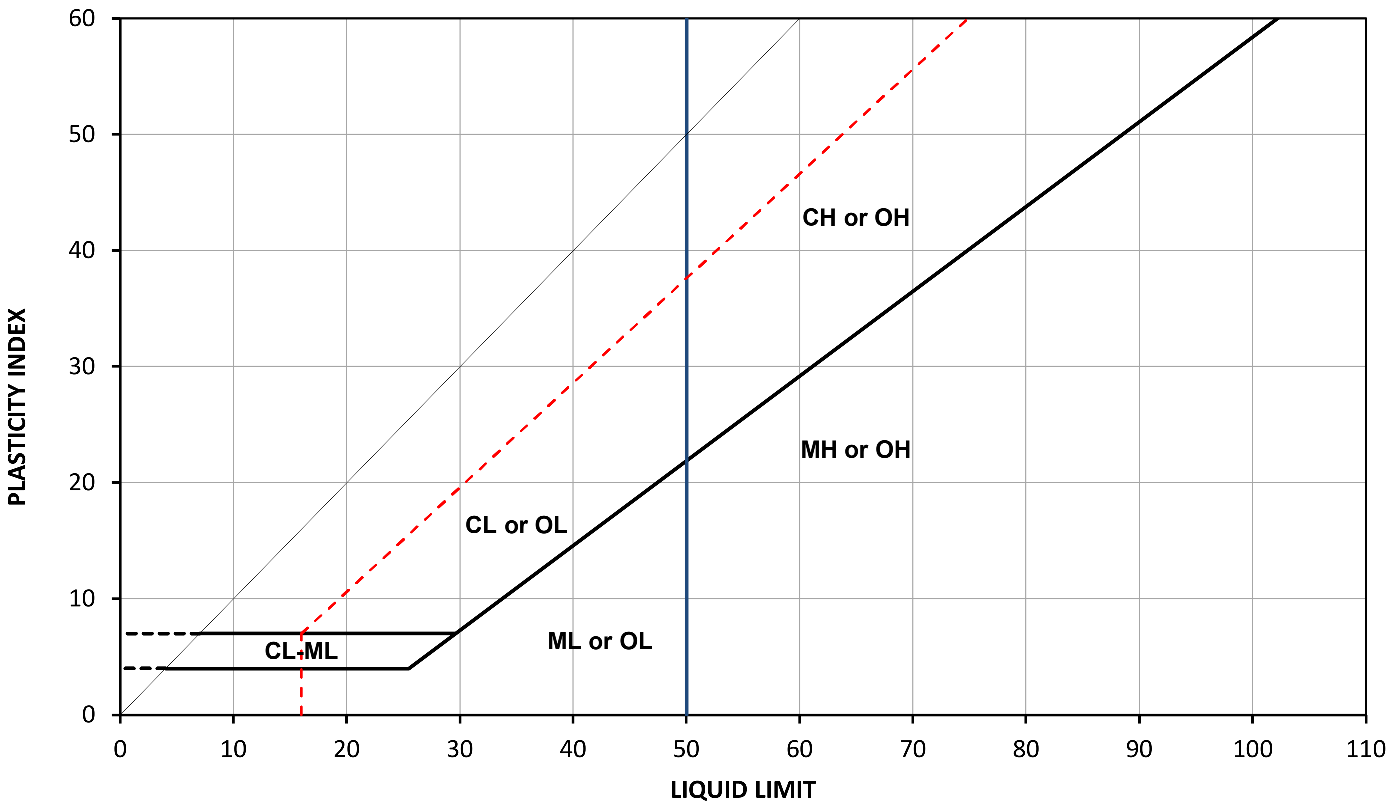
Disclaimer:

Tested by: JTimms **Date:** 19 Oct 2022 **Checked by:** MRuck **Date:** 27 Oct 2022 **Reviewed by:** JoNorris **Date:** 10 Nov 2022

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318

Test Request #	21451329-21600-610 BH301	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH301
Source:		Sample No.:	2
Soil Description:		Type:	SS
		Depth (m):	6.35 - 6.81

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	25 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH301	2	6.35	6.81	100	17.7		NP		

NP = Non-Plastic
ND = Not Determined

Test Preparation

Wet Preparation Tested after >425um removed

Notes:

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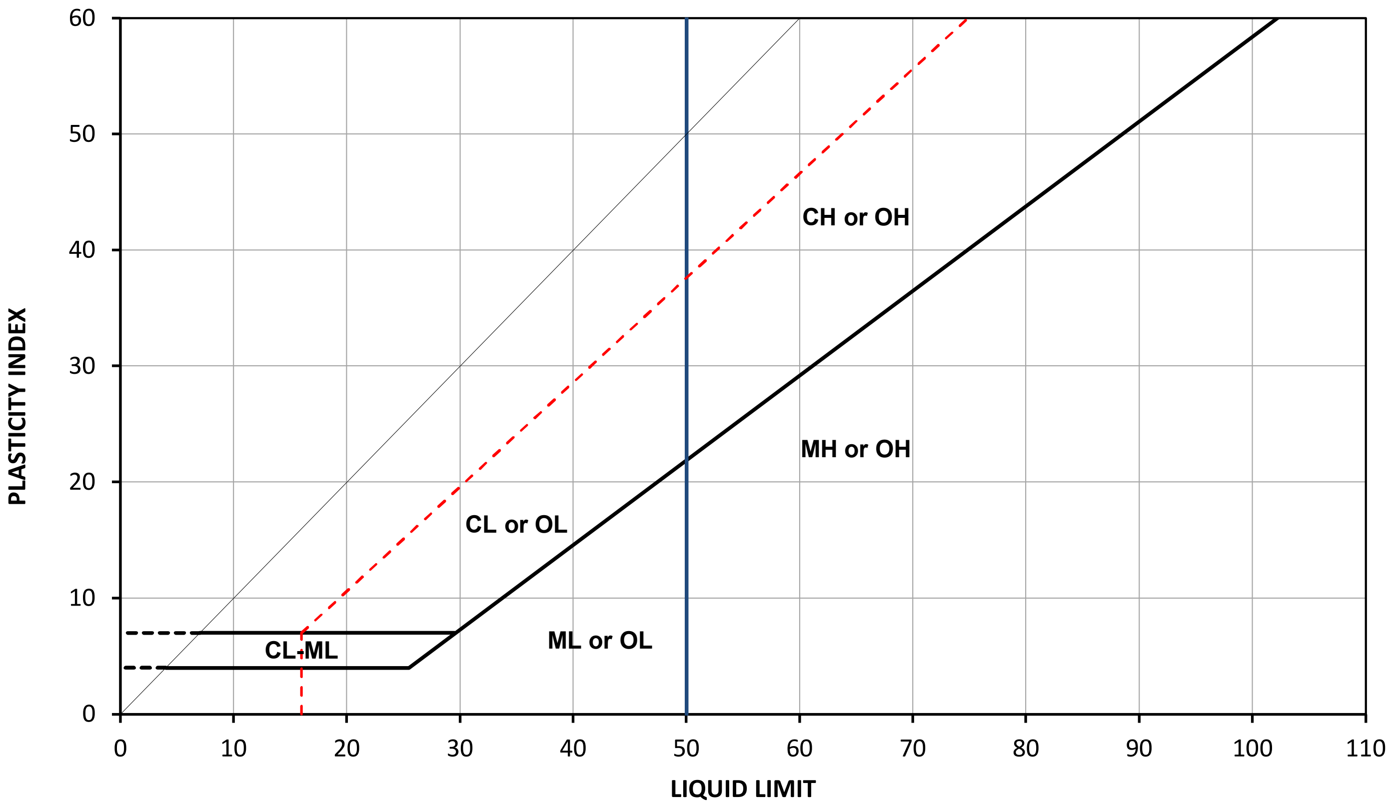
Tested by: JTimms **Date:** 25 Oct 2022
Checked by: MRuck **Date:** 27 Oct 2022
Reviewed by: JoNorris **Date:** 10 Nov 2022

GOLDER
MEMBER OF WSP

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318

Test Request #	21451329-21600-610 BH301	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH301
Source:		Sample No.:	12
Soil Description:		Type:	SS
		Depth (m):	12.44 - 12.90

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	25 Oct 2022
Specimen Description	NA				



Legend
━━ A-Line
- - - U-Line

Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH301	12	12.44	12.90	97	15.7		NP		

NP = Non-Plastic
ND = Not Determined

Test Preparation
Wet Preparation Tested after >425um removed

Notes:

Disclaimer:

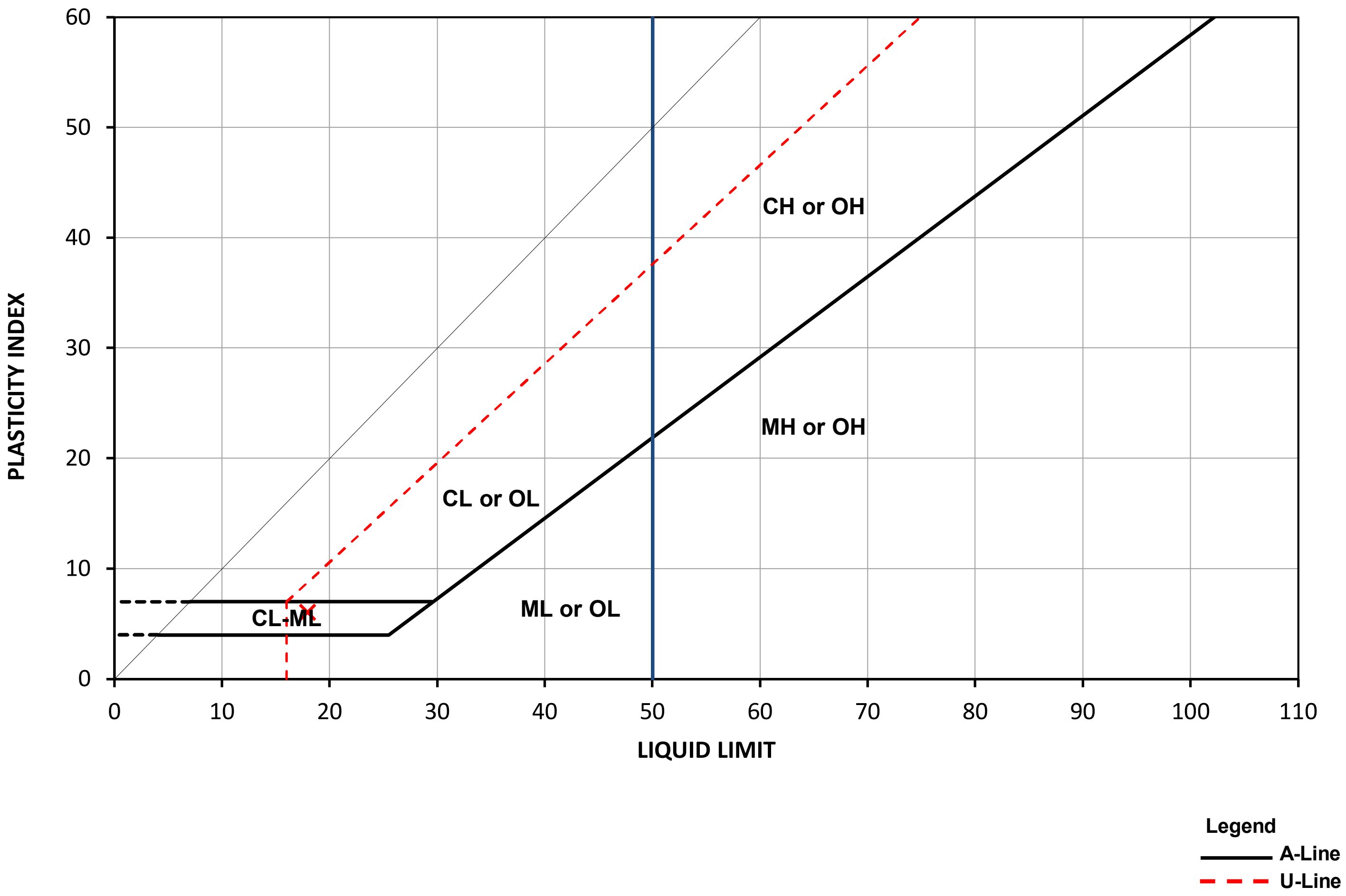
Tested by: JTimms **Date:** 25 Oct 2022
Checked by: MRuck **Date:** 27 Oct 2022
Reviewed by: JoNorris **Date:** 10 Nov 2022

GOLDER
MEMBER OF WSP

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318
Method A - Multipoint Test

Test Request #	21451329-21600-610 BH301	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH301
Source:		Sample No.:	14
Soil Description:		Type:	SS
		Depth (m):	13.66 - 14.12

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	25 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH301	14	13.66	14.12	94	10.7	18	12	6	-0.22

NP = Non-Plastic
ND = Not Determined

Test Preparation
Wet Preparation Tested after >425um removed

Notes:

Tested by: JTimms **Date:** 25 Oct 2022
Checked by: MRuck **Date:** 27 Oct 2022

Disclaimer:

Reviewed by: JoNorris **Date:** 10 Nov 2022

GOLDER
MEMBER OF WSP

SPECIFIC GRAVITY OF SOIL SOLIDS
ASTM D854
Pycnometer Method B

Test Request #	21451329-21600-610 BH301	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	NA
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH301
Source:		Sample No.:	6
Soil Description:		Type:	SS
		Depth (m)	8.79 - 9.24

Specimen Reference	NA	Specimen Depth	NA	Date of Test	26 Oct 2022
Specimen Description	NA				

Proportions		
Percentage Passing (4.75 mm)		%
Percentage Retained (4.75 mm)		%

Fine Fraction (D854)		
Calibrated Mass of Pycnometer		g
Calibrated Volume of Pycnometer	249.65	mL
Mass of Pycnometer	94.44	g
Test Temperature	19	oC
Mass of Pycnometer, soil and water	369.80	g
Mass of Container (or tare)	94.44	g
Mass of dry soil and container	135.81	g
Dry mass of soil solids	41.37	g
Specific Gravity at 20oC	**2.71**	

Coarse Fraction (C127)		
Mass of Oven Dry Sample		g
Mass of saturated-surface-dry in air		g
Apparent mass of saturated test sample in water		g
Specific Gravity Oven Dry		
Specific Gravity Saturated Surface Dry		
Specific Gravity with Weighted Average	**2.71**	

Notes:

Disclaimer:

Tested by: DPatel **Date:** 26 Oct 2022
Checked by: MRuck **Date:** 09 Nov 2022
Reviewed by: JoNorris **Date:** 10 Nov 2022

SPECIFIC GRAVITY OF SOIL SOLIDS
ASTM D854
Pycnometer Method B

Test Request #	21451329-21600-610 BH301	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	NA
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH301
Source:		Sample No.:	7
Soil Description:		Type:	SS
		Depth (m)	9.40 - 9.85

Specimen Reference	NA	Specimen Depth	NA	Date of Test	26 Oct 2022
Specimen Description	NA				

Proportions

Percentage Passing (4.75 mm)		%
Percentage Retained (4.75 mm)		%

Fine Fraction (D854)

Calibrated Mass of Pycnometer		g
Calibrated Volume of Pycnometer	249.72	mL
Mass of Pycnometer	90.98	g
Test Temperature	19	oC
Mass of Pycnometer, soil and water	366.15	g
Mass of Container (or tare)	90.98	g
Mass of dry soil and container	131.79	g
Dry mass of soil solids	40.81	g
Specific Gravity at 20oC	**2.73**	

Coarse Fraction (C127)

Mass of Oven Dry Sample		g
Mass of saturated-surface-dry in air		g
Apparent mass of saturated test sample in water		g
Specific Gravity Oven Dry		
Specific Gravity Saturated Surface Dry		
Specific Gravity with Weighted Average	**2.73**	

Notes:

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Tested by: DPatel **Date:** 26 Oct 2022

Checked by: MRuck **Date:** 09 Nov 2022

Reviewed by: JoNorris **Date:** 10 Nov 2022

Water (Moisture) Content, Ash Content, and Organic Material of Soils ASTM D2974 Method A

Test Request #	21451329-21600-610 BH301	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH301
Source:		Sample No.:	1
Soil Description:		Type:	SS
		Depth (m):	5.74 - 6.35

Specimen Reference	NA	Specimen Depth	NA	Date of Test	05 Oct 2022
Specimen Description	NA				

Furnace Temperature During Test (°C)	440
Duration of Test (nearest 15 minutes)	15705
Mass of Crucible With Lid (g)	65.30
Moist Mass of Specimen Plus Crucible With Lid (g)	147.19
Oven Dry Mass of Specimen Plus Crucible With Lid (g)	134.27
Mass of Crucible With Lid Plus Ash (g)	134.14
Water Content (%)	19
Ash Content (%)	99.8
Organic Material (%)	0.2

Test Preparation

Notes:

Disclaimer:

Tested by: JTimms **Date:** 05 Oct 2022

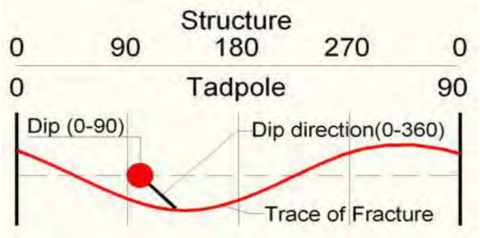
Checked by: MRuck **Date:** 27 Oct 2022

Reviewed by: JoNorris **Date:** 10 Nov 2022

Geophysical Record of Borehole: BH301

Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	~19 m bgs	**Location:**	Darlington, Ontario
Easting:	684079.19 m	**Drilled Depth:**	~60.64 m bgs	**Water Level:**	10.1 m bgs	**Log Date:**	Sept-2-2022
Northing:	4859780.93 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	78.09 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	E. Pineda



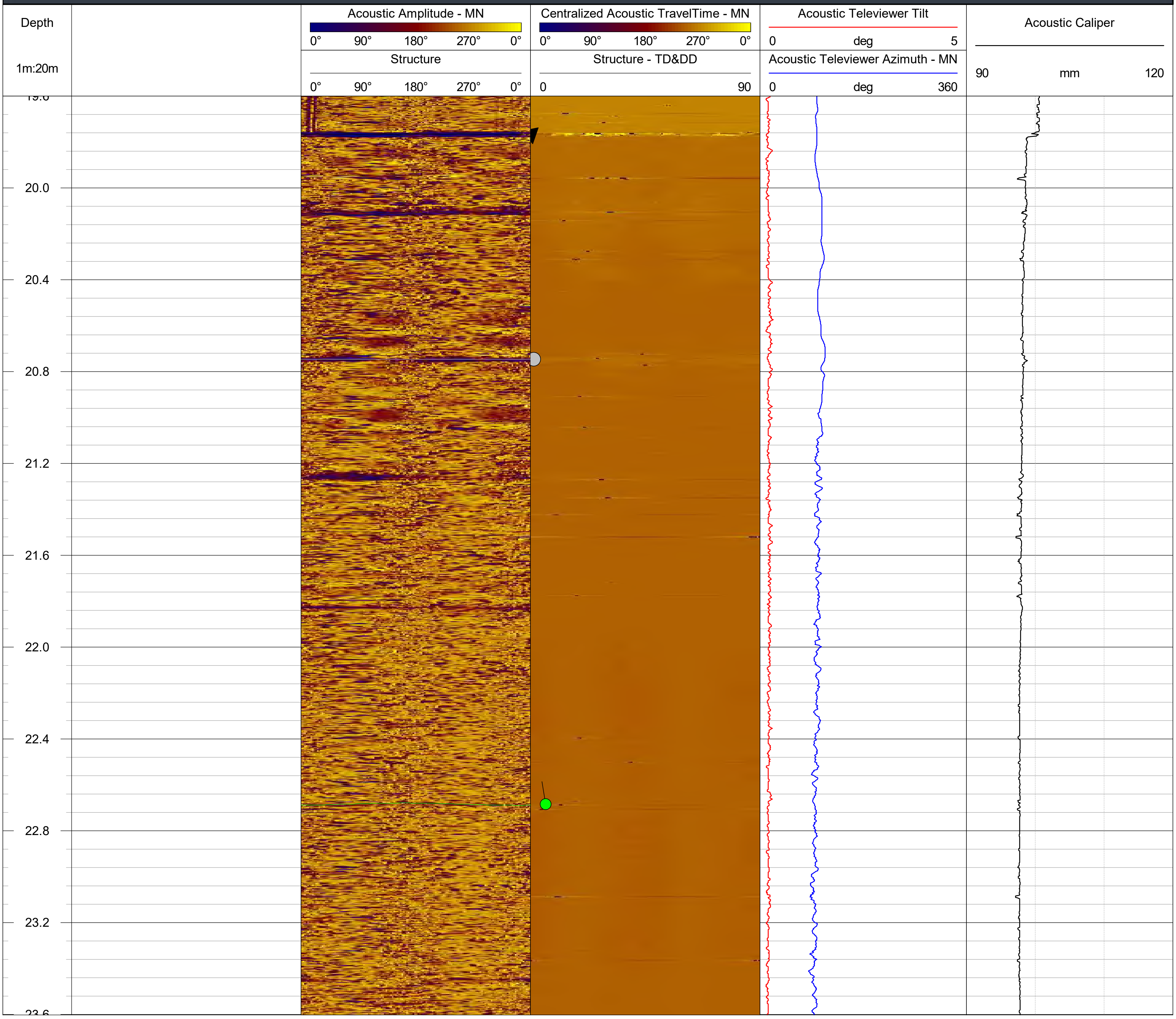
● Partially Open Joint / Fracture

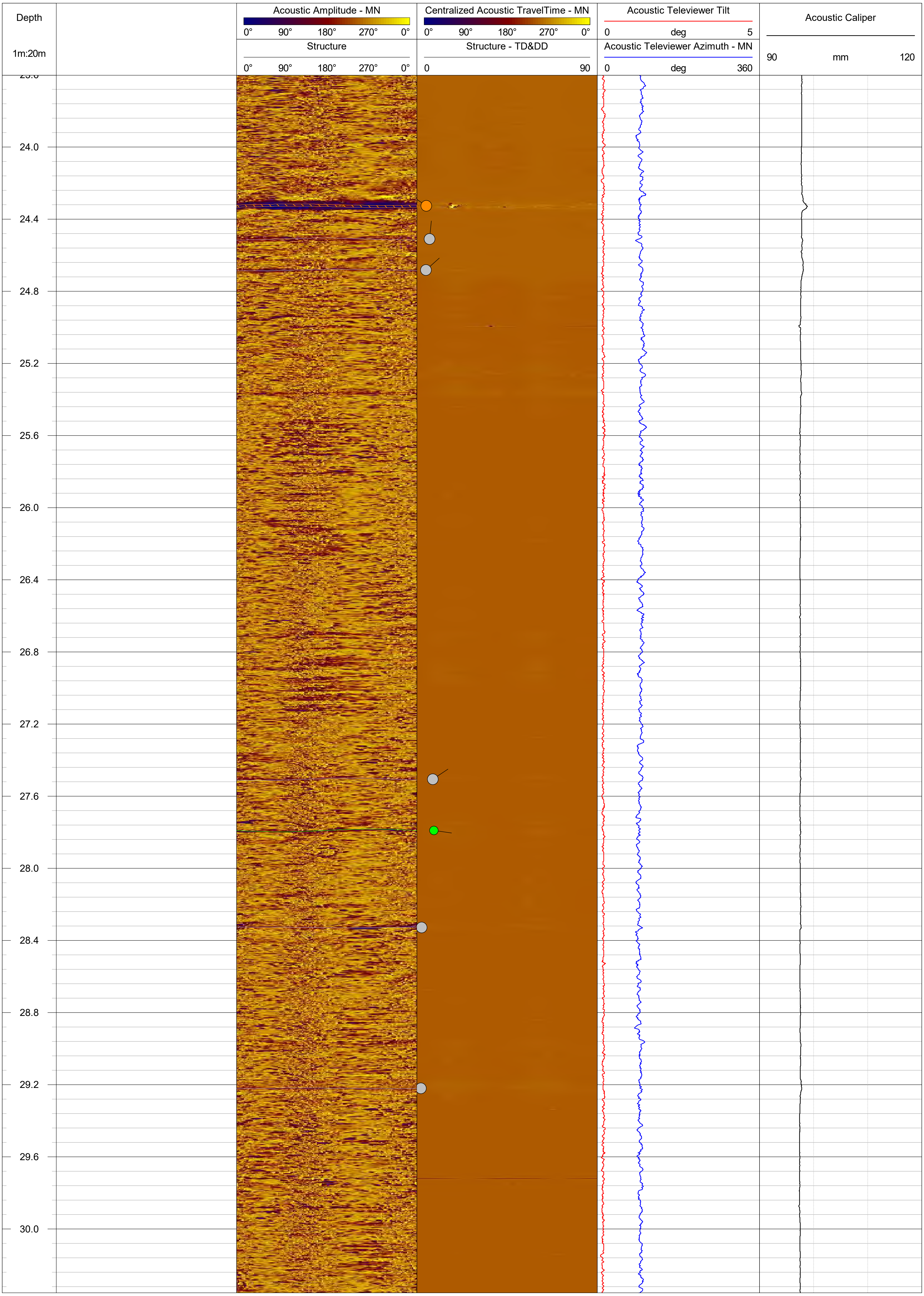
● Filled Fracture / Joint

● Bedding / Banding / Foliation

◀ Casing

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)




Depth
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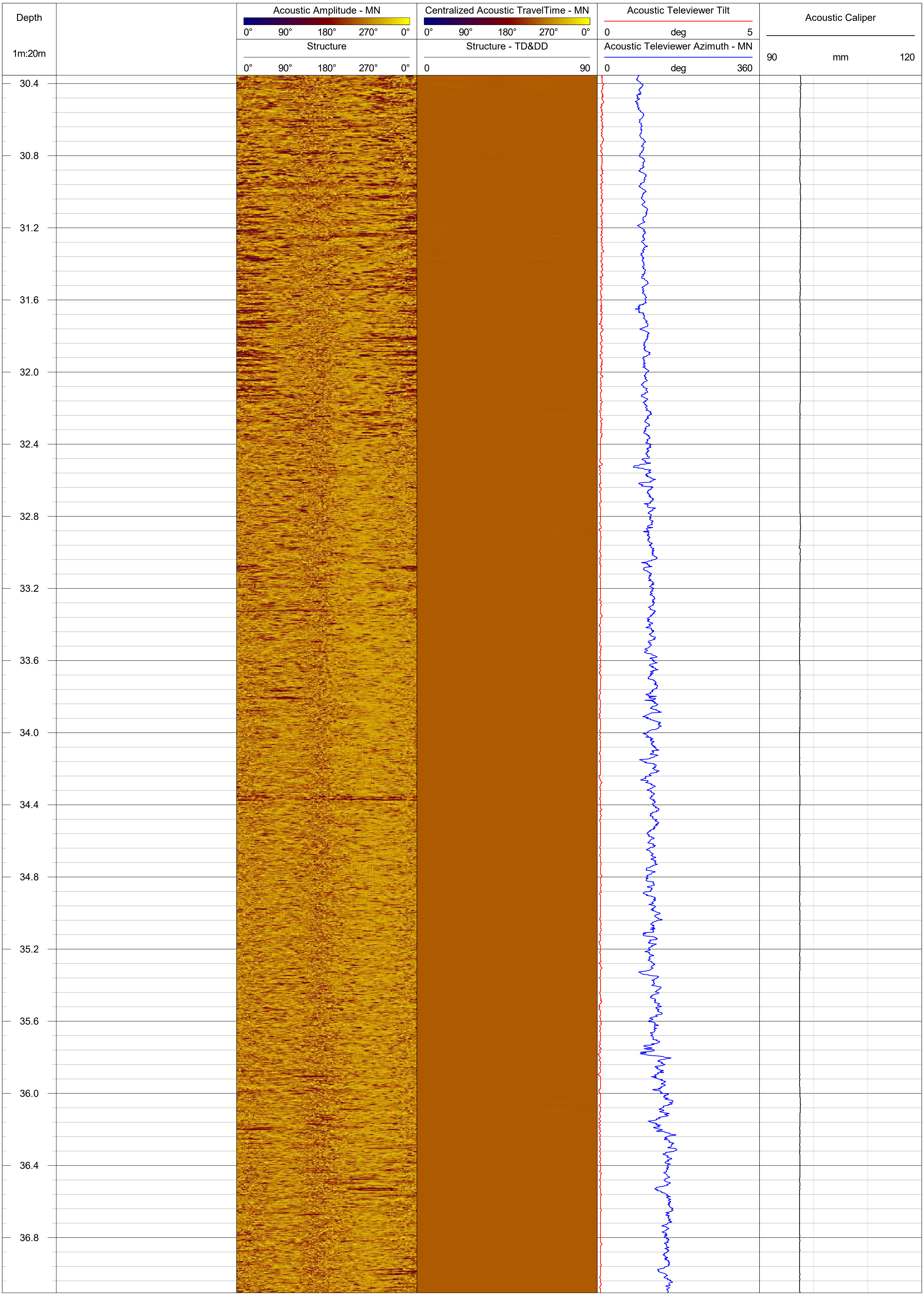
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
24.0
24.4
24.8
25.2
25.6
26.0
26.4
26.8
27.2
27.6
28.0
28.4
28.8
29.2
29.6
30.0


Depth
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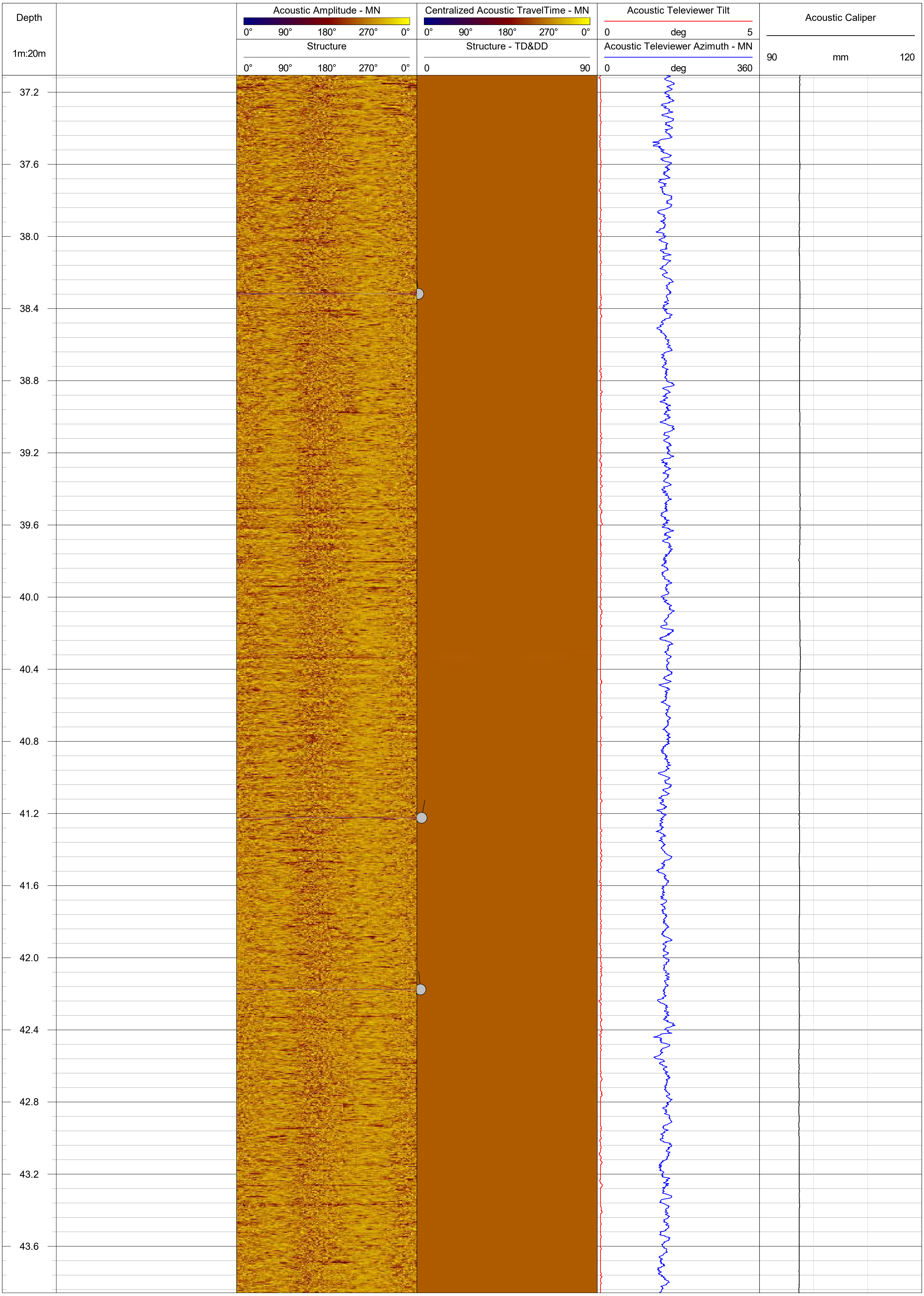
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
30.4
30.8
31.2
31.6
32.0
32.4
32.8
33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8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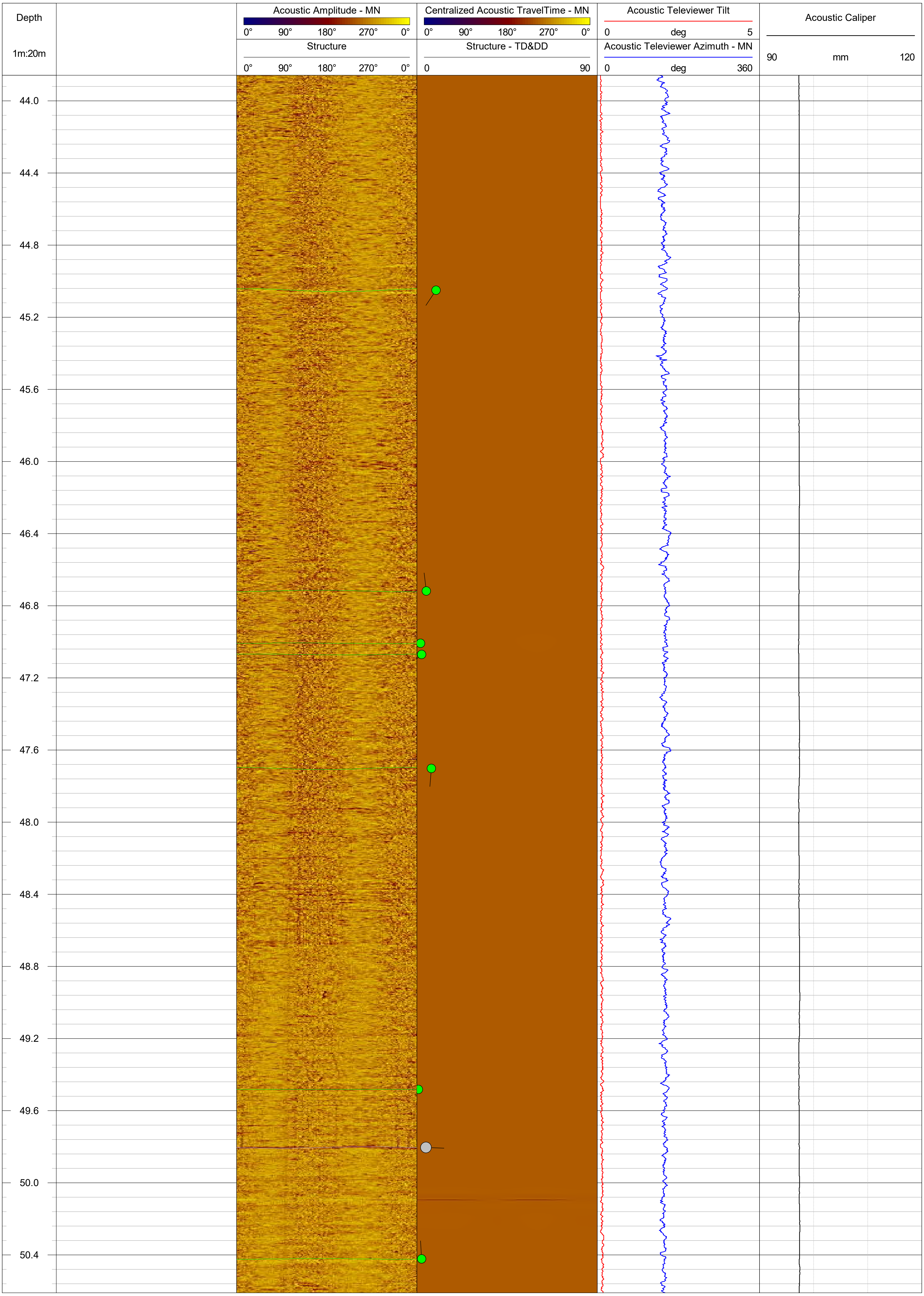
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
37.2
37.6
38.0
38.4
38.8
39.2
39.6
40.0
40.4
40.8
41.2
41.6
42.0
42.4
42.8
43.2
43.6


Depth
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
44.0
44.4
44.8
45.2
45.6
46.0
46.4
46.8
47.2
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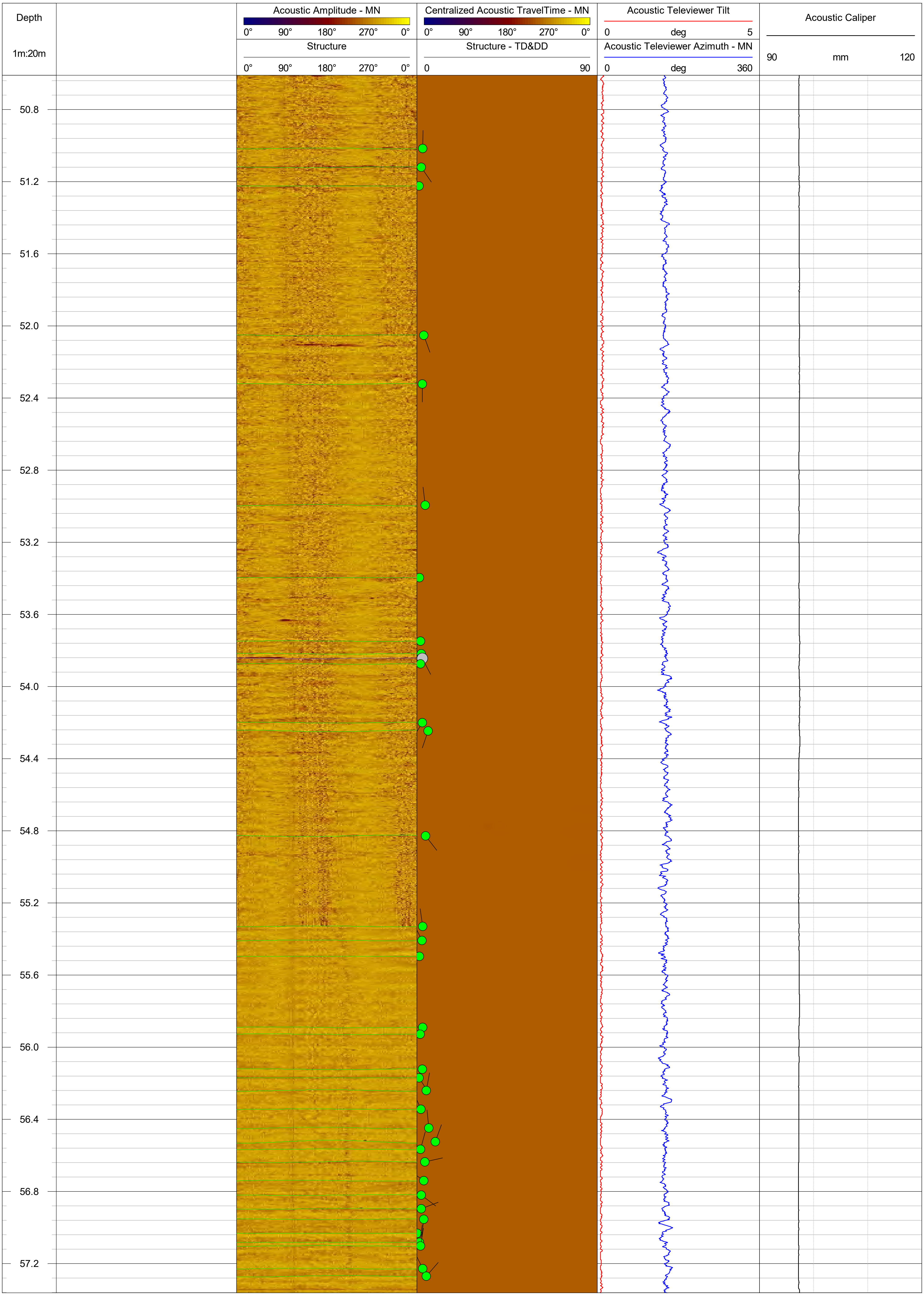
49.2
49.6
50.0
50.4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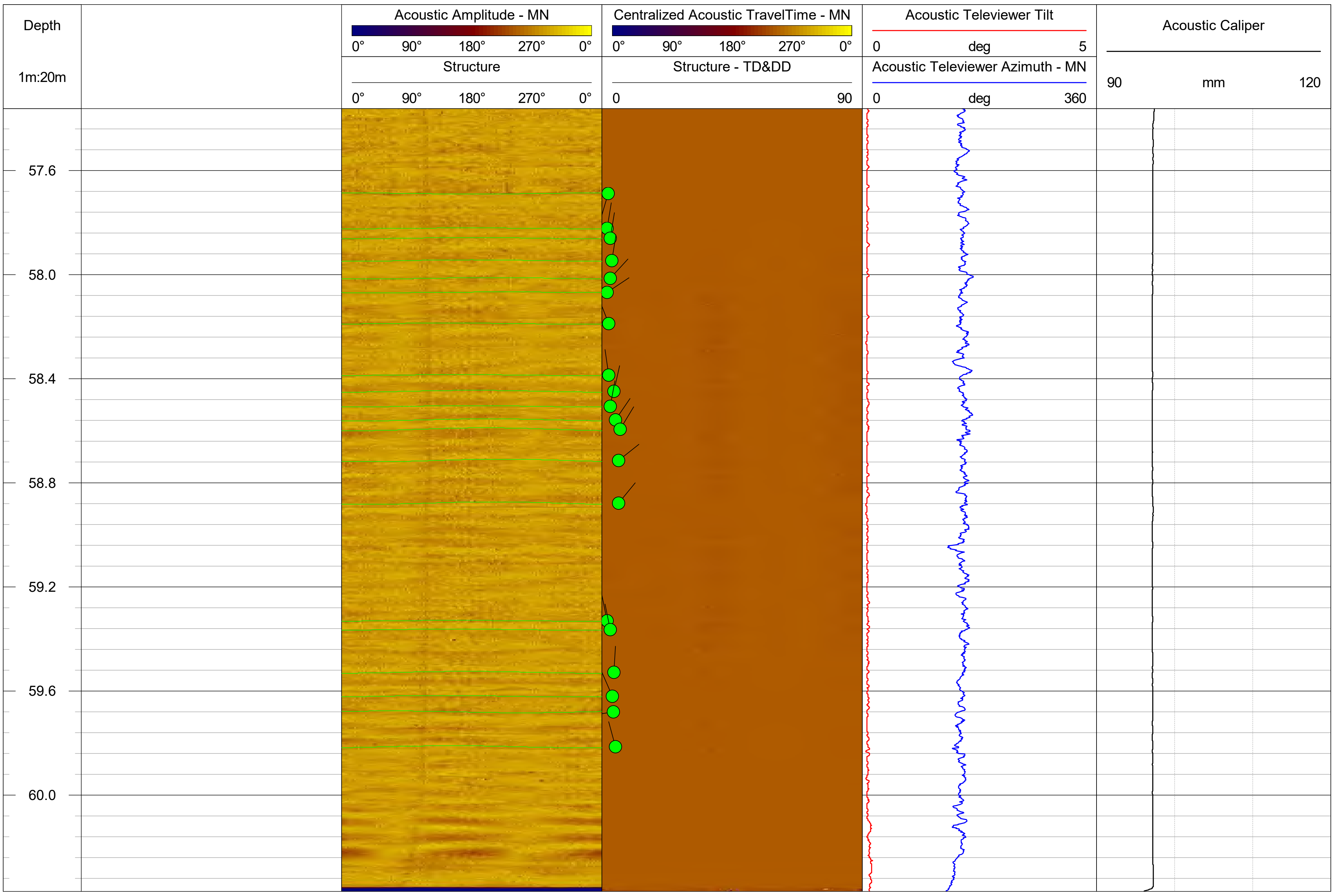
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
50.8
51.2
51.6
52.0
52.4
52.8
53.2
53.6
54.0
54.4
54.8
55.2
55.6
56.0
56.4
56.8
57.2


Depth
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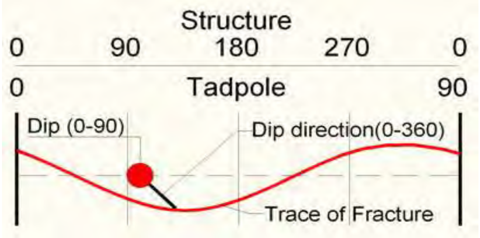
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
57.6
58.0
58.4
58.8
59.2
59.6
60.0

Geophysical Record of Borehole: BH301

Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	~19 m bgs	**Location:**	Darlington, Ontario
Easting:	684079.19 m	**Drilled Depth:**	~60.64 m bgs	**Water Level:**	10.1 m bgs	**Log Date:**	Sept-2-2022
Northing:	4859780.93 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	78.09 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	E. Pineda



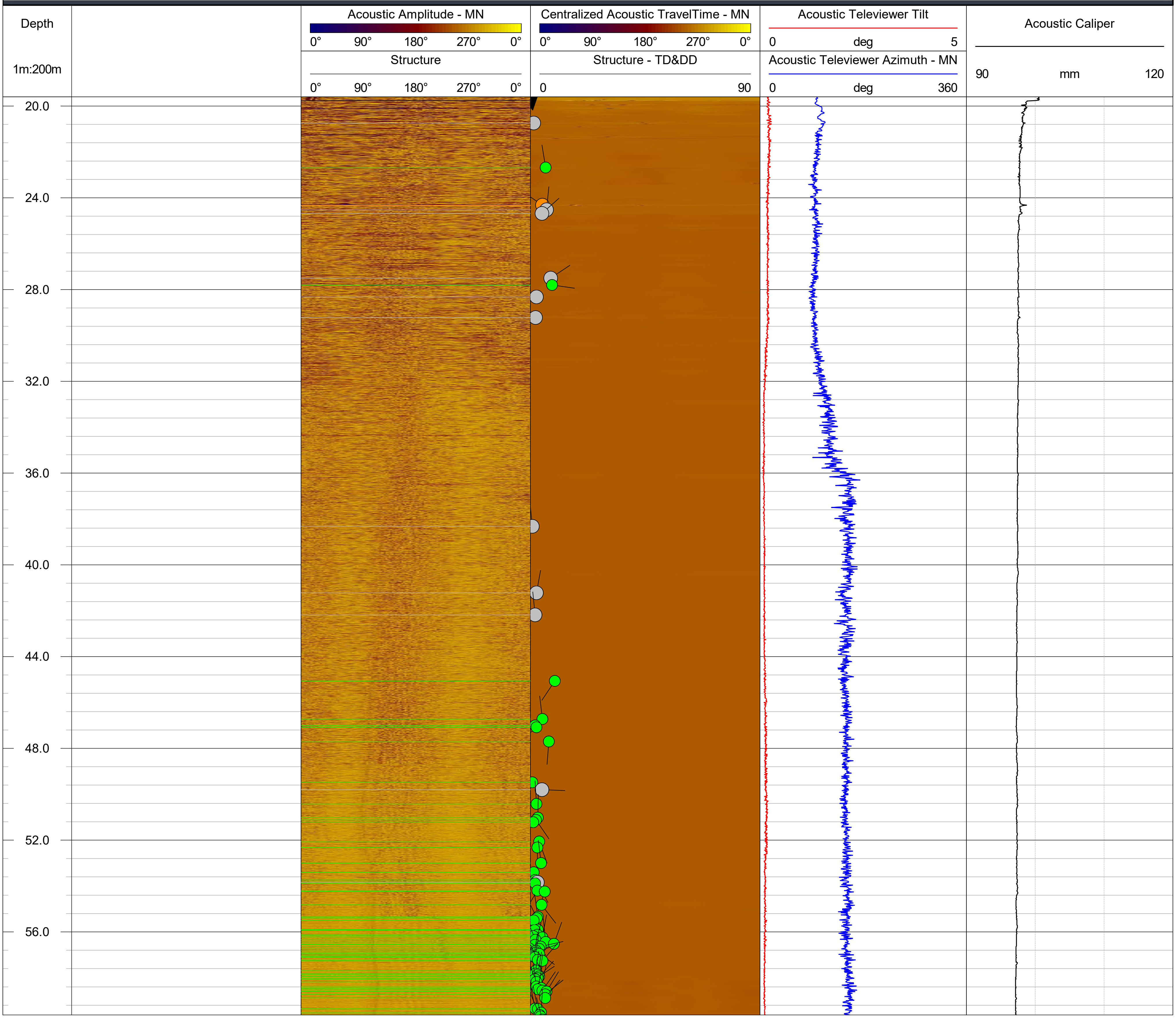
● Partially Open Joint / Fracture

● Filled Fracture / Joint

● Bedding / Banding / Foliation

◀ Casing

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)



Depth		Acoustic Amplitude - MN 0° 90° 180° 270° 0°	Centralized Acoustic TravelTime - MN 0° 90° 180° 270° 0°	Acoustic Televiewer Tilt 0 deg 5	Acoustic Caliper 90 mm 120
1m:200m		Structure 0° 90° 180° 270° 0°	Structure - TD&DD 0 90	Acoustic Televiewer Azimuth - MN 0 deg 360	

A15-BH302

PROJECT: 21451329
LOCATION: N 4859665.83; E 684177.79

RECORD OF BOREHOLE: BH302

BORING DATE: July 7 to 9, 2022
DRILL RIG: Diedrich 120 Track Mounted

SHEET 1 OF 8
DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80; SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-10} 10^{-8} 10^{-6} 10^{-4}; WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION; GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		BARGE DECK	78.82 0.00							
0–3.83	Mud Rotary Wash Boring (Tricone) UW Casing	WATER	74.99 3.83							
7.47		**Poorly graded Sand (SP)**, medium dense, brown, wet, fine to coarse sand (Glaciolacustrine) (Unit 4a)	71.35 7.47	1A	SS	26				
7.92		- Contains broken shells - Rock fragments in Spoon Sample 1		1B				○		
	Mud Rotary Wash Boring (Tricone) Open	**Silt with Sand (ML)**, dense to very dense, grey, moist to wet, trace of fine to medium sand (Glaciolacustrine) (Unit 4a)	70.90 7.92	2	SS	41		○		
				3	SS	81		○	NP γ=21.73 kN/m³	0 29 68 3
9.14		**Silty Sand (SM)**, very dense, grey, moist, fine to medium sand (Glaciolacustrine) (Unit 4a)	69.68 9.14	4A	SS	76				
9.60			69.22 9.60	4B						
10				5	SS	37				0 5 52 43

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: JD
CHECKED: SEMP

PROJECT: 21451329

LOCATION: N 4859665.83; E 684177.79

RECORD OF BOREHOLE: BH302

BORING DATE: July 7 to 9, 2022

DRILL RIG: Diedrich 120 Track Mounted

SHEET 2 OF 8

DATUM: Geodetic

--- CONTINUED FROM PREVIOUS PAGE ---

BORING METHOD: Mud Rotary Wash Boring (Tricone) — Open

DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)
10	**Lean Clay (CL)**, hard to very stiff, grey, moist, trace of fine to medium sand, low to medium plasticity (Glaciolacustrine) (Unit 4b)	
12.27	**Sandy Silty Clay (CL-ML)**, hard, grey, moist, fine to coarse sand, trace of angular to subangular fine to coarse gravel, low plasticity (Till) (Unit 5) - Sandy Silt inclusion in Spoon Sample 10 - Split Spoon refusal at 16.28 m - Spoon bouncing at 16.80 m	66.55 12.27
16.80	**Shale Bedrock**	62.02 16.80

Notes:

1. Bedrock cored from 16.80 m to 70.88 m depth

2. Refer to Record of Drillhole BH302

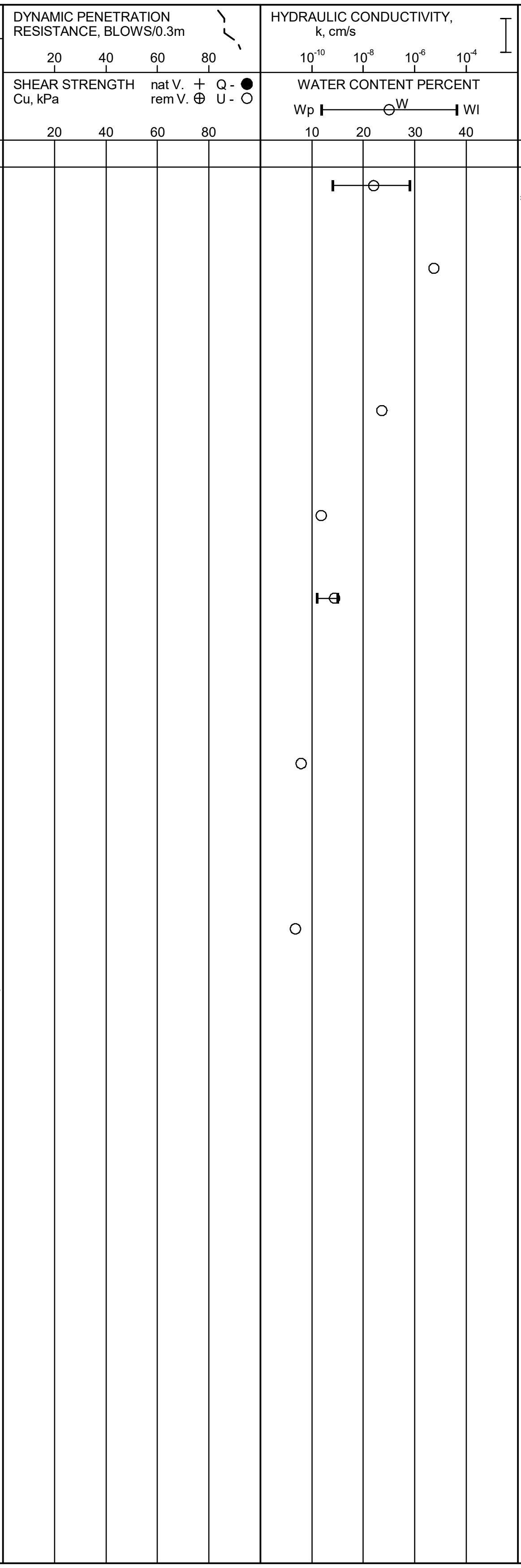
3. Water level in open borehole could not be measured upon completion of soil drilling due to use of mud-rotary technique.

4. Efficiency of the SPT hammer utilized was 75.2 %.

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	GR	SA	SI	CL
5	SS	37	γ=21.17 kN/m^3	0	5	52	43
6	SS	35					
7	SS	30					
8A							
8B	SS	22					
9	SS	100					
10	SS	151		3	27	54	16
11	SS	86					
12	SS	89					
13	SS	110					
14	SS	154					
15	SS	100/ 0.13					

PIEZOMETER OR STANDPIPE INSTALLATION

GRAIN SIZE DISTRIBUTION (%)



DEPTH SCALE

1 : 50

LOGGED: JD

CHECKED: SEMP

GTA-BHS 005 S:\CLIENTS\OPG\DARLINGTON_GENERATING_STATION\02_DATA\GINT\DARLINGTON_GENERATING_STATION.GPJ GAL-MIS.GDT 3/14/23

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859665.83; E 684177.79
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH302

DRILLING DATE: July 9 to 15, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 3 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DRILLING RECORD: Rotary Drill, HQ3 Core

DESCRIPTION	ELEV. DEPTH (m)
TOP OF BEDROCK	62.02
Slightly weathered, thinly to medium bedded, dark brownish grey, fine grained, faintly porous, slightly reactive to HCl, medium strong SHALE (Blue Mountain Formation) with very thin to thinly bedded, grey, fine to medium grained, limestone interbeds	16.80
Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong LIMESTONE (Lindsay Formation) with dark grey, fine grained, shale interbeds	61.00 17.82

RUN No.: 1, 2, 3, 4, 5

TYPE AND SURFACE DESCRIPTION		Jr	Ja	Jcon
BD,PL,RO	SO	1.5	1	20
BD,PL,RO	SO	1.5	1	20
BD,PL,RO	SO	1.5	1	20
BD,PL,RO	SO	1.5	1	20
BD,PL,RO	SO	1.5	1	20
BD,UN,SM	SO	2	1	20
BD,UN,SM	SO	2	1	20
BD,UN,RO	SO	3	1	25

DEPTH SCALE METRES: 17, 18, 19, 20, 21, 22, 23, 24, 25, 26

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: JD
CHECKED: AC

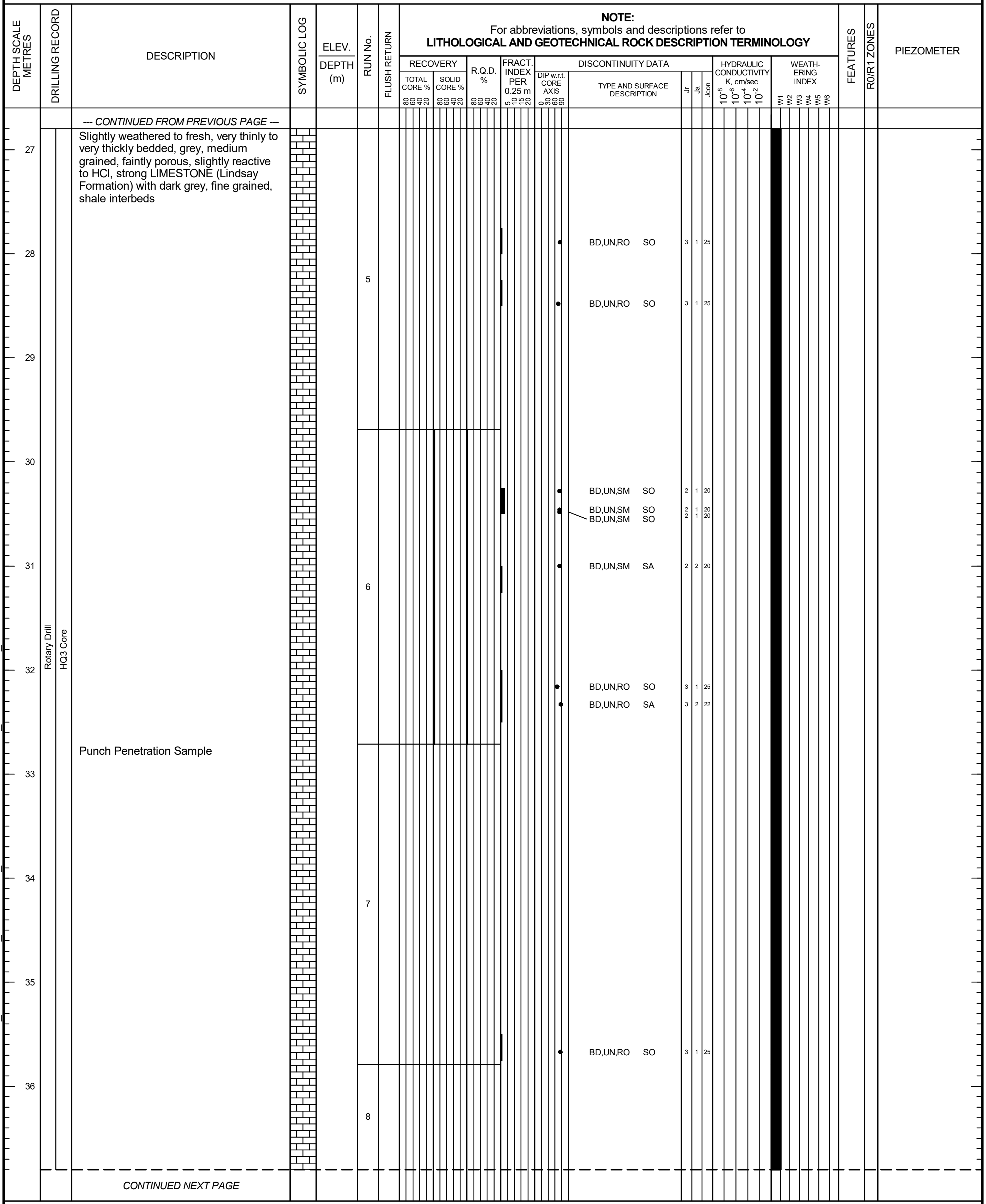
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859665.83; E 684177.79
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH302

DRILLING DATE: July 9 to 15, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 4 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



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Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong LIMESTONE (Lindsay Formation) with dark grey, fine grained, shale interbeds

Punch Penetration Sample

TYPE AND SURFACE DESCRIPTION		Jr	Ja	Jcon
BD,UN,RO	SO	3	1	25
BD,UN,RO	SO	3	1	25
BD,UN,SM	SO	2	1	20
BD,UN,SM	SO	2	1	20
BD,UN,SM	SO	2	1	20
BD,UN,SM	SA	2	2	20
BD,UN,RO	SO	3	1	25
BD,UN,RO	SA	3	2	22
BD,UN,RO	SO	3	1	25

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: JD
CHECKED: AC

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859665.83; E 684177.79
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH302

DRILLING DATE: July 9 to 15, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 5 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	RUN No.	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
37	Rotary Drill HQ3 Core	Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong LIMESTONE (Lindsay Formation) with dark grey, fine grained, shale interbeds Cerchar Sample	8				
38		UCS with Modulus Sample					
39							
40			9				
41							
42							
43			10				
44		Direct Shear Sample		BD,PL,RO SO	1.5	1	20
				BD,UN,RO SO	3	1	25
45							
46		Brazilian Sample	11				

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: JD
CHECKED: AC

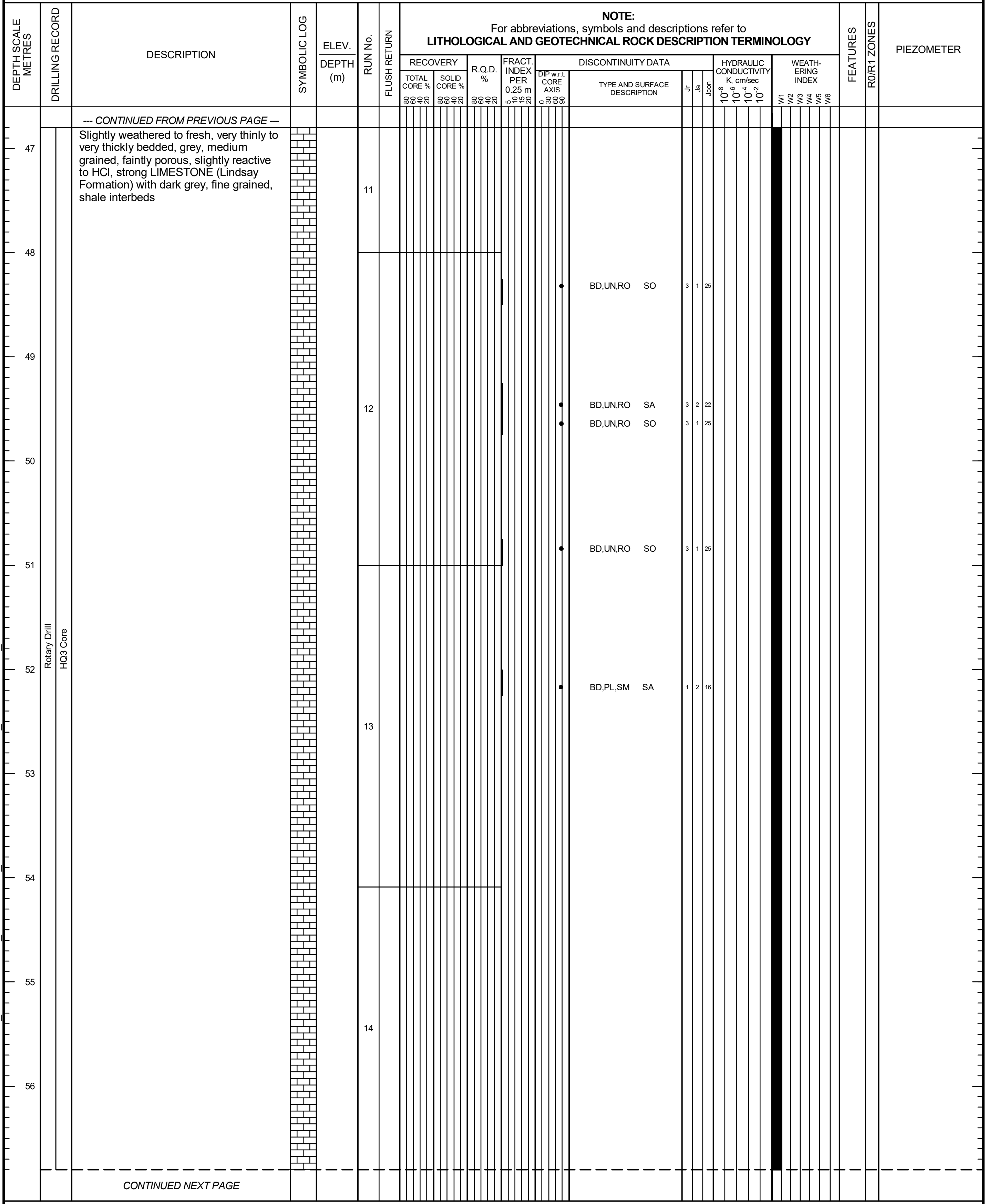
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859665.83; E 684177.79
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH302

DRILLING DATE: July 9 to 15, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 6 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



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Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong LIMESTONE (Lindsay Formation) with dark grey, fine grained, shale interbeds

Drilling record: Rotary Drill, HQ3 Core

RUN No.	TYPE AND SURFACE DESCRIPTION		Jr	Ja	Jcon
11					
12	BD,UN,RO	SO	3	1	25
12	BD,UN,RO	SA	3	2	22
12	BD,UN,RO	SO	3	1	25
12	BD,UN,RO	SO	3	1	25
13	BD,PL,SM	SA	1	2	16
14					

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: JD
CHECKED: AC

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859665.83; E 684177.79
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH302

DRILLING DATE: July 9 to 15, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 7 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE % 80 60 40 20	RECOVERY SOLID CORE % 80 60 40 20	R.Q.D. % 80 60 40 20	FRACT. INDEX PER 0.25 m 5 10 15 20	DIP w.r.t. CORE AXIS 0 30 60 90	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2}	WEATHERING INDEX W1 W2 W3 W4 W5 W6	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
57	Rotary Drill HQ3 Core	Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong LIMESTONE (Lindsay Formation) with dark grey, fine grained, shale interbeds			14															
58					15															
59											●	BD,UN,RO SA	3	2	22					
60					16															
61																				
62																				
63					17						●	BD,CU,RO SA	3	2	22					
64																				
65																				
66					18						●	BD,UN,RO SA	3	2	22					
		CONTINUED NEXT PAGE																		

DEPTH SCALE
1 : 50

LOGGED: JD
CHECKED: AC

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859665.83; E 684177.79
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH302

DRILLING DATE: July 9 to 15, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 8 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	ELEV. / DEPTH (m)	RUN No.
67–70.88	Rotary Drill HQ3 Core	Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong LIMESTONE (Lindsay Formation) with dark grey, fine grained, shale interbeds	7.94 70.88	18 19
70.88		END OF DRILLHOLE		

DISCONTINUITY DATA

TYPE AND SURFACE DESCRIPTION		Jr	Ja	Jcon
BD,UN,RO	SA	3	2	22
BD,UN,RO	SA	3	2	22
BD,UN,RO	SA	3	2	22
BD,UN,RO	SO	3	1	25

Column headings: SYMBOLIC LOG; FLUSH RETURN; RECOVERY (TOTAL CORE %, SOLID CORE %; 80 60 40 20); R.Q.D. % (80 60 40 20); FRACT. INDEX PER 0.25 m (5 10 15 20); DIP w.r.t. CORE AXIS (0 30 60 90); HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-8} 10^{-6} 10^{-4} 10^{-2}); WEATHERING INDEX (W1 W2 W3 W4 W5 W6); FEATURES; R0/R1 ZONES; PIEZOMETER

Depth scale: 67, 68, 69, 70, 71, 72, 73, 74, 75, 76

DEPTH SCALE
1 : 50

LOGGED: JD
CHECKED: AC

Water Content Summary
ASTM D2216

Test Request #	21451329-21600-610 BH302	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville		

Sample Location	Sample				Soil Description	Water Content %	Method	Remarks
	Ref	Top (m)	Base (m)	Type				
BH302	1B	7.92	8.08	SS		16.1	B	
BH302	2	8.08	8.53	SS		16.5	B	
BH302	3	8.69	9.14	SS		19.8	B	
BH302	5	9.91	10.36	SS		22.0	B	
BH302	6	10.52	10.97	SS		33.7	B	
BH302	8A	11.73	11.86	SS		23.6	B	
BH302	9	12.34	12.80	SS		11.8	B	
BH302	10	12.95	13.41	SS		14.4	B	
BH302	12	14.17	14.63	SS		7.9	B	
BH302	14	15.39	15.85	SS		6.8	B	

Notes:

Disclaimer:

Tested by: JTimms **Date:** 12 Oct 2022
Checked by: MRuck **Date:** 26 Oct 2022
Reviewed by: JoNorris **Date:** 10 Nov 2022

GOLDER
MEMBER OF WSP

PARTICLE SIZE DISTRIBUTION

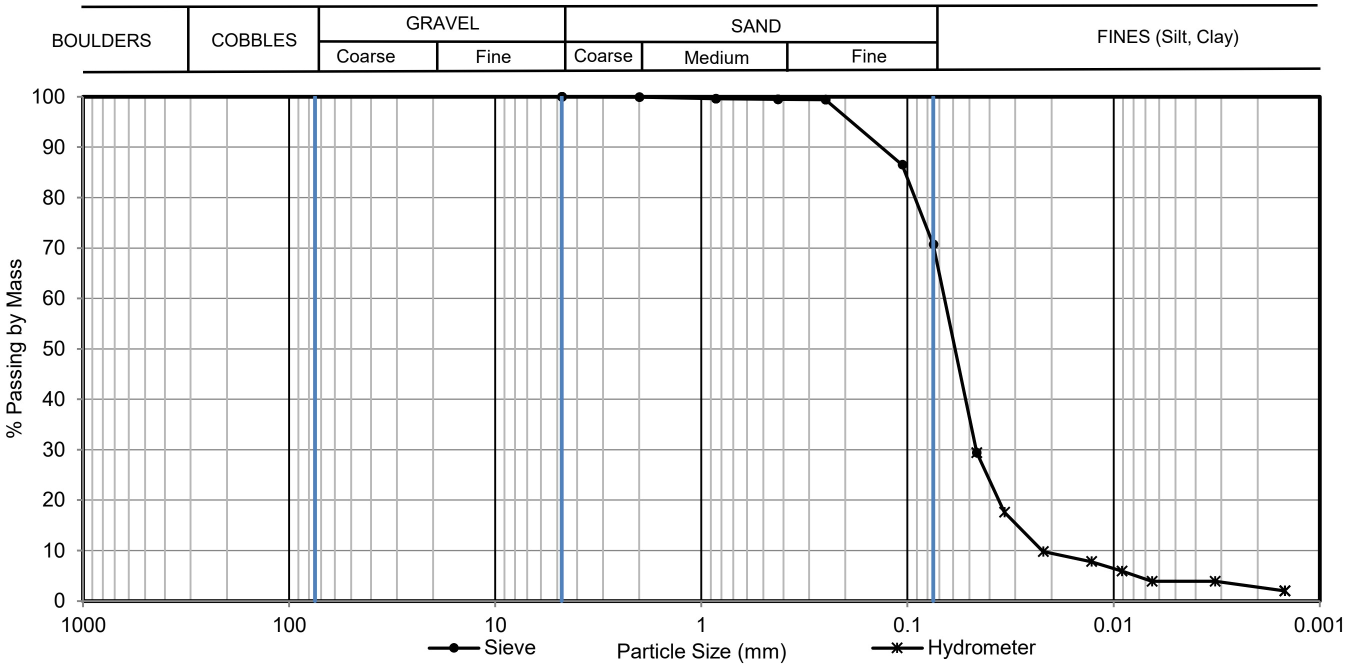
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH302	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH302
Source:		Sample No.:	3
		Type:	SS
Soil Description:		Depth (m):	8.69 - 9.14

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	18 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%) 0.0 29.3 70.7



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
#4	4.75	100.0	0.0462	29.4
#10	2	99.9	0.0339	17.6
#20	0.85	99.6	0.0220	9.8
#40	0.425	99.5	0.0128	7.8
#60	0.25	99.4	0.0091	5.9
#140	0.106	86.5	0.0065	3.9
#200	0.075	70.7	0.0032	3.9
			0.0015	2.0
			0.005 mm	3.90
			0.002 mm	2.74
			D60	0.07
			D30	0.05
			D10	0.02
			Cu	3.00
			Cc	1.50

Notes:

Disclaimer:

Tested by: JTimms **Date:** 18 Oct 2022 **Checked by:** MRuck **Date:** 26 Oct 2022 **Reviewed by:** JoNorris **Date:** 10 Nov 2022

PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422

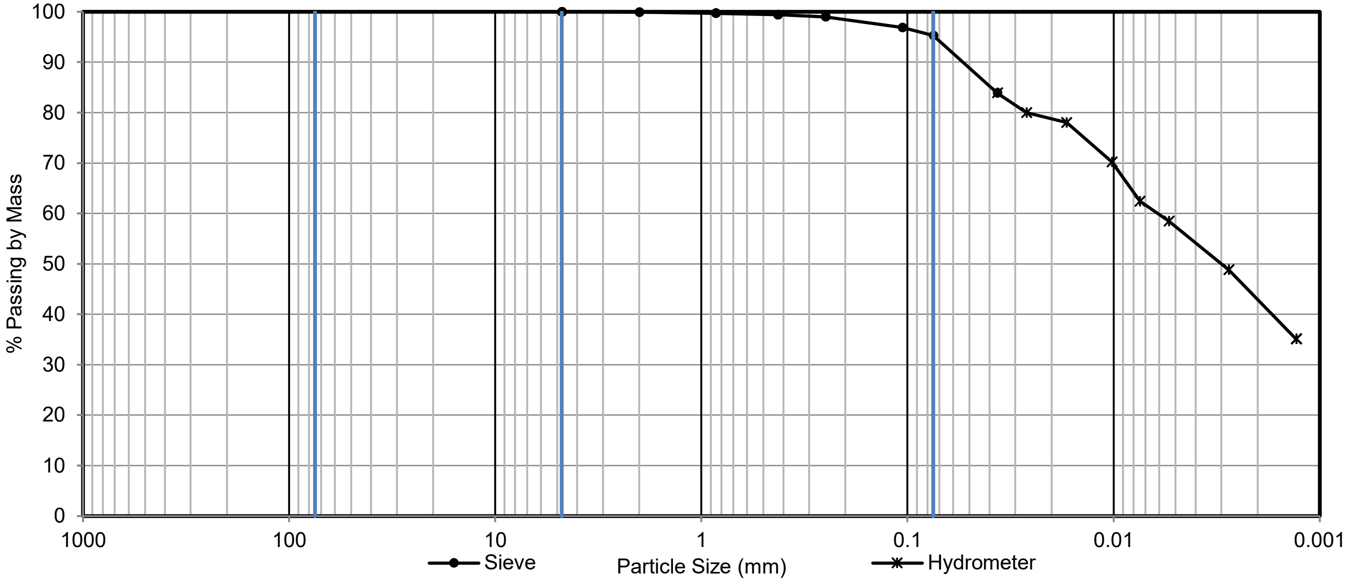
Method B

Test Request #	21451329-21600-610 BH302	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH302
Source:		Sample No.:	5
Soil Description:		Type:	SS
		Depth (m):	9.91 - 10.36

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	18 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)

BOULDERS	COBBLES	GRAVEL		SAND			FINES (Silt, Clay)
		0.0		4.7			95.3
		Coarse	Fine	Coarse	Medium	Fine	



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
#4	4.75	100.0	0.0367	83.9
#10	2	99.9	0.0265	80.0
#20	0.85	99.7	0.0169	78.0
#40	0.425	99.4	0.0102	70.2
#60	0.25	99.0	0.0075	62.4
#140	0.106	96.9	0.0054	58.5
#200	0.075	95.3	0.0028	48.8
			0.0013	35.1
			0.005 mm	57.41
			0.002 mm	42.94
			D60	0.01
			D30	
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

Tested by: JTimms **Date:** 18 Oct 2022 **Checked by:** MRuck **Date:** 26 Oct 2022 **Reviewed by:** JoNorris **Date:** 10 Nov 2022

GOLDER
MEMBER OF WSP

PARTICLE SIZE DISTRIBUTION

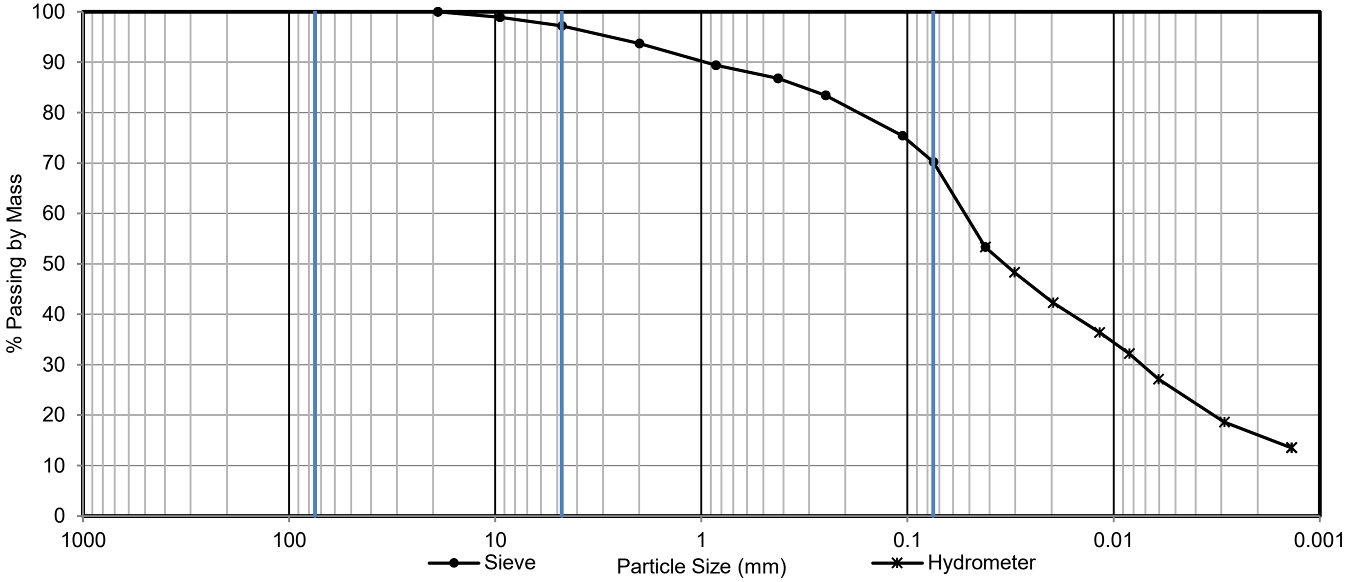
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH302	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH302
Source:		Sample No.:	10
Soil Description:		Type:	SS
		Depth (m):	12.95 - 13.41

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	20 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)			2.8		27.0			70.2
BOULDERS	COBBLES	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0419	53.3
3/8"	9.5	98.9	0.0303	48.3
#4	4.75	97.2	0.0197	42.3
#10	2	93.7	0.0117	36.4
#20	0.85	89.4	0.0084	32.2
#40	0.425	86.8	0.0061	27.1
#60	0.25	83.4	0.0029	18.6
#140	0.106	75.4	0.0014	13.5
#200	0.075	70.2		
			0.005 mm	24.87
			0.002 mm	16.06
			D60	0.05
			D30	0.01
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

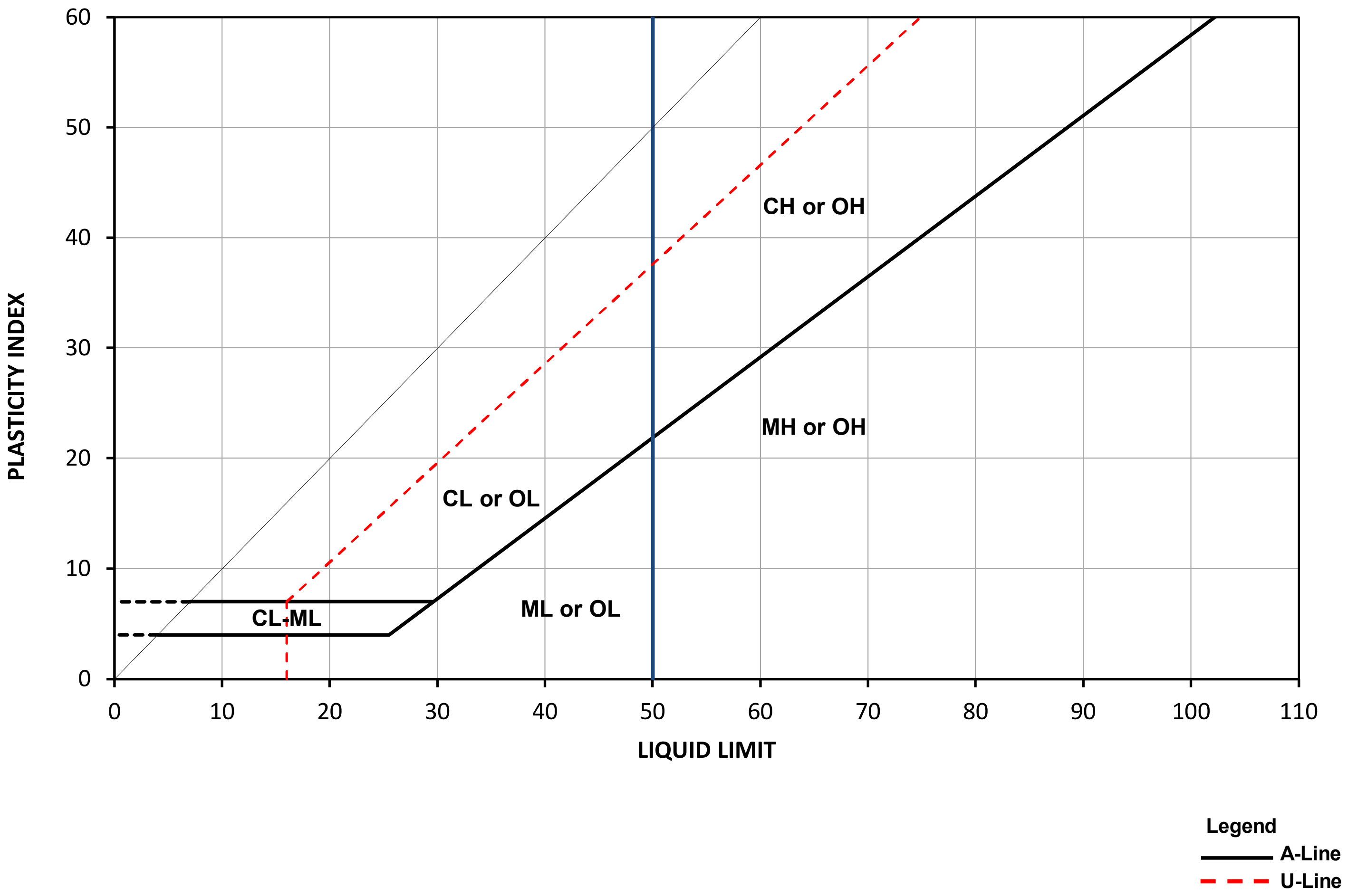
Tested by: KGill **Date:** 20 Oct 2022 **Checked by:** MRuck **Date:** 09 Nov 2022 **Reviewed by:** JoNorris **Date:** 10 Nov 2022

GOLDER
MEMBER OF WSP

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318

Test Request #	21451329-21600-610 BH302	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH302
Source:		Sample No.:	3
Soil Description:		Type:	SS
		Depth (m):	8.69 - 9.14

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	19 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH302	3	8.69	9.14	98	19.8		NP		

NP = Non-Plastic
ND = Not Determined

Test Preparation

Notes:

Tested by: JTimms **Date:** 19 Oct 2022
Checked by: MRuck **Date:** 26 Oct 2022

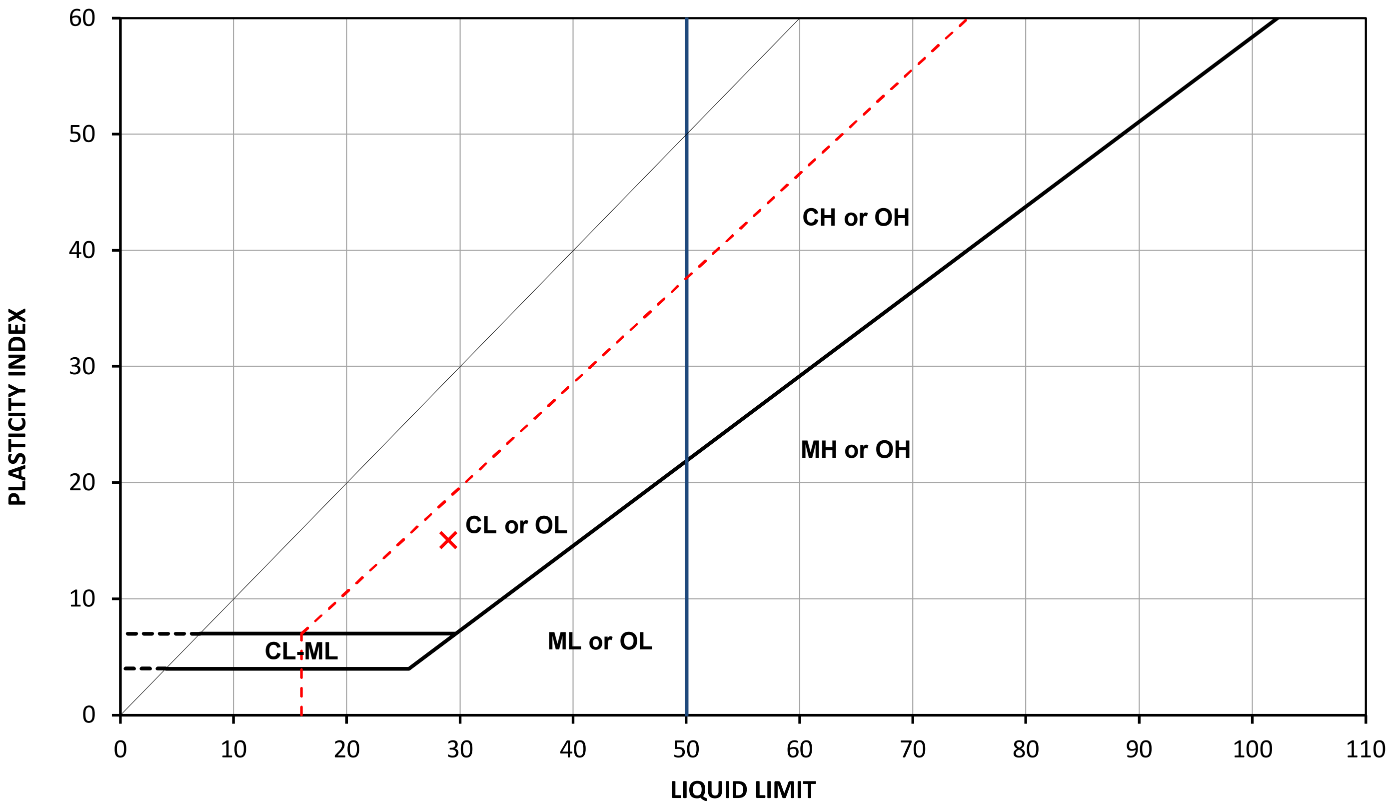
Disclaimer:
The laboratory testing services reported herein have been performed in accordance with the terms of a contract with Golder's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of Golder's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Reviewed by: JoNorris **Date:** 10 Nov 2022

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318
Method A - Multipoint Test

Test Request #	21451329-21600-610 BH302	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH302
Source:		Sample No.:	5
Soil Description:		Type:	SS
		Depth (m):	9.91 - 10.36

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	19 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH302	5	9.91	10.36	99	22.0	29	14	15	0.53

NP = Non-Plastic
ND = Not Determined

Test Preparation

Dry Preparation Tested after >425um removed

Notes:

Tested by: JTimms **Date:** 19 Oct 2022
Checked by: MRuck **Date:** 26 Oct 2022

Disclaimer:

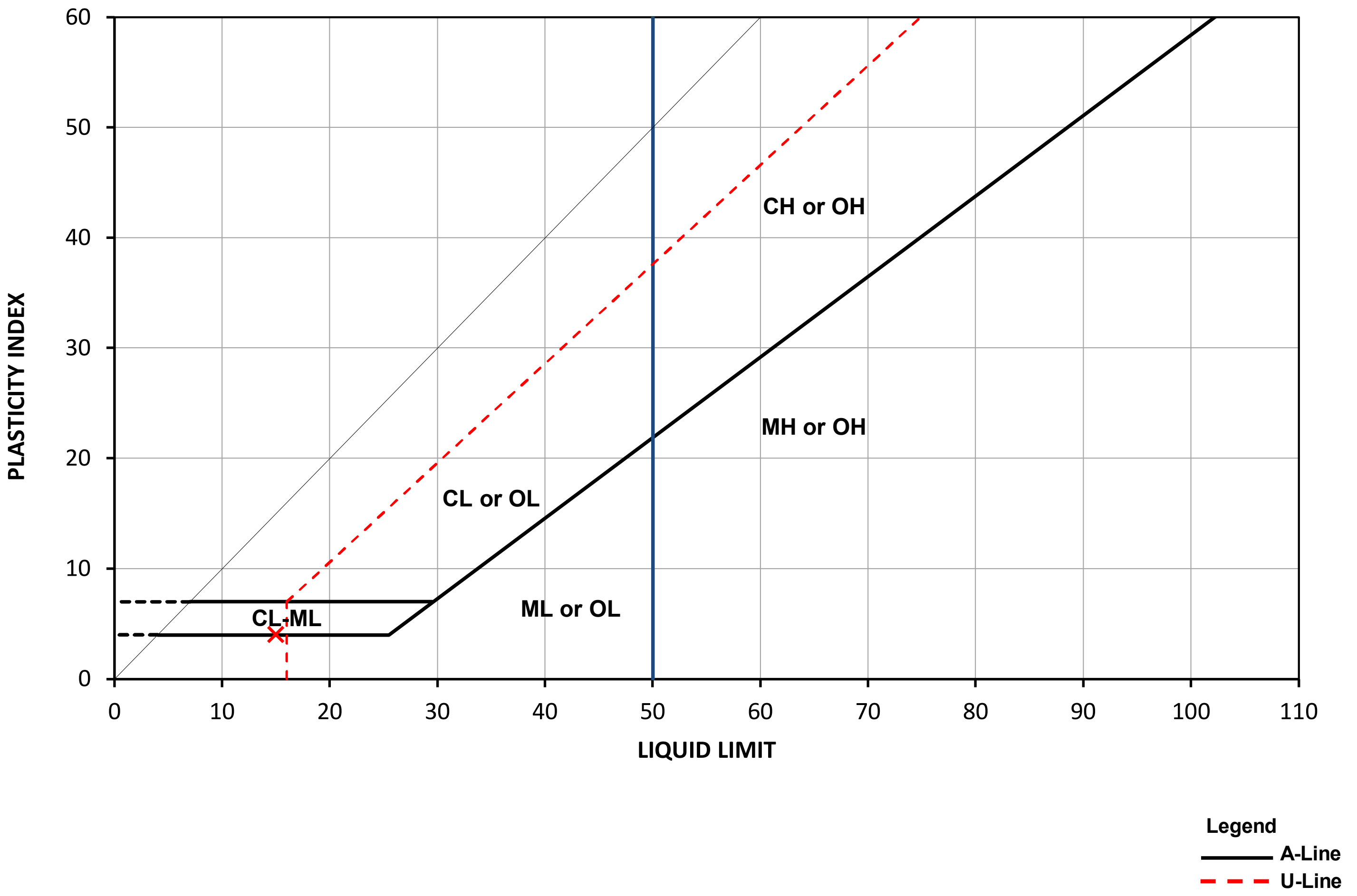
The laboratory testing services reported herein have been performed in accordance with the terms of a contract with Golder's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of Golder's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Reviewed by: JoNorris **Date:** 10 Nov 2022

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318
Method B - One-point Test

Test Request #	21451329-21600-610 BH302	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH302
Source:		Sample No.:	10
Soil Description:		Type:	SS
		Depth (m):	12.95 - 13.41

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	27 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH302	10	12.95	13.41	ND	14.4	15	11	4	0.85

NP = Non-Plastic
ND = Not Determined

Test Preparation

Dry Preparation Tested after >425um removed

Notes:

Tested by: XMeng **Date:** 27 Oct 2022
Checked by: MRuck **Date:** 08 Nov 2022

Disclaimer:

The laboratory testing services reported herein have been performed in accordance with the terms of a contract with Golder's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of Golder's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Reviewed by: JoNorris **Date:** 10 Nov 2022

SPECIFIC GRAVITY OF SOIL SOLIDS
ASTM D854
Pycnometer Method B

Test Request #	21451329-21600-610 BH302	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	NA
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH302
Source:		Sample No.:	4A
Soil Description:		Type:	SS
		Depth (m)	9.30 - 9.60

Specimen Reference	NA	Specimen Depth	NA	Date of Test	27 Oct 2022
Specimen Description	NA				

Proportions		
Percentage Passing (4.75 mm)		%
Percentage Retained (4.75 mm)		%

Fine Fraction (D854)		
Calibrated Mass of Pycnometer		g
Calibrated Volume of Pycnometer	249.75	mL
Mass of Pycnometer	91.55	g
Test Temperature	19.4	oC
Mass of Pycnometer, soil and water	366.16	g
Mass of Container (or tare)	91.55	g
Mass of dry soil and container	131.75	g
Dry mass of soil solids	40.20	g
Specific Gravity at 20oC	**2.69**	

Coarse Fraction (C127)		
Mass of Oven Dry Sample		g
Mass of saturated-surface-dry in air		g
Apparent mass of saturated test sample in water		g
Specific Gravity Oven Dry		
Specific Gravity Saturated Surface Dry		
Specific Gravity with Weighted Average	**2.69**	

Notes:

Disclaimer:

Tested by: DPatel **Date:** 27 Oct 2022

Checked by: MRuck **Date:** 09 Nov 2022 **Reviewed by:** JoNorris **Date:** 10 Nov 2022

SPECIFIC GRAVITY OF SOIL SOLIDS
ASTM D854
Pycnometer Method B

Test Request #	21451329-21600-610 BH302	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	NA
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH302
Source:		Sample No.:	10
Soil Description:		Type:	SS
		Depth (m)	12.95 - 13.41

Specimen Reference	NA	Specimen Depth	NA	Date of Test	24 Oct 2022
Specimen Description	NA				

Proportions		
Percentage Passing (4.75 mm)		%
Percentage Retained (4.75 mm)		%

Fine Fraction (D854)		
Calibrated Mass of Pycnometer		g
Calibrated Volume of Pycnometer	249.69	mL
Mass of Pycnometer	95.94	g
Test Temperature	17.8	oC
Mass of Pycnometer, soil and water	370.93	g
Mass of Container (or tare)	3.54	g
Mass of dry soil and container	44.29	g
Dry mass of soil solids	40.75	g
Specific Gravity at 20oC	**2.70**	

Coarse Fraction (C127)		
Mass of Oven Dry Sample		g
Mass of saturated-surface-dry in air		g
Apparent mass of saturated test sample in water		g
Specific Gravity Oven Dry		
Specific Gravity Saturated Surface Dry		
Specific Gravity with Weighted Average	**2.70**	

Notes:

Tested by: DPatel **Date:** 24 Oct 2022
Checked by: MRuck **Date:** 09 Nov 2022

Disclaimer:

Reviewed by: JoNorris **Date:** 10 Nov 2022

DENSITY (UNIT WEIGHT) OF SOIL SPECIMENS

ASTM D 7263 Method B

Borehole Number	BH302	BH302			
Sample Number	3	5			
Sample Depth, m	8.69-9.14	9.91-10.36			
Weight of Soil, g	162.5	173.0			
Diameter of Sample, cm	3.463	3.473			
Length of Sample, cm	7.782	8.456			
Volume of Sample, cc	73.30	80.11			
Water Content, %	18.34	23.22			
Wet Density, g/cm^3	2.216	2.159			
Dry Density, g/cm^3	1.873	1.752			
Unit Weight, kN/m^3	21.73	21.17			

Notes:
- Water contents determined from tested specimens
- Specimen was intact

Project Number	21451329-21600-610	Tested By	S. Khan
Date Tested	October 26, 2022	Checked By	LH

Water (Moisture) Content, Ash Content, and Organic Material of Soils
ASTM D2974 Method A

Test Request #	21451329-21600-610 BH302	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH302
Source:		Sample No.:	2
Soil Description:		Type:	SS
		Depth (m):	8.08 - 8.53

Specimen Reference	NA	Specimen Depth	NA	Date of Test	12 Oct 2022
Specimen Description	NA				

Furnace Temperature During Test (°C)	440
Duration of Test (nearest 15 minutes)	5850
Mass of Crucible With Lid (g)	57.97
Moist Mass of Specimen Plus Crucible With Lid (g)	154.29
Oven Dry Mass of Specimen Plus Crucible With Lid (g)	140.30
Mass of Crucible With Lid Plus Ash (g)	140.00
Water Content (%)	17
Ash Content (%)	99.6
Organic Material (%)	0.4

Test Preparation

Notes:

Disclaimer:

Tested by: JTimms **Date:** 12 Oct 2022

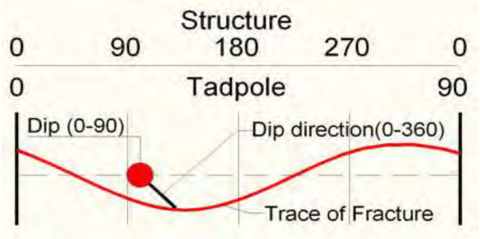
Checked by: MRuck **Date:** 26 Oct 2022

Reviewed by: JoNorris **Date:** 10 Nov 2022

Geophysical Record of Borehole: BH302

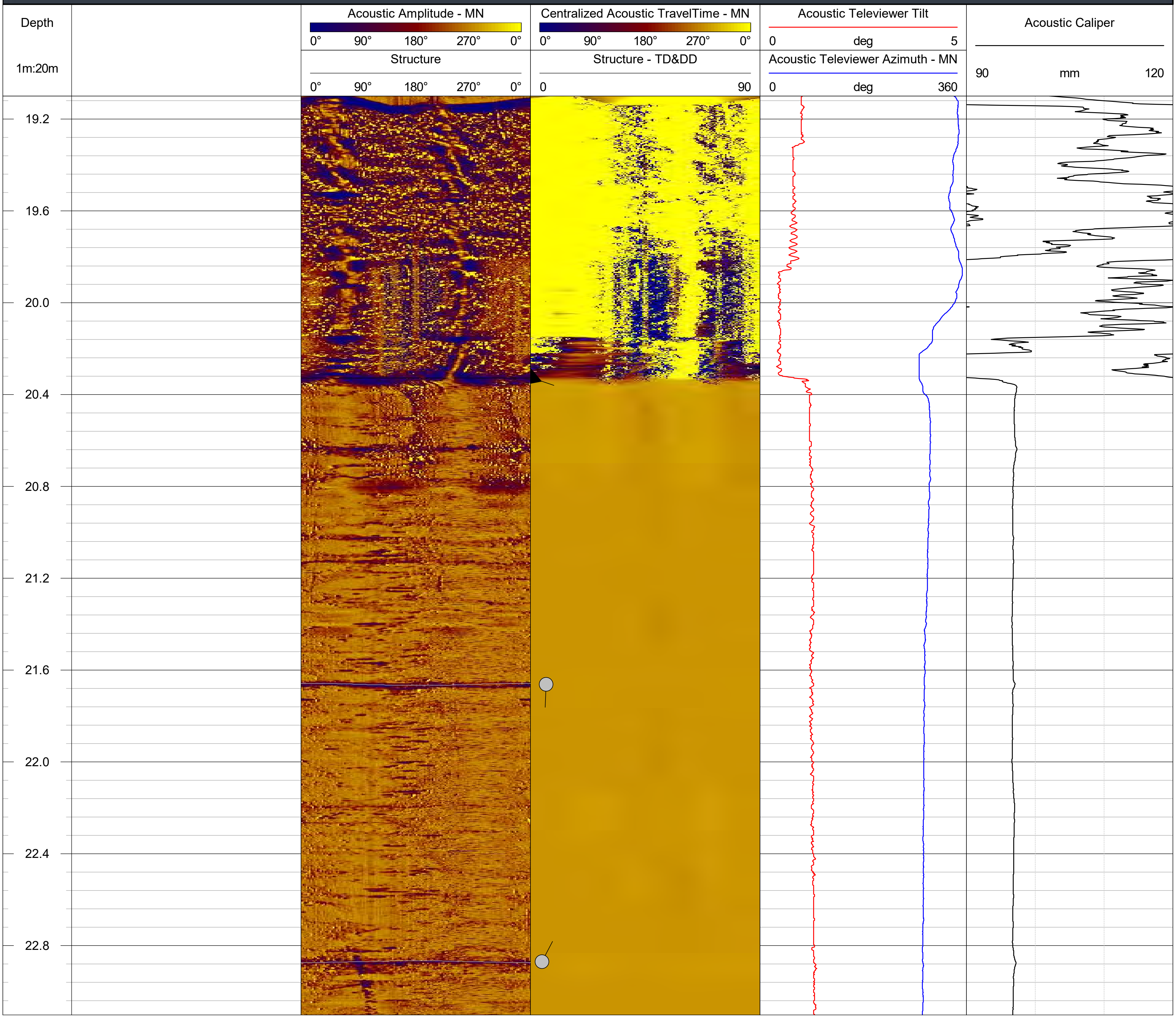
Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

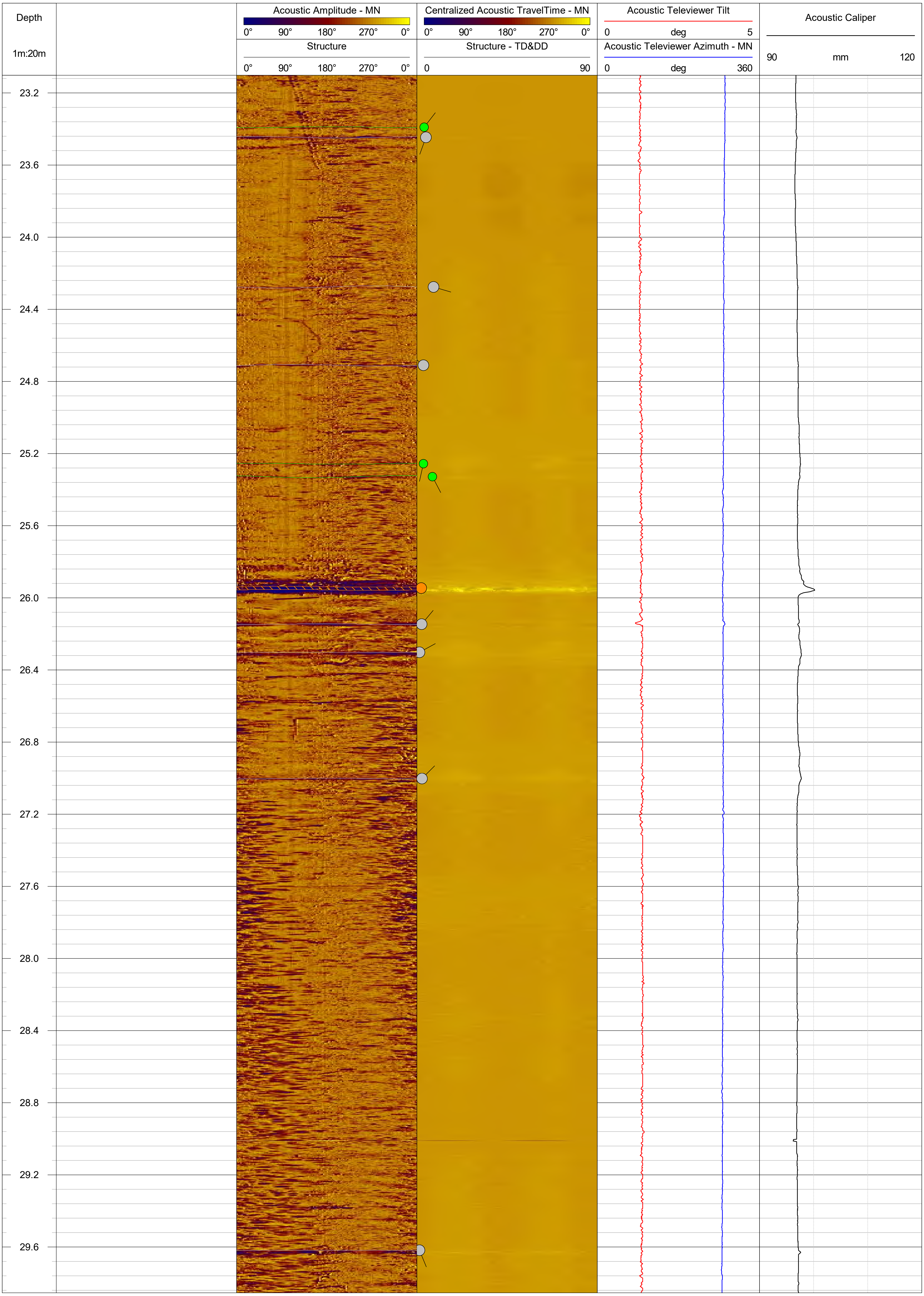
Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	~19.25 m bgs	**Location:**	Darlington, Ontario
Easting:	684177.79 m	**Drilled Depth:**	70.88 m bgs	**Water Level:**	5.0 m bgs	**Log Date:**	July-15-2022
Northing:	4859665.83 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	78.82 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	J. Crawford

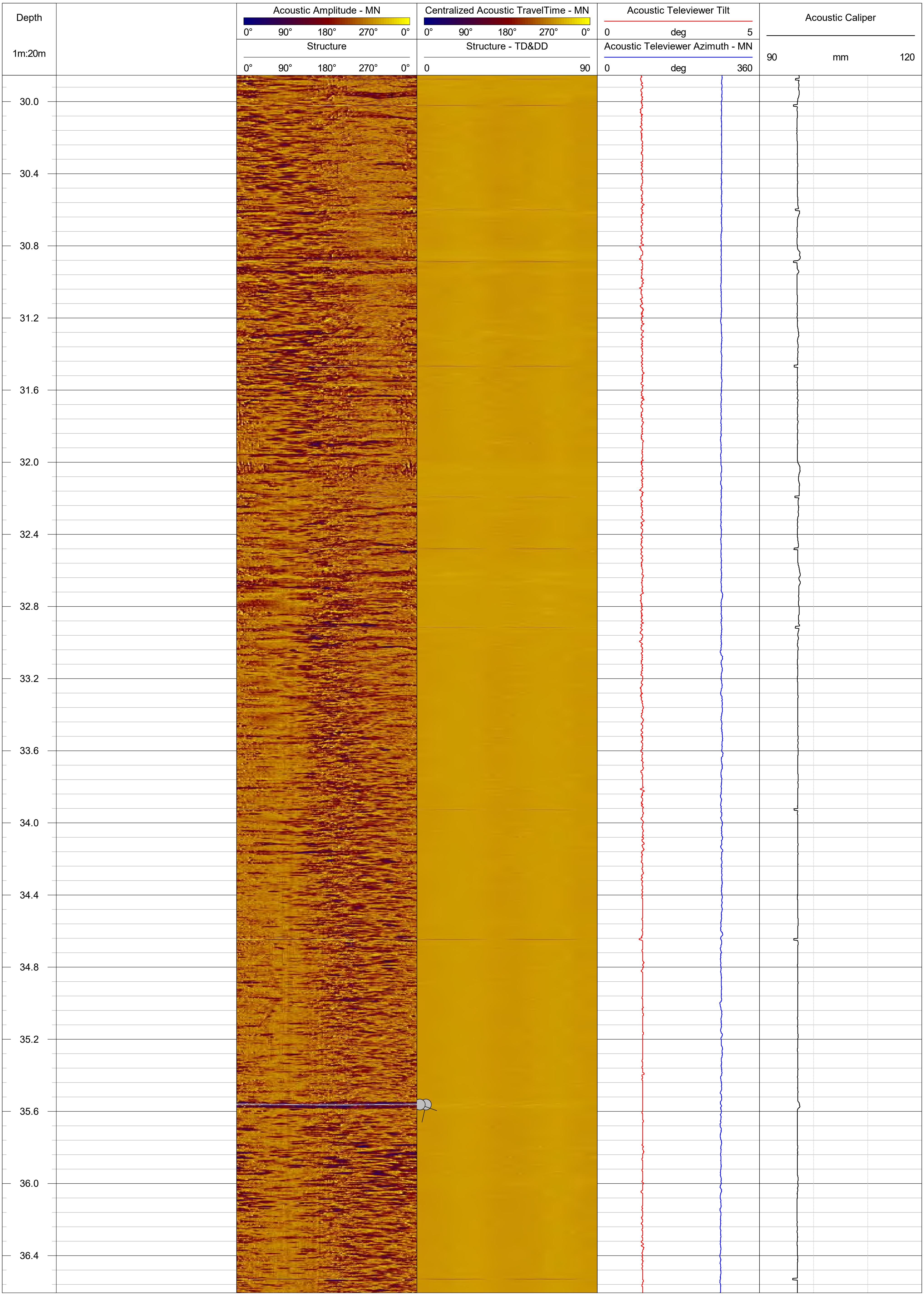


● Partially Open Joint / Fracture
● Filled Fracture / Joint
● Bedding / Banding / Foliation
◀ Casing

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)




Depth
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
23.2
23.6
24.0
24.4
24.8
25.2
25.6
26.0
26.4
26.8
27.2
27.6
28.0
28.4
28.8
29.2
29.6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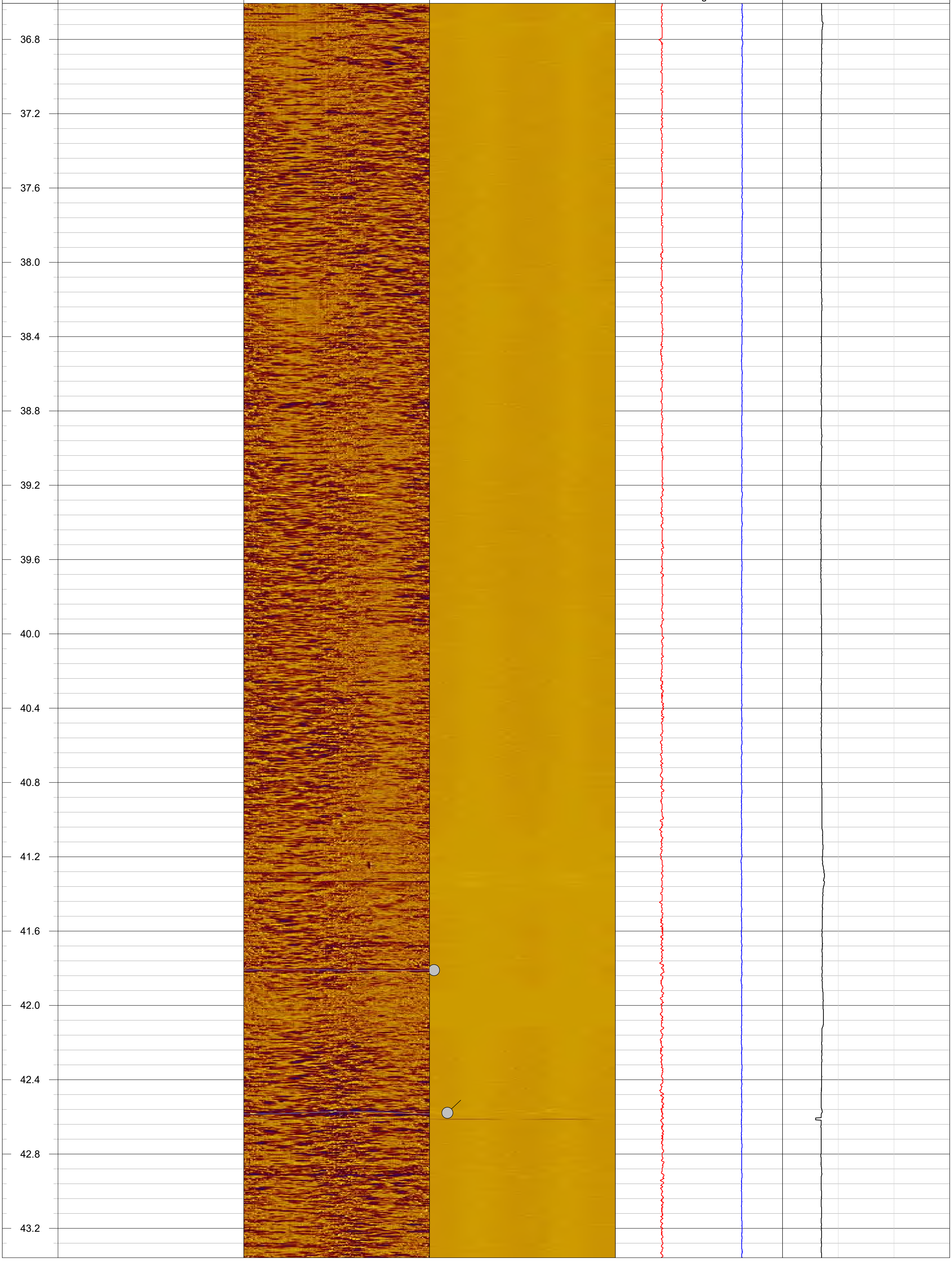
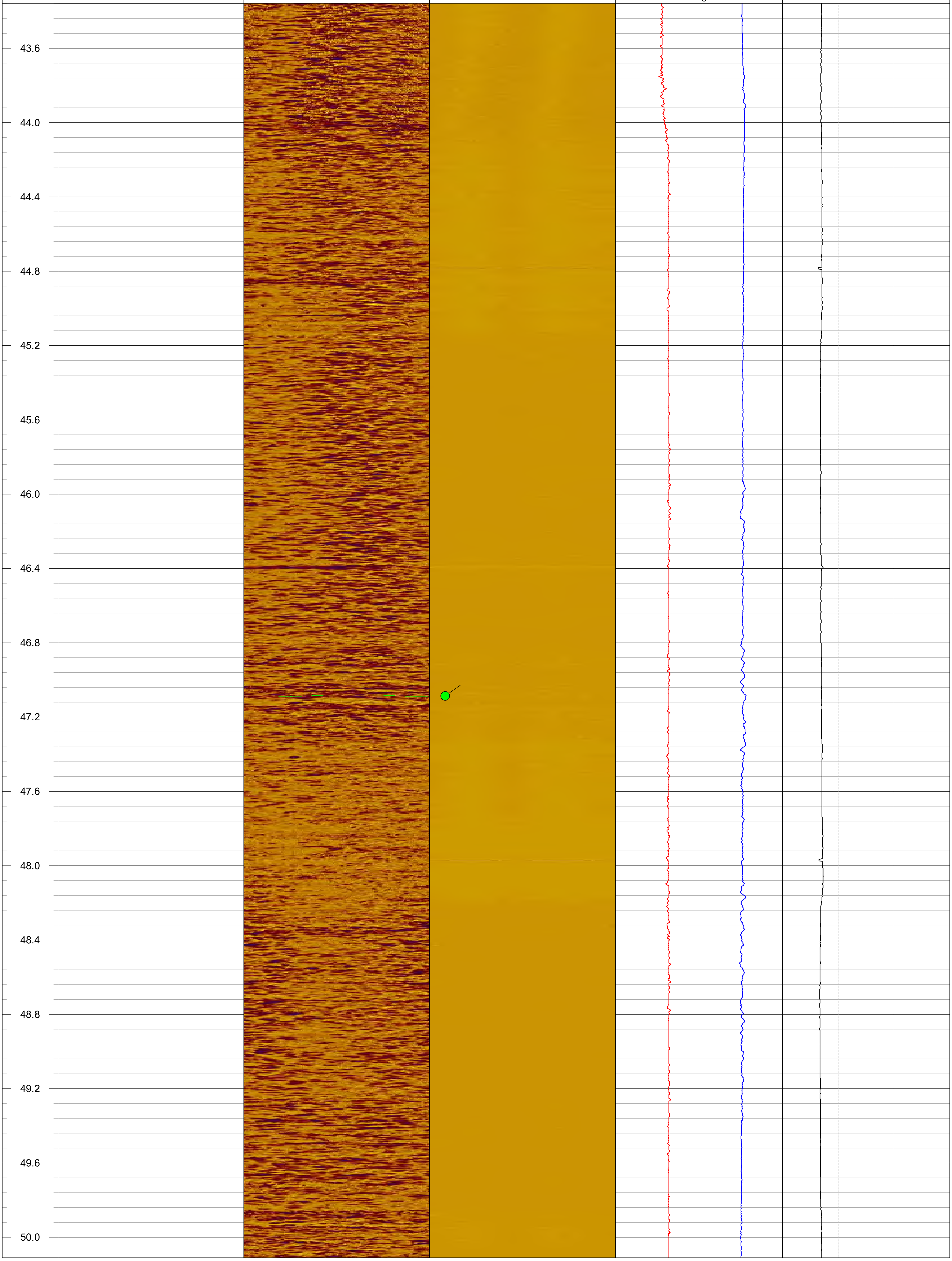
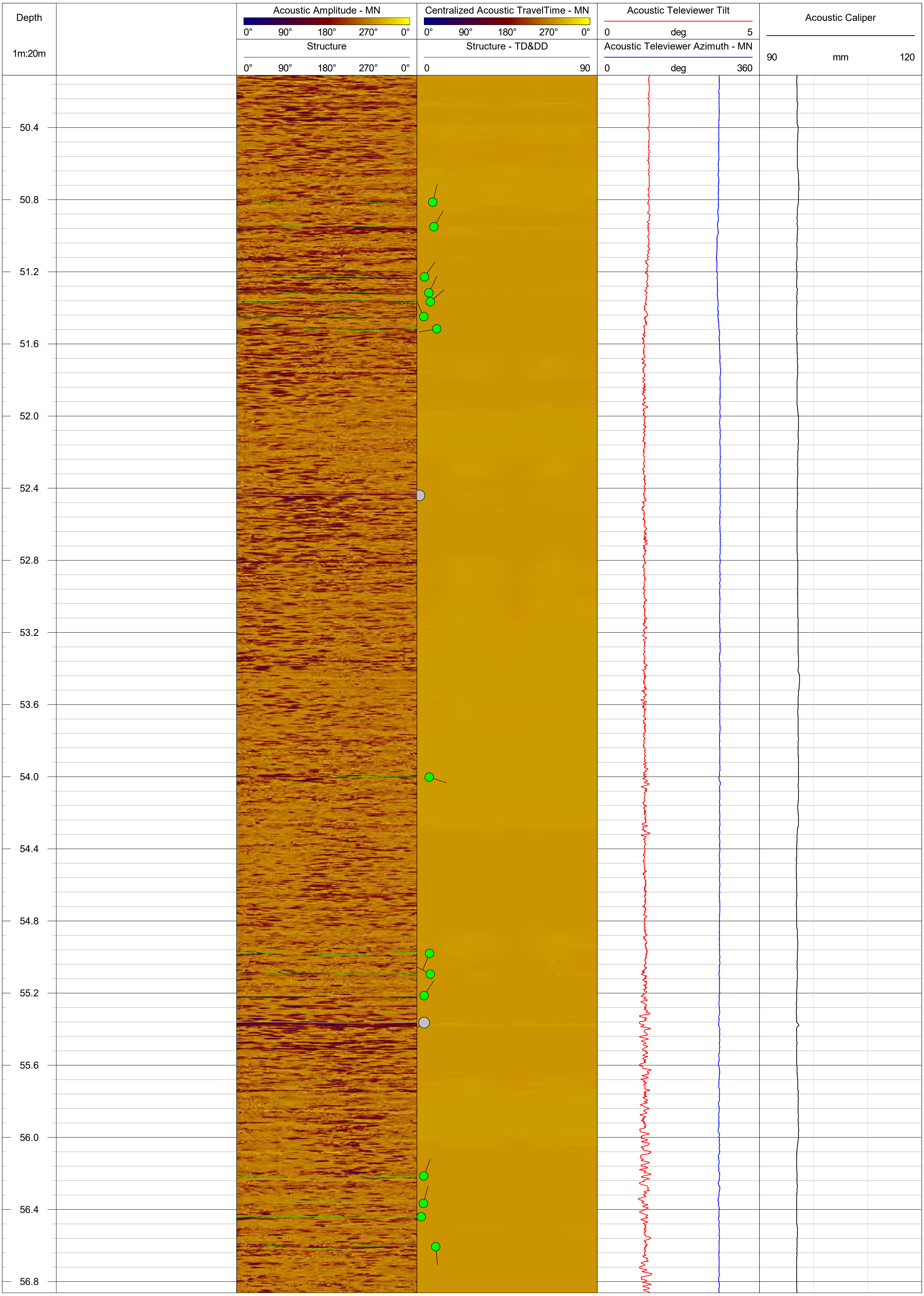
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
30.0
30.4
30.8
31.2
31.6
32.0
32.4
32.8
33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4

Depth 1m:20m		Acoustic Amplitude - MN 0° 90° 180° 270° 0° Structure 0° 90° 180° 270° 0°	Centralized Acoustic TravelTime - MN 0° 90° 180° 270° 0° Structure - TD&DD 0 90	Acoustic Televiewer Tilt 0 deg 5 Acoustic Televiewer Azimuth - MN 0 deg 360	Acoustic Caliper 90 mm 120



Depth 1m:20m		Acoustic Amplitude - MN 0° 90° 180° 270° 0° Structure 0° 90° 180° 270° 0°	Centralized Acoustic TravelTime - MN 0° 90° 180° 270° 0° Structure - TD&DD 0 90	Acoustic Televiewer Tilt 0 deg 5 Acoustic Televiewer Azimuth - MN 0 deg 360	Acoustic Caliper 90 mm 120

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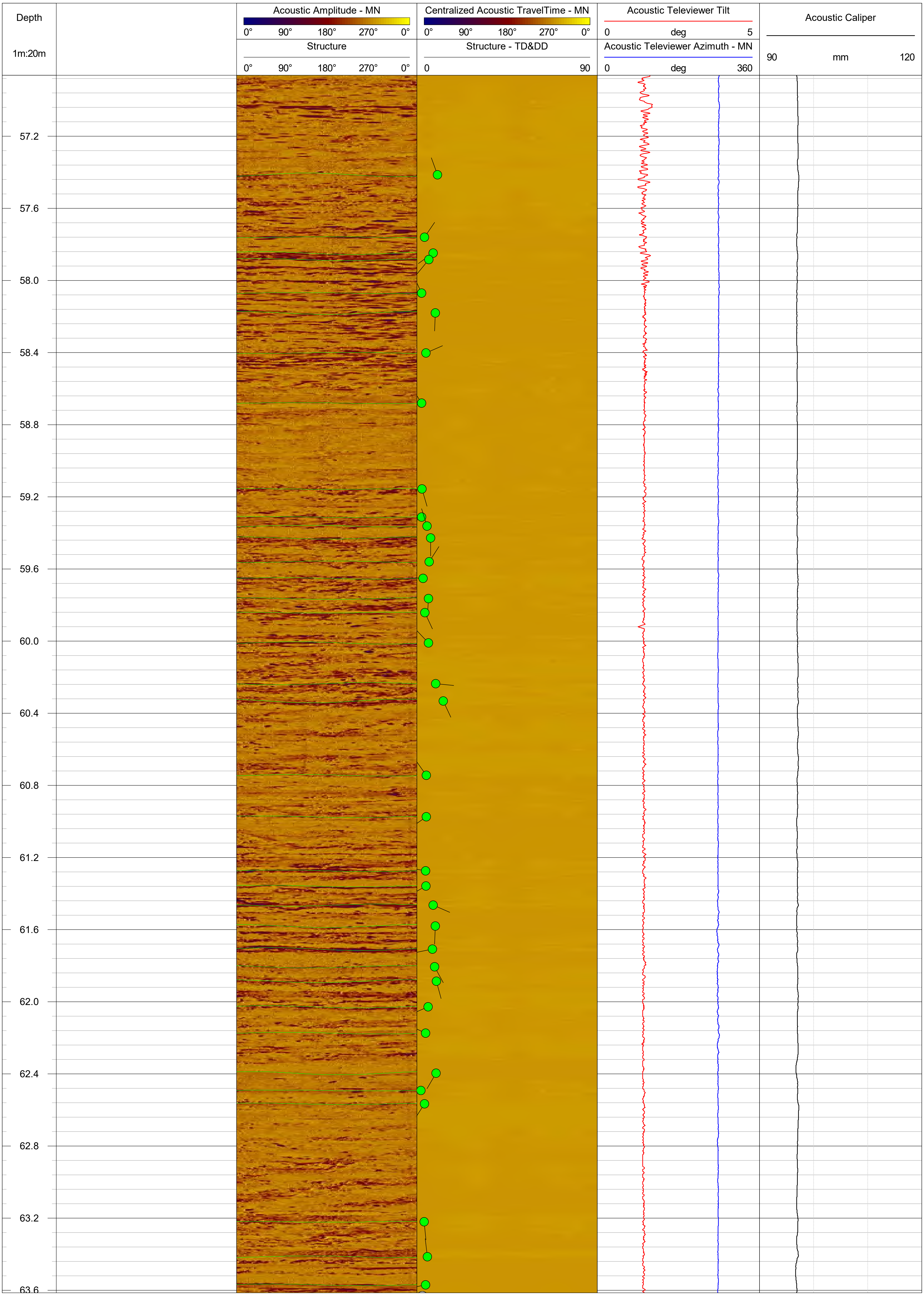
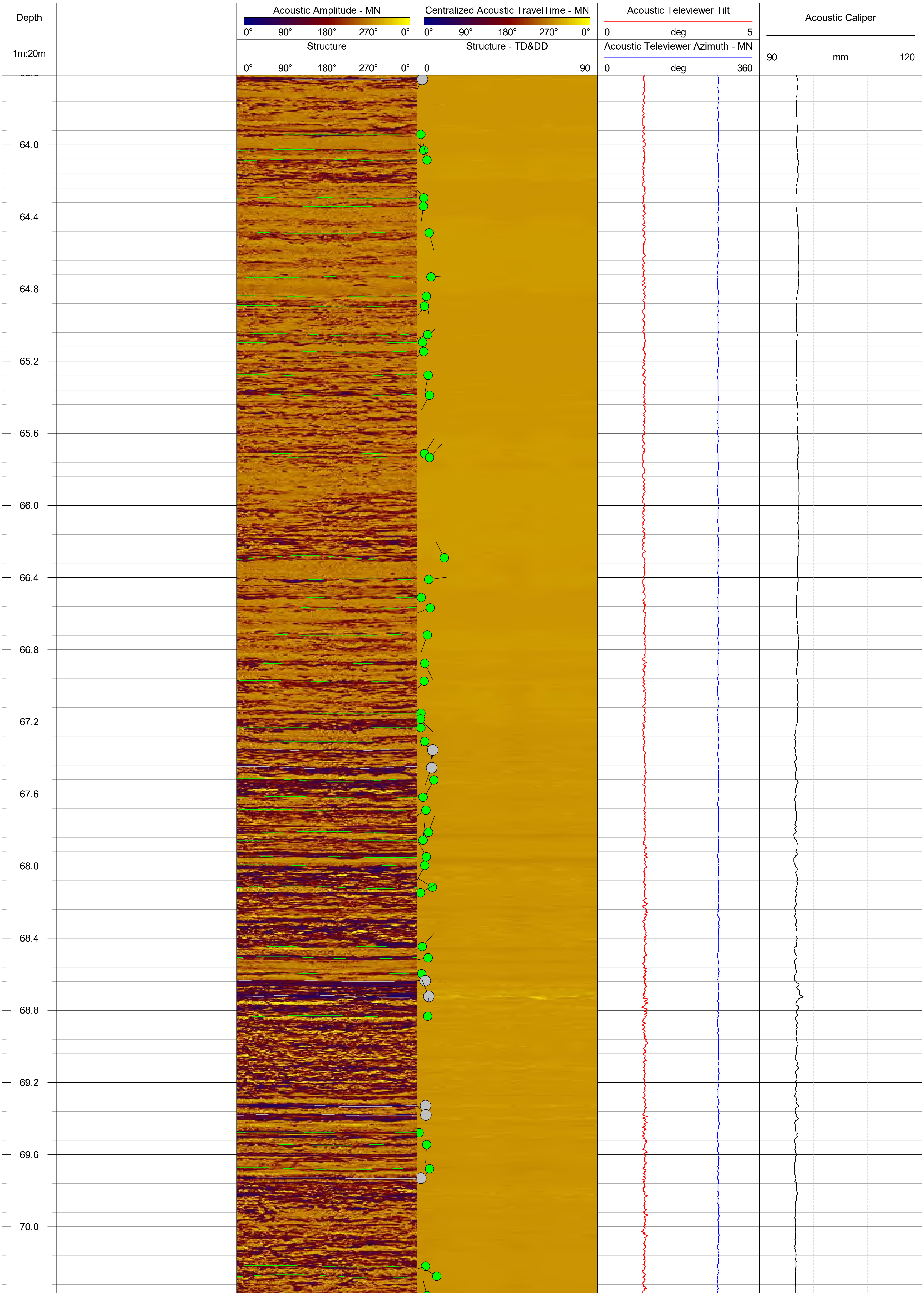
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
50.4
50.8
51.2
51.6
52.0
52.4
52.8
53.2
53.6
54.0
54.4
54.8
55.2
55.6
56.0
56.4
56.8


Depth
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
57.2
57.6
58.0
58.4
58.8
59.2
59.6
60.0
60.4
60.8
61.2
61.6
62.0
62.4
62.8
63.2
63.6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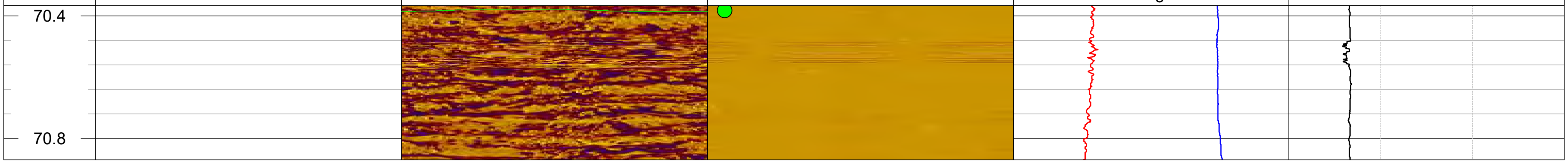
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
64.0
64.4
64.8
65.2
65.6
66.0
66.4
66.8
67.2
67.6
68.0
68.4
68.8
69.2
69.6
70.0

Depth 1m:20m		Acoustic Amplitude - MN 0° 90° 180° 270° 0° Structure 0° 90° 180° 270° 0°	Centralized Acoustic TravelTime - MN 0° 90° 180° 270° 0° Structure - TD&DD 0 90	Acoustic Televiewer Tilt 0 deg 5 Acoustic Televiewer Azimuth - MN 0 deg 360	Acoustic Caliper 90 mm 120



Geophysical Record of Borehole: BH302

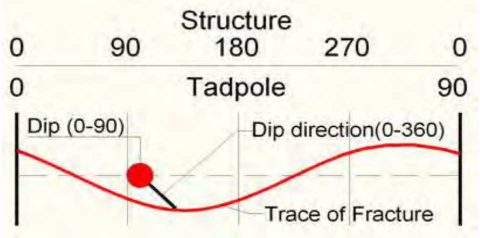
Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

Datum: NAD83, UTM Zone 17N
Easting: 684177.79 m
Northing: 4859665.83 m
Elevation: 78.82 m

Depth Reference: "0" at barge deck
Drilled Depth: 70.88 m bgs
Borehole Diameter: 96 mm
Casing Diameter: HQ

Casing Depth: ~19.25 m bgs
Water Level: 5.0 m bgs
Borehole Inclination: Vertical
Borehole Azimuth: N/A

Location: Darlington, Ontario
Log Date: July-15-2022
Logged By: J. Crawford



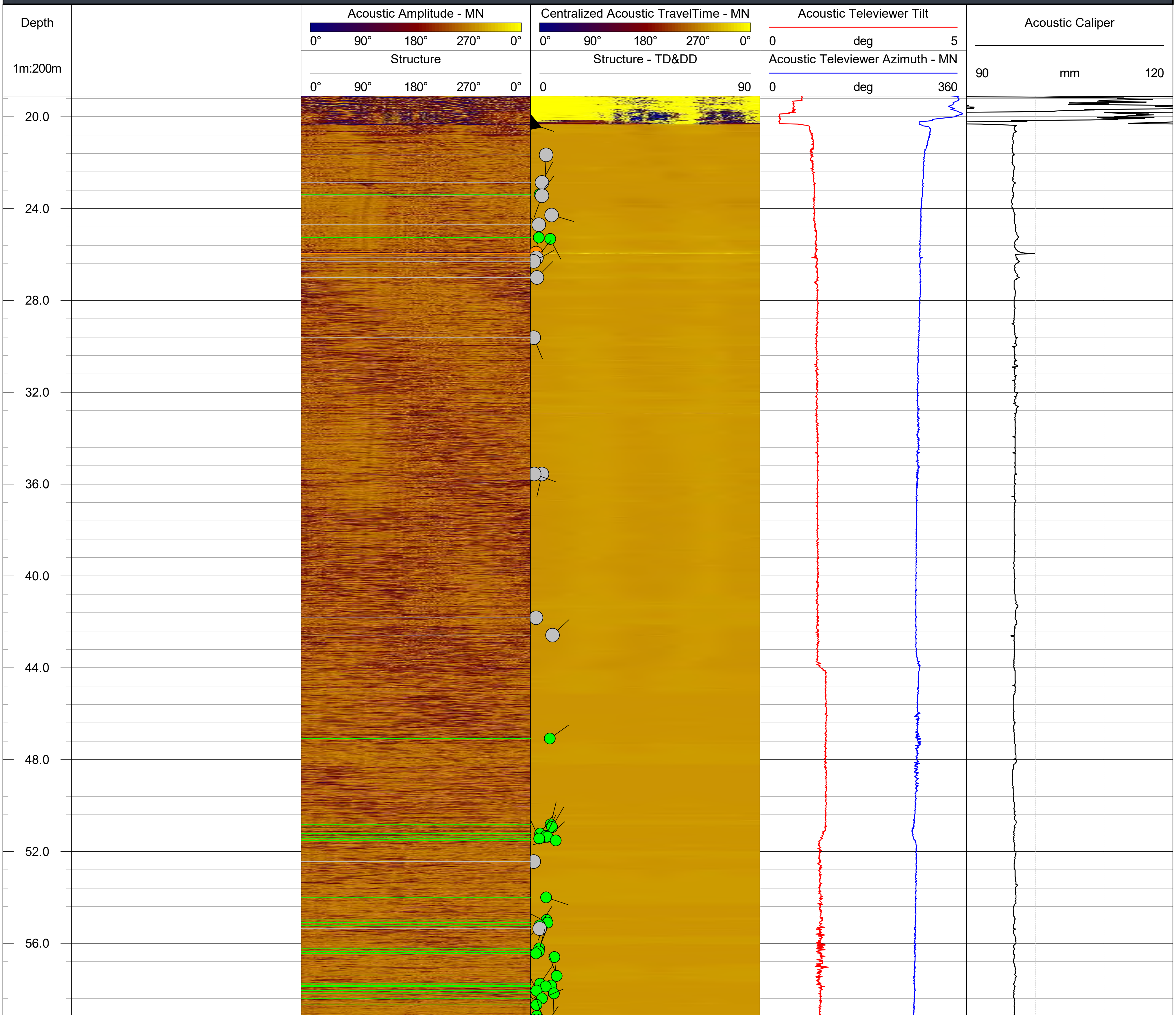
● Partially Open Joint / Fracture

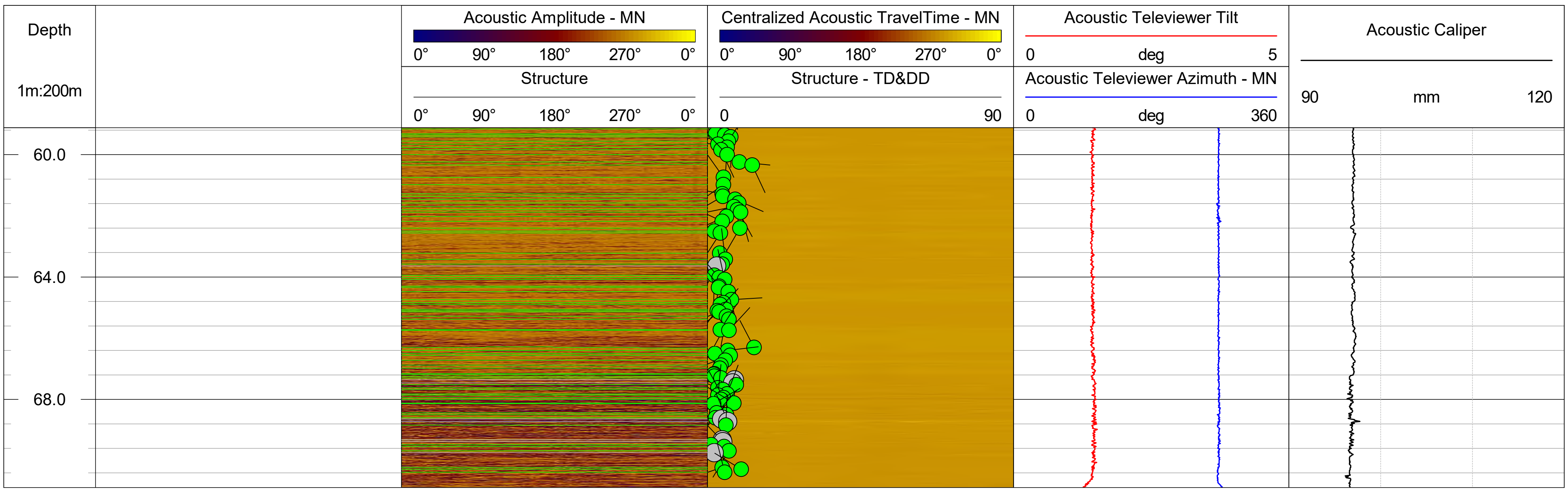
● Filled Fracture / Joint

● Bedding / Banding / Foliation

◀ Casing

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)




Depth
1m:200m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
60.0
64.0
68.0

A16-BH303

PROJECT: 21451329

LOCATION: N 4859647.01; E 684327.84

RECORD OF BOREHOLE: BH303

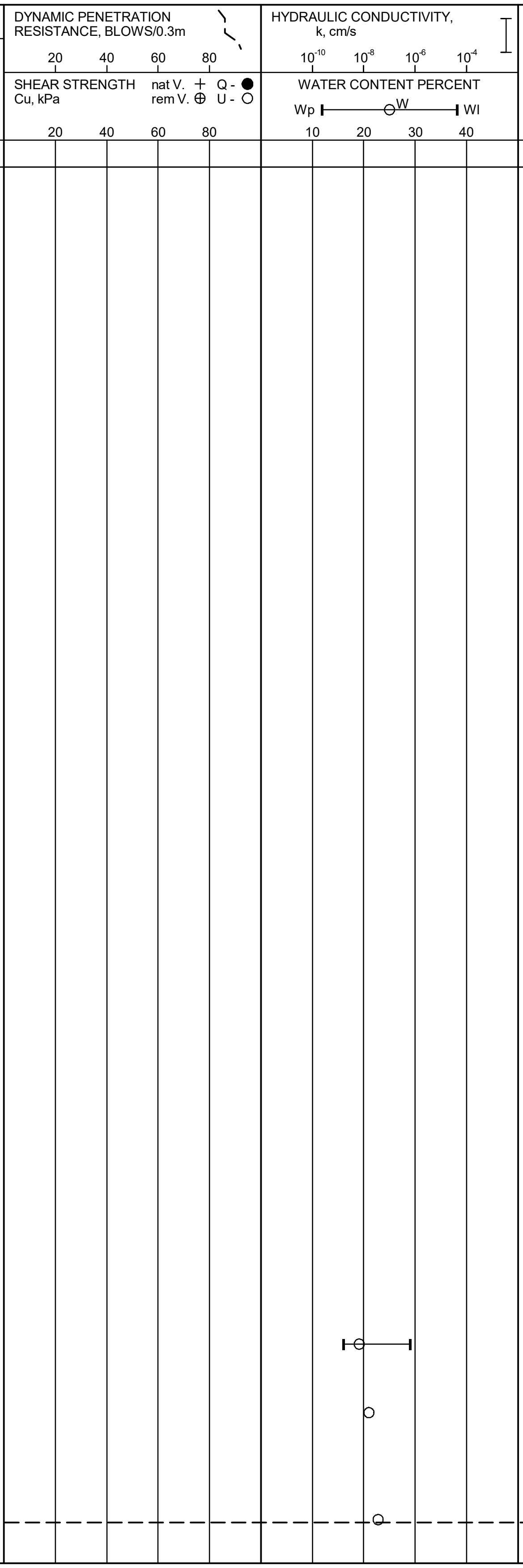
SHEET 1 OF 7

BORING DATE: June 24, 2022

DATUM: Geodetic

DRILL RIG: Diedrich 120 Track Mounted

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0		BARGE DECK		78.84 0.00					
4	Mud Rotary Wash Boring (Tricone) UW Casing	WATER		74.94 3.90					
	Mud Rotary Wash Boring (Tricone) Open	**Lean Clay (CL)**, hard, grey, trace of fine to medium sand, low to medium plasticity (Glaciolacustrine) (Unit 4b)		70.46 8.38	1	SS	39		0 3 56 41
9		**Sandy Silt (ML)**, very dense, grey, moist to wet, fine to medium sand (Glaciolacustrine) (Unit 4a)		69.70 9.14	2A 2B	SS	79		
					3	SS	74		
10		*CONTINUED NEXT PAGE*							



DEPTH SCALE

1 : 50

LOGGED: LT/JD

CHECKED: SEMP

PROJECT: 21451329
LOCATION: N 4859647.01; E 684327.84

RECORD OF BOREHOLE: BH303

SHEET 2 OF 7

BORING DATE: June 24, 2022
DATUM: Geodetic
DRILL RIG: Diedrich 120 Track Mounted

--- CONTINUED FROM PREVIOUS PAGE ---

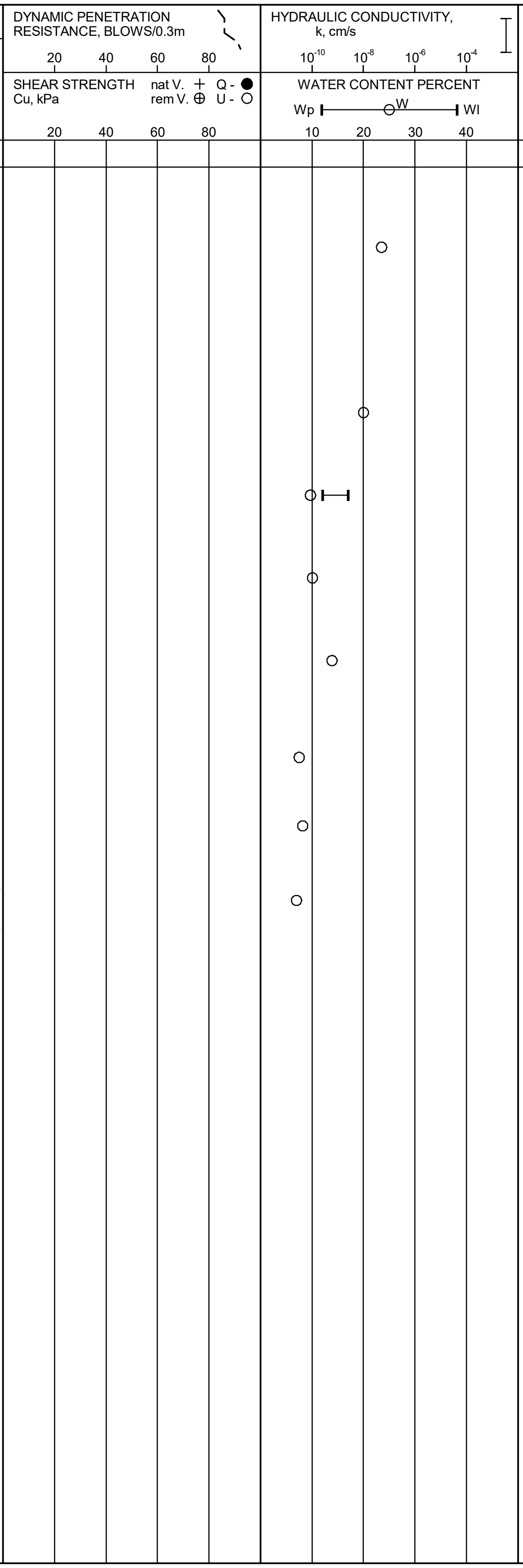
BORING METHOD: Mud Rotary Wash Boring (Tricone) — Open

DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
10			3	SS	74		
	Lean Clay (CL), hard to very stiff, grey, moist, trace of fine to medium sand, low to medium plasticity (Glaciolacustrine) (Unit 4b)	68.55 10.29	4	SS	37		
11			5	SS	41		
			6	SS	20		
12	**Silty Clay with Sand (CL-ML)**, hard, grey, moist, fine to coarse sand, low plasticity (Till) (Unit 5)	66.72 12.12	7	SS	36		3 24 54 19
13			8	SS	74		
	Silty Sand (SM), very dense, grey, moist, fine to medium sand (Glaciolacustrine) (Unit 4a)	65.50 13.34	9	SS	126	NP	1 60 34 5
14			10A	SS	116		
	Sandy Silty Clay with Gravel (CL-ML), hard, grey, moist, fine to coarse sand, angular fine to coarse gravel, low plasticity (Till) (Unit 5)	64.61 14.23	10B				
15			11	SS	177		
			12	SS	191/ 0.19		
	Shale Bedrock Fragments (Unit 6a) - Bedrock cored from 15.69 m to 61.69 m depth - Refer to Record of Drillhole BH303.	63.15 15.72	13	SS	100/ 0.03		

Notes:

1. Water level in open borehole could not be measured upon completion of soil drilling due to use of mud-rotary technique.

2. Efficiency of the SPT hammer utilized was 75.2 %.



DEPTH SCALE
1 : 50

LOGGED: LT/JD
CHECKED: SEMP

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859647.01; E 684327.84
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

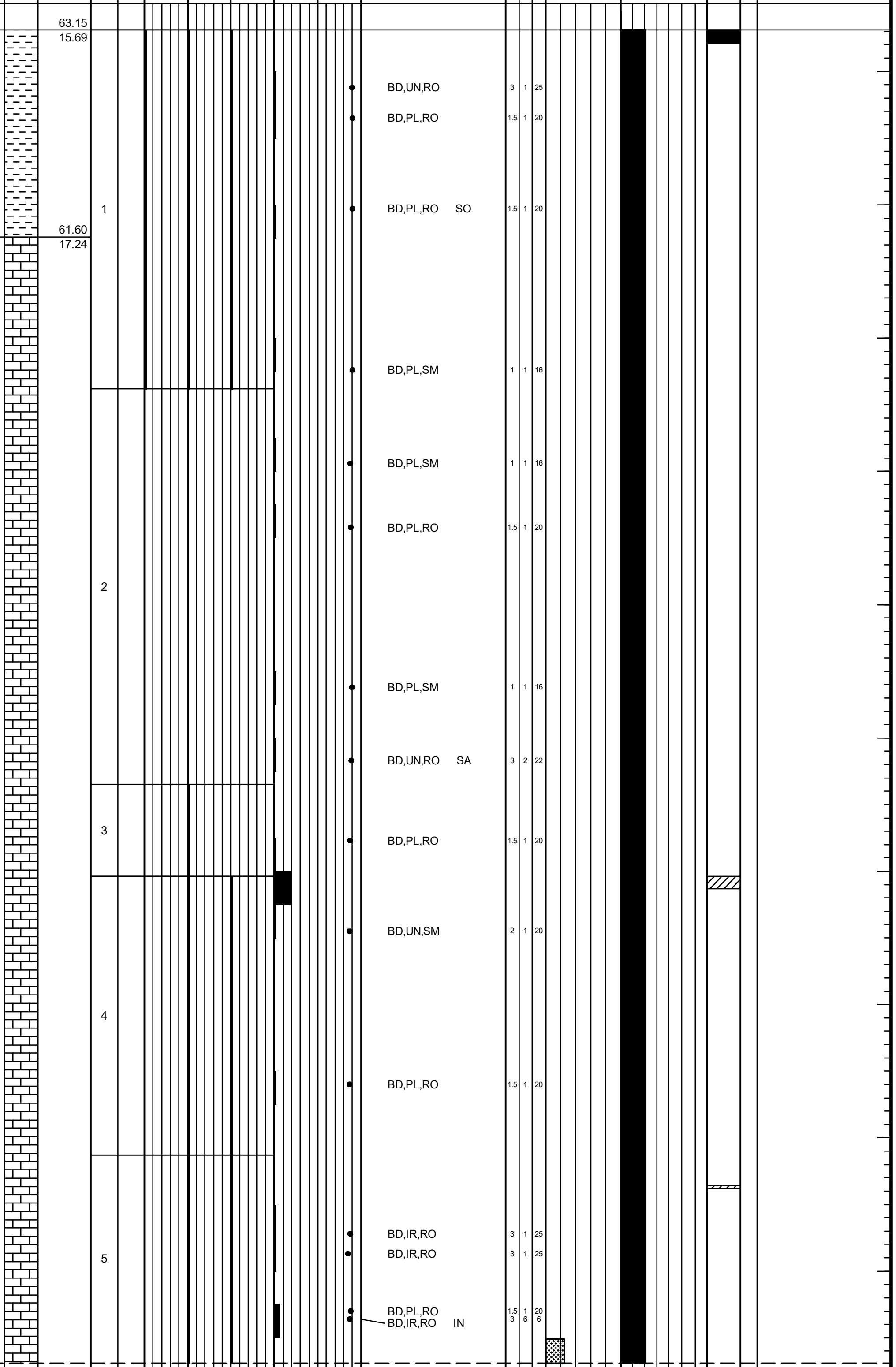
RECORD OF DRILLHOLE: BH303

DRILLING DATE: June 24, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 3 OF 7
DATUM: Geodetic

NOTE: For abbreviations, symbols and descriptions refer to **LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY**

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (m)	RUN No.
		TOP OF BEDROCK	63.15	
16 – 17	Rotary Drill HQ3 Core	Slightly weathered, thinly bedded, dark brownish grey, very fine grained, faintly porous, slightly reactive to HCl, medium strong SHALE (Blue Mountain Formation) with very thin to thin, grey, fine to medium grained limestone interbeds	15.69	1
17 – 26		Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey, shale interbeds	61.60 17.24	1, 2, 3, 4, 5



TYPE AND SURFACE DESCRIPTION		Jr	Ja	Jcon
BD,UN,RO		3	1	25
BD,PL,RO		1.5	1	20
BD,PL,RO	SO	1.5	1	20
BD,PL,SM		1	1	16
BD,PL,SM		1	1	16
BD,PL,RO		1.5	1	20
BD,PL,SM		1	1	16
BD,UN,RO	SA	3	2	22
BD,PL,RO		1.5	1	20
BD,UN,SM		2	1	20
BD,PL,RO		1.5	1	20
BD,IR,RO		3	1	25
BD,IR,RO		3	1	25
BD,PL,RO		1.5	1	20
BD,IR,RO	IN	3	6	6

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

wsp

LOGGED: LT
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859647.01; E 684327.84
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

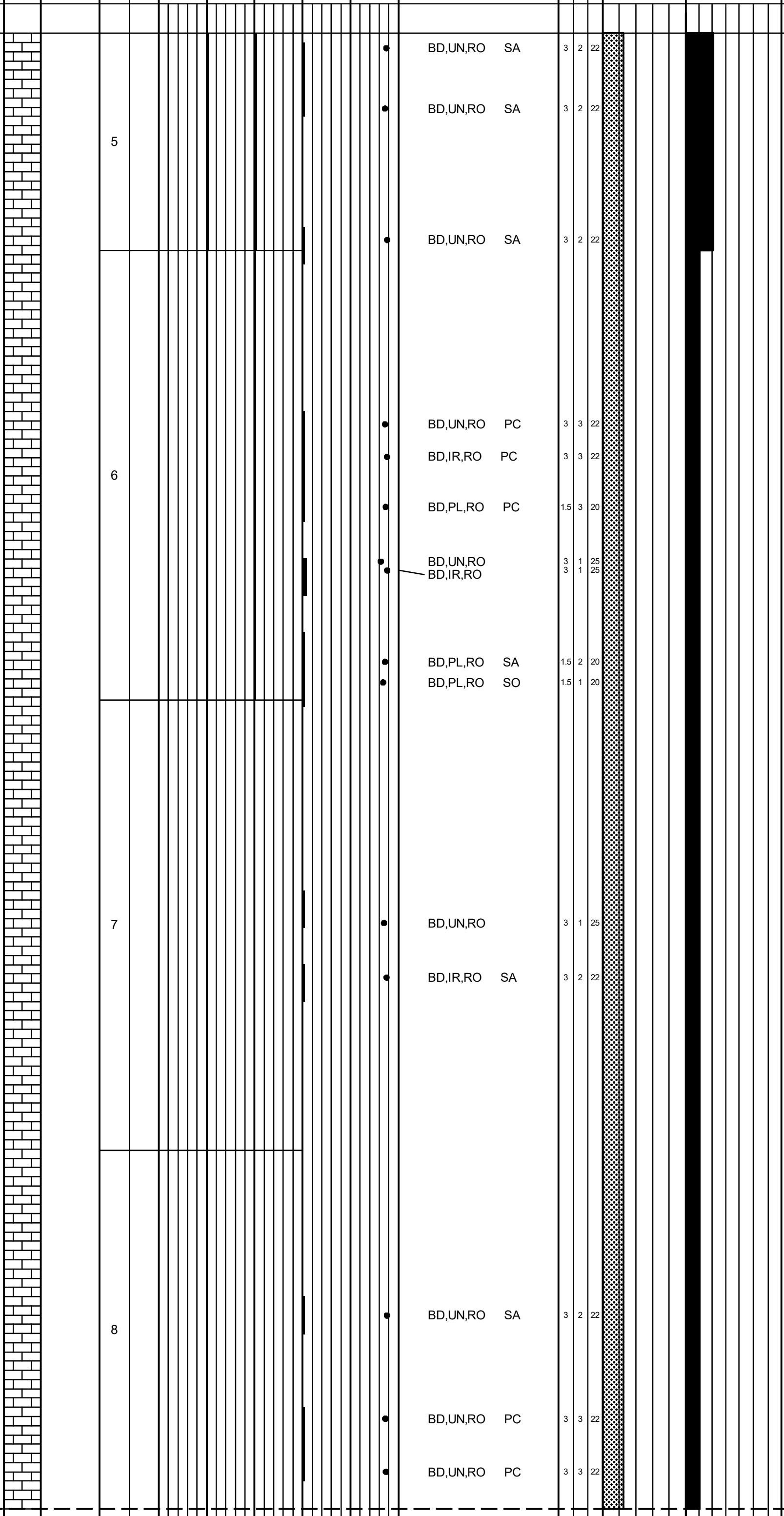
RECORD OF DRILLHOLE: BH303

DRILLING DATE: June 24, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 4 OF 7
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec	WEATHERING INDEX	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PAGE ---																		
26	Rotary Drill HQ3 Core	Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey, shale interbeds			5							BD,UN,RO SA	3	2	22					
												BD,UN,RO SA	3	2	22					
27												BD,UN,RO SA	3	2	22					
28					6							BD,UN,RO PC	3	3	22					
												BD,IR,RO PC	3	3	22					
29												BD,PL,RO PC	1.5	3	20					
												BD,UN,RO	3	1	25					
												BD,IR,RO	3	1	25					
30												BD,PL,RO SA	1.5	2	20					
												BD,PL,RO SO	1.5	1	20					
31		Punch Penetration Sample			7							BD,UN,RO	3	1	25					
32												BD,IR,RO SA	3	2	22					
33																				
34					8							BD,UN,RO SA	3	2	22					
35		UCS with Modulus Sample										BD,UN,RO PC	3	3	22					
												BD,UN,RO PC	3	3	22					
		CONTINUED NEXT PAGE																		



DEPTH SCALE
1 : 50

LOGGED: LT
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859647.01; E 684327.84
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH303

DRILLING DATE: June 24, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 5 OF 7
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

Column headings: DEPTH SCALE METRES | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (m) | RUN No. | FLUSH RETURN | RECOVERY (TOTAL CORE % 80 60 40 20; SOLID CORE % 80 60 40 20) | R.Q.D. % 80 60 40 20 | FRACT. INDEX PER 0.25 m 5 10 15 20 | DISCONTINUITY DATA (DIP w.r.t. CORE AXIS 0 30 60 90; TYPE AND SURFACE DESCRIPTION; Jr; Ja; Jcon) | HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2} | WEATH-ERING INDEX W1 W2 W3 W4 W5 W6 | FEATURES | R0/R1 ZONES | PIEZOMETER

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	RUN No.	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
	Rotary Drill HQ3 Core	Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey, shale interbeds					
36			8				
37		Cerchar Sample					
				BD,UN,RO SA	3	2	22
			9				
38							
				BD,PL,RO SA	1.5	2	20
39							
		UCS with Modulus Sample					
40							
				BD,IR,RO	3	1	25
			10	BD,UN,RO SA	3	2	22
41				BD,UN,RO PC	3	3	22
				BD,PL,SM SA	1	2	16
42		Specific Gravity Sample					
				BD,UN,RO	3	1	25
43							
			11				
44		Slake Durability Sample					
				BD,PL,RO SO	1.5	1	20
				BD,UN,RO	3	1	25
45				BD,UN,RO	3	1	25
			12				

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

wsp

LOGGED: LT
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859647.01; E 684327.84
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH303

DRILLING DATE: June 24, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 6 OF 7
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE % (80 60 40 20)	RECOVERY SOLID CORE % (80 60 40 20)	R.Q.D. % (80 60 40 20)	FRACT. INDEX PER 0.25 m (5 10 15 20)	DIP w.r.t. CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-8} 10^{-6} 10^{-4} 10^{-2})	WEATHERING INDEX (W1 W2 W3 W4 W5 W6)	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
46	Rotary Drill HQ3 Core	Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey, shale interbeds Brazilian Sample																		
											●	BD,PL,SM	1	1	16					
47					12															
											●	BD,PL,RO	1.5	1	20					
48																				
49																				
50					13															
											●	BD,UN,RO	3	1	25					
51																				
52																				
53					14															
54																				
55					15															
		CONTINUED NEXT PAGE																		

DEPTH SCALE
1 : 50

LOGGED: LT
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859647.01; E 684327.84
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH303

DRILLING DATE: June 24, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE % 80 60 40 20	RECOVERY SOLID CORE % 80 60 40 20	R.Q.D. % 80 60 40 20	FRACT. INDEX PER 0.25 m 5 10 15 20	DIP w.r.t. CORE AXIS 0 30 60 90	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2}	WEATHERING INDEX W1 W2 W3 W4 W5 W6	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
56	Rotary Drill HQ3 Core	Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey, shale interbeds			15						•	BD,UN,RO SA	3	2	22					
57																				
58																				
59					16						•	BD,UN,RO SA	3	2	22					
											•	BD,UN,RO SA	3	2	22					
60											•	BD,UN,RO SA	3	2	22					
61				17.15	17															
		END OF DRILLHOLE		61.69																
62																				
63																				
64																				
65																				

DEPTH SCALE
1 : 50

LOGGED: LT
CHECKED: PKS

GOLDER
MEMBER OF WSP

Water Content Summary
ASTM D2216

Test Request # 21451329-21600-610 BH303
Client: E.S. Fox Limited
Project Name: ES Fox/DNNP Invest/Bowmanville
Project Number: 21451329-21600-610
Project Location:

Sample Location	Sample				Soil Description	Water Content %	Method	Remarks
	Ref	Top (m)	Base (m)	Type				
BH303	1	8.38	8.99	SS		19.1	B	
BH303	2A	9.14	9.24	SS		21.0	B	
BH303	3	9.75	10.21	SS		22.8	B	
BH303	4	10.36	10.82	SS		23.5	B	
BH303	6	11.58	12.04	SS		20.0	B	
BH303	7	12.19	12.65	SS		9.7	B	
BH303	8	12.80	13.26	SS		10.1	B	
BH303	9	13.41	13.87	SS		13.9	B	
BH303	10B	14.23	14.48	SS		7.5	B	
BH303	11	14.63	15.09	SS		8.2	B	
BH303	12	15.24	15.58	SS		7.0	B	

Notes:

Tested by: JTimms **Date:** 12 Oct 2022
Checked by: MRuck **Date:** 26 Oct 2022

Disclaimer:

Reviewed by: JoNorris **Date:** 06 Nov 2022

GOLDER
MEMBER OF WSP

PARTICLE SIZE DISTRIBUTION

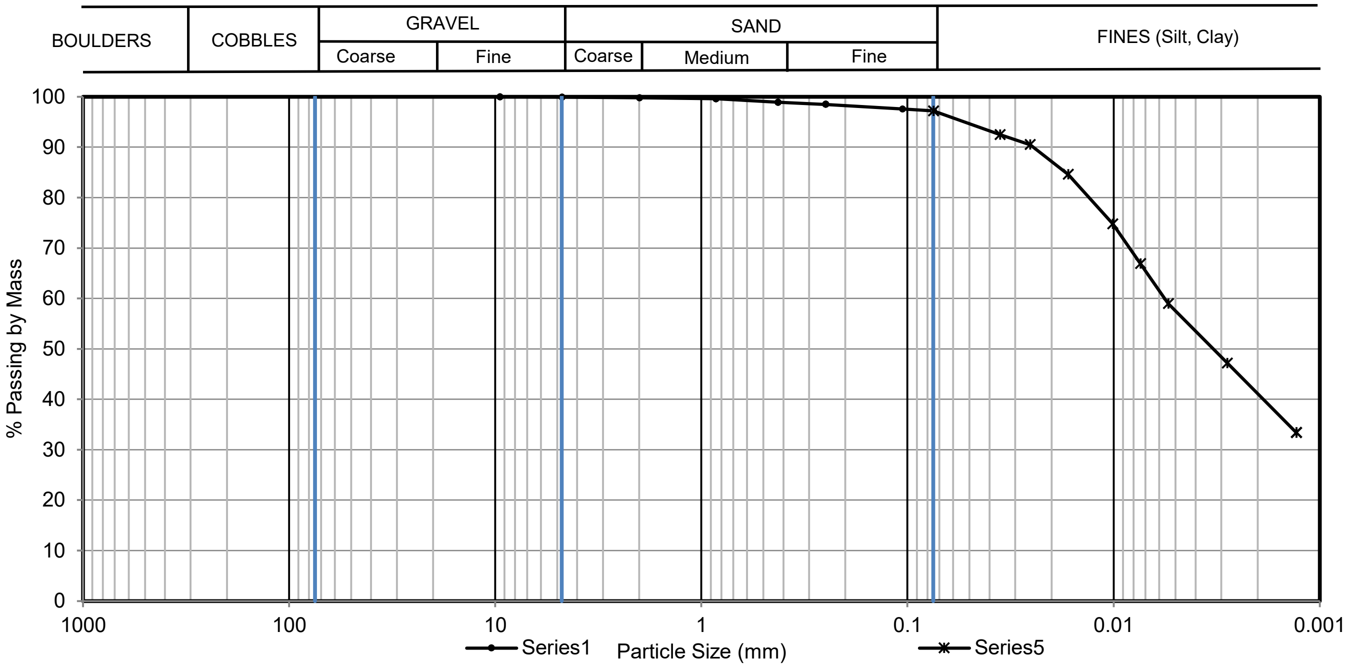
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH303	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH303
Source:		Sample No.:	1
		Type:	SS
Soil Description:		Depth (m):	8.38 - 8.99

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	14 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%) 0.1 2.7 97.2



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/8"	9.5	100.0	0.0356	92.5
#4	4.75	99.9	0.0254	90.5
#10	2	99.8	0.0166	84.6
#20	0.85	99.6	0.0101	74.8
#40	0.425	98.9	0.0074	66.9
#60	0.25	98.5	0.0054	59.0
#140	0.106	97.6	0.0028	47.2
#200	0.075	97.2	0.0013	33.4
			0.005 mm	57.52
			0.002 mm	41.11
			D60	0.01
			D30	
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

Tested by: JTimms **Date:** 14 Oct 2022 **Checked by:** MRuck **Date:** 26 Oct 2022 **Reviewed by:** JoNorris **Date:** 06 Nov 2022

PARTICLE SIZE DISTRIBUTION

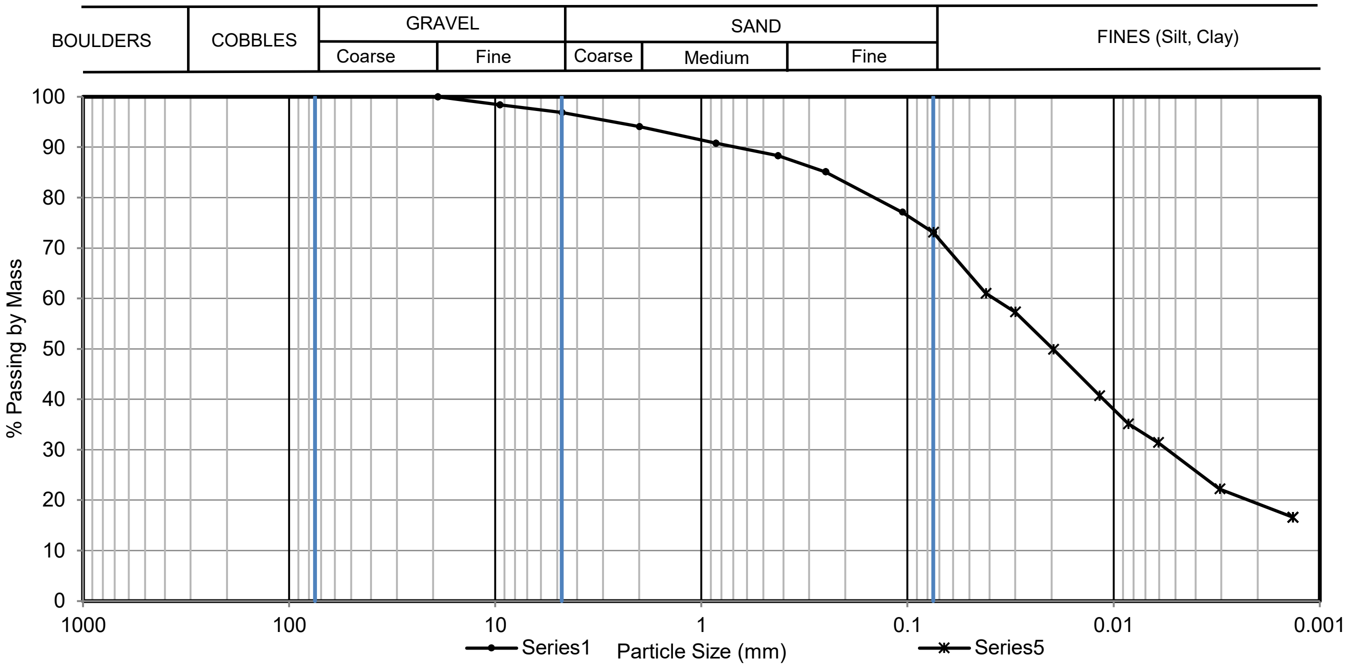
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH303	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH303
Source:		Sample No.:	7
Soil Description:		Type:	SS
		Depth (m):	12.19 - 12.65

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	14 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%) 3.1 23.8 73.1



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0417	61.0
3/8"	9.5	98.4	0.0300	57.3
#4	4.75	96.9	0.0196	49.9
#10	2	94.1	0.0117	40.7
#20	0.85	90.8	0.0085	35.1
#40	0.425	88.3	0.0061	31.4
#60	0.25	85.1	0.0031	22.2
#140	0.106	77.1	0.0014	16.6
#200	0.075	73.1		
			0.005 mm	28.80
			0.002 mm	19.29
			D60	0.04
			D30	0.01
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

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Tested by: JTimms **Date:** 14 Oct 2022 **Checked by:** MRuck **Date:** 26 Oct 2022 **Reviewed by:** JoNorris **Date:** 06 Nov 2022

PARTICLE SIZE DISTRIBUTION

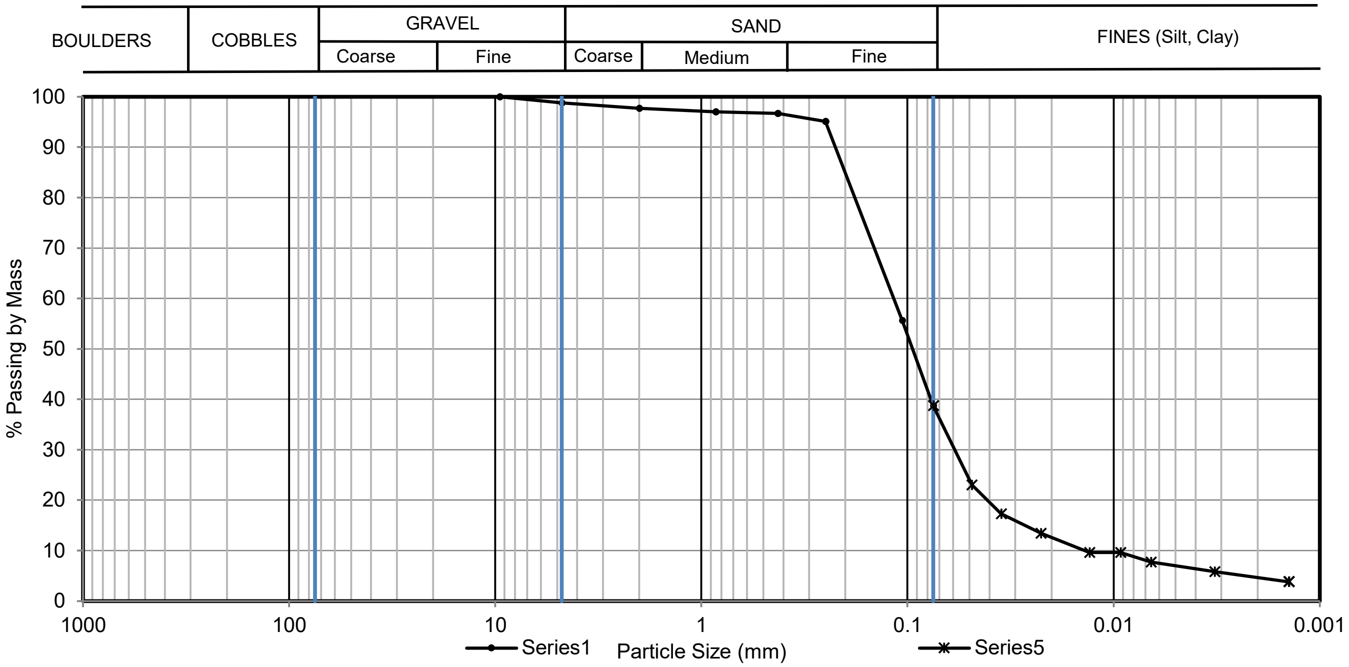
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH303	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH303
Source:		Sample No.:	9
		Type:	SS
Soil Description:		Depth (m):	13.41 - 13.87

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	14 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%) 1.2 60.1 38.7



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/8"	9.5	100.0	0.0487	23.0
#4	4.75	98.8	0.0351	17.3
#10	2	97.7	0.0225	13.4
#20	0.85	97.0	0.0131	9.6
#40	0.425	96.7	0.0093	9.6
#60	0.25	95.1	0.0066	7.7
#140	0.106	55.6	0.0032	5.8
#200	0.075	38.7	0.0014	3.8
			0.005 mm	6.97
			0.002 mm	4.64
			D60	0.12
			D30	0.06
			D10	0.01
			Cu	8.40
			Cc	2.20

Notes:

Disclaimer:

Tested by: JTimms **Date:** 14 Oct 2022 **Checked by:** MRuck **Date:** 26 Oct 2022 **Reviewed by:** JoNorris **Date:** 06 Nov 2022

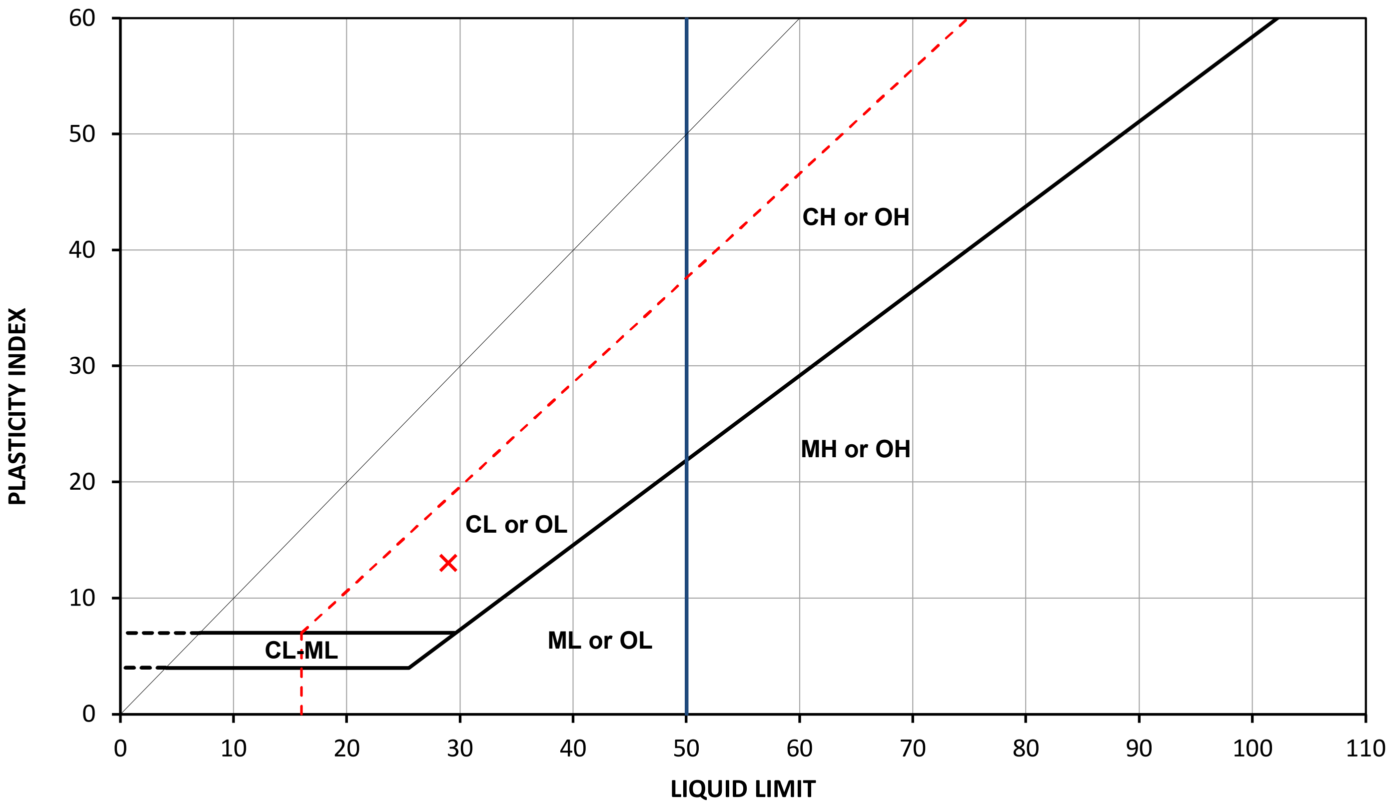
LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

ASTM D4318

Method A - Multipoint Test

Test Request #	21451329-21600-610 BH303	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH303
Source:		Sample No.:	1
Soil Description:		Type:	SS
		Depth (m):	8.38 - 8.99

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	18 Oct 2022
Specimen Description	NA				



Legend

- A-Line
- U-Line

Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH303	1	8.38	8.99	89	19.1	29	16	13	0.24

NP = Non-Plastic
ND = Not Determined

Test Preparation

Notes:

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Tested by: JTimms **Date:** 18 Oct 2022
Checked by: MRuck **Date:** 26 Oct 2022
Reviewed by: JoNorris **Date:** 06 Nov 2022

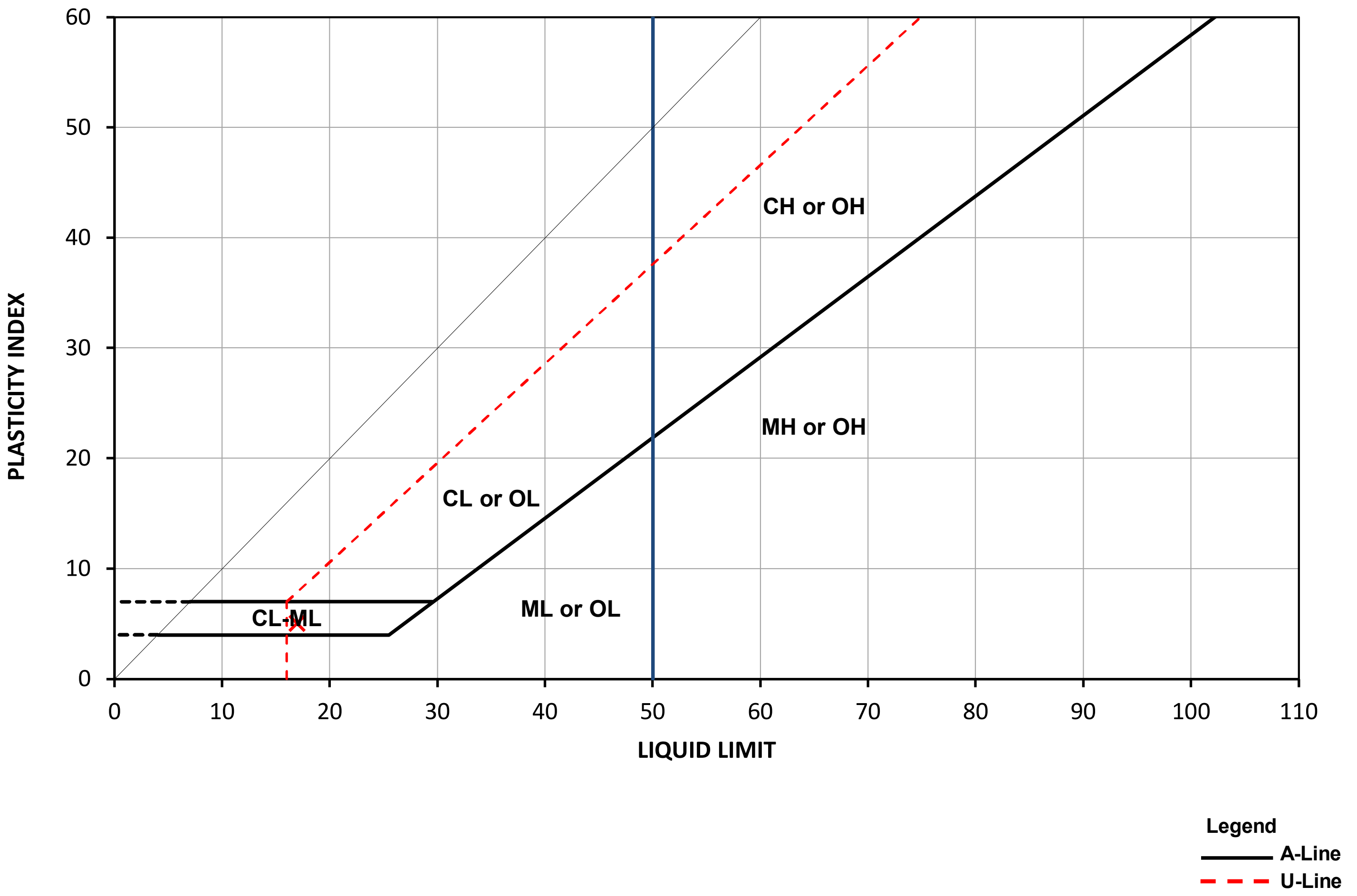
LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

ASTM D4318

Method A - Multipoint Test

Test Request #	21451329-21600-610 BH303	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH303
Source:		Sample No.:	7
Soil Description:		Type:	SS
		Depth (m):	12.19 - 12.65

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	18 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH303	7	12.19	12.65	89	9.7	17	12	5	-0.46

NP = Non-Plastic
ND = Not Determined

Test Preparation

Notes:

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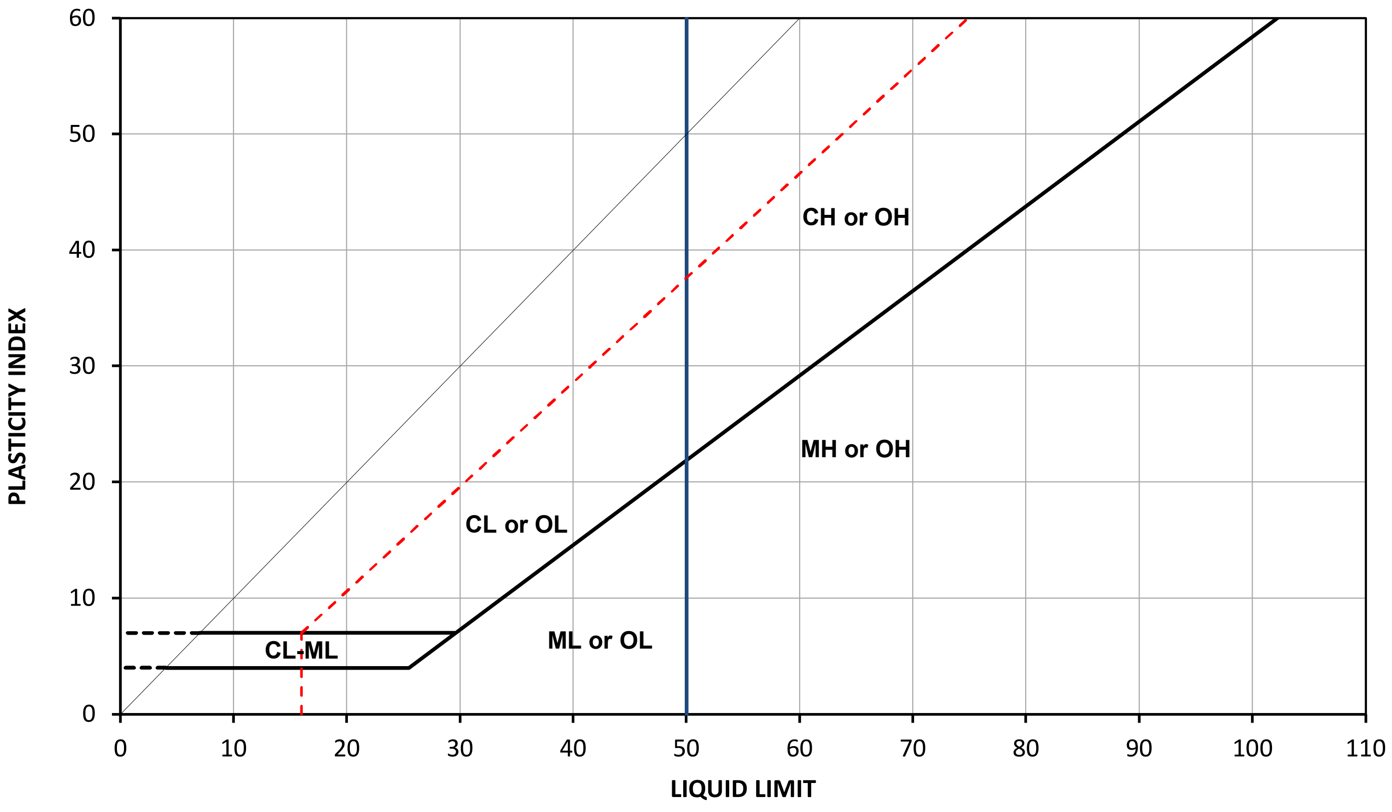
Tested by: JTimms **Date:** 18 Oct 2022
Checked by: MRuck **Date:** 26 Oct 2022
Reviewed by: JoNorris **Date:** 06 Nov 2022

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318

Test Request #	21451329-21600-610 BH303	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH303
Source:		Sample No.:	9
Soil Description:		Type:	SS
		Depth (m):	13.41 - 13.87

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	18 Oct 2022
Specimen Description	NA				



Legend
- A-Line
- U-Line

Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH303	9	13.41	13.87	99	13.9		NP		

NP = Non-Plastic
ND = Not Determined

Test Preparation

Notes:

Tested by: JTimms **Date:** 18 Oct 2022
Checked by: MRuck **Date:** 26 Oct 2022

Disclaimer:
The laboratory testing services reported herein have been performed in accordance with the terms of a contract with Golder's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of Golder's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Reviewed by: JoNorris **Date:** 06 Nov 2022

GOLDER
MEMBER OF WSP

SOIL RESISTIVITY USING THE WENNER FOUR ELECTRODE METHOD (ASTM G57-20)

November 3, 2022
Golder Project Number: 21451329-21600-610

Attention: Sarah Poot

Sample Description: **BH303, SA02B, 9.24-9.60m**

Date Scheduled:	October 3, 2022	Sampled By:	Golder Associates Ltd.
Date Received:	October 12, 2022	Golder Lab No.:	G-22-264
Date Tested:	October 12, 2022	Tested By:	E. Shallhorn

Resistivity Meter Model Number	Miller 400D
Soil Box Factor	0.976377953
Temperature of Sample (°C)	23.5
Measured Resistance (ohm)	4870.0
Resistivity (ohm•cm)	4755.0
Temperature Corrected Resistivity (ohm•cm)	**5706.0**

Data Input By: M. Ruck

Reviewed by:

Jodi Norris, Technical and Quality Coordinator

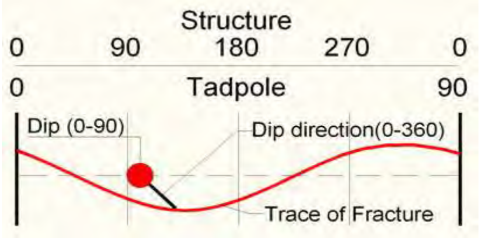
CCIL
The Voice Of Independent Canadian Laboratories
La voix des laboratoires indépendants canadiens

Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

Geophysical Record of Borehole: BH303

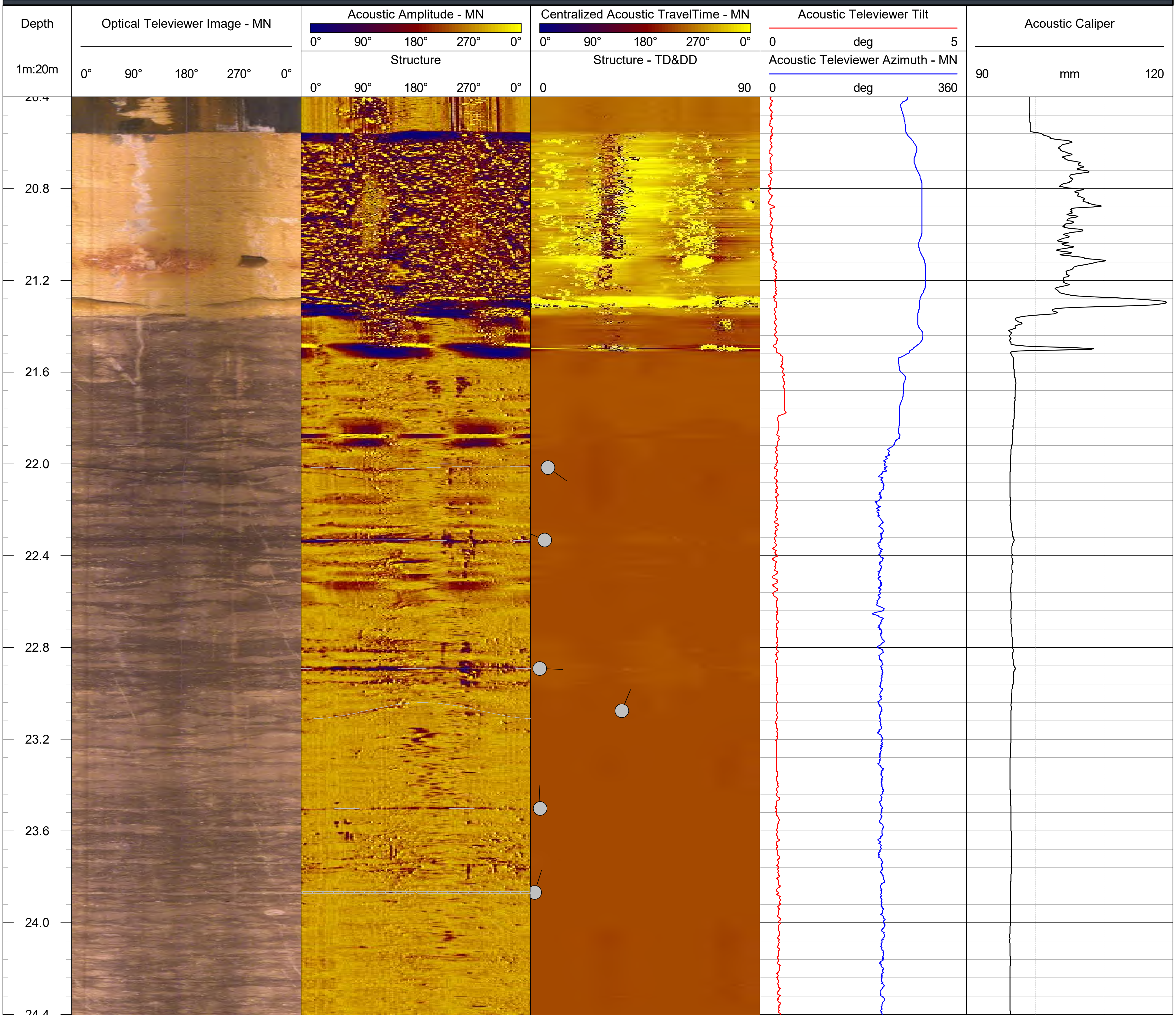
Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

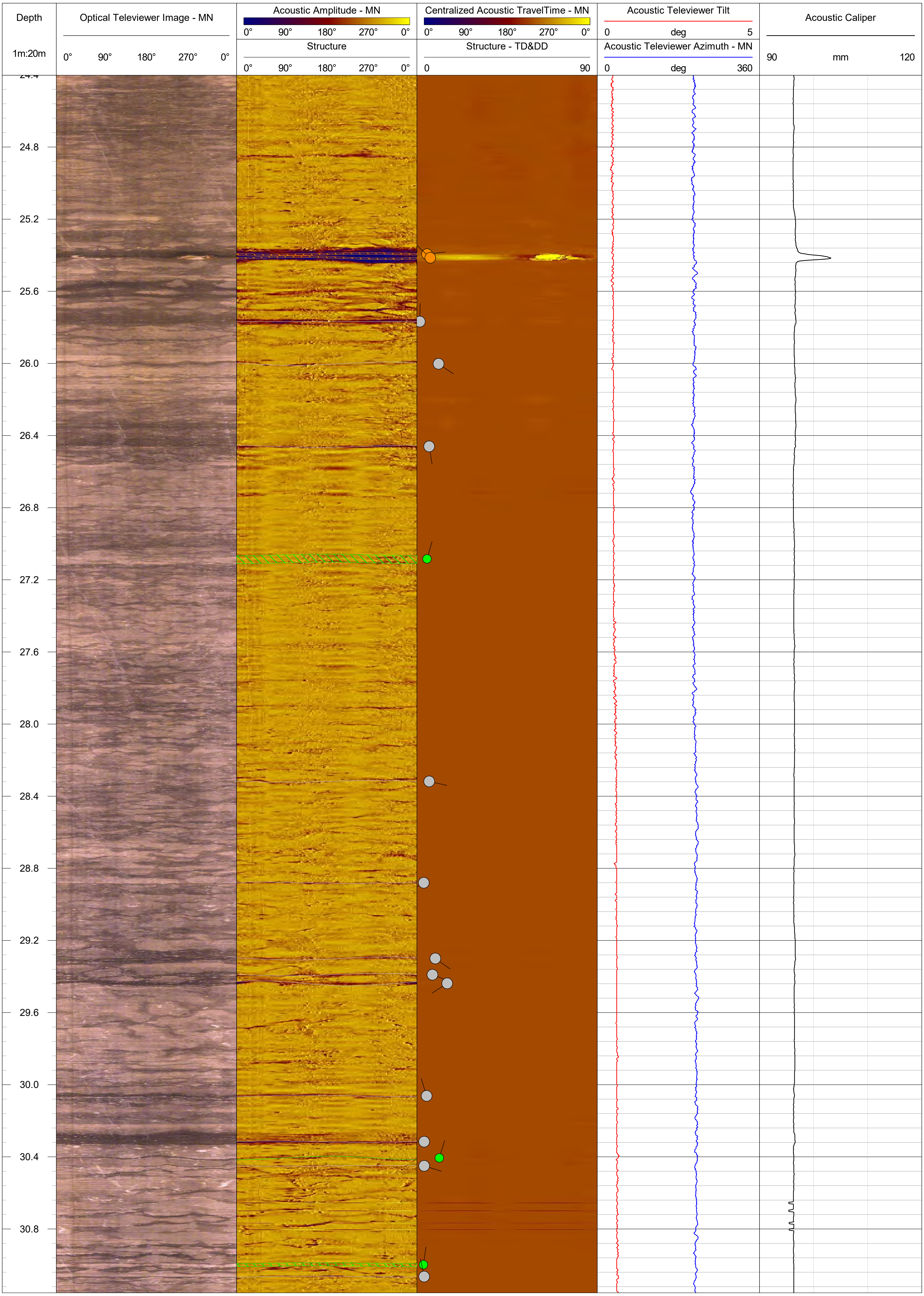
Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	20.5 m bgs	**Location:**	Darlington, Ontario
Easting:	684327.84 m	**Drilled Depth:**	60.65 m bgs	**Water Level:**	N/A	**Log Date:**	July-10-2022
Northing:	4859647.01 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	78.84 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	P. Leith



● Partially Open Joint / Fracture
● Filled Fracture / Joint
● Bedding / Banding / Foliation

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)

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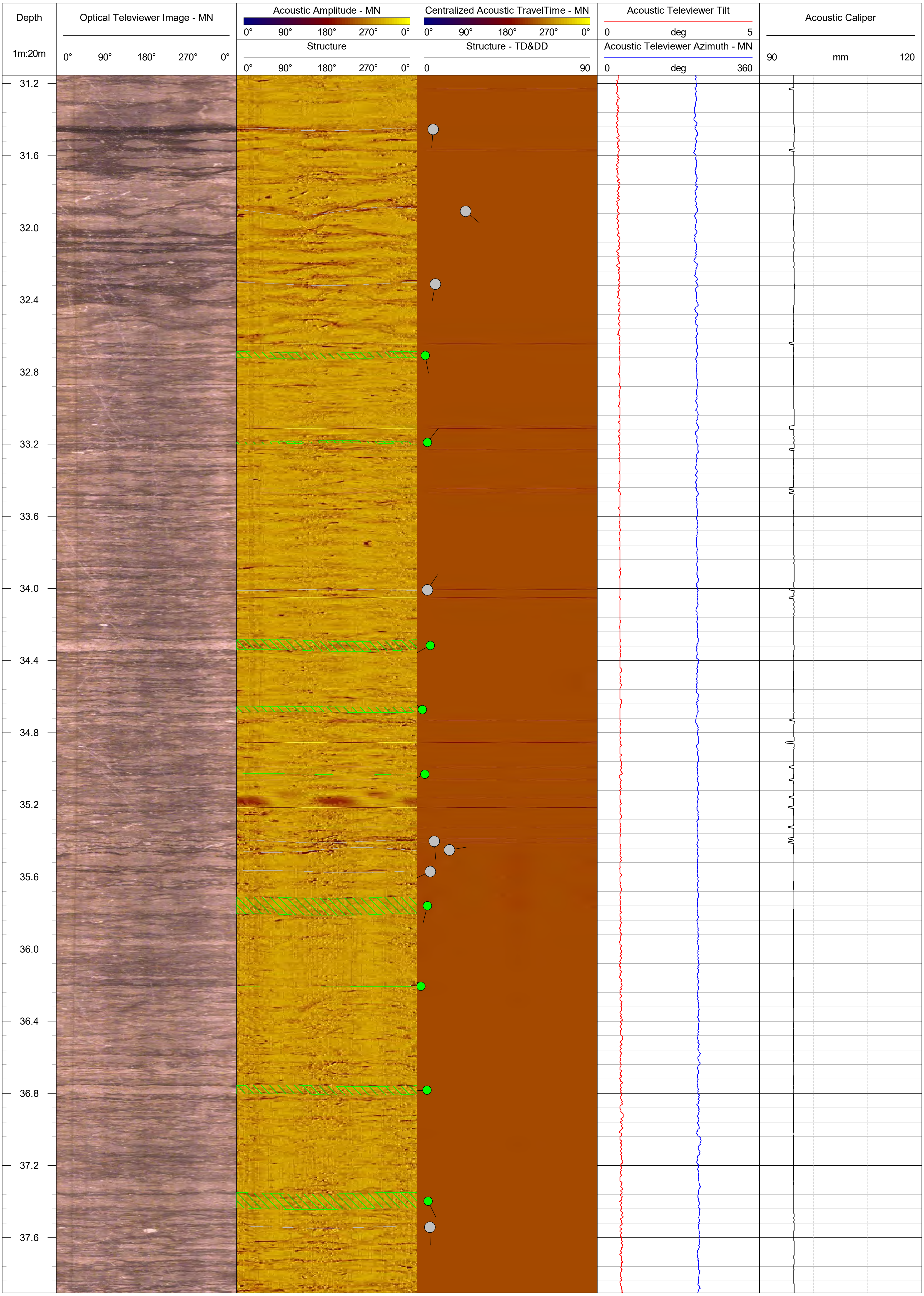
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
24.8
25.2
25.6
26.0
26.4
26.8
27.2
27.6
28.0
28.4
28.8
29.2
29.6
30.0
30.4
30.8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Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
31.2
31.6
32.0
32.4
32.8
33.2
33.6
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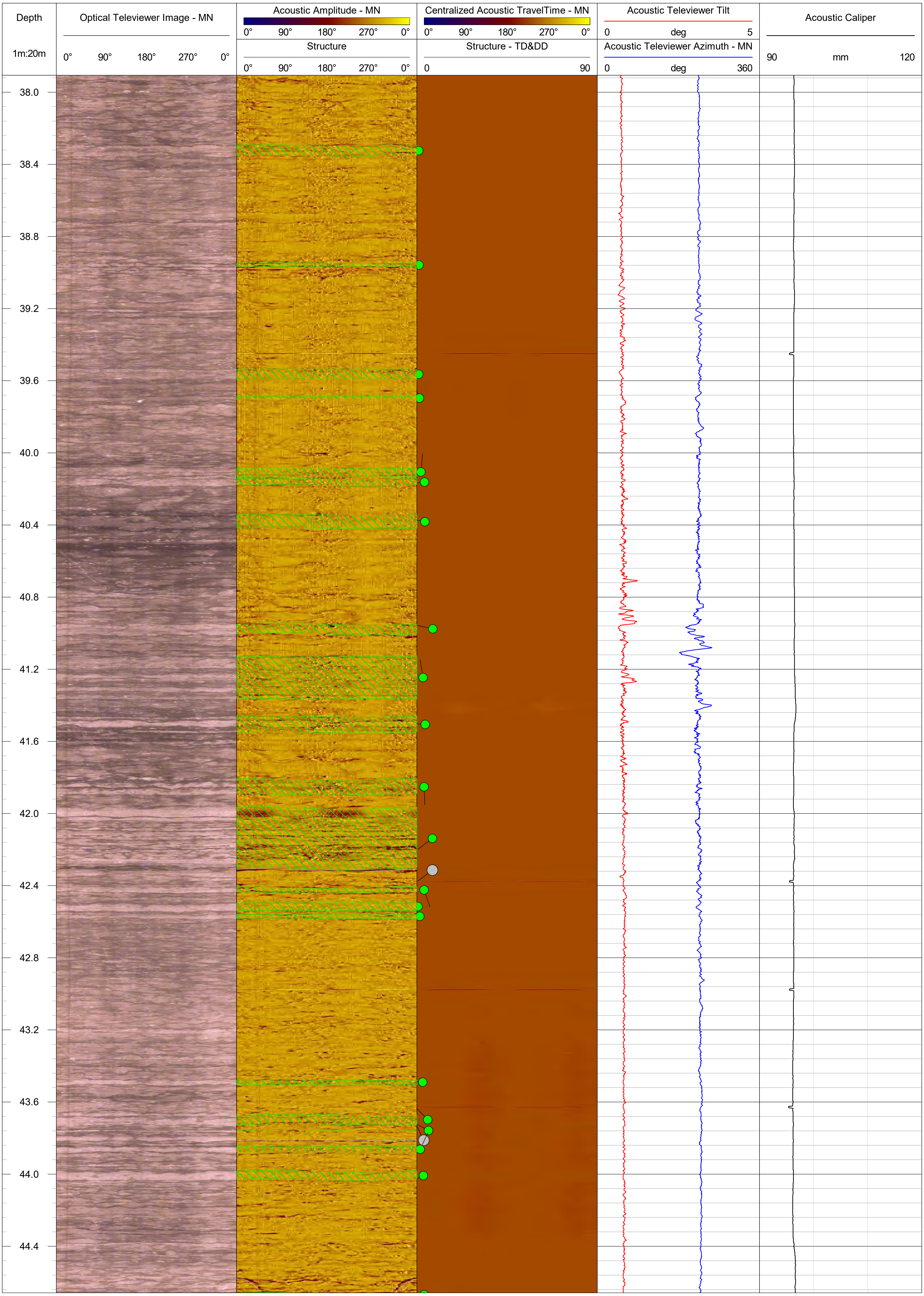
37.2
37.6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Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
38.0
38.4
38.8
39.2
39.6
40.0
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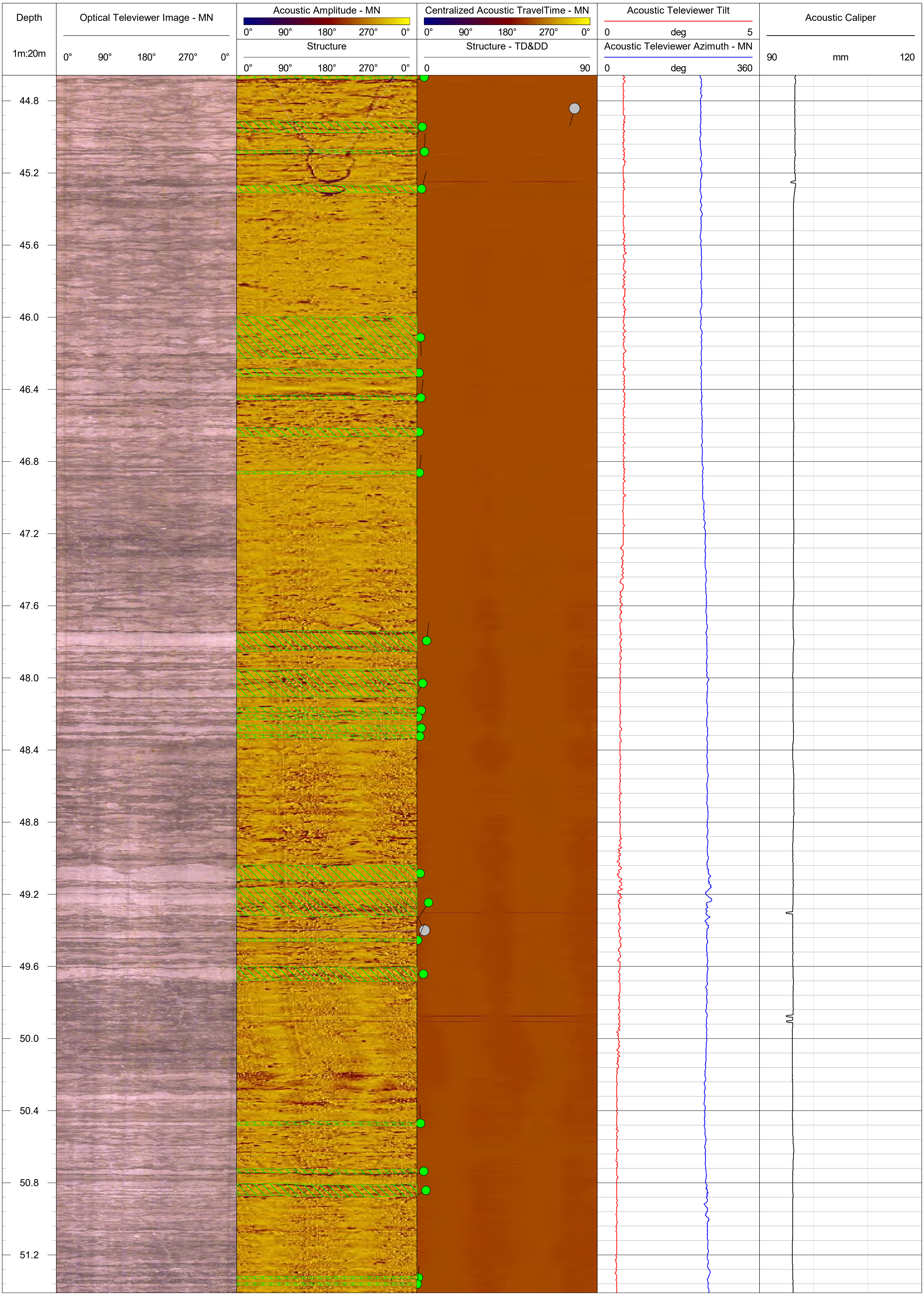
44.4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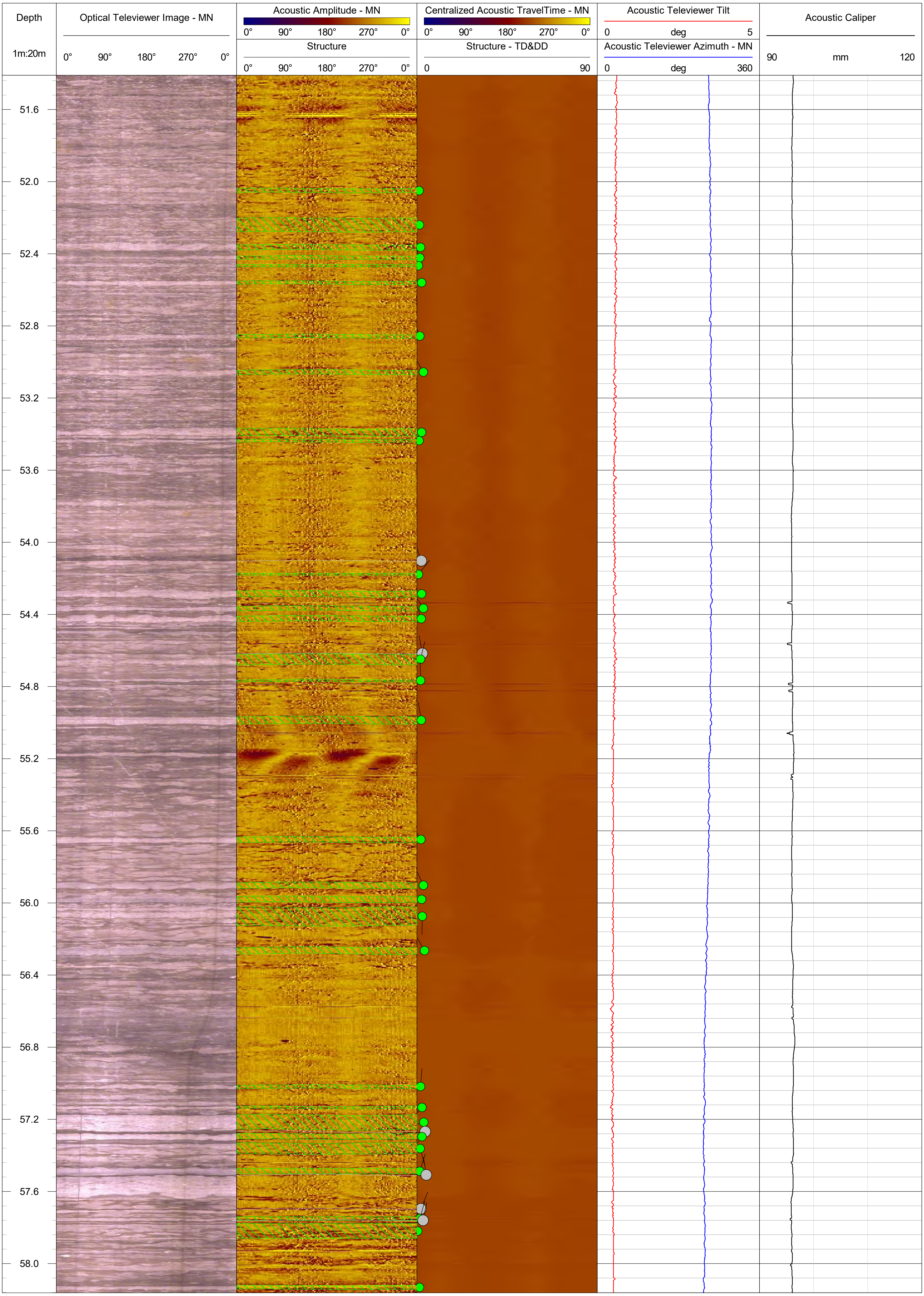
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
44.8
45.2
45.6
46.0
46.4
46.8
47.2
47.6
48.0
48.4
48.8
49.2
49.6
50.0
50.4
50.8
51.2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Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
51.6
52.0
52.4
52.8
53.2
53.6
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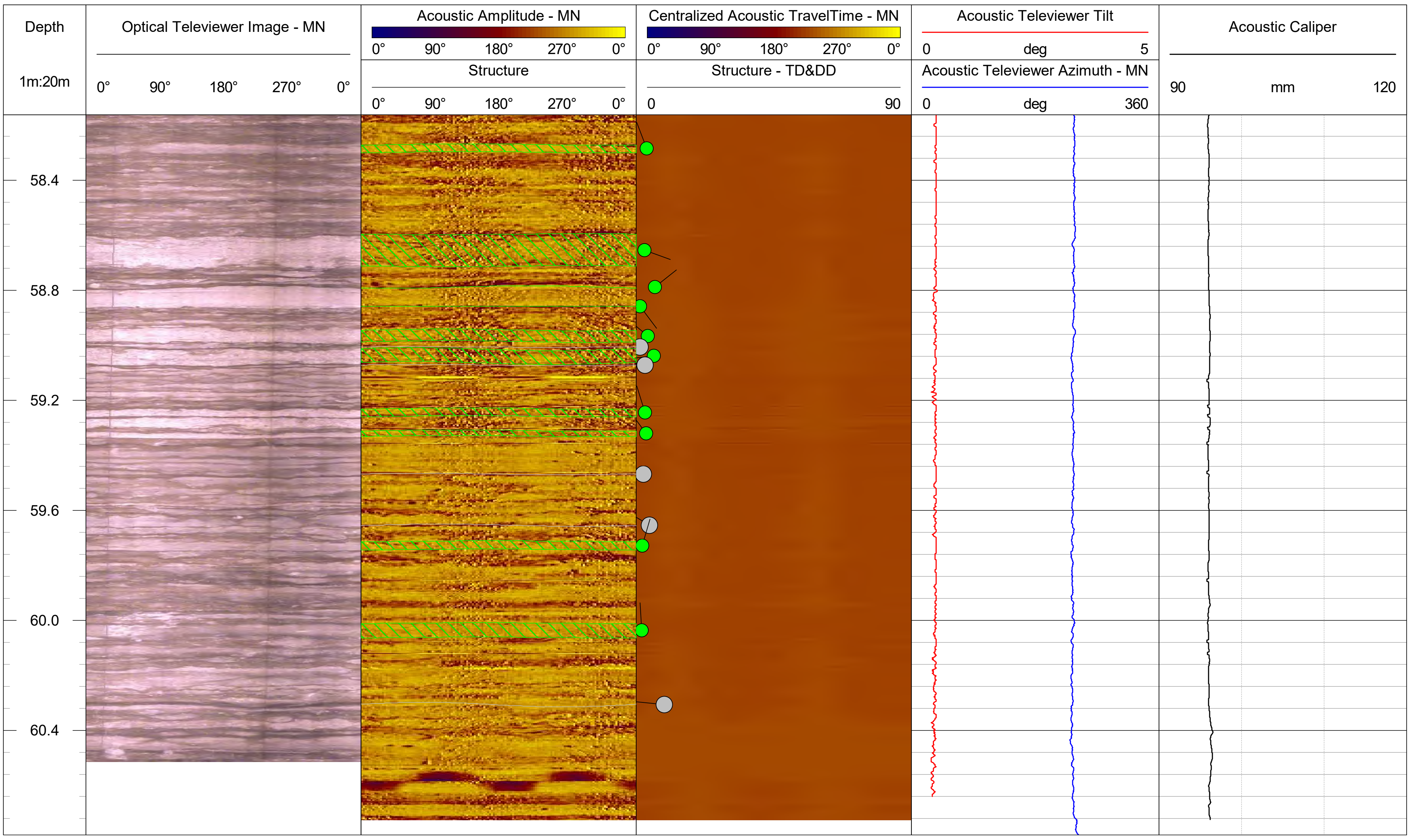
57.6
58.0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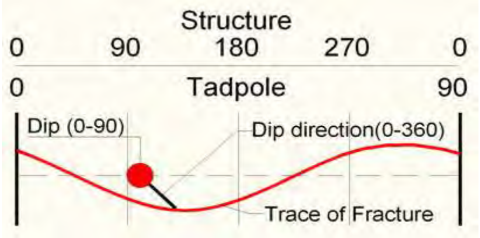
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
58.4
58.8
59.2
59.6
60.0
60.4

Geophysical Record of Borehole: BH303

Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	20.5 m bgs	**Location:**	Darlington, Ontario
Easting:	684327.84 m	**Drilled Depth:**	60.65 m bgs	**Water Level:**	N/A	**Log Date:**	July-10-2022
Northing:	4859647.01 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	78.84 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	P. Leith

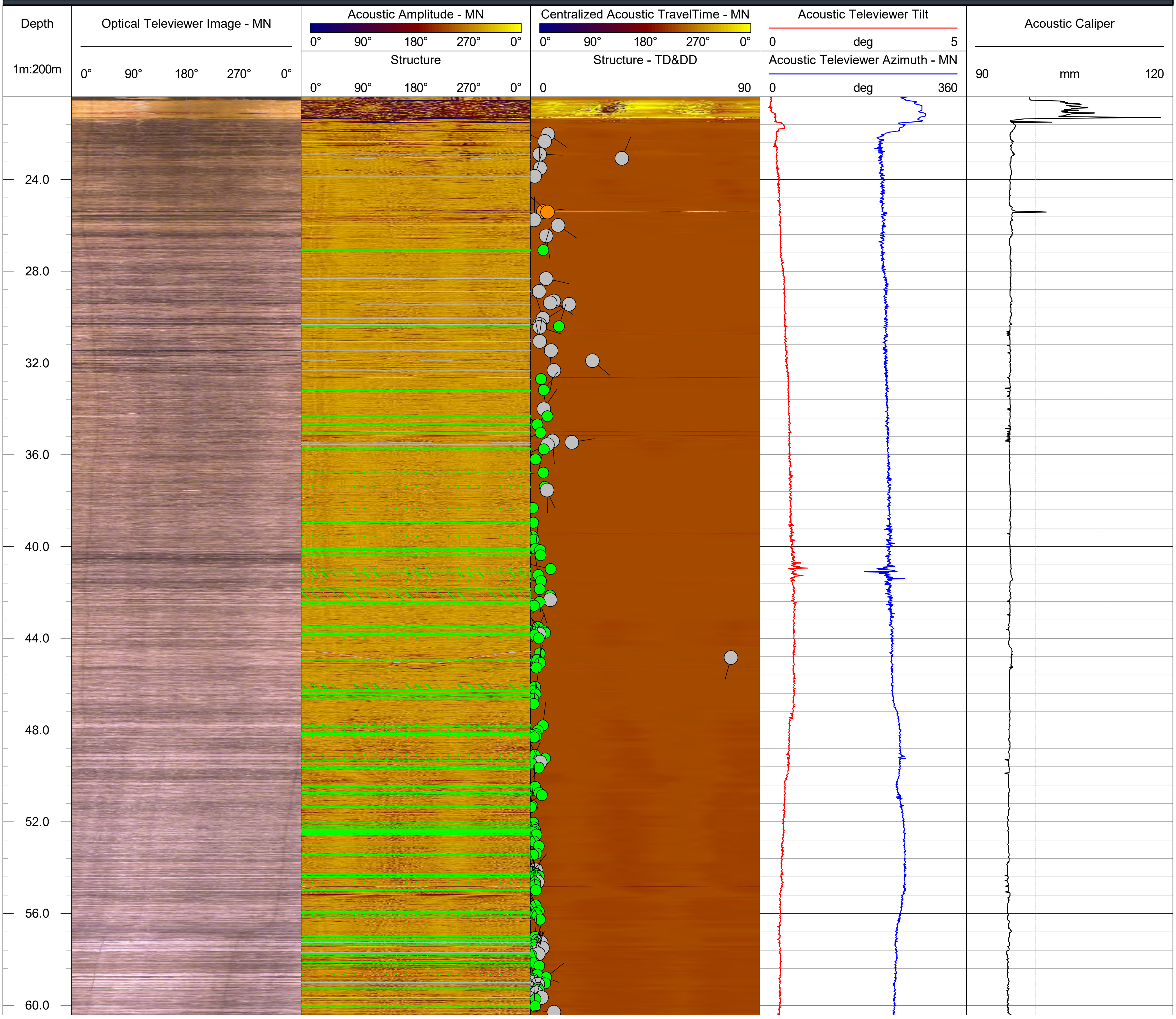


🟠 Partially Open Joint / Fracture

⚪ Filled Fracture / Joint

🟢 Bedding / Banding / Foliation

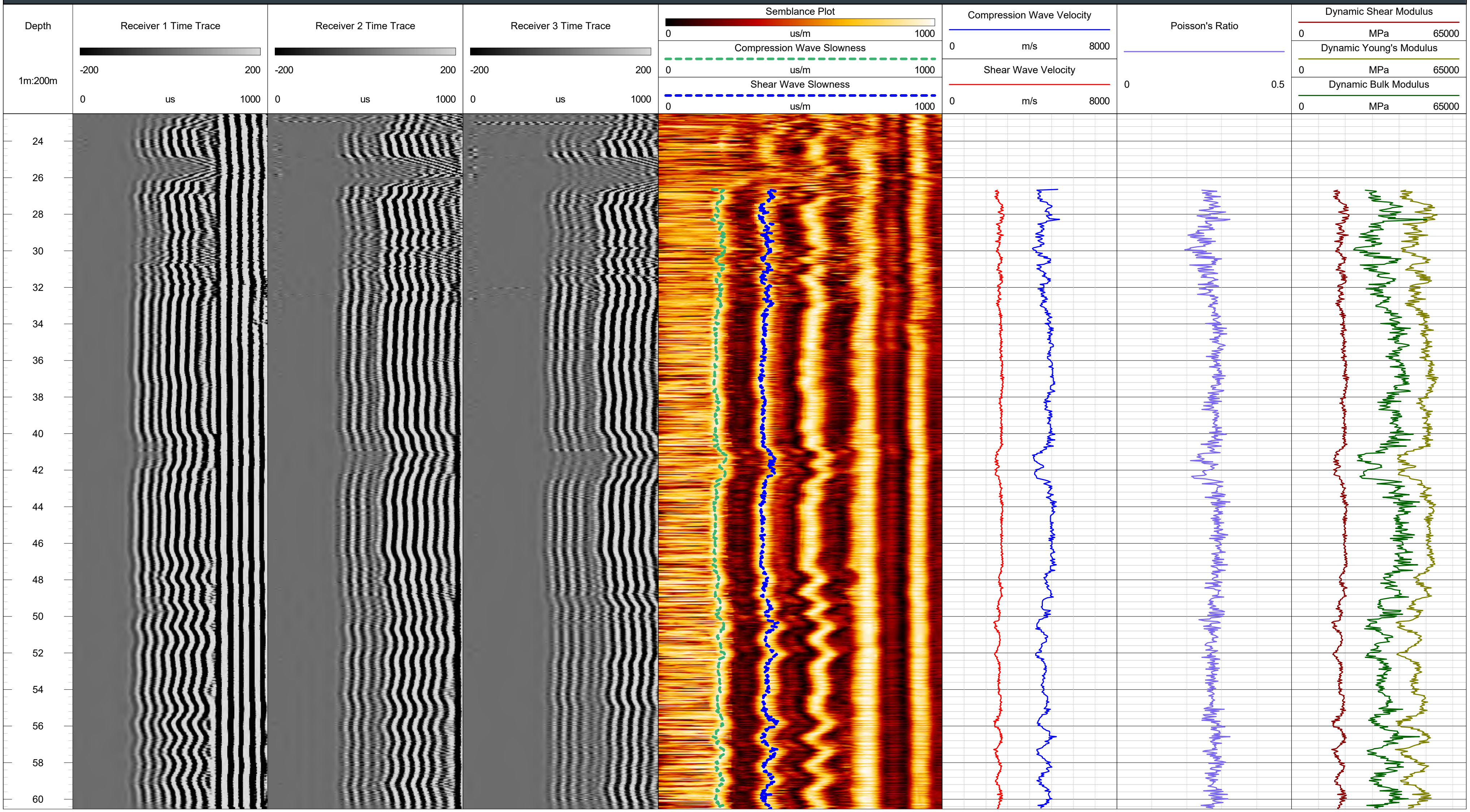
Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)



Depth	Optical Televiewer Image - MN	Acoustic Amplitude - MN	Centralized Acoustic TravelTime - MN	Acoustic Televiewer Tilt	Acoustic Caliper
		0° 90° 180° 270° 0°	0° 90° 180° 270° 0°	0 deg 5	
		Structure	Structure - TD&DD	Acoustic Televiewer Azimuth - MN	
1m:200m	0° 90° 180° 270° 0°	0° 90° 180° 270° 0°	0 90	0 deg 360	90 mm 120

Geophysical Record of Borehole: BH303

Log Title: Full Waveform Sonic Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023



A17-BH304

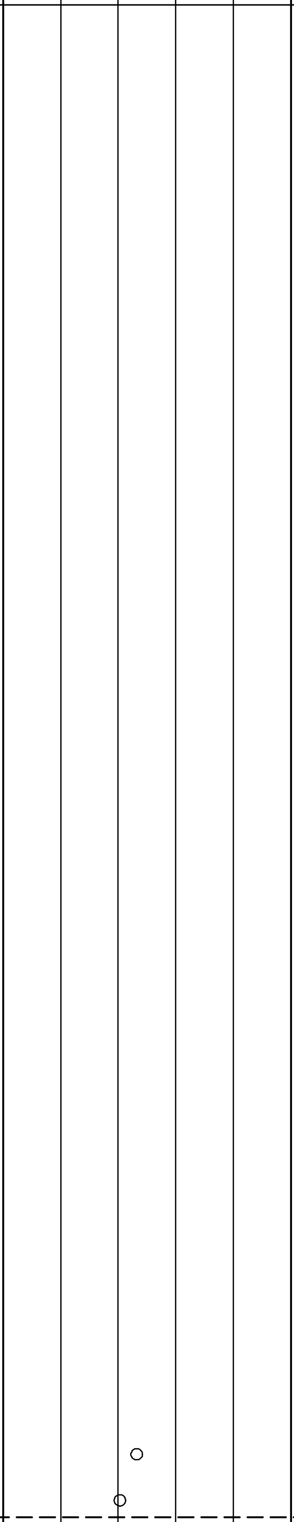
PROJECT: 21451329
LOCATION: N 4859536.18; E 684425.05

RECORD OF BOREHOLE: BH304

BORING DATE: May 31 to June 2, 2022
DRILL RIG: Diedrich 120 Track Mounted

SHEET 1 OF 8
DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 / SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-10} 10^{-8} 10^{-6} 10^{-4} / WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		BARGE DECK		79.40							
0	Mud Rotary Wash Boring (Tricone) UW Casing			0.00							
4		WATER		75.20 4.20							
9		**Silt (ML) to Silt with Sand (ML)**, medium dense, grey, wet to moist, fine to medium sand (Glaciolacustrine) (Unit 4a)		69.95 9.45	1A 1B	SS	17				
10		*CONTINUED NEXT PAGE*									



DEPTH SCALE
1 : 50

LOGGED: SC
CHECKED: SEMP

PROJECT: 21451329

LOCATION: N 4859536.18; E 684425.05

RECORD OF BOREHOLE: BH304

SHEET 2 OF 8

BORING DATE: May 31 to June 2, 2022

DATUM: Geodetic

DRILL RIG: Diedrich 120 Track Mounted

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	ELEV. DEPTH (m)
10 – 10.67	Mud Rotary Wash Boring (Tricone) UW Casing	**Silt (ML) to Silt with Sand (ML)**, medium dense, grey, wet to moist, fine to medium sand (Glaciolacustrine) (Unit 4a) - Coarse gravel in Spoon Sample 2 - Clay inclusions to 10.59 m	68.73 10.67
10.67 – 13.62	Mud Rotary Wash Boring (Tricone) UW Casing (to about 12.8 m); Mud Rotary Wash Boring (Tricone) Open	**Lean Clay (CL)**, stiff to hard, grey, moist, low to medium plasticity (Glaciolacustrine) (Unit 4b) - Rock fragments between 12.5 m and 13.92 m	65.78 13.62
13.62 – 15.49	Mud Rotary Wash Boring (Tricone) Open	**Sandy Silty Clay (CL-ML)**, hard, grey, moist, fine to coarse sand, angular fine to coarse gravel, low plasticity (Till) (Glaciolacustrine) (Unit 5)	63.91 15.49
15.49		**Shale Bedrock**	

Notes:

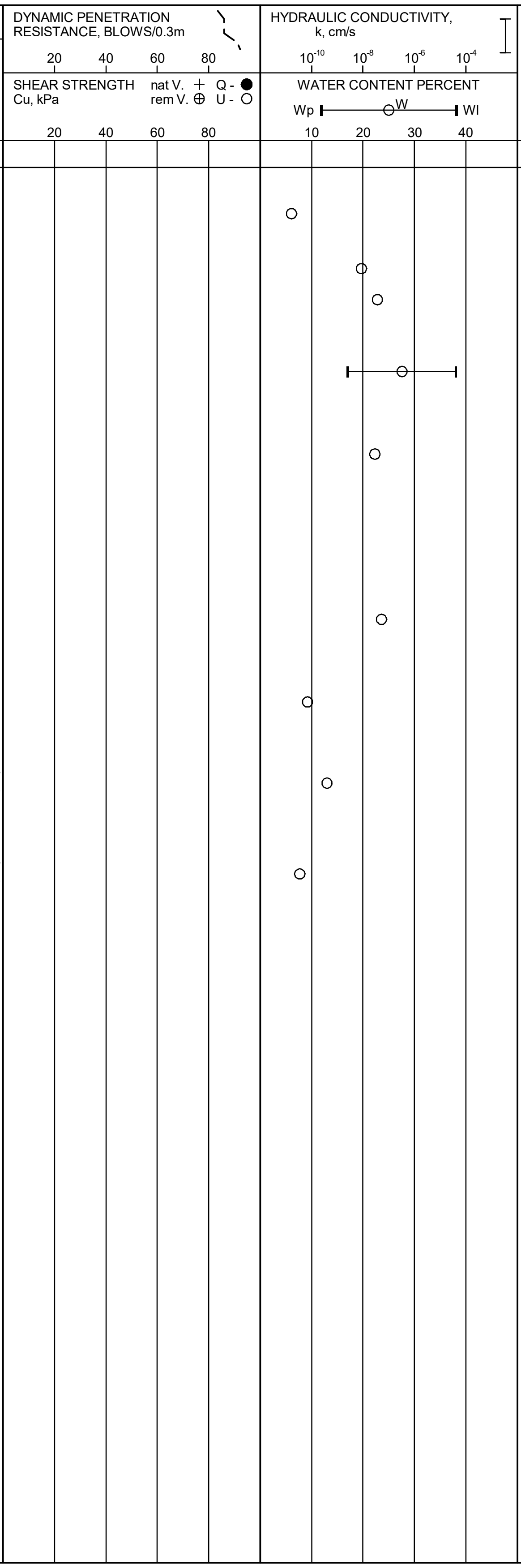
1. Bedrock cored from 15.49 m to 71.47 m depth

2. Refer to Record of Drillhole BH304.

3. Water level in open borehole could not be measured upon completion of soil drilling due to use of mud-rotary technique.

4. Efficiency of the SPT hammer utilized was 75.2 %.

SAMPLES NUMBER	TYPE	BLOWS/0.3m	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
2		17	
3A	SS	16	
3B			
4	SS	15	0 2 42 56
5	SS	11	
6A	SS	41	
6B			
7	SS	15	
8	SS	103	
9	SS	184/0.28	
10	SS	133/0.23	



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

LOGGED: SC

CHECKED: SEMP

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859536.18; E 684425.05
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

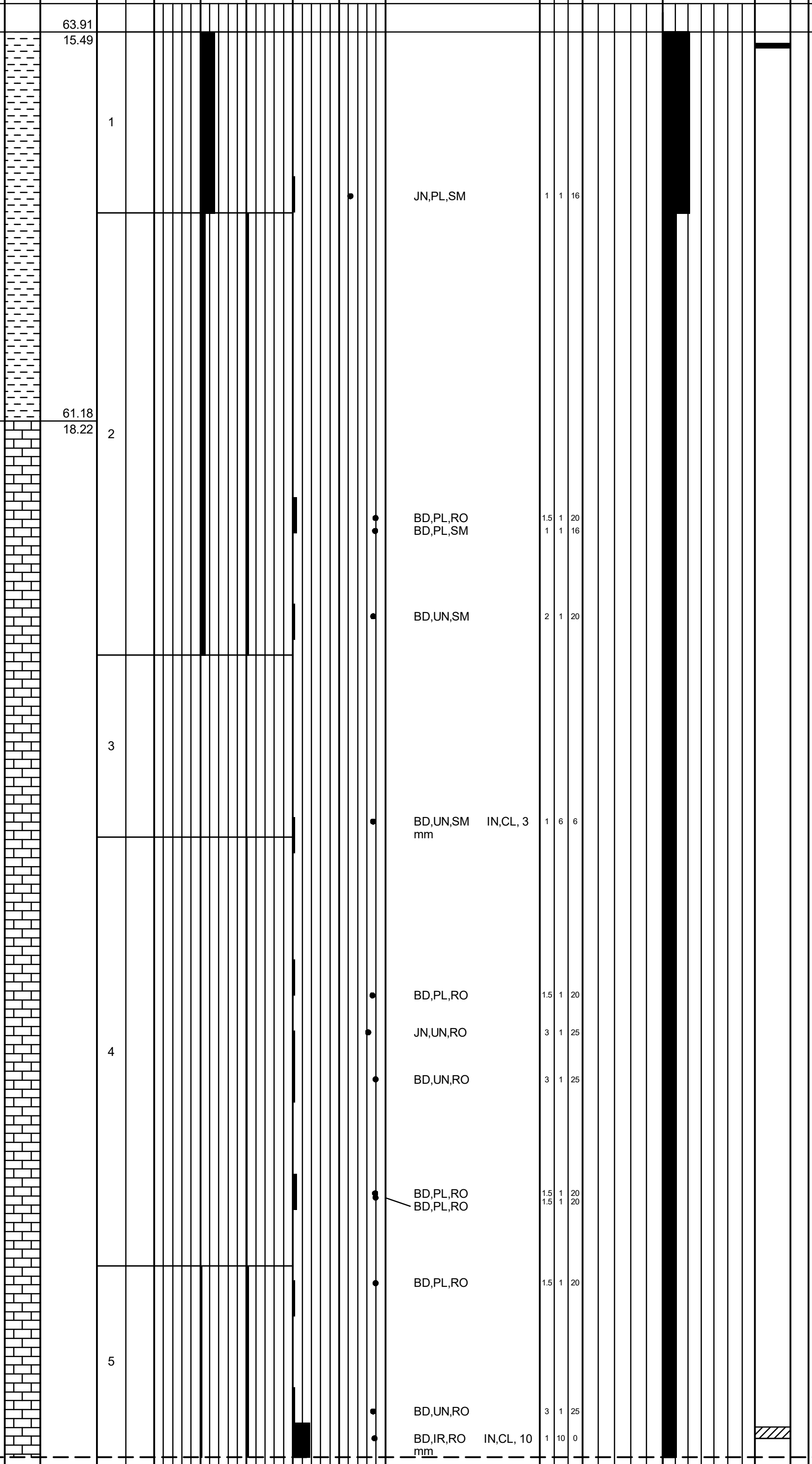
RECORD OF DRILLHOLE: BH304

DRILLING DATE: June 4, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 3 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	ELEV. / DEPTH (m)	RUN No.
		TOP OF BEDROCK	63.91	
	Rotary Drill HQ3 Core	Slightly weathered to fresh, very thinly to thinly bedded, dark brownish grey, fine grained, faintly porous, slightly reactive to HCl, medium strong SHALE (Blue Mountain Formation) with very thin to thin, grey, fine to medium grained limestone interbeds	15.49	1
16				
17				2
18			61.18	
		Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey, laminated to thinly bedded shale interbeds	18.22	
19				
20				3
21				4
22				
23				
24				5
25				



DISCONTINUITY DATA

TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
JN,PL,SM	1	1	16
BD,PL,RO	1.5	1	20
BD,PL,SM	1	1	16
BD,UN,SM	2	1	20
BD,UN,SM IN,CL, 3 mm	1	6	6
BD,PL,RO	1.5	1	20
JN,UN,RO	3	1	25
BD,UN,RO	3	1	25
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,UN,RO	3	1	25
BD,IR,RO IN,CL, 10 mm	1	10	0

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: JD
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859536.18; E 684425.05
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH304

DRILLING DATE: June 4, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 4 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

--- CONTINUED FROM PREVIOUS PAGE ---

DRILLING RECORD: Rotary Drill, HQ3 Core

Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey, laminated to thinly bedded shale interbeds

Punch Penetration Sample (at approx. 33 m)

RUN No.: 5, 6, 7, 8, 9, 10

DEPTH SCALE METRES	RUN No.	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
26	5	BD,PL,SM	1	1	16
		BD,UN,RO	3	1	25
28	6	BD,UN,RO	3	1	25
29	7				
30	8	BD,PL,SM	1	1	16
		BD,UN,RO	3	1	25
		BD,PL,RO	1.5	1	20
31		BD,PL,SM	1	1	16
32	9				
34	10	BD,UN,RO	3	1	25
		BD,PL,SM	1	1	16

Depth scale marks: 26, 27, 28, 29, 30, 31, 32, 33, 34, 35

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: JD
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859536.18; E 684425.05
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH304

DRILLING DATE: June 4, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 5 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE % 80 60 40 20	RECOVERY SOLID CORE % 80 60 40 20	R.Q.D. % 80 60 40 20	FRACT. INDEX PER 0.25 m 5 10 15 20	DIP w.r.t. CORE AXIS 0 30 60 90	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2}	WEATHERING INDEX W1 W2 W3 W4 W5 W6	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
36	Rotary Drill HQ3 Core	Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey, laminated to thinly bedded shale interbeds			10															
37		Specific Gravity Sample																		
38					11						●	BD,PL,RO IN,CL, 1 mm	1.5	3	6					
39		Petrographic Analysis Sample																		
40					12						●	BD,UN,SM	2	1	20					
41					13															
42		UCS with Modulus Sample									●	BD,PL,SM	1	1	16					
43					14															
44		Brazilian Sample			15															
45					16 17 18						●	BD,PL,SM	1	1	16					
		CONTINUED NEXT PAGE																		

DEPTH SCALE
1 : 50

LOGGED: JD
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859536.18; E 684425.05
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH304

DRILLING DATE: June 4, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE % (80 60 40 20)	RECOVERY SOLID CORE % (80 60 40 20)	R.Q.D. % (80 60 40 20)	FRACT. INDEX PER 0.25 m (5 10 15 20)	DIP w.r.t. CORE AXIS (0 30 60 90)	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-8} 10^{-6} 10^{-4} 10^{-2})	WEATHERING INDEX (W1 W2 W3 W4 W5 W6)	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
	Rotary Drill HQ3 Core	Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey, laminated to thinly bedded shale interbeds Cerchar Sample																		
46					18															
47																				
		Petrographic Analysis Sample																		
48					19															
49											●	BD,UN,RO SA	3	2	22					
50											●	BD,PL,SM	1	1	16					
51					20															
52																				
53											●	BD,PL,RO	1.5	1	20					
54					21						●	BD,UN,RO	3	1	25					
											●	BD,UN,RO	3	1	25					
											●	BD,UN,RO	3	1	25					
55																				
		CONTINUED NEXT PAGE																		

DEPTH SCALE
1 : 50

LOGGED: JD
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859536.18; E 684425.05
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH304

SHEET 7 OF 8
DATUM: Geodetic

DRILLING DATE: June 4, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES: 56, 57, 58, 59, 60, 61, 62, 63, 64, 65

DRILLING RECORD: Rotary Drill, HQ3 Core

DESCRIPTION: Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey, laminated to thinly bedded shale interbeds

RUN No.: 21, 22, 23, 24, 25

DISCONTINUITY DATA

TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,UN,RO	3	1	25
BD,UN,RO	3	1	25
BD,UN,SM	2	1	20

Column headings: ELEV. DEPTH (m); SYMBOLIC LOG; FLUSH RETURN; RECOVERY: TOTAL CORE % (80 60 40 20), SOLID CORE % (80 60 40 20); R.Q.D. % (80 60 40 20); FRACT. INDEX PER 0.25 m (5 10 15 20); DIP w.r.t. CORE AXIS (0 30 60 90); HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-8} 10^{-6} 10^{-4} 10^{-2}); WEATHERING INDEX (W1 W2 W3 W4 W5 W6); FEATURES; R0/R1 ZONES; PIEZOMETER

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: JD
CHECKED: PKS

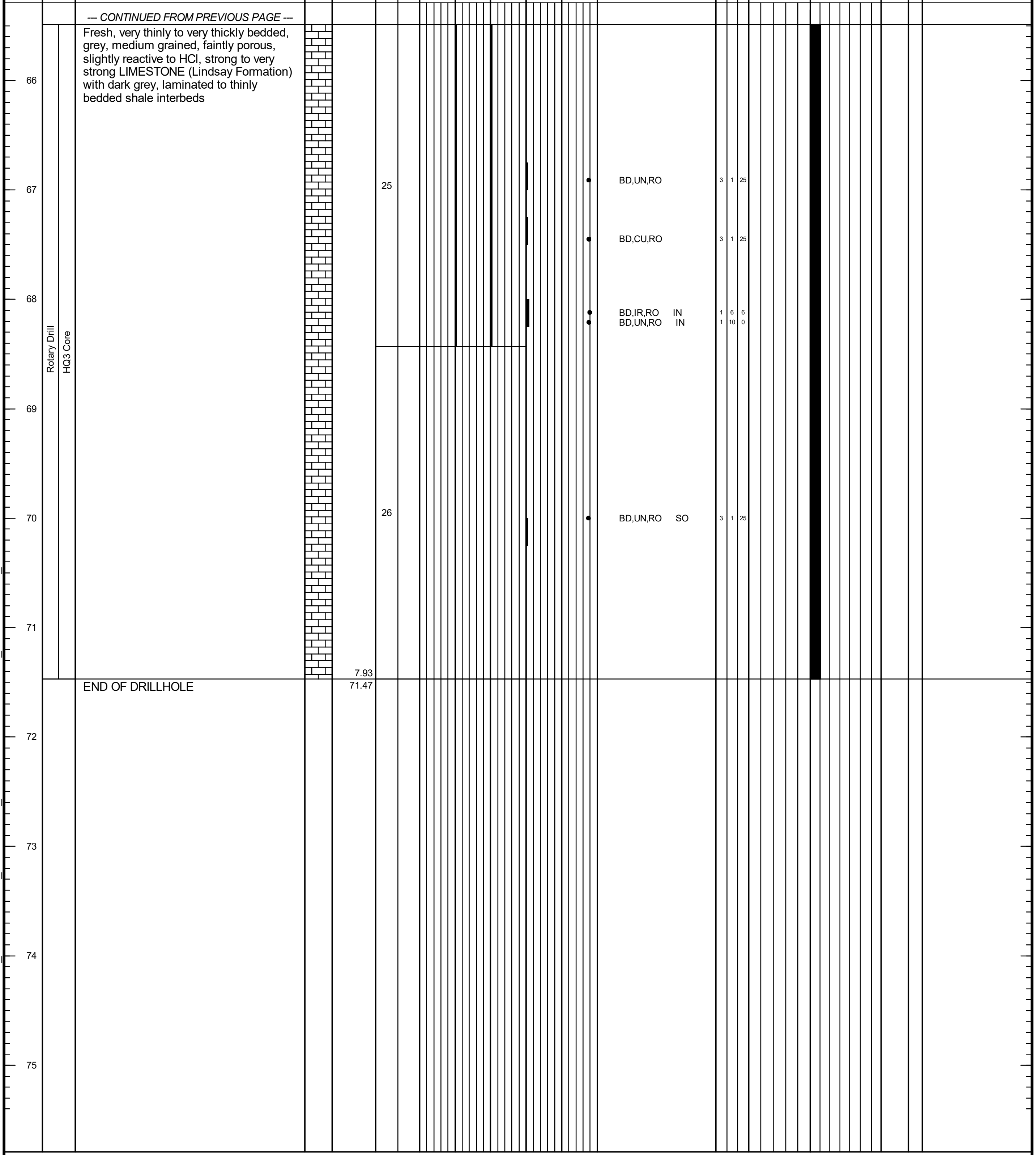
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859536.18; E 684425.05
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH304

DRILLING DATE: June 4, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 8 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



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DESCRIPTION	ELEV. DEPTH (m)	RUN No.	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
Fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, strong to very strong LIMESTONE (Lindsay Formation) with dark grey, laminated to thinly bedded shale interbeds		25	BD,UN,RO	3	1	25
			BD,CU,RO	3	1	25
			BD,IR,RO IN	1	6	6
			BD,UN,RO IN	1	10	0
		26	BD,UN,RO SO	3	1	25
	7.93 71.47					
END OF DRILLHOLE						

DEPTH SCALE
1 : 50

LOGGED: JD
CHECKED: PKS

Water Content Summary
ASTM D2216

Test Request #	21451329-21600-610 BH304	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville		

Sample Location	Sample				Soil Description	Water Content %	Method	Remarks
	Ref	Top (m)	Base (m)	Type				
BH304	1A	9.45	9.72	SS		23.2	B	
BH304	1B	9.72	10.06	SS		20.3	B	
BH304	2	10.06	10.52	SS		6.1	B	
BH304	3A	10.67	10.79	SS		19.7	B	
BH304	3B	10.79	11.13	SS		22.8	B	
BH304	4	11.28	11.73	SS		27.6	B	
BH304	5	11.90	12.34	SS		22.3	B	
BH304	7	13.11	13.56	SS		23.6	B	
BH304	8	13.72	14.17	SS		9.2	B	
BH304	9	14.33	14.75	SS		13.0	B	
BH304	10	14.94	15.33	SS		7.7	B	

Notes:

Tested by: JTimms **Date:** 05 Oct 2022
Checked by: MRuck **Date:** 26 Oct 2022

Disclaimer:

Reviewed by: JoNorris **Date:** 10 Nov 2022

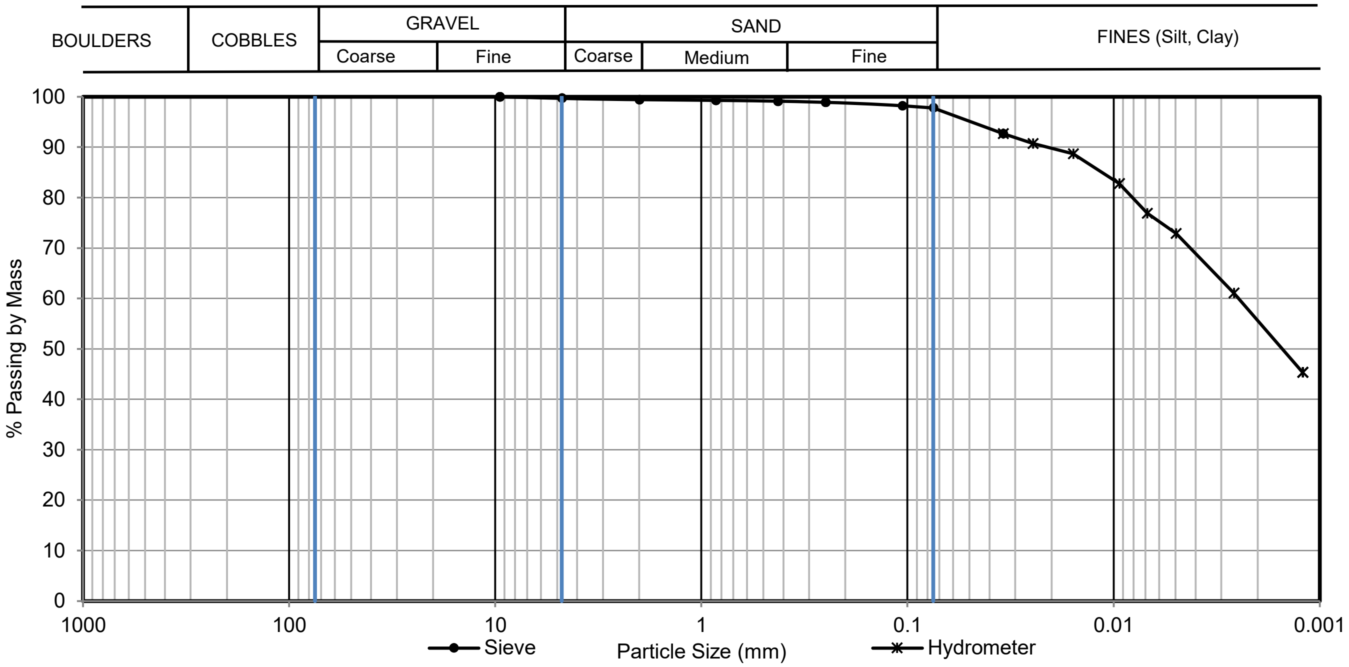
PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422
Method B

Test Request #	21451329-21600-610 BH304	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH304
Source:		Sample No.:	4
		Type:	SS
Soil Description:		Depth (m):	11.28 - 11.73

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	14 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%) 0.3 1.9 97.8



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/8"	9.5	100.0	0.0344	92.7
#4	4.75	99.7	0.0246	90.7
#10	2	99.4	0.0157	88.7
#20	0.85	99.3	0.0094	82.8
#40	0.425	99.1	0.0069	76.9
#60	0.25	98.9	0.0050	72.9
#140	0.106	98.2	0.0026	61.1
#200	0.075	97.8	0.0012	45.3
			0.005 mm	72.95
			0.002 mm	55.63
			D60	0.00
			D30	
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

Tested by: MKMarren **Date:** 14 Oct 2022 **Checked by:** MRuck **Date:** 26 Oct 2022 **Reviewed by:** JoNorris **Date:** 10 Nov 2022

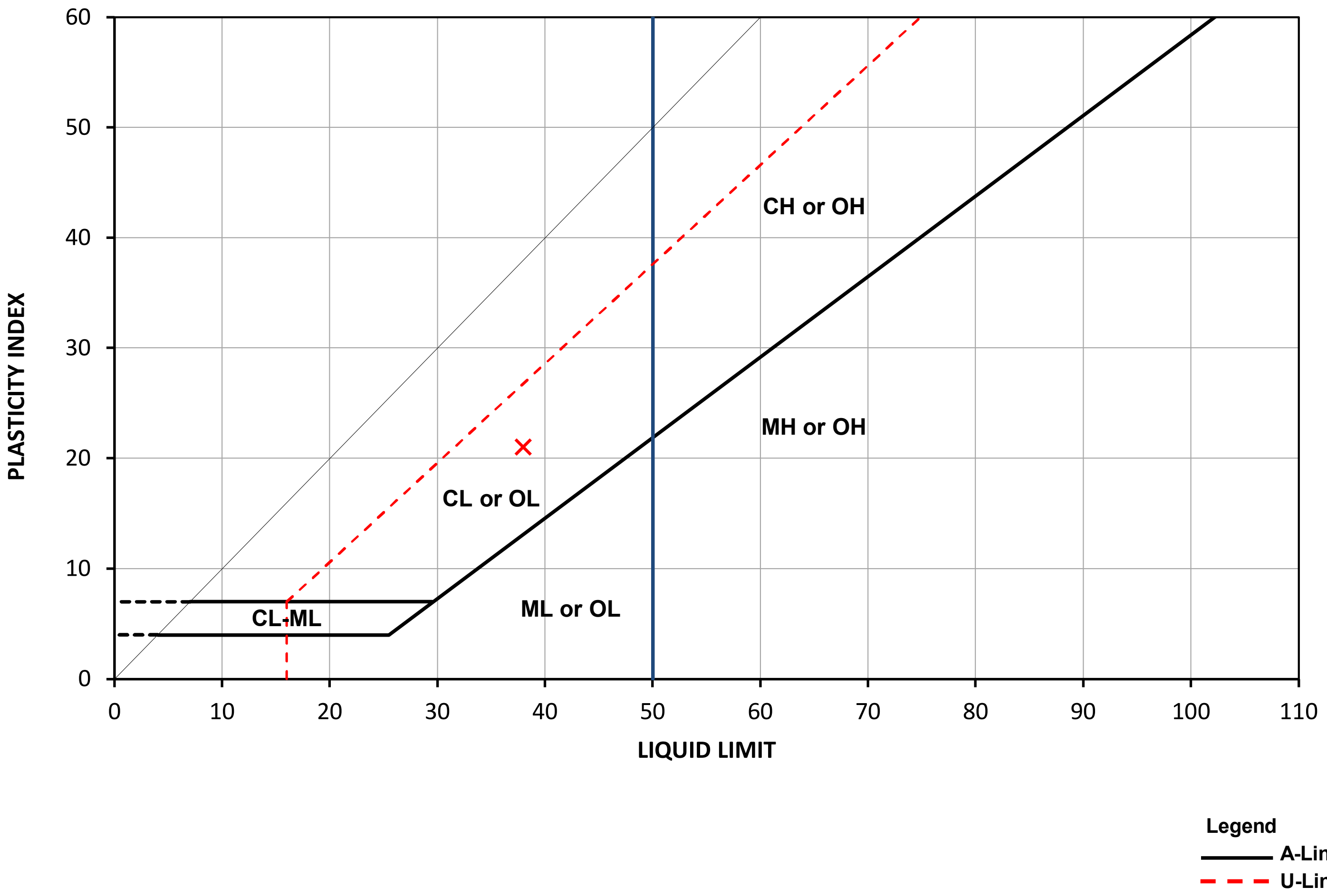
LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

ASTM D4318

Method A - Multipoint Test

Test Request #	21451329-21600-610 BH304	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH304
Source:		Sample No.:	4
Soil Description:		Type:	SS
		Depth (m):	11.28 - 11.73

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	17 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH304	4	11.28	11.73	96	27.6	38	17	21	0.50

NP = Non-Plastic
ND = Not Determined

Test Preparation

Dry Preparation Tested after >425um removed

Notes:

Tested by: JTimms **Date:** 17 Oct 2022
Checked by: MRuck **Date:** 26 Oct 2022

Disclaimer:

The laboratory testing services reported herein have been performed in accordance with the terms of a contract with Golder's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of Golder's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Reviewed by: JoNorris **Date:** 10 Nov 2022

GOLDER
MEMBER OF WSP

SPECIFIC GRAVITY OF SOIL SOLIDS
ASTM D854
Pycnometer Method B

Test Request #	21451329-21600-610 BH304	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	NA
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH304
Source:		Sample No.:	5
Soil Description:		Type:	SS
		Depth (m)	11.90 - 12.34

Specimen Reference	NA	Specimen Depth	NA	Date of Test	27 Oct 2022
Specimen Description	NA				

Proportions		
Percentage Passing (4.75 mm)		%
Percentage Retained (4.75 mm)		%

Fine Fraction (D854)		
Calibrated Mass of Pycnometer		g
Calibrated Volume of Pycnometer	249.57	mL
Mass of Pycnometer	91.06	g
Test Temperature	19.4	oC
Mass of Pycnometer, soil and water	365.69	g
Mass of Container (or tare)	91.06	g
Mass of dry soil and container	131.23	g
Dry mass of soil solids	40.17	g
Specific Gravity at 20oC	**2.73**	

Coarse Fraction (C127)		
Mass of Oven Dry Sample		g
Mass of saturated-surface-dry in air		g
Apparent mass of saturated test sample in water		g
Specific Gravity Oven Dry		
Specific Gravity Saturated Surface Dry		
Specific Gravity with Weighted Average	**2.73**	

Notes:

Disclaimer:
The laboratory testing services reported herein have been performed in accordance with the terms of a contract with Golder's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of Golder's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Tested by: DPatel **Date:** 27 Oct 2022
Checked by: MRuck **Date:** 09 Nov 2022
Reviewed by: JoNorris **Date:** 10 Nov 2022

WSP GOLDER

Water (Moisture) Content, Ash Content, and Organic Material of Soils ASTM D2974 Method A

Test Request #	21451329-21600-610 BH304	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH304
Source:		Sample No.:	1A
Soil Description:		Type:	SS
		Depth (m):	9.45 - 9.72

Specimen Reference NA
Specimen Depth NA
Date of Test 05 Oct 2022

Specimen Description NA

Furnace Temperature During Test (°C)	440
Duration of Test (nearest 15 minutes)	8640
Mass of Crucible With Lid (g)	56.31
Moist Mass of Specimen Plus Crucible With Lid (g)	145.80
Oven Dry Mass of Specimen Plus Crucible With Lid (g)	129.34
Mass of Crucible With Lid Plus Ash (g)	129.20
Water Content (%)	23
Ash Content (%)	99.8
Organic Material (%)	0.2

Test Preparation

Notes:

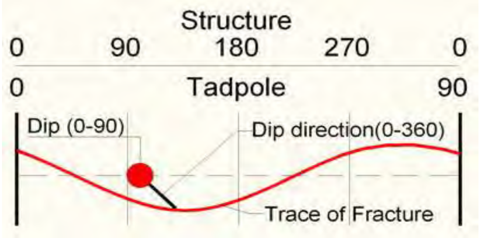
Disclaimer:

Tested by: JTimms **Date:** 05 Oct 2022
Checked by: MRuck **Date:** 26 Oct 2022
Reviewed by: JoNorris **Date:** 10 Nov 2022

Geophysical Record of Borehole: BH304

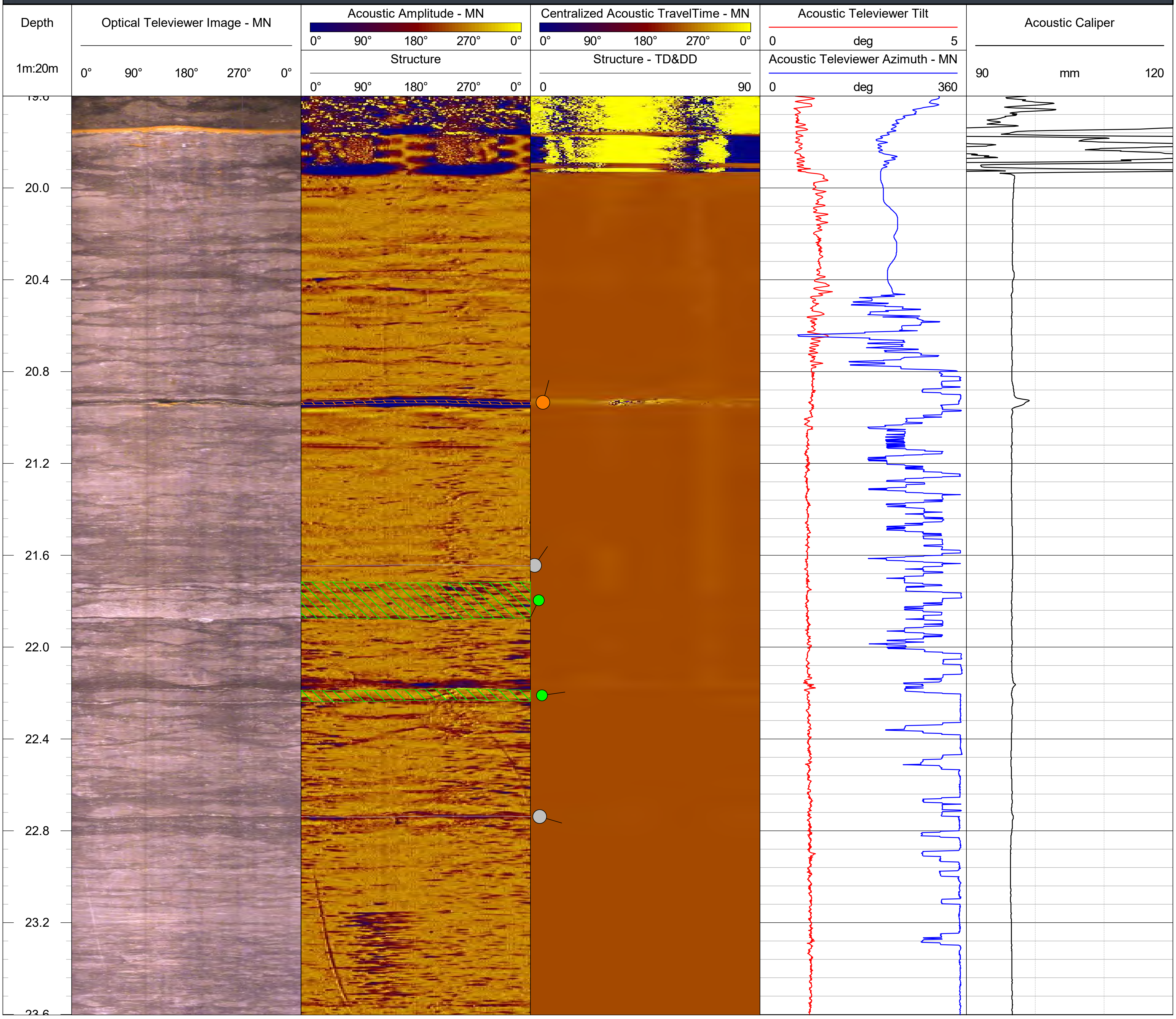
Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

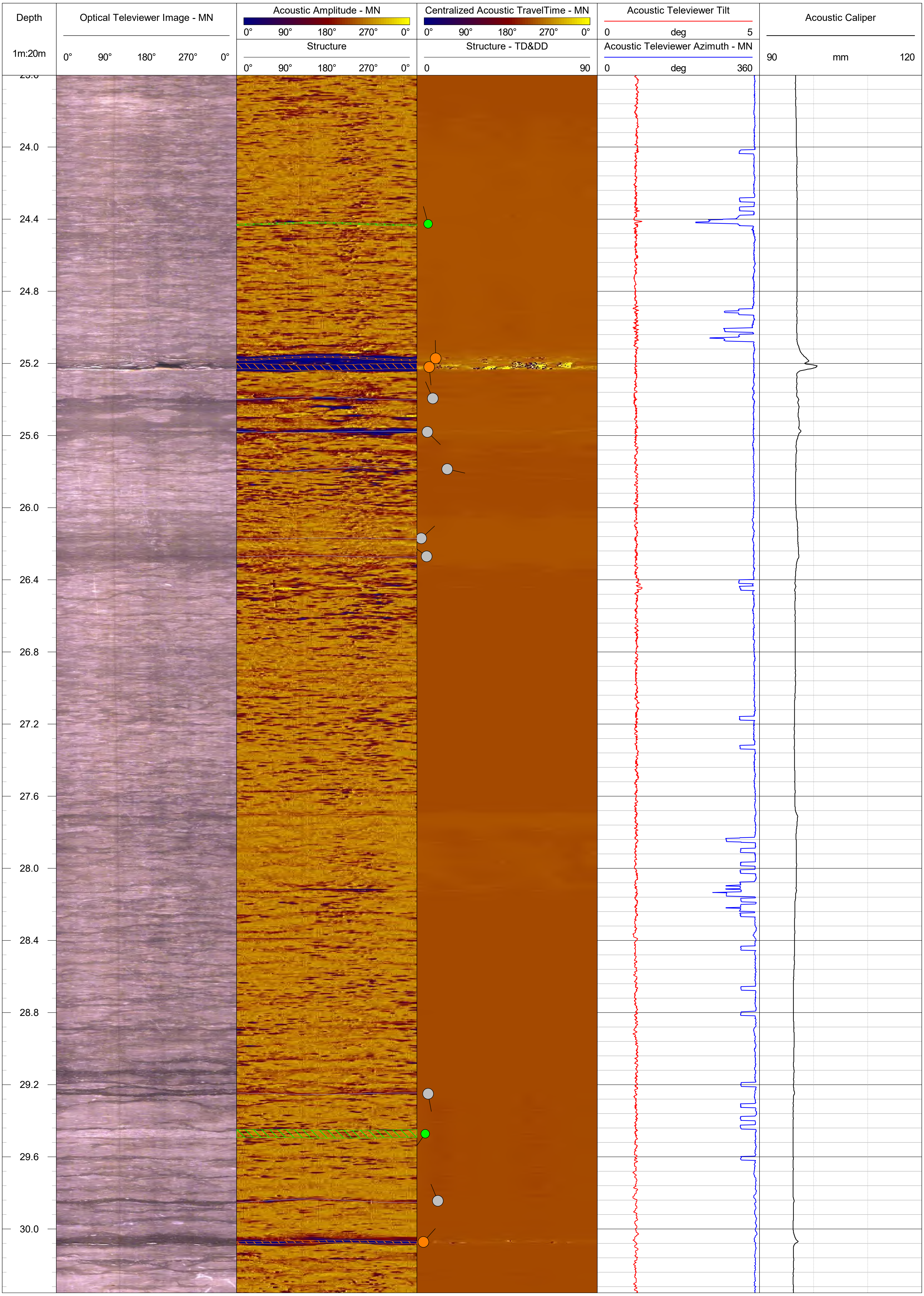
Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	~19.86 m bgs	**Location:**	Darlington, Ontario
Easting:	684425.05 m	**Drilled Depth:**	71.47 m bgs	**Water Level:**	4.7 m bgs	**Log Date:**	June-14-2022
Northing:	4859536.18 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	79.40 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	E. Pineda

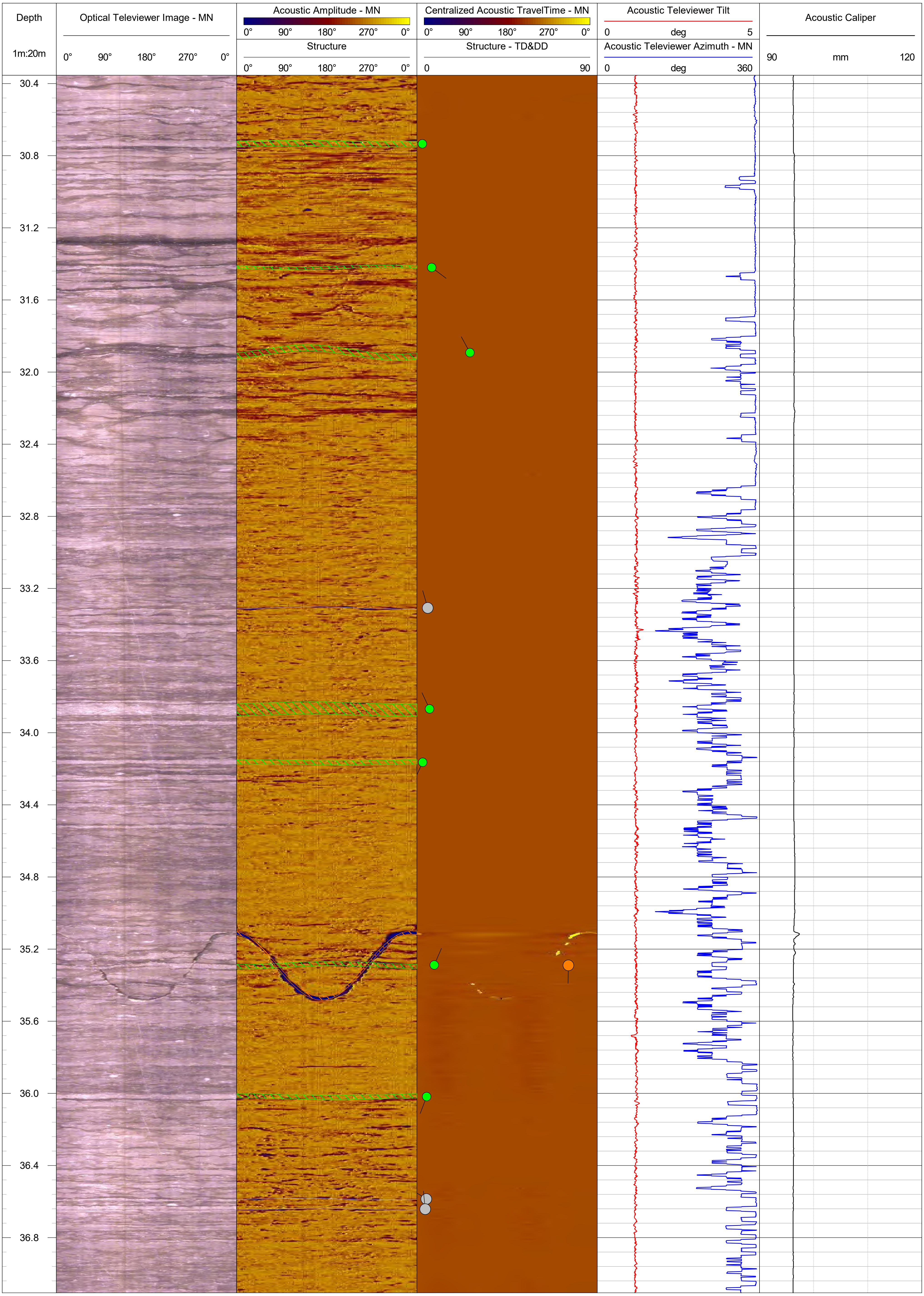


🔴 Major Open Joint / Fracture
🟠 Partially Open Joint / Fracture
⚪ Filled Fracture / Joint
🟢 Bedding / Banding / Foliation
◀ Casing

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)




Depth
1m:20m
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
24.0
24.4
24.8
25.2
25.6
26.0
26.4
26.8
27.2
27.6
28.0
28.4
28.8
29.2
29.6
30.0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Optical Televiewer Image - MN
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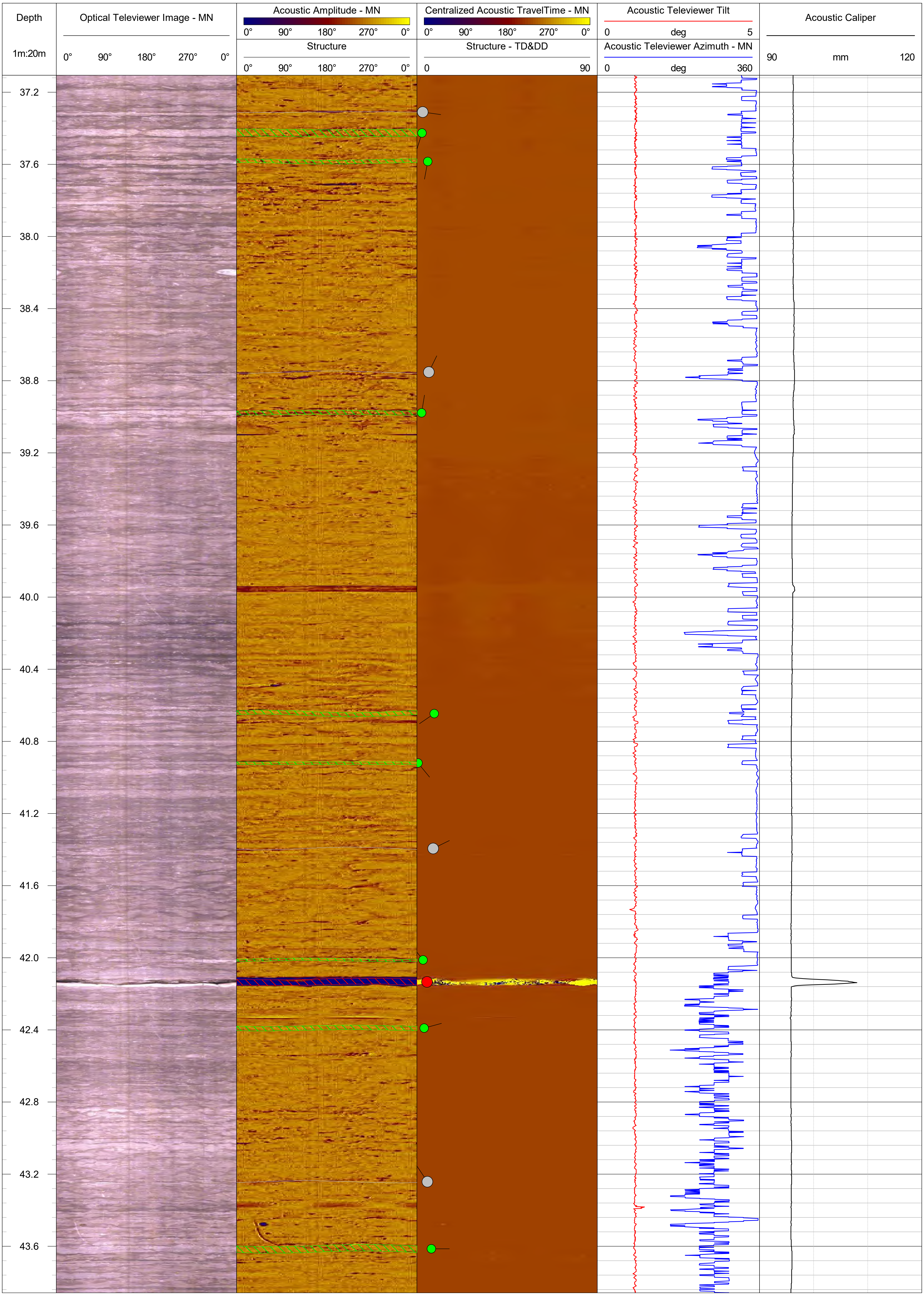
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
30.4
30.8
31.2
31.6
32.0
32.4
32.8
33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8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Optical Televiewer Image - MN
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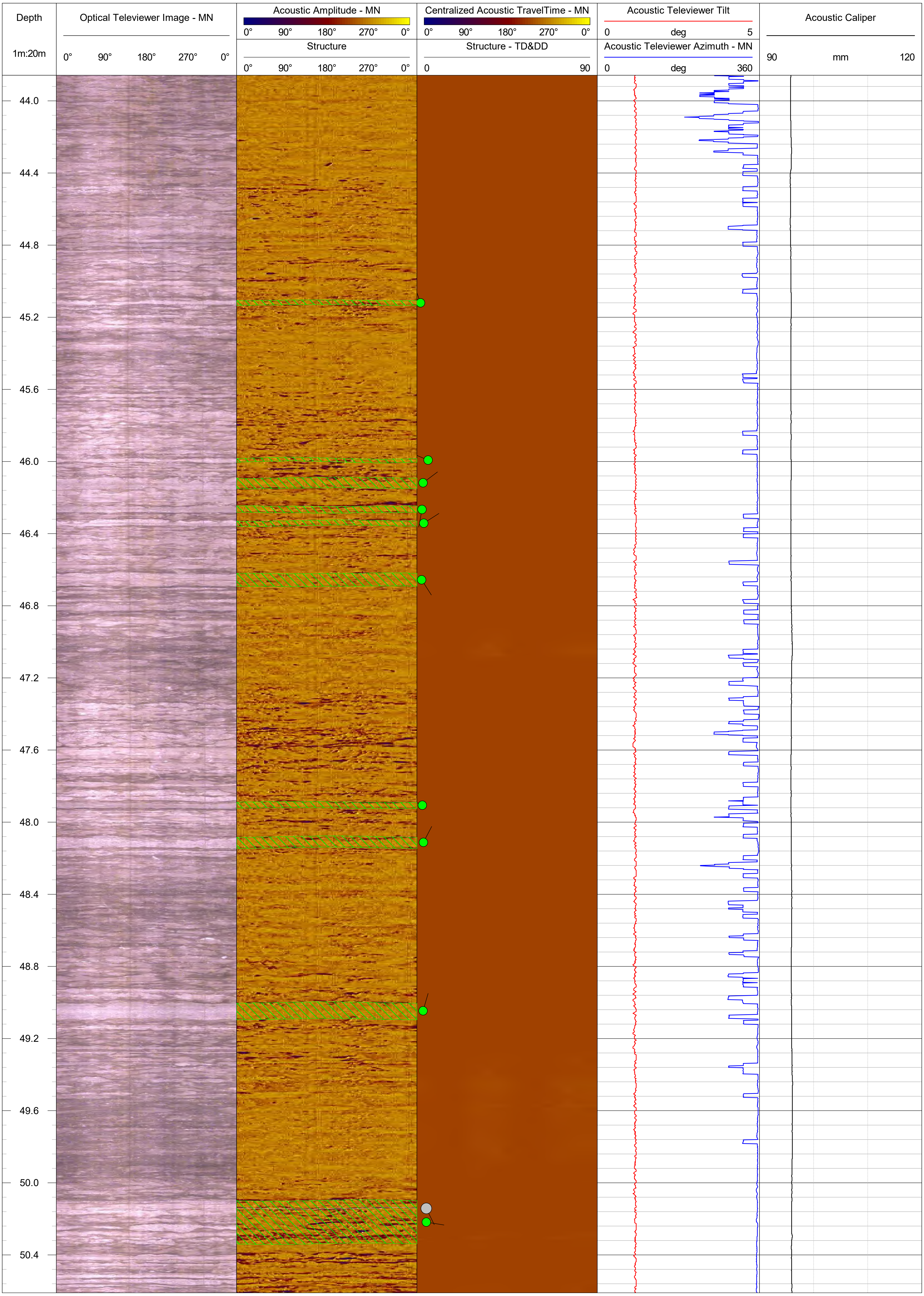
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
37.2
37.6
38.0
38.4
38.8
39.2
39.6
40.0
40.4
40.8
41.2
41.6
42.0
42.4
42.8
43.2
43.6


Depth
1m:20m
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
44.0
44.4
44.8
45.2
45.6
46.0
46.4
46.8
47.2
47.6
48.0
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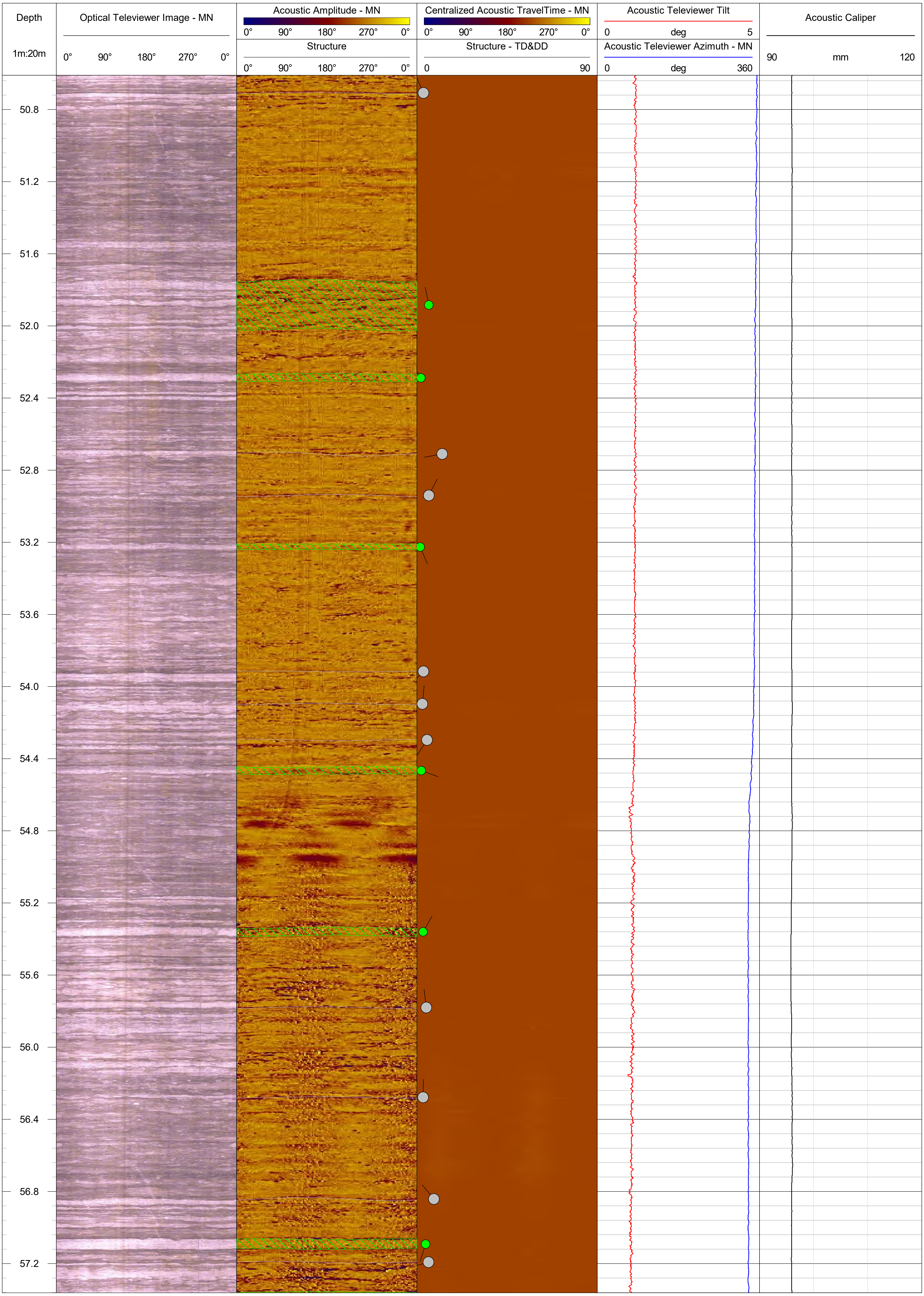
48.8
49.2
49.6
50.0
50.4


Depth
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Optical Televiewer Image - MN
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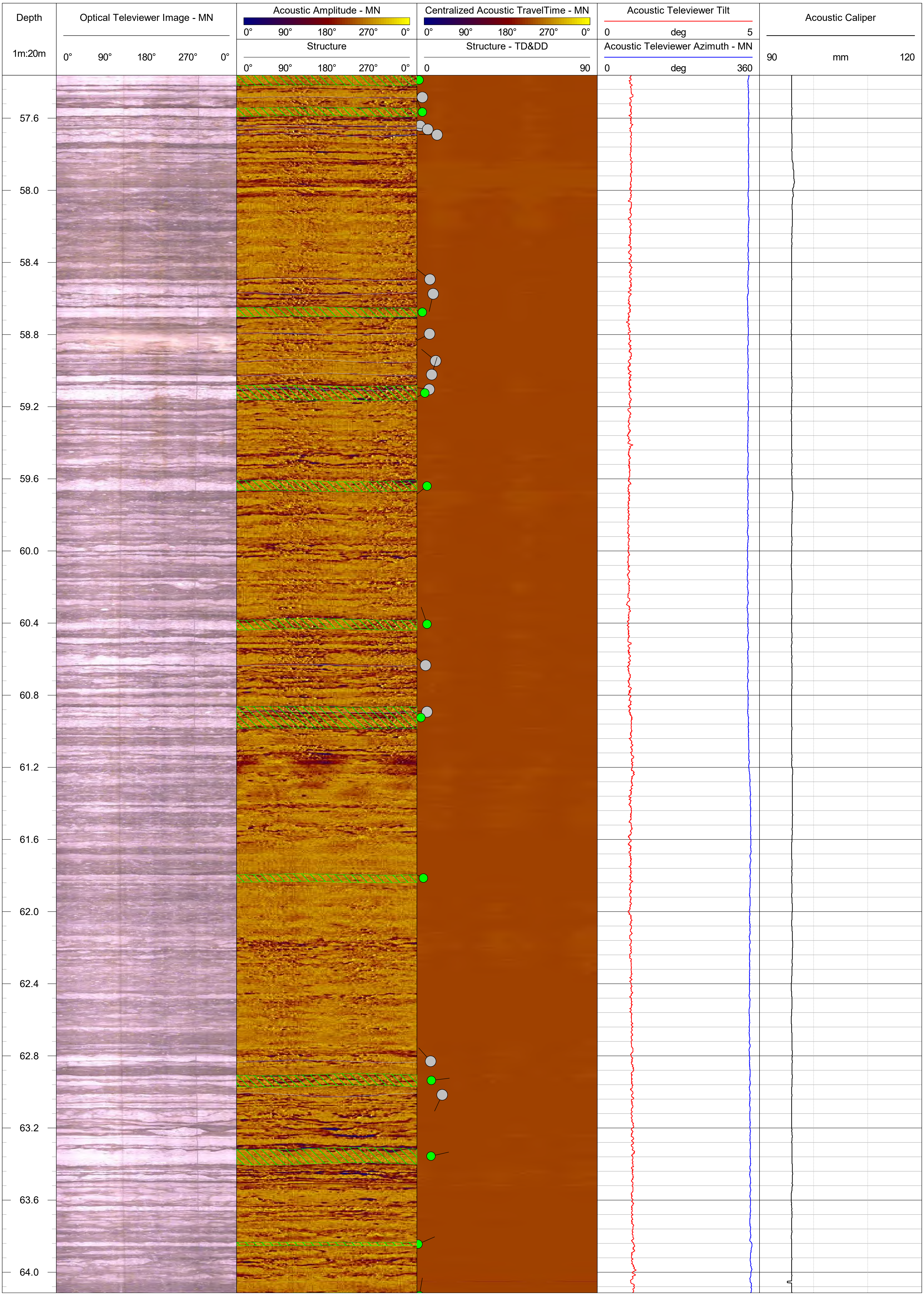
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
50.8
51.2
51.6
52.0
52.4
52.8
53.2
53.6
54.0
54.4
54.8
55.2
55.6
56.0
56.4
56.8
57.2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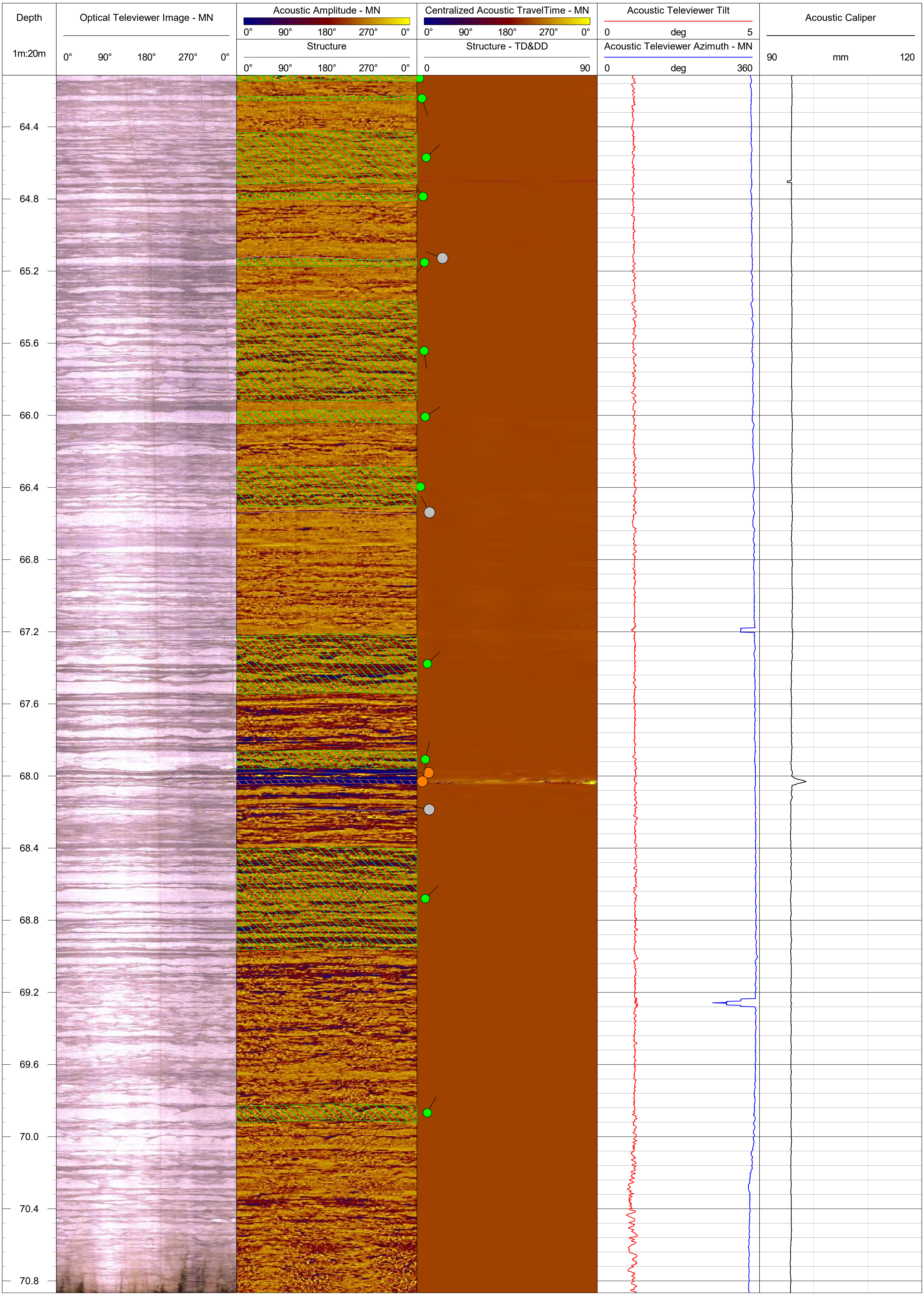
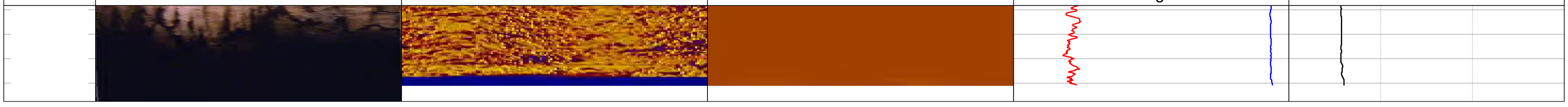
1m:20m
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
57.6
58.0
58.4
58.8
59.2
59.6
60.0
60.4
60.8
61.2
61.6
62.0
62.4
62.8
63.2
63.6
64.0


Depth
1m:20m
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
64.4
64.8
65.2
65.6
66.0
66.4
66.8
67.2
67.6
68.0
68.4
68.8
69.2
69.6
70.0
70.4
70.8

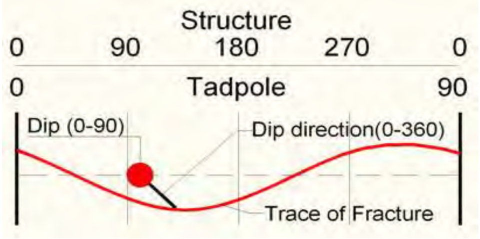
Depth	Optical Televiewer Image - MN	Acoustic Amplitude - MN 0° 90° 180° 270° 0°	Centralized Acoustic TravelTime - MN 0° 90° 180° 270° 0°	Acoustic Televiewer Tilt 0 deg 5	Acoustic Caliper
1m:20m	0° 90° 180° 270° 0°	Structure 0° 90° 180° 270° 0°	Structure - TD&DD 0 90	Acoustic Televiewer Azimuth - MN 0 deg 360	90 mm 120



Geophysical Record of Borehole: BH304

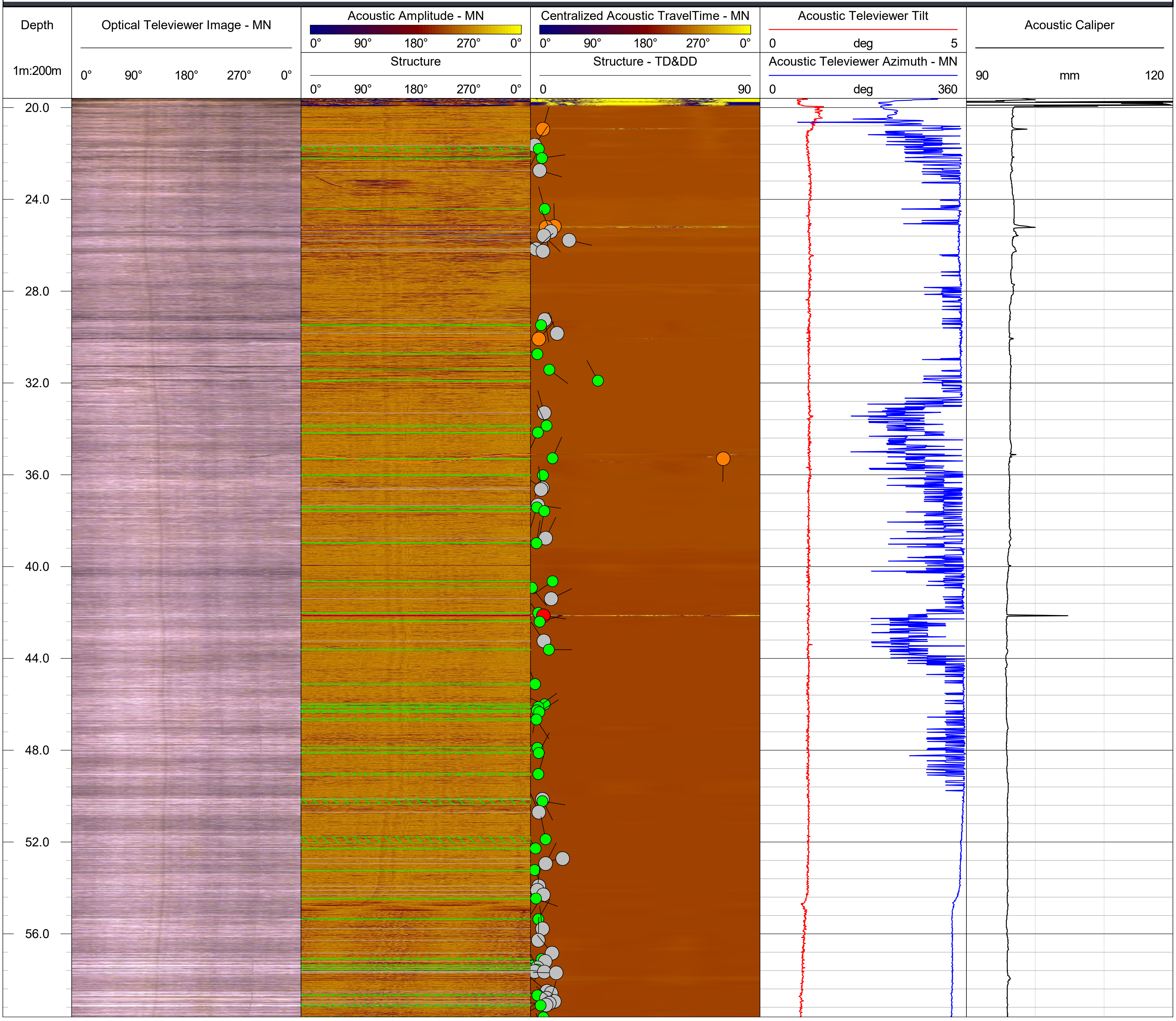
Log Title:	Darlington DNNP Geophysical Log
Project Number:	21451329
Client:	Ontario Power Generation
Date:	January 2023

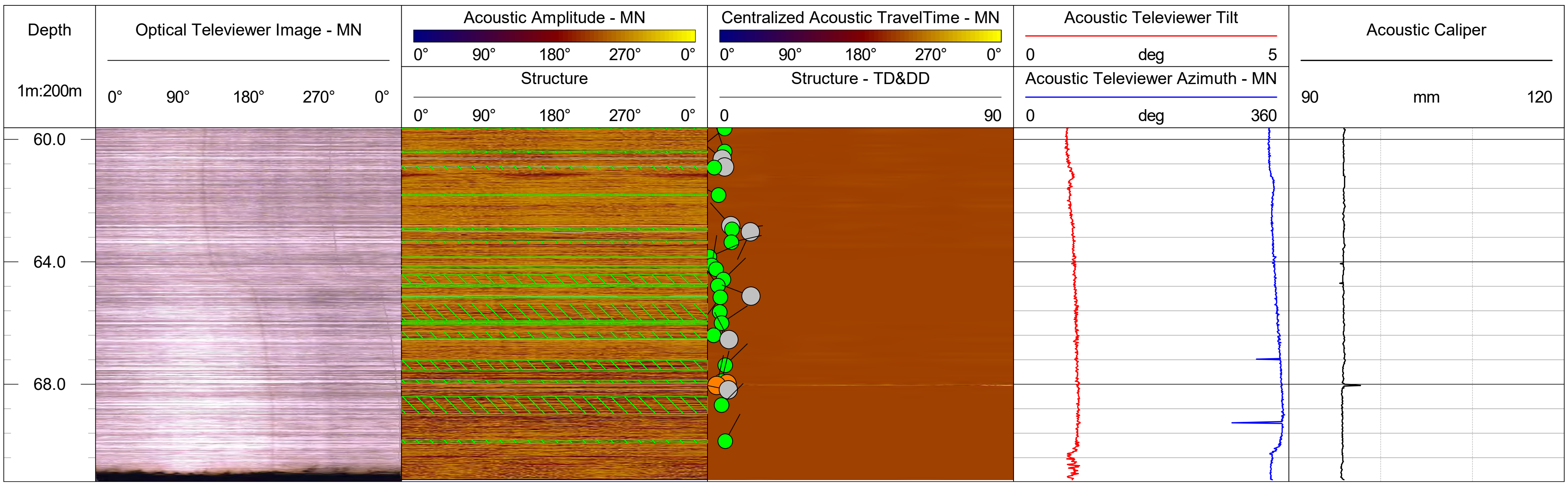
Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	~19.86 m bgs	**Location:**	Darlington, Ontario
Easting:	684425.05 m	**Drilled Depth:**	71.47 m bgs	**Water Level:**	4.7 m bgs	**Log Date:**	June-14-2022
Northing:	4859536.18 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	79.40 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	E. Pineda



🔴 Major Open Joint / Fracture
🟠 Partially Open Joint / Fracture
⚪ Filled Fracture / Joint
🟢 Bedding / Banding / Foliation
◀ Casing

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)




Depth
1m:200m
60.0
64.0
68.0
Optical Televiewer Image - MN
0°
90°
180°
270°
0°
Acoustic Amplitude - MN
0°
90°
180°
270°
0°
Structure
0°
90°
180°
270°
0°
Centralized Acoustic TravelTime - MN
0°
90°
180°
270°
0°
Structure - TD&DD
0
90
Acoustic Televiewer Tilt
0
deg
5
Acoustic Televiewer Azimuth - MN
0
deg
360
Acoustic Caliper
90
mm
120

A18-BH305

PROJECT: 21451329

LOCATION: N 4859517.43; E 684574.02

RECORD OF BOREHOLE: BH305

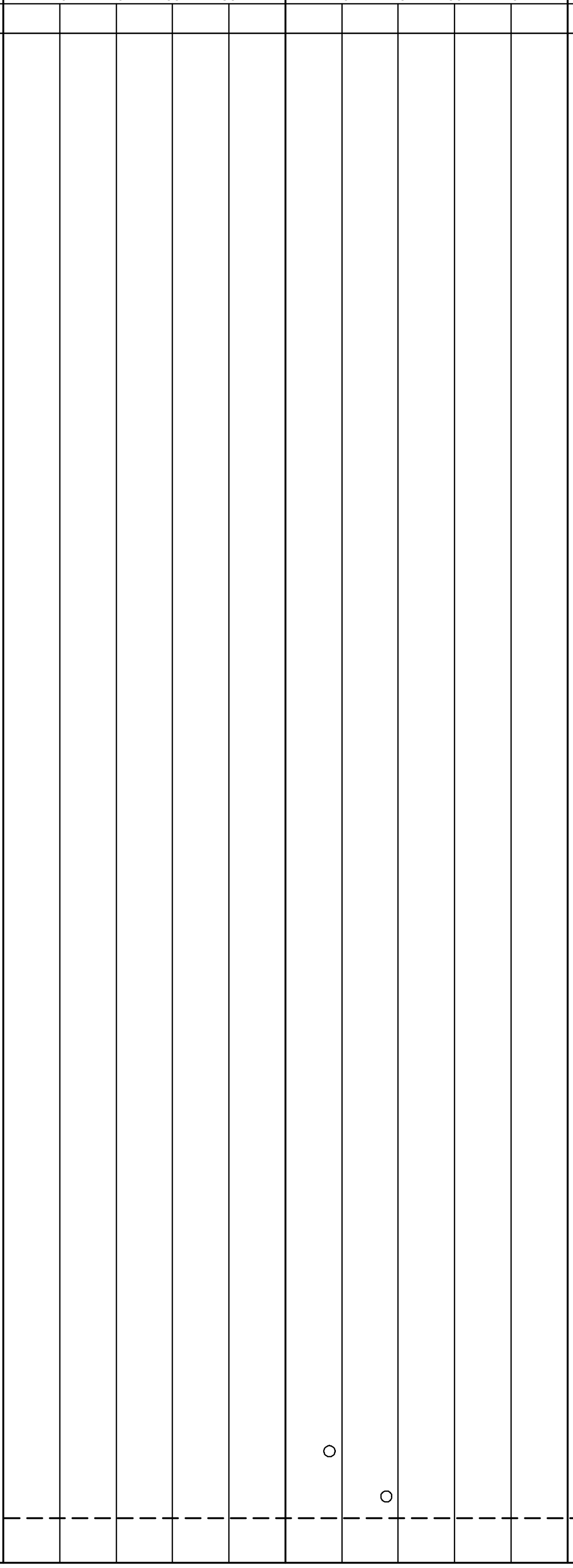
BORING DATE: September 10, 2022

DRILL RIG: Diedrich 120 Track Mounted

SHEET 1 OF 7

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-10} 10^{-8} 10^{-6} 10^{-4}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION; GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		BARGE DECK		78.37 0.00							
0 – 10	Mud Rotary Wash Boring (Tricone) UW Casing										
4		WATER		74.42 3.95							
9.5		**Silty Sand (SM) to Sandy Silt (ML)**, dense, grey, moist to wet, fine to medium sand (Glaciolacustrine) (Unit 4a) - Rock fragments in Spoon Sample 1		68.87 9.50	1A 1B	SS	44				



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DEPTH SCALE

1 : 50

LOGGED: BD/KL

CHECKED: SEMP

PROJECT: 21451329

LOCATION: N 4859517.43; E 684574.02

RECORD OF BOREHOLE: BH305

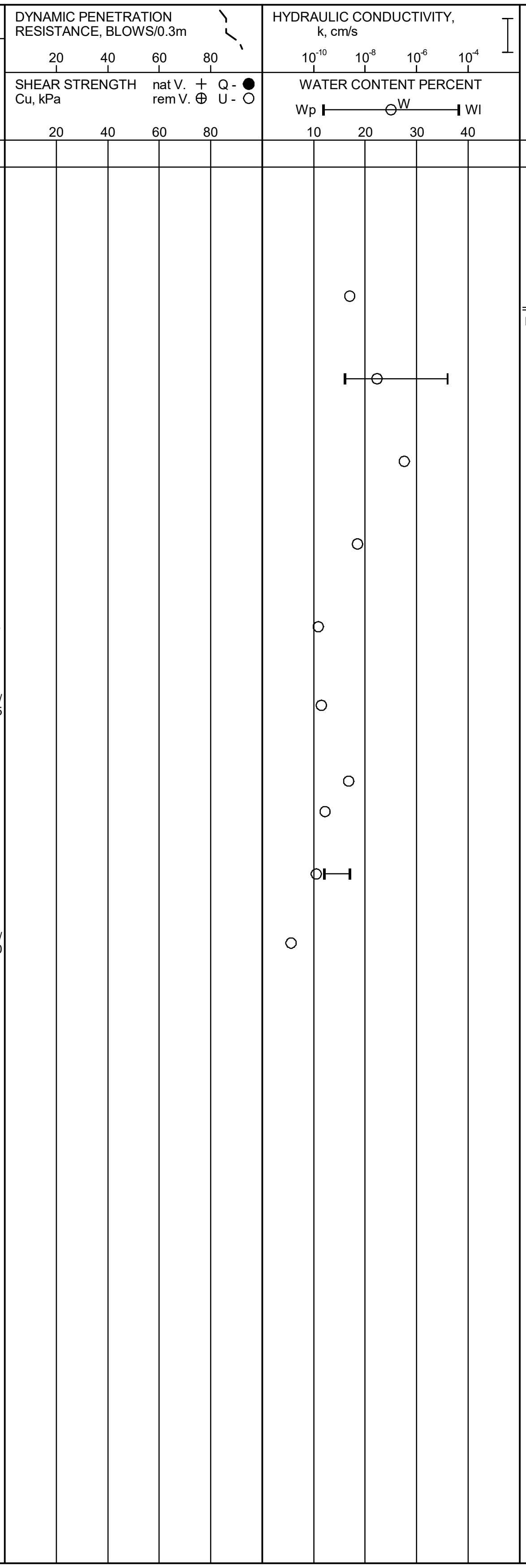
SHEET 2 OF 7

BORING DATE: September 10, 2022

DATUM: Geodetic

DRILL RIG: Diedrich 120 Track Mounted

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
10	Mud Rotary Wash Boring (Tricone) UW Casing	*--- CONTINUED FROM PREVIOUS PAGE ---*		1B				
		Lean Clay (CL), medium stiff to hard, grey, moist, trace of fine to medium sand (Glaciolacustrine) (Unit 4b) - No recovery in Spoon Sample 2	68.26 10.11	2	SS	5		
11				3	SS	16	γ=21.61 kN/m^3	
		- Tricone grinding below 11.3 m depth		4	SS	34		0 4 45 51
12				5	SS	35		
		- Rock fragments in Spoon Sample 6		6	SS	93		
13	Open	**Sandy Silty Clay (CL-ML)**, hard, grey, moist, fine sand, angular to subangular fine to coarse gravel, low plasticity (Till) (Unit 5)	65.29 13.08	7	SS	108		
14				8	SS	167/ 0.25		
		Silty Sand (SM), very dense, grey, wet, fine to medium sand (Glaciolacustrine) (Unit 4a)	64.10 14.27	9A	SS	86		
		Silty Clay with Sand (CL-ML), hard, grey, moist, fine to coarse sand, angular to subangular gravel, low plasticity (Till) (Unit 5)	63.69 14.68	9B				
15				10	SS	49		3 25 49 23
		- Low to non plastic below 15.52 m - Rock fragments in Spoon Sample 11		11	SS	100/ 0.10		
16		- Spoon attempted at 16.20 m depth; spoon bouncing **Shale Bedrock**	62.17 16.20					
17								
18								
19								
20								



Notes:

1. Bedrock cored from 16.20 m to 60.62 m depth

2. Refer to Record of Drillhole BH305.

3. Water level in open borehole could not be measured upon completion of soil drilling due to use of mud-rotary technique.

4. Efficiency of the SPT hammer utilized was 75.2 %.

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

LOGGED: BD/KL

CHECKED: SEMP

GTA-BHS 005 S:\CLIENTS\OPG\DARLINGTON_GENERATING_STATION\02_DATA\GINT\DARLINGTON_GENERATING_STATION.GPJ GAL-MIS.GDT 3/14/23

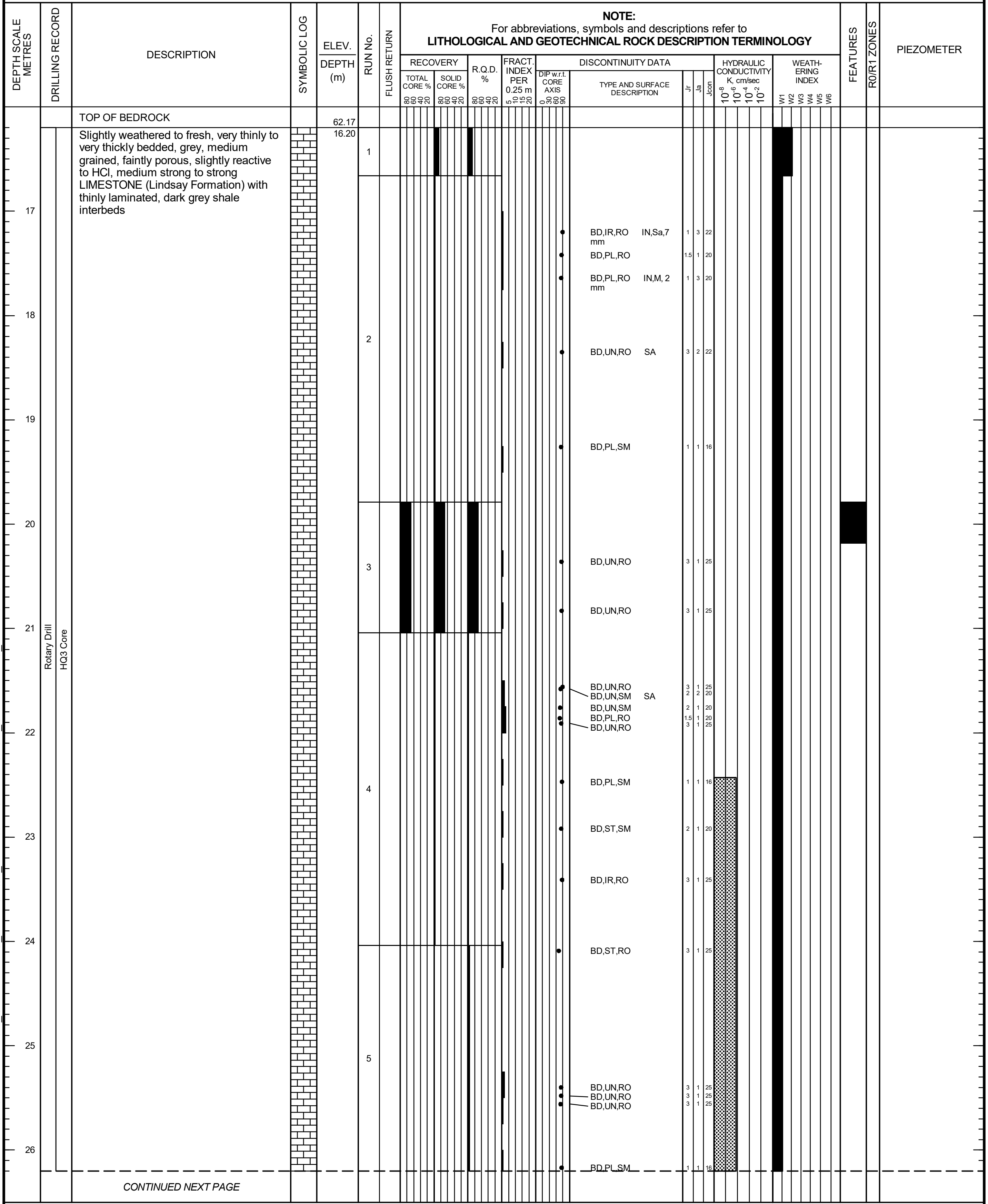
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859517.43; E 684574.02
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH305

DRILLING DATE: September 10 to 23, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



TOP OF BEDROCK — ELEV. 62.17, DEPTH 16.20

Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with thinly laminated, dark grey shale interbeds

TYPE AND SURFACE DESCRIPTION		Jr	Ja	Jcon
BD,IR,RO mm	IN,Sa,7	1	3	22
BD,PL,RO		1.5	1	20
BD,PL,RO mm	IN,M, 2	1	3	20
BD,UN,RO	SA	3	2	22
BD,PL,SM		1	1	16
BD,UN,RO		3	1	25
BD,UN,RO		3	1	25
BD,UN,RO		3	1	25
BD,UN,SM	SA	2	2	20
BD,UN,SM		2	1	20
BD,PL,RO		1.5	1	20
BD,UN,RO		3	1	25
BD,PL,SM		1	1	16
BD,ST,SM		2	1	20
BD,IR,RO		3	1	25
BD,ST,RO		3	1	25
BD,UN,RO		3	1	25
BD,UN,RO		3	1	25
BD,UN,RO		3	1	25
BD,PL,SM		1	1	16

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: KL
CHECKED: PKS

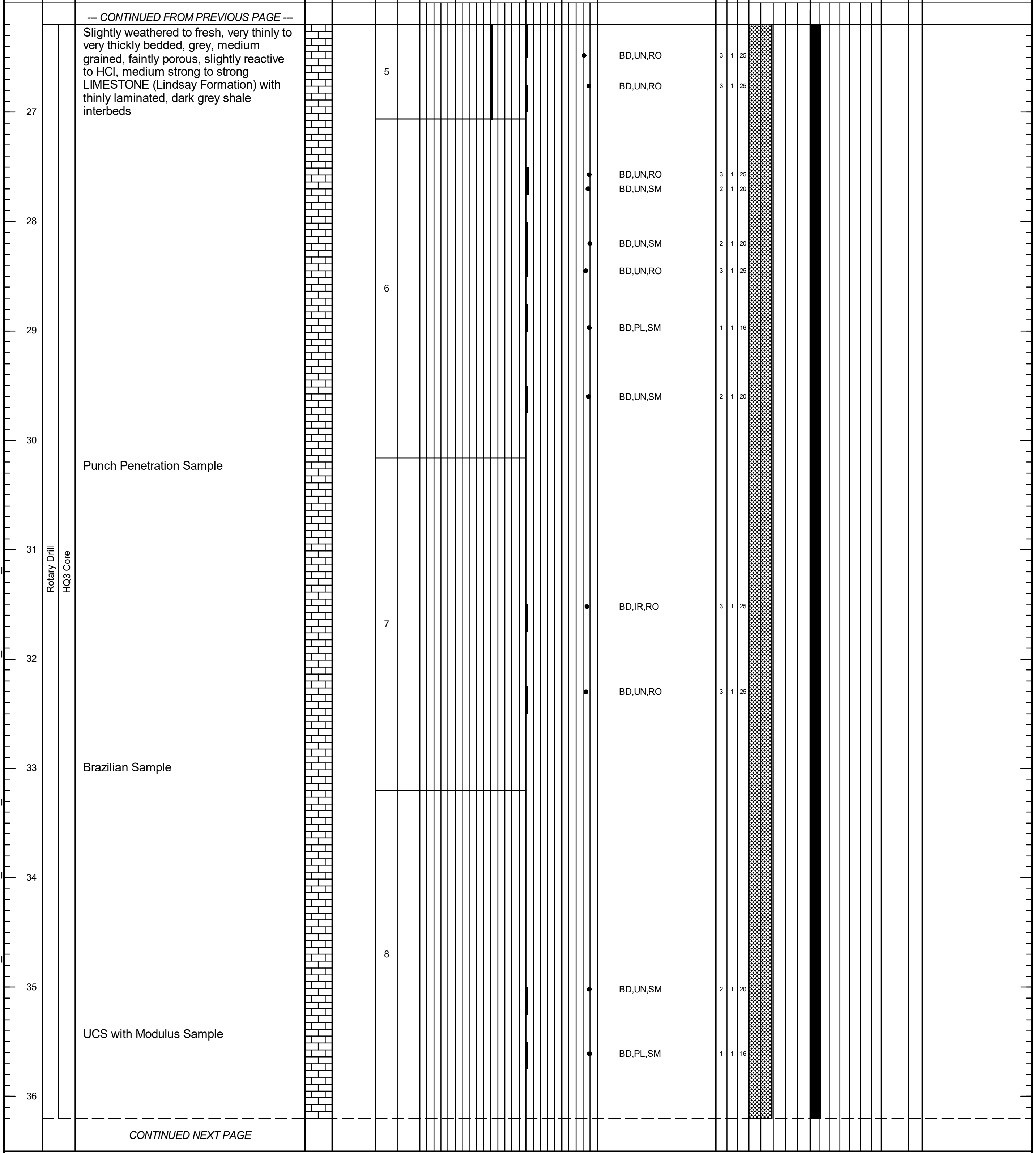
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859517.43; E 684574.02
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH305

DRILLING DATE: September 10 to 23, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



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Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with thinly laminated, dark grey shale interbeds

Punch Penetration Sample

Brazilian Sample

UCS with Modulus Sample

RUN No.	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
5	BD,UN,RO	3	1	25
	BD,UN,RO	3	1	25
6	BD,UN,RO	3	1	25
	BD,UN,SM	2	1	20
	BD,UN,SM	2	1	20
	BD,UN,RO	3	1	25
	BD,PL,SM	1	1	16
	BD,UN,SM	2	1	20
7	BD,IR,RO	3	1	25
	BD,UN,RO	3	1	25
8	BD,UN,SM	2	1	20
	BD,PL,SM	1	1	16

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: KL
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859517.43; E 684574.02
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

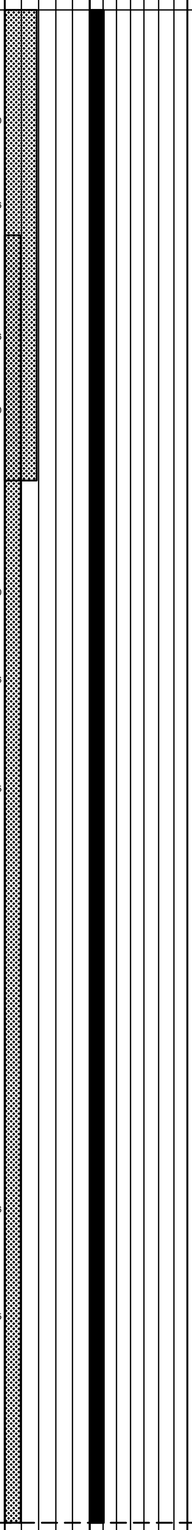
RECORD OF DRILLHOLE: BH305

DRILLING DATE: September 10 to 23, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 5 OF 7
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	RUN No.	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
		--- CONTINUED FROM PREVIOUS PAGE ---					
	Rotary Drill HQ3 Core	Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with thinly laminated, dark grey shale interbeds					
37				BD,UN,SM	2	1	20
				BD,PL,SM	1	1	16
			9				
38							
				BD,PL,SM	1	1	16
				BD,UN,SM	2	1	20
39							
		Cerchar Sample					
40				BD,UN,SM SO	2	1	20
				BD,PL,SM	1	1	16
			10				
41							
				BD,UN,RO	3	1	25
42							
43							
			11				
44		Direct Shear Sample		BD,PL,SM SO	1	1	16
				BD,UN,RO	3	1	25
45							
			12				
46		Cerchar Sample					
		CONTINUED NEXT PAGE					



Column headings: SYMBOLIC LOG; ELEV. DEPTH (m); FLUSH RETURN; RECOVERY: TOTAL CORE % (80 60 40 20), SOLID CORE % (80 60 40 20); R.Q.D. % (80 60 40 20); FRACT. INDEX PER 0.25 m (5 10 15 20); DIP w.r.t. CORE AXIS (0 30 60 90); FEATURES; R0/R1 ZONES; PIEZOMETER

DEPTH SCALE
1 : 50

LOGGED: KL
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859517.43; E 684574.02
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH305

DRILLING DATE: September 10 to 23, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

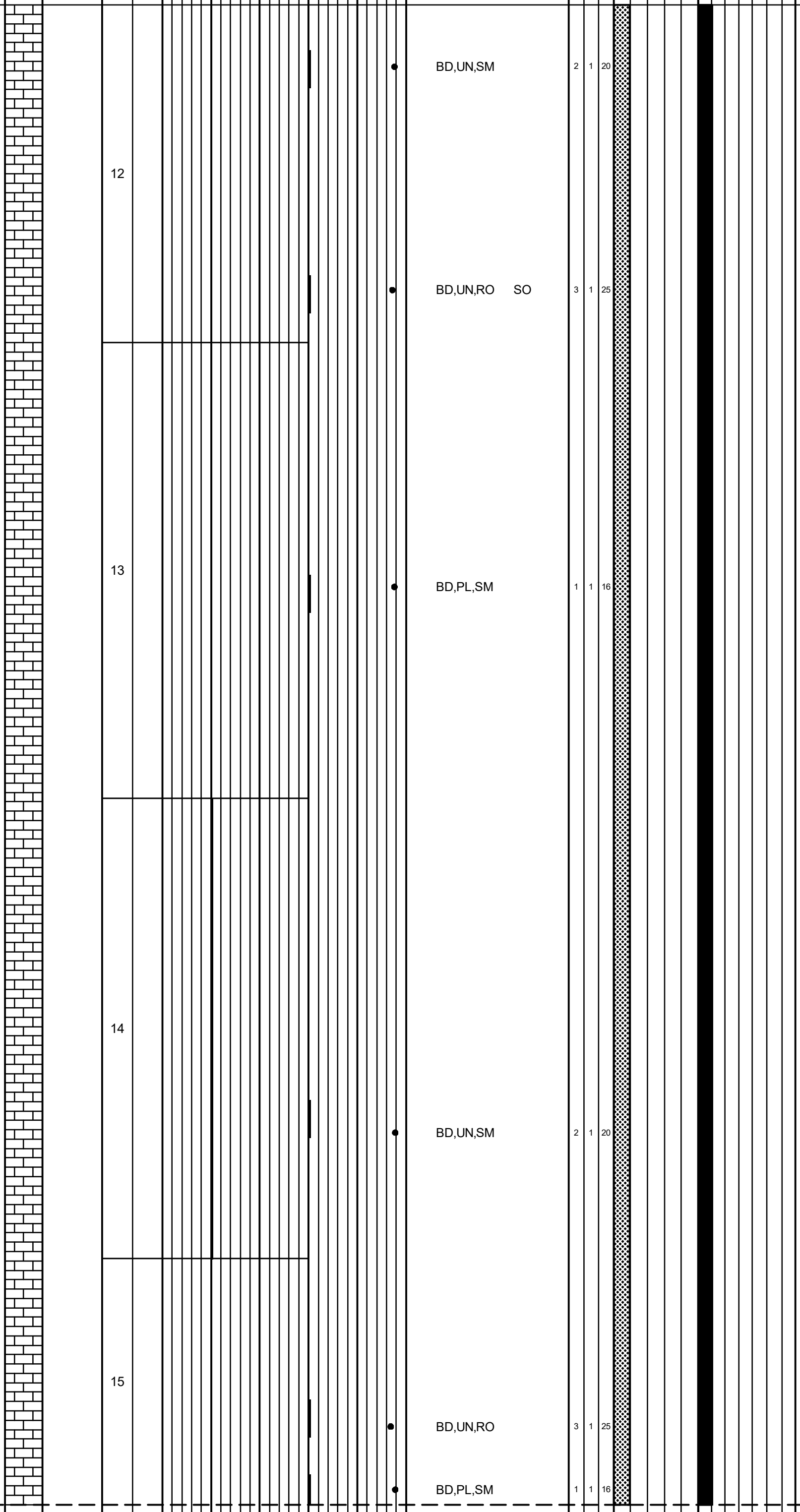
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

--- CONTINUED FROM PREVIOUS PAGE ---

DESCRIPTION: Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with thinly laminated, dark grey shale interbeds

DRILLING RECORD: Rotary Drill, HQ3 Core



DEPTH SCALE METRES	RUN No.	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
		BD,UN,SM	2	1	20
47					
	12				
48					
		BD,UN,RO SO	3	1	25
49					
50	13				
		BD,PL,SM	1	1	16
51					
52					
53	14				
		BD,UN,SM	2	1	20
54					
55					
	15				
		BD,UN,RO	3	1	25
56					
		BD,PL,SM	1	1	16

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: KL
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859517.43; E 684574.02
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH305

DRILLING DATE: September 10 to 23, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 7 OF 7
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (m)	RUN No.	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
		--- CONTINUED FROM PREVIOUS PAGE ---						
	Rotary Drill HQ3 Core	Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with thinly laminated, dark grey shale interbeds			BD,UN,RO	3	1	25
				15	BD,UN,RO SO	3	1	25
57								
58					BD,UN,SM	2	1	20
59				16	BD,PL,SM	1	1	16
60					BD,UN,RO	3	1	25
		END OF DRILLHOLE	17.75 60.62					
61								
62								
63								
64								
65								
66								

Column headings also printed: SYMBOLIC LOG; FLUSH RETURN; RECOVERY (TOTAL CORE % 80 60 40 20; SOLID CORE % 80 60 40 20); R.Q.D. % 80 60 40 20; FRACT. INDEX PER 0.25 m 5 10 15 20; DIP w.r.t. CORE AXIS 0 30 60 90; HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2}; WEATH-ERING INDEX W1 W2 W3 W4 W5 W6; FEATURES; R0/R1 ZONES; PIEZOMETER

DEPTH SCALE
1 : 50

LOGGED: KL
CHECKED: PKS

Water Content Summary
ASTM D2216

Test Request #	21451329-21600-610 BH305	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville		

Sample Location	Sample				Soil Description	Water Content %	Method	Remarks
	Ref	Top (m)	Base (m)	Type				
BH305	1A	9.50	9.60	SS		7.8	B	
BH305	1B	9.60	10.11	SS		17.9	B	
BH305	3	10.72	11.18	SS		17.0	B	
BH305	4	11.33	11.79	SS		22.3	B	
BH305	5	11.94	12.40	SS		27.6	B	
BH305	6	12.55	13.01	SS		18.5	B	
BH305	7	13.16	13.62	SS		10.9	B	
BH305	8	13.77	14.17	SS		11.5	B	
BH305	9A	14.38	14.68	SS		16.8	B	
BH305	9B	14.68	14.83	SS		12.2	B	
BH305	10	14.99	15.44	SS		10.5	B	
BH305	11	15.60	15.85	SS		5.6	B	

Notes:

Disclaimer:

Tested by: JTimms **Date:** 12 Oct 2022
Checked by: MRuck **Date:** 20 Oct 2022
Reviewed by: JoNorris **Date:** 10 Nov 2022

PARTICLE SIZE DISTRIBUTION

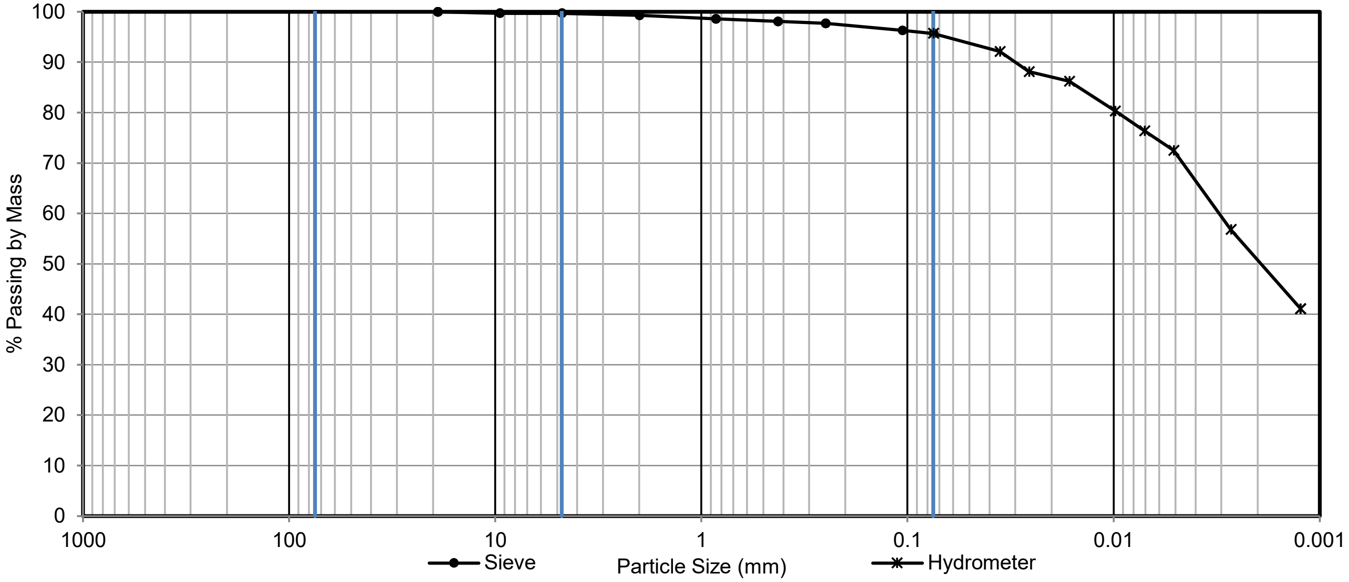
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH305	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH305
Source:		Sample No.:	4
Soil Description:		Type:	SS
		Depth (m):	11.33 - 11.79

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	14 Oct 2022
Specimen Description	NA				

	BOULDERS	COBBLES	GRAVEL		SAND			FINES (Silt, Clay)
			Coarse	Fine	Coarse	Medium	Fine	
Grain Size Distribution (%)			0.3		4.0			95.7



Sieve			**Hydrometer Sedimentation**	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0356	92.1
3/8"	9.5	99.7	0.0257	88.1
#4	4.75	99.7	0.0164	86.2
#10	2	99.3	0.0098	80.3
#20	0.85	98.6	0.0071	76.4
#40	0.425	98.1	0.0051	72.5
#60	0.25	97.7	0.0027	56.8
#140	0.106	96.3	0.0012	41.1
#200	0.075	95.7		
			0.005 mm	71.96
			0.002 mm	50.74
			D60	0.00
			D30	
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

Tested by: JTimms **Date:** 14 Oct 2022 **Checked by:** MRuck **Date:** 20 Oct 2022 **Reviewed by:** JoNorris **Date:** 10 Nov 2022

GOLDER
MEMBER OF WSP

PARTICLE SIZE DISTRIBUTION

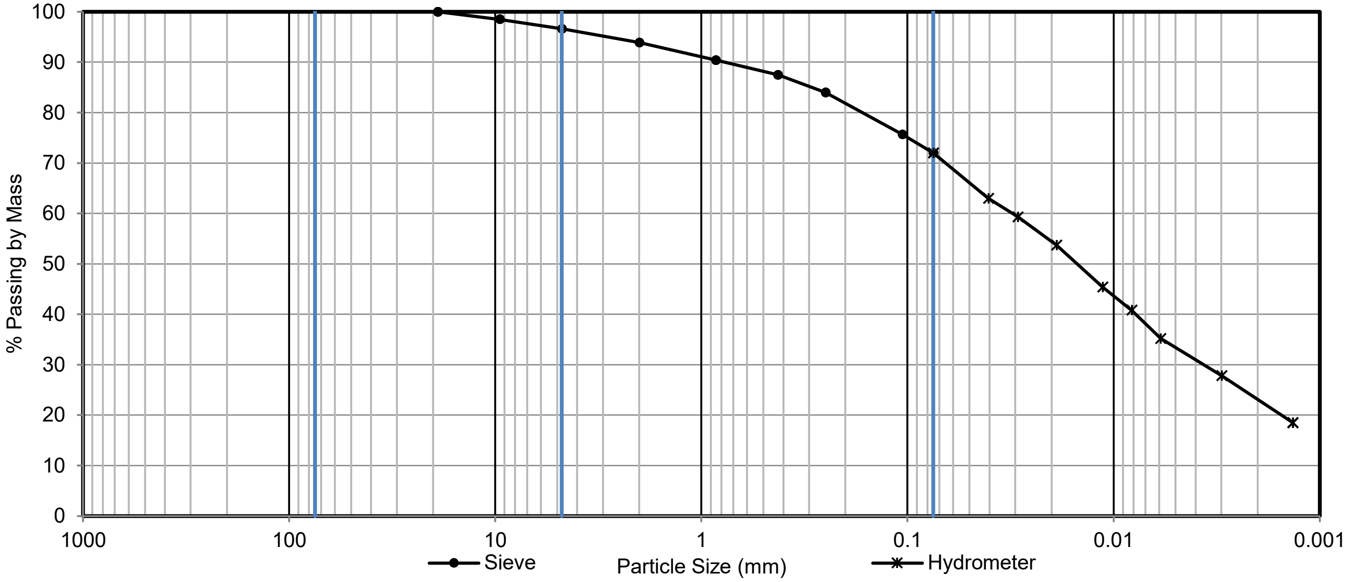
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH305	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH305
Source:		Sample No.:	10
Soil Description:		Type:	SS
		Depth (m):	14.99 - 15.44

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	14 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)			3.4			24.6		72.0
BOULDERS	COBBLES	GRAVEL		SAND				FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine		



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0405	63.0
3/8"	9.5	98.5	0.0291	59.3
#4	4.75	96.6	0.0189	53.7
#10	2	93.9	0.0113	45.4
#20	0.85	90.4	0.0082	40.8
#40	0.425	87.5	0.0059	35.2
#60	0.25	84.0	0.0030	27.8
#140	0.106	75.7	0.0014	18.5
#200	0.075	72.0		
			0.005 mm	33.38
			0.002 mm	23.10
			D60	0.03
			D30	0.00
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

Tested by: JTimms **Date:** 14 Oct 2022 **Checked by:** MRuck **Date:** 20 Oct 2022 **Reviewed by:** JoNorris **Date:** 10 Nov 2022

GOLDER
MEMBER OF WSP

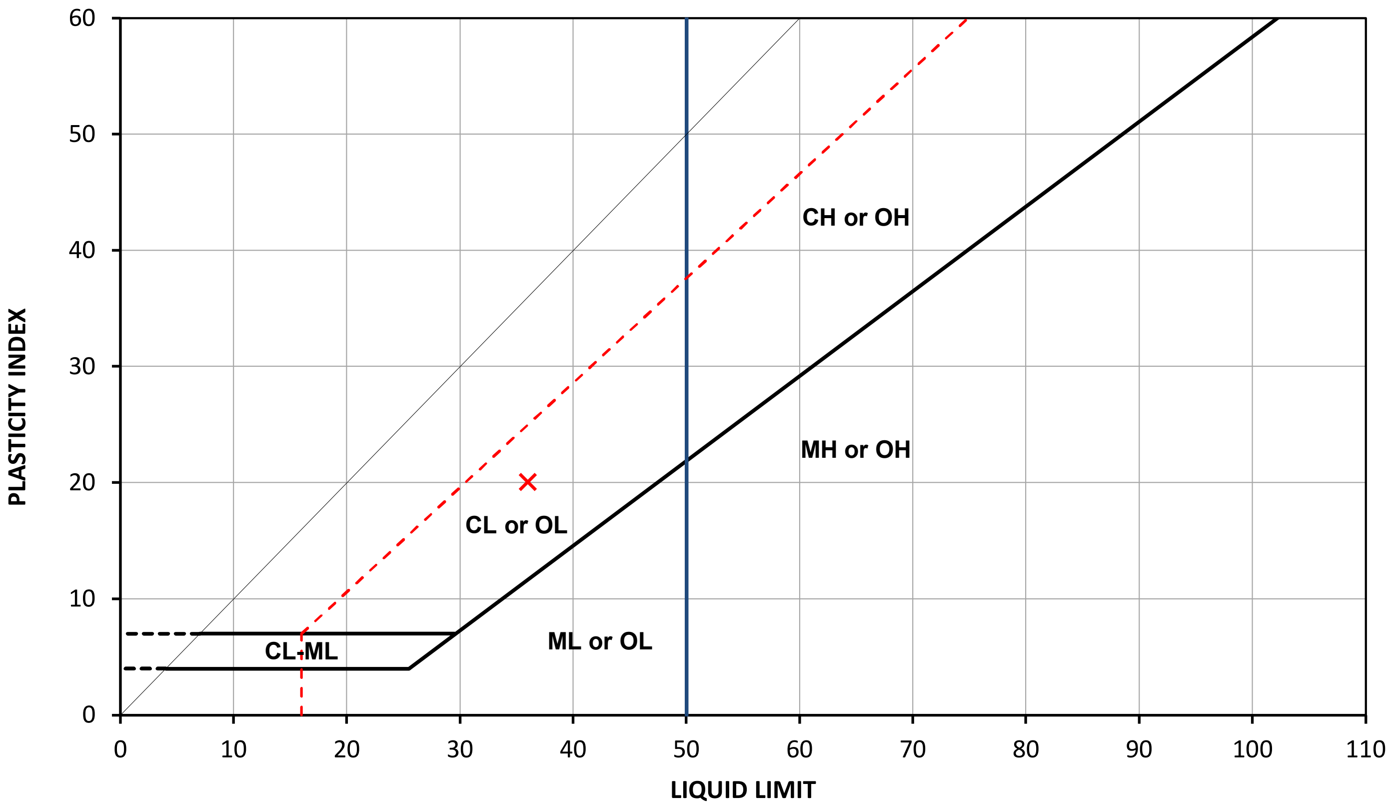
LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

ASTM D4318

Method A - Multipoint Test

Test Request #	21451329-21600-610 BH305	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH305
Source:		Sample No.:	4
Soil Description:		Type:	SS
		Depth (m):	11.33 - 11.79

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	18 Oct 2022
Specimen Description	NA				



Legend
- A-Line
- U-Line

Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH305	4	11.33	11.79	83	22.3	36	16	20	0.32

NP = Non-Plastic
ND = Not Determined

Test Preparation
Dry Preparation Tested after >425um removed

Notes:

Tested by: JTimms **Date:** 18 Oct 2022
Checked by: MRuck **Date:** 20 Oct 2022

Disclaimer:

Reviewed by: JoNorris **Date:** 10 Nov 2022

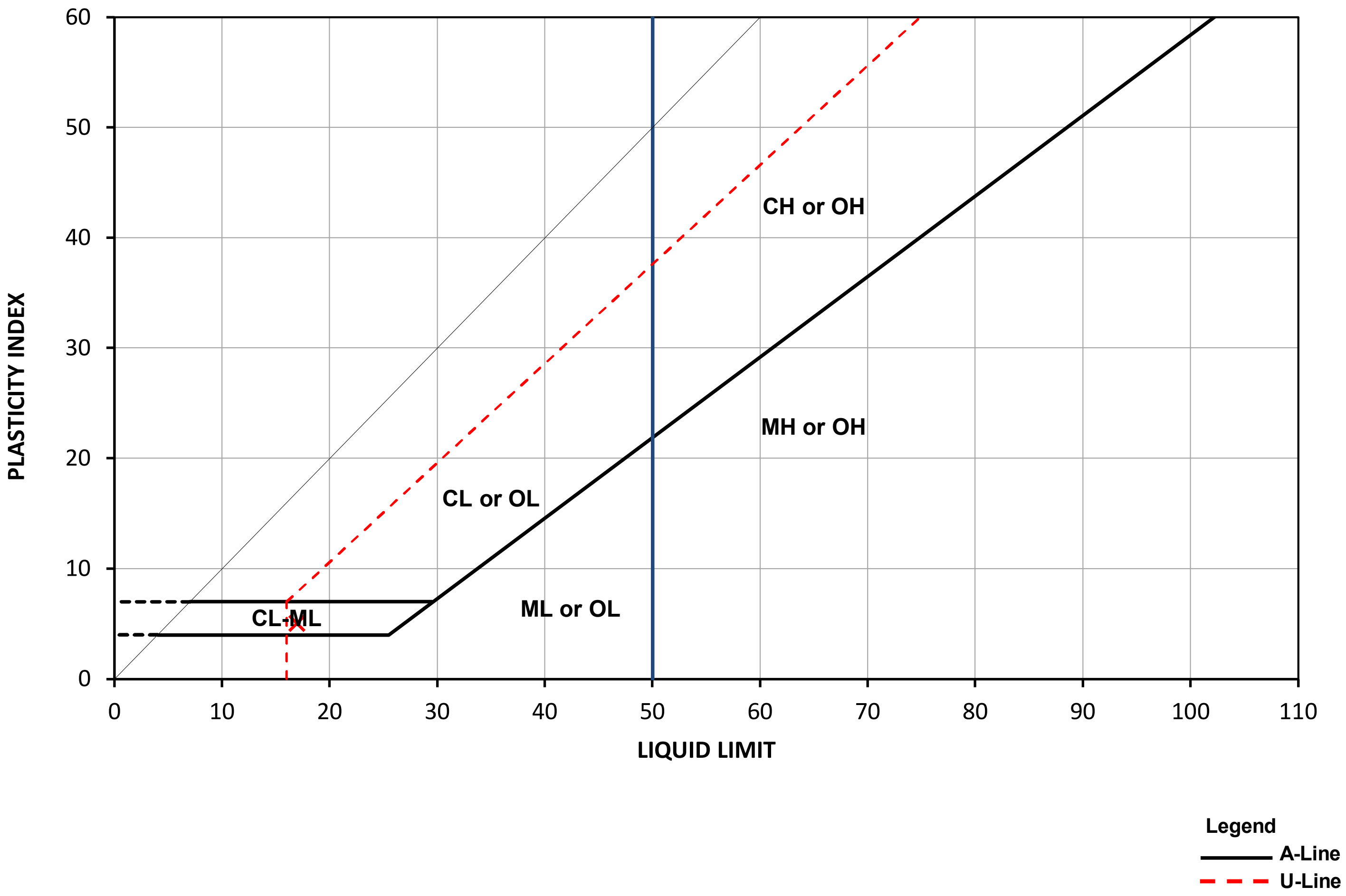
LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

ASTM D4318

Method A - Multipoint Test

Test Request #	21451329-21600-610 BH305	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH305
Source:		Sample No.:	10
Soil Description:		Type:	SS
		Depth (m):	14.99 - 15.44

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	18 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH305	10	14.99	15.44	86	10.5	17	12	5	-0.30

NP = Non-Plastic
ND = Not Determined

Test Preparation

Dry Preparation Tested after >425um removed

Notes:

Disclaimer:

The laboratory testing services reported herein have been performed in accordance with the terms of a contract with Golder's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of Golder's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Tested by: JTimms **Date:** 18 Oct 2022
Checked by: MRuck **Date:** 20 Oct 2022
Reviewed by: JoNorris **Date:** 10 Nov 2022

DENSITY (UNIT WEIGHT) OF SOIL SPECIMENS

ASTM D 7263 Method B

Borehole Number	BH305				
Sample Number	3				
Sample Depth, m	10.72-11.18				
Weight of Soil, g	154.8				
Diameter of Sample, cm	3.457				
Length of Sample, cm	7.482				
Volume of Sample, cc	70.23				
Water Content, %	26.290				
Wet Density, g/cm^3	2.204				
Dry Density, g/cm^3	1.745				
Unit Weight, kN/m^3	21.61				

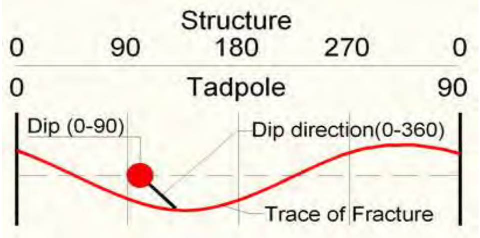
Notes:
- Water contents determined from tested specimens
- Specimen was intact

Project Number	21451329-21600-610	Tested By	S. Khan
Date Tested	October 26, 2022	Checked By	LH

Geophysical Record of Borehole: BH305

Log Title:	Darlington DNNP Geophysical Log
Project Number:	21451329
Client:	Ontario Power Generation
Date:	January 2023

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	~20 m bgs	**Location:**	Darlington, Ontario
Easting:	684574.02 m	**Drilled Depth:**	60 m bgs	**Water Level:**	5 m bgs	**Log Date:**	Sept-23-2022
Northing:	4859517.43 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	78.37 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	J. Crawford

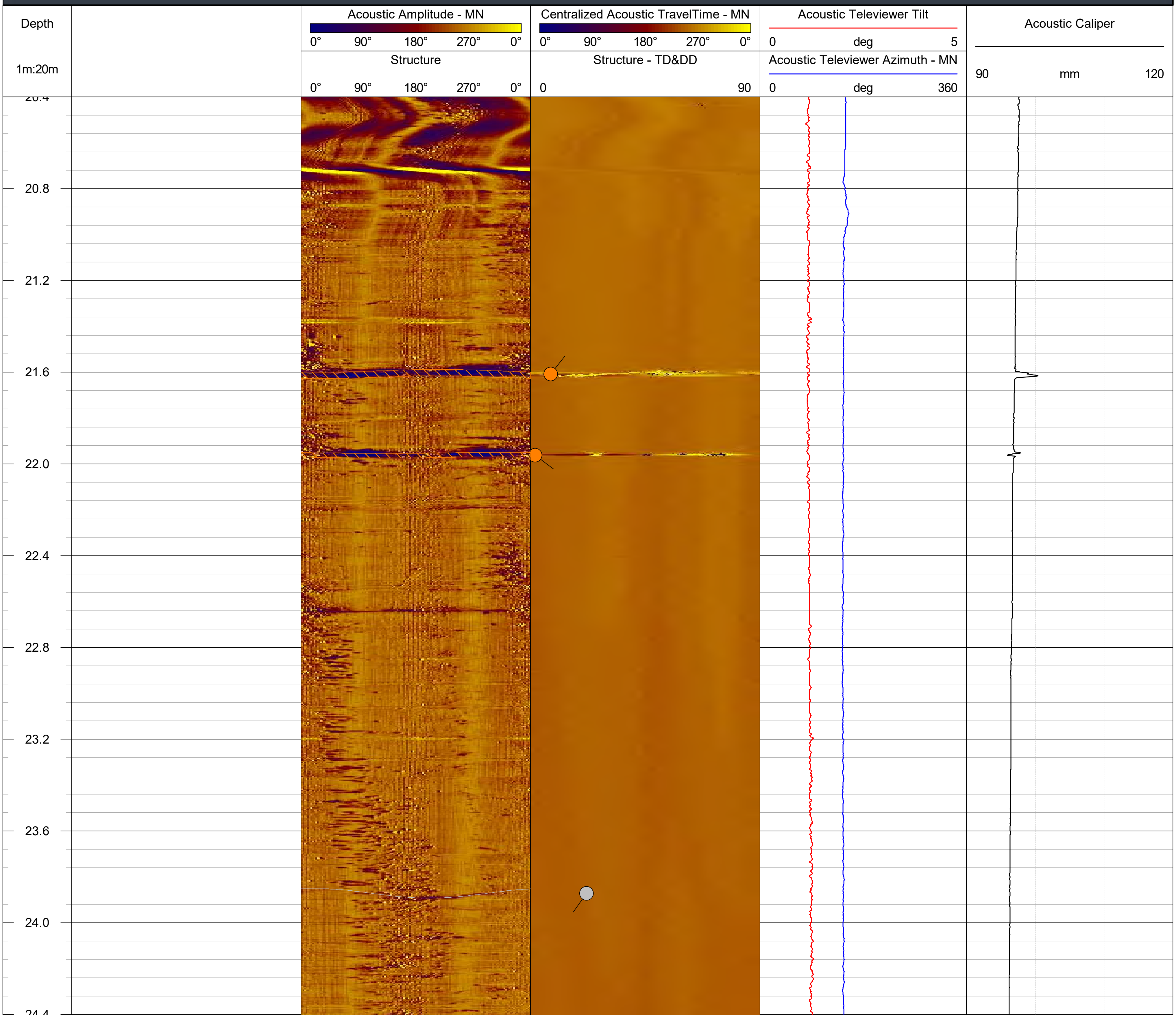


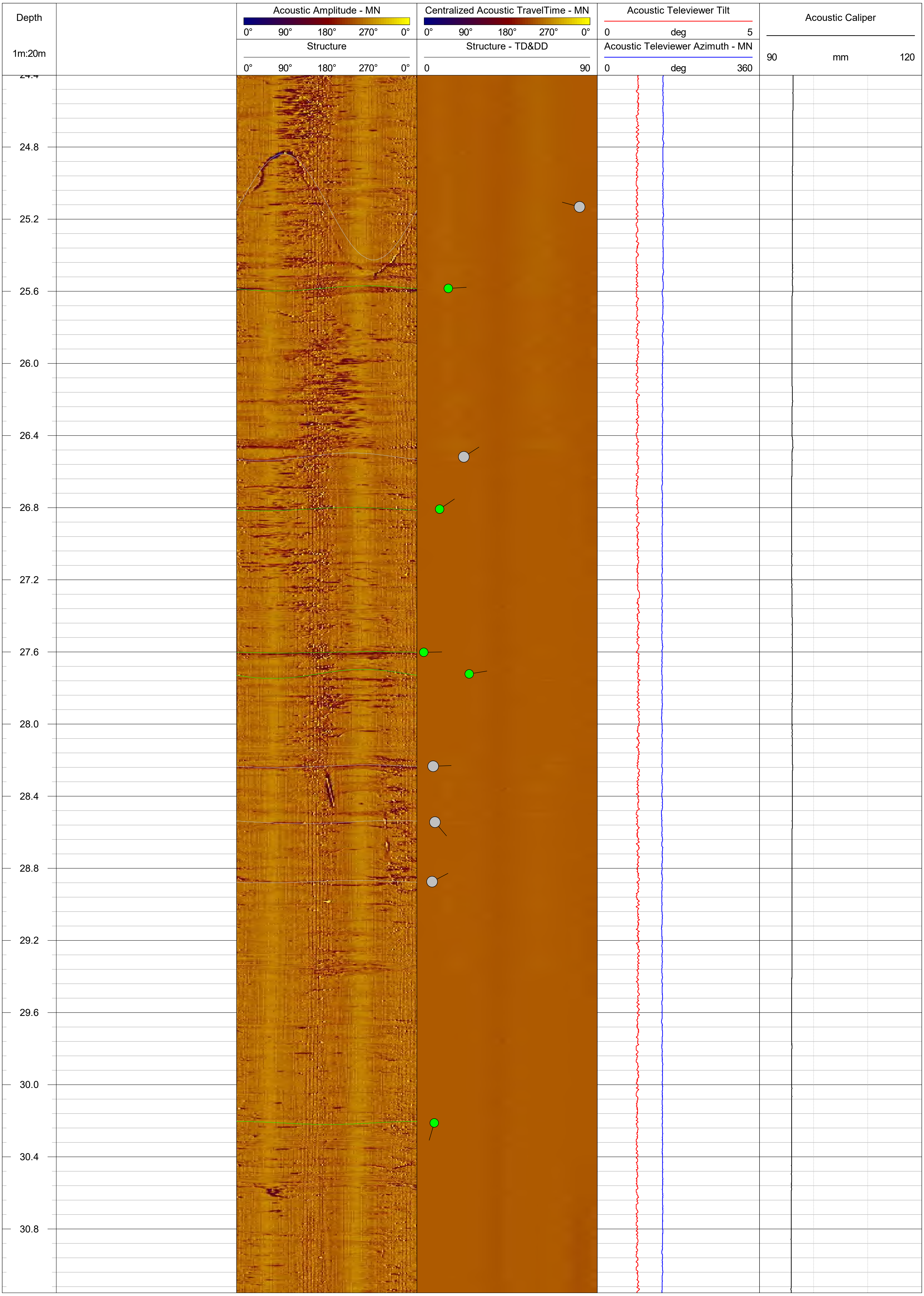
🟠 Partially Open Joint / Fracture

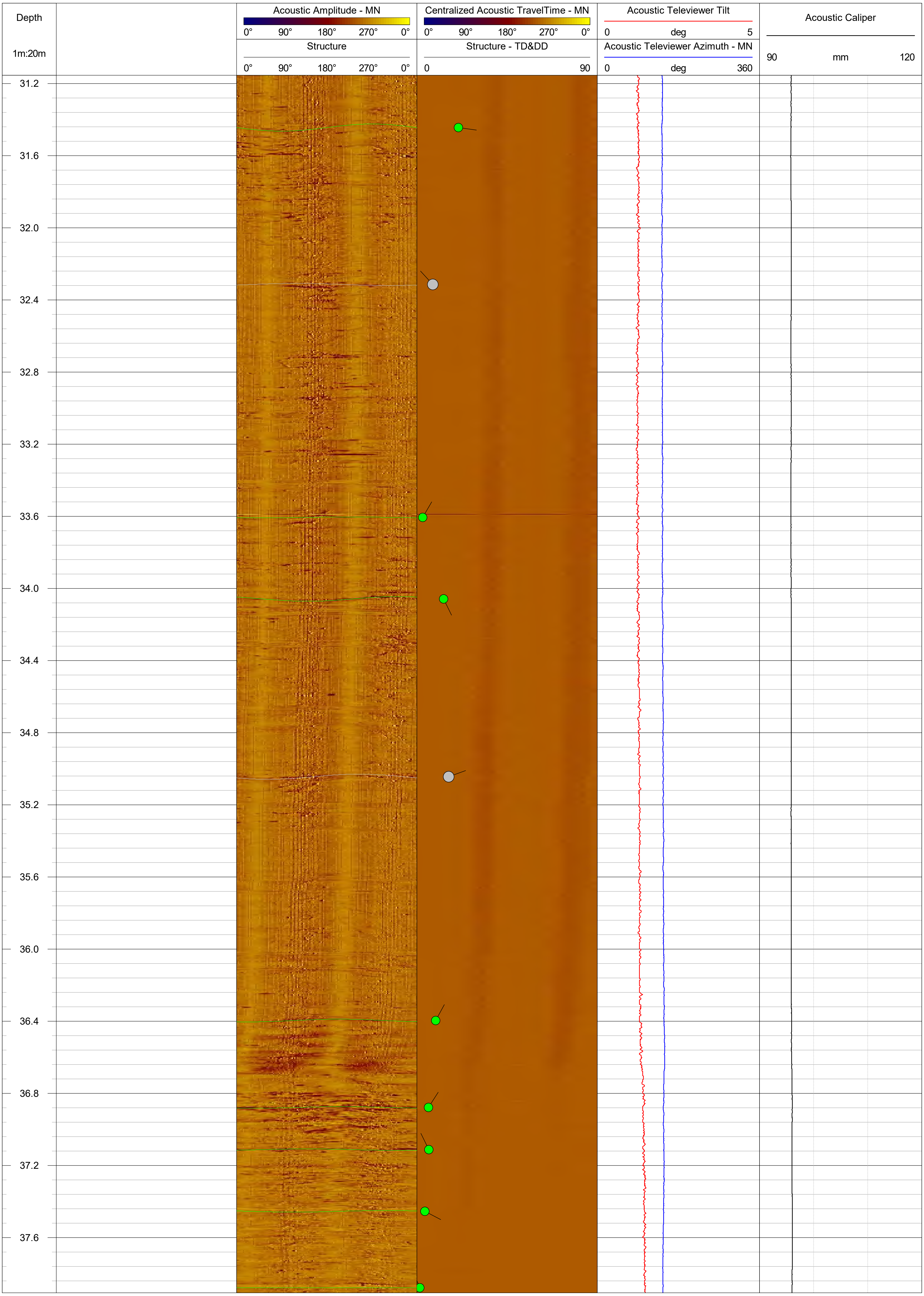
⚪ Filled Fracture / Joint

🟢 Bedding / Banding / Foliation

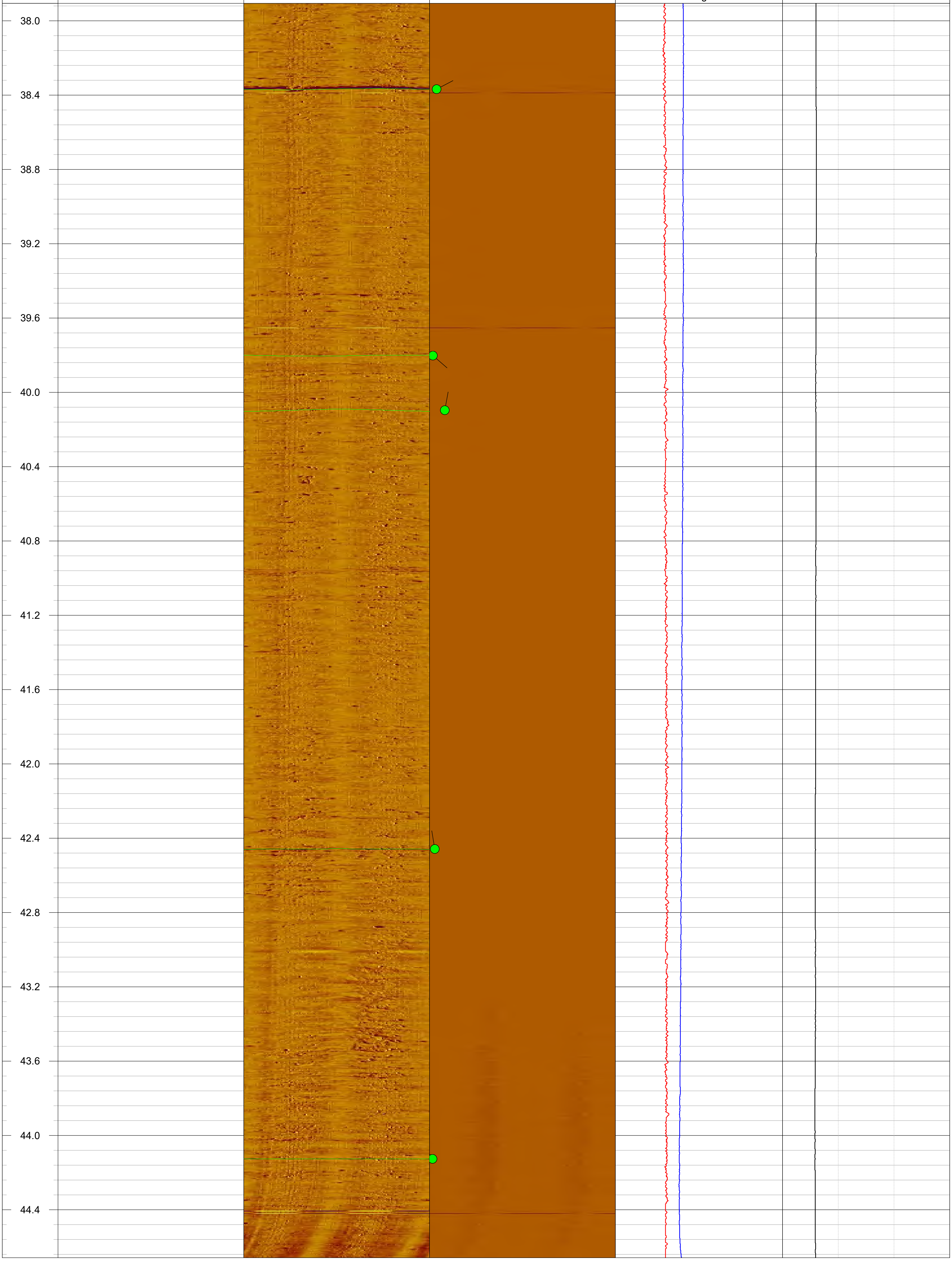
Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)

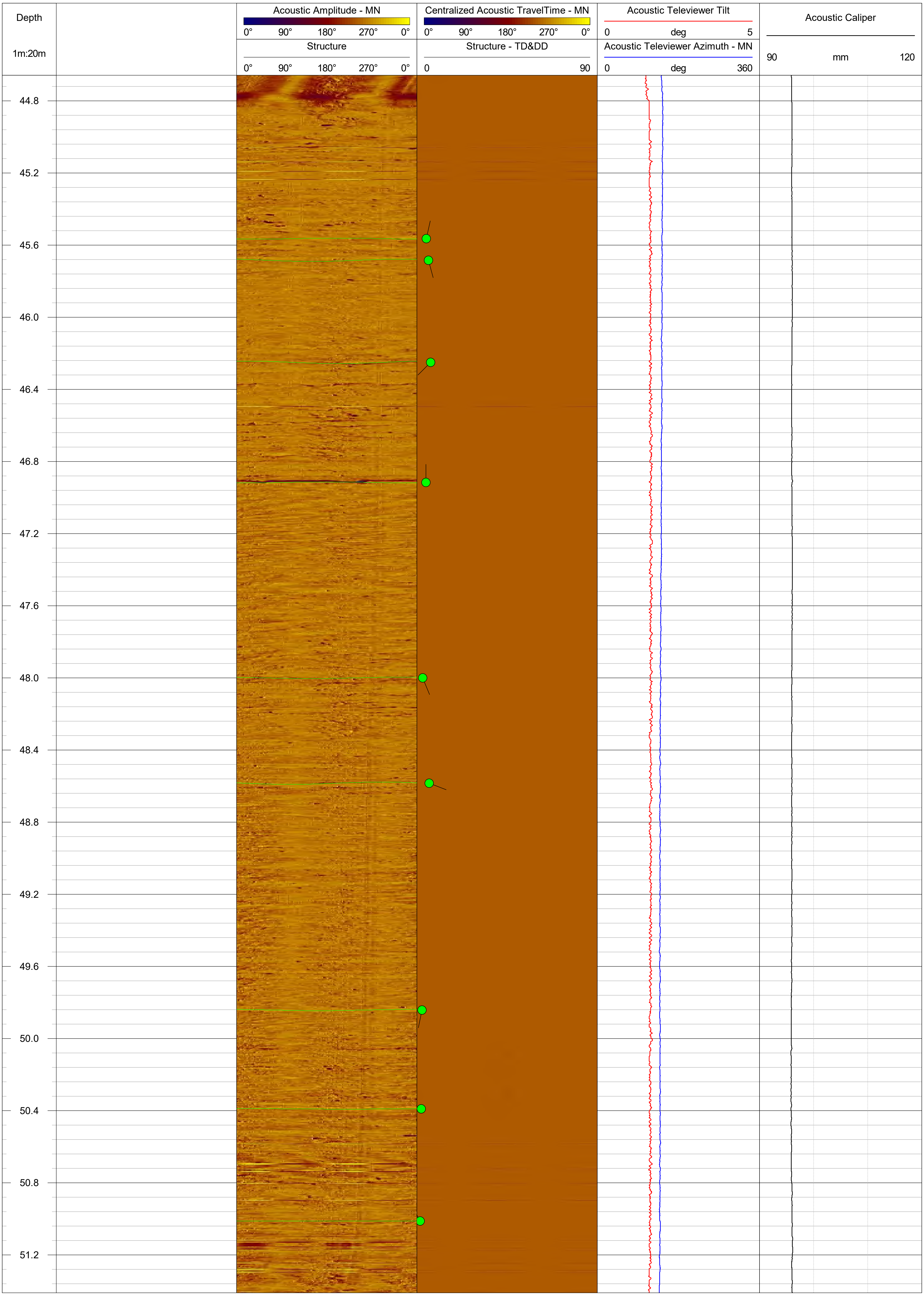


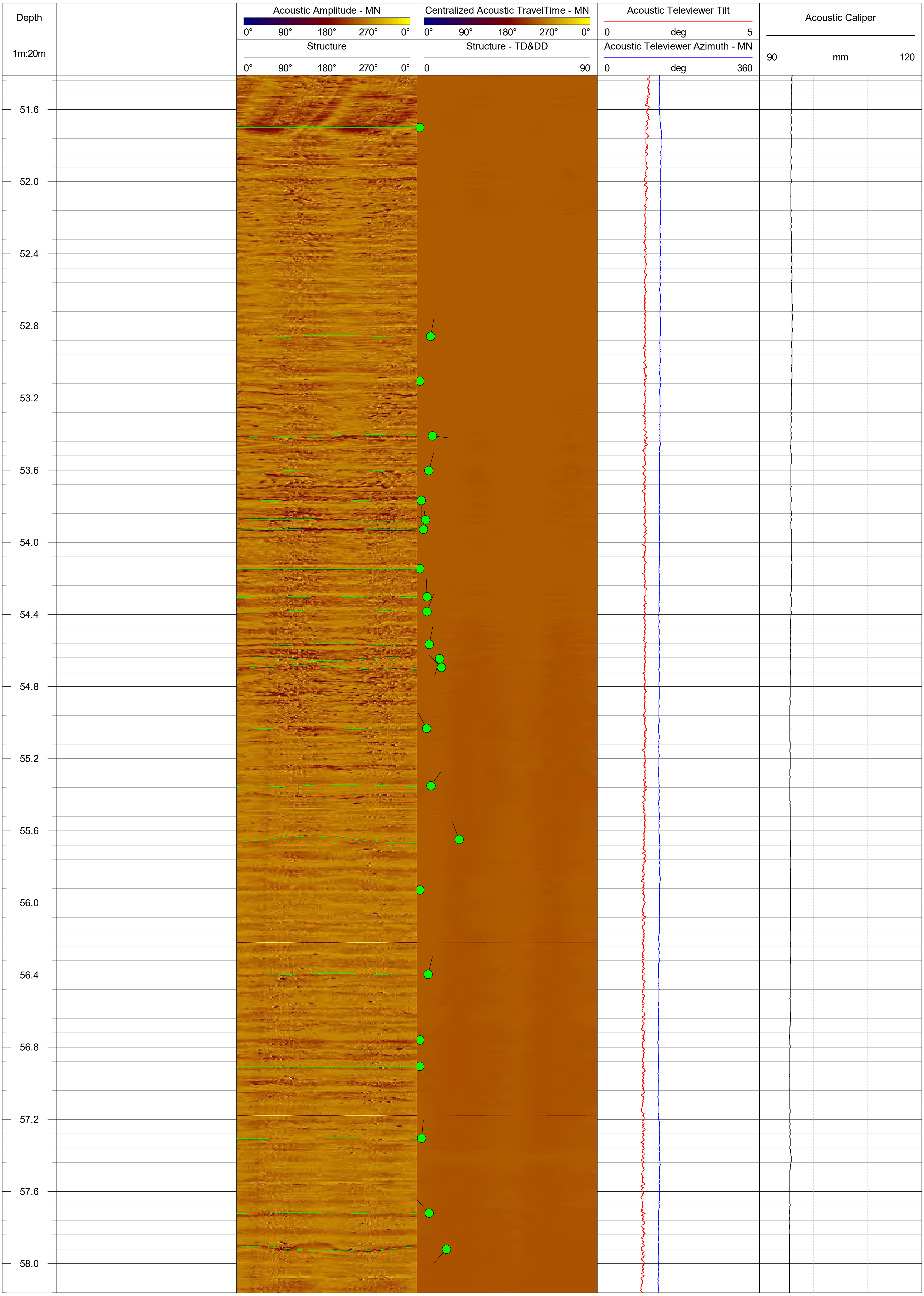

Depth
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
24.8
25.2
25.6
26.0
26.4
26.8
27.2
27.6
28.0
28.4
28.8
29.2
29.6
30.0
30.4
30.8

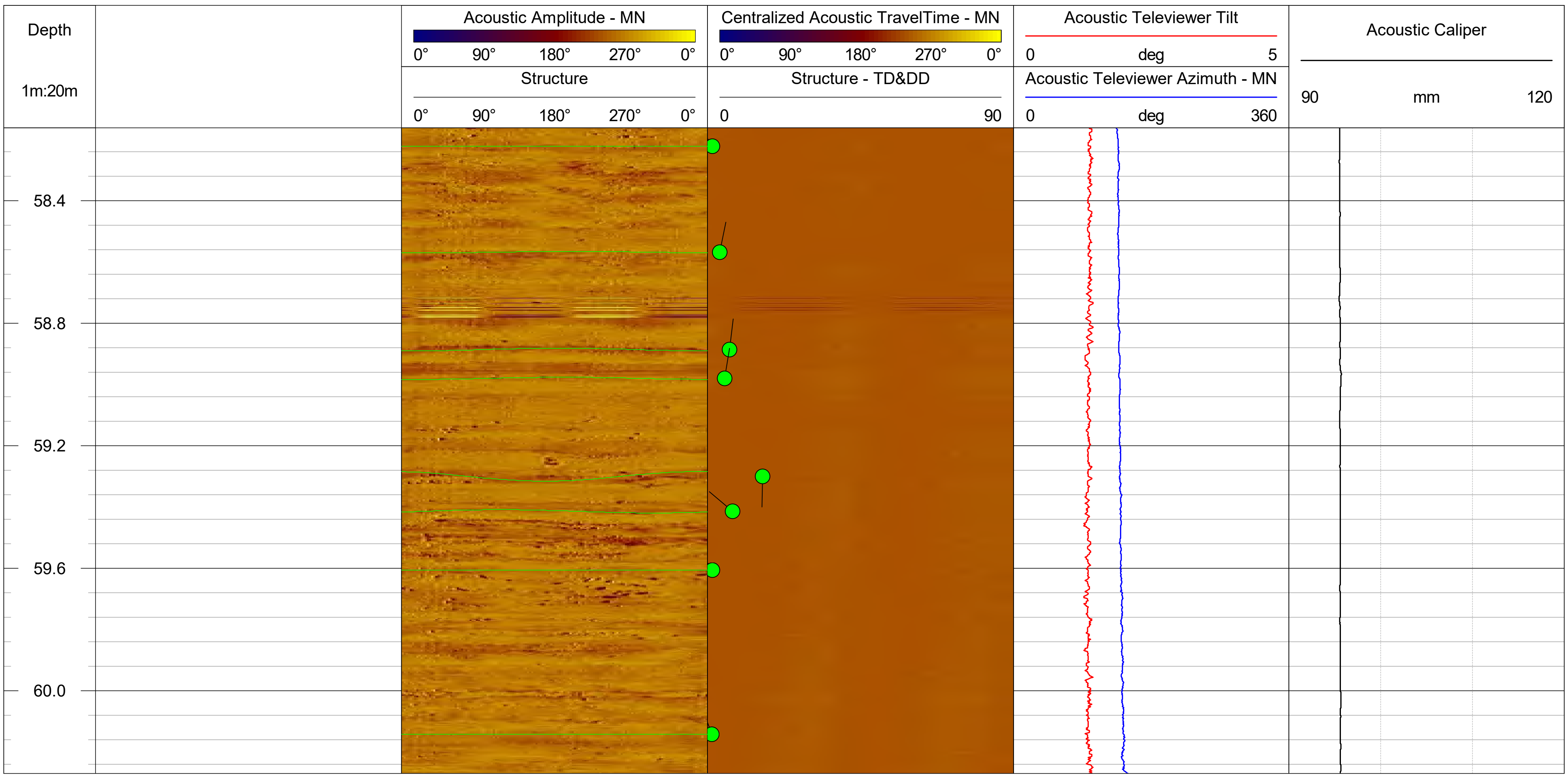

Depth
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
31.2
31.6
32.0
32.4
32.8
33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8
37.2
37.6

Depth 1m:20m		Acoustic Amplitude - MN 0° 90° 180° 270° 0° Structure 0° 90° 180° 270° 0°	Centralized Acoustic TravelTime - MN 0° 90° 180° 270° 0° Structure - TD&DD 0 90	Acoustic Televiewer Tilt 0 deg 5 Acoustic Televiewer Azimuth - MN 0 deg 360	Acoustic Caliper 90 mm 120




Depth
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
44.8
45.2
45.6
46.0
46.4
46.8
47.2
47.6
48.0
48.4
48.8
49.2
49.6
50.0
50.4
50.8
51.2

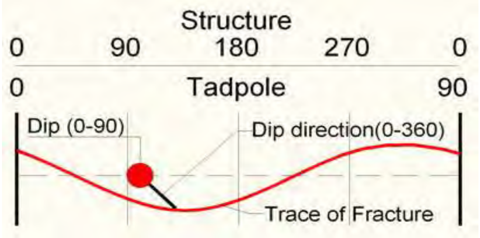

Depth
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
51.6
52.0
52.4
52.8
53.2
53.6
54.0
54.4
54.8
55.2
55.6
56.0
56.4
56.8
57.2
57.6
58.0


Depth
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
58.4
58.8
59.2
59.6
60.0

Geophysical Record of Borehole: BH305

Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	~20 m bgs	**Location:**	Darlington, Ontario
Easting:	684574.02 m	**Drilled Depth:**	60 m bgs	**Water Level:**	5 m bgs	**Log Date:**	Sept-23-2022
Northing:	4859517.43 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	78.37 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	J. Crawford

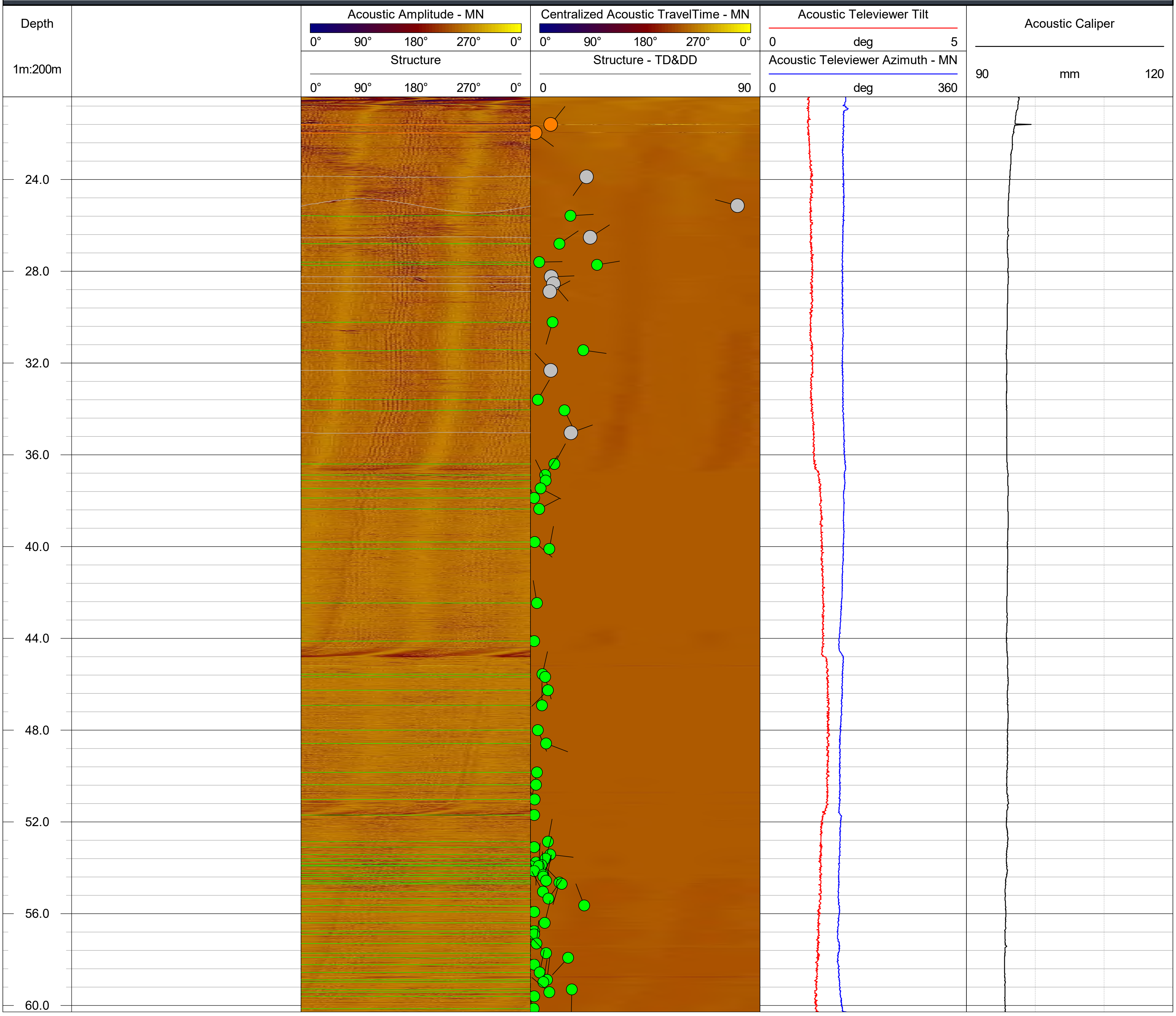


🟠 Partially Open Joint / Fracture

⚪ Filled Fracture / Joint

🟢 Bedding / Banding / Foliation

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)



A19-BH306

PROJECT: 21451329
LOCATION: N 4859406.21; E 684686.37

RECORD OF BOREHOLE: BH306

BORING DATE: May 21 to 23, 2022
DRILL RIG: Diedrich 120 Track Mounted

SHEET 1 OF 8
DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) SHEAR STRENGTH Cu, kPa (20 40 60 80) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-10} 10^{-8} 10^{-6} 10^{-4}) WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION GRAIN SIZE DISTRIBUTION (%)
		BARGE DECK		79.17							GR SA SI CL
0	Mud Rotary Wash Boring (Tricone) UW Casing			0.00							
1											
2											
3											
4		WATER		75.10 4.07							
5											
6											
7											
8											
9											
10											

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: ML/SK
CHECKED: SEMP

RECORD OF BOREHOLE: BH306

PROJECT: 21451329
LOCATION: N 4859406.21; E 684686.37
BORING DATE: May 21 to 23, 2022
DRILL RIG: Diedrich 120 Track Mounted
SHEET 2 OF 8
DATUM: Geodetic

--- CONTINUED FROM PREVIOUS PAGE ---

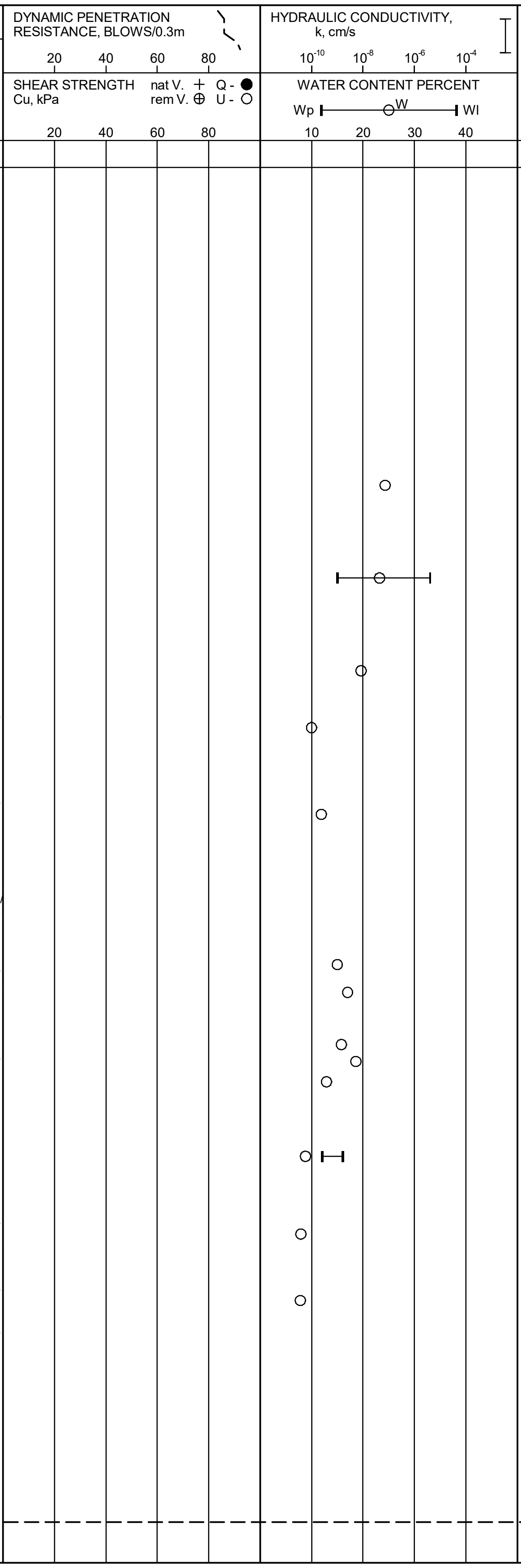
DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)
10	Mud Rotary Wash Boring (Tricone) / UW Casing	WATER	
12		**Lean Clay (CL)**, medium stiff to hard, moist, fine to medium sand, low to medium plasticity (Glaciolacustrine) (Unit 4b)	67.13 / 12.04
15		**Sandy Silty Clay (CL-ML)**, hard, grey, moist, fine to coarse sand, trace of angular fine gravel, low plasticity (Till) (Unit 5)	64.18 / 14.99
		Lean Clay (CL), hard, grey, moist, trace of fine to medium sand, low to medium plasticity (Glaciolacustrine) (Unit 4b)	63.46 / 15.71
		Silt (ML), very dense, grey, moist, fine sand (Glaciolacustrine) (Unit 4a) - Slight plasticity to 16 m depth	15.85
		Silty Clay (CL-ML), hard, grey, moist, fine to coarse sand, low plasticity (Glaciolacustrine) (Unit 4b)	62.90 / 16.27
		Silt (ML), very dense, grey, moist, trace of fine sand (Glaciolacustrine) (Unit 4a)	62.63 / 16.54
17	Mud Rotary Wash Boring (Tricone) / Open	**Silty Clay with Sand (CL-ML)**, hard, grey, moist, fine to coarse sand, trace of angular fine gravel, low plasticity (Till) (Unit 5)	16.66
18.69		**Shale Bedrock Fragments** (Unit 6a) - Bedrock cored from 18.69 m to 70.28 m depth - Refer to Record of Drillhole BH306.	60.50 / 18.69

Notes:

1. Water level in open borehole could not be measured upon completion of soil

SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1	SS	5		
2	SS	22		0 8 45 47
3	SS	33		
4	SS	100/0.07		
5	SS	100/0.14		
6	SS	1964/0.25		
7A, 7B	SS	117/0.25	NP	0 2 87 11
8A, 8B, 8C	SS	164/0.28		
9	SS	158		3 26 49 22
10	SS	151/0.29		
11	SS	100/0.03		
12	SS	100/0.03		

RQD = 98%



PIEZOMETER OR STANDPIPE INSTALLATION

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DEPTH SCALE
1 : 50

LOGGED: ML/SK
CHECKED: SEMP

GTA-BHS 005 S:\CLIENTS\OPG\DARLINGTON_GENERATING_STATION\02_DATA\GINT\DARLINGTON_GENERATING_STATION.GPJ GAL-MIS.GDT 6/5/23

PROJECT: 21451329

LOCATION: N 4859406.21; E 684686.37

RECORD OF BOREHOLE: BH306

SHEET 3 OF 8

BORING DATE: May 21 to 23, 2022

DATUM: Geodetic

DRILL RIG: Diedrich 120 Track Mounted

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-10} 10^{-8} 10^{-6} 10^{-4}); WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION; GRAIN SIZE DISTRIBUTION (%)
		--- CONTINUED FROM PREVIOUS PAGE ---									GR SA SI CL
20		drilling due to use of mud-rotary technique. 2. Efficiency of the SPT hammer utilized was 77.9 %.									
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											

DEPTH SCALE

1 : 50

LOGGED: ML/SK

CHECKED: SEMP

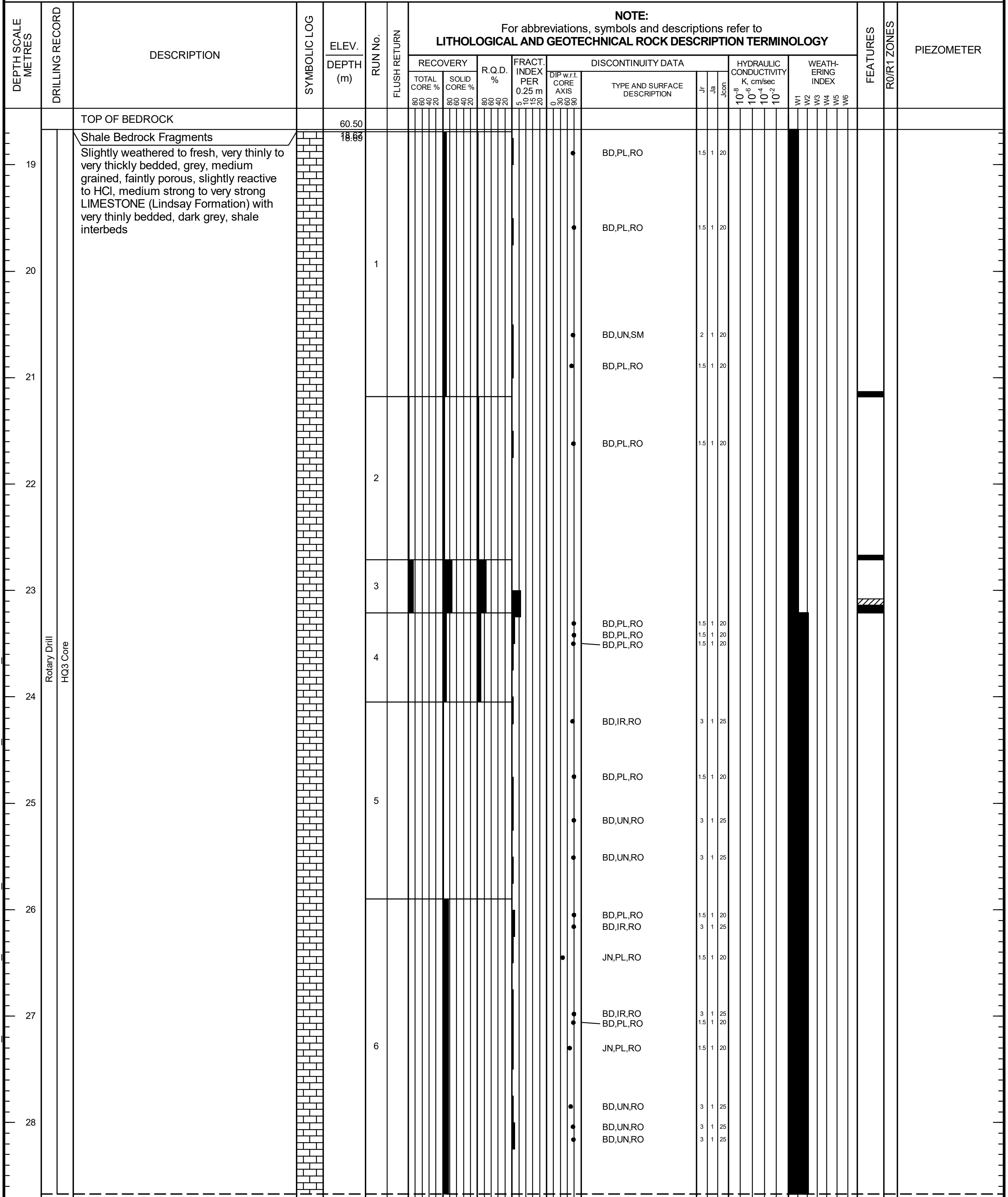
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859406.21; E 684686.37
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH306

DRILLING DATE: May 23 to June 2, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 3 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



TOP OF BEDROCK

Shale Bedrock Fragments

Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to very strong LIMESTONE (Lindsay Formation) with very thinly bedded, dark grey, shale interbeds

TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,UN,SM	2	1	20
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,IR,RO	3	1	25
BD,PL,RO	1.5	1	20
BD,UN,RO	3	1	25
BD,UN,RO	3	1	25
BD,PL,RO	1.5	1	20
BD,IR,RO	3	1	25
JN,PL,RO	1.5	1	20
BD,IR,RO	3	1	25
BD,PL,RO	1.5	1	20
JN,PL,RO	1.5	1	20
BD,UN,RO	3	1	25
BD,UN,RO	3	1	25
BD,UN,RO	3	1	25

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: ML
CHECKED: PKS

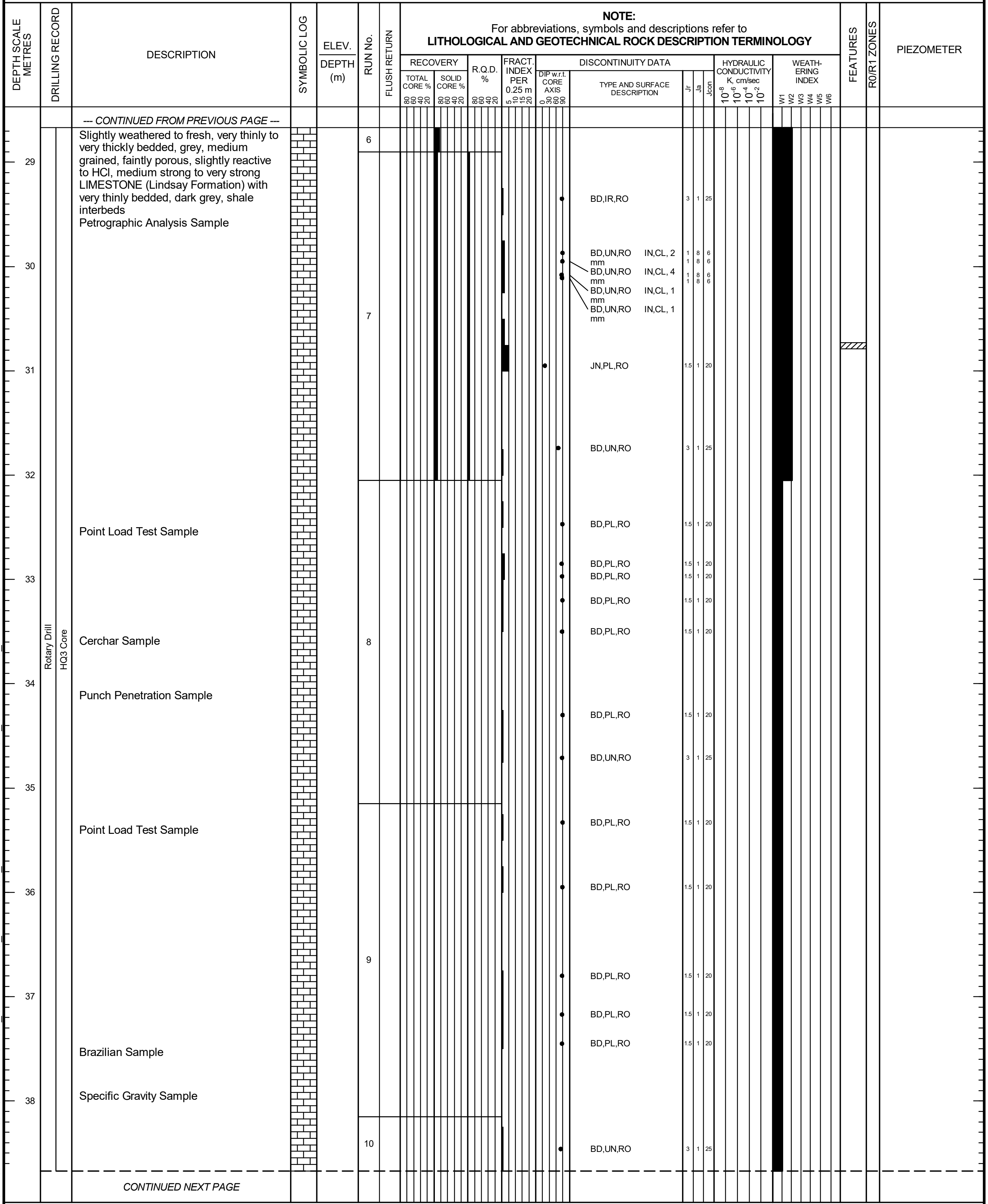
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859406.21; E 684686.37
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH306

DRILLING DATE: May 23 to June 2, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

DATUM: Geodetic

NOTE: For abbreviations, symbols and descriptions refer to **LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY**



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Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to very strong LIMESTONE (Lindsay Formation) with very thinly bedded, dark grey, shale interbeds

Petrographic Analysis Sample

Point Load Test Sample

Cerchar Sample

Punch Penetration Sample

Point Load Test Sample

Brazilian Sample

Specific Gravity Sample

TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,IR,RO	3	1	25
BD,UN,RO IN,CL, 2 mm	1	8	6
BD,UN,RO IN,CL, 4 mm	1	8	6
BD,UN,RO IN,CL, 1 mm	1	8	6
BD,UN,RO IN,CL, 1 mm	1	8	6
JN,PL,RO	1.5	1	20
BD,UN,RO	3	1	25
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,UN,RO	3	1	25
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,UN,RO	3	1	25

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: ML
CHECKED: PKS

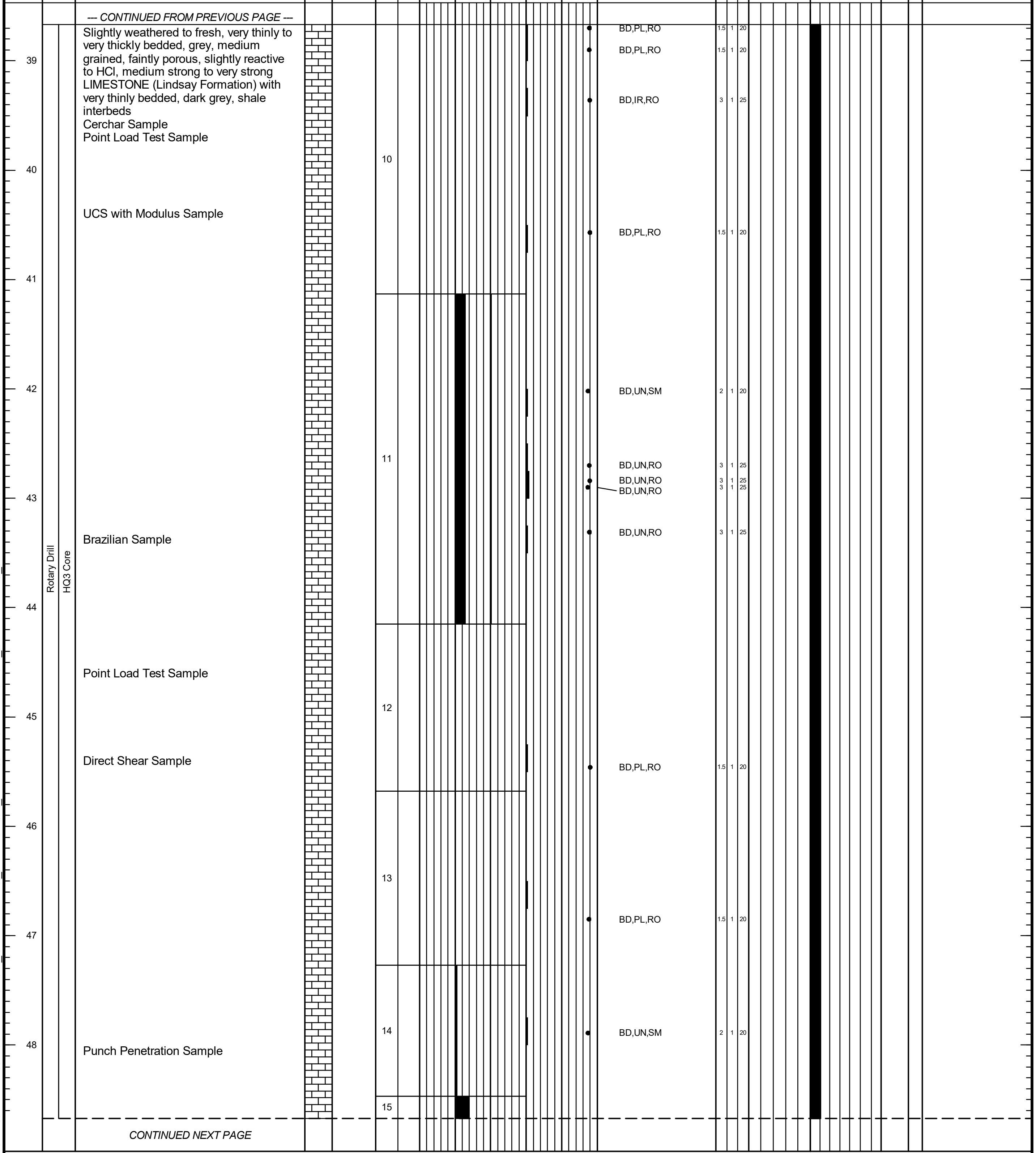
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859406.21; E 684686.37
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH306

DRILLING DATE: May 23 to June 2, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 5 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



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Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to very strong LIMESTONE (Lindsay Formation) with very thinly bedded, dark grey, shale interbeds
Cerchar Sample
Point Load Test Sample

UCS with Modulus Sample

Brazilian Sample

Point Load Test Sample

Direct Shear Sample

Punch Penetration Sample

TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,IR,RO	3	1	25
BD,PL,RO	1.5	1	20
BD,UN,SM	2	1	20
BD,UN,RO	3	1	25
BD,UN,RO	3	1	25
BD,UN,RO	3	1	25
BD,UN,RO	3	1	25
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,UN,SM	2	1	20

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: ML
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859406.21; E 684686.37
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH306

SHEET 6 OF 8

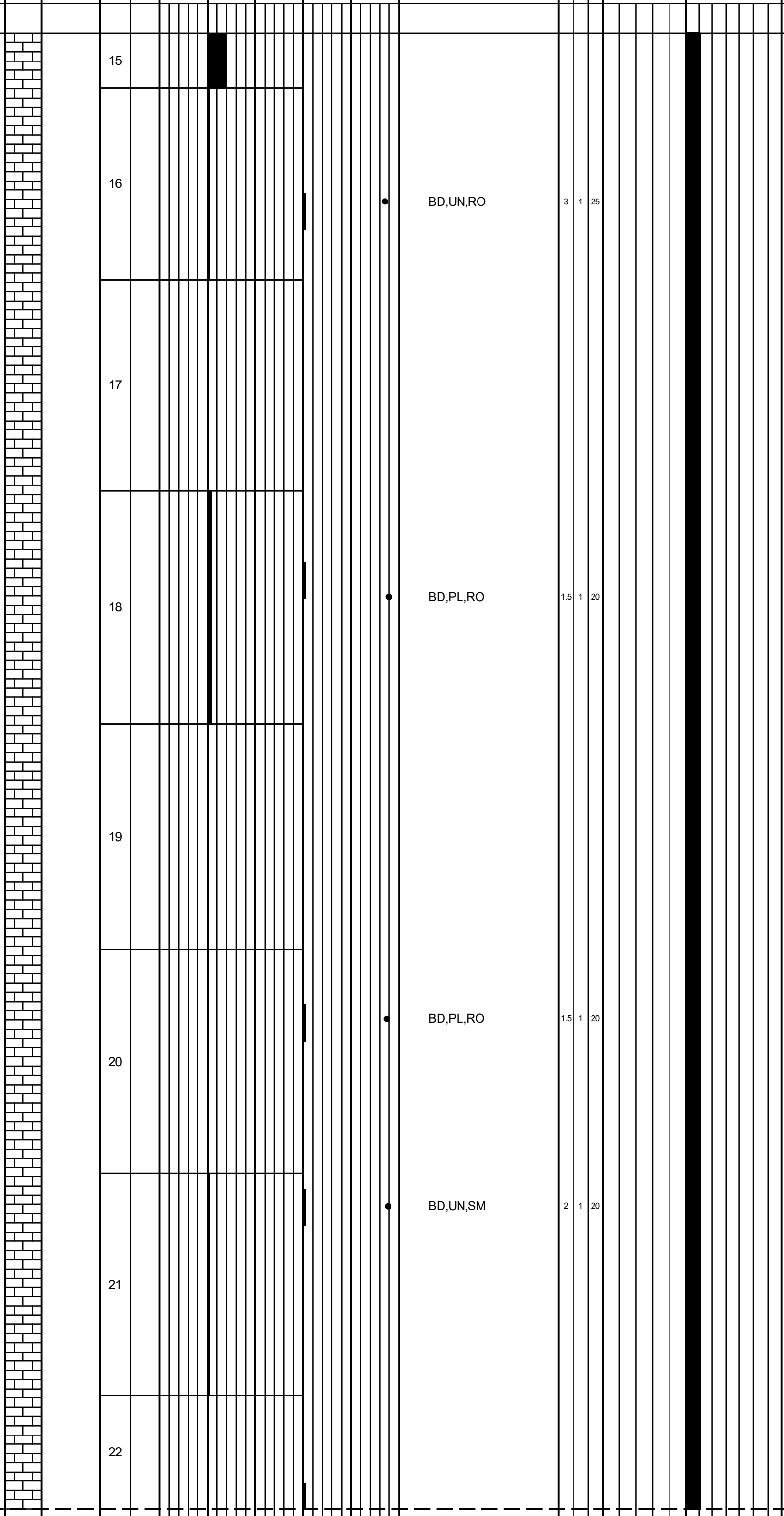
DRILLING DATE: May 23 to June 2, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION
49–58	Rotary Drill HQ3 Core	Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to very strong LIMESTONE (Lindsay Formation) with very thinly bedded, dark grey, shale interbeds Petrographic Analysis Sample Point Load Test Sample



Depth (m)	RUN No.
48.7–49.1	15
49.1–50.4	16
50.4–51.8	17
51.8–53.4	18
53.4–54.9	19
54.9–56.4	20
56.4–57.9	21
57.9–58.7	22

TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,UN,RO	3	1	25
BD,PL,RO	1.5	1	20
BD,PL,RO	1.5	1	20
BD,UN,SM	2	1	20

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: ML
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859406.21; E 684686.37
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

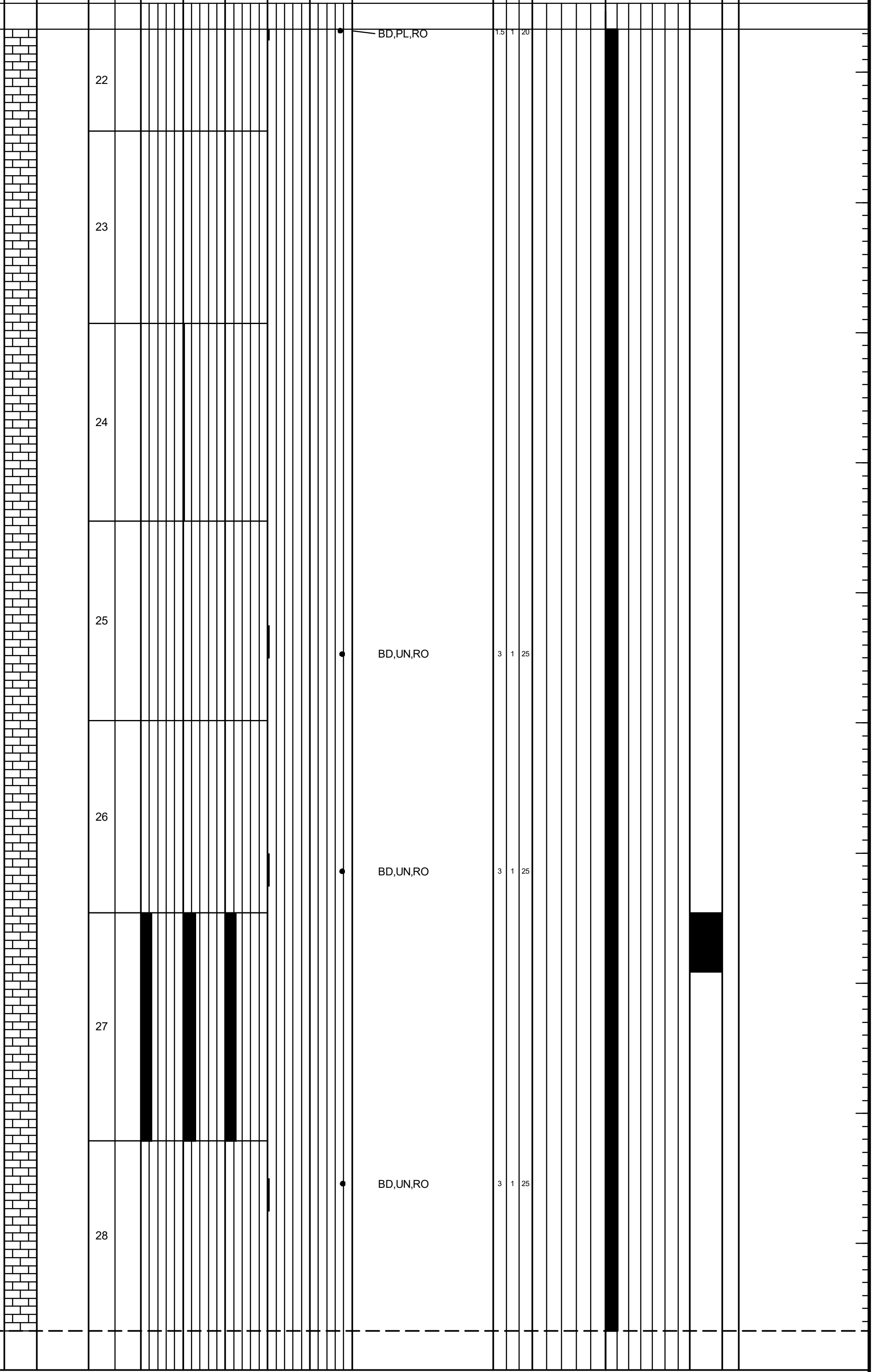
RECORD OF DRILLHOLE: BH306

DRILLING DATE: May 23 to June 2, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 7 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION
		--- CONTINUED FROM PREVIOUS PAGE ---
59 60 61 62 63 64 65 66 67 68	Rotary Drill HQ3 Core	Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to very strong LIMESTONE (Lindsay Formation) with very thinly bedded, dark grey, shale interbeds
		CONTINUED NEXT PAGE



TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,PL,RO	1.5	1	20
BD,UN,RO	3	1	25
BD,UN,RO	3	1	25
BD,UN,RO	3	1	25

DEPTH SCALE
1 : 50

LOGGED: ML
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859406.21; E 684686.37
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH306

DRILLING DATE: May 23 to June 2, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 8 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

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DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (m)	RUN No.	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
69 70	Rotary Drill HQ3 Core	Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to very strong LIMESTONE (Lindsay Formation) with very thinly bedded, dark grey, shale interbeds	8.89 70.28	29	BD,UN,RO	3	1	25
71 72 73 74 75 76 77 78		END OF DRILLHOLE						

DEPTH SCALE
1 : 50

LOGGED: ML
CHECKED: PKS

Water Content Summary
ASTM D2216

Test Request # 21451329-21600-610 BH306
Client: E.S. Fox Limited
Project Name: ES Fox/DNNP Invest/Bowmanville
Project Number: 21451329-21600-610
Project Location:

Sample Location	Sample				Soil Description	Water Content %	Method	Remarks
	Ref	Top (m)	Base (m)	Type				
BH306	1	12.04	12.65	SS		24.3	B	
BH306	2	12.80	13.26	SS		23.2	B	
BH306	3	13.50	13.96	SS		19.6	B	
BH306	4	14.02	14.26	SS		10.0	B	
BH306	5	14.63	14.90	SS		11.9	B	
BH306	7A	15.79	16.00	SS		15.0	B	
BH306	7B	16.00	16.18	SS		17.0	B	
BH306	8A	16.40	16.54	SS		15.8	B	
BH306	8B	16.54	16.66	SS		18.6	B	
BH306	8C	16.66	16.84	SS		12.9	B	
BH306	9	17.07	17.53	SS		8.8	B	
BH306	10	17.65	18.11	SS		7.9	B	
BH306	11	18.29	18.44	SS		7.8	B	

Notes:

Tested by: JTimms **Date:** 05 Oct 2022
Checked by: MRuck **Date:** 27 Oct 2022

Disclaimer:

Reviewed by: JoNorris **Date:** 10 Nov 2022

GOLDER
MEMBER OF WSP

PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422

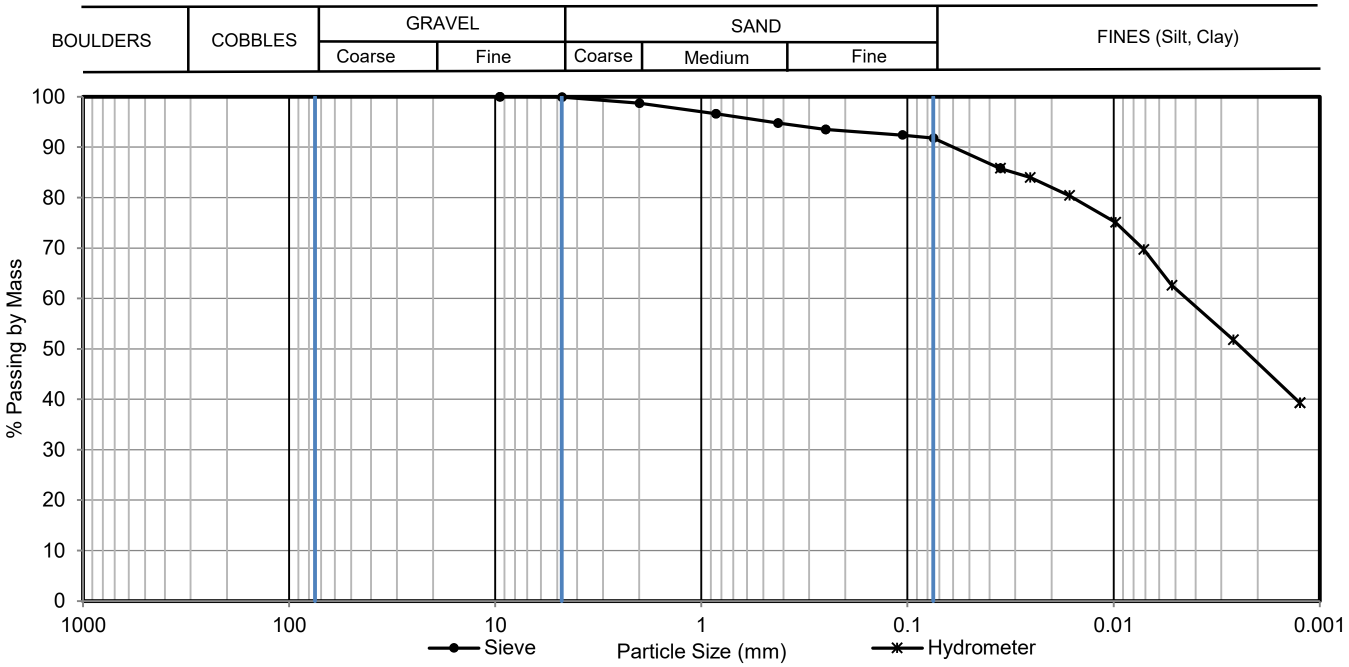
Method B

Test Request #	21451329-21600-610 BH306	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH306
Source:		Sample No.:	2
Soil Description:		Type:	SS
		Depth (m):	12.80 - 13.26

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	24 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)

BOULDERS	COBBLES	GRAVEL	SAND	FINES (Silt, Clay)
		0.1	8.1	91.8



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/8"	9.5	100.0	0.0355	85.8
#4	4.75	99.9	0.0254	84.0
#10	2	98.7	0.0164	80.4
#20	0.85	96.6	0.0098	75.1
#40	0.425	94.8	0.0071	69.7
#60	0.25	93.5	0.0052	62.6
#140	0.106	92.4	0.0026	51.8
#200	0.075	91.8	0.0013	39.3
			0.005 mm	61.89
			0.002 mm	47.20
			D60	0.00
			D30	
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

Tested by: KGill **Date:** 24 Oct 2022 **Checked by:** MRuck **Date:** 09 Nov 2022 **Reviewed by:** JoNorris **Date:** 10 Nov 2022

PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422

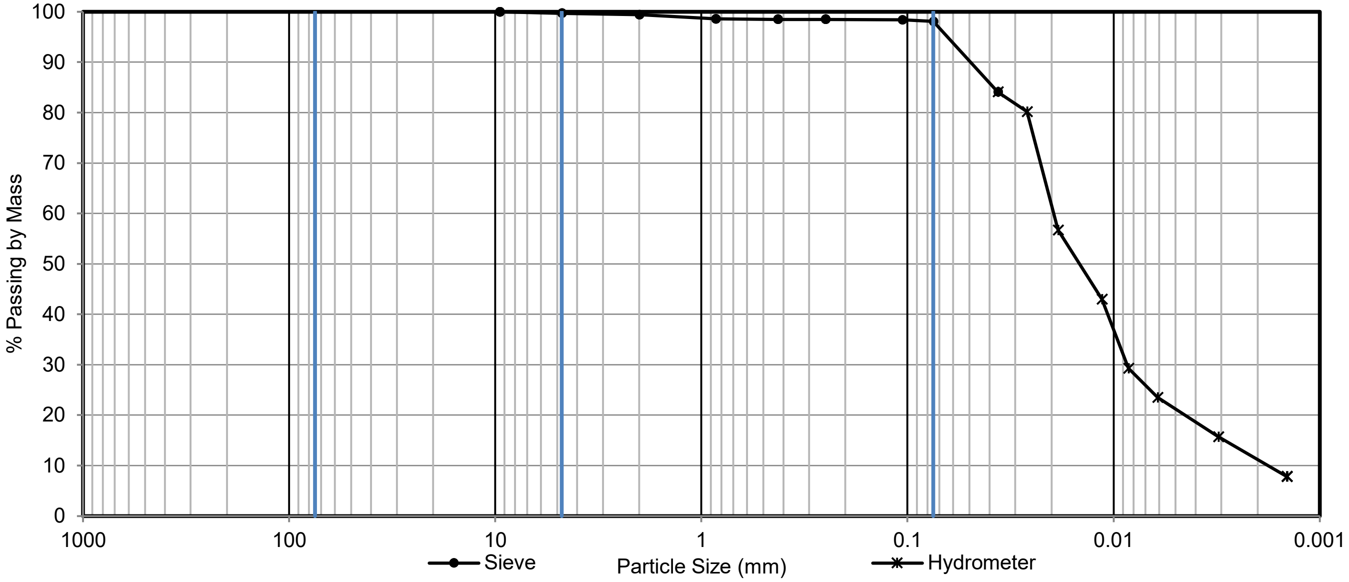
Method B

Test Request #	21451329-21600-610 BH306	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH306
Source:		Sample No.:	7A
Soil Description:		Type:	SS
		Depth (m):	15.79 - 16.00

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	17 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)

BOULDERS	COBBLES	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	
		0.3		1.6			98.1



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/8"	9.5	100.0	0.0364	84.1
#4	4.75	99.7	0.0263	80.2
#10	2	99.4	0.0186	56.7
#20	0.85	98.6	0.0114	43.0
#40	0.425	98.5	0.0085	29.3
#60	0.25	98.5	0.0061	23.5
#140	0.106	98.4	0.0031	15.7
#200	0.075	98.1	0.0014	7.8
			0.005 mm	21.20
			0.002 mm	11.18
			D60	0.02
			D30	0.01
			D10	0.00
			Cu	11.00
			Cc	2.10

Notes:

Disclaimer:

Tested by: MKMarren **Date:** 17 Oct 2022 **Checked by:** MRuck **Date:** 27 Oct 2022 **Reviewed by:** JoNorris **Date:** 10 Nov 2022

PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422

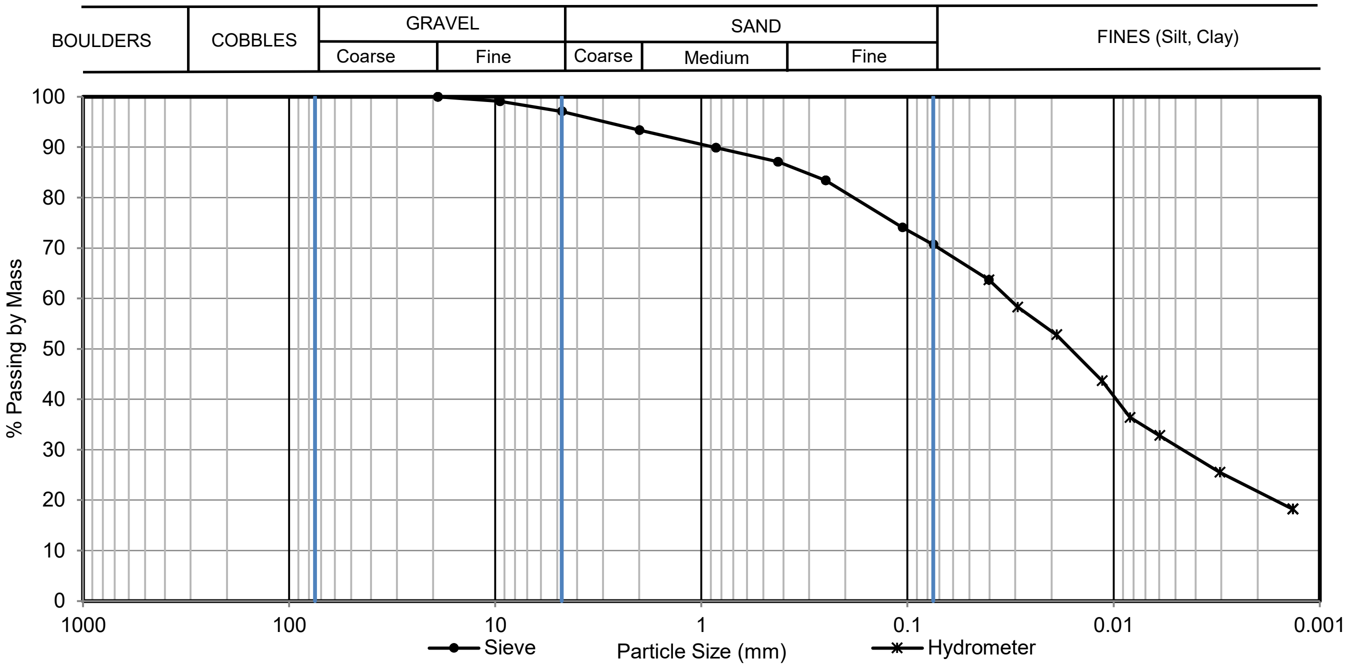
Method B

Test Request #	21451329-21600-610 BH306	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH306
Source:		Sample No.:	9
Soil Description:		Type:	SS
		Depth (m):	17.07 - 17.53

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	18 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)

Gravel	Sand	Fines
2.9	26.4	70.7



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0403	63.7
3/8"	9.5	99.1	0.0292	58.3
#4	4.75	97.1	0.0189	52.8
#10	2	93.4	0.0114	43.7
#20	0.85	89.9	0.0083	36.4
#40	0.425	87.1	0.0060	32.8
#60	0.25	83.4	0.0031	25.5
#140	0.106	74.1	0.0014	18.2
#200	0.075	70.7		
			0.005 mm	30.86
			0.002 mm	21.72
			D60	0.03
			D30	0.00
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

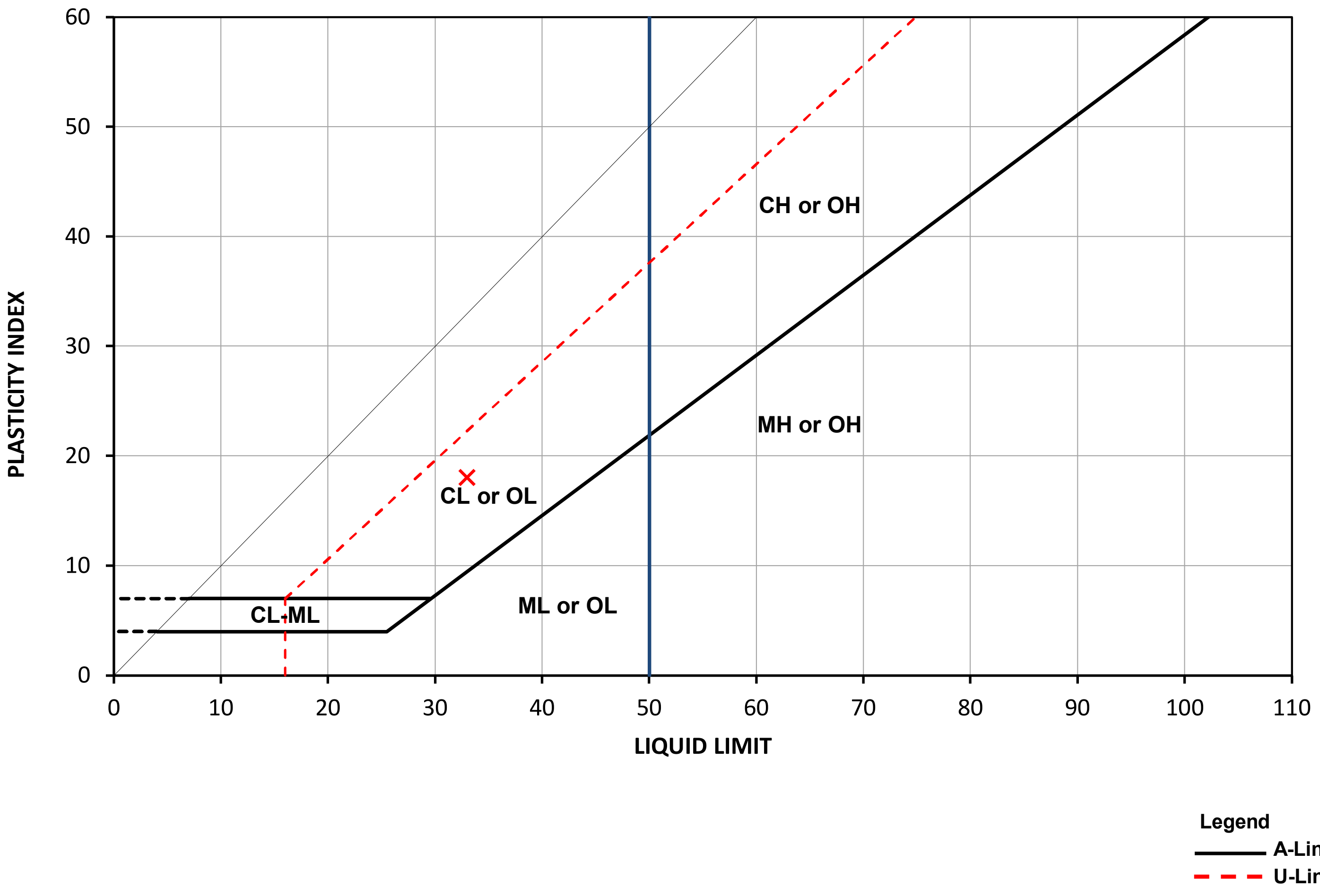
Tested by: MKMarren **Date:** 18 Oct 2022 **Checked by:** MRuck **Date:** 27 Oct 2022 **Reviewed by:** JoNorris **Date:** 10 Nov 2022

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318
Method B - One-point Test

Test Request #	21451329-21600-610 BH306	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH306
Source:		Sample No.:	2
Soil Description:		Type:	SS
		Depth (m):	12.80 - 13.26

Specimen Reference NA Specimen Depth (m): NA Date of Test 28 Oct 2022

Specimen Description NA



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH306	2	12.80	13.26	ND	23.2	33	15	18	0.46

NP = Non-Plastic
ND = Not Determined

Test Preparation

Notes:

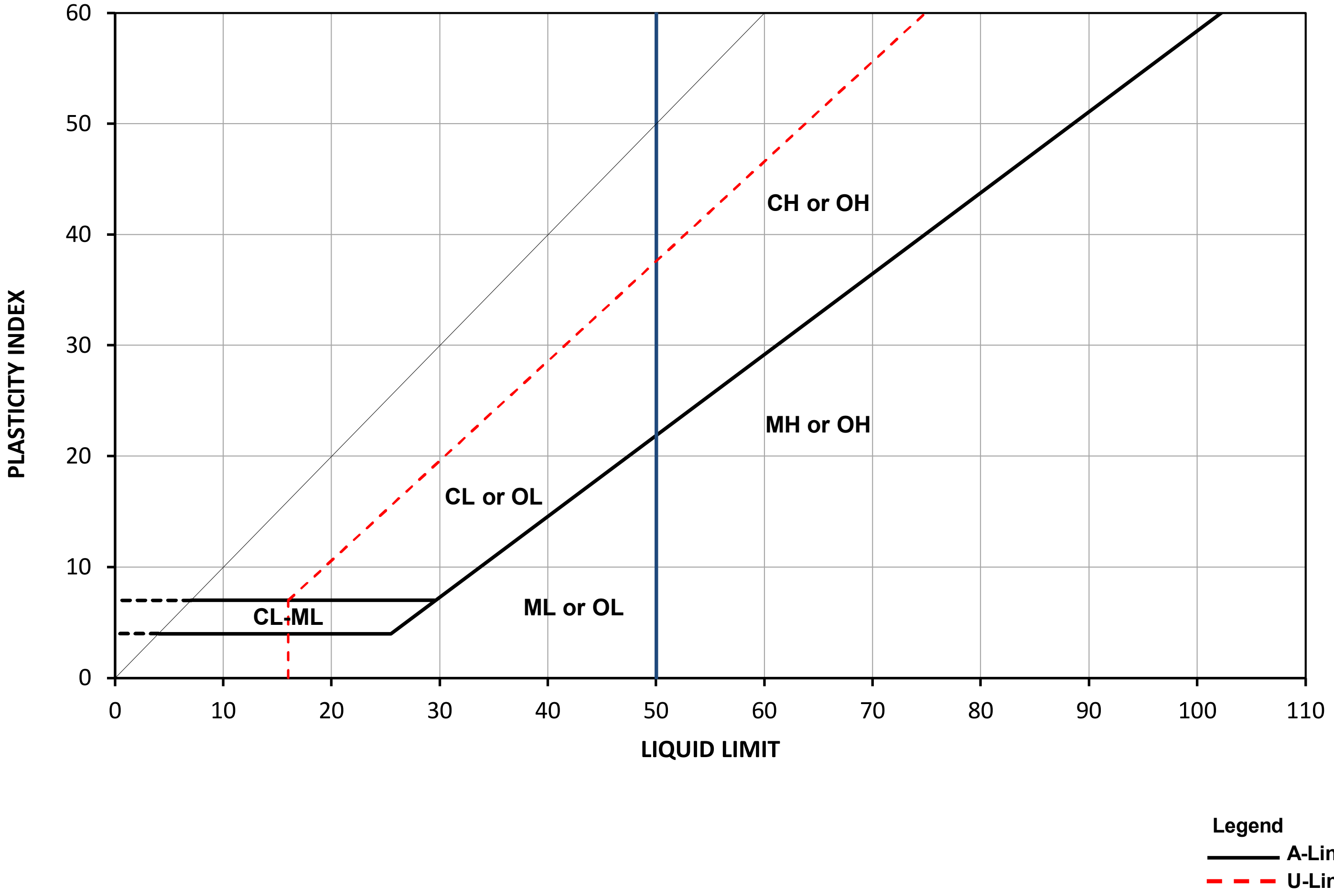
Disclaimer:
The laboratory testing services reported herein have been performed in accordance with the terms of a contract with Golder's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of Golder's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Tested by: XMeng **Date:** 28 Oct 2022
Checked by: MRuck **Date:** 08 Nov 2022
Reviewed by: JoNorris **Date:** 10 Nov 2022

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318

Test Request #	21451329-21600-610 BH306	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH306
Source:		Sample No.:	7A
Soil Description:		Type:	SS
		Depth (m):	15.79 - 16.00

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	19 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH306	7A	15.79	16.00	95	15.0		NP		

NP = Non-Plastic
ND = Not Determined

Test Preparation

Notes:

Tested by: JTimms **Date:** 19 Oct 2022
Checked by: MRuck **Date:** 27 Oct 2022

Disclaimer:

Reviewed by: JoNorris **Date:** 10 Nov 2022

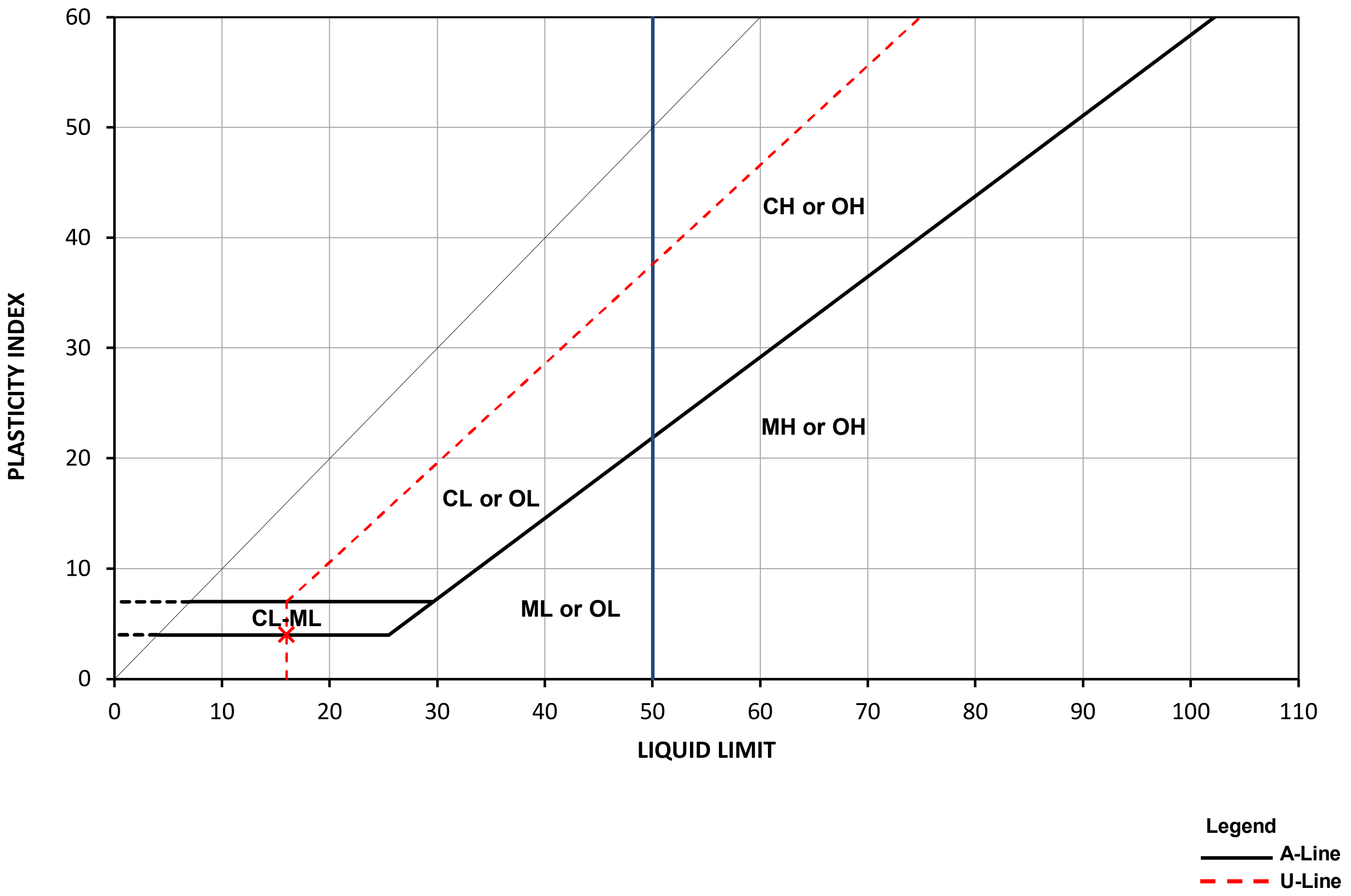
LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

ASTM D4318

Method A - Multipoint Test

Test Request #	21451329-21600-610 BH306	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH306
Source:		Sample No.:	9
Soil Description:		Type:	SS
		Depth (m):	17.07 - 17.53

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	21 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH306	9	17.07	17.53	87	8.8	16	12	4	-0.80

NP = Non-Plastic
ND = Not Determined

Test Preparation

Dry Preparation Tested after >425um removed

Notes:

Tested by: JTimms **Date:** 21 Oct 2022
Checked by: MRuck **Date:** 27 Oct 2022

Disclaimer:

Reviewed by: JoNorris **Date:** 10 Nov 2022

SPECIFIC GRAVITY OF SOIL SOLIDS
ASTM D854
Pycnometer Method B

Test Request #	21451329-21600-610 BH306	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	NA
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH306
Source:		Sample No.:	2
Soil Description:		Type:	SS
		Depth (m)	12.80 - 13.26

Specimen Reference	NA	Specimen Depth	NA	Date of Test	28 Oct 2022
Specimen Description	NA				

Proportions		
Percentage Passing (4.75 mm)		%
Percentage Retained (4.75 mm)		%

Fine Fraction (D854)		
Calibrated Mass of Pycnometer		g
Calibrated Volume of Pycnometer	249.72	mL
Mass of Pycnometer	90.96	g
Test Temperature	17.8	oC
Mass of Pycnometer, soil and water	366.07	g
Mass of Container (or tare)	3.54	g
Mass of dry soil and container	44.17	g
Dry mass of soil solids	40.63	g
Specific Gravity at 20oC	**2.73**	

Coarse Fraction (C127)		
Mass of Oven Dry Sample		g
Mass of saturated-surface-dry in air		g
Apparent mass of saturated test sample in water		g
Specific Gravity Oven Dry		
Specific Gravity Saturated Surface Dry		
Specific Gravity with Weighted Average	**2.73**	

Notes:

Disclaimer:

Tested by:	DPatel	**Date:**	28 Oct 2022
Checked by:	MRuck	**Date:**	09 Nov 2022

Reviewed by: JoNorris **Date:** 10 Nov 2022

SPECIFIC GRAVITY OF SOIL SOLIDS

ASTM D854

Pycnometer Method B

Test Request #	21451329-21600-610 BH306	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	NA
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH306
Source:		Sample No.:	7B
Soil Description:		Type:	SS
		Depth (m)	16.00 - 16.18

Specimen Reference	NA	Specimen Depth	NA	Date of Test	27 Oct 2022
Specimen Description	NA				

Proportions		
Percentage Passing (4.75 mm)		%
Percentage Retained (4.75 mm)		%

Fine Fraction (D854)		
Calibrated Mass of Pycnometer		g
Calibrated Volume of Pycnometer	249.66	mL
Mass of Pycnometer	90.68	g
Test Temperature	19.4	oC
Mass of Pycnometer, soil and water	365.29	g
Mass of Container (or tare)	90.69	g
Mass of dry soil and container	130.90	g
Dry mass of soil solids	40.21	g
Specific Gravity at 20oC	**2.71**	

Coarse Fraction (C127)		
Mass of Oven Dry Sample		g
Mass of saturated-surface-dry in air		g
Apparent mass of saturated test sample in water		g
Specific Gravity Oven Dry		
Specific Gravity Saturated Surface Dry		
Specific Gravity with Weighted Average	**2.71**	

Notes:

Tested by: DPatel **Date:** 27 Oct 2022

Checked by: MRuck **Date:** 09 Nov 2022

Disclaimer:

Reviewed by: JoNorris **Date:** 10 Nov 2022

Water (Moisture) Content, Ash Content, and Organic Material of Soils
ASTM D2974 Method A

Test Request #	21451329-21600-610 BH306	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH306
Source:		Sample No.:	1
Soil Description:		Type:	SS
		Depth (m):	12.04 - 12.65

Specimen Reference	NA	Specimen Depth	NA	Date of Test	05 Oct 2022
Specimen Description	NA				

Furnace Temperature During Test (°C)	
Duration of Test (nearest 15 minutes)	8640
Mass of Crucible With Lid (g)	61.16
Moist Mass of Specimen Plus Crucible With Lid (g)	121.99
Oven Dry Mass of Specimen Plus Crucible With Lid (g)	111.18
Mass of Crucible With Lid Plus Ash (g)	110.67
Water Content (%)	22
Ash Content (%)	99.0
Organic Material (%)	1.0

Test Preparation

Notes:

Disclaimer:

Tested by: JTimms **Date:** 05 Oct 2022

Checked by: MRuck **Date:** 27 Oct 2022

Reviewed by: JoNorris **Date:** 10 Nov 2022

SOIL RESISTIVITY USING THE WENNER FOUR ELECTRODE METHOD (ASTM G57-20)

October 5, 2022
Golder Project Number: 21451329-21600-610

Attention: Sarah Poot

Sample Description: **BH306, SA3, 13.50- 13.96m**

Date Scheduled:	October 3, 2022	Sampled By:	Golder Associates Ltd.
Date Received:	October 4, 2022	Golder Lab No.:	G-22-253
Date Tested:	October 5, 2022	Tested By:	E. Shallhorn

Resistivity Meter Model Number	Miller 400D
Soil Box Factor	0.976377953
Temperature of Sample (°C)	22.0
Measured Resistance (ohm)	1310.0
Resistivity (ohm•cm)	1279.1
Temperature Corrected Resistivity (ohm•cm)	**1487.0**

Data Input By: E. Shallhorn

Reviewed by:

Jodi Norris, Technical and Quality Coordinator

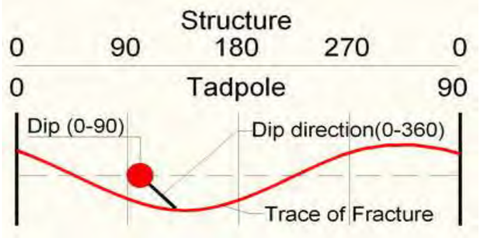
CCIL
The Voice Of Independent Canadian Laboratories
La voix des laboratoires indépendants canadiens

Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

Geophysical Record of Borehole: BH306

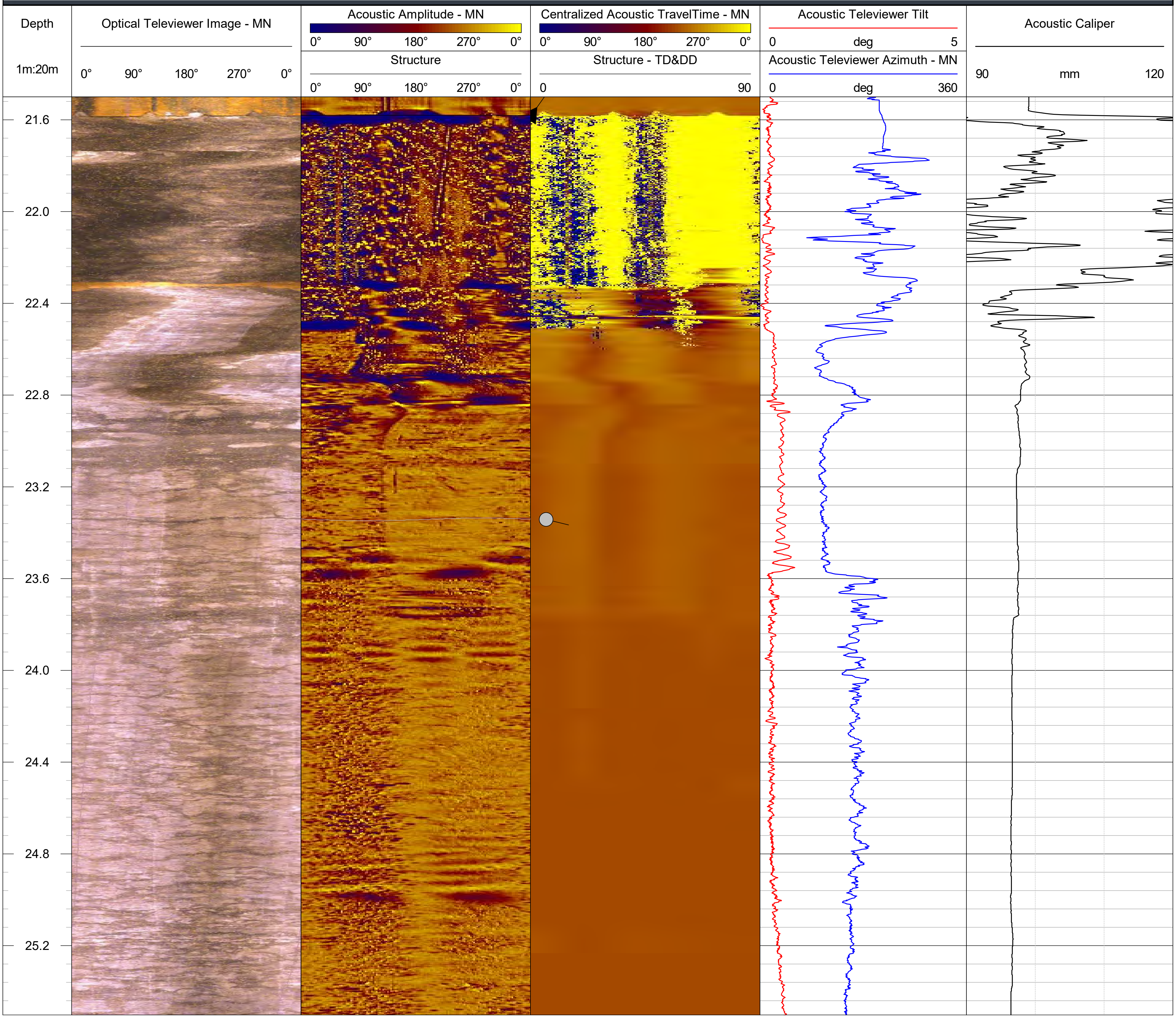
Log Title:	Darlington DNNP Geophysical Log
Project Number:	21451329
Client:	Ontario Power Generation
Date:	January 2023

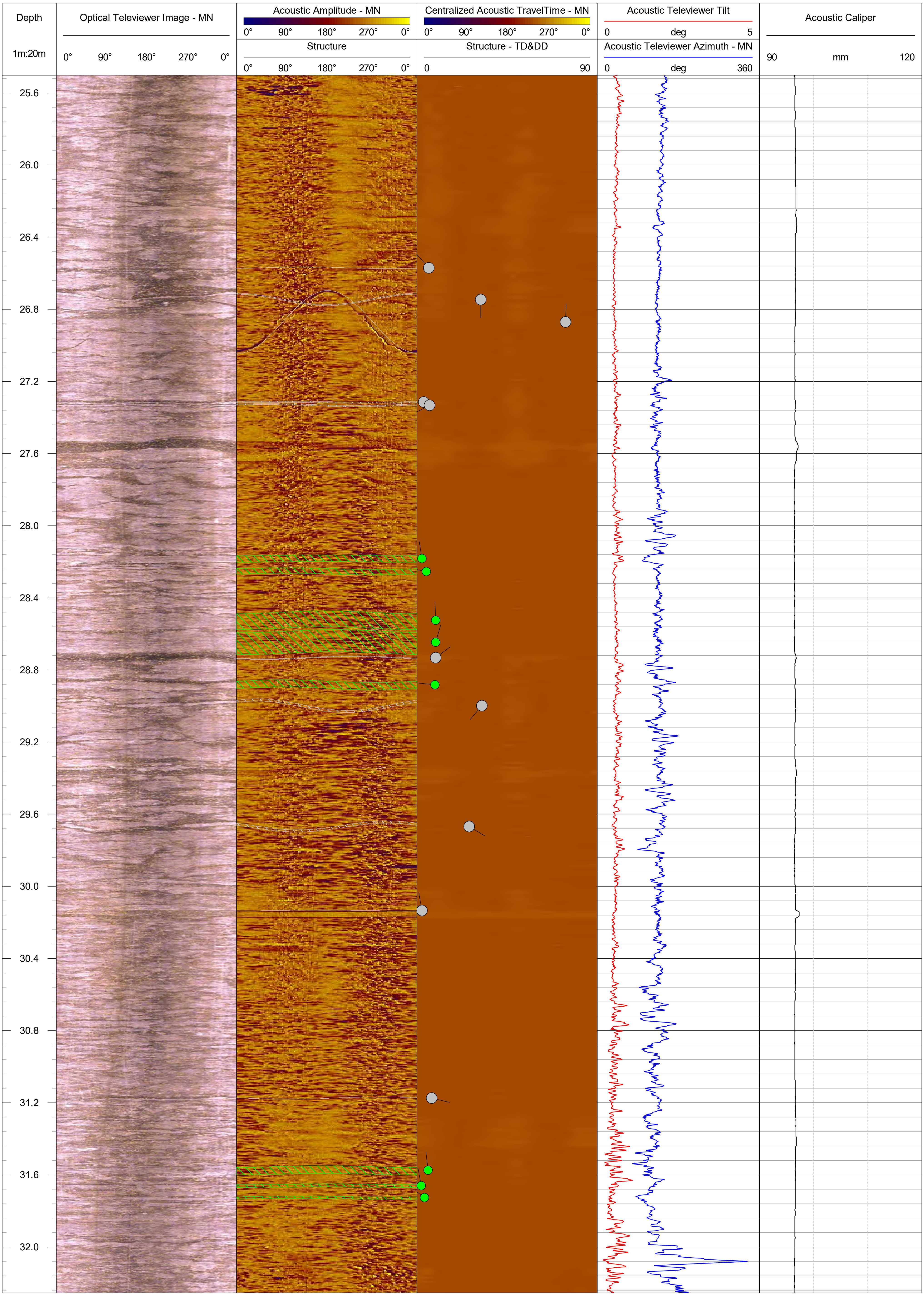
Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	~22.45 m bgs	**Location:**	Darlington, Ontario
Easting:	684686.37 m	**Drilled Depth:**	70.3 m bgs	**Water Level:**	N/A	**Log Date:**	June-10-2022
Northing:	4859406.21 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	79.17 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	P. Leith



- ● Major Open Joint / Fracture
- ● Filled Fracture / Joint
- ● Bedding / Banding / Foliation
- ◀ Casing

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)

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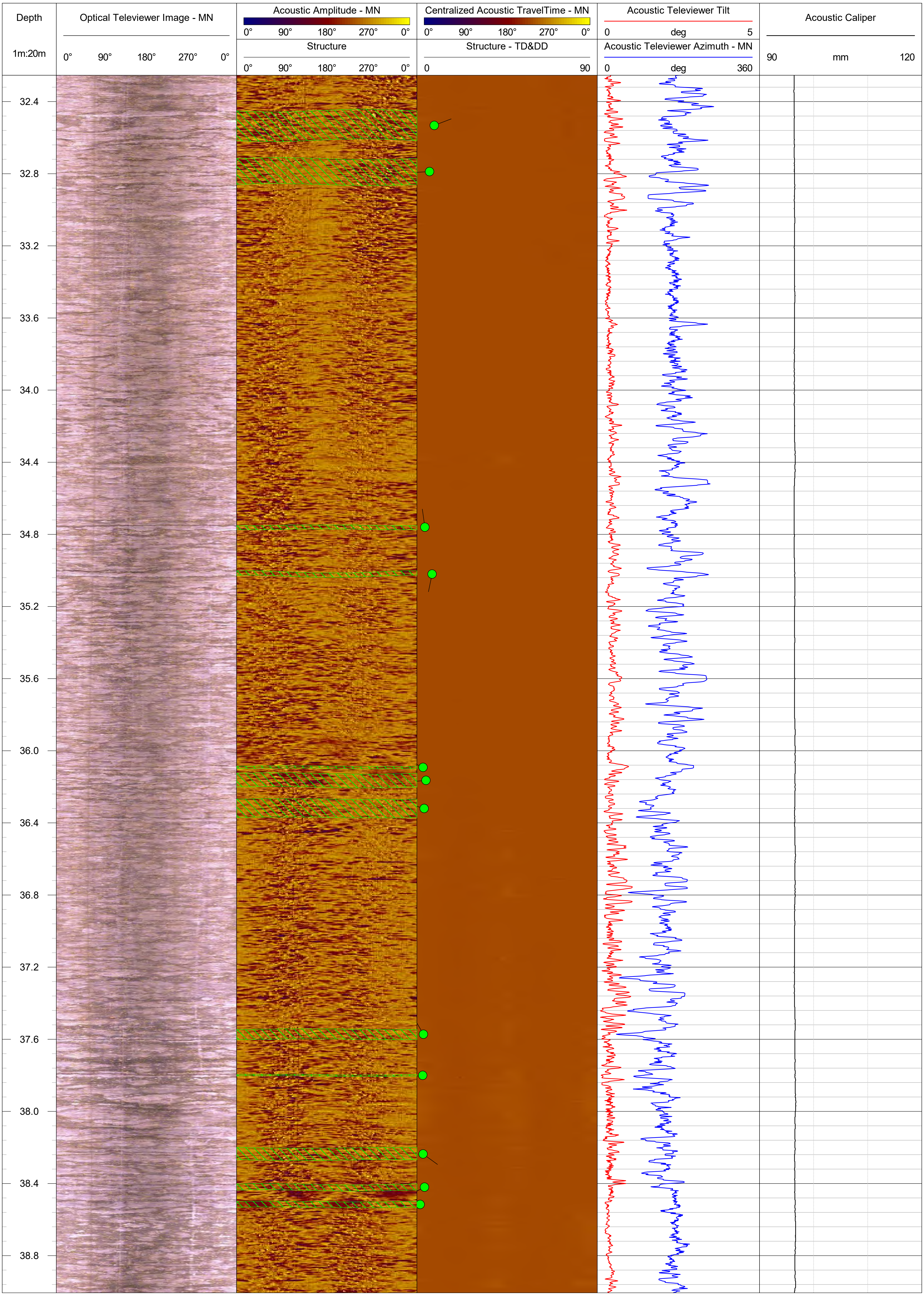
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
25.6
26.0
26.4
26.8
27.2
27.6
28.0
28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0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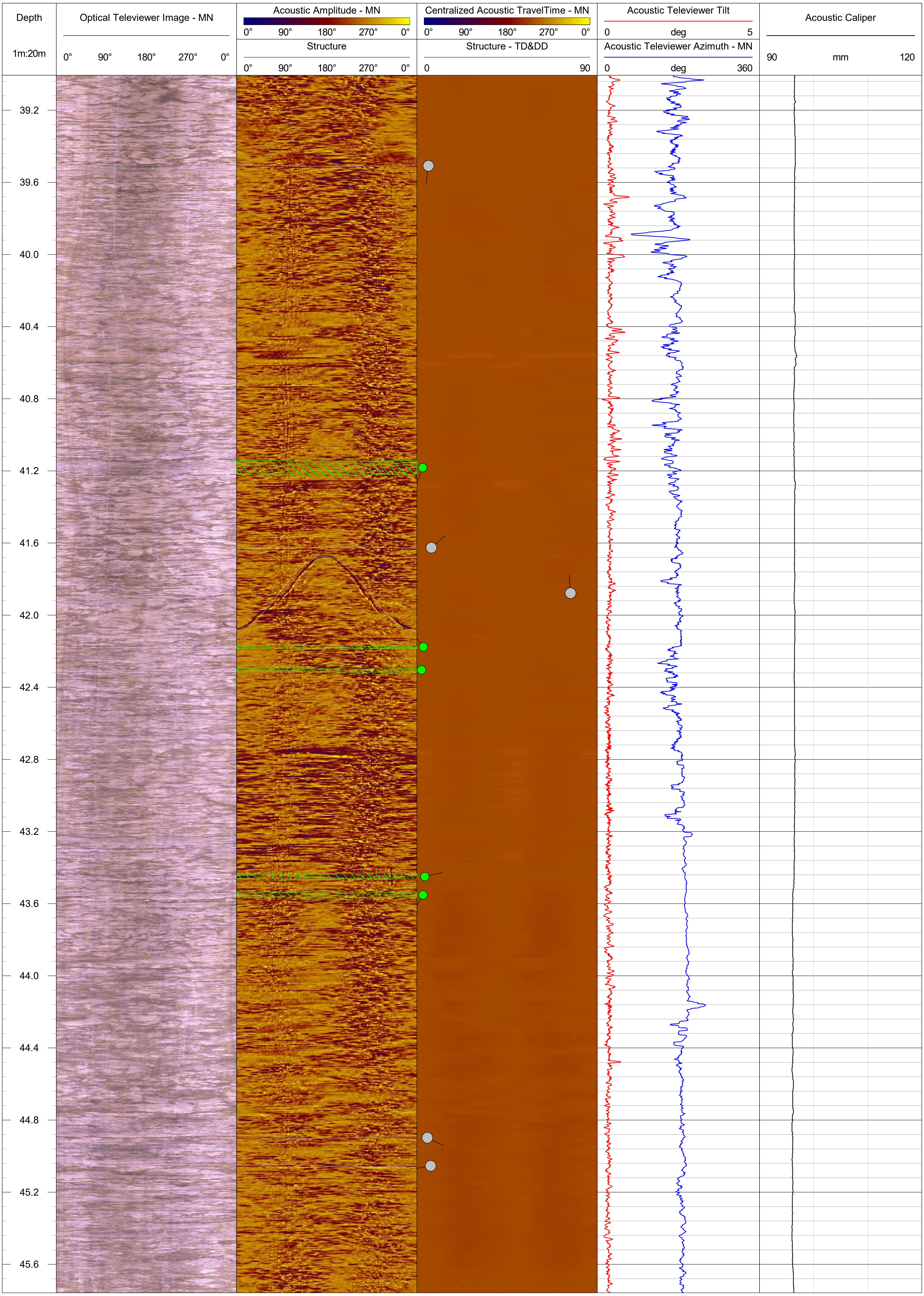
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
32.4
32.8
33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8
37.2
37.6
38.0
38.4
38.8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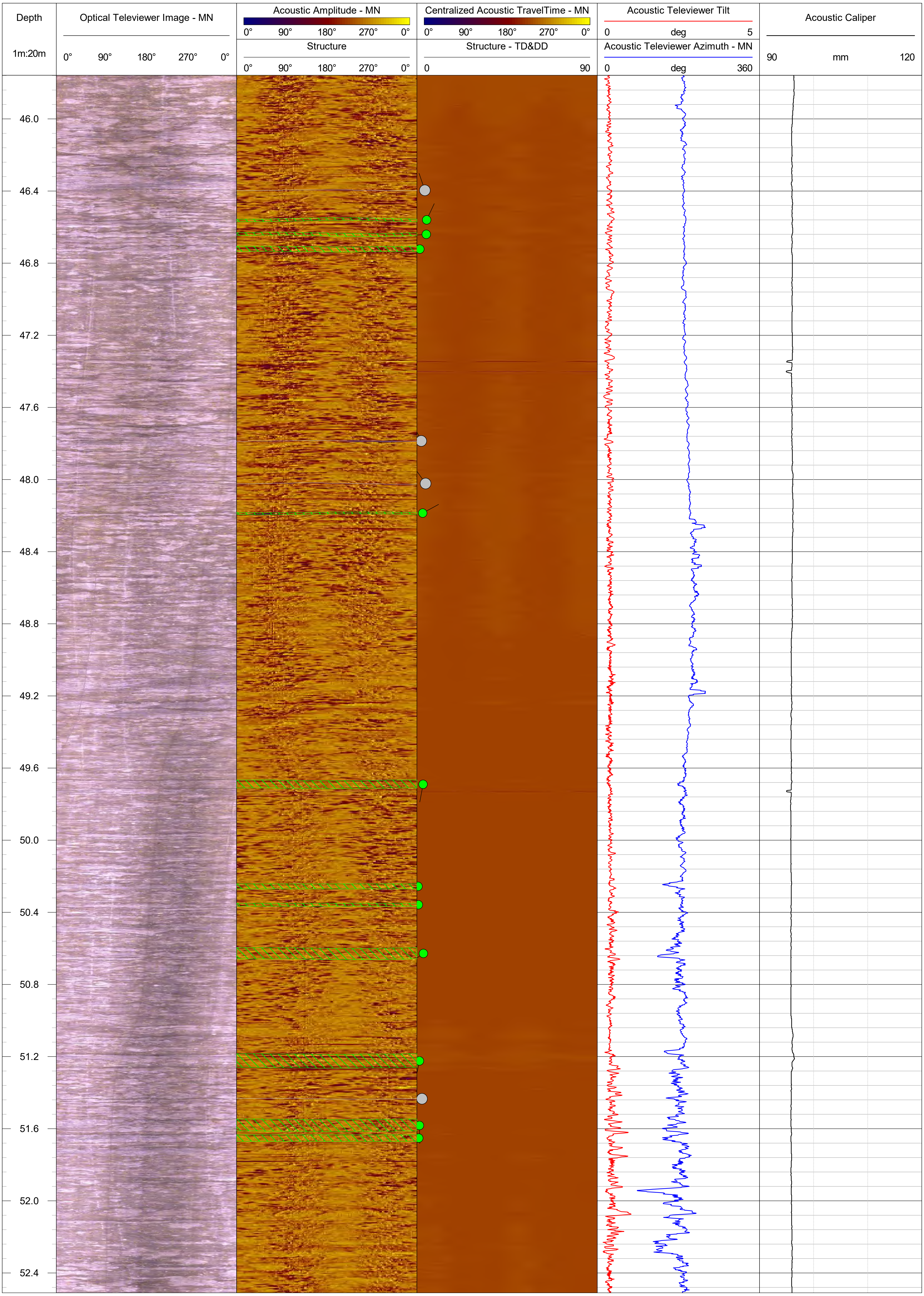
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
39.2
39.6
40.0
40.4
40.8
41.2
41.6
42.0
42.4
42.8
43.2
43.6
44.0
44.4
44.8
45.2
45.6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Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
46.0
46.4
46.8
47.2
47.6
48.0
48.4
48.8
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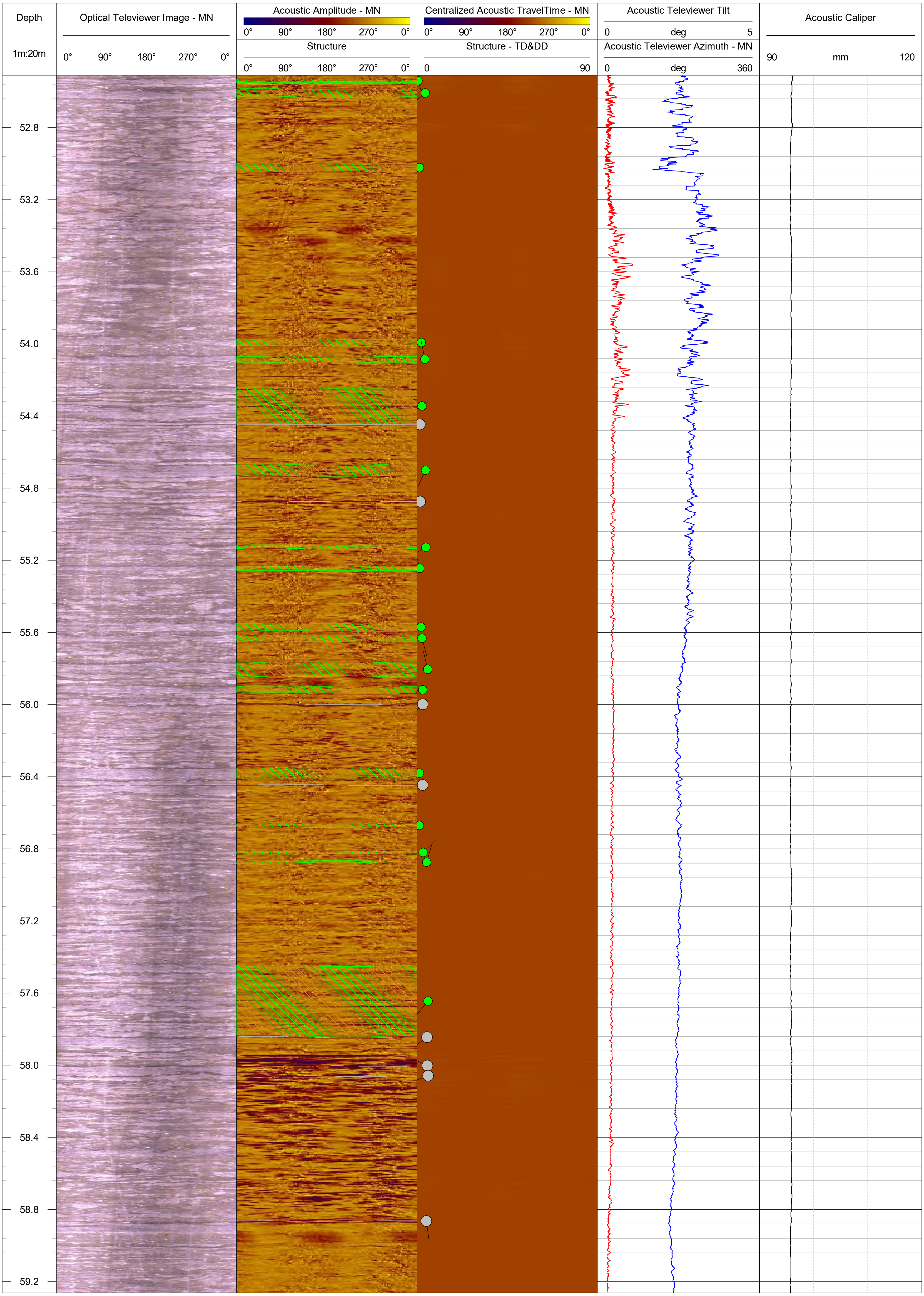
51.6
52.0
52.4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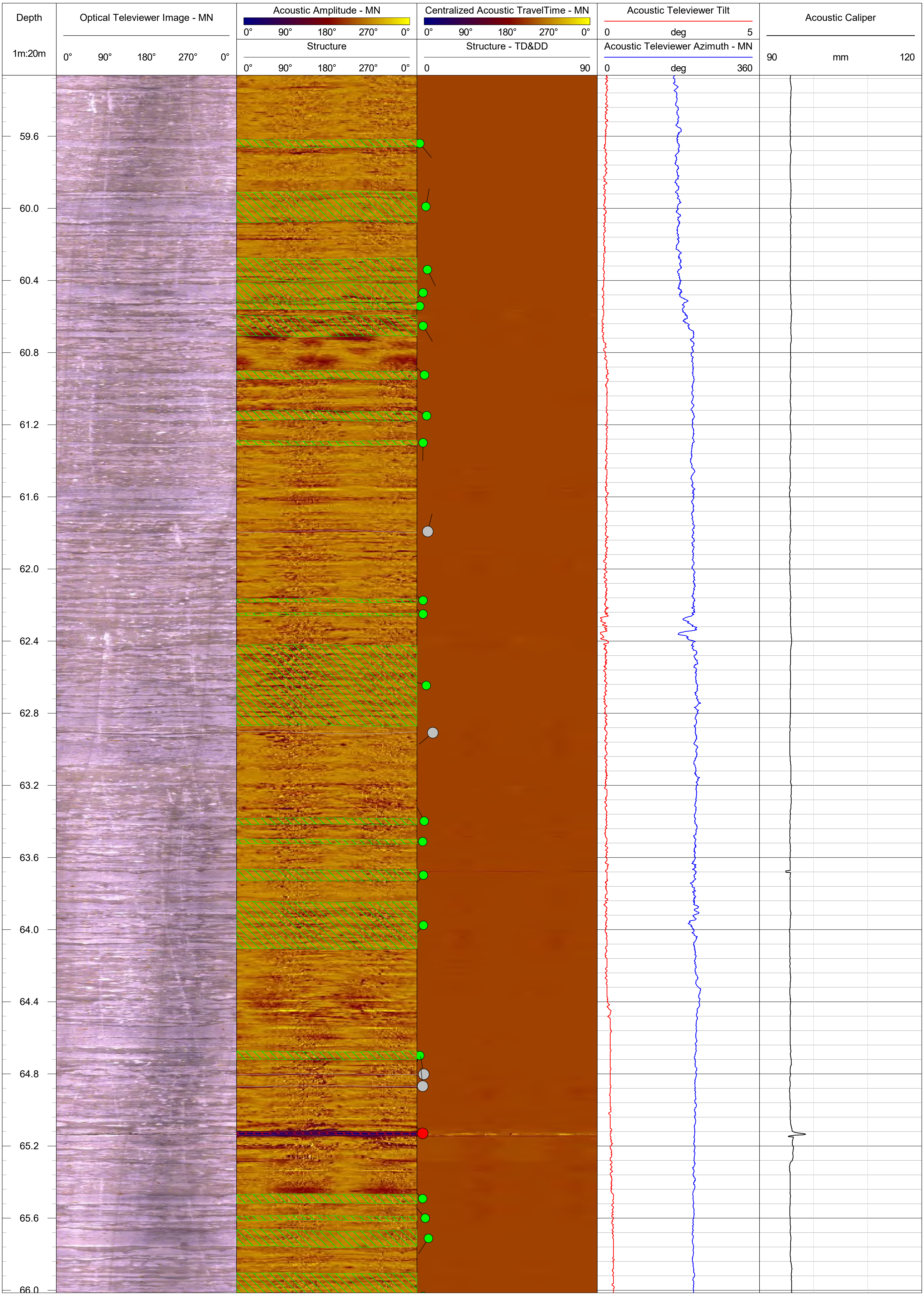
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
52.8
53.2
53.6
54.0
54.4
54.8
55.2
55.6
56.0
56.4
56.8
57.2
57.6
58.0
58.4
58.8
59.2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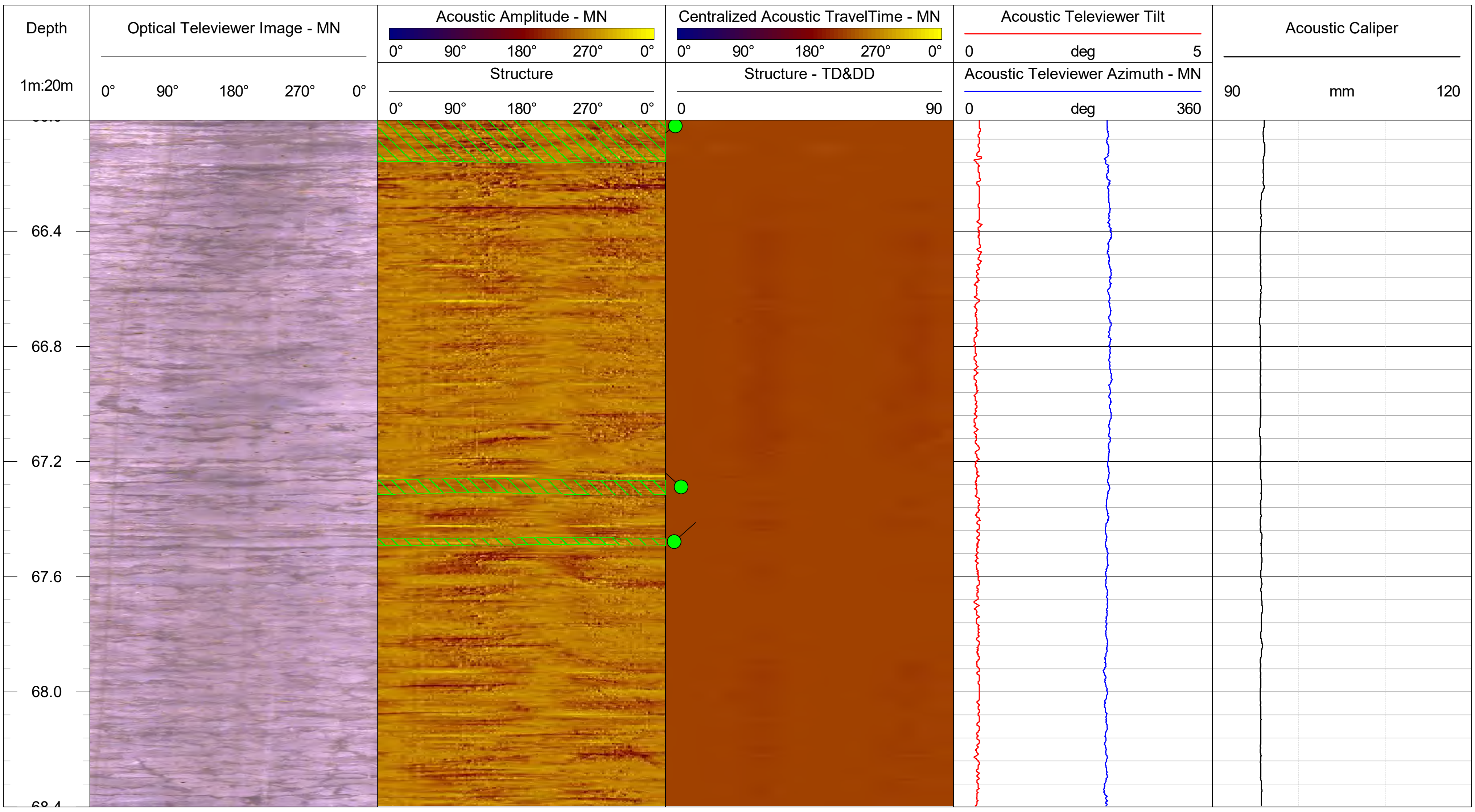
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
59.6
60.0
60.4
60.8
61.2
61.6
62.0
62.4
62.8
63.2
63.6
64.0
64.4
64.8
65.2
65.6
66.0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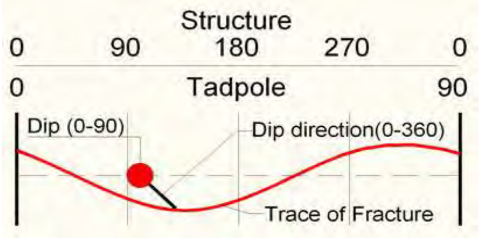
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
66.4
66.8
67.2
67.6
68.0

Geophysical Record of Borehole: BH306

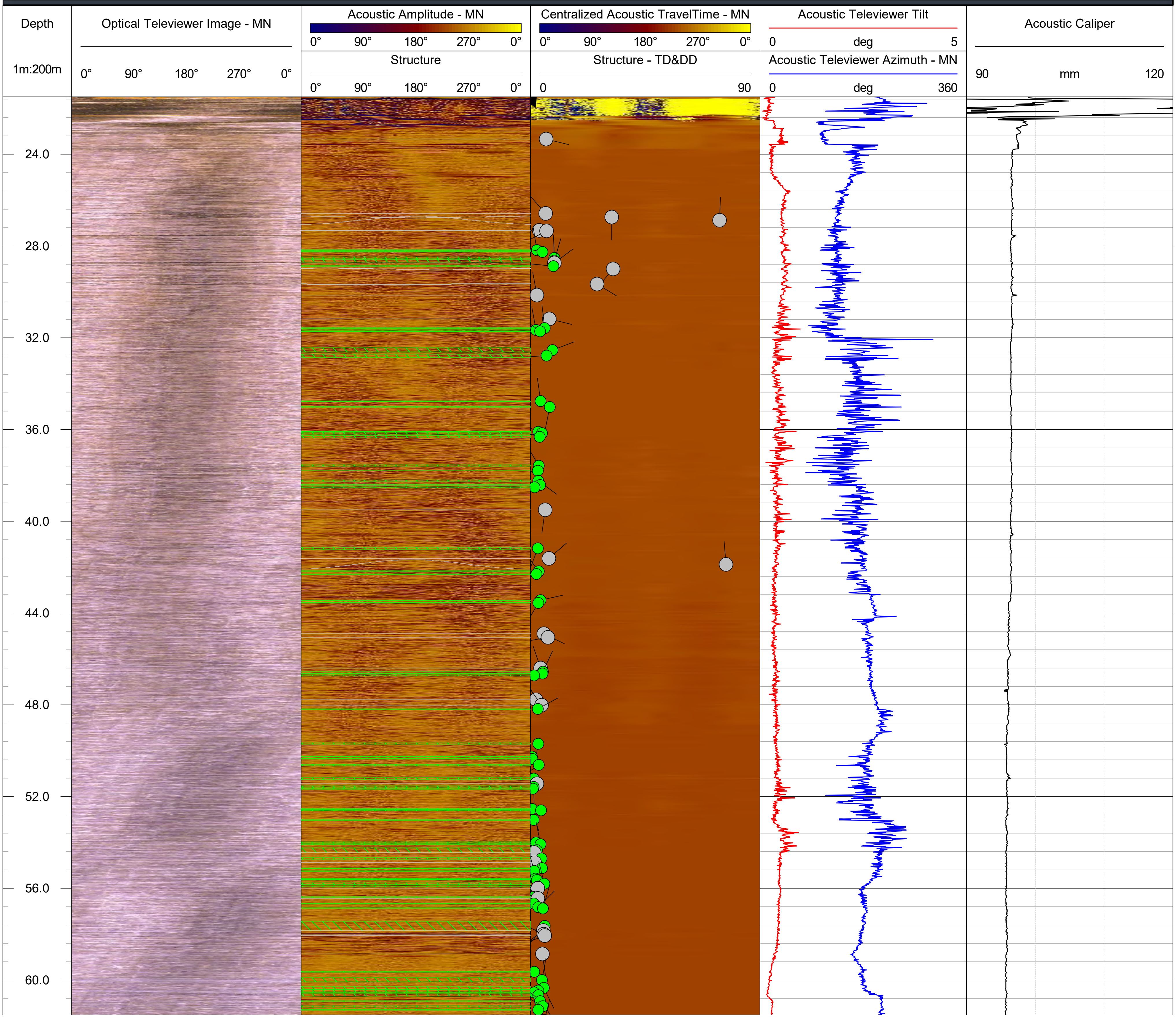
Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

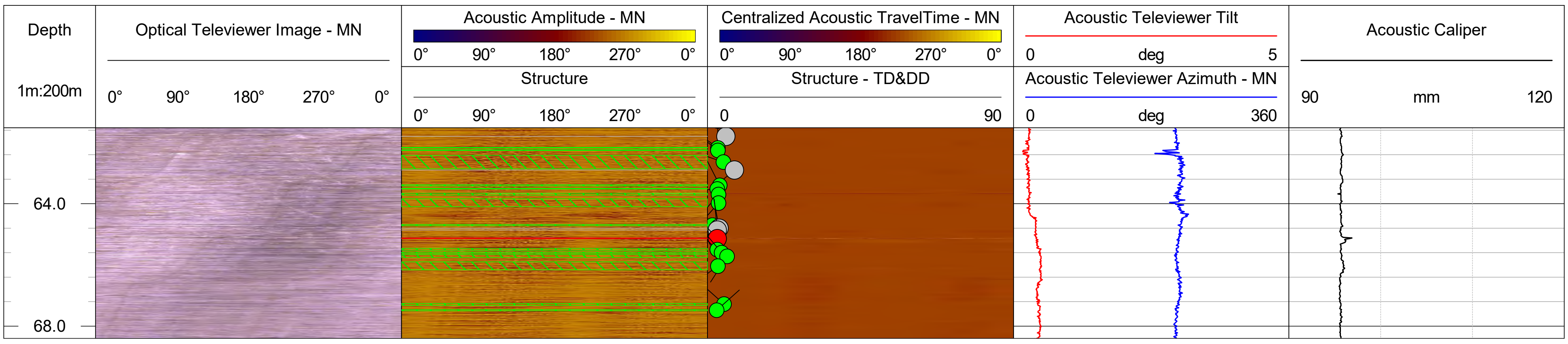
Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	~22.45 m bgs	**Location:**	Darlington, Ontario
Easting:	684686.37 m	**Drilled Depth:**	70.3 m bgs	**Water Level:**	N/A	**Log Date:**	June-10-2022
Northing:	4859406.21 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	79.17 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	P. Leith



🔴 Major Open Joint / Fracture
⚪ Filled Fracture / Joint
🟢 Bedding / Banding / Foliation
◀ Casing

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)




Depth
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0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
64.0
68.0

A20-BH307

PROJECT: 21451329

LOCATION: N 4859394.50; E 684833.78

RECORD OF BOREHOLE: BH307

SHEET 1 OF 7

BORING DATE: June 22 to 24, 2022

DATUM: Geodetic

DRILL RIG: Diedrich 120 Track Mounted

DEPTH SCALE METRES

BORING METHOD

SOIL PROFILE: DESCRIPTION; STRATA PLOT; ELEV. DEPTH (m)

SAMPLES: NUMBER; TYPE; BLOWS/0.3m

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○: 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-10} 10^{-8} 10^{-6} 10^{-4}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl: 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GRAIN SIZE DISTRIBUTION (%): GR SA SI CL

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	ELEV. DEPTH (m)
		BARGE DECK	78.90 0.00
0	Mud Rotary Wash Boring (Tricone) UW Casing		
4		WATER	74.93 3.97
10			

Depth scale marks: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

LOGGED: KL

CHECKED: SEMP

PROJECT: 21451329

LOCATION: N 4859394.50; E 684833.78

RECORD OF BOREHOLE: BH307

BORING DATE: June 22 to 24, 2022

DRILL RIG: Diedrich 120 Track Mounted

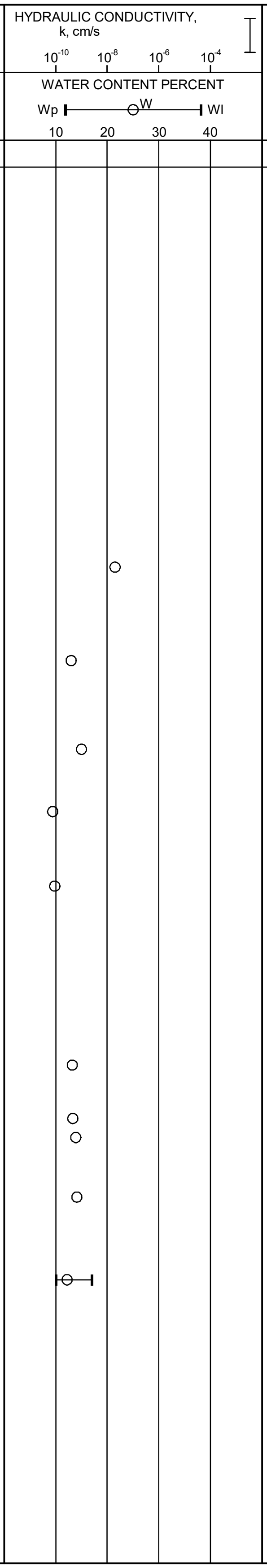
SHEET 2 OF 7

DATUM: Geodetic

--- CONTINUED FROM PREVIOUS PAGE ---

BORING METHOD: Mud Rotary Wash Boring (Tricone) – UW Casing (10 to approx. 13.7 m); Mud Rotary Wash Boring (Tricone) – Open (approx. 13.7 to 19.15 m)

DEPTH SCALE METRES	DESCRIPTION	ELEV. / DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
10	WATER						
12.74	**Sandy Lean Clay (CL)**, very stiff, grey, moist, fine to coarse sand, trace angular fine gravel, low to medium plasticity (Glaciolacustrine) (Unit 4b) - Rock fragments in Spoon Sample 1	66.16 12.74	1	SS	192/ 0.26		
13.28	**Silt (ML)**, medium dense, grey, moist, fine to medium sand, subangular fine gravel (Glaciolacustrine) (Unit 4a)	65.62 13.28	2	SS	18	NP	13 8 65 14
13.95	**Sandy Silt (ML)**, very dense, grey, moist, fine to coarse sand, angular fine to coarse gravel, low plasticity (Till) (Unit 5)	64.95 13.95	3	SS	100/ 0.24		
			4	SS	100/ 0.10	NP	11 22 54 12
			5	SS	100/ 0.13		
			6	SS	100/ 0.10		
			7	SS	89/ 0.28		
			8A 8B	SS	100/ 0.13		
17.31	**Silty Sand (SM)**, very dense, grey, moist, fine to medium sand (Glaciolacustrine) (Unit 4a) **Sandy Silty Clay (CL-ML)**, hard, grey, moist, fine to coarse sand, angular fine to coarse gravel, low plasticity (Till) (Unit 5)	61.65 17.31	9		74		
			10		64		6 26 49 19
			11		190/ 0.28		
19.15	**Shale Bedrock Fragments** (Unit 6a) - Bedrock cored from 19.15 m to 60.98 m depth - Refer to Record of Drillhole BH307	59.80 19.15	12A 12B		100/ 0.07		



DEPTH SCALE

1 : 50

LOGGED: KL

CHECKED: SEMP

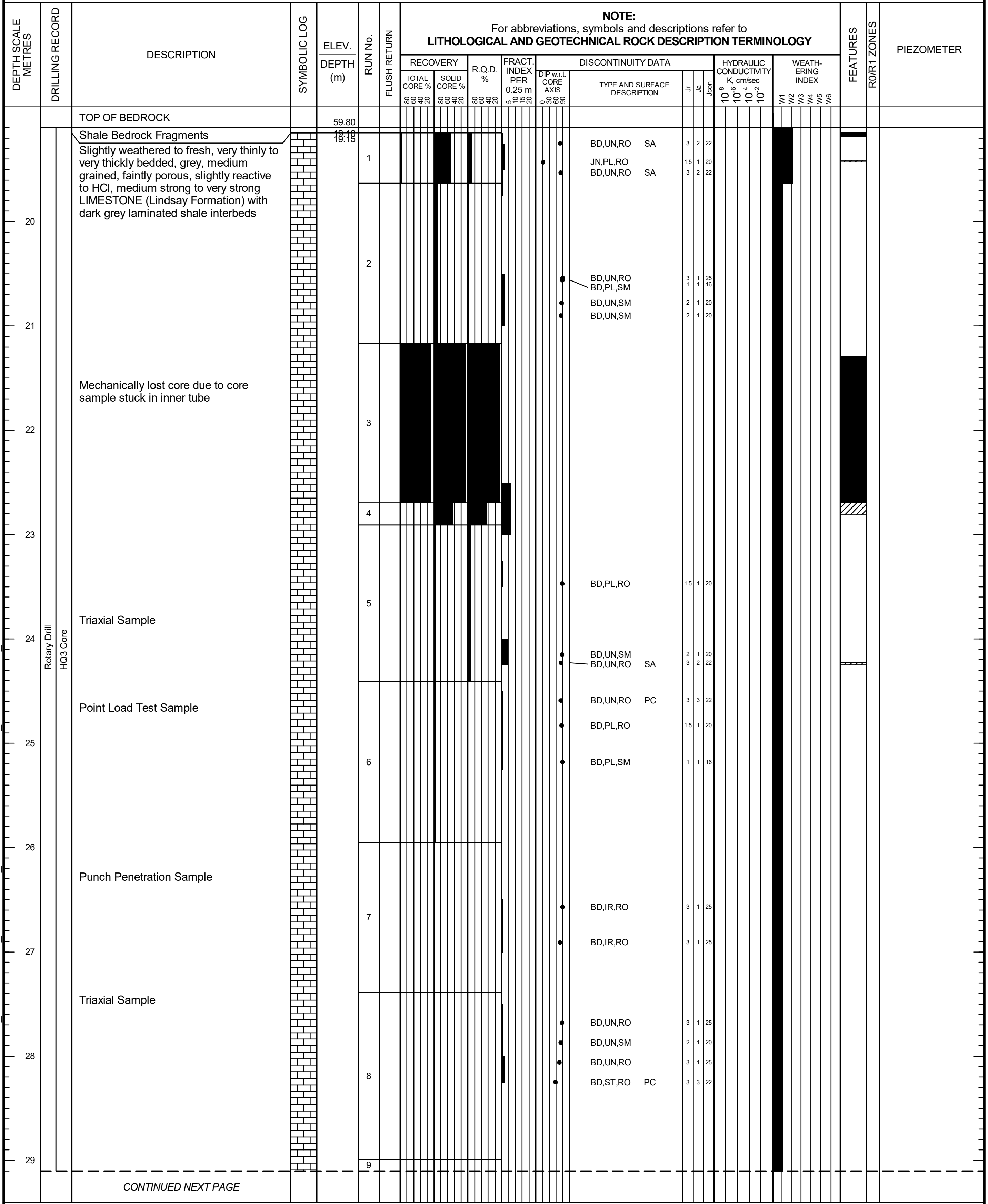
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859394.5; E 684833.78
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH307

DRILLING DATE: June 24 to July 6, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 3 OF 7
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



TOP OF BEDROCK — 59.80

Shale Bedrock Fragments — 19.10

Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to very strong LIMESTONE (Lindsay Formation) with dark grey laminated shale interbeds — 19.15

Mechanically lost core due to core sample stuck in inner tube

Triaxial Sample

Point Load Test Sample

Punch Penetration Sample

Triaxial Sample

TYPE AND SURFACE DESCRIPTION		Jr	Ja	Jcon
BD,UN,RO	SA	3	2	22
JN,PL,RO		1.5	1	20
BD,UN,RO	SA	3	2	22
BD,UN,RO		3	1	25
BD,PL,SM		1	1	16
BD,UN,SM		2	1	20
BD,UN,SM		2	1	20
BD,PL,RO		1.5	1	20
BD,UN,SM		2	1	20
BD,UN,RO	SA	3	2	22
BD,UN,RO	PC	3	3	22
BD,PL,RO		1.5	1	20
BD,PL,SM		1	1	16
BD,IR,RO		3	1	25
BD,IR,RO		3	1	25
BD,UN,RO		3	1	25
BD,UN,SM		2	1	20
BD,UN,RO		3	1	25
BD,ST,RO	PC	3	3	22

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: ML
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859394.5; E 684833.78
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH307

DRILLING DATE: June 24 to July 6, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE % 80 60 40 20	RECOVERY SOLID CORE % 80 60 40 20	R.Q.D. % 80 60 40 20	FRACT. INDEX PER 0.25 m 5 10 15 20	DISCONTINUITY DATA DIP w.r.t. CORE AXIS 0 30 60 90	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2}	WEATHERING INDEX W1 W2 W3 W4 W5 W6	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
	Rotary Drill HQ3 Core	Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to very strong LIMESTONE (Lindsay Formation) with dark grey laminated shale interbeds			9															
30					10															
		Point Load Test Sample																		
					11															
31																				
		Triaxial Sample			12															
32		Triaxial Sample																		
					13															
33		Point Load Test Sample																		
											●	BD,PL,RO	1.5	1	20					
34											●	BD,UN,RO	3	1	25					
					14															
35		Triaxial Sample																		
					15						●	BD,UN,RO	3	1	25					
36		Triaxial Sample																		
		UCS with Modulus Sample																		
37					16															
											●	BD,UN,RO	3	1	25					
38		Direct Shear Sample																		
					17						●	BD,PL,SM	1	1	16					
39																				
		CONTINUED NEXT PAGE																		

DEPTH SCALE
1 : 50

LOGGED: ML
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859394.5; E 684833.78
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH307

DRILLING DATE: June 24 to July 6, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 5 OF 7
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	RUN No.	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
		--- CONTINUED FROM PREVIOUS PAGE ---					
		Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to very strong LIMESTONE (Lindsay Formation) with dark grey laminated shale interbeds Cerchar Sample	17				
40			18				
			19				
41		Brazilian Sample					
42			20	BD,UN,RO	3	1	25
		UCS with Modulus Sample					
43							
		Triaxial Sample	21				
44	Rotary Drill HQ3 Core	Point Load Test Sample					
				BD,ST,SM	2	1	20
			22				
45				BD,ST,RO	3	1	25
			23				
		Triaxial Sample					
46							
			24				
				BD,PL,SM	1	1	16
47							
		Triaxial Sample					
		Triaxial Sample					
48			25	BD,PL,RO	1.5	1	20
				BD,PL,SM	1	1	16
		Brazilian Sample					
49			26				
		CONTINUED NEXT PAGE					

Other columns: SYMBOLIC LOG; ELEV. DEPTH (m); FLUSH RETURN; RECOVERY TOTAL CORE % 80 60 40 20; SOLID CORE % 80 60 40 20; R.Q.D. % 80 60 40 20; FRACT. INDEX PER 0.25 m 5 10 15 20; DIP w.r.t. CORE AXIS 0 30 60 90; HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2}; WEATHERING INDEX W1 W2 W3 W4 W5 W6; FEATURES; R0/R1 ZONES; PIEZOMETER

DEPTH SCALE
1 : 50

LOGGED: ML
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859394.5; E 684833.78
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH307

DRILLING DATE: June 24 to July 6, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 6 OF 7
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

--- CONTINUED FROM PREVIOUS PAGE ---

Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to very strong LIMESTONE (Lindsay Formation) with dark grey laminated shale interbeds
Point Load Test Sample
Punch Penetration Sample

Triaxial Sample

Triaxial Sample

DRILLING RECORD: Rotary Drill, HQ3 Core

DEPTH SCALE METRES	RUN No.
49–50.3	26
50.3–51.9	27
51.9–53.4	28
53.4–55.0	29
55.0–56.5	30
56.5–58.0	31
58.0–59.1	32

DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,PL,SM	1	1	16
BD,PL,RO	1.5	1	20

Column headings: DEPTH SCALE METRES; DRILLING RECORD; DESCRIPTION; SYMBOLIC LOG; ELEV. DEPTH (m); RUN No.; FLUSH RETURN; RECOVERY TOTAL CORE % (80 60 40 20), SOLID CORE % (80 60 40 20); R.Q.D. % (80 60 40 20); FRACT. INDEX PER 0.25 m (5 10 15 20); DIP w.r.t. CORE AXIS (0 30 60 90); DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION, Jr, Ja, Jcon; HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-8} 10^{-6} 10^{-4} 10^{-2}); WEATHERING INDEX (W1 W2 W3 W4 W5 W6); FEATURES; R0/R1 ZONES; PIEZOMETER

Depth scale: 50, 51, 52, 53, 54, 55, 56, 57, 58, 59

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: ML
CHECKED: PKS

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859394.5; E 684833.78
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH307

DRILLING DATE: June 24 to July 6, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 7 OF 7
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE % (80 60 40 20)	RECOVERY SOLID CORE % (80 60 40 20)	R.Q.D. % (80 60 40 20)	FRACT. INDEX PER 0.25 m (5 10 15 20)	DISCONTINUITY DATA DIP w.r.t. CORE AXIS (0 30 60 90)	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-8} 10^{-6} 10^{-4} 10^{-2})	WEATHERING INDEX (W1 W2 W3 W4 W5 W6)	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
60	Rotary Drill HQ3 Core	Slightly weathered to fresh, very thinly to very thickly bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to very strong LIMESTONE (Lindsay Formation) with dark grey laminated shale interbeds			32 33												W1			
61		END OF DRILLHOLE		17.92 60.98																
62																				
63																				
64																				
65																				
66																				
67																				
68																				
69																				

DEPTH SCALE
1 : 50

LOGGED: ML
CHECKED: PKS

GOLDER
MEMBER OF WSP

Water Content Summary
ASTM D2216

Test Request #	21451329-21600-610 BH307	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville		

Sample Location	Sample				Soil Description	Water Content %	Method	Remarks
	Ref	Top (m)	Base (m)	Type				
BH307	1	12.74	13.17	SS		21.5	B	
BH307	2	13.41	13.87	SS		13.0	B	
BH307	3	14.02	14.42	SS		15.0	B	
BH307	4	14.63	14.87	SS		9.4	B	
BH307	5	15.24	15.36	SS		9.8	B	
BH307	7	16.40	16.86	SS		13.2	B	
BH307	8A	16.98	17.07	SS		13.3	B	
BH307	8B	17.07	17.25	SS		13.9	B	
BH307	9	17.37	17.83	SS		14.1	B	
BH307	10	18.23	18.44	SS		12.2	B	

Notes:

Disclaimer:

Tested by: JTimms **Date:** 12 Oct 2022
Checked by: MRuck **Date:** 26 Oct 2022
Reviewed by: JoNorris **Date:** 10 Nov 2022

GOLDER
MEMBER OF WSP

PARTICLE SIZE DISTRIBUTION

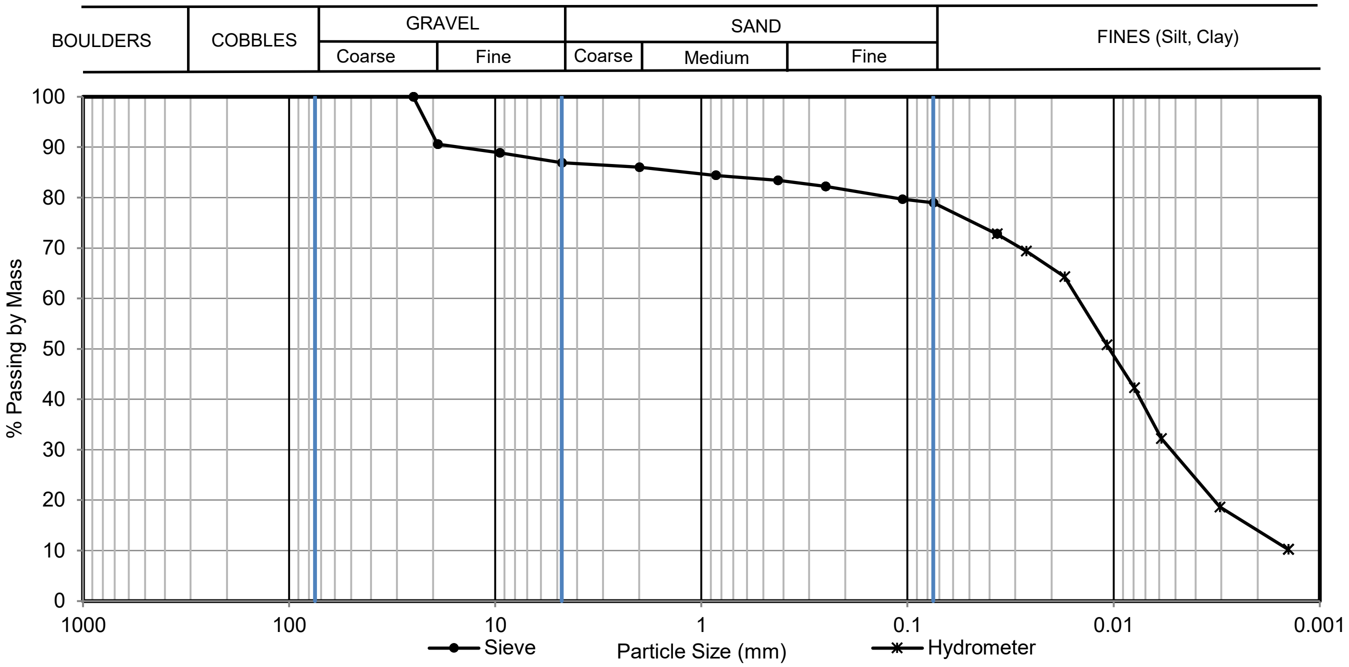
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH307	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH307
Source:		Sample No.:	2
		Type:	SS
Soil Description:		Depth (m):	13.41 - 13.87

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	18 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)	Gravel	Sand	Fines
	13.1	7.9	79.0



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1"	25	100.0	0.0368	72.8
3/4"	19	90.6	0.0266	69.4
3/8"	9.5	88.9	0.0173	64.3
#4	4.75	86.9	0.0108	50.8
#10	2	86.0	0.0079	42.3
#20	0.85	84.4	0.0059	32.2
#40	0.425	83.4	0.0031	18.6
#60	0.25	82.2	0.0014	10.2
#140	0.106	79.7		
#200	0.075	79.0		
			0.005 mm	28.87
			0.002 mm	13.96
			D60	0.01
			D30	0.01
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

Tested by: JTimms **Date:** 18 Oct 2022 **Checked by:** MRuck **Date:** 26 Oct 2022 **Reviewed by:** JoNorris **Date:** 10 Nov 2022

PARTICLE SIZE DISTRIBUTION

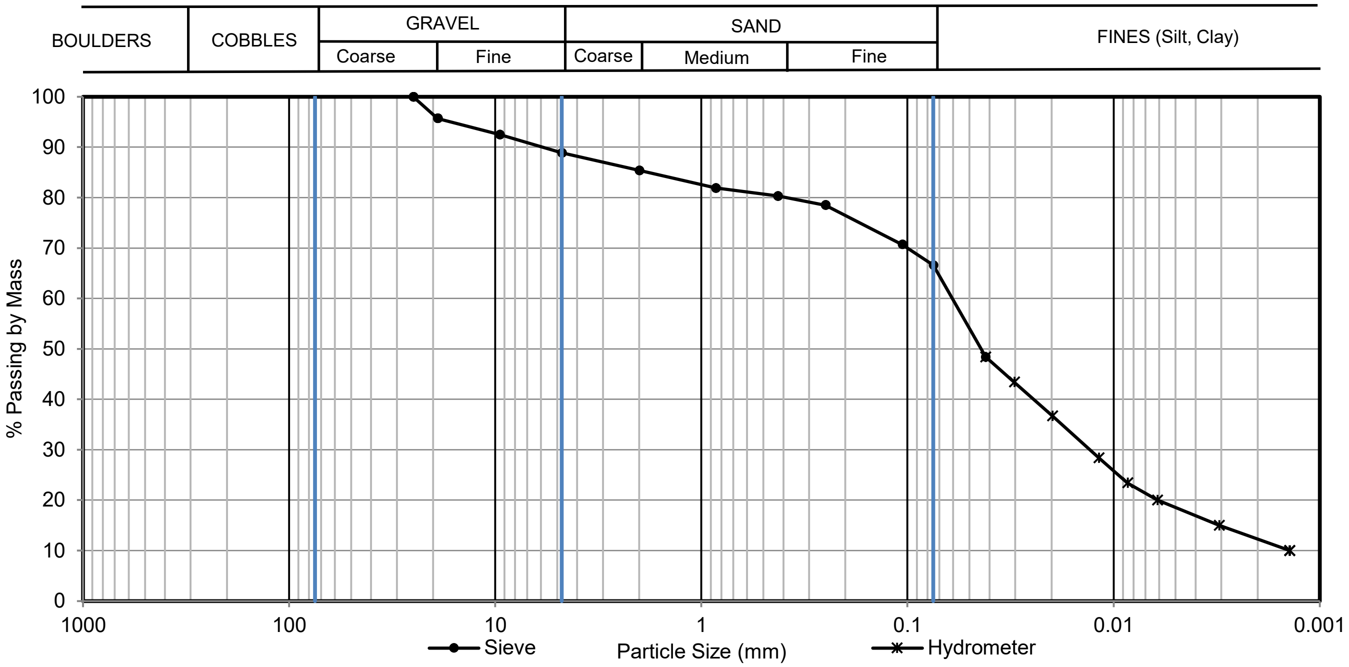
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH307	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH307
Source:		Sample No.:	4
		Type:	SS
Soil Description:		Depth (m):	14.63 - 14.87

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	18 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)	Gravel	Sand	Fines (Silt, Clay)
	11.1	22.3	66.6



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1"	25	100.0	0.0418	48.4
3/4"	19	95.7	0.0303	43.4
3/8"	9.5	92.5	0.0198	36.7
#4	4.75	88.9	0.0118	28.4
#10	2	85.4	0.0086	23.4
#20	0.85	81.9	0.0061	20.0
#40	0.425	80.3	0.0031	15.0
#60	0.25	78.5	0.0014	10.0
#140	0.106	70.7		
#200	0.075	66.6		
			0.005 mm	18.51
			0.002 mm	12.26
			D60	0.06
			D30	0.01
			D10	0.00
			Cu	43.00
			Cc	2.00

Notes:

Disclaimer:

Tested by: JTimms **Date:** 18 Oct 2022 **Checked by:** MRuck **Date:** 26 Oct 2022 **Reviewed by:** JoNorris **Date:** 10 Nov 2022

GOLDER
MEMBER OF WSP

PARTICLE SIZE DISTRIBUTION

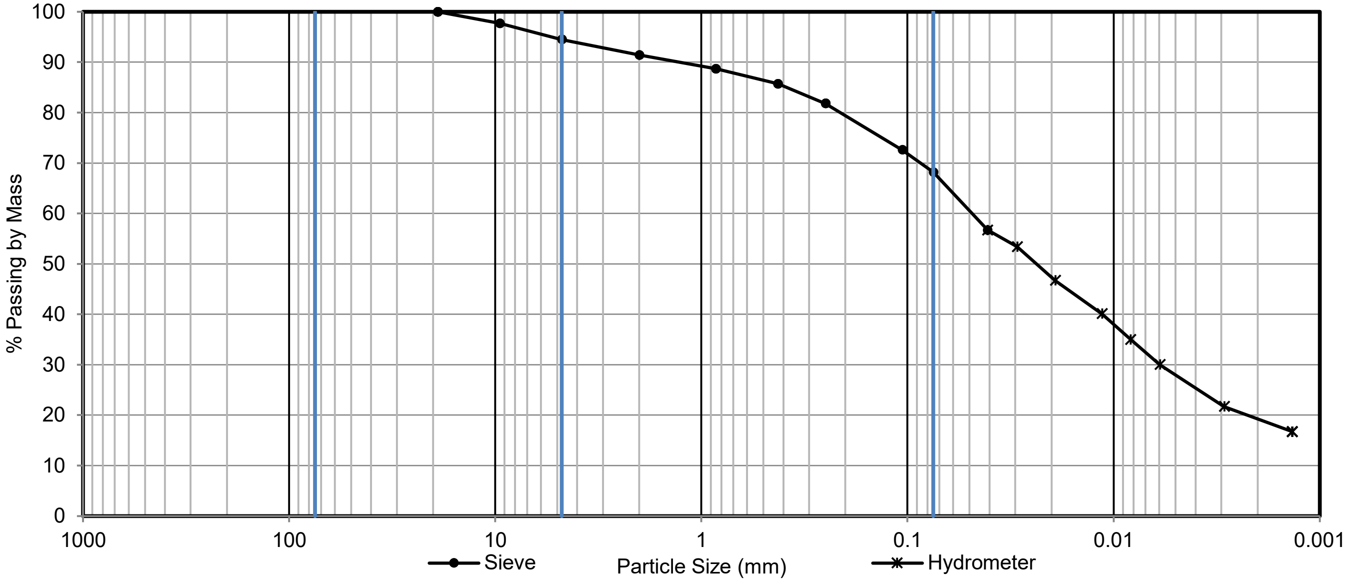
ASTM D6913 and ASTM D422
Method B

Test Request #: 21451329-21600-610 BH307
Client: E.S. Fox Limited
Project Name: ES Fox/DNNP Invest/Bowmanville
Source:
Soil Description:

Project Number: 21451329-21600-610
Project Location:
Sample Location: BH307
Sample No.: 10
Type: SS
Depth (m): 18.23 - 18.44

Specimen Reference: NA
Specimen Depth (m): NA
Date of Test: 24 Oct 2022
Specimen Description: NA

Grain Size Distribution (%)			5.5			26.3		68.2
BOULDERS	COBBLES	GRAVEL		SAND				FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine		



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0409	56.7
3/8"	9.5	97.7	0.0294	53.4
#4	4.75	94.5	0.0192	46.7
#10	2	91.4	0.0114	40.1
#20	0.85	88.7	0.0083	35.0
#40	0.425	85.7	0.0060	30.0
#60	0.25	81.8	0.0029	21.7
#140	0.106	72.6	0.0014	16.7
#200	0.075	68.2		
			0.005 mm	27.95
			0.002 mm	19.24
			D60	0.05
			D30	0.01
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

The laboratory testing services reported herein have been performed in accordance with the terms of a contract with Golder's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of Golder's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Tested by: KGill **Date:** 24 Oct 2022 **Checked by:** MRuck **Date:** 09 Nov 2022 **Reviewed by:** JoNorris **Date:** 10 Nov 2022

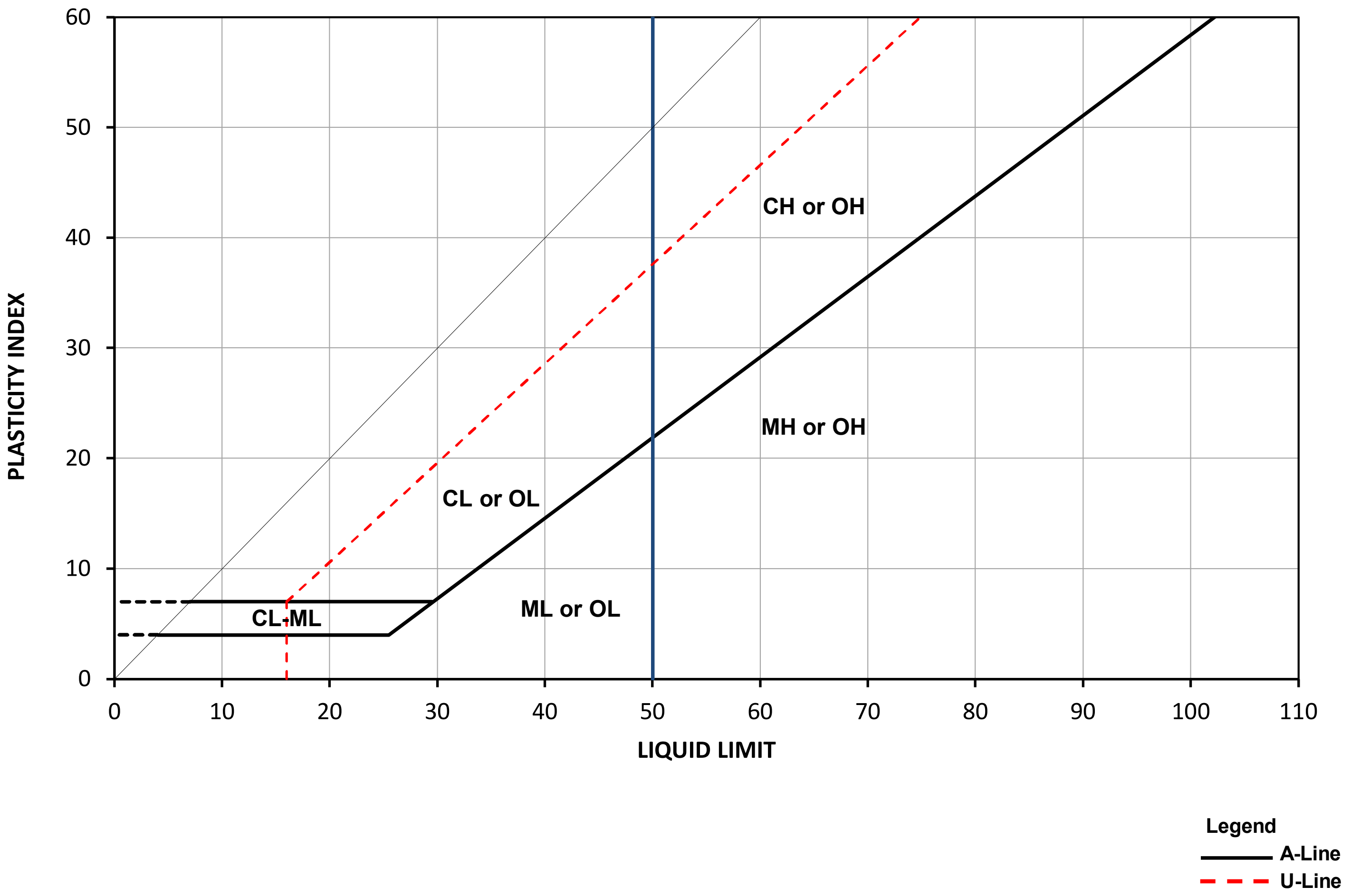
GOLDER
MEMBER OF WSP

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318

Test Request #: 21451329-21600-610 BH307
Client: E.S. Fox Limited
Project Name: ES Fox/DNNP Invest/Bowmanville
Source:
Soil Description:

Project Number: 21451329-21600-610
Project Location:
Sample Location: BH307
Sample No.: 2
Type: SS
Depth (m): 13.41 - 13.87

Specimen Reference: NA
Specimen Depth (m): NA
Date of Test: 19 Oct 2022
Specimen Description: NA



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH307	2	13.41	13.87	92	13.0		NP		

NP = Non-Plastic
ND = Not Determined

Test Preparation
Dry Preparation Tested after >425um removed

Notes:

Tested by: JTimms **Date:** 19 Oct 2022
Checked by: MRuck **Date:** 26 Oct 2022

Disclaimer:
The laboratory testing services reported herein have been performed in accordance with the terms of a contract with Golder's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of Golder's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Reviewed by: JoNorris **Date:** 10 Nov 2022

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318

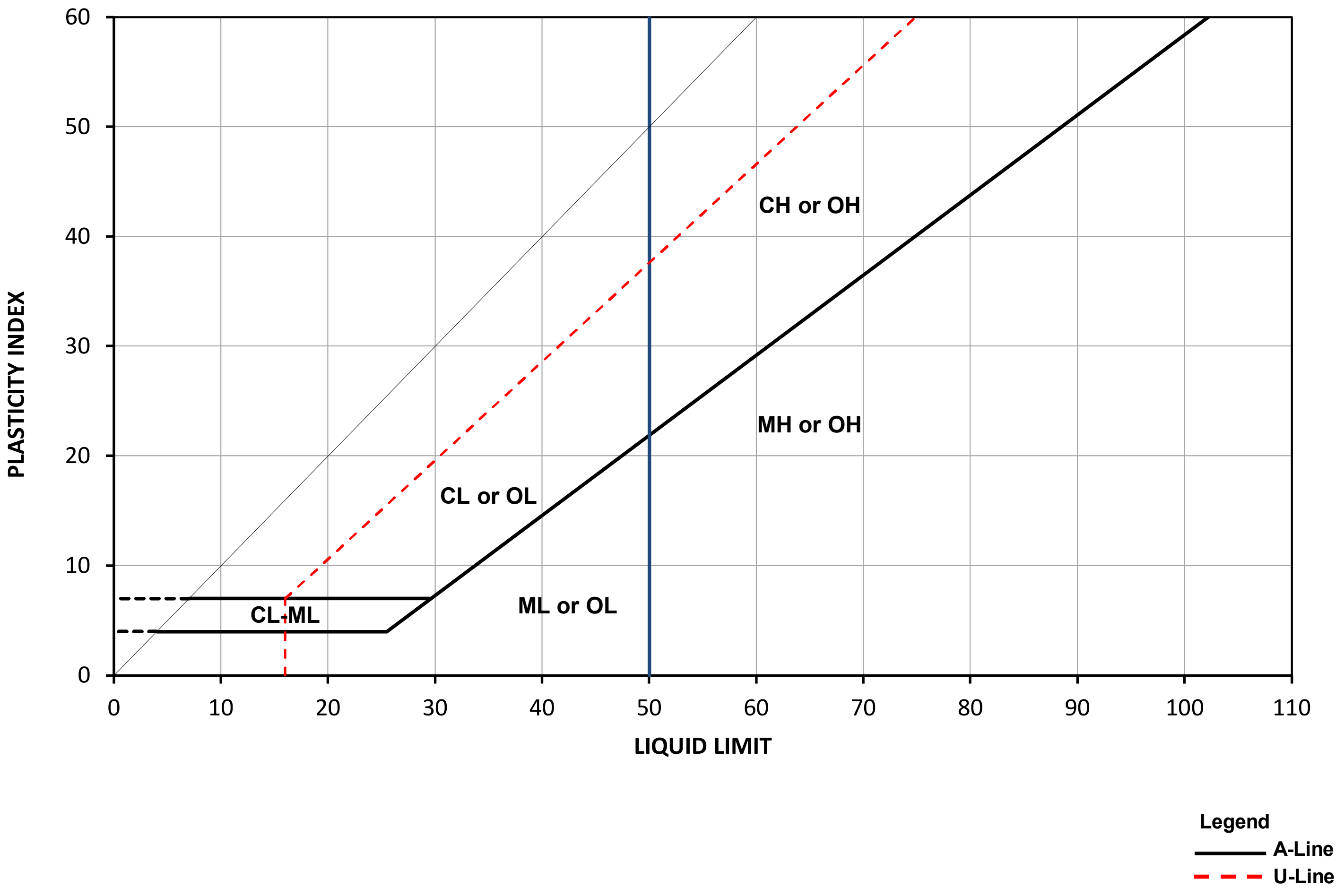
Test Request #	21451329-21600-610 BH307	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH307
Source:		Sample No.:	4
Soil Description:		Type:	SS
		Depth (m):	14.63 - 14.87

Specimen Reference NA

Specimen Depth (m): NA

Date of Test 21 Oct 2022

Specimen Description NA



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH307	4	14.63	14.87	88	9.4		NP		

NP = Non-Plastic
ND = Not Determined

Test Preparation
Dry Preparation Tested after >425um removed

Notes:

Tested by: JTimms **Date:** 21 Oct 2022
Checked by: MRuck **Date:** 26 Oct 2022

Disclaimer:
The laboratory testing services reported herein have been performed in accordance with the terms of a contract with Golder's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of Golder's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Reviewed by: JoNorris **Date:** 10 Nov 2022

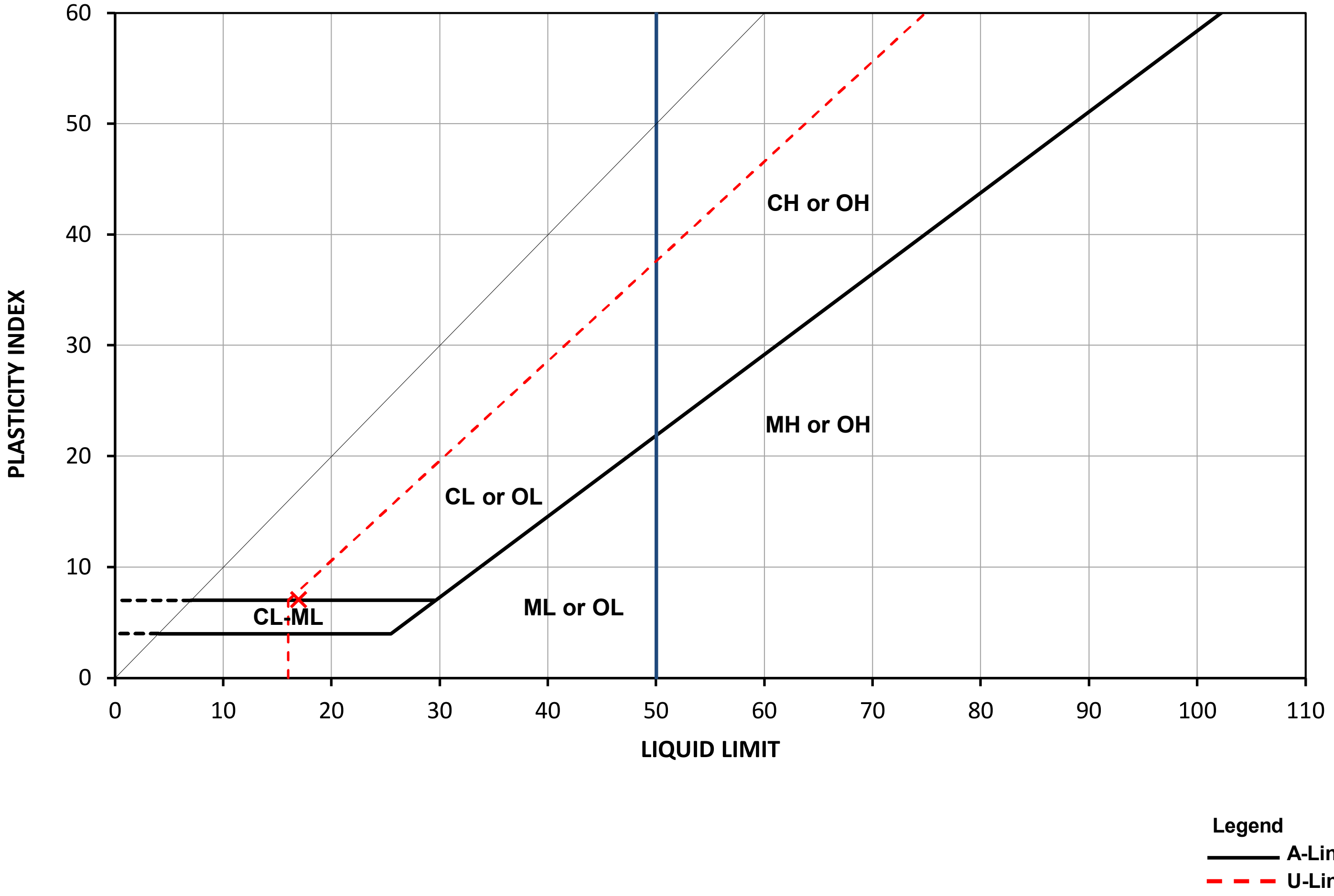
LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

ASTM D4318

Method B - One-point Test

Test Request #	21451329-21600-610 BH307	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH307
Source:		Sample No.:	10
Soil Description:		Type:	SS
		Depth (m):	18.23 - 18.44

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	27 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH307	10	18.23	18.44	ND	12.2	17	10	7	0.31

NP = Non-Plastic
ND = Not Determined

Test Preparation

Notes:

Tested by: XMeng **Date:** 27 Oct 2022
Checked by: MRuck **Date:** 08 Nov 2022

Disclaimer:

The laboratory testing services reported herein have been performed in accordance with the terms of a contract with Golder's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of Golder's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Reviewed by: JoNorris **Date:** 10 Nov 2022

GOLDER
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SPECIFIC GRAVITY OF SOIL SOLIDS
ASTM D854
Pycnometer Method B

Test Request #	21451329-21600-610 BH307	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	NA
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH307
Source:		Sample No.:	10
Soil Description:		Type:	SS
		Depth (m)	17.98 - 18.44

Specimen Reference	NA	Specimen Depth	NA	Date of Test	27 Oct 2022
Specimen Description	NA				

Proportions		
Percentage Passing (4.75 mm)		%
Percentage Retained (4.75 mm)		%

Fine Fraction (D854)		
Calibrated Mass of Pycnometer		g
Calibrated Volume of Pycnometer	249.75	mL
Mass of Pycnometer	102.33	g
Test Temperature	17.8	oC
Mass of Pycnometer, soil and water	377.48	g
Mass of Container (or tare)	3.55	g
Mass of dry soil and container	44.28	g
Dry mass of soil solids	40.73	g
Specific Gravity at 20oC	**2.72**	

Coarse Fraction (C127)		
Mass of Oven Dry Sample		g
Mass of saturated-surface-dry in air		g
Apparent mass of saturated test sample in water		g
Specific Gravity Oven Dry		
Specific Gravity Saturated Surface Dry		
Specific Gravity with Weighted Average	**2.72**	

Notes:

Disclaimer:

Tested by: DPatel **Date:** 27 Oct 2022

Checked by: MRuck **Date:** 09 Nov 2022

Reviewed by: JoNorris **Date:** 10 Nov 2022

Water (Moisture) Content, Ash Content, and Organic Material of Soils
ASTM D2974 Method A

Test Request #	21451329-21600-610 BH307	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH307
Source:		Sample No.:	1
Soil Description:		Type:	SS
		Depth (m):	12.74 - 13.17

Specimen Reference	NA	Specimen Depth	NA	Date of Test	12 Oct 2022
Specimen Description	NA				

Furnace Temperature During Test (°C)	440
Duration of Test (nearest 15 minutes)	5850
Mass of Crucible With Lid (g)	58.36
Moist Mass of Specimen Plus Crucible With Lid (g)	147.32
Oven Dry Mass of Specimen Plus Crucible With Lid (g)	131.39
Mass of Crucible With Lid Plus Ash (g)	131.02
Water Content (%)	22
Ash Content (%)	99.5
Organic Material (%)	0.5

Test Preparation

Notes:

Disclaimer:

Tested by: JTimms **Date:** 12 Oct 2022

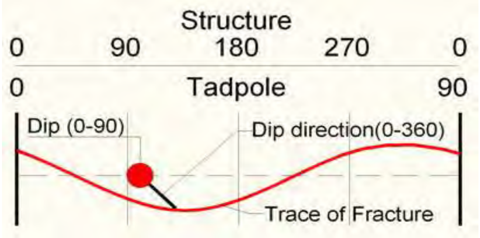
Checked by: MRuck **Date:** 26 Oct 2022

Reviewed by: JoNorris **Date:** 10 Nov 2022

Geophysical Record of Borehole: BH307

Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	~22 m bgs	**Location:**	Darlington, Ontario
Easting:	684686.37 m	**Drilled Depth:**	60.98 m bgs	**Water Level:**	N/A	**Log Date:**	July-8-2022
Northing:	4859406.21 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	78.90	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	J. Crawford



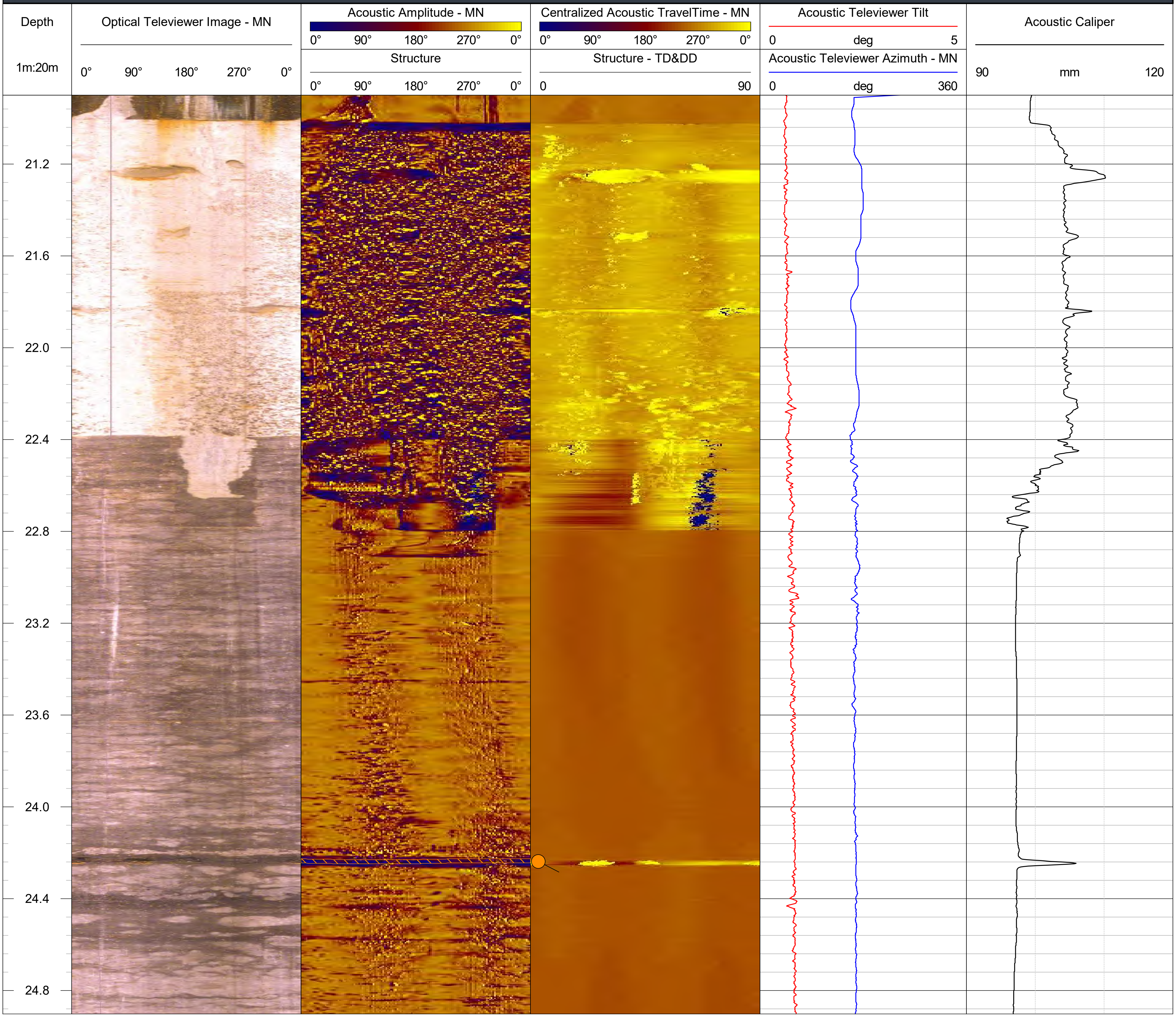
● Partially Open Joint / Fracture

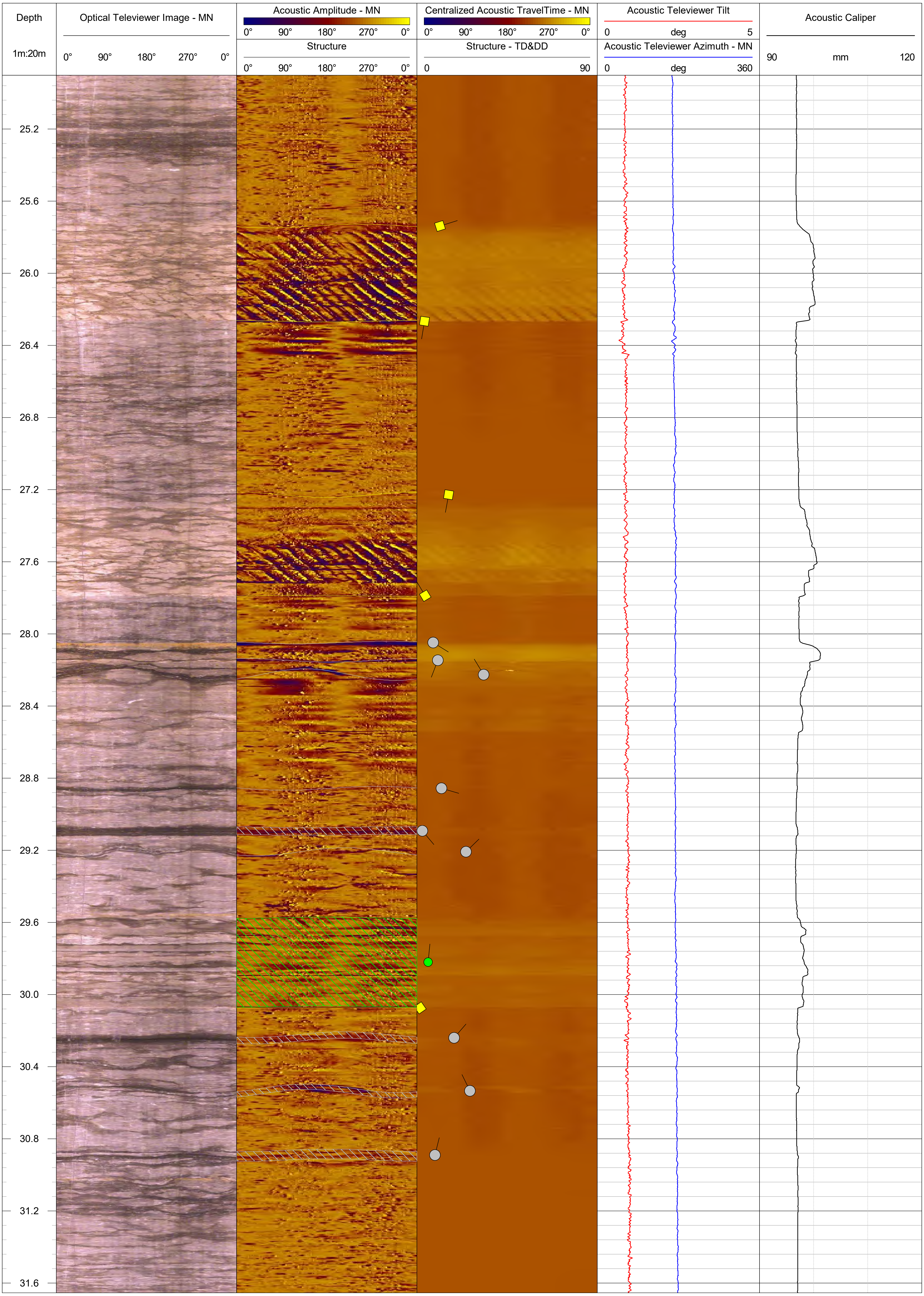
● Filled Fracture / Joint

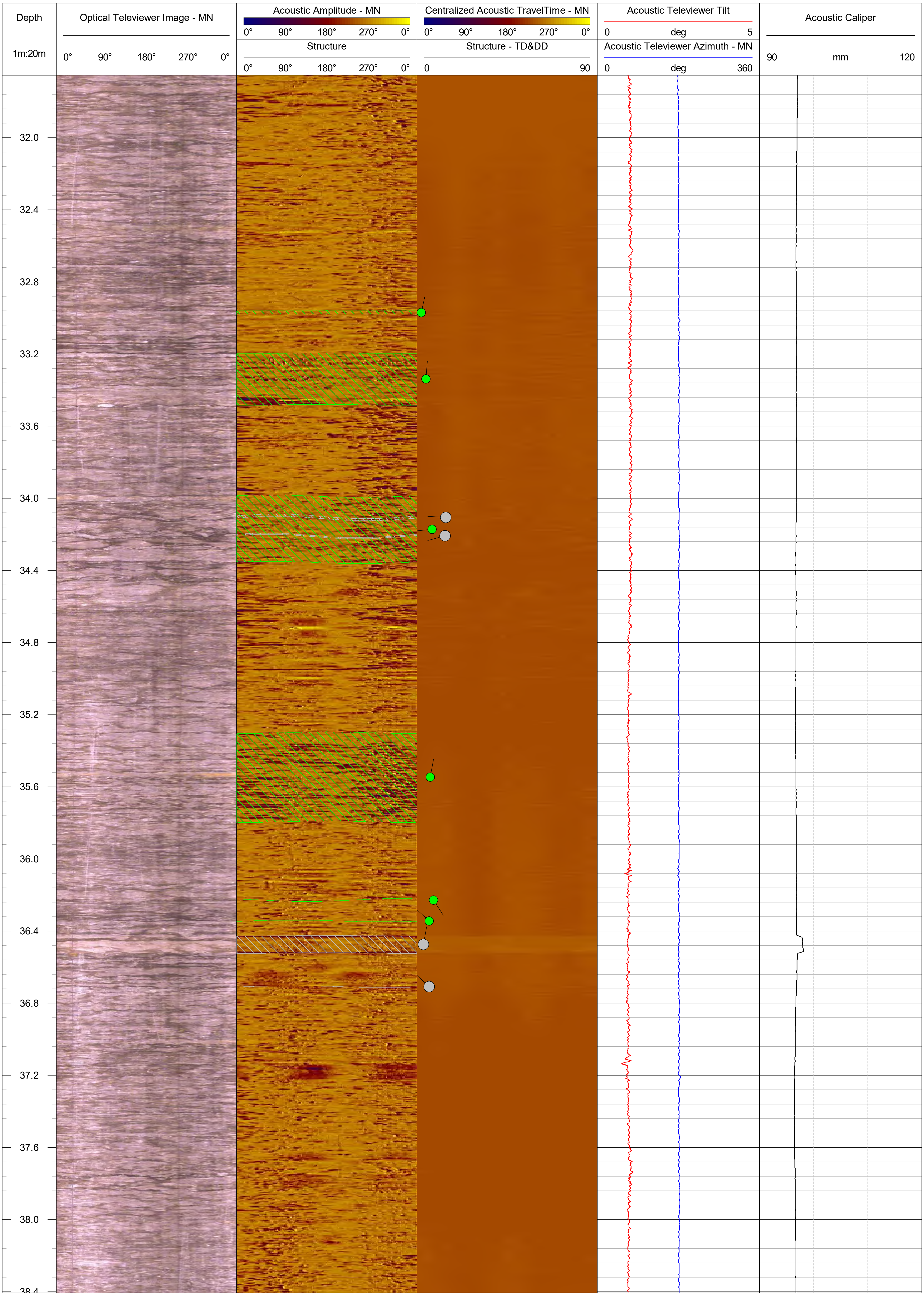
● Bedding / Banding / Foliation

◆ Contact

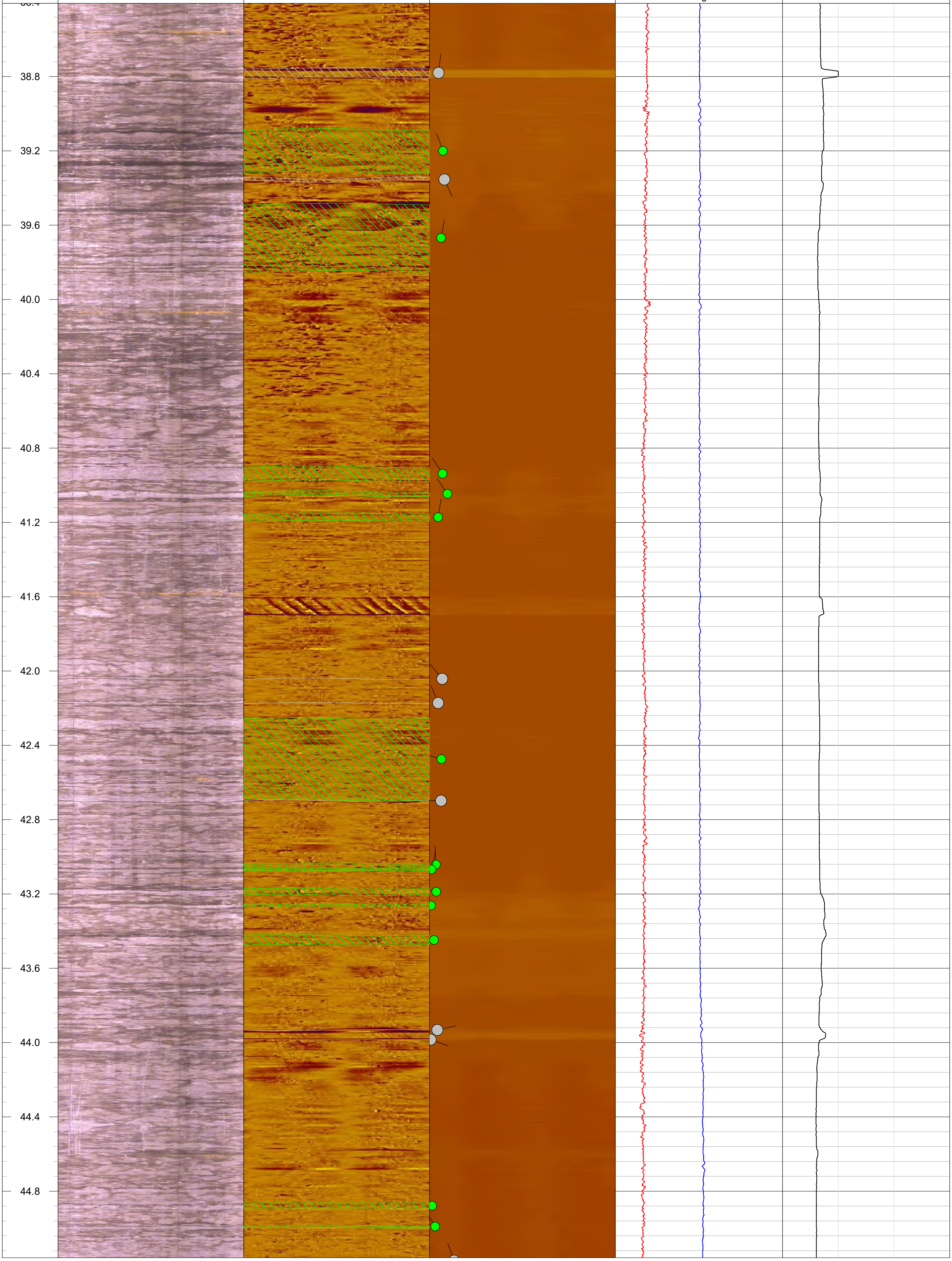
Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)

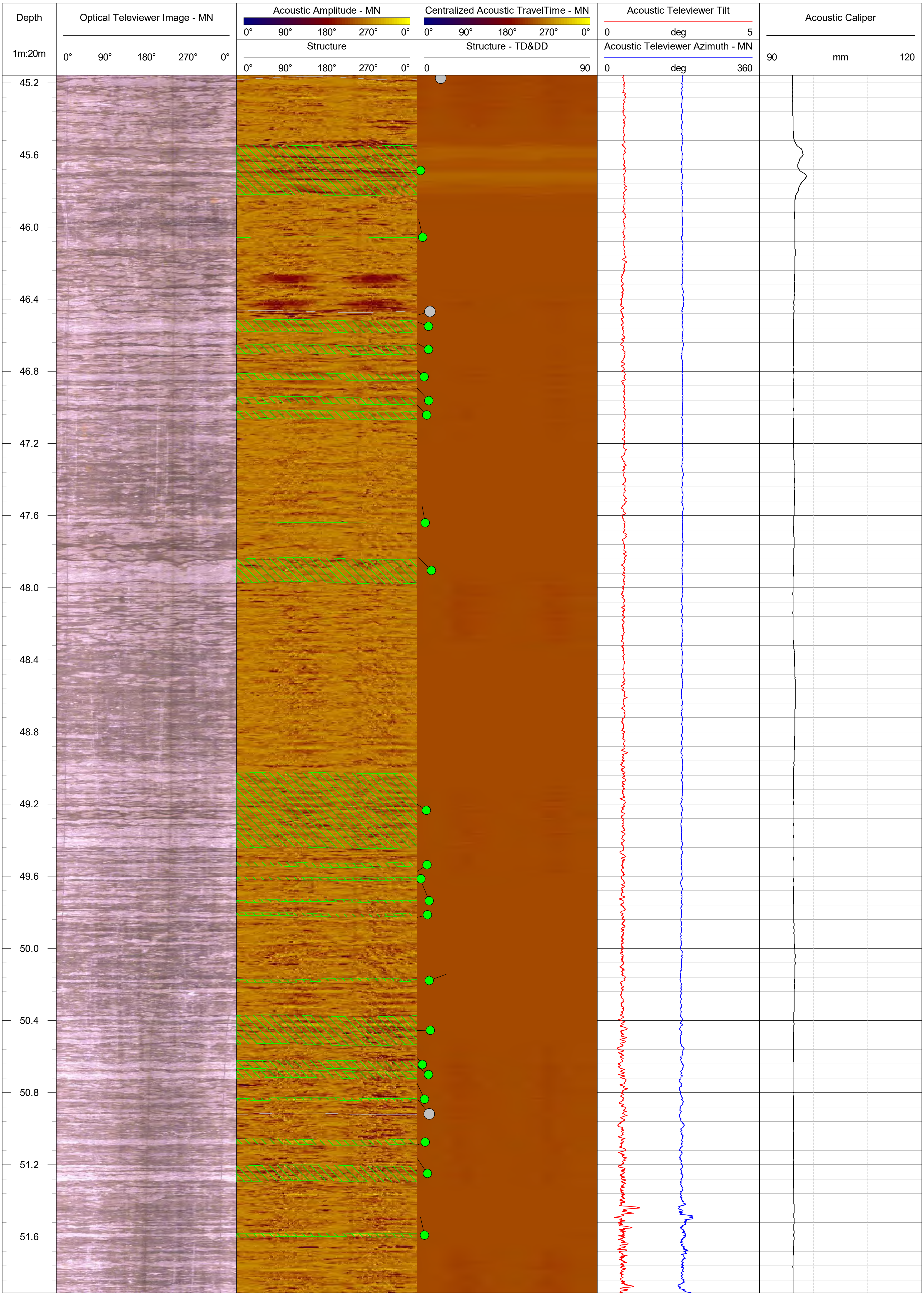


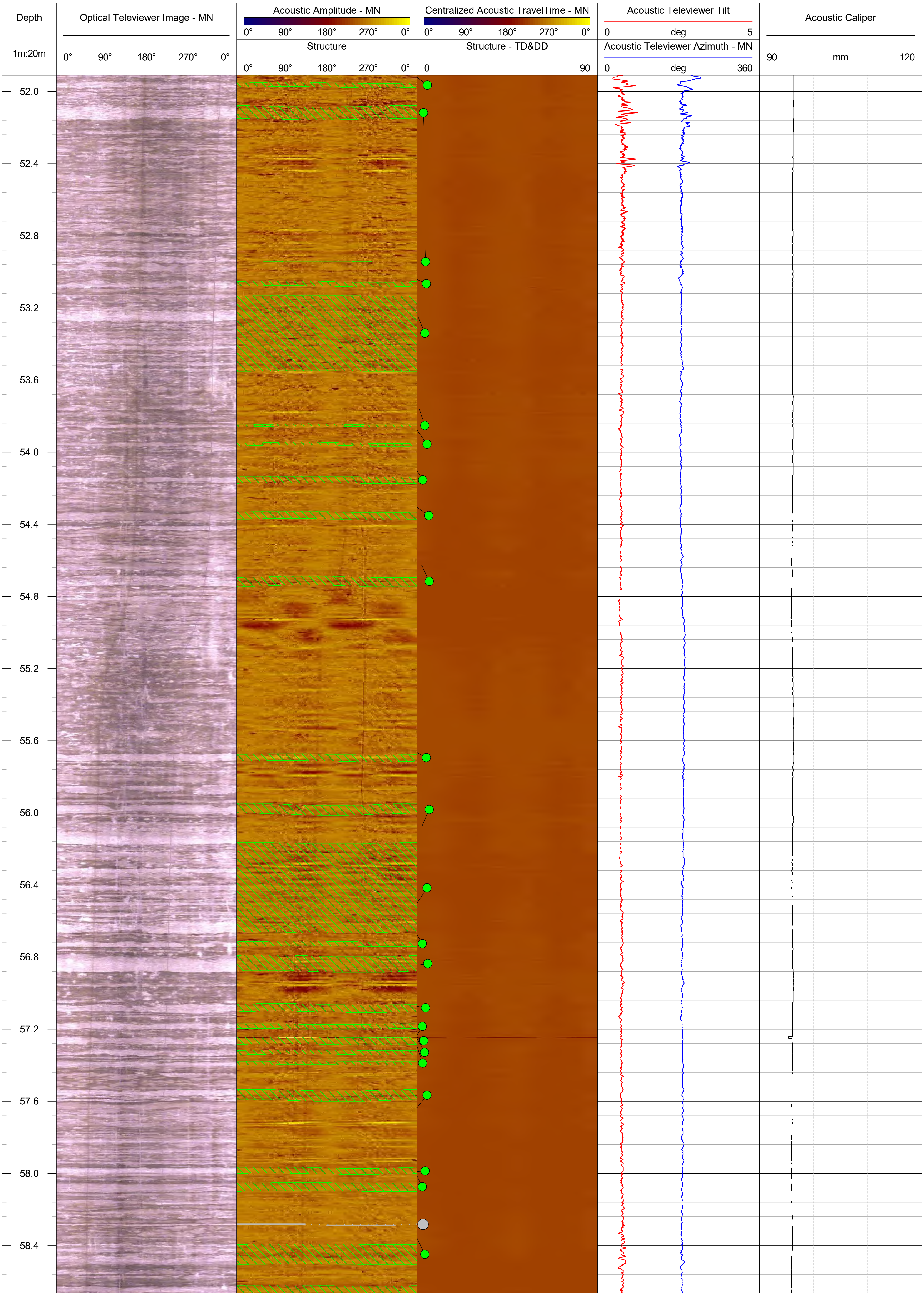

Depth
1m:20m
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
25.2
25.6
26.0
26.4
26.8
27.2
27.6
28.0
28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2
31.6

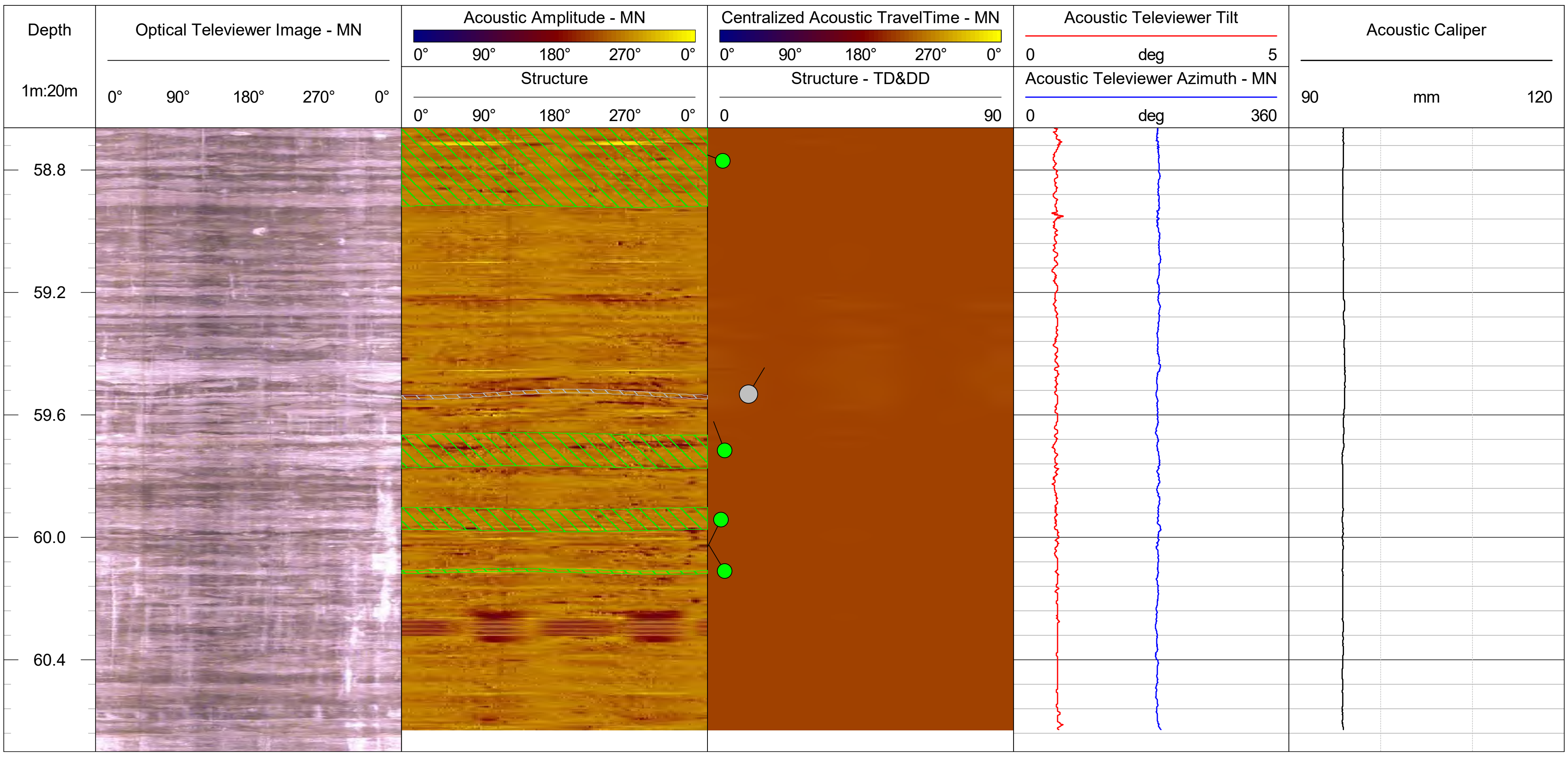

Depth
1m:20m
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
32.0
32.4
32.8
33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8
37.2
37.6
38.0
38.4

Depth 1m:20m	Optical Televiewer Image - MN 0° 90° 180° 270° 0°	Acoustic Amplitude - MN 0° 90° 180° 270° 0° Structure 0° 90° 180° 270° 0°	Centralized Acoustic TravelTime - MN 0° 90° 180° 270° 0° Structure - TD&DD 0 90	Acoustic Televiewer Tilt 0 deg 5 Acoustic Televiewer Azimuth - MN 0 deg 360	Acoustic Caliper 90 mm 120




Depth
1m:20m
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
45.2
45.6
46.0
46.4
46.8
47.2
47.6
48.0
48.4
48.8
49.2
49.6
50.0
50.4
50.8
51.2
51.6

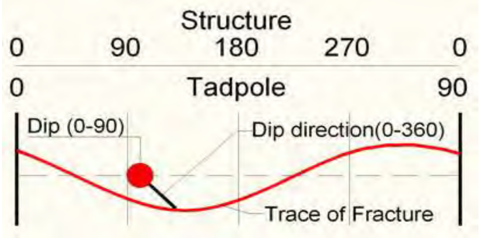

Depth
1m:20m
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
52.0
52.4
52.8
53.2
53.6
54.0
54.4
54.8
55.2
55.6
56.0
56.4
56.8
57.2
57.6
58.0
58.4


Depth
1m:20m
Optical Televiewer Image - MN
0° 90° 180° 270° 0°
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
58.8
59.2
59.6
60.0
60.4

Geophysical Record of Borehole: BH307

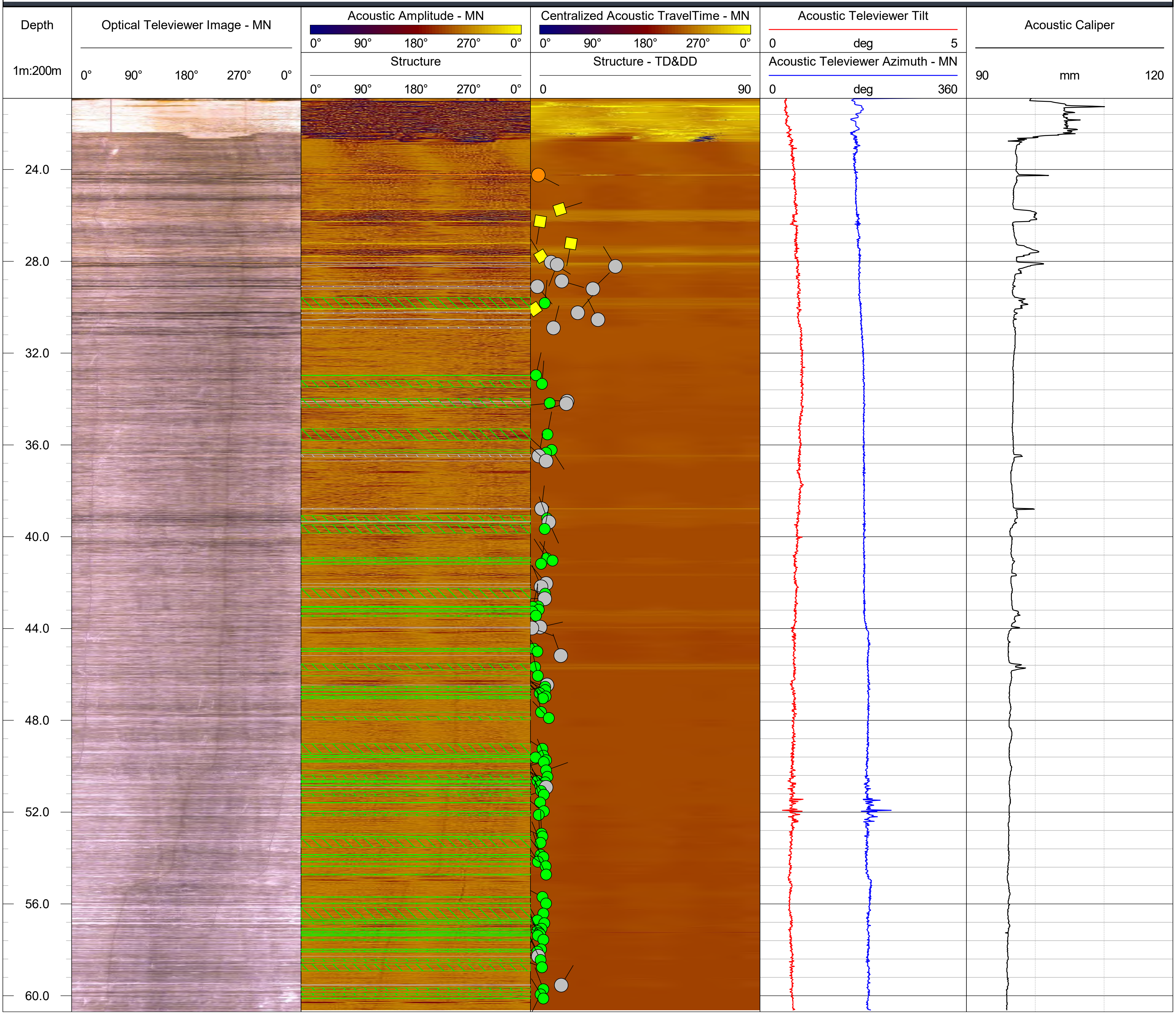
Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	~22 m bgs	**Location:**	Darlington, Ontario
Easting:	684686.37 m	**Drilled Depth:**	60.98 m bgs	**Water Level:**	N/A	**Log Date:**	July-8-2022
Northing:	4859406.21 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	78.90	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	J. Crawford



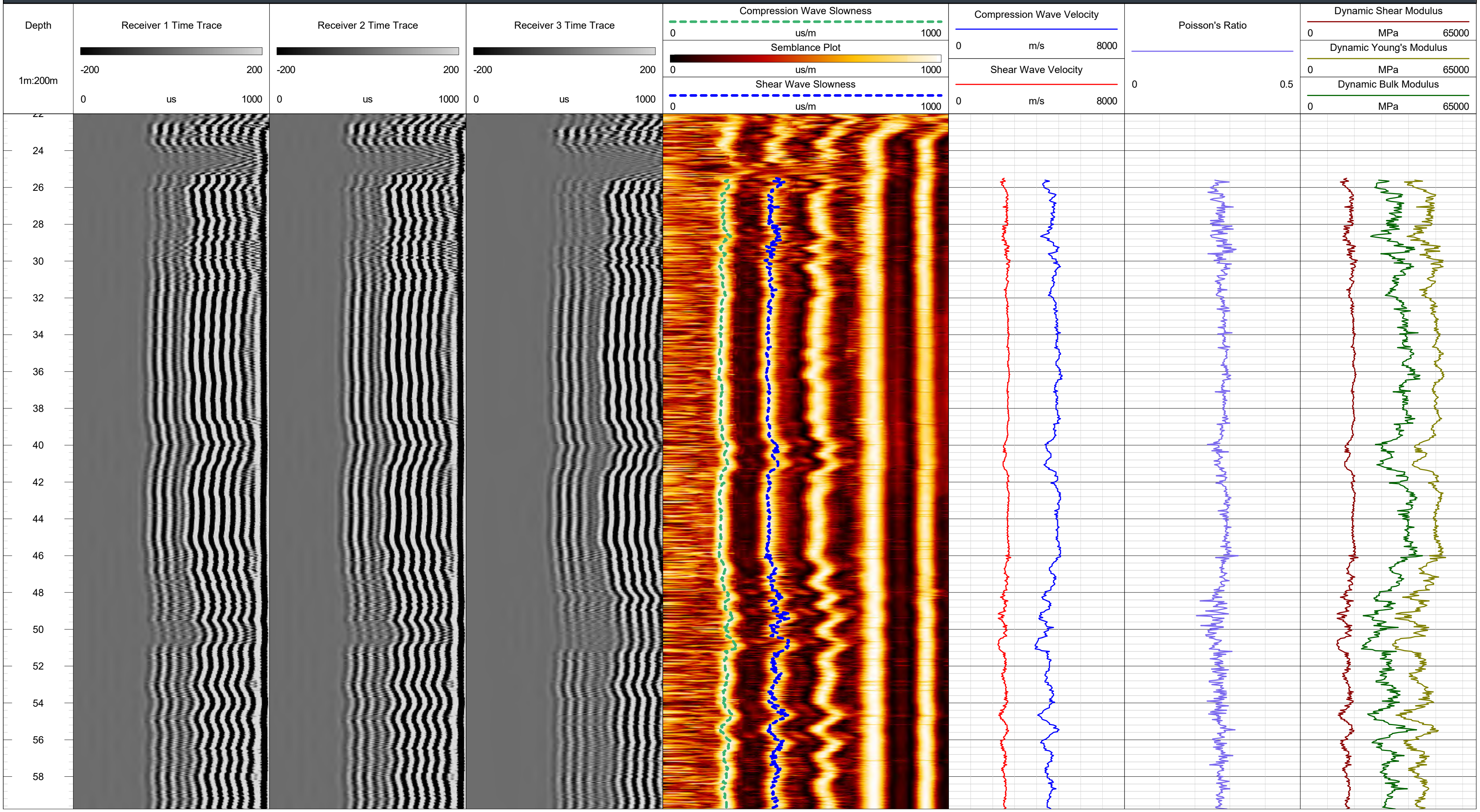
● Partially Open Joint / Fracture
● Filled Fracture / Joint
● Bedding / Banding / Foliation
◇ Contact

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)



Geophysical Record of Borehole: BH307

Log Title: Full Waveform Sonic Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023



A21-BH308

PROJECT: 21451329

LOCATION: N 4859279.18; E 684944.13

RECORD OF BOREHOLE: BH308

SHEET 1 OF 8

BORING DATE: July 16 to 19, 2022

DATUM: Geodetic

DRILL RIG: Diedrich 120 Track Mounted

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-10} 10^{-8} 10^{-6} 10^{-4} WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION GRAIN SIZE DISTRIBUTION (%)
		BARGE DECK		78.60 0.00							GR SA SI CL
0	Mud Rotary Wash Boring (Tricone) UW Casing										
1											
2											
3											
		WATER		74.79 3.81							
4											
5											
6											
7											
8											
9											
10											

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

LOGGED: KL

CHECKED: SEMP

PROJECT: 21451329

LOCATION: N 4859279.18; E 684944.13

RECORD OF BOREHOLE: BH308

BORING DATE: July 16 to 19, 2022

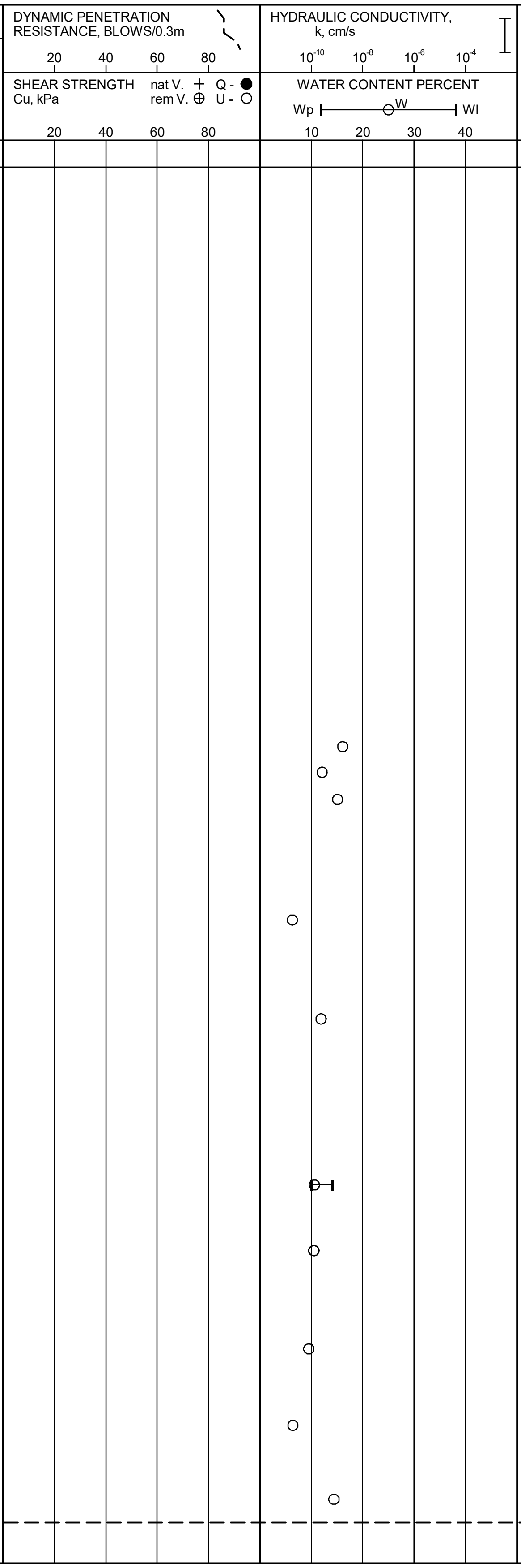
DRILL RIG: Diedrich 120 Track Mounted

SHEET 2 OF 8

DATUM: Geodetic

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
10	Mud Rotary Wash Boring (Tricone) UW Casing	WATER						
14		**Sandy Silt (ML)**, dense, grey, moist to wet, fine to medium sand, trace of subangular fine to coarse gravel (Glaciolacustrine) (Unit 4a)	64.43 14.17	1A				
				1B	SS	41	NP	5 39 51 5
				1C				
15		**Silty Sand with Gravel (SM)**, very dense, grey, moist, fine to coarse sand, angular to subangular fine to coarse gravel (Till) (Unit 5)	63.82 14.78	2	SS	100/ 0.10		
				3	SS	170/ 0.24	NP	24 40 29 7
16				4	SS	100/ 0.11		
17	Mud Rotary Wash Boring (Tricone) Open	- Rock fragments in Spoon Sample 5		5A 5B	SS	140/ 0.25		
		- Low plasticity silty clay fines in Spoon Sample 6		6	SS	100/ 0.13		7 39 42 12
18				7	SS	100/ 0.08		
		- Low plasticity silty clay fines in Spoon Sample 8		8	SS	100/ 0.10		
19				9	SS	100/ 0.13		
20				10	SS	100/ 0.13		



PIEZOMETER OR STANDPIPE INSTALLATION

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

LOGGED: KL

CHECKED: SEMP

PROJECT: 21451329

LOCATION: N 4859279.18; E 684944.13

RECORD OF BOREHOLE: BH308

SHEET 3 OF 8

BORING DATE: July 16 to 19, 2022

DATUM: Geodetic

DRILL RIG: Diedrich 120 Track Mounted

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
		--- CONTINUED FROM PREVIOUS PAGE ---				
20	Open	**Silty Sand with Gravel (SM)**, very dense, grey, moist, fine to coarse sand, angular to subangular fine to coarse gravel (Till) (Unit 5)		11	SS	69
21		**Shale Bedrock Fragments** (Unit 6a)	57.57 21.03	12	SS	100/ 0.08
		- Bedrock cored from 21.14 m to 68.63 m depth - Refer to Record of Drillhole BH308.	21.14			

Other columns (empty on this sheet): DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa (nat V. + Q - ●; rem V. ⊕ U - ○; 20, 40, 60, 80); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-10}, 10^{-8}, 10^{-6}, 10^{-4}); WATER CONTENT PERCENT (Wp ⊢ ○W ⊣ Wl; 10, 20, 30, 40); ADDITIONAL LAB. TESTING; PIEZOMETER OR STANDPIPE INSTALLATION; GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Depth scale: 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30

Notes:

1. Water level in open borehole could not be measured upon completion of soil drilling due to use of mud-rotary technique.

2. Efficiency of the SPT hammer utilized was 77.9 %.

DEPTH SCALE

1 : 50

LOGGED: KL

CHECKED: SEMP

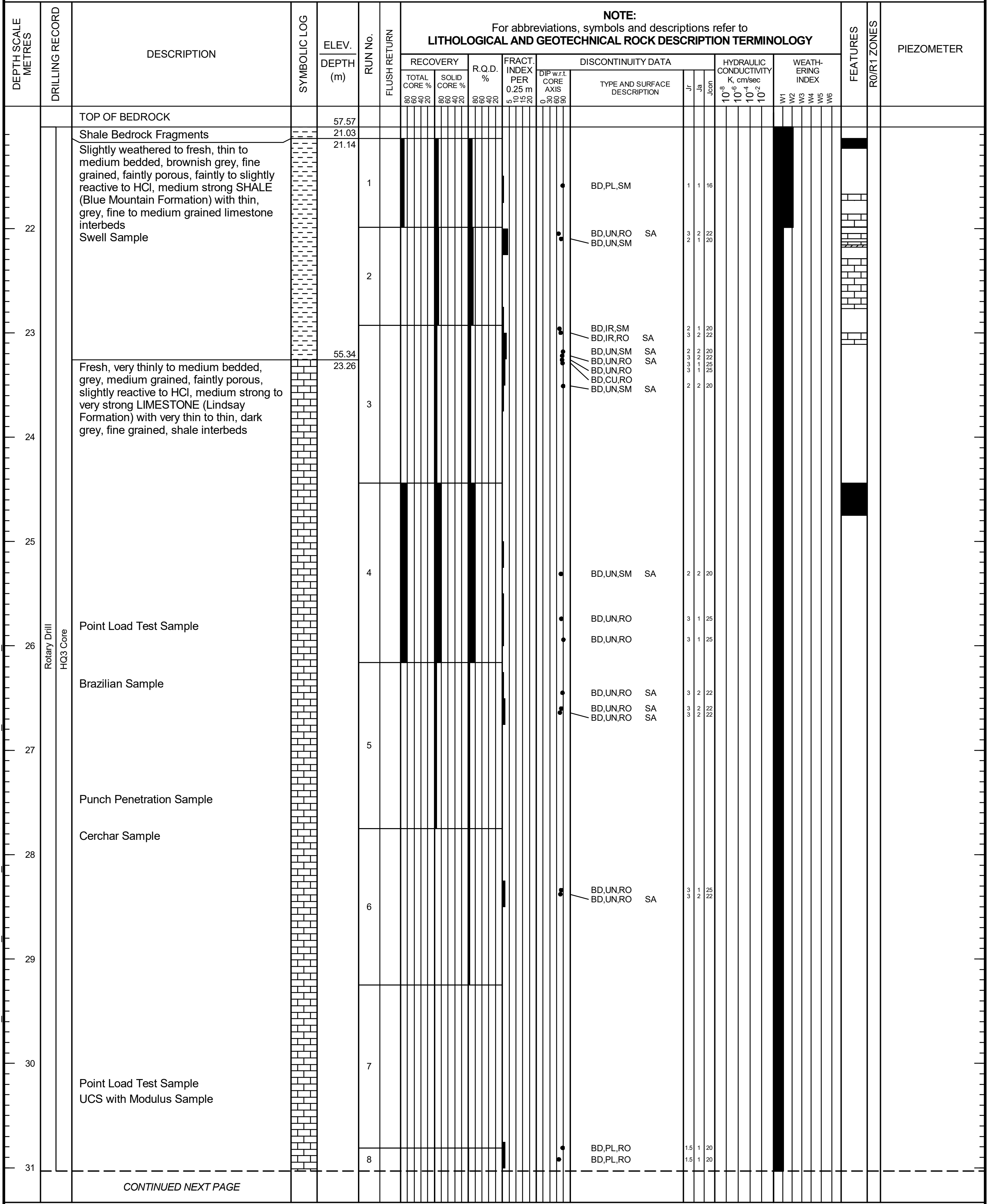
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859279.18; E 684944.13
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH308

DRILLING DATE: July 20 to July 29, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 4 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



ELEV. DEPTH (m)	DESCRIPTION
57.57	TOP OF BEDROCK
21.03	Shale Bedrock Fragments
21.14	Slightly weathered to fresh, thin to medium bedded, brownish grey, fine grained, faintly porous, faintly to slightly reactive to HCl, medium strong SHALE (Blue Mountain Formation) with thin, grey, fine to medium grained limestone interbeds Swell Sample
55.34 23.26	Fresh, very thinly to medium bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to very strong LIMESTONE (Lindsay Formation) with very thin to thin, dark grey, fine grained, shale interbeds Point Load Test Sample Brazilian Sample Punch Penetration Sample Cerchar Sample Point Load Test Sample UCS with Modulus Sample

TYPE AND SURFACE DESCRIPTION		Jr	Ja	Jcon
BD,PL,SM		1	1	16
BD,UN,RO	SA	3	2	22
BD,UN,SM		2	1	20
BD,IR,SM		2	1	20
BD,IR,RO	SA	3	2	22
BD,UN,SM	SA	2	2	20
BD,UN,RO	SA	3	2	22
BD,UN,RO		3	1	25
BD,CU,RO		3	1	25
BD,UN,SM	SA	2	2	20
BD,UN,SM	SA	2	2	20
BD,UN,RO		3	1	25
BD,UN,RO		3	1	25
BD,UN,RO	SA	3	2	22
BD,UN,RO	SA	3	2	22
BD,UN,RO	SA	3	2	22
BD,UN,RO		3	1	25
BD,UN,RO	SA	3	2	22
BD,PL,RO		1.5	1	20
BD,PL,RO		1.5	1	20

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: LT
CHECKED: CM

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859279.18; E 684944.13
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH308

DRILLING DATE: July 20 to July 29, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec	WEATHERING INDEX	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---					80 60 40 20	80 60 40 20	80 60 40 20	5 10 15 20	0 30 60 90					10^{-8} 10^{-6} 10^{-4} 10^{-2}	W1 W2 W3 W4 W5 W6			
	Rotary Drill HQ3 Core	Fresh, very thinly to medium bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to very strong LIMESTONE (Lindsay Formation) with very thin to thin, dark grey, fine grained, shale interbeds Brazilian Sample			8															
32		Specific Gravity Sample			9															
33		Slake Durability Sample																		
34					10							BD,UN,RO	3	1	25					
35		Punch Penetration Sample																		
36		Cerchar Sample			11															
37		Brazilian Sample Point Load Test Sample			12															
38												BD,PL,RO PC	1.5	3	20					
39		Cerchar Sample			13															
40		Punch Penetration Sample Specific Gravity Sample			14							BD,UN,RO SA	3	2	22					
41																				

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: LT
CHECKED: CM

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859279.18; E 684944.13
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH308

DRILLING DATE: July 20 to July 29, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 6 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (m)	RUN No.	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon
		--- CONTINUED FROM PREVIOUS PAGE ---						
	Rotary Drill HQ3 Core	Fresh, very thinly to medium bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to very strong LIMESTONE (Lindsay Formation) with very thin to thin, dark grey, fine grained, shale interbeds		14				
42				15				
43								
		Punch Penetration Sample		16				
44					BD,UN,RO SA	3	2	22
45		Point Load Test Sample		17	BD,UN,RO	3	1	25
46								
		UCS with Modulus Sample		18	BD,UN,RO	3	1	25
47								
48		Cerchar Sample		19	BD,UN,SM	2	1	20
49								
50		Brazilian Sample		20	BD,UN,RO	3	1	25
51				21				
		CONTINUED NEXT PAGE						

Other column headings: SYMBOLIC LOG; FLUSH RETURN; RECOVERY (TOTAL CORE %, SOLID CORE %; 80 60 40 20); R.Q.D. % (80 60 40 20); FRACT. INDEX PER 0.25 m (5 10 15 20); DIP w.r.t. CORE AXIS (0 30 60 90); HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-8} 10^{-6} 10^{-4} 10^{-2}); WEATHERING INDEX (W1 W2 W3 W4 W5 W6); FEATURES; R0/R1 ZONES; PIEZOMETER

DEPTH SCALE
1 : 50

LOGGED: LT
CHECKED: CM

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859279.18; E 684944.13
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH308

DRILLING DATE: July 20 to July 29, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 7 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE % 80 60 40 20	RECOVERY SOLID CORE % 80 60 40 20	R.Q.D. % 80 60 40 20	FRACT. INDEX PER 0.25 m 5 10 15 20	DIP w.r.t. CORE AXIS 0 30 60 90	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2}	WEATHERING INDEX W1 W2 W3 W4 W5 W6	FEATURES	R0/R1 ZONES	PIEZOMETER

--- CONTINUED FROM PREVIOUS PAGE ---

Fresh, very thinly to medium bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to very strong LIMESTONE (Lindsay Formation) with very thin to thin, dark grey, fine grained, shale interbeds

Point Load Test Sample

Drilling record: Rotary Drill, HQ3 Core

Depth scale: 52, 53, 54, 55, 56, 57, 58, 59, 60, 61

Run No.: 21, 22, 23, 24, 25, 26, 27

Type and surface description	Jr	Ja	Jcon
BD,UN,RO SA	3	2	22
BD,UN,SM	2	1	20
BD,PL,RO	1.5	1	20
BD,UN,SM	2	1	20
BD,UN,SM	2	1	20

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: LT
CHECKED: CM

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859279.18; E 684944.13
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH308

DRILLING DATE: July 20 to July 29, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 8 OF 8
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE % 80 60 40 20	RECOVERY SOLID CORE % 80 60 40 20	R.Q.D. % 80 60 40 20	FRACT. INDEX PER 0.25 m 5 10 15 20	DISCONTINUITY DATA DIP w.r.t. CORE AXIS 0 30 60 90	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2}	WEATHERING INDEX W1 W2 W3 W4 W5 W6	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
	Rotary Drill HQ3 Core	Fresh, very thinly to medium bedded, grey, medium grained, faintly porous, slightly reactive to HCl, medium strong to very strong LIMESTONE (Lindsay Formation) with very thin to thin, dark grey, fine grained, shale interbeds			28															
					28															
62																				
63																				
					29															
64																				
											●	BD,UN,SM	2	1	20					
					30															
65																				
66																				
					31															
											●	BD,UN,RO	3	1	25					
67																				
					32						●	BD,UN,RO	3	1	25					
68																				
				9.97																
		END OF DRILLHOLE		68.63																
69																				
70																				
71																				

DEPTH SCALE
1 : 50

LOGGED: LT
CHECKED: CM

Water Content Summary
ASTM D2216

Test Request #	21451329-21600-610 BH308	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville		

Sample Location	Sample				Soil Description	Water Content %	Method	Remarks
	Ref	Top (m)	Base (m)	Type				
BH308	1A	14.17	14.39	SS		16.1	B	
BH308	1B	14.39	14.57	SS		12.1	B	
BH308	1C	14.57	14.78	SS		15.1	B	
BH308	3	15.33	15.70	SS		6.3	B	
BH308	4	16.15	16.43	SS		11.9	B	
BH308	6	17.37	17.65	SS		10.6	B	
BH308	7	17.98	18.01	SS		10.5	B	
BH308	8	18.59	18.84	SS		9.5	B	
BH308	9	19.20	19.35	SS		6.4	B	
BH308	10	19.81	19.84	SS		14.4	B	

Notes:

Disclaimer:

Tested by: JTimms **Date:** 12 Oct 2022
Checked by: MRuck **Date:** 20 Oct 2022
Reviewed by: JoNorris **Date:** 28 Nov 2022

GOLDER
MEMBER OF WSP

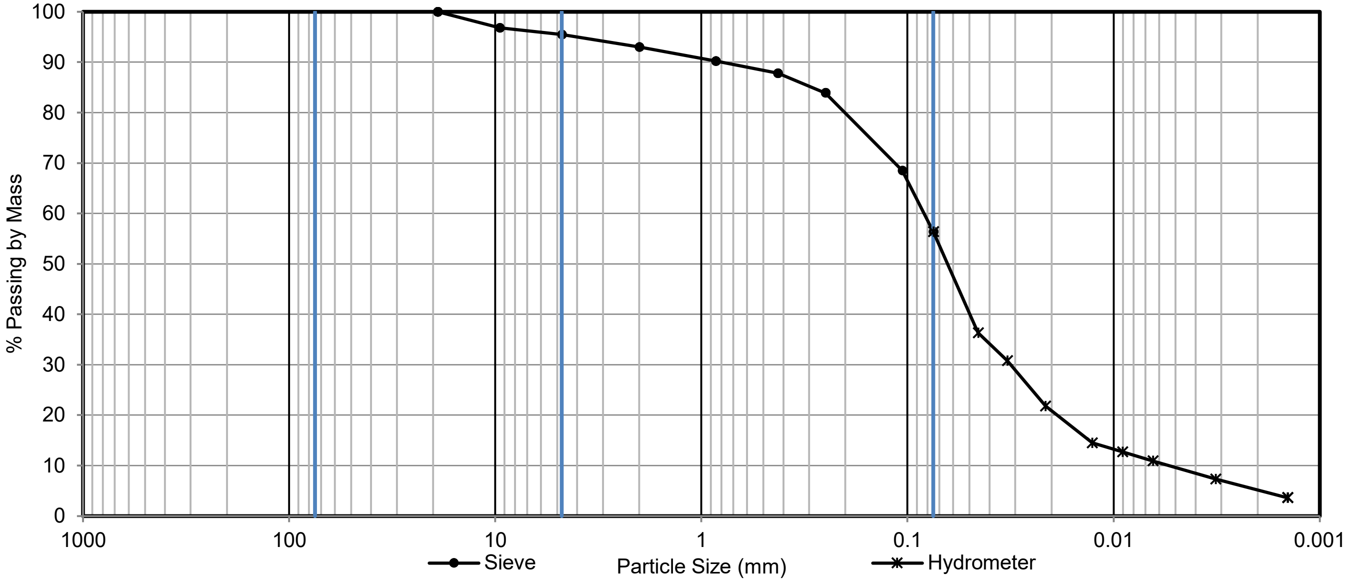
PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422
Method B

Test Request #	21451329-21600-610 BH308	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH308
Source:		Sample No.:	1B
Soil Description:		Type:	SS
		Depth (m):	14.39 - 14.57

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	14 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%)			4.5		39.1			56.4
BOULDERS	COBBLES	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0454	36.3
3/8"	9.5	96.8	0.0328	30.8
#4	4.75	95.5	0.0214	21.8
#10	2	93.0	0.0127	14.5
#20	0.85	90.2	0.0091	12.7
#40	0.425	87.8	0.0064	10.9
#60	0.25	83.9	0.0032	7.3
#140	0.106	68.5	0.0014	3.6
#200	0.075	56.4		
			0.005 mm	9.60
			0.002 mm	5.14
			D60	0.08
			D30	0.03
			D10	0.01
			Cu	15.00
			Cc	2.20

Notes:

Disclaimer:

Tested by: JTimms **Date:** 14 Oct 2022 **Checked by:** MRuck **Date:** 20 Oct 2022 **Reviewed by:** JoNorris **Date:** 10 Nov 2022

GOLDER
MEMBER OF WSP

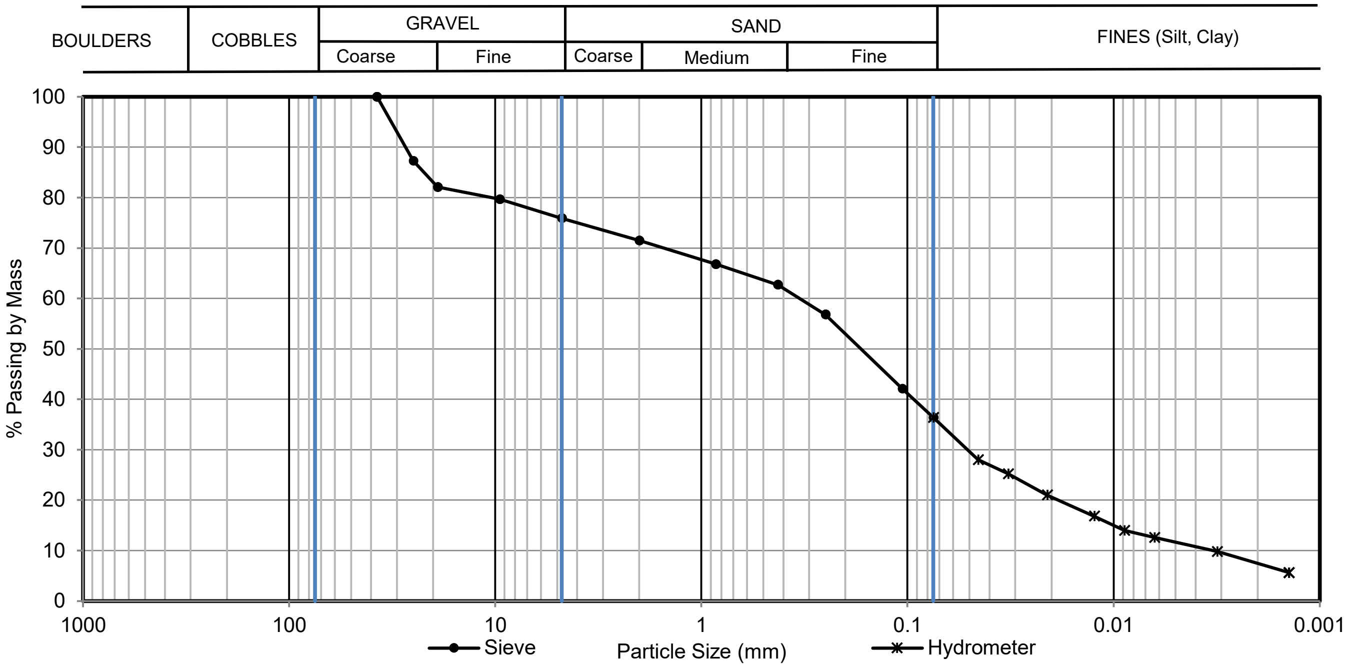
PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422
Method B

Test Request #	21451329-21600-610 BH308	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH308
Source:		Sample No.:	3
		Type:	SS
Soil Description:		Depth (m):	15.33 - 15.70

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	14 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%) 24.1 39.5 36.4



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1 1/2"	37.5	100.0	0.0454	28.0
1"	25	87.3	0.0325	25.2
3/4"	19	82.1	0.0210	21.0
3/8"	9.5	79.7	0.0124	16.8
#4	4.75	75.9	0.0089	14.0
#10	2	71.5	0.0063	12.6
#20	0.85	66.8	0.0031	9.8
#40	0.425	62.7	0.0014	5.6
#60	0.25	56.8		
#140	0.106	42.1		
#200	0.075	36.4		
			0.005 mm	11.66
			0.002 mm	7.43
			D60	0.33
			D30	0.05
			D10	0.00
			Cu	100.00
			Cc	2.40

Notes:

Disclaimer:

Tested by: JTimms **Date:** 14 Oct 2022 **Checked by:** MRuck **Date:** 20 Oct 2022 **Reviewed by:** JoNorris **Date:** 10 Nov 2022

PARTICLE SIZE DISTRIBUTION

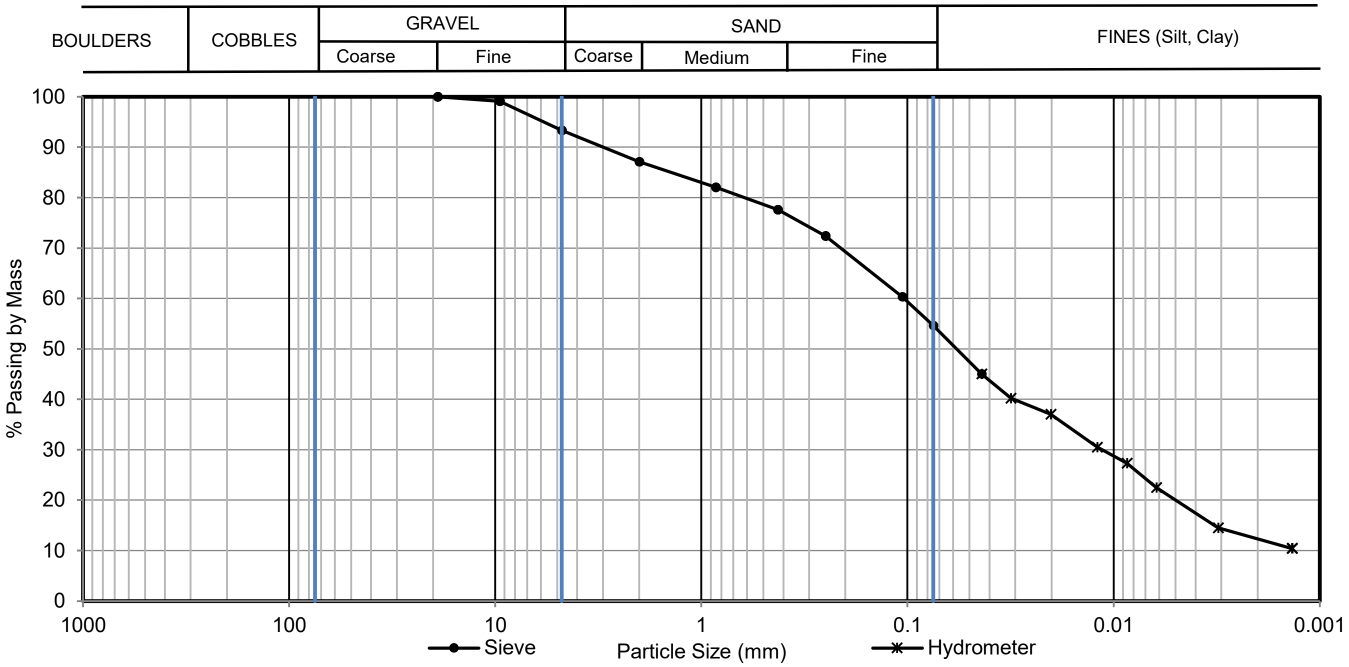
ASTM D6913 and ASTM D422

Method B

Test Request #	21451329-21600-610 BH308	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH308
Source:		Sample No.:	6
		Type:	SS
Soil Description:		Depth (m):	17.37 - 17.65

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	20 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%) 6.7 38.7 54.6



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0436	45.0
3/8"	9.5	99.1	0.0315	40.2
#4	4.75	93.3	0.0202	37.0
#10	2	87.1	0.0120	30.5
#20	0.85	82.0	0.0086	27.3
#40	0.425	77.6	0.0062	22.5
#60	0.25	72.4	0.0031	14.5
#140	0.106	60.3	0.0014	10.4
#200	0.075	54.6		
			0.005 mm	20.01
			0.002 mm	12.31
			D60	0.10
			D30	0.01
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

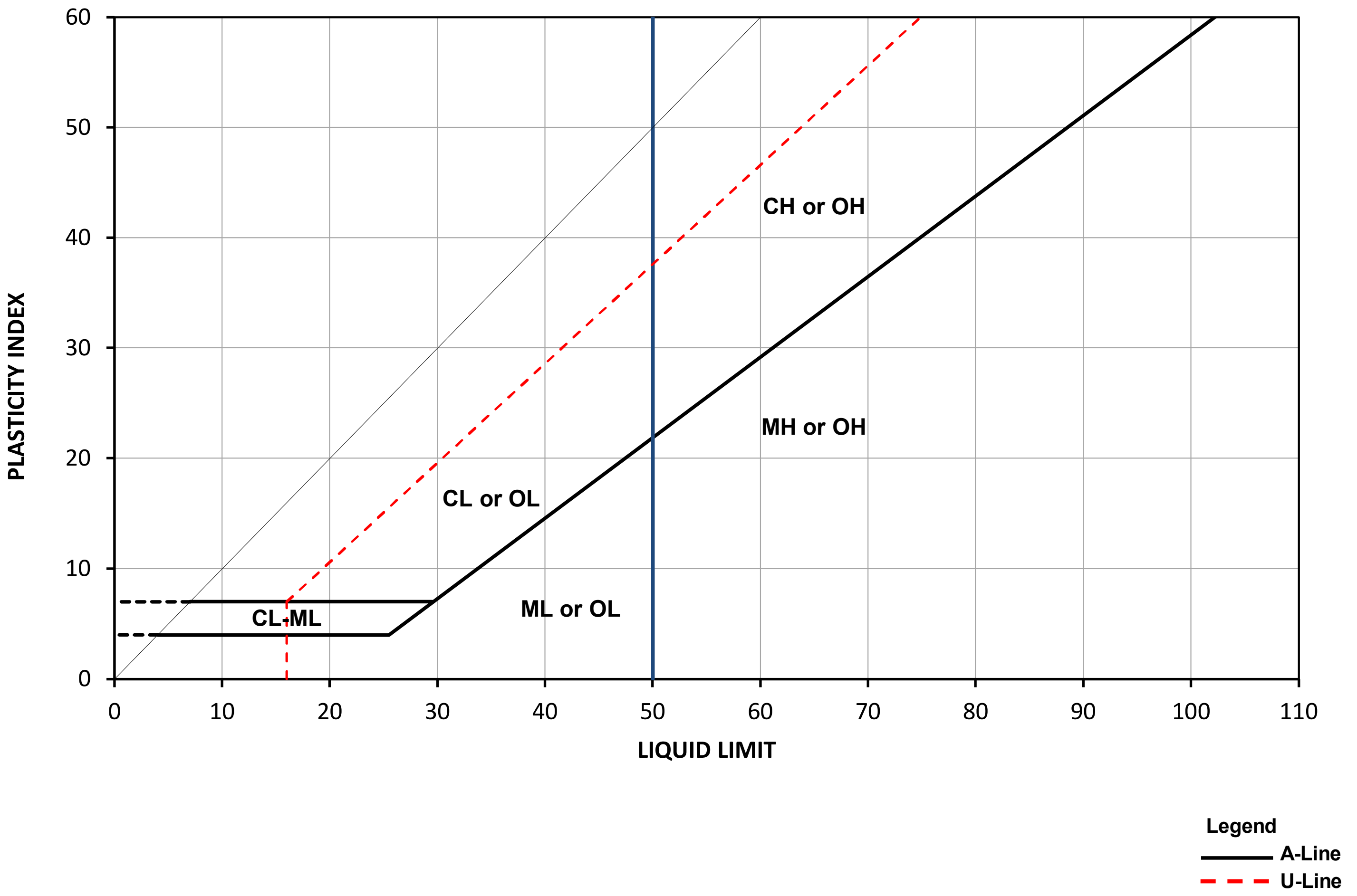
Tested by: KGill **Date:** 20 Oct 2022 **Checked by:** MRuck **Date:** 09 Nov 2022 **Reviewed by:** JoNorris **Date:** 10 Nov 2022

Golder Associates
100 Scotia Court Whitby, ON L1N 8Y6 Canada
[+1] 905-723-2727

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318

Test Request #	21451329-21600-610 BH308	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH308
Source:		Sample No.:	1B
Soil Description:		Type:	SS
		Depth (m):	14.39 - 14.57

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	17 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH308	1B	14.39	14.57	ND	12.1		NP		

NP = Non-Plastic
ND = Not Determined

Test Preparation

Notes:

Tested by: JTimms **Date:** 17 Oct 2022
Checked by: MRuck **Date:** 20 Oct 2022

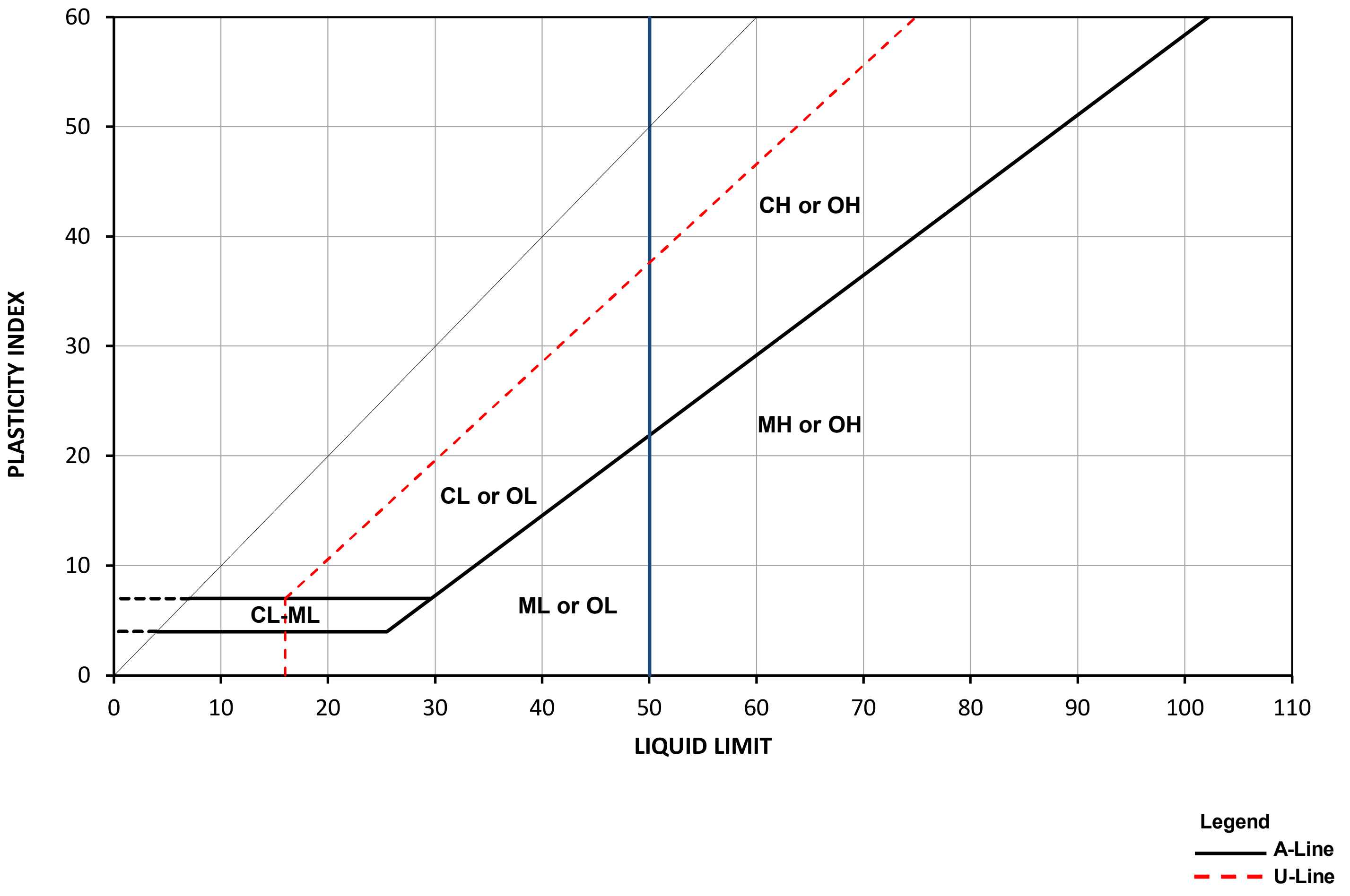
Disclaimer:

Reviewed by: JoNorris **Date:** 10 Nov 2022

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318

Test Request #	21451329-21600-610 BH308	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH308
Source:		Sample No.:	3
Soil Description:		Type:	SS
		Depth (m):	15.33 - 15.70

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	18 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH308	3	15.33	15.70	ND	6.3		NP		

NP = Non-Plastic
ND = Not Determined

Test Preparation

Notes:

Tested by: JTimms **Date:** 18 Oct 2022
Checked by: MRuck **Date:** 20 Oct 2022

Disclaimer:

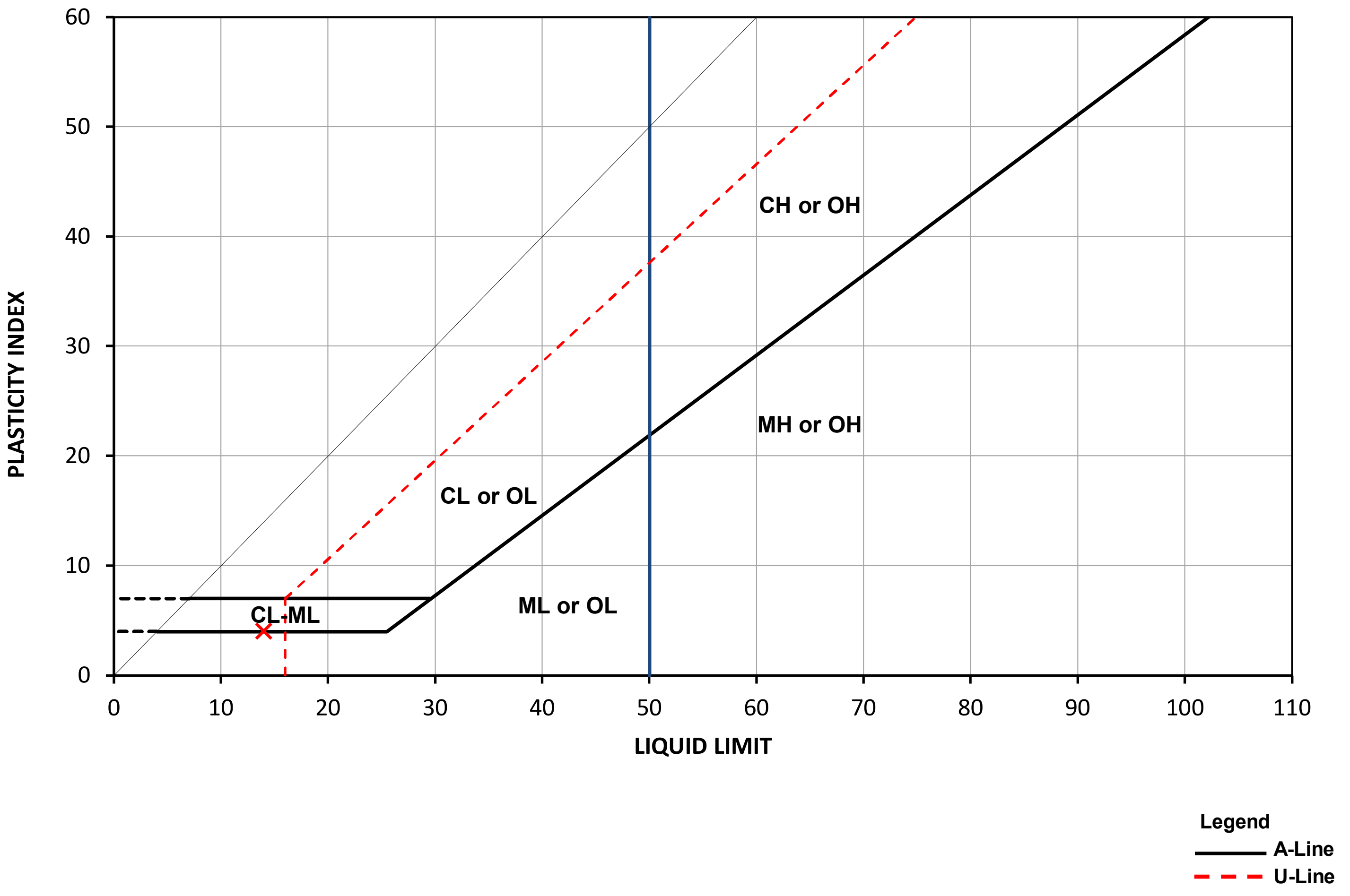
Reviewed by: JoNorris **Date:** 10 Nov 2022

GOLDER
MEMBER OF WSP

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318
Method B - One-point Test

Test Request #	21451329-21600-610 BH308	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH308
Source:		Sample No.:	6
Soil Description:		Type:	SS
		Depth (m):	17.37 - 17.65

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	25 Oct 2022
Specimen Description	NA				



Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH308	6	17.37	17.65	ND	10.6	14	10	4	0.15

NP = Non-Plastic
ND = Not Determined

Test Preparation

Notes:

Tested by: XMeng **Date:** 25 Oct 2022
Checked by: MRuck **Date:** 08 Nov 2022

Disclaimer:
The laboratory testing services reported herein have been performed in accordance with the terms of a contract with Golder's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of Golder's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Reviewed by: JoNorris **Date:** 10 Nov 2022

GOLDER
MEMBER OF WSP

SPECIFIC GRAVITY OF SOIL SOLIDS
ASTM D854
Pycnometer Method B

Test Request #	21451329-21600-610 BH308	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	NA
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH308
Source:		Sample No.:	1C
Soil Description:		Type:	SS
		Depth (m)	14.57 - 14.78

Specimen Reference	NA	Specimen Depth	NA	Date of Test	27 Oct 2022
Specimen Description	NA				

Proportions		
Percentage Passing (4.75 mm)		%
Percentage Retained (4.75 mm)		%

Fine Fraction (D854)		
Calibrated Mass of Pycnometer		g
Calibrated Volume of Pycnometer	249.72	mL
Mass of Pycnometer	103.88	g
Test Temperature	19.4	oC
Mass of Pycnometer, soil and water	378.69	g
Mass of Container (or tare)	103.88	g
Mass of dry soil and container	144.19	g
Dry mass of soil solids	40.31	g
Specific Gravity at 20oC	**2.72**	

Coarse Fraction (C127)		
Mass of Oven Dry Sample		g
Mass of saturated-surface-dry in air		g
Apparent mass of saturated test sample in water		g
Specific Gravity Oven Dry		
Specific Gravity Saturated Surface Dry		
Specific Gravity with Weighted Average	**2.72**	

Notes:

Tested by: DPatel **Date:** 27 Oct 2022
Checked by: MRuck **Date:** 09 Nov 2022

Disclaimer:

Reviewed by: JoNorris **Date:** 10 Nov 2022

SPECIFIC GRAVITY OF SOIL SOLIDS
ASTM D854
Pycnometer Method B

Test Request #	21451329-21600-610 BH308	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	NA
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH308
Source:		Sample No.:	6
Soil Description:		Type:	SS
		Depth (m)	17.37 - 17.65

Specimen Reference	NA	Specimen Depth	NA	Date of Test	26 Oct 2022
Specimen Description	NA				

Proportions		
Percentage Passing (4.75 mm)		%
Percentage Retained (4.75 mm)		%

Fine Fraction (D854)		
Calibrated Mass of Pycnometer		g
Calibrated Volume of Pycnometer	249.75	mL
Mass of Pycnometer	103.60	g
Test Temperature	15.1	oC
Mass of Pycnometer, soil and water	379.31	g
Mass of Container (or tare)	4.58	g
Mass of dry soil and container	46.19	g
Dry mass of soil solids	41.61	g
Specific Gravity at 20oC	**2.70**	

Coarse Fraction (C127)		
Mass of Oven Dry Sample		g
Mass of saturated-surface-dry in air		g
Apparent mass of saturated test sample in water		g
Specific Gravity Oven Dry		
Specific Gravity Saturated Surface Dry		
Specific Gravity with Weighted Average	**2.70**	

Notes:

Disclaimer:

Tested by: ShKhan **Date:** 26 Oct 2022

Checked by: MRuck **Date:** 09 Nov 2022

Reviewed by: JoNorris **Date:** 10 Nov 2022

SOIL RESISTIVITY USING THE WENNER FOUR ELECTRODE METHOD (ASTM G57-20)

November 3, 2022
Golder Project Number: 21451329-21600-610

Attention: Sarah Poot

Sample Description: **BH308, SA8, 18.59-18.84m**

Date Scheduled:	October 3, 2022	Sampled By:	Golder Associates Ltd.
Date Received:	October 12, 2022	Golder Lab No.:	G-22-265
Date Tested:	October 12, 2022	Tested By:	E. Shallhorn

Resistivity Meter Model Number	Miller 400D
Soil Box Factor	0.976377953
Temperature of Sample (°C)	23.5
Measured Resistance (ohm)	2370.0
Resistivity (ohm•cm)	2314.0
Temperature Corrected Resistivity (ohm•cm)	**2776.8**

Data Input By: M. Ruck

Reviewed by:

Jodi Norris, Technical and Quality Coordinator

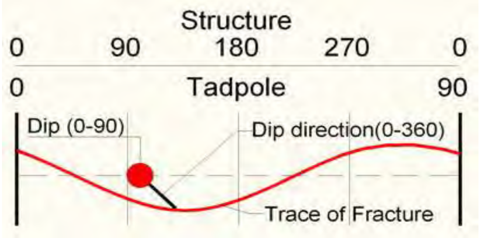
The Voice Of Independent Canadian Laboratories
La voix des laboratoires indépendants canadiens

Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

Geophysical Record of Borehole: BH308

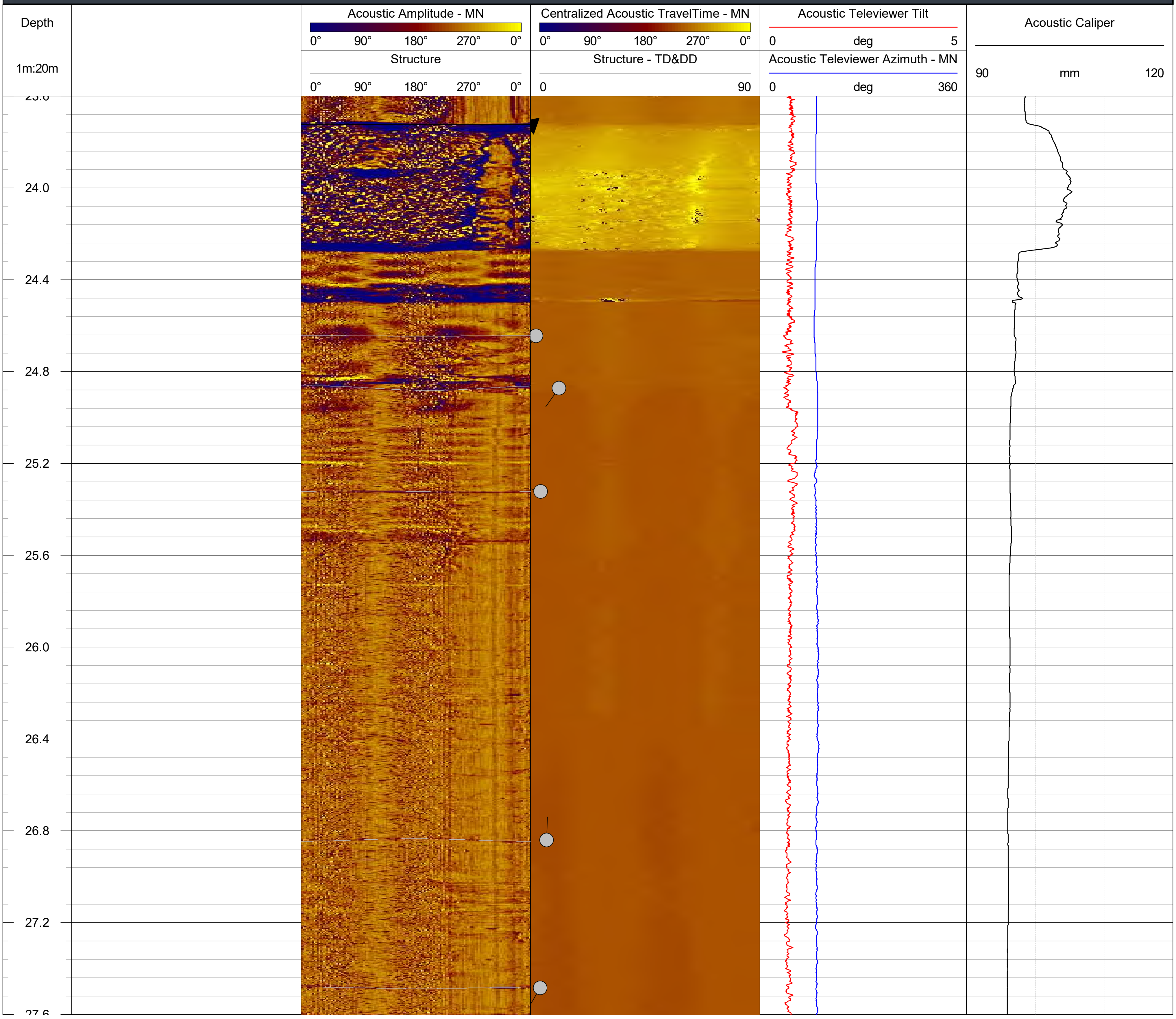
Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

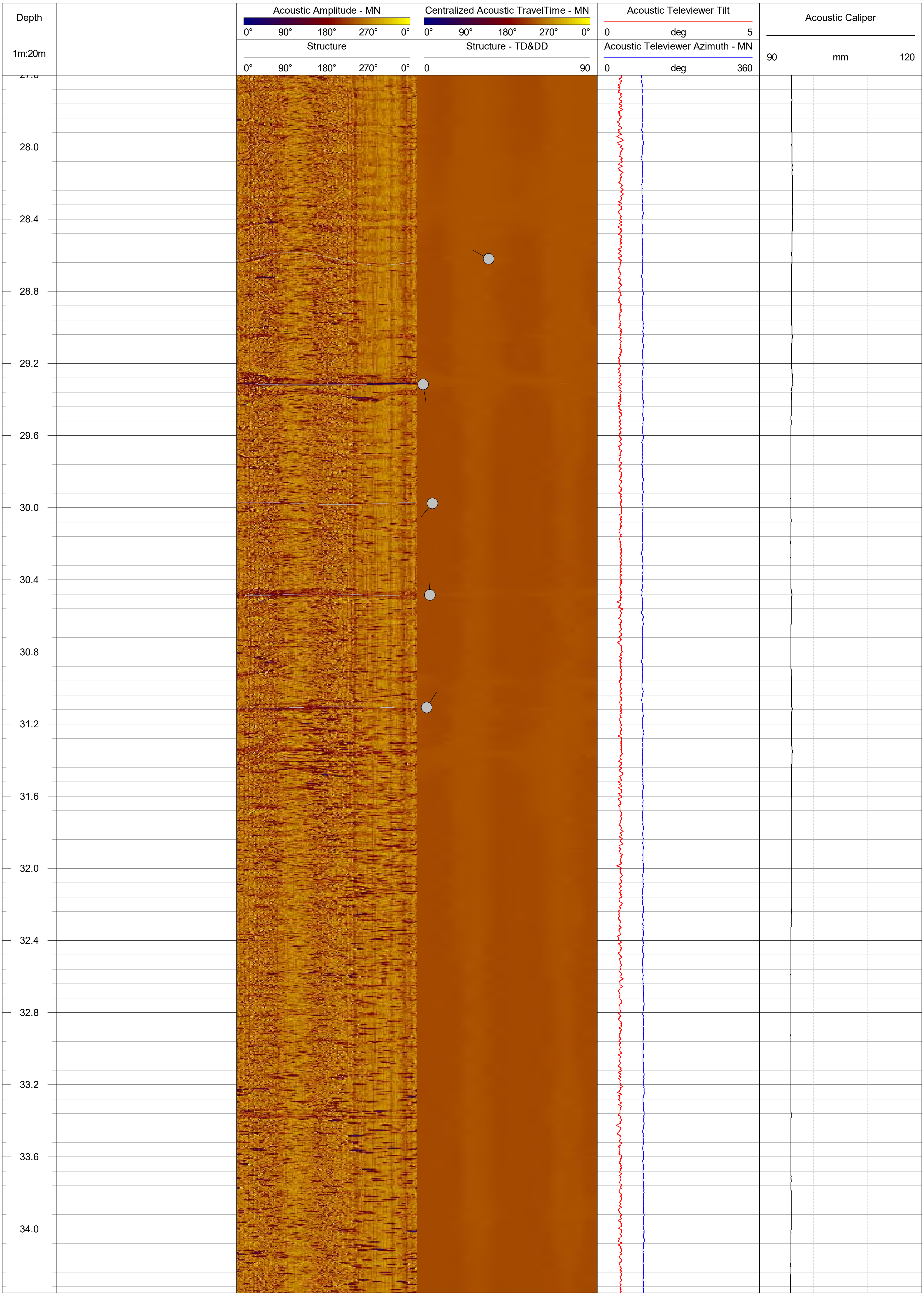
Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	~24.04 m bgs	**Location:**	Darlington, Ontario
Easting:	684944.13 m	**Drilled Depth:**	68.5 m bgs	**Water Level:**	2.13 m bgs	**Log Date:**	July-31-2022
Northing:	4859279.18 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	78.60 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	E. Pineda



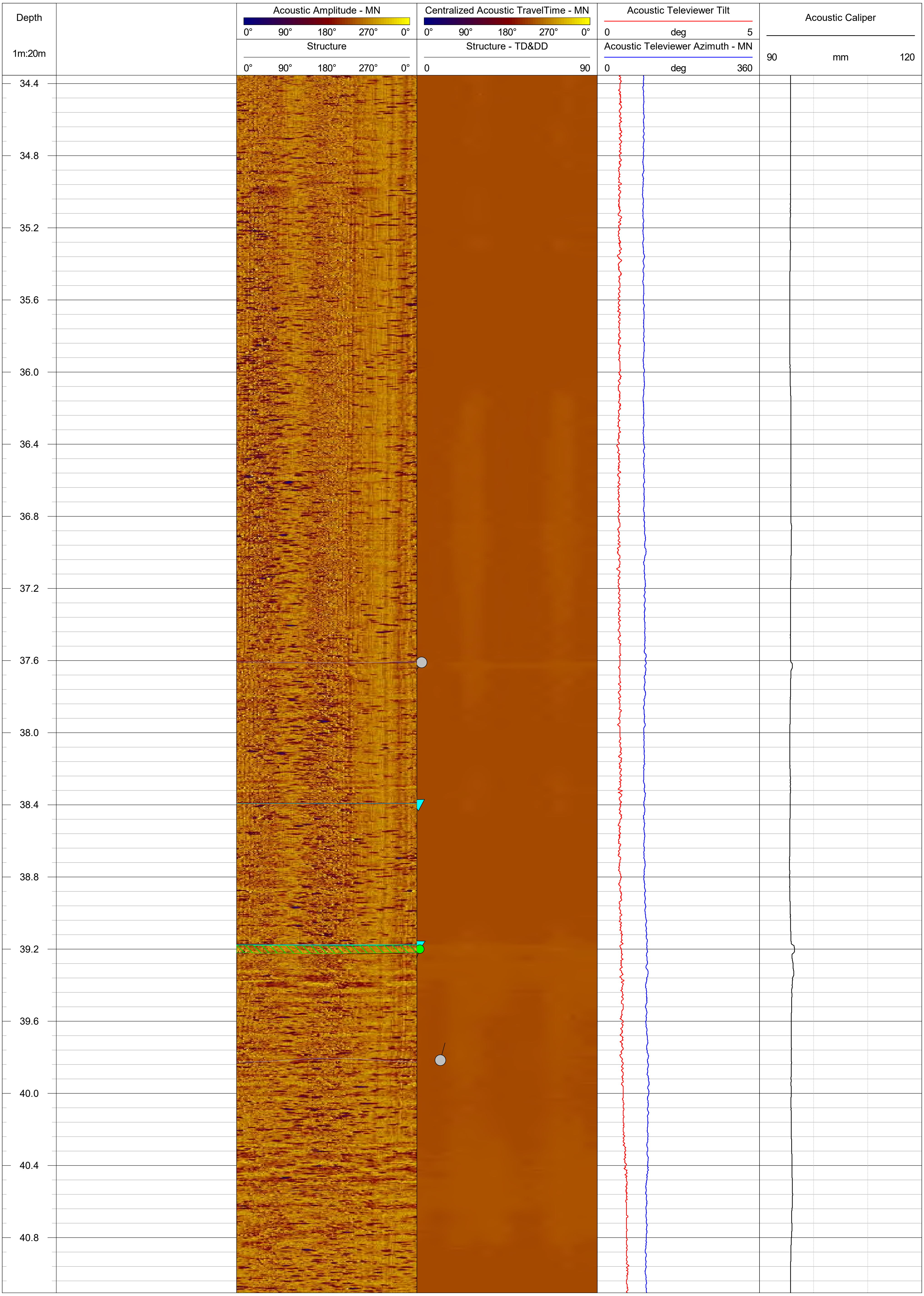
● Partially Open Joint / Fracture
● Filled Fracture / Joint
● Bedding / Banding / Foliation
▼ Induced Fracture
▼ Casing

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)





Depth
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
28.0
28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0
32.4
32.8
33.2
33.6
34.0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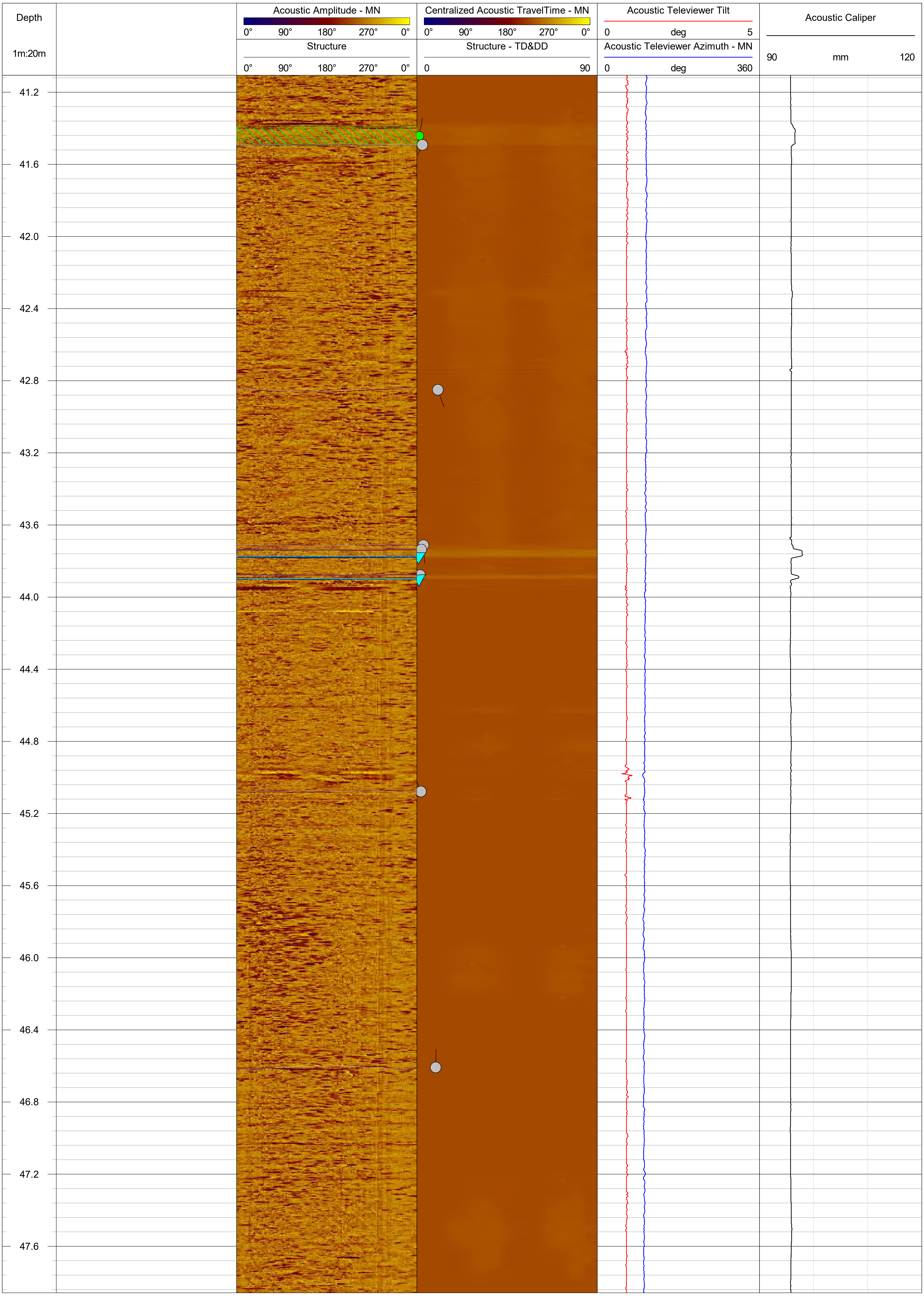
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
34.4
34.8
35.2
35.6
36.0
36.4
36.8
37.2
37.6
38.0
38.4
38.8
39.2
39.6
40.0
40.4
40.8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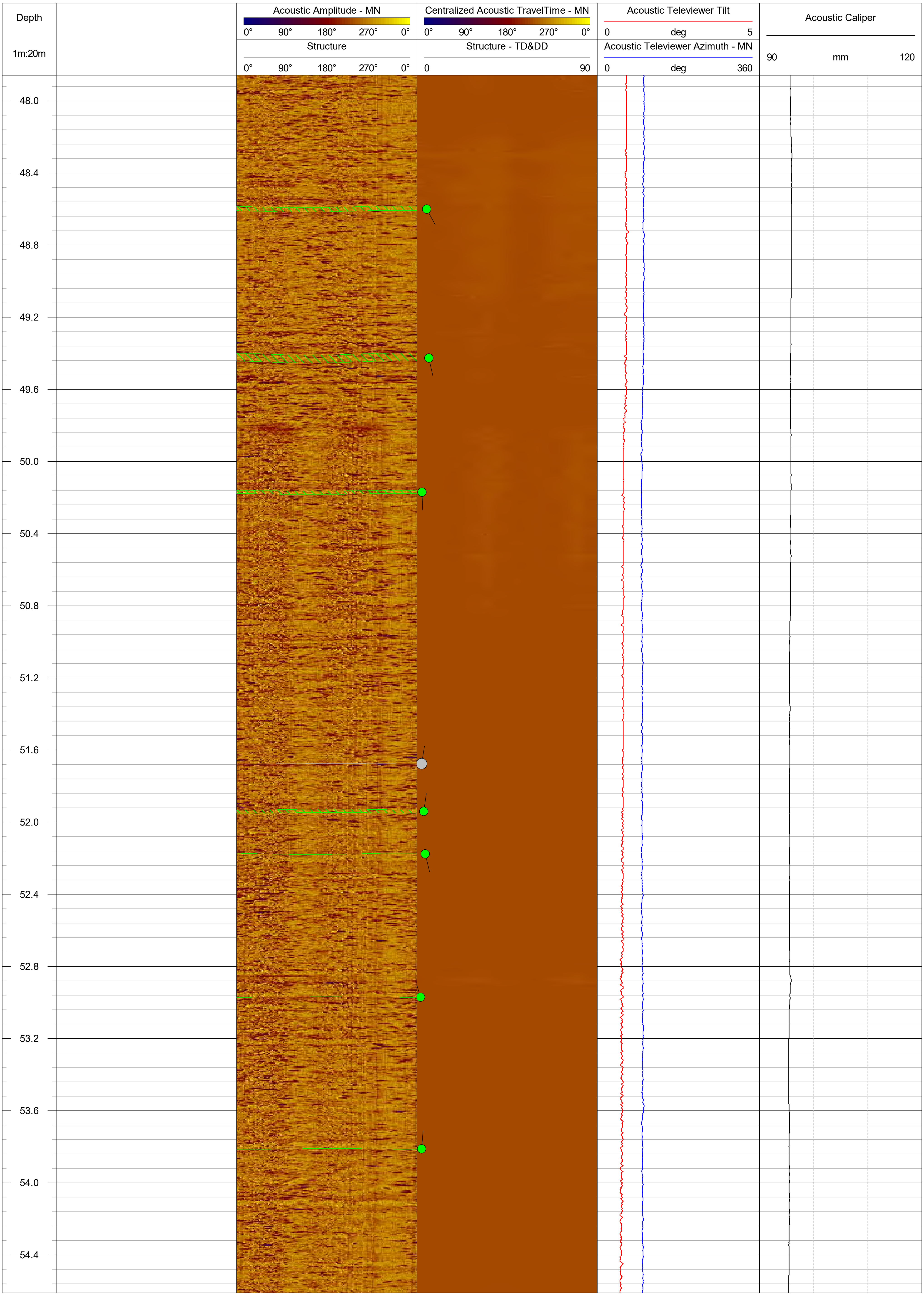
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
41.2
41.6
42.0
42.4
42.8
43.2
43.6
44.0
44.4
44.8
45.2
45.6
46.0
46.4
46.8
47.2
47.6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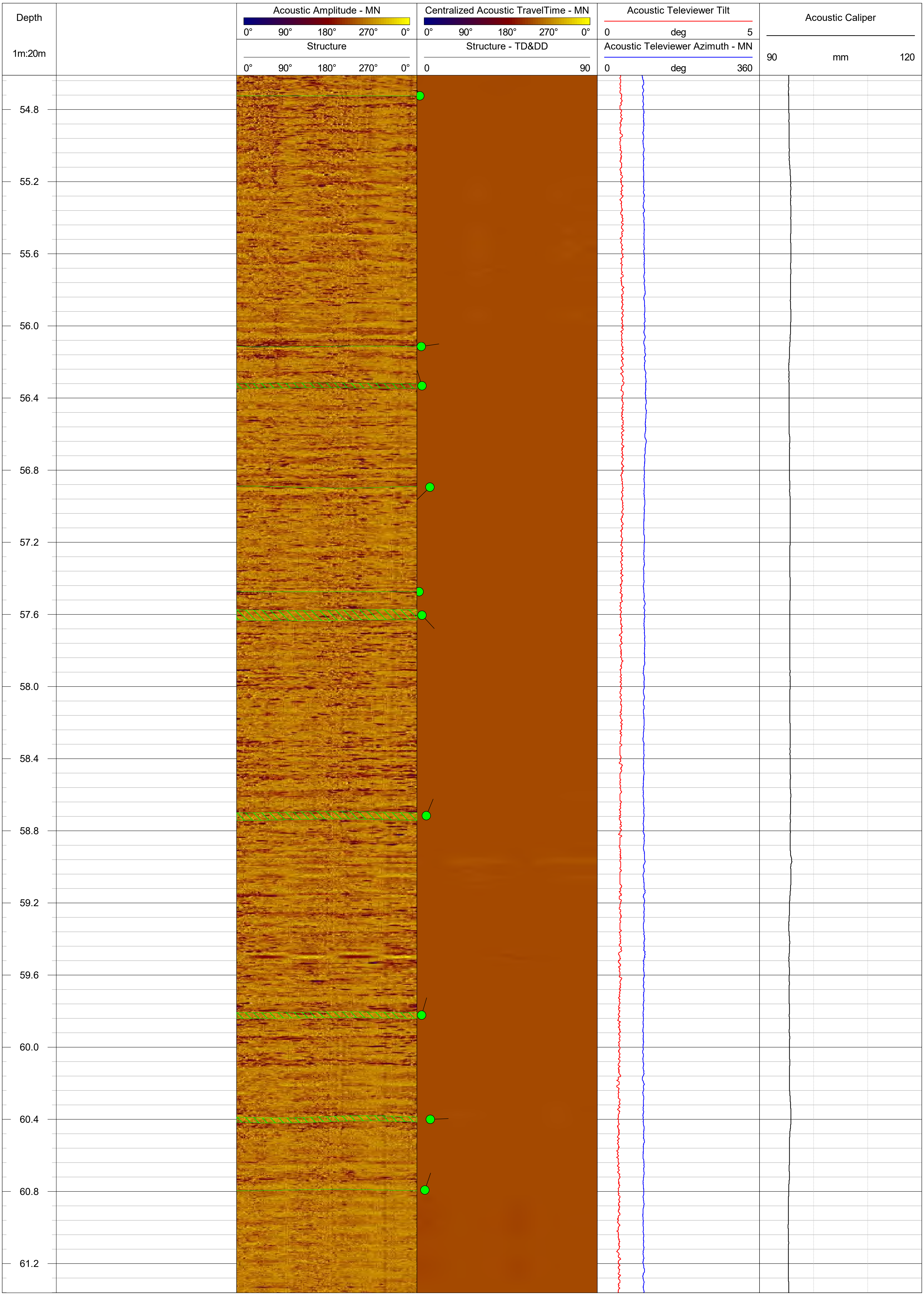
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
48.0
48.4
48.8
49.2
49.6
50.0
50.4
50.8
51.2
51.6
52.0
52.4
52.8
53.2
53.6
54.0
54.4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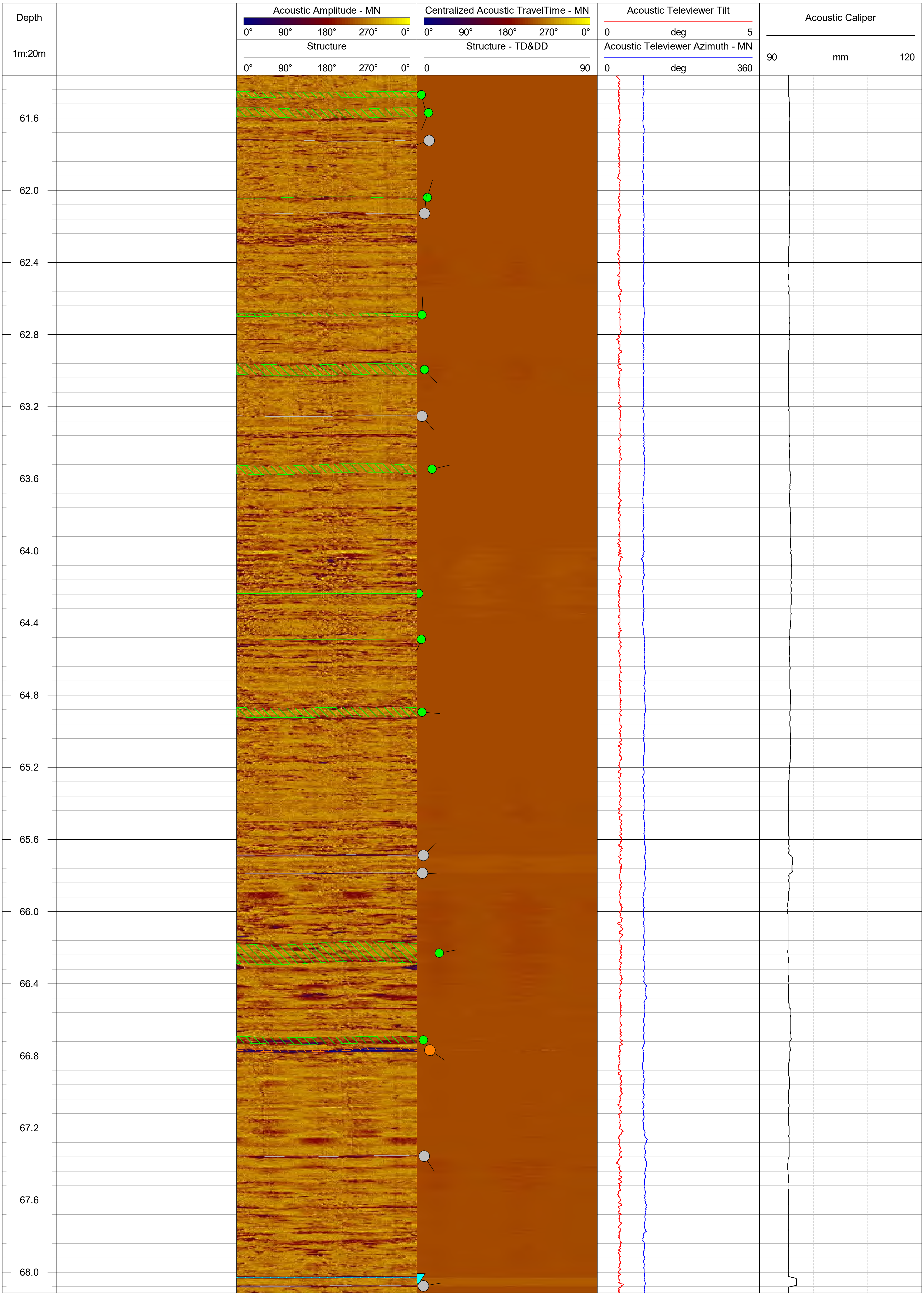
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
54.8
55.2
55.6
56.0
56.4
56.8
57.2
57.6
58.0
58.4
58.8
59.2
59.6
60.0
60.4
60.8
61.2

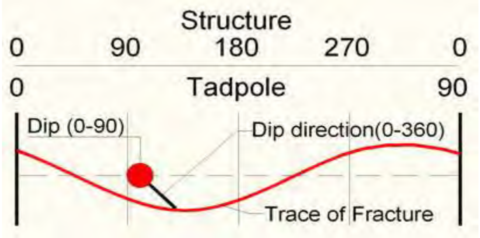

Depth
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
61.6
62.0
62.4
62.8
63.2
63.6
64.0
64.4
64.8
65.2
65.6
66.0
66.4
66.8
67.2
67.6
68.0

Depth		Acoustic Amplitude - MN 0° 90° 180° 270° 0°	Centralized Acoustic TravelTime - MN 0° 90° 180° 270° 0°	Acoustic Televiewer Tilt 0 deg 5	Acoustic Caliper 90 mm 120
1m:20m		Structure 0° 90° 180° 270° 0°	Structure - TD&DD 0 90	Acoustic Televiewer Azimuth - MN 0 deg 360	

Geophysical Record of Borehole: BH308

Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	~24.04 m bgs	**Location:**	Darlington, Ontario
Easting:	684944.13 m	**Drilled Depth:**	68.5 m bgs	**Water Level:**	2.13 m bgs	**Log Date:**	July-31-2022
Northing:	4859279.18 m	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	78.60 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	E. Pineda



● Partially Open Joint / Fracture

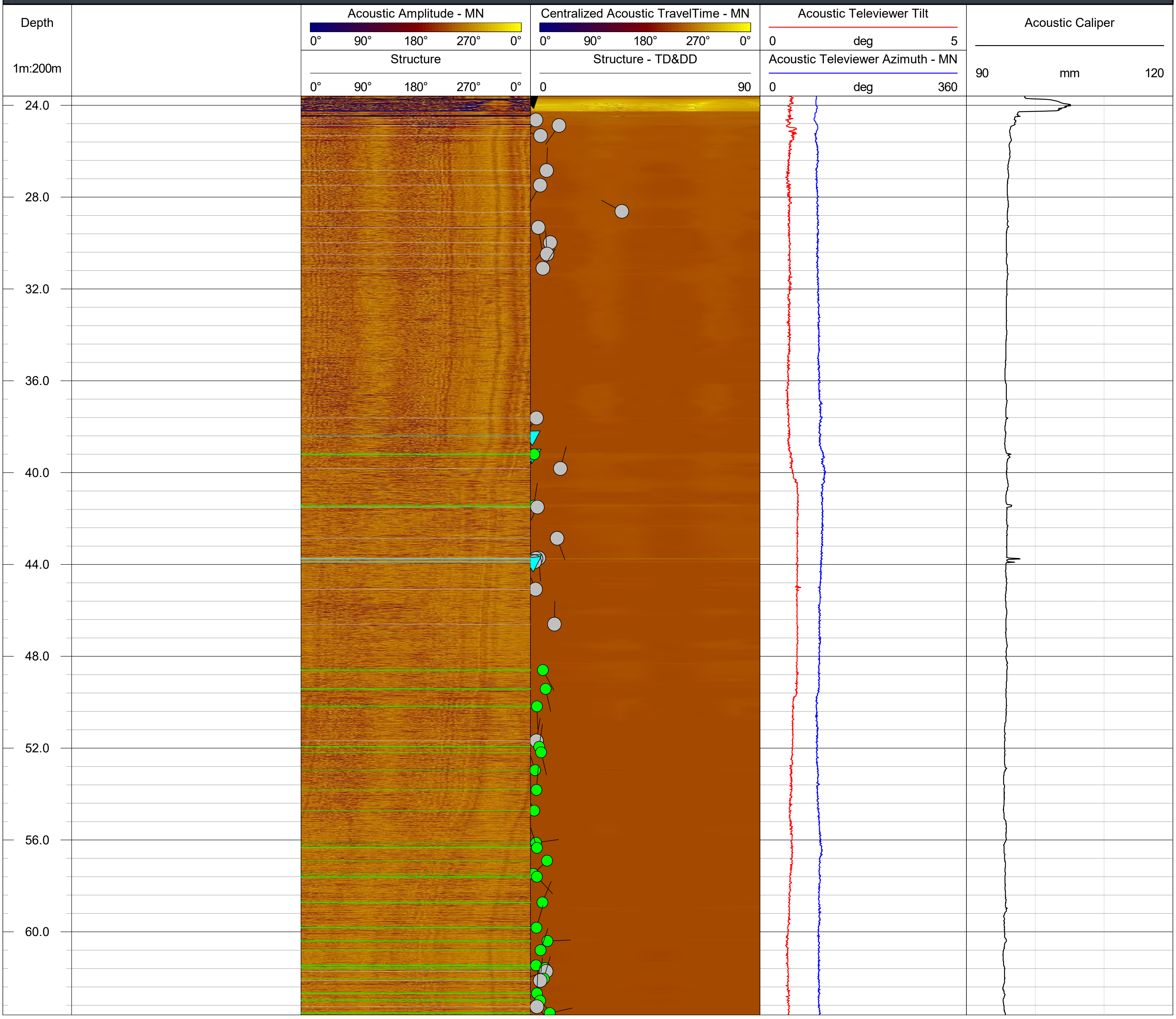
● Filled Fracture / Joint

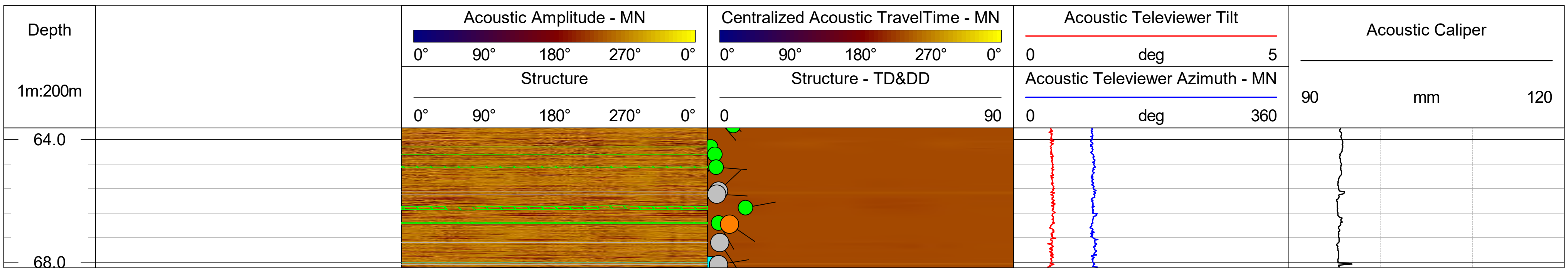
● Bedding / Banding / Foliation

▼ Induced Fracture

▼ Casing

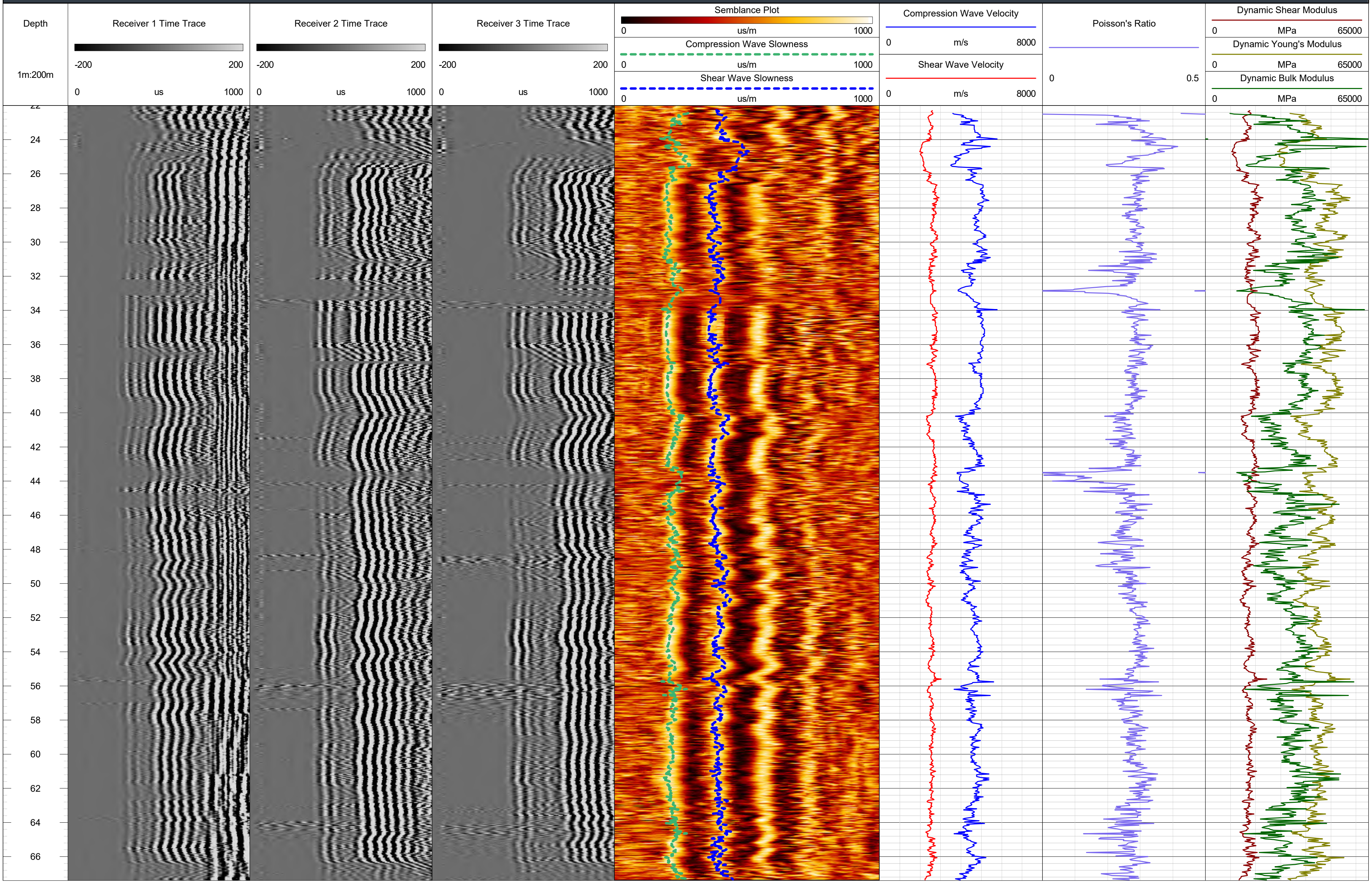
Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)




Depth
1m:200m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
64.0
68.0

Geophysical Record of Borehole: BH308

Log Title: Full Waveform Sonic Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023



A22-BH309

PROJECT: 21451329

LOCATION: N 4859188.25; E 685151.90

RECORD OF BOREHOLE: BH309

SHEET 1 OF 7

BORING DATE: August 12, 2022

DATUM: Geodetic

DRILL RIG: Diedrich 120 Track Mounted

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-10} 10^{-8} 10^{-6} 10^{-4}) / WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION / GRAIN SIZE DISTRIBUTION (%)
		BARGE DECK		78.52							GR SA SI CL
0	Mud Rotary Wash Boring (Tricone) UW Casing			0.00							
1											
2											
3											
		WATER		74.72 3.80							
4											
5											
6											
7											
8											
9											
10											

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

LOGGED: LT/JD

CHECKED: SEMP

GTA-BHS 005 S:\CLIENTS\OPG\DARLINGTON_GENERATING_STATION\02_DATA\GINT\DARLINGTON_GENERATING_STATION.GPJ GAL-MIS.GDT 3/14/23

PROJECT: 21451329

LOCATION: N 4859188.25; E 685151.90

RECORD OF BOREHOLE: BH309

SHEET 2 OF 7

BORING DATE: August 12, 2022

DATUM: Geodetic

DRILL RIG: Diedrich 120 Track Mounted

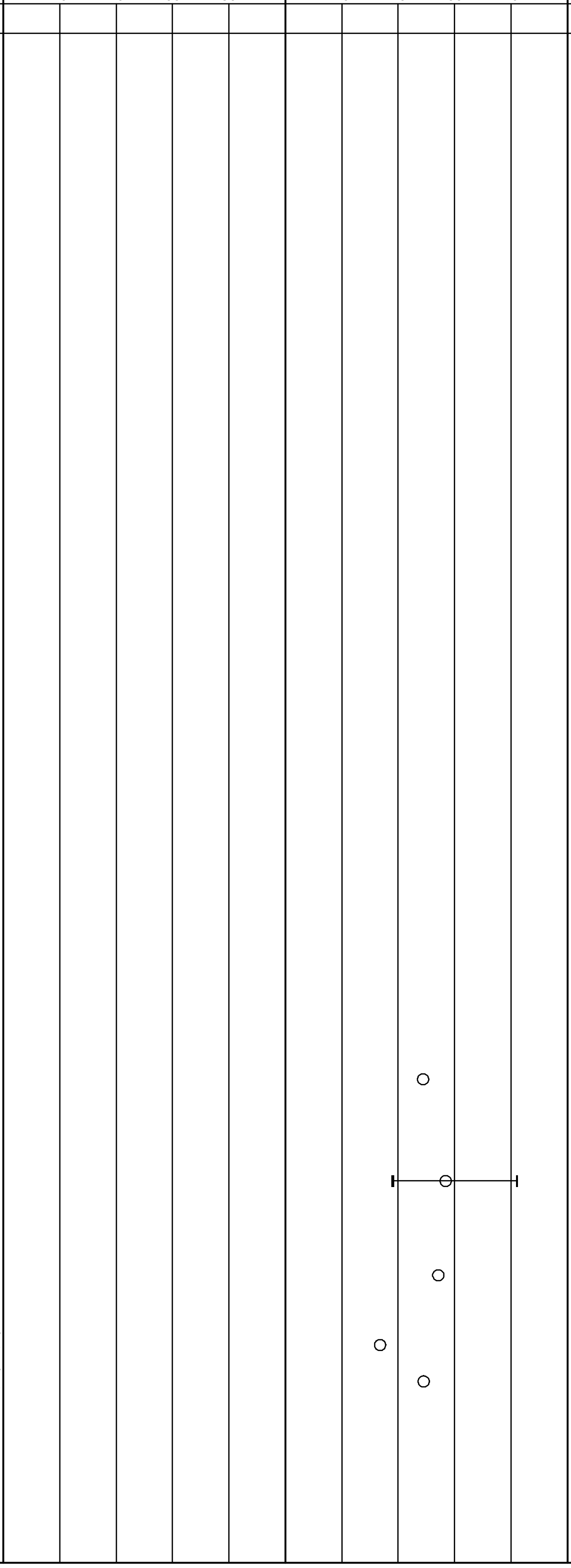
DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		--- CONTINUED FROM PREVIOUS PAGE ---							
10	Mud Rotary Wash Boring (Tricone) UW Casing	WATER							
16.74		**Lean Clay with Gravel (CL)**, stiff to very stiff, grey, moist, fine to medium sand, angular fine gravel, low to medium plasticity (Glaciolacustrine) (Unit 4b)		61.78 16.74	1	SS	14		
					2	SS	20		18 2 30 50
					3A 3B	SS	12		
18.64		**Sandy Silty Clay (CL-ML)**, hard, grey, moist, fine to coarse sand, angular to subangular fine to coarse gravel, low plasticity (Till) (Unit 5)		59.88 18.64	4	SS	100/ 0.07		
	Open				5	SS	100/ 0.10		
19.14	Mud Rotary Wash Boring (Tricone)	**Shale Bedrock** - Bedrock cored from 19.14 m to 60.85 m depth - Refer to Record of Drillhole BH309.		59.38 19.14					
20									

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-10} 10^{-8} 10^{-6} 10^{-4}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl 10 20 30 40



DEPTH SCALE

1 : 50

LOGGED: LT/JD

CHECKED: SEMP

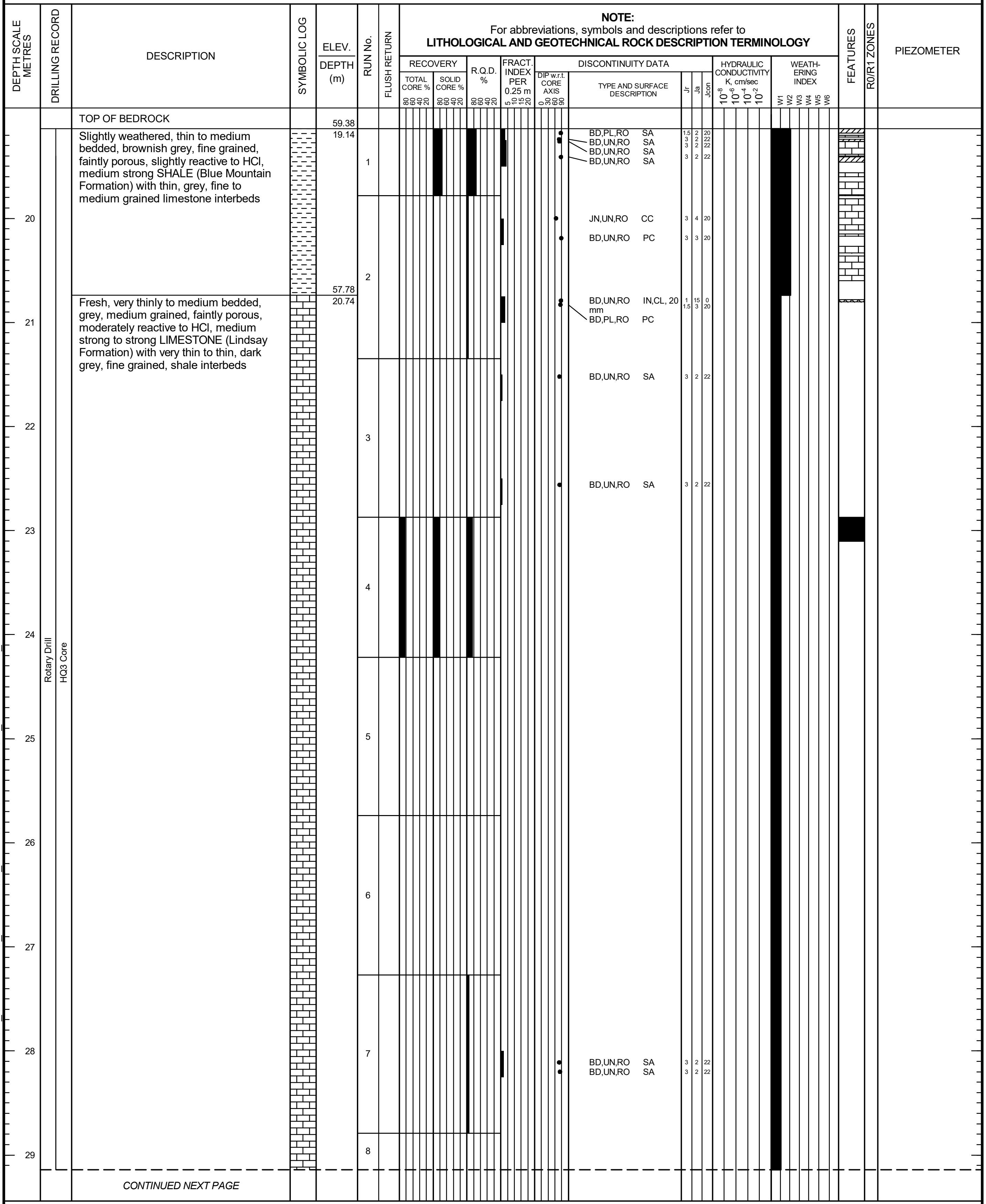
PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859188.25; E 685151.9
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH309

DRILLING DATE: August 13 to 17, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 3 OF 7
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY



DESCRIPTION	ELEV. DEPTH (m)
TOP OF BEDROCK	59.38
Slightly weathered, thin to medium bedded, brownish grey, fine grained, faintly porous, slightly reactive to HCl, medium strong SHALE (Blue Mountain Formation) with thin, grey, fine to medium grained limestone interbeds	19.14
Fresh, very thinly to medium bedded, grey, medium grained, faintly porous, moderately reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with very thin to thin, dark grey, fine grained, shale interbeds	57.78 20.74

TYPE AND SURFACE DESCRIPTION		Jr	Ja	Jcon
BD,PL,RO	SA	1.5	2	20
BD,UN,RO	SA	3	2	22
BD,UN,RO	SA	3	2	22
BD,UN,RO	SA	3	2	22
JN,UN,RO	CC	3	4	20
BD,UN,RO	PC	3	3	20
BD,UN,RO	IN,CL, 20 mm	1	15	0
BD,PL,RO	PC	1.5	3	20
BD,UN,RO	SA	3	2	22
BD,UN,RO	SA	3	2	22
BD,UN,RO	SA	3	2	22
BD,UN,RO	SA	3	2	22

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: JD
CHECKED: CM

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859188.25; E 685151.9
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH309

DRILLING DATE: August 13 to 17, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 4 OF 7
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE % 80 60 40 20	RECOVERY SOLID CORE % 80 60 40 20	R.Q.D. % 80 60 40 20	FRACT. INDEX PER 0.25 m 5 10 15 20	DIP w.r.t. CORE AXIS 0 30 60 90	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2}	WEATHERING INDEX W1 W2 W3 W4 W5 W6	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
	Rotary Drill HQ3 Core	Fresh, very thinly to medium bedded, grey, medium grained, faintly porous, moderately reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with very thin to thin, dark grey, fine grained, shale interbeds			8															
30																				
					9							BD,UN,RO SA	3	2	22					
31																				
32		Direct Shear Sample										BD,UN,RO	3	1	25					
					10															
33																				
		Punch Penetration Sample																		
34					11															
35		Specific Gravity Sample																		
					12															
36																				
37					13															
38																				
		Brazilian Sample			14							BD,UN,RO SA	3	2	22					
39																				
		CONTINUED NEXT PAGE																		

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: JD
CHECKED: CM

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859188.25; E 685151.9
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH309

DRILLING DATE: August 13 to 17, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 5 OF 7
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec	WEATHERING INDEX	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
	Rotary Drill HQ3 Core	Fresh, very thinly to medium bedded, grey, medium grained, faintly porous, moderately reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with very thin to thin, dark grey, fine grained, shale interbeds			14												W1			
40					15						●	BD,UN,RO	3	1	25					
41					16															
42																				
43					17															
44																				
45		UCS with Modulus Sample			18															
46					19															
47					20						●	BD,UN,SM	2	1	20					
48																				
49					21															
		CONTINUED NEXT PAGE																		

DEPTH SCALE
1 : 50

wsp

LOGGED: JD
CHECKED: CM

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859188.25; E 685151.9
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH309

DRILLING DATE: August 13 to 17, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 6 OF 7
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE % (80 60 40 20)	RECOVERY SOLID CORE % (80 60 40 20)	R.Q.D. % (80 60 40 20)	FRACT. INDEX PER 0.25 m (5 10 15 20)	DIP w.r.t. CORE AXIS (0 30 60 90)	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-8} 10^{-6} 10^{-4} 10^{-2})	WEATHERING INDEX (W1 W2 W3 W4 W5 W6)	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
		Fresh, very thinly to medium bedded, grey, medium grained, faintly porous, moderately reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with very thin to thin, dark grey, fine grained, shale interbeds			21															
50																				
					22															
51																				
52																				
					23															
53																				
54	Rotary Drill HQ3 Core				24															
55		Direct Shear Sample									●	BD,UN,SM SA	2	2	20					
					25															
56																				
57					26															
58																				
					27						●	BD,UN,SM	2	1	20					
59																				
		CONTINUED NEXT PAGE																		

DEPTH SCALE
1 : 50

LOGGED: JD
CHECKED: CM

PROJECT: 21451329
PROJECT NAME: DNNP
LOCATION: N 4859188.25; E 685151.9
LOCATION DESCRIPTION: Darlington, ON
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH309

DRILLING DATE: August 13 to 17, 2022
DRILL RIG: Diedrich 120 Track Mounted
DRILLING CONTRACTOR: Walker Drilling

SHEET 7 OF 7
DATUM: Geodetic

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE % 80 60 40 20	RECOVERY SOLID CORE % 80 60 40 20	R.Q.D. % 80 60 40 20	FRACT. INDEX PER 0.25 m 5 10 15 20	DISCONTINUITY DATA DIP w.r.t. CORE AXIS 0 30 60 90	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jcon	HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-8} 10^{-6} 10^{-4} 10^{-2}	WEATHERING INDEX W1 W2 W3 W4 W5 W6	FEATURES	R0/R1 ZONES	PIEZOMETER
		--- CONTINUED FROM PREVIOUS PAGE ---																		
60	Rotary Drill HQ3 Core	Fresh, very thinly to medium bedded, grey, medium grained, faintly porous, moderately reactive to HCl, medium strong to strong LIMESTONE (Lindsay Formation) with very thin to thin, dark grey, fine grained, shale interbeds		17.67 60.85	27 28												W1			
61		END OF DRILLHOLE																		
62																				
63																				
64																				
65																				
66																				
67																				
68																				
69																				

DEPTH SCALE
1 : 50

LOGGED: JD
CHECKED: CM

Water Content Summary
ASTM D2216

Test Request #	21451329-21600-610 BH309	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville		

Sample Location	Sample				Soil Description	Water Content %	Method	Remarks
	Ref	Top (m)	Base (m)	Type				
BH309	1	16.73	17.34	SS		24.4	B	
BH309	2	17.50	17.95	SS		28.4	B	
BH309	3B	18.17	18.56	SS		27.1	B	
BH309	4	18.71	18.96	SS		16.8	B	
BH309	5	19.02	19.14	SS		24.5	B	

Notes:

Tested by: JTimms **Date:** 12 Oct 2022

Checked by: MRuck **Date:** 20 Oct 2022

Disclaimer:

Reviewed by: JoNorris **Date:** 03 Nov 2022

GOLDER
MEMBER OF WSP

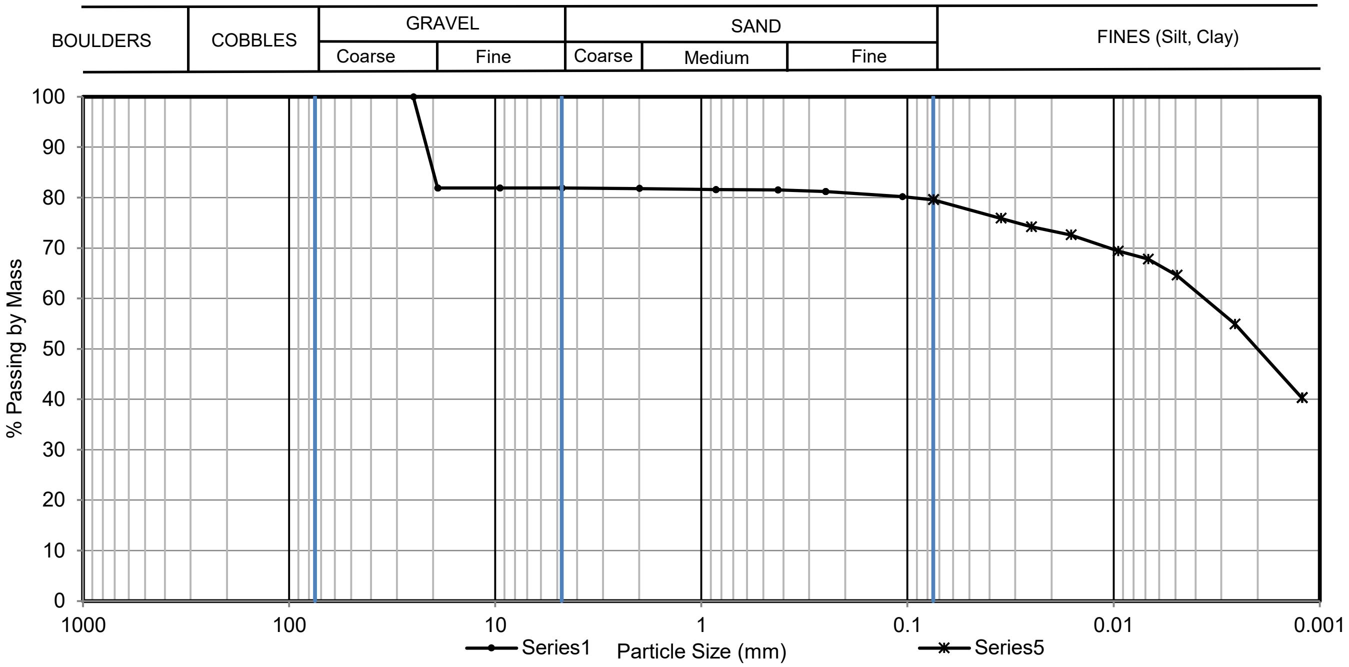
PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422
Method B

Test Request #	21451329-21600-610 BH309	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH309
Source:		Sample No.:	2
Soil Description:		Type:	SS
		Depth (m):	17.50 - 17.95

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	14 Oct 2022
Specimen Description	NA				

Grain Size Distribution (%) 18.1 2.3 79.6



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1"	25	100.0	0.0352	75.9
3/4"	19	81.9	0.0251	74.2
3/8"	9.5	81.9	0.0161	72.6
#4	4.75	81.9	0.0095	69.4
#10	2	81.8	0.0068	67.8
#20	0.85	81.6	0.0049	64.6
#40	0.425	81.5	0.0026	54.9
#60	0.25	81.2	0.0012	40.3
#140	0.106	80.2		
#200	0.075	79.6		
			0.005 mm	64.74
			0.002 mm	49.94
			D60	0.00
			D30	
			D10	
			Cu	
			Cc	

Notes:

Not enough material for hygroscopic

Disclaimer:

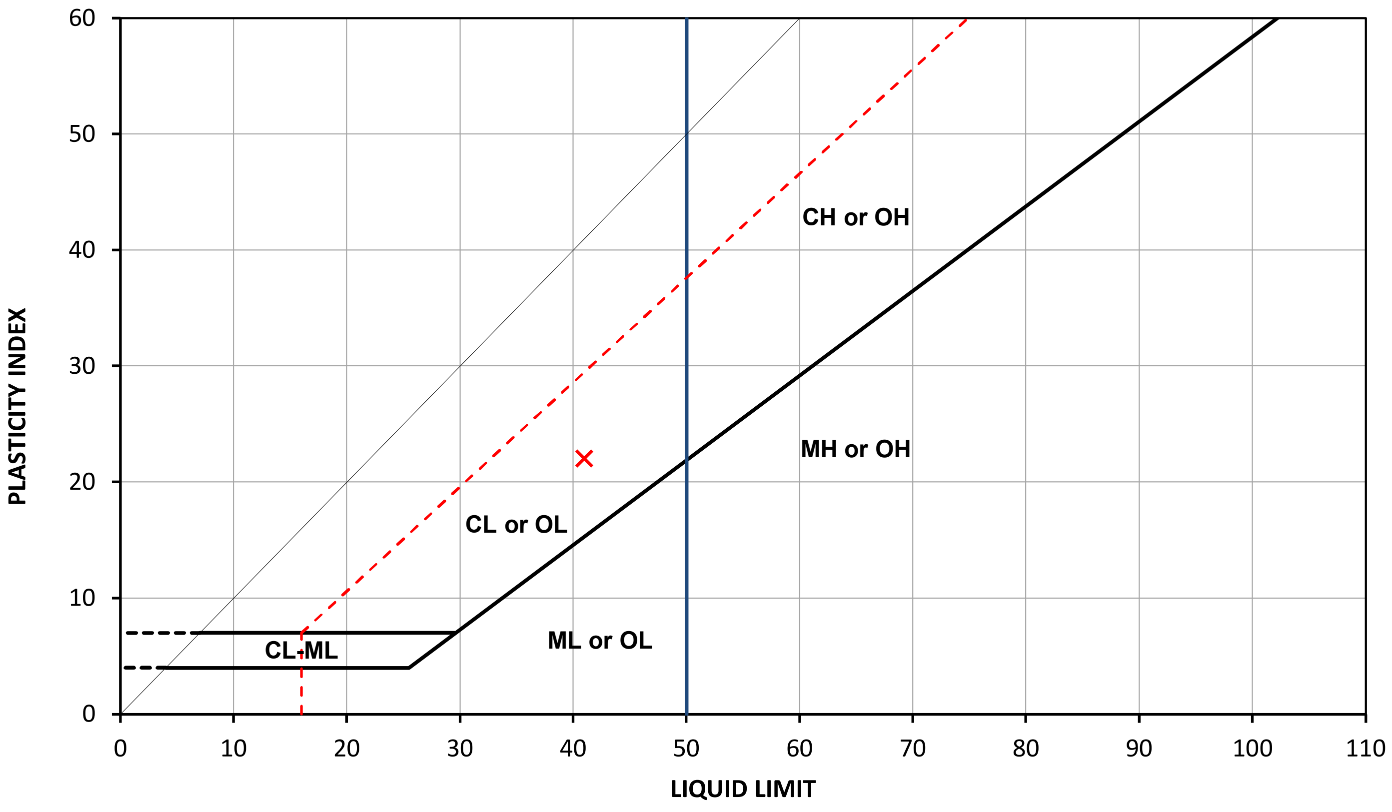
Tested by: JTimms **Date:** 14 Oct 2022 **Checked by:** MRuck **Date:** 20 Oct 2022 **Reviewed by:** JoNorris **Date:** 03 Nov 2022

Golder Associates
100 Scotia Court Whitby, ON L1N 8Y6 Canada
[+1] 905-723-2727

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
ASTM D4318
Method A - Multipoint Test

Test Request #	21451329-21600-610 BH309	Project Number:	21451329-21600-610
Client:	E.S. Fox Limited	Project Location:	
Project Name:	ES Fox/DNNP Invest/Bowmanville	Sample Location:	BH309
Source:		Sample No.:	2
Soil Description:		Type:	SS
		Depth (m):	17.50 - 17.95

Specimen Reference	NA	Specimen Depth (m):	NA	Date of Test	17 Oct 2022
Specimen Description	NA				



Legend
- A-Line
- U-Line

Sample Location	Sample / Specimen Number	Top Depth (m)	Base Depth (m)	Percent Passing #40 Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BH309	2	17.50	17.95	100	28.4	41	19	22	0.43

NP = Non-Plastic
ND = Not Determined

Test Preparation
Dry Preparation Tested after >425um removed

Notes:

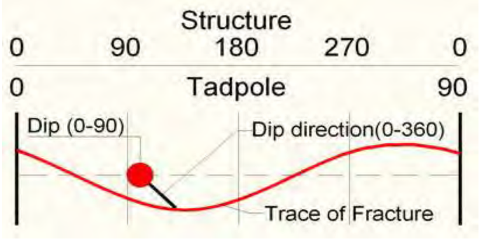
Disclaimer:

Tested by: JTimms **Date:** 17 Oct 2022
Checked by: MRuck **Date:** 20 Oct 2022
Reviewed by: JoNorris **Date:** 03 Nov 2022

Geophysical Record of Borehole: BH309

Log Title:	Darlington DNNP Geophysical Log
Project Number:	21451329
Client:	Ontario Power Generation
Date:	January 2023

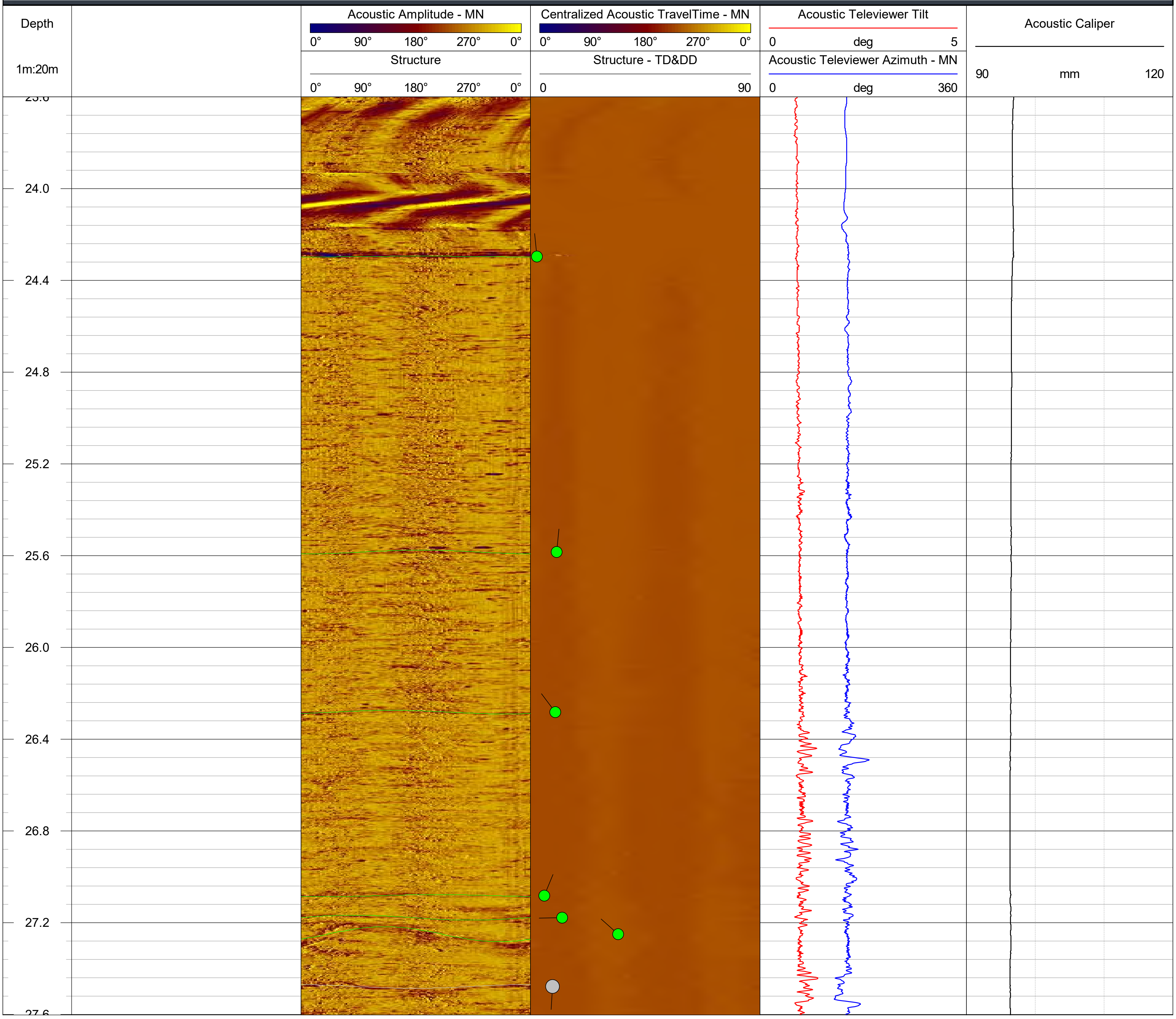
Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	~23 m bgs	**Location:**	Darlington, Ontario
Easting:	685151.90 m	**Drilled Depth:**	60 m bgs	**Water Level:**	N/A	**Log Date:**	Aug-18-2022
Northing:	4859188.25 n	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	78.52 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	C. Phillips

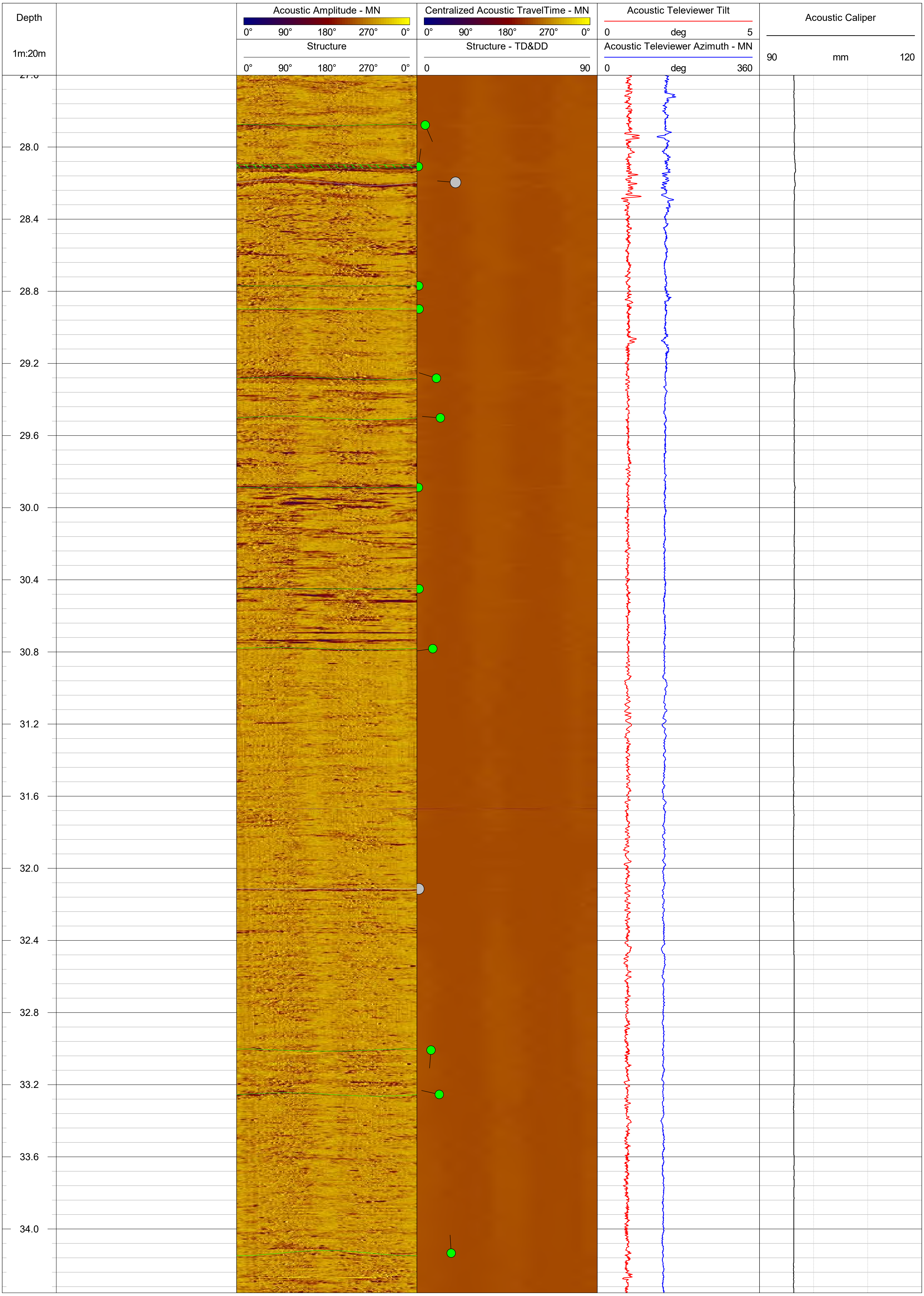


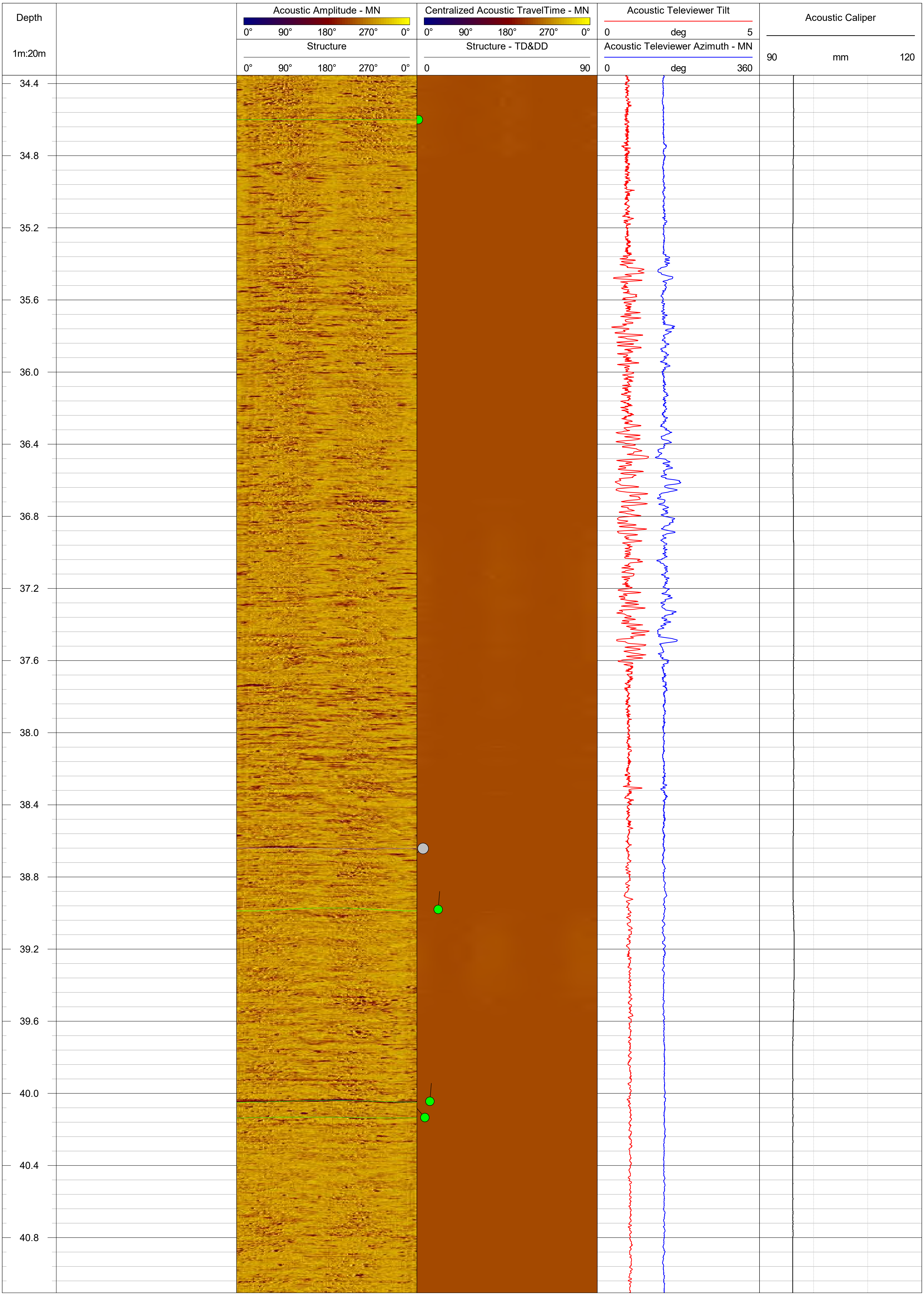
● Filled Fracture / Joint

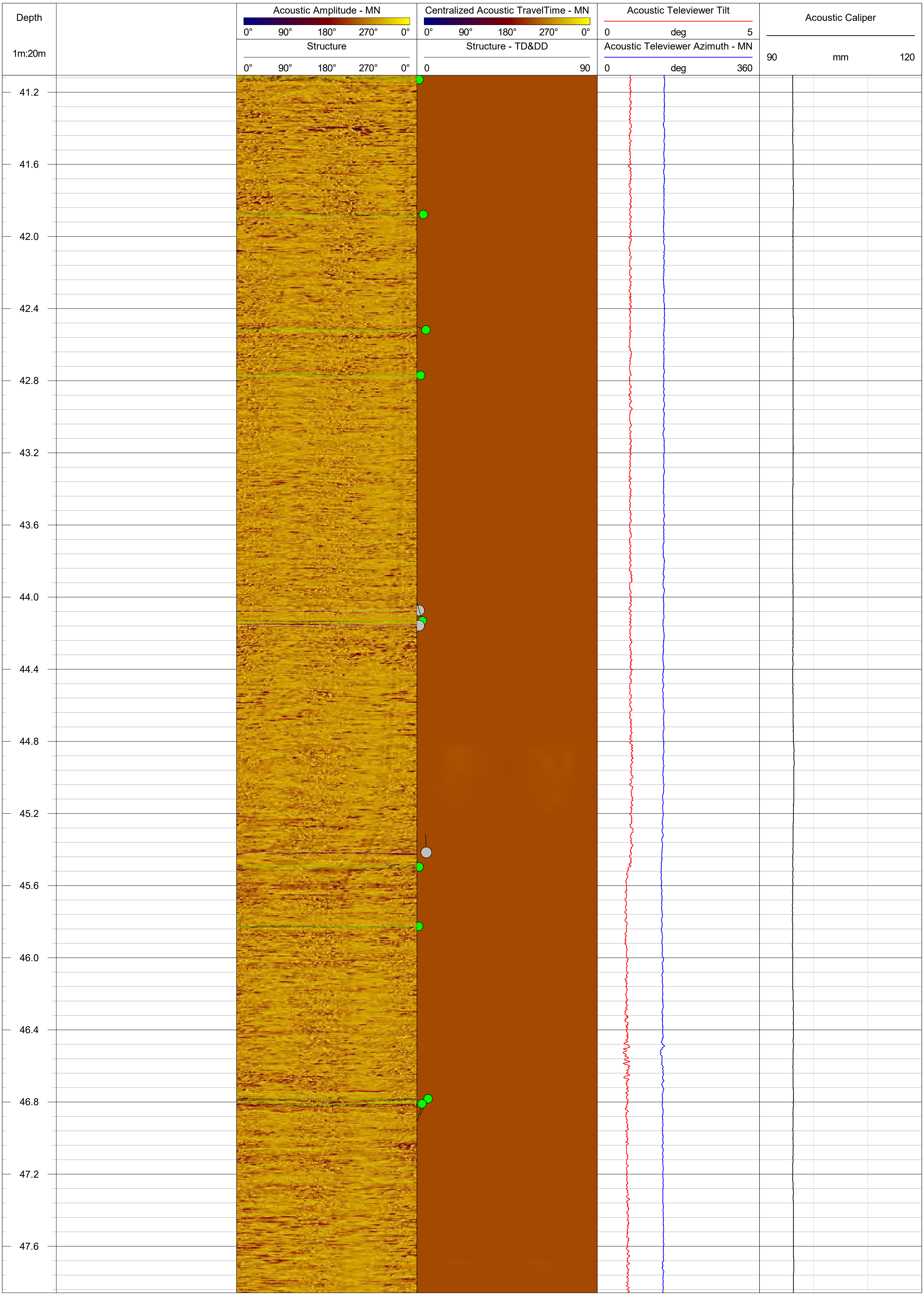
🟢 Bedding / Banding / Foliation

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)

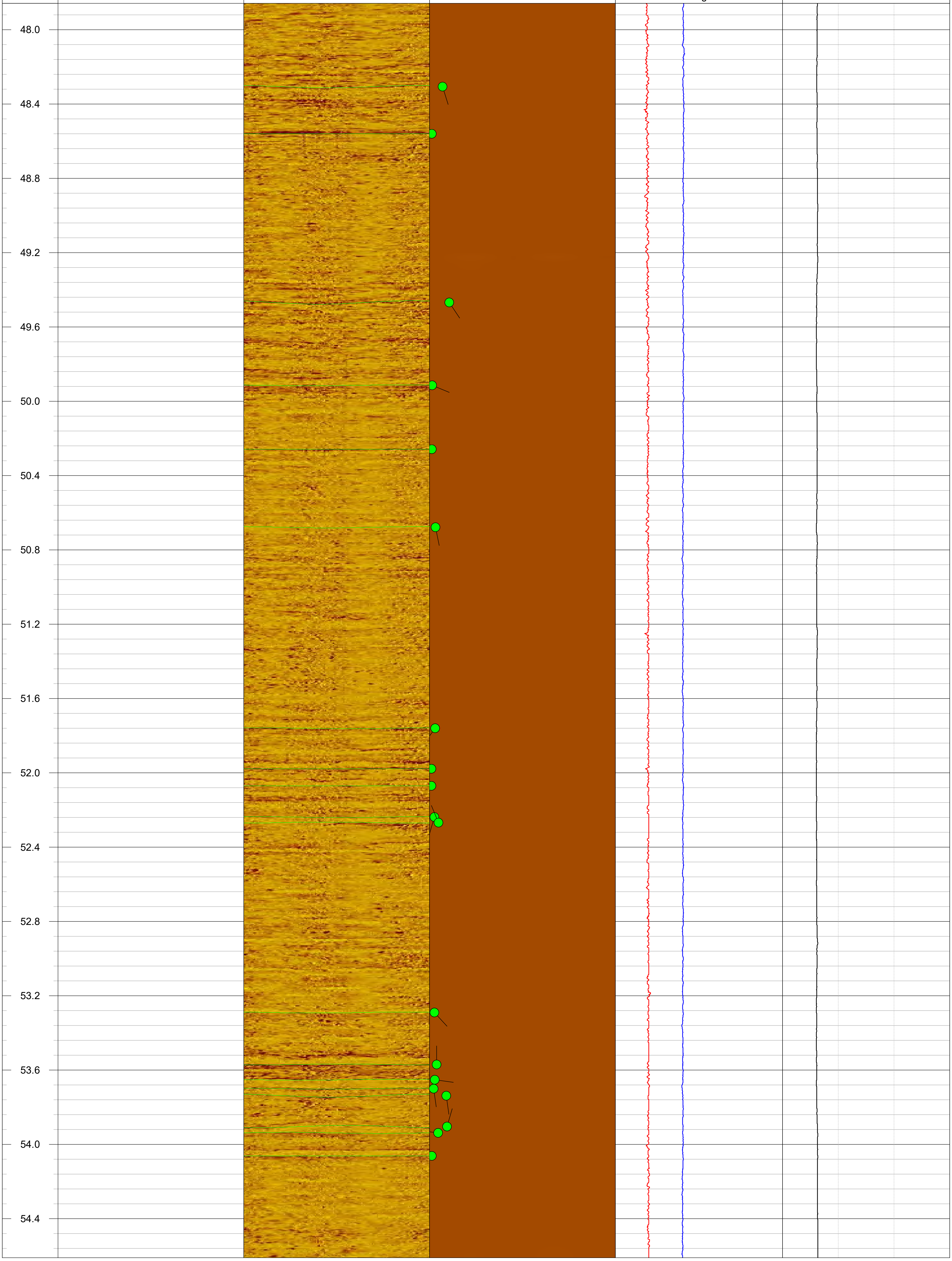


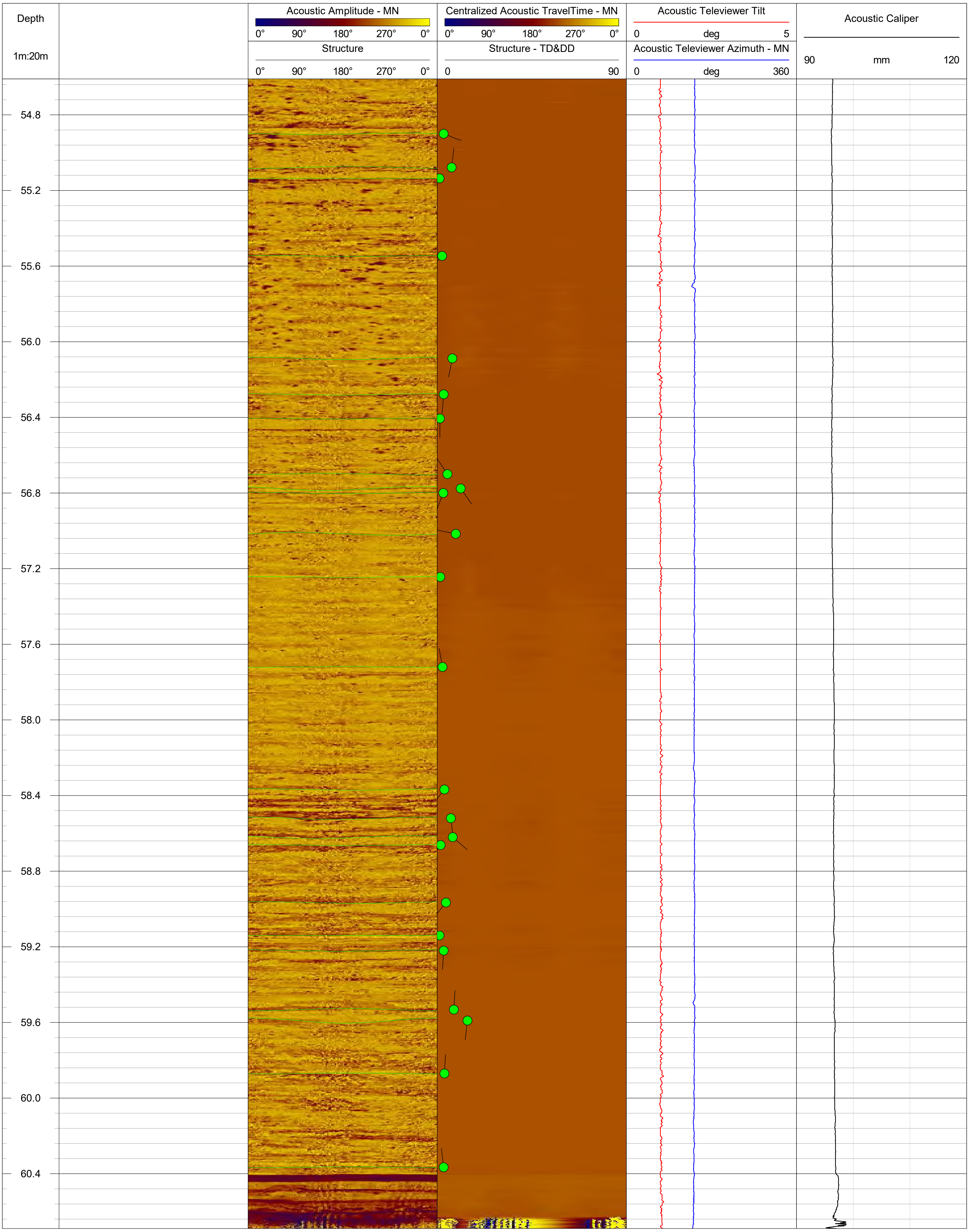

Depth
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
28.0
28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0
32.4
32.8
33.2
33.6
34.0


Depth
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
34.4
34.8
35.2
35.6
36.0
36.4
36.8
37.2
37.6
38.0
38.4
38.8
39.2
39.6
40.0
40.4
40.8


Depth
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
41.2
41.6
42.0
42.4
42.8
43.2
43.6
44.0
44.4
44.8
45.2
45.6
46.0
46.4
46.8
47.2
47.6

Depth 1m:20m		Acoustic Amplitude - MN 0° 90° 180° 270° 0° Structure 0° 90° 180° 270° 0°	Centralized Acoustic TravelTime - MN 0° 90° 180° 270° 0° Structure - TD&DD 0 90	Acoustic Televiewer Tilt 0 deg 5 Acoustic Televiewer Azimuth - MN 0 deg 360	Acoustic Caliper 90 mm 120

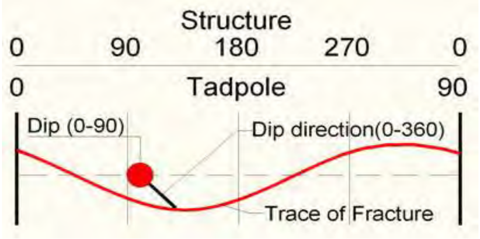



Depth
1m:20m
Acoustic Amplitude - MN
0° 90° 180° 270° 0°
Structure
0° 90° 180° 270° 0°
Centralized Acoustic TravelTime - MN
0° 90° 180° 270° 0°
Structure - TD&DD
0 90
Acoustic Televiewer Tilt
0 deg 5
Acoustic Televiewer Azimuth - MN
0 deg 360
Acoustic Caliper
90 mm 120
54.8
55.2
55.6
56.0
56.4
56.8
57.2
57.6
58.0
58.4
58.8
59.2
59.6
60.0
60.4

Geophysical Record of Borehole: BH309

Log Title: Darlington DNNP Geophysical Log
Project Number: 21451329
Client: Ontario Power Generation
Date: January 2023

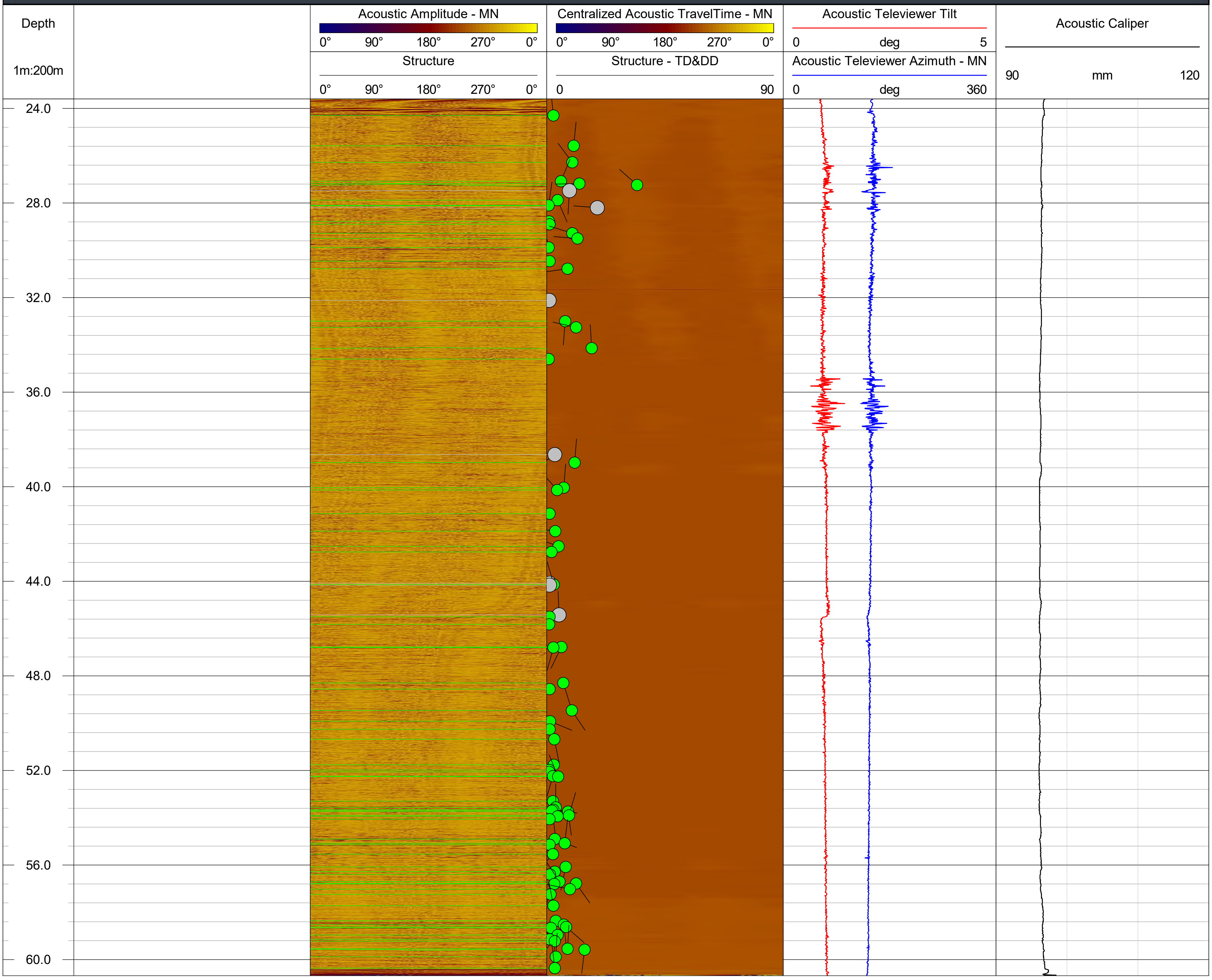
Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at barge deck	**Casing Depth:**	~23 m bgs	**Location:**	Darlington, Ontario
Easting:	685151.90 m	**Drilled Depth:**	60 m bgs	**Water Level:**	N/A	**Log Date:**	Aug-18-2022
Northing:	4859188.25 n	**Borehole Diameter:**	96 mm	**Borehole Inclination:**	Vertical		
Elevation:	78.52 m	**Casing Diameter:**	HQ	**Borehole Azimuth:**	N/A	**Logged By:**	C. Phillips



⚪ Filled Fracture / Joint

🟢 Bedding / Banding / Foliation

Notes: Magnetic Declination of 10.75 Degrees West used to correct structure data to True Dip and Dip Direction (TD&DD)



A23-Corrosion Analysis Report

2910 12TH STREET NE
CALGARY, ALBERTA
CANADA T2E 7P7
TEL (403)735-2005
FAX (403)735-2771
http://www.agatlabs.com

CLIENT NAME: GOLDER ASSOCIATES LTD.
100 SCOTIA COURT
WHITBY, ON L1N8Y6
(905) 723-2727

ATTENTION TO: Reza Vahdani

PROJECT: 21451329-Darlington New Nuclear Project (DNNP)

AGAT WORK ORDER: 22T952966

ROCK ANALYSIS REVIEWED BY: Meredith White, Senior Technician

SOIL ANALYSIS REVIEWED BY: Jacky Zhu, Spectroscopy Technician

TRACE ORGANICS REVIEWED BY: Oksana Gushyla, Trace Organics Lab Supervisor

DATE REPORTED: Oct 28, 2022

PAGES (INCLUDING COVER): 11

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (403) 735-2005

*Notes

VERSION 1:Partial excluding Sulphide.

Disclaimer:

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Environmental Services Association of Alberta (ESAA)

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Certificate of Analysis

AGAT WORK ORDER: 22T952966

PROJECT: 21451329-Darlington New Nuclear Project (DNNP)

CLIENT NAME: GOLDER ASSOCIATES LTD.

ATTENTION TO: Reza Vahdani

SAMPLING SITE:1 Holt Rd South, Bowmenville, ON L1C 3Z8

SAMPLED BY:Debasish Roy

(283-042) Sulfide (CGY)

DATE RECEIVED: 2022-10-04

DATE REPORTED: 2022-10-28

				BH23-SA15	BH24-SA30S	BH25-SA11	BH25-SA15	BH25-SA19	BH26-SA14	BH82-SA12	BH202-SA12
			SAMPLE DESCRIPTION:	(50'-50' 11.5")	(58'-60')	(30'-30'10")	(50'-51'6")	(70'-71'6")	(26'-27'6")	(40'-41'6")	(41'8"-43'2")
			SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
			DATE SAMPLED:	2022-07-04	2022-07-27	2022-07-27	2022-06-27	2022-06-28	2022-07-13	2022-06-21	2022-08-09
Parameter	Unit	G / S	RDL	4374222	4374226	4374227	4374228	4374229	4374230	4374231	4374232
Sulphide	%		0.01	<0.01	0.01	<0.01	0.01	0.03	0.01	<0.01	<0.01

				BH203-SA6	BH204-SA4	BH205-SA5	BH206-SA1	BH301-SA5	BH302-SA6	BH303-SA3	BH304-SA7
			SAMPLE DESCRIPTION:	(36'-37'6")	(41'9"-43'3")	(46'2"-47'8")	(50'6"-52'6")	(26'10"-28'4")	(34'6"-36')	(32'-33'6")	(43'-44'6")
			SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
			DATE SAMPLED:	2022-07-21	2022-04-19	2022-08-25	2022-08-03	2022-08-23	2022-07-08	2022-07-19	2022-06-21
Parameter	Unit	G / S	RDL	4374233	4374234	4374235	4374236	4374237	4374238	4374239	4374240
Sulphide	%		0.01	0.03	0.01	<0.01	<0.01	0.38	0.01	<0.01	0.01

				BH305-SA7	BH305-SA9A	BH306-SA8B	BH307-SA3	BH308-SA2	BH309-SA1
			SAMPLE DESCRIPTION:	(43'2"-44'8")	(47'2"-48'2")	(54'3"-54'8")	(46'-47'3.5")	(48'6"-49'4")	(54'11"-56'11")
			SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil
			DATE SAMPLED:	2022-09-11	2022-09-11	2022-05-23	2022-06-23	2022-07-16	2022-08-12
Parameter	Unit	G / S	RDL	4374241	4374242	4374243	4374244	4374245	4374246
Sulphide	%		0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Calgary (unless marked by *)

Certified By:

Certificate of Analysis

AGAT WORK ORDER: 22T952966

PROJECT: 21451329-Darlington New Nuclear Project (DNNP)

CLIENT NAME: GOLDER ASSOCIATES LTD.

ATTENTION TO: Reza Vahdani

SAMPLING SITE:1 Holt Rd South, Bowmenville, ON L1C 3Z8

SAMPLED BY:Debasish Roy

Corrosivity Package

DATE RECEIVED: 2022-10-04

DATE REPORTED: 2022-10-28

			SAMPLE DESCRIPTION:	BH23-SA15 (50'-50' 11.5")	BH24-SA30S (58'-60')	BH25-SA11 (30'-30'10")	BH25-SA15 (50'-51'6")	BH25-SA19 (70'-71'6")	BH26-SA14 (26'-27'6")	BH82-SA12 (40'-41'6")	BH202-SA12 (41'8"-43'2")
			SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
			DATE SAMPLED:	2022-07-04	2022-07-27	2022-07-27	2022-06-27	2022-06-28	2022-07-13	2022-06-21	2022-08-09
Parameter	Unit	G / S	RDL	4374222	4374226	4374227	4374228	4374229	4374230	4374231	4374232
Chloride (2:1)	µg/g		2	5	9	7	5	4	6	5	7
Sulphate (2:1)	µg/g		2	89	172	124	100	162	106	202	78
pH (2:1)	pH Units		NA	7.13	7.92	8.17	8.55	8.34	8.53	8.34	8.76
Electrical Conductivity (2:1)	mS/cm		0.005	0.193	0.361	0.244	0.199	0.289	0.230	0.317	0.180
Resistivity (2:1) (Calculated)	ohm.cm		1	5180	2770	4100	5030	3460	4350	3150	5560
Redox Potential 1	mV		NA	344	318	311	292	254	261	235	241
Redox Potential 2	mV		NA	374	333	316	294	273	270	247	252
Redox Potential 3	mV		NA	352	342	318	298	280	276	256	259

			SAMPLE DESCRIPTION:	BH203-SA6 (36'-37'6")	BH204-SA4 (41'9"-43'3")	BH205-SA5 (46'2"-47'8")	BH206-SA1 (50'6"-52'6")	BH301-SA5 (26'10"-28'4")	BH302-SA6 (34'6"-36')	BH303-SA3 (32'-33'6")	BH304-SA7 (43'-44'6")
			SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
			DATE SAMPLED:	2022-07-21	2022-04-19	2022-08-25	2022-08-03	2022-08-23	2022-07-08	2022-07-19	2022-06-21
Parameter	Unit	G / S	RDL	4374233	4374234	4374235	4374236	4374237	4374238	4374239	4374240
Chloride (2:1)	µg/g		2	5	5	2	9	7	4	13	9
Sulphate (2:1)	µg/g		2	145	255	122	134	107	193	194	272
pH (2:1)	pH Units		NA	8.53	8.31	8.47	8.36	8.39	8.27	8.27	8.20
Electrical Conductivity (2:1)	mS/cm		0.005	0.280	0.450	0.243	0.276	0.258	0.373	0.330	0.489
Resistivity (2:1) (Calculated)	ohm.cm		1	3570	2220	4120	3620	3880	2680	3030	2040
Redox Potential 1	mV		NA	199	232	179	230	246	235	225	227
Redox Potential 2	mV		NA	216	236	189	239	249	239	236	229
Redox Potential 3	mV		NA	220	237	196	241	250	245	239	231

Certified By:

XIANDONG ZHU

Certificate of Analysis

AGAT WORK ORDER: 22T952966

PROJECT: 21451329-Darlington New Nuclear Project (DNNP)

CLIENT NAME: GOLDER ASSOCIATES LTD.

ATTENTION TO: Reza Vahdani

SAMPLING SITE:1 Holt Rd South, Bowmenville, ON L1C 3Z8

SAMPLED BY:Debasish Roy

Corrosivity Package

DATE RECEIVED: 2022-10-04

DATE REPORTED: 2022-10-28

			SAMPLE DESCRIPTION:	BH305-SA7 (43'2"-44'8")	BH305-SA9A (47'2"-48'2")	BH306-SA8B (54'3"-54'8")	BH307-SA3 (46'-47'3.5")	BH308-SA2 (48'6"-49'4")	BH309-SA1 (54'11"-56'11")
			SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil
			DATE SAMPLED:	2022-09-11	2022-09-11	2022-05-23	2022-06-23	2022-07-16	2022-08-12
Parameter	Unit	G / S	RDL	4374241	4374242	4374243	4374244	4374245	4374246
Chloride (2:1)	µg/g		2	79	221	464	141	8	9
Sulphate (2:1)	µg/g		2	92	56	67	136	41	74
pH (2:1)	pH Units		NA	8.41	8.37	7.62	6.80	8.20	7.97
Electrical Conductivity (2:1)	mS/cm		0.005	0.346	0.511	0.906	0.536	0.148	0.280
Resistivity (2:1) (Calculated)	ohm.cm		1	2890	1960	1100	1870	6760	3570
Redox Potential 1	mV		NA	166	182	254	268	245	230
Redox Potential 2	mV		NA	175	197	257	264	249	233
Redox Potential 3	mV		NA	180	200	259	267	251	235

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

4374222-4374246 EC, pH, Chloride and Sulphate were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil). Resistivity is a calculated parameter.
Redox potential measured on as received sample. Due to the potential for rapid change in sample equilibrium chemistry with exposure to oxidative/reduction conditions laboratory results may differ from field measured results.
Redox potential measurement in soil is quite variable and non reproducible due in part, to the general heterogeneity of a given soil. It is also related to the introduction of increased oxygen into the sample after extraction. The interpretation of soil redox potential should be considered in terms of its general range rather than as an absolute measurement.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By: NIANDONG ZHU

AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 22T952966

PROJECT: 21451329-Darlington New Nuclear Project (DNNP)

CLIENT NAME: GOLDER ASSOCIATES LTD.

ATTENTION TO: Reza Vahdani

SAMPLING SITE:1 Holt Rd South, Bowmenville, ON L1C 3Z8

SAMPLED BY:Debasish Roy

Moisture content (Soil)

DATE RECEIVED: 2022-10-04

DATE REPORTED: 2022-10-28

		SAMPLE DESCRIPTION:		BH23-SA15 (50'-50' 11.5")	BH24-SA30S (58'-60')	BH25-SA11 (30'-30'10")	BH25-SA15 (50'-51'6")	BH25-SA19 (70'-71'6")	BH26-SA14 (26'-27'6")	BH82-SA12 (40'-41'6")	BH202-SA12 (41'8"-43'2")
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		2022-07-04	2022-07-27	2022-07-27	2022-06-27	2022-06-28	2022-07-13	2022-06-21	2022-08-09
Parameter	Unit	G / S	RDL	4374222	4374226	4374227	4374228	4374229	4374230	4374231	4374232
Moisture Content	%		0.1	12.8	17.8	6.8	14.3	7.6	9.1	16.1	16.0

		SAMPLE DESCRIPTION:		BH203-SA6 (36'-37'6")	BH204-SA4 (41'9"-43'3")	BH205-SA5 (46'2"-47'8")	BH206-SA1 (50'6"-52'6")	BH301-SA5 (26'10"-28'4")	BH302-SA6 (34'6"-36')	BH303-SA3 (32'-33'6")	BH304-SA7 (43'-44'6")
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		2022-07-21	2022-04-19	2022-08-25	2022-08-03	2022-08-23	2022-07-08	2022-07-19	2022-06-21
Parameter	Unit	G / S	RDL	4374233	4374234	4374235	4374236	4374237	4374238	4374239	4374240
Moisture Content	%		0.1	9.8	17.2	9.0	8.5	15.4	19.9	17.9	16.8

		SAMPLE DESCRIPTION:		BH305-SA7 (43'2"-44'8")	BH305-SA9A (47'2"-48'2")	BH306-SA8B (54'3"-54'8")	BH307-SA3 (46'-47'3.5")	BH308-SA2 (48'6"-49'4")	BH309-SA1 (54'11"-56'11")
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		2022-09-11	2022-09-11	2022-05-23	2022-06-23	2022-07-16	2022-08-12
Parameter	Unit	G / S	RDL	4374241	4374242	4374243	4374244	4374245	4374246
Moisture Content	%		0.1	10.2	15.2	16.1	13.3	6.5	19.6

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:

Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD.

PROJECT: 21451329-Darlington New Nuclear Project (DNNP)

SAMPLING SITE:1 Holt Rd South, Bowmenville, ON L1C 3Z8

AGAT WORK ORDER: 22T952966

ATTENTION TO: Reza Vahdani

SAMPLED BY:Debasish Roy

Rock Analysis

RPT Date: Oct 28, 2022			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
(283-042) Sulfide (CGY)															
Total Sulfur	4213979	4213979	0.06	0.06	2.9%	< 0.01	104%								
Sulfate	4374222	4374222	<0.01	<0.01	NA	< 0.01	94%								
(283-042) Sulfide (CGY)															
Total Sulfur	2	4374244	<0.01	<0.01	NA	< 0.01	102%								
Sulfate	4374244	4374244	0.01	0.01	NA	< 0.01	97%								

Certified By:

Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD.
PROJECT: 21451329-Darlington New Nuclear Project (DNNP)
SAMPLING SITE:1 Holt Rd South, Bowmenville, ON L1C 3Z8

AGAT WORK ORDER: 22T952966
ATTENTION TO: Reza Vahdani
SAMPLED BY:Debasish Roy

Soil Analysis

RPT Date: Oct 28, 2022			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Corrosivity Package															
Chloride (2:1)	4374222	4374222	5	5	NA	< 2	93%	70%	130%	99%	80%	120%	100%	70%	130%
Sulphate (2:1)	4374222	4374222	89	93	4.4%	< 2	97%	70%	130%	95%	80%	120%	94%	70%	130%
pH (2:1)	4374222	4374222	7.13	7.72	7.9%	NA	100%	80%	120%						
Electrical Conductivity (2:1)	4374222	4374222	0.193	0.193	0.0%	< 0.005	95%	80%	120%						
Redox Potential 1							100%	90%	110%						
Corrosivity Package															
Chloride (2:1)	4374244	4374244	141	142	0.7%	< 2	98%	70%	130%	99%	80%	120%	105%	70%	130%
Sulphate (2:1)	4374244	4374244	136	133	2.2%	< 2	97%	70%	130%	95%	80%	120%	100%	70%	130%
pH (2:1)	4374508		7.55	7.61	0.8%	NA	100%	80%	120%						
Electrical Conductivity (2:1)	4374508		1.57	1.60	1.9%	< 0.005	120%	80%	120%						
Redox Potential 1							100%	90%	110%						

Comments: NA signifies Not Applicable.
pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.

Duplicate NA: results are under 5X the RDL and will not be calculated.

Certified By: Xiaodong Zhu

NIANDONG ZHU

Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD.
PROJECT: 21451329-Darlington New Nuclear Project (DNNP)
SAMPLING SITE:1 Holt Rd South, Bowmenville, ON L1C 3Z8

AGAT WORK ORDER: 22T952966
ATTENTION TO: Reza Vahdani
SAMPLED BY:Debasish Roy

Trace Organics Analysis

RPT Date: Oct 28, 2022			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Moisture content (Soil)															
Moisture Content	4374241	4374241	10.22	10.00	2.2%	< 0.1									

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By:

Method Summary

CLIENT NAME: GOLDER ASSOCIATES LTD.
AGAT WORK ORDER: 22T952966
PROJECT: 21451329-Darlington New Nuclear Project (DNNP)
ATTENTION TO: Reza Vahdani
SAMPLING SITE:1 Holt Rd South, Bowmenville, ON L1C 3Z8
SAMPLED BY:Debasish Roy

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Rock Analysis			
Sulphide			ICP/OES
Soil Analysis			
Chloride (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	modified from EPA 9045D and MCKEAGUE 3.11	PH METER
Electrical Conductivity (2:1)	INOR-93-6075	modified from MSA PART 3, CH 14 and SM 2510 B	PC TITRATE
Resistivity (2:1) (Calculated)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	CALCULATION
Redox Potential 1	INOR-93-6066	G200-20, SM 2580 B	REDOX POTENTIAL ELECTRODE
Redox Potential 2	INOR-93-6066	G200-20, SM 2580 B	REDOX POTENTIAL ELECTRODE
Redox Potential 3	INOR-93-6066	G200-20, SM 2580 B	REDOX POTENTIAL ELECTRODE
Trace Organics Analysis			
Moisture Content	ORG-91-5009	modified from CCME Tier 1 Method	BALANCE

AGAT Laboratories

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Laboratory Use Only

Work Order #: 22T952966

Cooler Quantity:

Arrival Temperatures: 3.2 | 3.8 | 4.4

Custody Seal Intact: ☐Yes ☐No ☐N/A

Notes:

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Report Information:

Company: Golder Associates LTd.
Contact: Sarah Poot / Reza Vahdani
Address: 100 Scotia court, whitby, ON L1N 8Y6
Phone: 9057232727 Fax: 905 723 2182
Reports to be sent to:
1. Email: Sarah.Poot@wsp.com/Reza.vahdani@wsp.com
2. Email: Ulfat.Salmanov@wsp.com

Regulatory Requirements:

(Please check all applicable boxes)

☐ Regulation 153/04
Table ____ *Indicate One*
☐Ind/Com
☐Res/Park
☐Agriculture
Soil Texture *(Check One)*
☐Coarse
☐Fine

☐ Excess Soils R406
Table ____ *Indicate One*
☐ Regulation 558
☐ CCME

☐ Sewer Use
☐Sanitary ☐Storm
____ Region
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
____ Indicate One

Is this submission for a Record of Site Condition?
☐ Yes ☑ No

Report Guideline on Certificate of Analysis
☑ Yes ☐ No

Turnaround Time (TAT) Required:

Regular TAT ☑ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply): ____

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

For 'Same Day' analysis, please contact your AGAT CPM

Project Information:

Project: 21451329 - Darlington New Nuclear Project (DNNP)
Site Location: 1 Holt Rd South, Bowmenville, ON L1C 3Z8
Sampled By: Debasish Roy
AGAT Quote #: ____ PO: ____
Please note: *If quotation number is not provided, client will be billed full price for analysis.*

Invoice Information:

Bill To Same: Yes ☑ No ☐
Company:
Contact:
Address:
Email:

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI, DOC Y/N	O. Reg 153: Metals & Inorganics	O. Reg 153: Metals - ☐ CrVI, ☐ Hg, ☐ HWSB	O. Reg 153: BTEX, F1-F4 PHCs	O. Reg 153: PAHs	O. Reg 153: PCBs	O. Reg 153: VOC	O. Reg 558: Aroclors	Landfill Disposal Characterization TCLP: TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	O. Reg 406: Excess Soils SPLP Rainwater Leach SPLP: ☐ Metals ☐ VOCs ☐ SVOCs	O. Reg 406: Excess Soils Characterization Package pH, ICPMS Metals, BTEX, F1-F4	Corrosivity: Include Moisture ☐ Sulphide ☐	Oxidation reduction (i.e redox)	PH	Sulfides	Chlorides	Sulphates	Conductivity + Soil resistivity	Potentially Hazardous or High Concentration (Y/N)
BH23-SA15 (50'-50' 11.5")	July/4/2022	AM PM	1	Soil														✓	✓	✓	✓	✓	✓	
BH 24-SA30s (58'-60')	July/27/2022	AM PM	1	Soil														✓	✓	✓	✓	✓	✓	
BH 25-SA11 (30'-30' 10")	Ju[illegible]/27/2022	AM PM	1	Soil														✓	✓	✓	✓	✓	✓	
BH25-SA15 (50'-51' 6")	June/27/2022	AM PM	1	Soil														✓	✓	✓	✓	✓	✓	
BH 25-SA19 (70'-71'6")	June/28/2022	AM PM	1	Soil														✓	✓	✓	✓	✓	✓	
BH 26-SA 14 (26'-27'6")	July/13/2022	AM PM	1	Soil														✓	✓	✓	✓	✓	✓	
BH82-SA12 (40'-41'6")	June/21/2022	AM PM	1	Soil														✓	✓	✓	✓	✓	✓	
BH202-SA12 (41'8"-43'2")	Aug/9/2022	AM PM	1	Soil														✓	✓	✓	✓	✓	✓	
BH 203-SA 6 (36'-37'6")	July/21/2022	AM PM	1	Soil														✓	✓	✓	✓	✓	✓	
BH204-SA4 (41'9"-43'3")	April/19/2022	AM PM	1	Soil														✓	✓	✓	✓	✓	✓	
BH 205-SA5 (46'2"-47'8")	Aug/25/2022	AM PM	1	Soil														✓	✓	✓	✓	✓	✓	

Samples Relinquished By (Print Name and Sign): Debasish Roy	Date Oct/3/22	Time 07:20 pm	Samples Received By (Print Name and Sign): Amber	Date	Time
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time

22 OCT 4 1:30pm

Page 1 of 2

Nº: T - 134152

Pink Copy - Client | Yellow Copy - AGAT | White Copy- AGAT

AGAT Laboratories

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Laboratory Use Only

Work Order #:

Cooler Quantity: 1cm

Arrival Temperatures:

Custody Seal Intact: ☐Yes ☐No ☑N/A

Notes: loose IC

Report Information:

Company: Golder Associates Ltd

Contact: Sarah Poot / Reza Vahdani

Address: 100 Scotia Court, Whitby, ON
L1N 8Y6

Phone: 905 7232727 Fax: 9057232182

Reports to be sent to:

1. Email: Sarah.Poot@wsp.com / Reza.vahdani@wsp.com
2. Email: Ulfat.Salmanov@wsp.com

Regulatory Requirements:

(Please check all applicable boxes)

☐ Regulation 153/04
Table ____ *Indicate One*
☐Ind/Com
☐Res/Park
☐Agriculture
Soil Texture *(Check One)*
☐Coarse
☐Fine

☐ Excess Soils R406
Table ____ *Indicate One*
☐ Regulation 558
☐ CCME

☐ Sewer Use
☐Sanitary ☐Storm
____ *Region*
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
____ *Indicate One*

Is this submission for a Record of Site Condition? ☐ Yes ☑ No

Report Guideline on *Certificate of Analysis* ☑ Yes ☐ No

Turnaround Time (TAT) Required:

Regular TAT ☑ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
*TAT is exclusive of weekends and statutory holidays

For 'Same Day' analysis, please contact your AGAT CPM

Project Information:

Project: 21451329-Darlington NEW Nuclear Project (DNNP)

Site Location: 1 Holt Rd South, Bowmanville, ON, L1C 3Z8

Sampled By: Debasish Roy

AGAT Quote #: PO:

Please note: If quotation number is not provided, client will be billed full price for analysis.

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Invoice Information:

Bill To Same: Yes ☑ No ☐

Company:
Contact:
Address:
Email:

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI, DOC Y/N	O. Reg 153 Metals & Inorganics	O. Reg 153 Metals - ☐CrVI, ☐Hg, ☐HWSB	O. Reg 153 BTEX, F1-F4 PHCs	PAHs	PCBs	VOC	Aroclors	O. Reg 558 Landfill Disposal Characterization TCLP: TCLP: ☐M&I ☐VOCs ☐ABNs ☐B(a)P☐PCBs	O. Reg 406 Excess Soils SPLP Rainwater Leach SPLP: ☐Metals ☐VOCs ☐SVOCs	O. Reg 406 Excess Soils Characterization Package pH, ICPMS Metals, BTEX, F1-F4	Corrosivity: Include Moisture ☐ Sulphide ☐	Oxidation reduction (i.e. redox)	pH	Sulfides	Chlorides	Sulphates	Conductivity + soil resistivity	Potentially Hazardous or High Concentration (Y/N)
BH206-SA1(50'6"-52'6")	Aug/2/22	AM [✓ PM]	1	Soil														✓	✓	✓	✓	✓	✓	
BH301-SA5(26'10"-28'4")	Aug/23/22	AM PM	1	Soil														✓	✓	✓	✓	✓	✓	
BH302-SA6(34'6"-36')	July/8/22	AM [✓ PM]	1	Soil														✓	✓	✓	✓	✓	✓	
BH303-SA3(32'-33.6")	June/24/22	AM PM	1	Soil														✓	✓	✓	✓	✓	✓	
BH304-SA7(43'-44'6")	June/21/22	AM [✓ PM]	1	Soil														✓	✓	✓	✓	✓	✓	
BH305-SA7(43'2"-44'8")	Sept/11/22	AM PM	1	Soil														✓	✓	✓	✓	✓	✓	
BH305-SA9A(47'2"-48'2")	Sept/11/22	AM PM	1	Soil														✓	✓	✓	✓	✓	✓	
BH306-SA8B(54'3"-54'8")	May/23/22	AM [✓ PM]	1	Soil														✓	✓	✓	✓	✓	✓	
BH307-SA03(46'-47'3.5")	June/23/22	AM [✓ PM]	1	Soil														✓	✓	✓	✓	✓	✓	
BH308-SA2(48'6"-49'4")	July/16/22	AM PM	1	Soil														✓	✓	✓	✓	✓	✓	
BH309-SA1(54'11"-56'11")	Aug/12/22	AM PM	1	Soil														✓	✓	✓	✓	✓	✓	

Samples Relinquished By (Print Name and Sign): Debasish Roy	Date Oct/3/22	Time 07:20pm	Samples Received By (Print Name and Sign):	Date	Time	22OCT 4 11:30AM
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time	Page 2 of 2
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time	Nº: T - 134144

Pink Copy - Client | Yellow Copy - AGAT | White Copy- AGAT

A24-Geophysical FWS Results

Dynamic Properties in Rock for Each Borehole from Full Waveform Sonic

Depth (m)	BH205				BH207				BH303				BH307			
	Poisson's Ratio	Dynamic Shear Modulus (MPa)	Dynamic Young's Modulus (MPa)	Dynamic Bulk Modulus (MPa)	Poisson's Ratio	Dynamic Shear Modulus (MPa)	Dynamic Young's Modulus (MPa)	Dynamic Bulk Modulus (MPa)	Poisson's Ratio	Dynamic Shear Modulus (MPa)	Dynamic Young's Modulus (MPa)	Dynamic Bulk Modulus (MPa)	Poisson's Ratio	Dynamic Shear Modulus (MPa)	Dynamic Young's Modulus (MPa)	Dynamic Bulk Modulus (MPa)
22.0	-0.09	18768.2	34106.7	9612.4												
23.0	0.24	14829.2	36715.1	23349.8												
24.0	0.28	14829.2	38076.9	29360.0												
25.0	0.38	14647.8	40513.4	57671.9												
26.0	0.26	18510.2	46827.5	33198.5	0.19	18490.9	43939.2	23481.8					0.24	17068.4	42426.7	27497.4
27.0	0.31	14123.1	37021.0	32586.4	0.29	22655.8	58319.0	45646.7	0.26	17296.7	43708.9	30803.0	0.28	19300.6	49250.2	36624.0
28.0	0.30	16625.1	43175.4	35712.0	0.25	20234.6	50770.1	34472.3	0.27	20435.7	51713.6	36719.7	0.27	19031.6	48424.9	35433.4
29.0	0.26	19031.6	48103.8	33941.2	0.23	20234.6	49705.8	30483.7	0.23	19031.6	46696.7	28489.9	0.28	18510.2	47430.4	36128.6
30.0	0.22	19856.0	48398.9	28680.8	0.25	21736.2	54140.4	35440.7	0.24	16625.1	41377.5	26983.6	0.27	20142.7	51170.0	37110.3
31.0	0.23	17529.7	43199.2	26882.3	0.25	23192.0	58033.0	38865.9	0.23	17529.7	43199.2	26882.3	0.28	18510.2	47430.4	36128.6
32.0	0.29	18257.5	46938.7	36465.5	0.23	21065.7	51696.6	31564.4	0.26	19031.6	47771.0	32503.3	0.28	18510.2	47430.4	36128.6
33.0	0.25	19575.3	49083.8	33216.3	0.27	22138.0	56128.9	40271.3	0.27	16844.6	42869.3	31405.9	0.28	19300.6	49561.9	38233.1
34.0	0.26	17529.7	44132.1	30492.4	0.28	22138.0	56726.3	43209.5	0.25	19575.3	49083.8	33216.3	0.28	19856.0	50956.5	39164.9
35.0	0.24	19031.6	47068.1	29780.0	0.28	21637.7	55189.8	40938.3	0.27	20435.7	52068.5	38392.0	0.29	20435.7	52740.7	41939.4
36.0	0.23	19856.0	48806.5	30017.9	0.28	21154.2	54261.3	41583.0	0.30	19031.6	49337.1	40346.0	0.29	20142.7	52155.3	42330.0
37.0	0.22	21354.0	52050.4	30844.7	0.28	21637.7	55189.8	40938.3	0.31	19300.6	50434.5	43452.9	0.28	19300.6	49250.2	36624.0
38.0	0.23	19300.6	47512.3	29421.3	0.27	22138.0	56128.9	40271.3	0.28	19300.6	49561.9	38233.1	0.28	19300.6	49561.9	38233.1
39.0	0.26	19856.0	49940.7	34334.3	0.29	22138.0	57290.3	46337.1	0.28	19575.3	50093.9	37866.8	0.28	19300.6	49250.2	36624.0
40.0	0.26	19856.0	49940.7	34334.3	0.30	20234.6	52441.3	42809.2	0.30	19575.3	50709.8	41277.8	0.27	16811.5	42541.8	30204.5
41.0	0.26	21673.9	54743.5	38479.7	0.28	18181.7	46573.7	35409.8	0.27	16844.6	42869.3	31405.9	0.27	16484.0	41932.6	30641.2
42.0	0.30	17068.4	44429.8	37308.4	0.29	21637.7	55748.9	43876.5	0.27	15589.5	39523.1	28346.2	0.28	19031.6	48734.9	36982.6
43.0	0.27	15991.8	40511.6	28932.8	0.28	23192.0	59362.6	44931.7	0.29	20142.7	51838.6	40521.3	0.29	20142.7	51838.6	40521.3
44.0	0.30	21673.9	56224.5	46174.1	0.27	23747.5	60419.7	44191.1	0.31	20142.7	52756.5	46173.1	0.28	19575.3	50093.9	37866.8
45.0	0.32	20735.1	54639.8	49918.2	0.27	22655.8	57716.3	42519.0	0.29	19856.0	51271.6	40903.6	0.28	19300.6	49561.9	38233.1
46.0	0.32	18510.2	48769.5	44506.7	0.26	23747.5	59728.6	41063.4	0.30	19575.3	50709.8	41277.8	0.32	18009.9	47691.8	45173.7
47.0	0.26	20435.7	51345.3	35110.5	0.27	18181.7	46129.6	33220.9	0.28	20735.1	52987.5	39731.5	0.29	18257.5	46938.7	36465.5
48.0	0.22	20142.7	49266.3	29635.6	0.30	21637.7	56277.6	47004.2	0.27	18510.2	47134.2	34636.4	0.26	17296.7	43420.5	29557.6
49.0	0.30	18009.9	46715.9	38344.8	0.30	20686.7	53836.9	45144.5	0.28	19031.6	48734.9	36982.6	0.23	18009.9	44320.6	27403.9
50.0	0.27	20735.1	52630.6	37992.7	0.28	17808.7	45428.3	33718.1	0.30	17529.7	45734.3	38985.1	0.27	17529.7	44422.1	31782.5
51.0	0.30	19031.6	49323.5	40264.1	0.32	14913.0	39244.9	35508.6	0.27	18257.5	46359.4	33535.4	0.25	14123.1	35272.4	23397.5
52.0	0.30	17529.7	45488.9	37435.9	0.30	18181.7	47396.1	40180.1	0.27	15788.7	40133.6	29203.6	0.27	18009.9	45601.1	32479.2
53.0	0.29	14829.2	38280.1	30483.0	0.28	17447.2	44734.4	34200.3	0.28	18510.2	47368.9	35809.8	0.25	18009.9	44983.5	29852.0
54.0	0.33	15589.5	41394.0	40022.8	0.28	19797.1	50608.7	38026.2	0.26	18768.2	47309.5	32903.8	0.28	18257.5	46654.0	34973.3
55.0	0.29	18257.5	47213.9	38014.7	0.29	15794.4	40755.1	32372.8	0.26	19300.6	48690.3	34006.9	0.26	17296.7	43708.9	30803.0
56.0	0.32	15991.8	42269.2	39486.4	0.32	20234.6	53342.4	48875.0	0.30	15589.5	40419.0	33079.3	0.25	16625.1	41656.6	28088.5
57.0	0.31	15788.7	41241.9	35440.8	0.27	19797.1	50097.6	35572.3	0.28	18768.2	47861.8	35465.8	0.28	18257.5	46654.0	34973.3
58.0	0.31	17529.7	45971.8	40594.3	0.30	15198.4	39553.6	33167.4	0.31	18009.9	47219.8	41626.3	0.28	16409.9	42040.2	31985.4
59.0	0.31	17296.7	45250.9	39295.7	0.31	18963.6	49815.2	44503.8	0.27	15991.8	40511.6	28932.8	0.26	18257.5	46054.4	32149.1
60.0	0.25	19575.3	49083.8	33216.3	0.29	17447.2	45129.0	36389.1	0.32	18009.9	47459.6	43365.0				
61.0	0.32	16409.9	43164.5	38929.0	0.31	17808.7	46622.4	40677.3								
62.0	0.31	16625.1	43512.8	37899.5	0.31	17651.9	46293.7	40886.4								
63.0	0.31	17296.7	45250.9	39295.7	0.33	16600.7	44039.5	42288.0								
64.0	0.30	17529.7	45734.3	38985.1	0.31	14635.6	38385.5	33917.8								
65.0	0.32	17068.4	44993.3	41209.4	0.31	15024.1	39480.6	35360.5								
66.0	0.31	15394.0	40416.0	35967.1	0.28	17096.5	43657.1	32597.3								
67.0	0.27	15991.8	40511.6	28932.8	0.25	16212.3	40403.7	26519.8								
68.0	0.27	19300.6	48927.3	35074.8												

Depth (m)	BH308			
	Poisson's Ratio	Dynamic Shear Modulus (MPa)	Dynamic Young's Modulus (MPa)	Dynamic Bulk Modulus (MPa)
23.0	0.26	16711.1	42182.5	29553.4
24.0	0.36	14294.8	38770.7	44907.5
25.0	0.26	11660.2	29390.4	20434.7
26.0	0.31	16198.8	42300.8	36280.3
27.0	0.30	19856.0	51575.7	42712.4
28.0	0.29	20142.7	51838.6	40521.3
29.0	0.29	17296.7	44518.1	34816.4
30.0	0.28	19300.6	49250.2	36624.0
31.0	0.35	15991.8	43167.9	47864.5
32.0	0.29	15991.8	41223.0	32542.9
33.0	0.20	18064.3	43392.2	24191.3
34.0	0.25	20151.0	50465.7	33940.9
35.0	0.28	21041.1	53927.8	41132.1
36.0	0.29	19300.6	49862.8	39905.4
37.0	0.30	18009.9	46972.0	39954.0
38.0	0.28	20435.7	52410.7	40130.7
39.0	0.29	19856.0	51271.6	40903.6
40.0	0.22	18510.2	45118.6	26736.9
41.0	0.25	16198.8	40628.8	27533.8
42.0	0.26	18768.2	47298.1	32854.5
43.0	0.28	19300.6	49250.2	36624.0
44.0	0.03	20435.7	42120.1	14953.8
45.0	0.25	19856.0	49576.7	32842.1
46.0	0.27	19856.0	50630.0	37492.6
47.0	0.22	17068.4	41800.8	25288.6
48.0	0.26	17767.4	44858.8	31465.6
49.0	0.17	17767.4	41708.8	21306.9
50.0	0.32	15014.0	39607.3	36473.9
51.0	0.28	14123.1	36108.2	27149.4
52.0	0.32	16409.9	43164.5	38929.0
53.0	0.29	17296.7	44518.1	34816.4
54.0	0.32	18009.9	47691.8	45173.7
55.0	0.26	16198.8	40891.5	28656.8
56.0	0.18	16625.1	39354.4	20729.2
57.0	0.24	18257.5	45411.1	29522.0
58.0	0.24	16625.1	41372.7	26965.5
59.0	0.24	18009.9	44658.0	28606.6
60.0	0.29	17767.4	45704.4	35626.8
61.0	0.25	20435.7	50963.1	33561.3
62.0	0.31	16844.6	44299.5	39898.6
63.0	0.27	17068.4	43287.9	31107.4
64.0	0.24	18257.5	45411.1	29522.0
65.0	0.25	16409.9	41000.3	27252.4
66.0	0.32	16625.1	44037.0	41800.4
67.0	0.18	16122.4	38068.7	19865.6

Compression and Shear Wave Velocities in Rock for Each Borehole from Full Waveform Sonic

Depth (m)	BH205		BH207		BH303		BH307		BH308	
	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)
22.00	3594	2646								
22.05	4187	2337								
22.10	4536	2396								
22.15	3699	2215								
22.20	2843	2337								
22.25	2953	2295								
22.30	3372	2396								
22.35	4233	2442								
22.40	4187	2366								
22.45	3629	2309							3594	2628
22.50	3928	2281							3663	2610
22.55	3561	2411							4053	2503
22.60	3561	2337							4141	2440
22.65	5862	2411							4011	2404
22.70	6145	2309							4233	2369
22.75	3561	2396							4233	2416
22.80	4646	2295							4536	2416
22.85	4233	2442							4482	2440
22.90	4330	2610							4823	2440
22.95	4233	2411							4011	2452
23.00	4011	2352							4430	2515
23.05	4097	2592							4141	2515
23.10	4011	2557							3969	2515
23.15	4590	2646							4646	2515
23.20	4590	2574							4648	2628
23.25	4097	2442							4648	2628
23.30	4646	2490							4648	2557
23.35	4430	2781							4648	2610
23.40	4430	2702							4648	2523
23.45	4430	2721							4692	2458
23.50	5219	2557							4692	2442
23.55	7056	2474							4692	2507
23.60	5443	2574							4832	2474
23.65	6246	2574							4832	2381
23.70	5080	2474							4929	2474
23.75	4590	2442							4929	2507
23.80	4141	2442							4948	2523
23.85	4330	2523							4763	2523
23.90	4430	2523							5292	2442
23.95	4141	2366							5773	2557
24.00	4281	2352							4885	2309
24.05	4482	2474							4430	2474
24.10	4330	2523							4590	2295

Depth (m)	BH205		BH207		BH303		BH307		BH308	
	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)
24.15	4590	2523							4430	2140
24.20	4536	2474							4097	2131
24.25	4646	2610							4187	2103
24.30	4536	2721							4011	2077
24.35	4536	2458							4885	2077
24.40	4330	2741							5443	2077
24.45	4281	2309							5013	2077
24.50	4187	2309							5013	2042
24.55	4763	2381							4330	2025
24.60	4379	2761							4233	2017
24.65	4379	2458							4330	2017
24.70	4330	2381							4396	1974
24.75	5080	2337							4357	2128
24.80	4281	2202							4233	2048
24.85	5953	2215							3969	2005
24.90	5953	2411							4011	2042
24.95	4430	2540							3772	2068
25.00	5366	2337							3663	2085
25.05	4646	2458							3810	2131
25.10	4646	2761							3969	2131
25.15	4823	2761							3848	2140
25.20	4704	2721							3888	2150
25.25	5013	2702							3735	2150
25.30	4482	2628							3772	2169
25.35	4430	2628							3735	2169
25.40	4430	2741							3735	2169
25.45	4430	2683							3528	2169
25.50	4379	2592							3495	2150
25.55	4379	2574							3561	2169
25.60	4233	2507					4379	2507	3888	2188
25.65	4281	2490					4590	2574	4948	2249
25.70	4379	2474					4379	2352	5013	2249
25.75	4430	2540					4330	2474	4330	2281
25.80	4536	2540					4281	2427	4536	2165
25.85	4646	2557	4630	2589			4281	2411	4482	2337
25.90	4646	2610	4310	2589			4330	2490	4536	2396
25.95	4763	2574	4464	2564			4330	2490	4763	2540
26.00	4646	2628	4237	2626			4330	2523	4646	2458
26.05	5000	2540	4630	2626			4430	2557	4482	2442
26.10	5000	2490	4808	2614			4536	2574	4536	2540
26.15	4931	2165	4717	2652			4590	2628	4704	2396
26.20	4931	2646	4630	2604			4590	2592	4590	2507
26.25	4863	2254	4624	2577			4536	2664	4482	2411
26.30	4494	2741	4471	2577			4590	2664	4482	2427
26.35	4494	2683	4386	2451			4823	2664	4233	2352
26.40	4494	2490	4386	2451			4885	2702	4590	2323

Depth (m)	BH205		BH207		BH303		BH307		BH308	
	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)
26.45	4097	2507	4237	2451			4823	2702	4590	2442
26.50	4053	2309	4237	2427			4823	2646	4646	2540
26.55	5219	2474	4464	2577			4704	2610	4763	2523
26.60	4330	2540	4630	2688			4704	2702	4885	2702
26.65	3735	2352	4630	2688			4646	2702	5080	2822
26.70	3888	2281	4717	2747	4330	2523	4590	2628	5080	2781
26.75	3888	2523	5208	2907	4430	2427	4646	2610	5080	2761
26.80	4281	2557	5435	3012	4536	2574	4763	2628	5080	2761
26.85	3848	2458	5556	3012	4430	2574	4885	2683	5013	2761
26.90	3629	2048	5435	3012	4379	2458	4763	2646	4948	2702
26.95	3810	2366	5319	2976	4430	2540	4823	2646	4948	2721
27.00	4379	2295	5319	2907	4482	2540	4823	2683	5080	2721
27.05	3735	2574	5102	2874	4482	2411	4704	2474	5013	2610
27.10	3699	2268	4902	2809	4379	2523	4763	2702	5080	2781
27.15	3000	2323	4630	2809	4379	2458	4823	2646	4948	2741
27.20	2931	2228	4902	2809	4590	2557	4763	2610	5080	2702
27.25	3464	2059	5000	2841	4482	2592	4763	2702	5149	2761
27.30	3663	2105	5000	2907	4482	2557	4763	2610	5149	2801
27.35	3528	2059	4902	2907	4763	2610	4823	2646	5013	2822
27.40	3561	2323	4902	2941	4823	2628	4646	2646	5080	2931
27.45	3594	2574	5000	2976	4823	2683	4704	2664	5080	2664
27.50	3528	2490	5102	2976	4885	2761	4704	2610	5219	2843
27.55	3735	2540	5208	2976	5013	2761	4763	2683	5366	2865
27.60	4141	2177	5208	2976	5013	2702	4823	2646	5080	2781
27.65	4330	2557	5000	2907	4948	2801	4763	2683	5080	2801
27.70	3888	2702	5000	2841	4823	2683	4646	2610	4948	2721
27.75	4233	2683	4902	2809	4763	2702	4763	2628	4823	2592
27.80	4379	2165	4808	2778	4763	2801	4646	2702	4823	2801
27.85	4379	2721	4808	2747	4704	2664	4646	2557	4948	2628
27.90	4536	2540	4664	2717	4885	2557	4646	2664	5080	2741
27.95	4704	2442	4746	2778	4885	2664	4646	2702	5013	2721
28.00	4646	2490	4788	2747	4885	2761	4763	2664	5013	2741
28.05	4379	2628	4874	2809	5013	2822	4646	2683	5013	2574
28.10	4590	2610	5000	2874	4763	2822	4646	2458	4885	2683
28.15	4590	2540	4630	2841	4823	2801	4536	2490	5013	2646
28.20	4646	2523	4902	2841	4885	2664	4704	2610	4885	2761
28.25	4482	2442	5000	2874	4885	2801	4646	2442	4885	2741
28.30	4536	2822	4902	2809	5366	2741	4590	2557	4885	2801
28.35	4646	2702	4808	2809	5013	2646	4482	2592	4823	2761
28.40	4536	2741	4902	2747	4763	2741	4536	2507	4704	2574
28.45	4646	2557	4630	2778	4763	2721	4590	2592	4646	2702
28.50	4704	2683	4717	2717	4646	2664	4536	2458	4704	2646
28.55	4763	2843	4545	2717	4379	2474	4379	2507	4763	2702
28.60	4948	2865	4630	2778	4536	2540	4281	2490	4590	2628
28.65	4948	2822	4545	2717	4646	2628	4187	2427	4763	2646
28.70	5013	2781	4717	2747	4482	2646	4330	2507	4823	2610

Depth (m)	BH205		BH207		BH303		BH307		BH308	
	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)
28.75	4482	2781	4464	2688	4590	2557	4482	2523	4885	2664
28.80	4763	2741	4630	2778	4646	2628	4590	2540	4704	2646
28.85	4948	2801	4808	2747	4646	2574	4482	2427	4763	2574
28.90	4763	2741	4808	2778	4536	2683	4590	2610	4704	2523
28.95	4763	2741	4464	2747	4590	2702	4704	2557	4646	2523
29.00	4704	2664	4630	2747	4482	2664	4763	2628	4646	2540
29.05	4763	2721	4630	2747	4330	2507	4763	2628	4763	2592
29.10	4646	2741	4808	2688	4281	2557	4763	2523	4885	2574
29.15	4430	2646	4464	2688	4590	2801	4763	2702	4763	2490
29.20	4704	2801	4717	2809	4646	2683	4885	2761	4763	2574
29.25	4885	2801	4630	2632	4281	2592	5013	2664	4704	2646
29.30	4482	2741	4237	2525	4482	2683	4948	2721	4646	2540
29.35	4646	2822	4310	2577	4590	2574	4948	2557	4948	2721
29.40	4885	2801	4237	2577	4536	2664	4885	2557	4948	2781
29.45	5149	2822	4167	2660	4379	2592	4948	2741	5013	2741
29.50	4948	2741	4630	2682	4430	2442	4885	2574	5080	2702
29.55	4646	2801	4630	2688	4536	2664	4704	2610	5149	2761
29.60	4823	2721	4808	2702	4646	2610	4536	2664	5219	2865
29.65	4823	2886	5000	2702	4646	2646	4590	2540	5080	2822
29.70	4646	2781	5319	2831	4482	2592	4646	2646	5219	2843
29.75	4763	2702	5435	2838	4536	2610	4704	2664	5080	2761
29.80	4330	2610	5435	2907	4379	2592	4704	2610	5013	2865
29.85	4646	2683	5435	3012	4164	2523	4704	2664	4885	2801
29.90	4763	2741	5000	2874	4142	2507	4885	2664	4823	2702
29.95	4590	2741	4902	2809	4176	2574	4885	2801	4763	2646
30.00	4536	2721	4902	2847	4282	2490	4885	2741	4823	2683
30.05	3928	2721	4902	2803	4318	2474	4948	2781	4823	2523
30.10	4141	2683	4808	2760	4282	2574	4763	2702	4590	2490
30.15	4646	2683	4310	2577	4590	2574	4948	2628	4763	2523
30.20	4590	2664	4310	2577	4482	2646	5013	2741	4823	2540
30.25	5366	2628	4386	2551	4379	2610	5013	2741	4885	2664
30.30	5013	2702	4808	2525	4482	2646	5080	2761	5013	2683
30.35	4482	2646	4902	2841	4823	2664	4948	2721	5013	2664
30.40	4536	2664	5102	2907	4646	2761	4948	2646	5080	2683
30.45	4590	2683	4630	2688	4948	2646	4885	2683	5292	2801
30.50	4281	2610	5000	2874	4948	2741	4885	2721	4948	2646
30.55	4430	2646	5435	2976	4948	2702	4823	2664	4763	2801
30.60	4536	2646	5319	3086	4823	2702	4885	2683	5080	2761
30.65	5013	2683	5435	3049	4948	2721	4885	2683	5219	2574
30.70	4430	2646	5435	2976	4763	2664	4885	2646	5292	2540
30.75	4281	2628	5319	2941	4646	2557	4885	2664	5013	2628
30.80	4482	2610	5208	2907	4330	2628	4763	2702	5013	2592
30.85	4141	2574	5208	2976	4482	2557	4763	2683	4948	2843
30.90	4233	2523	5319	2809	4536	2540	4704	2646	5443	2721
30.95	3928	2574	5208	2941	4482	2610	4763	2610	5292	2646
31.00	4330	2557	5102	2941	4330	2557	4763	2628	5080	2442

Depth (m)	BH205		BH207		BH303		BH307		BH308	
	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)
31.05	4379	2781	5102	2941	4482	2490	4704	2664	4646	2683
31.10	4097	2683	4902	2907	4482	2646	4763	2721	5219	2628
31.15	4330	2381	5102	2841	4634	2721	4823	2702	4590	2592
31.20	4281	2474	5000	2778	4648	2592	4763	2702	5013	2490
31.25	4482	2458	4672	2774	4750	2592	4780	2664	4281	2507
31.30	4430	2557	4672	2760	4648	2683	4780	2664	4379	2490
31.35	4763	2490	4672	2692	4706	2741	4750	2664	4330	2490
31.40	4379	2540	4630	2632	4590	2628	4721	2646	4330	2721
31.45	4885	2592	4808	2660	4763	2781	4677	2610	4430	2442
31.50	5080	2646	4808	2660	4763	2646	4648	2628	4536	2442
31.55	4885	2646	4630	2717	4948	2741	4648	2523	4704	2474
31.60	4885	2664	4464	2778	4823	2628	4648	2628	4330	2411
31.65	4763	2721	4237	2717	4948	2761	4646	2592	4011	2592
31.70	4823	2741	4386	2717	4885	2741	4590	2592	4141	2490
31.75	5013	2702	4464	2778	4823	2741	4646	2628	4097	2458
31.80	4823	2628	4464	2874	4823	2683	4590	2610	4482	2574
31.85	4536	2721	4902	2778	4482	2646	4536	2574	4590	2474
31.90	4379	2610	4464	2747	4646	2557	4646	2610	4379	2490
31.95	4482	2507	4386	2774	4646	2523	4704	2592	4430	2442
32.00	4763	2610	4717	2803	4646	2664	4763	2628	4482	2442
32.05	4704	2490	4545	2803	4646	2664	4763	2664	4430	2540
32.10	4482	2490	4545	2719	4379	2574	4763	2646	4379	2411
32.15	5013	2886	4386	2525	4646	2592	4823	2646	4482	2458
32.20	4704	2664	4032	2551	4482	2540	4823	2683	4704	2574
32.25	4823	2801	3968	2525	4646	2610	4885	2683	4482	2702
32.30	4763	2781	4386	2551	4704	2664	4885	2702	4482	2458
32.35	4536	2557	4808	2632	4536	2610	4885	2683	4482	2540
32.40	4885	2741	4545	2717	4536	2683	4823	2646	4604	2557
32.45	4948	2801	4630	2747	4646	2574	4885	2721	4519	2592
32.50	5013	2843	4630	2809	4536	2557	4885	2664	4519	2646
32.55	4885	2822	4902	2809	4763	2592	4885	2628	4519	2574
32.60	4823	2702	5208	2841	4704	2574	4763	2702	4243	2610
32.65	5292	2741	5000	2841	4823	2702	4823	2664	4101	2610
32.70	4823	2781	5208	2841	4704	2592	4948	2646	4000	2610
32.75	4823	2801	5102	2874	4590	2507	4885	2702	3935	2628
32.80	5522	2741	5102	2809	4763	2628	4823	2664	3873	2592
32.85	4763	2741	5000	2874	4590	2557	4823	2646	3873	2781
32.90	4823	2761	5000	2809	4536	2474	4885	2683	4000	2610
32.95	4590	2761	5000	2841	4590	2592	4885	2683	4067	2652
33.00	4704	2702	5102	2874	4482	2507	4885	2683	4243	2596
33.05	4646	2664	5000	2809	4536	2574	4885	2702	4319	2542
33.10	4763	2664	5102	2841	4646	2592	4885	2702	4243	2515
33.15	4379	2628	5000	2809	4704	2592	4948	2721	4396	2515
33.20	4646	2628	5000	2841	4763	2646	4948	2683	4396	2503
33.25	4948	2628	5102	2841	4704	2592	4885	2721	4477	2503
33.30	4646	2610	5102	2809	4823	2664	4885	2683	4477	2503

Depth (m)	BH205		BH207		BH303		BH307		BH308	
	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)
33.35	4536	2610	5000	2841	4823	2664	4948	2702	4604	2503
33.40	4379	2592	5000	2874	4704	2628	4948	2702	4604	2503
33.45	4379	2702	5102	2841	4948	2702	4885	2702	4604	2503
33.50	4482	2628	5102	2874	4763	2592	4948	2702	4692	2503
33.55	4482	2557	5208	2907	4885	2741	4948	2702	4832	2503
33.60	4536	2574	5102	2941	4885	2628	4823	2721	4929	2515
33.65	4763	2628	5208	2907	5013	2721	4885	2683	4832	2582
33.70	4590	2741	5208	2907	4885	2664	4948	2721	4784	2610
33.75	4704	2664	5102	2907	4823	2683	4885	2683	4784	2610
33.80	4763	2721	5102	2907	4823	2683	4948	2702	4646	2628
33.85	4704	2702	5102	2907	4885	2683	4948	2721	4823	2721
33.90	4590	2628	5102	2907	4948	2702	5080	2683	4823	2696
33.95	4482	2574	5102	2907	4948	2664	4885	2761	5773	2696
34.00	4482	2557	5208	2874	4704	2702	4948	2721	4763	2742
34.05	4590	2574	5102	2874	4872	2610	4948	2741	4948	2742
34.10	4330	2490	5000	2841	4872	2721	4948	2721	4763	2773
34.15	4187	2628	5102	2907	4903	2683	4948	2702	5013	2865
34.20	4610	2557	5102	2907	4919	2721	4948	2721	5013	2801
34.25	4863	2683	5102	2907	5080	2646	4948	2702	4948	2592
34.30	4733	2664	5208	2907	4885	2721	4885	2702	5013	2610
34.35	4863	2628	5102	2907	5080	2761	4948	2702	4823	2664
34.40	4931	2683	5208	2907	4948	2628	4885	2702	4948	2822
34.45	4763	2721	5208	2941	4948	2683	4885	2702	5013	2721
34.50	4704	2761	5319	2941	4823	2683	4885	2702	5080	2741
34.55	5292	2721	5208	2907	5013	2610	4885	2683	5080	2592
34.60	4763	2664	5208	2907	5013	2702	4885	2683	5080	2741
34.65	4704	2781	5208	2907	4885	2646	4948	2646	5013	2721
34.70	4590	2761	5102	2907	4948	2664	4823	2721	5013	2761
34.75	4763	2781	5208	2874	4885	2702	4948	2721	4948	2741
34.80	4763	2781	5102	2874	4948	2683	5013	2702	5013	2741
34.85	4885	2702	5000	2809	4823	2721	5013	2721	5080	2741
34.90	4763	2702	5000	2809	4948	2702	5013	2741	5013	2741
34.95	4704	2741	5000	2841	4948	2683	5013	2721	5013	2801
35.00	4536	2664	5102	2841	4948	2761	5080	2761	5080	2801
35.05	4482	2646	5000	2874	4885	2664	5080	2761	5080	2801
35.10	4590	2664	5102	2874	5013	2721	5013	2721	5149	2801
35.15	4646	2664	5102	2907	5080	2683	5013	2741	5149	2801
35.20	4590	2741	5102	2907	5080	2664	5013	2721	5149	2822
35.25	4646	2683	5208	2907	5080	2741	5013	2721	5149	2843
35.30	4646	2628	5319	2976	4951	2683	5013	2741	5149	2801
35.35	4536	2664	5208	2941	4951	2702	4948	2721	5149	2801
35.40	4646	2610	5208	2976	4951	2628	4948	2721	5080	2801
35.45	4430	2664	5319	2976	4951	2664	4885	2683	5149	2574
35.50	4536	2646	5208	2976	4903	2741	4885	2702	5149	2801
35.55	4482	2610	5319	2941	4872	2646	4885	2702	5080	2801
35.60	4646	2664	5319	2941	4948	2664	4885	2683	5013	2702

Depth (m)	BH205		BH207		BH303		BH307		BH308	
	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)
35.65	4823	2610	5208	2941	4823	2702	4885	2721	5013	2801
35.70	4885	2683	5208	2907	4948	2721	4948	2683	5013	2610
35.75	4590	2610	5208	2907	4948	2683	4948	2721	5013	2822
35.80	4590	2664	5208	2907	4823	2761	5013	2721	4948	2721
35.85	4482	2628	5102	2907	4823	2628	5013	2741	4948	2664
35.90	4590	2610	5000	2874	4823	2702	5080	2741	4948	2721
35.95	4646	2683	5000	2841	4885	2702	5013	2741	4948	2628
36.00	4590	2721	5102	2809	4951	2664	5080	2741	4948	2683
36.05	5013	2741	5102	2907	4967	2761	5080	2761	5013	2474
36.10	4948	2721	5102	2907	5000	2741	5080	2741	5080	2557
36.15	4763	2822	5102	2907	5033	2761	5013	2781	5080	2540
36.20	4646	2781	5208	2941	5033	2721	5149	2741	5080	2592
36.25	4704	2865	5208	2941	5033	2781	5149	2761	5013	2523
36.30	4885	2822	5319	2976	5033	2702	5080	2761	5013	2741
36.35	4646	2721	5319	2976	4885	2761	5080	2741	5080	2865
36.40	4885	2843	5319	2976	5013	2761	5149	2741	5013	2721
36.45	4763	2761	5435	3012	5080	2741	4948	2721	4948	2574
36.50	4763	2801	5319	3012	5013	2721	4948	2741	4823	2592
36.55	4823	2843	5435	3012	5050	2761	4948	2721	4948	2664
36.60	5080	2761	5319	3012	5050	2702	4885	2683	4948	2664
36.65	4885	2741	5319	2976	5050	2741	4885	2702	4948	2781
36.70	4885	2741	5319	2976	5050	2702	4885	2702	4948	2801
36.75	4823	2781	5319	2976	5050	2702	4823	2683	5013	2702
36.80	5149	2761	5319	2976	5013	2781	4885	2683	5013	2628
36.85	4704	2781	5319	2941	5080	2664	4823	2683	4885	2574
36.90	4763	2761	5208	2907	4948	2761	4823	2683	4823	2557
36.95	4885	2822	5208	2874	5080	2822	4823	2664	4823	2721
37.00	4704	2822	5102	2841	5080	2683	4823	2683	4885	2592
37.05	4948	2822	5102	2809	5080	2801	4948	2646	4948	2557
37.10	5013	2822	5102	2809	5080	2741	4763	2721	4379	2396
37.15	5080	2865	5000	2809	5080	2781	4885	2664	4536	2323
37.20	4823	2801	5000	2809	5149	2781	4885	2683	4590	2442
37.25	5080	2843	5000	2778	5080	2781	4885	2702	4590	2610
37.30	5080	2843	5000	2809	5149	2761	4885	2702	4704	2592
37.35	5013	2801	5102	2841	5033	2741	4948	2702	4590	2490
37.40	4885	2781	5102	2841	4967	2781	4948	2721	4590	2574
37.45	4823	2761	5102	2841	4951	2781	4948	2702	4646	2628
37.50	4704	2761	5102	2874	4951	2721	4885	2702	4646	2664
37.55	5013	2822	5102	2874	4951	2761	4948	2683	4590	2646
37.60	5013	2801	5102	2874	4948	2761	4885	2683	4763	2664
37.65	4948	2721	5102	2874	5080	2683	4885	2702	4646	2664
37.70	4763	2702	5102	2907	5149	2741	4948	2702	5013	2741
37.75	4590	2646	5102	2874	4948	2741	4948	2702	5013	2702
37.80	4590	2683	5102	2874	4823	2741	4885	2702	4885	2721
37.85	4763	2702	5102	2907	4948	2683	4885	2683	5013	2741
37.90	4646	2664	5102	2874	4885	2721	4885	2683	4948	2761

Depth (m)	BH205		BH207		BH303		BH307		BH308	
	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)
37.95	4704	2646	5102	2874	4823	2721	4885	2702	5013	2741
38.00	4536	2683	5102	2874	4885	2683	4885	2683	5013	2761
38.05	4885	2664	5102	2874	4823	2741	4885	2702	4948	2702
38.10	4482	2646	5102	2874	4823	2610	4948	2721	4948	2822
38.15	4885	2761	5102	2874	4704	2664	4948	2702	4948	2721
38.20	5013	2781	5102	2874	4704	2646	4948	2721	4948	2741
38.25	4590	2781	5102	2874	4948	2646	4948	2702	4948	2781
38.30	5080	2865	5102	2809	4646	2683	4948	2721	5013	2721
38.35	4823	2843	5102	2874	4763	2592	4948	2721	4948	2761
38.40	5219	2843	5102	2907	4763	2664	5013	2721	5013	2741
38.45	4763	2865	5102	2874	4763	2664	5013	2721	4948	2761
38.50	4948	2801	5102	2874	4704	2721	4948	2741	5013	2843
38.55	4948	2801	5208	2907	4823	2683	5080	2741	5080	2741
38.60	4948	2801	5208	2907	4763	2646	5013	2721	5080	2741
38.65	4948	2781	5208	2907	4704	2664	4948	2741	5080	2801
38.70	4948	2741	5102	2874	4704	2741	4948	2702	5080	2610
38.75	4885	2761	5208	2907	4885	2664	4948	2702	5080	2781
38.80	4885	2721	5208	2874	5013	2761	5013	2683	5080	2741
38.85	4763	2702	5208	2874	4885	2721	4763	2702	5080	2843
38.90	4885	2761	5319	2874	4948	2683	4823	2683	5013	2721
38.95	4885	2721	5208	2941	5013	2741	4823	2664	4948	2843
39.00	4763	2721	5319	2874	4885	2702	4823	2683	5013	2721
39.05	4885	2741	5208	2874	5013	2721	4823	2664	4948	2574
39.10	4885	2761	5208	2907	5013	2721	4763	2664	5013	2801
39.15	4823	2741	5102	2841	4823	2664	4763	2664	4885	2592
39.20	4763	2843	5102	2874	4948	2702	4885	2683	4948	2646
39.25	4823	2781	5102	2809	4885	2721	4823	2683	4885	2702
39.30	4482	2721	4902	2778	4948	2702	4823	2683	4885	2646
39.35	4590	2721	4902	2778	4885	2702	4823	2683	4763	2646
39.40	4885	2781	4808	2688	4885	2702	4823	2702	4763	2664
39.45	4763	2741	4630	2688	4823	2683	4885	2702	4646	2592
39.50	4948	2761	4808	2688	4948	2741	4823	2664	4704	2702
39.55	5080	2721	4717	2688	4948	2702	4823	2683	4823	2683
39.60	4704	2702	4808	2688	4948	2721	4763	2646	4763	2646
39.65	4590	2664	4808	2717	4948	2761	4763	2646	4704	2646
39.70	4885	2781	4902	2717	4948	2646	4704	2646	4823	2664
39.75	4590	2721	4808	2747	5013	2761	4646	2610	4948	2741
39.80	4590	2683	4808	2747	4948	2702	4590	2592	4704	2646
39.85	4763	2702	5000	2717	4948	2721	4482	2574	4430	2540
39.90	4590	2702	5102	2747	5013	2683	4536	2540	4646	2628
39.95	4763	2702	5000	2747	4885	2761	4379	2574	4646	2610
40.00	4763	2721	5102	2747	5013	2702	4430	2504	4379	2628
40.05	4430	2721	4808	2717	5149	2683	4430	2492	4646	2574
40.10	4763	2702	4717	2577	4948	2741	4430	2488	4281	2540
40.15	4704	2646	4717	2500	4885	2664	4430	2523	4097	2442
40.20	4763	2683	4808	2577	4823	2702	4482	2574	3735	2309

Depth (m)	BH205		BH207		BH303		BH307		BH308	
	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)
40.25	4823	2721	4717	2500	4948	2721	4482	2490	4141	2381
40.30	4885	2702	4464	2451	4823	2664	4482	2592	4053	2323
40.35	5080	2683	4237	2404	5149	2741	4590	2474	3888	2323
40.40	4823	2721	4237	2404	4823	2702	4590	2610	4097	2309
40.45	4823	2702	4386	2404	4823	2741	4646	2628	4011	2366
40.50	5292	2741	4310	2404	4948	2683	4646	2610	3928	2337
40.55	5080	2865	4310	2451	4823	2702	4646	2610	4011	2411
40.60	5013	2865	4237	2475	4763	2781	4646	2610	4281	2458
40.65	5149	2865	4386	2475	4885	2702	4646	2574	4187	2411
40.70	5219	2843	4545	2551	5080	2721	4590	2557	4233	2366
40.75	5149	2886	4717	2604	4646	2646	4536	2557	4430	2507
40.80	5080	2865	4902	2632	4763	2683	4482	2523	4330	2507
40.85	5013	2843	4630	2577	4763	2646	4430	2540	4097	2442
40.90	5080	2721	4717	2577	4646	2574	4430	2480	4233	2458
40.95	5080	2781	4902	2604	4590	2592	4430	2480	4379	2442
41.00	5013	2843	4717	2604	4482	2507	4430	2480	4281	2458
41.05	4885	2865	4717	2525	4590	2474	4330	2480	4011	2411
41.10	5013	2801	4717	2551	4330	2507	4379	2480	4281	2474
41.15	4885	2702	4545	2427	4330	2557	4430	2492	4330	2411
41.20	4885	2908	4386	2451	4141	2442	4482	2521	4187	2352
41.25	4885	2781	4464	2404	4233	2474	4590	2525	4187	2323
41.30	4885	2801	4386	2427	4176	2474	4536	2546	4187	2366
41.35	4763	2908	4237	2427	4176	2442	4704	2610	4141	2411
41.40	4763	2886	4237	2404	4199	2427	4763	2646	4233	2442
41.45	4646	2801	4310	2427	4222	2458	4885	2664	4430	2474
41.50	4885	2931	4237	2451	4222	2557	4885	2664	4482	2458
41.55	4823	2822	4310	2500	4330	2411	4885	2683	4097	2523
41.60	4885	2628	4464	2525	4330	2523	4885	2664	4536	2683
41.65	4885	2761	4630	2660	4430	2557	4823	2741	4482	2574
41.70	4885	2592	4808	2660	4482	2442	4948	2721	4590	2702
41.75	5522	2646	4808	2747	4606	2557	4948	2683	4646	2646
41.80	4885	2843	4902	2778	4634	2610	4948	2702	4379	2664
41.85	4885	2781	4902	2809	4634	2592	4948	2702	4646	2683
41.90	4948	2574	5000	2809	4524	2507	4948	2702	4590	2683
41.95	4733	2540	5102	2841	4430	2474	4885	2741	4430	2664
42.00	4733	2523	5208	2841	4281	2411	4823	2664	4646	2646
42.05	4671	2540	5000	2841	4330	2507	4646	2646	4646	2702
42.10	4610	2458	5102	2841	4258	2474	4823	2683	4590	2683
42.15	4610	2458	5000	2778	4234	2442	4823	2664	4704	2646
42.20	4379	2442	5000	2778	4234	2442	4885	2702	4763	2628
42.25	4430	2474	5000	2809	4234	2427	4885	2664	4763	2628
42.30	4233	2352	5000	2809	4282	2474	4885	2664	4763	2646
42.35	4281	2442	4902	2747	4294	2592	4948	2702	4823	2664
42.40	4430	2442	5000	2747	4318	2592	4948	2683	4763	2664
42.45	4430	2442	5102	2717	4330	2592	4948	2702	4763	2721
42.50	4379	2458	5000	2809	4482	2574	4948	2721	5013	2664

Depth (m)	BH205		BH207		BH303		BH307		BH308	
	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)
42.55	4330	2490	5000	2747	4704	2628	5013	2721	4823	2741
42.60	4330	2490	5000	2747	4823	2646	5080	2761	5013	2683
42.65	4379	2523	5000	2747	4948	2628	5013	2741	5013	2761
42.70	4482	2557	5000	2747	4823	2646	5080	2741	5080	2761
42.75	4379	2592	5000	2809	4646	2702	5013	2741	4763	2741
42.80	4646	2610	5000	2809	4763	2610	5080	2741	4948	2702
42.85	5219	2540	5102	2907	4885	2664	5080	2702	4948	2761
42.90	4482	2822	5208	2874	5013	2664	5080	2741	4823	2761
42.95	4646	2801	5208	2941	4885	2664	5080	2721	5013	2761
43.00	4330	2442	5319	2941	5013	2741	5013	2741	4823	2683
43.05	4438	2442	5319	2976	4948	2702	5013	2741	4704	2702
43.10	4438	2381	5319	2976	4948	2702	5013	2702	5149	2741
43.15	4438	2427	5319	3012	4885	2683	4948	2721	4763	2822
43.20	4329	2523	5435	3012	4885	2664	4948	2721	4590	2683
43.25	4281	2337	5435	2976	4823	2702	5013	2683	4187	2702
43.30	4379	2366	5319	2976	4885	2628	5013	2721	4482	2646
43.35	4536	2683	5319	2976	5080	2664	5013	2702	4704	2628
43.40	4590	2337	5319	2976	4948	2761	5013	2702	4482	2702
43.45	4053	2557	5319	2941	4948	2610	5013	2721	4379	2781
43.50	4097	2442	5208	2941	4763	2741	4948	2683	3810	2721
43.55	4590	2557	5208	2907	4885	2702	4823	2721	3810	2628
43.60	4885	2592	5208	2907	4948	2664	4948	2683	4000	2721
43.65	4763	2702	5208	2907	4948	2683	4948	2664	4000	2822
43.70	4763	2702	5208	2907	5013	2741	4948	2702	3967	2592
43.75	4763	2741	5208	2941	5219	2664	4823	2702	3935	2610
43.80	4763	2781	5208	2941	4948	2781	4948	2683	3935	2523
43.85	5080	2741	5208	2941	5149	2702	4885	2702	3935	2592
43.90	4823	2801	5208	2907	5013	2801	4948	2664	3935	2610
43.95	4823	2761	5319	2976	5080	2761	4885	2664	3935	2628
44.00	5292	2843	5319	2976	5219	2741	4885	2702	3967	2761
44.05	5149	2741	5319	2907	5013	2721	4948	2664	4067	2523
44.10	4948	2781	5208	2907	5013	2761	4948	2702	4101	2574
44.15	4948	2721	5208	2907	5080	2761	4948	2683	4243	2442
44.20	4948	2741	5102	2841	5080	2761	4948	2683	4357	2396
44.25	4885	2721	5208	2907	5013	2781	4948	2683	4357	2540
44.30	4823	2683	5208	2874	5149	2741	4948	2683	4357	2574
44.35	4948	2702	5102	2809	5084	2761	4948	2683	4187	2490
44.40	5013	2741	5102	2809	5084	2702	4948	2721	4053	2610
44.45	4948	2721	5102	2841	5000	2741	5013	2664	4379	2490
44.50	4646	2761	5102	2874	4967	2761	4948	2702	4330	2507
44.55	4948	2781	5208	2874	4951	2702	4948	2683	4379	2523
44.60	4823	2801	5208	2907	4951	2683	4885	2664	3810	2490
44.65	5013	2741	5208	2907	4951	2781	4948	2702	4187	2540
44.70	5773	2702	5208	2907	4951	2664	4948	2702	4646	2557
44.75	5443	2702	5208	2907	4951	2761	4948	2664	4379	2610
44.80	4885	2664	5208	2907	4951	2683	4948	2683	5149	2610

Depth (m)	BH205		BH207		BH303		BH307		BH308	
	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)
44.85	5292	2761	5208	2907	4951	2741	4948	2702	4646	2628
44.90	5292	2664	5319	2941	5080	2683	4948	2664	4704	2628
44.95	5366	2741	5208	2907	4948	2741	4948	2721	4823	2741
45.00	5379	2781	5208	2907	5013	2721	4885	2683	4704	2721
45.05	5221	2741	5102	2874	5013	2702	4948	2683	4646	2664
45.10	5221	2741	5102	2874	4948	2702	4885	2683	4704	2702
45.15	5379	2822	5102	2874	5013	2721	4948	2702	4948	2721
45.20	5635	2822	5102	2907	4948	2741	4948	2741	4885	2781
45.25	5635	2741	5208	2907	5080	2702	5013	2683	4823	2761
45.30	5726	2721	5208	2907	5080	2721	5013	2702	4704	2761
45.35	6017	2702	5208	2907	4948	2741	5013	2741	5443	2702
45.40	6121	2721	5208	2907	5013	2721	5013	2721	5013	2683
45.45	6048	2683	5208	2976	5013	2741	5013	2721	4823	2721
45.50	6569	2646	5208	2976	5080	2721	4948	2761	4948	2702
45.55	5080	2646	5319	2976	5149	2664	5080	2702	4646	2646
45.60	6927	2628	5319	2976	4948	2781	5080	2761	4482	2442
45.65	4590	2574	5208	2941	5013	2683	5013	2741	4823	2646
45.70	5149	2557	5208	2907	5149	2702	5080	2741	5080	2610
45.75	5219	2574	5208	2976	4885	2761	5080	2702	4482	2592
45.80	5080	2610	5319	3012	5080	2702	5080	2761	4482	2664
45.85	5013	2574	5319	2976	4885	2702	5080	2741	4379	2610
45.90	4704	2540	5319	2976	5013	2741	5080	2721	4763	2646
45.95	4885	2702	5319	2976	5013	2702	5013	2761	4536	2646
46.00	5080	2628	5208	2976	5013	2702	5080	2592	4885	2721
46.05	4948	2664	5319	3012	5013	2702	5080	2721	4885	2741
46.10	4763	2664	5435	3012	5013	2683	4948	2822	5013	2664
46.15	4763	2741	5435	3012	4948	2721	4885	2628	4948	2702
46.20	4885	2721	5435	2976	5013	2741	4948	2702	5080	2664
46.25	5080	2843	5319	2976	5013	2702	4885	2721	4885	2761
46.30	4763	2741	5435	2941	4948	2702	4885	2664	4763	2702
46.35	4948	2761	5435	2976	5080	2741	4763	2646	4763	2761
46.40	5219	2781	5435	2941	5080	2721	4763	2610	4885	2664
46.45	5292	2865	5435	2907	5080	2741	4704	2610	4948	2721
46.50	5292	2801	5319	2874	5149	2702	4704	2610	4823	2664
46.55	5080	2781	5319	2809	5013	2761	4704	2610	4763	2664
46.60	5292	2865	5319	2809	4967	2781	4646	2574	4536	2628
46.65	5366	2801	5208	2778	4967	2702	4590	2574	4482	2628
46.70	5149	2977	5208	2717	4967	2721	4590	2523	4590	2574
46.75	5013	2822	5102	2747	5000	2761	4590	2557	4379	2574
46.80	5149	2843	5102	2660	5033	2721	4590	2557	4536	2646
46.85	5013	2801	5000	2660	5033	2781	4646	2574	4536	2557
46.90	5149	2683	4902	2660	5149	2721	4646	2592	4281	2540
46.95	5013	2801	4808	2632	4948	2761	4646	2523	4330	2507
47.00	4823	2761	4630	2604	5013	2781	4763	2610	4233	2523
47.05	4763	2761	4717	2632	5149	2741	4823	2646	4482	2574
47.10	4948	2761	4717	2604	5013	2781	4823	2664	4281	2474

Depth (m)	BH205		BH207		BH303		BH307		BH308	
	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)
47.15	4885	2761	4630	2632	5080	2781	4885	2741	4141	2507
47.20	5013	2801	4630	2632	5219	2702	4763	2628	4330	2592
47.25	4885	2822	4630	2604	4948	2781	4885	2683	4646	2592
47.30	5080	2822	4808	2747	4948	2761	4823	2646	4536	2683
47.35	5080	2801	4808	2747	4948	2702	4763	2557	4590	2702
47.40	5149	2721	4902	2809	4948	2702	4763	2646	4823	2610
47.45	5080	2761	5000	2874	4948	2683	4763	2664	5013	2646
47.50	5149	2761	5102	2907	5149	2702	4823	2683	4704	2721
47.55	4948	2801	5208	2976	4885	2721	4823	2683	4281	2646
47.60	4948	2843	5319	2976	4948	2664	4763	2610	4141	2610
47.65	5013	2865	5319	3012	4823	2702	4704	2592	4646	2822
47.70	4863	2741	5319	2907	4704	2628	4646	2610	4646	2741
47.75	4931	2761	5435	2976	4823	2628	4646	2610	5013	2741
47.80	5462	2843	5556	2976	4763	2610	4646	2610	4885	2557
47.85	5462	2801	5435	2907	4763	2592	4646	2664	4823	2702
47.90	4590	2761	5208	2874	4646	2574	4590	2523	4590	2574
47.95	4704	2702	5319	2809	4704	2628	4379	2490	4646	2592
48.00	4590	2741	5319	2841	4704	2628	4430	2540	4536	2574
48.05	4763	2721	5102	2717	4763	2628	4379	2490	4281	2574
48.10	4704	2822	5208	2747	4763	2592	4330	2442	4233	2540
48.15	4430	2683	5208	2717	4823	2574	4430	2557	4482	2490
48.20	4763	2702	5102	2688	4704	2702	4330	2490	4430	2574
48.25	4885	2664	5000	2604	4763	2592	4233	2352	4141	2592
48.30	4948	2683	4902	2551	4823	2683	4281	2474	4233	2474
48.35	4948	2702	4717	2551	4885	2628	4281	2458	4430	2458
48.40	4590	2801	4545	2525	4795	2702	4379	2523	4097	2381
48.45	4646	2664	4545	2525	4825	2781	4482	2702	4053	2366
48.50	5080	2741	4464	2451	4841	2683	4590	2523	4233	2323
48.55	5219	2721	4386	2451	4903	2702	4590	2592	4379	2474
48.60	5080	2761	4386	2451	4951	2664	4646	2523	4379	2540
48.65	5080	2721	4464	2551	4967	2702	4590	2610	4590	2574
48.70	4948	2822	4464	2577	4967	2702	4646	2628	4330	2592
48.75	4763	2741	4545	2551	4967	2702	4536	2610	4053	2458
48.80	4885	2646	4717	2551	5013	2721	4590	2540	4053	2442
48.85	4885	2664	4808	2604	4948	2702	4590	2490	4233	2507
48.90	4885	2592	5102	2632	4948	2761	4590	2540	4281	2664
48.95	4885	2646	5319	2809	5080	2683	4430	2507	3928	2490
49.00	4823	2592	5208	2778	4823	2664	4379	2592	4097	2574
49.05	4823	2721	5102	2717	4706	2646	4330	2458	4823	2427
49.10	4704	2592	5102	2688	4634	2610	4187	2337	4536	2396
49.15	4823	2628	5000	2604	4606	2610	4187	2254	4141	2490
49.20	4823	2646	5102	2632	4592	2557	4233	2411	4141	2427
49.25	4948	2781	5000	2604	4592	2592	4141	2523	4011	2366
49.30	5013	2683	4808	2525	4590	2557	4141	2396	4187	2323
49.35	4885	2721	4545	2451	4590	2610	4281	2474	3969	2366
49.40	5013	2664	4464	2381	4590	2557	4097	2254	4233	2352

Depth (m)	BH205		BH207		BH303		BH307		BH308	
	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)
49.45	5013	2721	4464	2336	4590	2523	4141	2337	4233	2411
49.50	5080	2761	4464	2315	4536	2540	4233	2442	4281	2352
49.55	5080	2801	4386	2336	4590	2592	4379	2427	4379	2381
49.60	4948	2801	4386	2336	4590	2490	4482	2490	4379	2427
49.65	5080	2721	4310	2315	4646	2592	4430	2490	4233	2427
49.70	5219	2761	4310	2336	4948	2646	4379	2540	4482	2490
49.75	5219	2865	4237	2336	4885	2574	4430	2523	4233	2396
49.80	5149	2574	4386	2404	4704	2664	4430	2664	4482	2474
49.85	5149	2592	4386	2475	4704	2646	4482	2474	4948	2664
49.90	5013	2801	4464	2451	4948	2610	4763	2628	4590	2628
49.95	4948	2781	4464	2577	4646	2646	4482	2610	4590	2557
50.00	4948	2781	4630	2577	4823	2557	4536	2557	4590	2366
50.05	4885	2664	4717	2688	4823	2610	4536	2664	4379	2540
50.10	4823	2702	4808	2747	4646	2610	4430	2592	4482	2490
50.15	4885	2628	4902	2717	4590	2592	4330	2540	4646	2741
50.20	4763	2540	5000	2747	4431	2610	4379	2490	4646	2592
50.25	4646	2490	5102	2717	4431	2557	4430	2557	4590	2610
50.30	4704	2592	4902	2717	4419	2411	4379	2592	4704	2574
50.35	4646	2574	5000	2717	4393	2366	4482	2646	4482	2458
50.40	4704	2474	5102	2717	4355	2442	4379	2507	4536	2523
50.45	4646	2442	5000	2688	4330	2442	4233	2474	4330	2396
50.50	4330	2396	5000	2660	4330	2427	4086	2352	4379	2442
50.55	4536	2458	4902	2632	4330	2507	4086	2323	4330	2458
50.60	4646	2646	4808	2551	4330	2396	4075	2268	4141	2442
50.65	4948	2523	5000	2632	4482	2411	4053	2268	4233	2411
50.70	4704	2592	5102	2660	4281	2474	4021	2268	4281	2337
50.75	5219	2592	4808	2525	4536	2474	4000	2295	4330	2366
50.80	4948	2592	4717	2525	4536	2574	3969	2241	4187	2381
50.85	4948	2843	4808	2475	4536	2507	3928	2254	4097	2381
50.90	4885	2427	4630	2475	4646	2628	3928	2268	4233	2323
50.95	5953	2490	4630	2404	4646	2592	4053	2323	4011	2268
51.00	4948	2664	4545	2358	4646	2610	3969	2295	4141	2295
51.05	4885	2628	4386	2294	4763	2628	3928	2295	4233	2309
51.10	4763	2557	4310	2273	4823	2646	4141	2323	4482	2295
51.15	4885	2557	4310	2252	4823	2628	4233	2381	4281	2442
51.20	4646	2523	4237	2294	4704	2628	4590	2427	4482	2352
51.25	4430	2507	4167	2252	4763	2646	4430	2474	4536	2411
51.30	4430	2427	4167	2336	4763	2664	4482	2574	4482	2366
51.35	4379	2411	4237	2358	4763	2646	4536	2474	4763	2458
51.40	4482	2396	4386	2404	4763	2610	4482	2574	4646	2557
51.45	4482	2411	4386	2451	4646	2646	4482	2490	4646	2557
51.50	4646	2427	4545	2551	4590	2628	4536	2557	4482	2523
51.55	4379	2352	4545	2577	4536	2610	4482	2540	4536	2523
51.60	4097	2268	4630	2604	4565	2628	4482	2610	4536	2557
51.65	4330	2396	4717	2660	4565	2557	4646	2610	4646	2574
51.70	4330	2442	4808	2688	4537	2557	4646	2592	4646	2574

Depth (m)	BH205		BH207		BH303		BH307		BH308	
	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)
51.75	4430	2458	4808	2688	4524	2523	4590	2540	4646	2540
51.80	4646	2458	4808	2688	4484	2523	4590	2628	4704	2574
51.85	4590	2490	4902	2717	4430	2540	4590	2540	4590	2507
51.90	4646	2490	4902	2688	4536	2474	4590	2628	4763	2523
51.95	4646	2702	5000	2717	4536	2507	4590	2574	4885	2557
52.00	4763	2557	4902	2604	4330	2427	4590	2592	4763	2474
52.05	4590	2557	4808	2632	4281	2411	4590	2557	4590	2507
52.10	4948	2557	4902	2577	4281	2396	4590	2523	4823	2523
52.15	4646	2442	5000	2660	4281	2442	4536	2628	4885	2490
52.20	4823	2592	4902	2604	4430	2442	4590	2474	5013	2557
52.25	4590	2646	4902	2632	4330	2523	4536	2574	4646	2523
52.30	4885	2702	4808	2551	4482	2490	4430	2557	4646	2523
52.35	4885	2683	4808	2577	4646	2507	4430	2507	4823	2427
52.40	4823	2646	4902	2525	4536	2557	4430	2411	4646	2574
52.45	4763	2557	4717	2525	4590	2540	4379	2442	4646	2490
52.50	4763	2507	4717	2475	4646	2574	4379	2474	4590	2474
52.55	4646	2628	4630	2475	4646	2646	4430	2411	4590	2474
52.60	4646	2574	4630	2451	4704	2557	4482	2490	4536	2411
52.65	4646	2427	4630	2525	4704	2646	4482	2523	4482	2458
52.70	4430	2490	4630	2525	4704	2610	4430	2442	4482	2474
52.75	4823	2458	4630	2525	4763	2628	4430	2523	4590	2507
52.80	4704	2474	4630	2500	4704	2664	4379	2557	4590	2490
52.85	4590	2442	4717	2475	4763	2574	4379	2557	4646	2523
52.90	4430	2411	4630	2525	4646	2664	4536	2507	4646	2507
52.95	4430	2381	4717	2475	4763	2592	4536	2557	4646	2523
53.00	4330	2352	4630	2551	4750	2628	4482	2592	4646	2540
53.05	4379	2337	4717	2525	4750	2664	4646	2574	4823	2507
53.10	4281	2323	4545	2500	4721	2646	4646	2592	4763	2540
53.15	4379	2366	4545	2525	4677	2610	4704	2628	4763	2610
53.20	4330	2309	4630	2525	4704	2574	4704	2592	4823	2628
53.25	4281	2442	4630	2551	4590	2628	4646	2592	4823	2664
53.30	4379	2411	4717	2577	4646	2574	4590	2610	4823	2610
53.35	4379	2458	4630	2577	4646	2610	4763	2592	4885	2592
53.40	4590	2507	4717	2604	4704	2592	4704	2702	4763	2610
53.45	4704	2628	4717	2604	4606	2557	4704	2557	4823	2683
53.50	4823	2557	4808	2660	4606	2646	4763	2664	4885	2610
53.55	4704	2646	4902	2747	4634	2523	4763	2592	4885	2702
53.60	4763	2396	5000	2778	4634	2574	4763	2628	4948	2557
53.65	4948	2507	5000	2778	4606	2646	4704	2646	4948	2540
53.70	4823	2474	4902	2778	4592	2557	4704	2557	5013	2683
53.75	4885	2592	5000	2717	4536	2574	4646	2664	4823	2628
53.80	4885	2574	5000	2747	4536	2557	4590	2523	4948	2427
53.85	4948	2507	5000	2717	4646	2574	4704	2646	4948	2610
53.90	4885	2458	5000	2717	4590	2592	4590	2702	4948	2646
53.95	4763	2442	4902	2688	4648	2557	4823	2683	4823	2721
54.00	4763	2411	4902	2717	4648	2646	4704	2610	5080	2592

Depth (m)	BH205		BH207		BH303		BH307		BH308	
	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)
54.05	4763	2557	4902	2660	4648	2592	4646	2646	4948	2646
54.10	4823	2442	4808	2660	4606	2628	4590	2592	4948	2610
54.15	4823	2523	4902	2688	4565	2557	4590	2474	4948	2610
54.20	4885	2474	5208	2717	4646	2592	4590	2610	4885	2683
54.25	4823	2442	5102	2809	4646	2574	4590	2557	4823	2507
54.30	4885	2490	5102	2688	4704	2628	4482	2523	4763	2574
54.35	4763	2592	5208	2717	4763	2702	4379	2507	4948	2540
54.40	4763	2474	5102	2660	4823	2683	4330	2352	4763	2523
54.45	4763	2507	5102	2660	4823	2702	4281	2474	4646	2540
54.50	4704	2442	5208	2660	4823	2702	4281	2490	4704	2474
54.55	4646	2474	5102	2604	4823	2683	4233	2309	4590	2442
54.60	4646	2458	4808	2475	4823	2664	4141	2427	4482	2427
54.65	4763	2557	4630	2475	4763	2664	4053	2281	4379	2411
54.70	4646	2523	4717	2427	4885	2721	4141	2352	4430	2396
54.75	4646	2474	4545	2427	4763	2683	4187	2337	4482	2396
54.80	4704	2540	4630	2404	4780	2664	4233	2396	4430	2411
54.85	4704	2474	4464	2358	4780	2702	4233	2366	4885	2474
54.90	4823	2540	4386	2358	4780	2664	4281	2474	4379	2427
54.95	4704	2664	4386	2336	4750	2646	4430	2458	4379	2396
55.00	4823	2610	4464	2427	4721	2683	4482	2540	4330	2458
55.05	4763	2574	4386	2358	4677	2702	4536	2540	4330	2474
55.10	4646	2574	4310	2427	4948	2610	4590	2592	4536	2507
55.15	4763	2507	4386	2404	4763	2741	4590	2574	4590	2540
55.20	4823	2646	4386	2500	4885	2646	4763	2664	4704	2610
55.25	4763	2628	4464	2500	4704	2646	4885	2664	4823	2721
55.30	4704	2592	4630	2604	4823	2683	4885	2664	4704	2702
55.35	4763	2610	4630	2604	4763	2610	4763	2664	4823	2683
55.40	4823	2523	4717	2660	4565	2646	4948	2683	4885	2702
55.45	4763	2702	4902	2717	4565	2628	5013	2610	4763	2702
55.50	4885	2474	5000	2747	4537	2490	4948	2721	4885	2761
55.55	4885	2507	5102	2809	4484	2574	4948	2702	4763	2702
55.60	4885	2411	5102	2778	4457	2592	4763	2610	4823	3024
55.65	4885	2490	5102	2809	4431	2458	4704	2664	4885	2646
55.70	4885	2664	5102	2747	4419	2574	4646	2592	4823	2781
55.75	4885	2474	5208	2809	4393	2366	4590	2574	5603	2646
55.80	4885	2574	5319	2841	4380	2458	4590	2557	4590	2523
55.85	4823	2523	5319	2841	4355	2396	4536	2490	4536	2523
55.90	4823	2490	5319	2778	4482	2427	4482	2507	4379	2557
55.95	4763	2490	5208	2747	4379	2396	4430	2557	4171	2592
56.00	4763	2442	5319	2747	4482	2411	4330	2490	4000	2490
56.05	4763	2702	5319	2688	4592	2411	4233	2366	4000	2411
56.10	4763	2474	5000	2604	4592	2574	4233	2427	4141	2442
56.15	4823	2557	4902	2525	4634	2540	4187	2396	4330	2396
56.20	4430	2646	4902	2551	4706	2646	4330	2352	3663	2381
56.25	4823	2574	4717	2427	4763	2610	4330	2458	4141	2337
56.30	4763	2411	4717	2451	4903	2646	4330	2381	4823	2381

Depth (m)	BH205		BH207		BH303		BH307		BH308	
	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)
56.35	4646	2610	4545	2404	4919	2664	4379	2442	4646	2366
56.40	4763	2411	4464	2315	4919	2646	4330	2490	4379	2490
56.45	4763	2474	4464	2381	4903	2721	4330	2396	4430	2490
56.50	4823	2507	4464	2451	4903	2646	4430	2523	4330	2490
56.55	4823	2427	4464	2315	4903	2741	4379	2442	5443	2507
56.60	4763	2646	4310	2451	5219	2664	4590	2540	4379	2458
56.65	4536	2442	4464	2427	4885	2761	4646	2592	4330	2427
56.70	4590	2442	4386	2451	5013	2702	4704	2574	4379	2523
56.75	4536	2427	4464	2500	4885	2721	4646	2592	4536	2610
56.80	4536	2411	4630	2500	4885	2702	4646	2574	4233	2557
56.85	4590	2427	4545	2632	4704	2646	4763	2507	4646	2523
56.90	4536	2427	4545	2551	4885	2741	4704	2646	4281	2540
56.95	4536	2442	4630	2660	4885	2610	4646	2523	4482	2592
57.00	4590	2427	4808	2717	4750	2646	4704	2610	4482	2610
57.05	4590	2474	5000	2809	4721	2592	4646	2610	4590	2646
57.10	4704	2458	5000	2874	4648	2574	4646	2592	4536	2646
57.15	4590	2523	5000	2874	4606	2540	4704	2540	4482	2646
57.20	4763	2557	5000	2809	4592	2523	4590	2610	4590	2474
57.25	4823	2523	5000	2841	4430	2474	4536	2490	4704	2610
57.30	4885	2474	5319	2941	4330	2366	4482	2523	4536	2646
57.35	4948	2507	5435	2809	4330	2490	4536	2646	4233	2490
57.40	4885	2664	5208	2688	4379	2540	4536	2507	4430	2557
57.45	4948	2507	5208	2747	4379	2442	4536	2540	4763	2507
57.50	5013	2574	5208	2747	4430	2427	4430	2474	4590	2490
57.55	4948	2801	5000	2688	4330	2474	4379	2411	4430	2490
57.60	5013	2610	5102	2660	4430	2442	4482	2490	4536	2474
57.65	4885	2557	5102	2551	4536	2557	4379	2411	4704	2523
57.70	4948	2646	5000	2604	4590	2458	4430	2490	4646	2458
57.75	5149	2646	4808	2525	4592	2557	4379	2474	4482	2490
57.80	4885	2646	4808	2500	4677	2523	4430	2507	4646	2507
57.85	4885	2540	4630	2451	4721	2592	4536	2540	4536	2557
57.90	4948	2592	4630	2381	4721	2610	4482	2523	4379	2474
57.95	4948	2557	4545	2315	4823	2557	4482	2540	4482	2610
58.00	4885	2557	4464	2381	4948	2592	4482	2474	4281	2490
58.05	4823	2557	4464	2451	4763	2702	4482	2523	4536	2523
58.10	4823	2523	4464	2475	4903	2592	4590	2557	4482	2592
58.15	4704	2490	4464	2475	4903	2646	4590	2592	4590	2646
58.20	4704	2523	4545	2475	4951	2721	4704	2610	4763	2664
58.25	4536	2540	4545	2551	5013	2683	4704	2523	5013	2702
58.30	4482	2442	4630	2577	4823	2702	4763	2610	4948	2702
58.35	4536	2458	4630	2604	4763	2683	4536	2574	5013	2664
58.40	4763	2474	4808	2660	4823	2683	4704	2610	4948	2610
58.45	4536	2490	4808	2660	4885	2628	4646	2592	5080	2592
58.50	4536	2523	4808	2717	4885	2683	4704	2557	4885	2761
58.55	4482	2474	4902	2778	4704	2574	4646	2610	4823	2721
58.60	4590	2574	4902	2747	4536	2610	4704	2628	4948	2574

Depth (m)	BH205		BH207		BH303		BH307		BH308	
	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)
58.65	4536	2474	4902	2778	4646	2523	4885	2610	4885	2646
58.70	4536	2411	5000	2747	4536	2574	4704	2628	4823	2741
58.75	4646	2592	5000	2747	4646	2557	4704	2610	4823	2628
58.80	4704	2442	5102	2809	4430	2474	4646	2592	4763	2592
58.85	4763	2646	5102	2778	4430	2540	4646	2574	4704	2646
58.90	4948	2507	5102	2688	4430	2523	4646	2610	4763	2523
58.95	4823	2490	4902	2688	4536	2474	4590	2574	4646	2610
59.00	4823	2540	5102	2660	4330	2442	4590	2610	4430	2592
59.05	4763	2474	5000	2688	4430	2442	4590	2592	4704	2574
59.10	4948	2540	4902	2688	4536	2523	4646	2574	4590	2628
59.15	5080	2540	4902	2660	4536	2523	4590	2523	4536	2574
59.20	4823	2523	4902	2688	4430	2474	4590	2610	4948	2557
59.25	4948	2592	4808	2604	4646	2610	4536	2557	4704	2610
59.30	4885	2646	4902	2660	4590	2610	4482	2490	4646	2628
59.35	4885	2490	5000	2632	4704	2610	4536	2557	4536	2592
59.40	4885	2574	4808	2551	4763	2610	4482	2523	4590	2523
59.45	4885	2683	4717	2604	4823	2646	4482	2507	4482	2557
59.50	4948	2702	4717	2577	4885	2610	4482	2490	4536	2442
59.55	4823	2507	4630	2525	4704	2721	4482	2523	4646	2474
59.60	4763	2523	4630	2475	4948	2628	4482	2507	4885	2646
59.65	4704	2523	4630	2475	4885	2683	4482	2557	4536	2474
59.70	4646	2474	4630	2551	4872	2741	4590	2610	4704	2442
59.75	4763	2540	4545	2500	4872	2523	4646	2523	4590	2507
59.80	4536	2610	4464	2427	4872	2761			4590	2557
59.85	4590	2610	4630	2525	4903	2721			4482	2523
59.90	4590	2557	4630	2500	4919	2628			4482	2574
59.95	4646	2557	4630	2525	4919	2761			4646	2557
60.00	4704	2702	4717	2551	5013	2592			4704	2574
60.05	4763	2557	4717	2525	4763	2628			4646	2540
60.10	4733	2574	4717	2525	4885	2721			4482	2523
60.15	4733	2523	4717	2475	4763	2610			4536	2523
60.20	4823	2540	4902	2451	4885	2592			4482	2523
60.25	4823	2610	4808	2525	4704	2628			4536	2557
60.30	4885	2490	4717	2525	4763	2646			4590	2540
60.35	4763	2540	4717	2500	4379	2557			4536	2628
60.40	4885	2540	4717	2525	4646	2574			4646	2610
60.45	4948	2523	4808	2525	4524	2592			4482	2557
60.50	4948	2702	4717	2604	4524	2523			4763	2540
60.55	4823	2574	4630	2577					4646	2610
60.60	4763	2592	4717	2577					4704	2474
60.65	4704	2442	4717	2551					4763	2610
60.70	4885	2507	4717	2577					4885	2664
60.75	4948	2490	4902	2604					4948	2628
60.80	4763	2474	4808	2604					4948	2540
60.85	4885	2557	4902	2577					4763	2523
60.90	4885	2523	4808	2604					4646	2474

Depth (m)	BH205		BH207		BH303		BH307		BH308	
	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)
60.95	4704	2507	4902	2632					4823	2628
61.00	4763	2474	4902	2577					4763	2761
61.05	4823	2557	4902	2688					4948	2592
61.10	4823	2540	4902	2660					4885	2507
61.15	4823	2592	5000	2660					5366	2557
61.20	4885	2574	4902	2660					4763	2507
61.25	4885	2540	4902	2604					4763	2628
61.30	4885	2540	4902	2604					4763	2702
61.35	4885	2427	4808	2551					4948	2592
61.40	4885	2540	4902	2577					5366	2592
61.45	4763	2458	4808	2551					5080	2592
61.50	4704	2592	4630	2525					5366	2592
61.55	4763	2540	4630	2500					5013	2557
61.60	4763	2442	4717	2525					4823	2557
61.65	4763	2523	4717	2525					4763	2458
61.70	4704	2458	4808	2551					4704	2574
61.75	4863	2490	4808	2577					4763	2574
61.80	4931	2540	4808	2551					5013	2507
61.85	4863	2490	4808	2577					4823	2592
61.90	4733	2490	4808	2604					4885	2540
61.95	4671	2490	4902	2604					4590	2592
62.00	4733	2490	4902	2566					4823	2507
62.05	4931	2557	4717	2536					4823	2523
62.10	5000	2610	4808	2518					4823	2442
62.15	4931	2523	4902	2506					4704	2646
62.20	4863	2592	4902	2500					4885	2628
62.25	4610	2442	4717	2488					4885	2574
62.30	4610	2474	4630	2500					4646	2574
62.35	4610	2664	4630	2488					4763	2523
62.40	4931	2474	4808	2471					4763	2557
62.45	4948	2557	4902	2471					4646	2540
62.50	4885	2507	4808	2471					5080	2557
62.55	4823	2557	4717	2483					4646	2507
62.60	4885	2540	4717	2488					4885	2610
62.65	4646	2490	4902	2483					4704	2683
62.70	5149	2574	4902	2483					4885	2411
62.75	4885	2474	4808	2488					4590	2337
62.80	4948	2557	4630	2488					4646	2366
62.85	4885	2592	4717	2488					4482	2574
62.90	4885	2592	4902	2488					4482	2540
62.95	4948	2574	4902	2488					4536	2557
63.00	4823	2540	4902	2488					4482	2523
63.05	4885	2540	4630	2488					4330	2574
63.10	4704	2474	5000	2488					4281	2507
63.15	4763	2523	4808	2488					4233	2523
63.20	4763	2523	4545	2488					4763	2396

Depth (m)	BH205		BH207		BH303		BH307		BH308	
	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)
63.25	4763	2628	4808	2488					4141	2474
63.30	4763	2442	4808	2483					4536	2474
63.35	4704	2490	4717	2483					4646	2540
63.40	4885	2507	4808	2483					4646	2474
63.45	4763	2490	4808	2483					4536	2458
63.50	4704	2458	4630	2551					4590	2683
63.55	4704	2458	4902	2525					4646	2474
63.60	4948	2507	5000	2577					4536	2458
63.65	4823	2474	4902	2451					4646	2523
63.70	4763	2474	4630	2427					4536	2458
63.75	4948	2458	4545	2451					4187	2490
63.80	4704	2507	4464	2336					4097	2540
63.85	4948	2507	4386	2404					4379	2540
63.90	4763	2507	4386	2336					4885	2592
63.95	4885	2574	4310	2427					4187	2490
64.00	4823	2557	4464	2336					4482	2610
64.05	4763	2507	4464	2525					5149	2523
64.10	4823	2557	4630	2475					4281	2557
64.15	4823	2490	4717	2551					4396	2366
64.20	4763	2540	4808	2525					4171	2458
64.25	4763	2507	4902	2660					4101	2474
64.30	4704	2523	5000	2577					4101	2507
64.35	4763	2540	4902	2432					4233	2523
64.40	4590	2490	4902	2443					4233	2490
64.45	4763	2540	4808	2460					4281	2474
64.50	4763	2474	4808	2460					4536	2411
64.55	4763	2507	4717	2471					3888	2268
64.60	4704	2458	4808	2460					4187	2309
64.65	4763	2540	4717	2454					3663	2396
64.70	4763	2523	4717	2443					4330	2352
64.75	4763	2523	4717	2426					4097	2366
64.80	4646	2574	4717	2426					4379	2366
64.85	4823	2490	4717	2410					4281	2396
64.90	4763	2507	4902	2383					4141	2592
64.95	4823	2474	4808	2373					4330	2721
65.00	4885	2523	4545	2367					4281	2474
65.05	4885	2610	4464	2357					4482	2592
65.10	5013	2628	4386	2357					4482	2427
65.15	4885	2592	4386	2346					4646	2592
65.20	4885	2574	4310	2346					4763	2702
65.25	4763	2646	4310	2301					4646	2646
65.30	4590	2474	4167	2326					4590	2628
65.35	4646	2557	4237	2326					4646	2741
65.40	4763	2628	4386	2475					4590	2574
65.45	4763	2490	4630	2475					4482	2442
65.50	4704	2490	4545	2577					4379	2540

Depth (m)	BH205		BH207		BH303		BH307		BH308	
	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)
65.55	4763	2507	4717	2525					4281	2458
65.60	4646	2490	4902	2660					4281	2366
65.65	4590	2411	4902	2552					4379	2411
65.70	4536	2490	4808	2528					4482	2474
65.75	4646	2442	5208	2505					4281	2781
65.80	4482	2411	4902	2470					4430	2610
65.85	4763	2507	4630	2475					4482	2458
65.90	4646	2442	4717	2525					4646	2574
65.95	4646	2490	4630	2315					4536	2702
66.00	4590	2396	4545	2525					4885	2490
66.05	4823	2507	4545	2551					5219	2822
66.10	4646	2523	4545	2551					4885	2683
66.15	4823	2557	4464	2525					4704	2646
66.20	4763	2592	4545	2551					4823	2702
66.25	4885	2574	4717	2604					4948	2646
66.30	4823	2741	4808	2577					4823	2523
66.35	4823	2664	4808	2660					4948	2490
66.40	4763	2610	4902	2577					4763	2523
66.45	4763	2781	4717	2604					4763	2646
66.50	4590	2592	4902	2475					4379	2381
66.55	4590	2592	5000	2660					4482	2574
66.60	4646	2628	5000	2778					4379	2574
66.65	4536	2592	5000	2747					4646	2610
66.70	4590	2610	5000	2717					4536	2523
66.75	4823	2610	4808	2604					4281	2507
66.80	4590	2646	4717	2660					4536	2592
66.85	4590	2458	5000	2604					4379	2458
66.90	4482	2396	4630	2505					4233	2337
66.95	4482	2396	4464	2493					4379	2490
67.00	4330	2442	4237	2459					3928	2452
67.05	4379	2381	4386	2404					4097	2503
67.10	4379	2507	4237	2415					4141	2503
67.15	4704	2574							4281	2313
67.20	4590	2523							4097	2313
67.25	4536	2507							4233	2280
67.30	4482	2442							3735	2249
67.35	4379	2557							3969	2239
67.40	4646	2702								
67.45	4763	2474								
67.50	4885	2628								
67.55	4885	2702								
67.60	4823	2540								
67.65	4590	2721								
67.70	4646	2664								
67.75	4646	2646								
67.80	4590	2702								

Depth (m)	BH205		BH207		BH303		BH307		BH308	
	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)	Compression Wave Velocity (m/s)	Shear Wave Velocity (m/s)
67.85	4763	2442								
67.90	4704	2664								
67.95	4646	2628								
68.00	4763	2683								
68.05	4646	2702								
68.10	4763	2664								
68.15	4885	2664								
68.20	4763	2664								
68.25	4885	2702								
68.30	4763	2610								
68.35	4704	2702								
68.40	4763	2523								
68.45	4885	2702								
68.50	4885	2721								
68.55	4885	2507								
68.60	4763	2523								
68.65	4590	2683								
68.70	4704	2702								
68.75	4704	2628								
68.80	4590	2490								
68.85	4646	2523								
68.90	4482	2458								
68.95	4590	2366								

APPENDIX B

Soil Photographs (SPT)

SPT Sampling Photographs

Borehole BH23, Samples SA1 to SA6

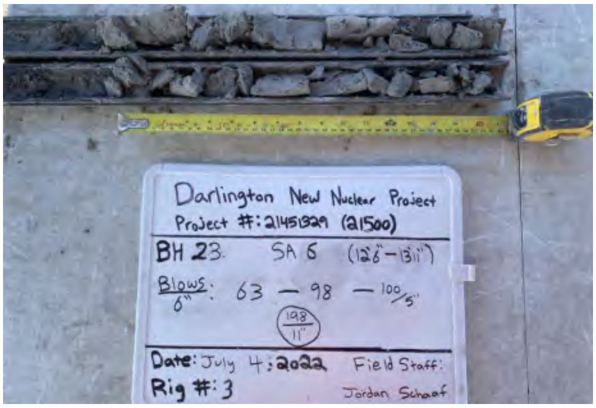
Darlington New Nuclear Project
Project #: 21451329 (21500)
BH 23 SA 1 (0'–2')
Blows/6": 30 — 32 — 21 - 9
(53)
Date: June 30, 2022 Field Staff:
Rig #: 3 Jordan Schaaf

Darlington New Nuclear Project
Project #: 21451329 (21500)
BH 23 SA 2 (2'6"–4')
Blows/6": 12 — 8 — 7
(15)
Date: June 30, 2022 Field Staff:

Darlington New Nuclear Project
Project #: 21451329 (21500)
BH 23 SA 3 (5'–6'6")
Blows/6": 19 — 32 — 29
(61)
Date: June 30, 2022 Field Staff:
Rig #: 3 Jordan Schaaf

Darlington New Nuclear Project
Project #: 21451329 (21500)
BH 23 SA 4 (7'6"–9')
Blows/6": 34 — 61 — 89
(150)
Date: June 30, 2022 Field Staff:
Rig #: 3 Jordan Schaaf

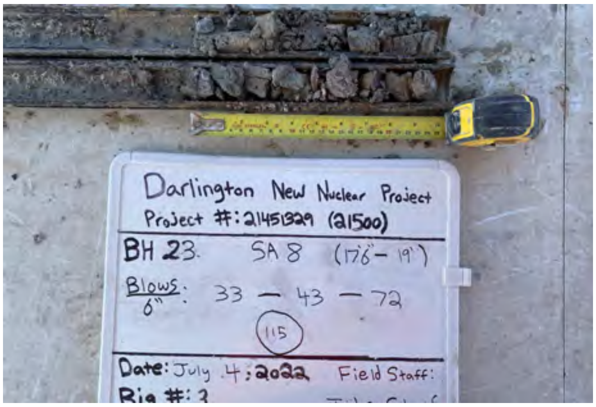
Darlington New Nuclear Project
Project #: 21451329 (21500)
BH 23 SA 5 (10'–11'5")
Blows/6": 41 — 84 — 100/5"
(184/11")
Date: June 30, 2022 Field Staff:
Rig #: 3 Jordan Schaaf



Darlington New Nuclear Project
Project #: 21451329 (21500)
BH 23 SA 6 (12'6"–13'11")
Blows/6": 63 — 98 — 100/5"
(198/11")
Date: July 4, 2022 Field Staff:
Rig #: 3 Jordan Schaaf

SPT Sampling Photographs

Borehole BH23, Samples SA7 to SA12



Date: October 2022
Project: 21451329

Prepared By: KL
Checked By: RV

SPT Sampling Photographs

Borehole BH23, Samples SA13 to SA18

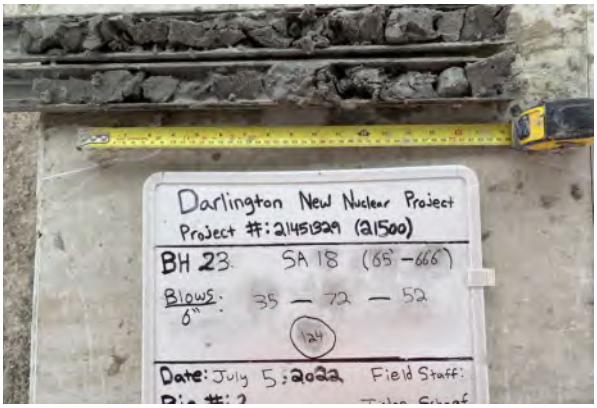
Darlington New Nuclear Project
Project #: 21451329 (21500)
BH 23 SA 13 (40' – 40'5")
Blows/6": 100/5" — —
100/5"
Date: July 4: 2022 Field Staff:

Darlington New Nuclear Project
Project #: 21451329 (21500)
BH 23 SA 14 (45' – 45'9")
Blows/6": 63 — 100/3" —
100/3"
Date: July 4: 2022 Field Staff:

Darlington New Nuclear Project
Project #: 21451329 (21500)
BH 23 SA 15 (50' – 50'11.5")
Blows/6": 58 — 100/5.5" —
100/5.5"
Date: July 4: 2022 Field Staff:
Rig #: 3 Jordan Schaaf

Darlington New Nuclear Project
Project #: 21451329 (21500)
BH 23 SA 16 (55' – 56'5")
Blows/6": 72 — 84 — 100/5"
184/11"
Date: July 5: 2022 Field Staff:
Rig #: 3 Jordan Schaaf

Darlington New Nuclear Project
Project #: 21451329 (21500)
BH 23 SA 17 (60' – 60'11")
Blows/6": 48 — 100/5" —
100/5"
Date: July 5: 2022 Field Staff:



Darlington New Nuclear Project
Project #: 21451329 (21500)
BH 23 SA 18 (65' – 66'6")
Blows/6": 35 — 72 — 52
124
Date: July 5: 2022 Field Staff:

Date: October 2022
Project: 21451329

Prepared By: KL
Checked By: RV

SPT Sampling Photographs

Borehole BH23, Samples SA19 to SA20

Date: October 2022

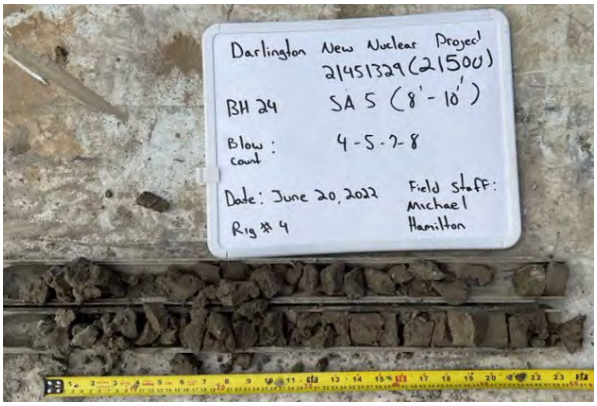
Project: 21451329

Prepared By: KL

Checked By: RV

SPT Sampling Photographs

Borehole BH24, Samples SA1 to SA6

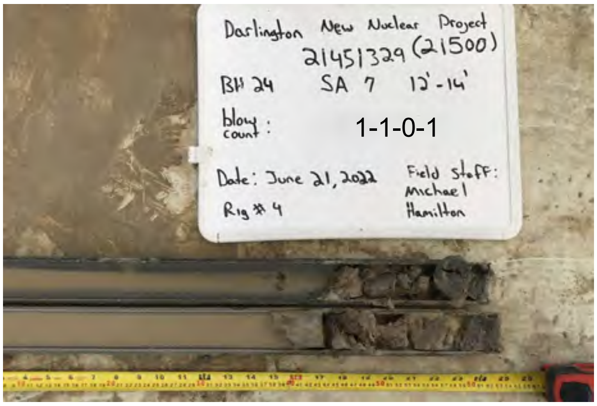


Date: October 2022
Project: 21451329

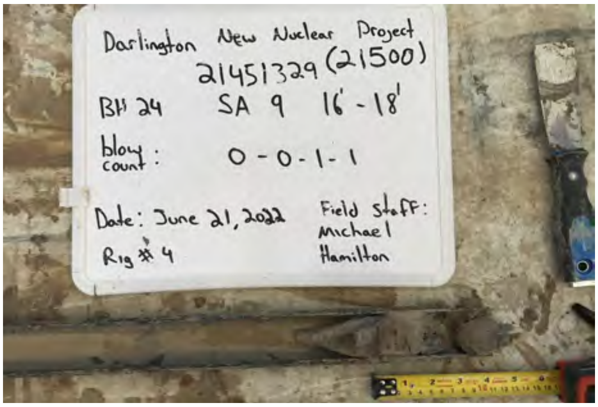
Prepared By: KL
Checked By: RV

SPT Sampling Photographs

Borehole BH24, Samples SA7 to SA13

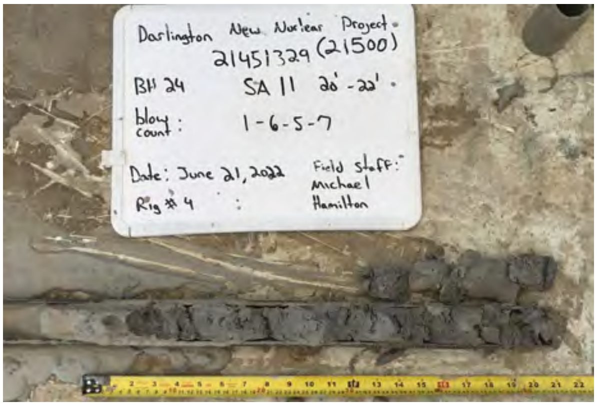


Darlington New Nuclear Project
21451329 (21500)
BH 24 SA 7 12'-14'
blow count: 1-1-0-1
Date: June 21, 2022
Rig # 4
Field staff: Michael Hamilton

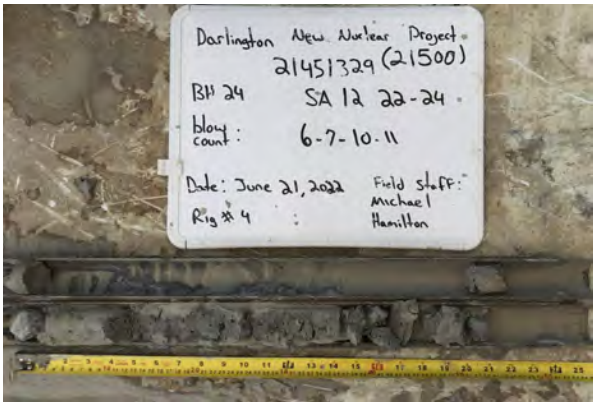


Darlington New Nuclear Project
21451329 (21500)
BH 24 SA 9 16'-18'
blow count: 0-0-1-1
Date: June 21, 2022
Rig # 4
Field staff: Michael Hamilton

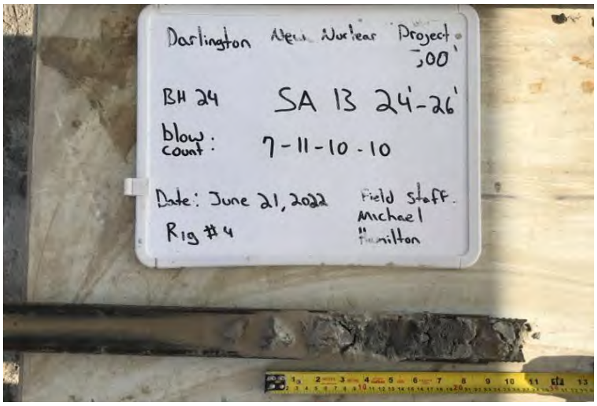
Darlington New Nuclear Project
21451329 (21500)
BH 24 SA 10 18'-20'
blow count: 2-1-2-1
Date: June 21, 2022
Rig # 4
Field staff: Michael Hamilton



Darlington New Nuclear Project
21451329 (21500)
BH 24 SA 11 20'-22'
blow count: 1-6-5-7
Date: June 21, 2022
Rig # 4
Field staff: Michael Hamilton



Darlington New Nuclear Project
21451329 (21500)
BH 24 SA 12 22-24
blow count: 6-7-10-11
Date: June 21, 2022
Rig # 4
Field staff: Michael Hamilton



Darlington New Nuclear Project
500)
BH 24 SA 13 24'-26'
blow count: 7-11-10-10
Date: June 21, 2022
Rig # 4
Field staff: Michael Hamilton

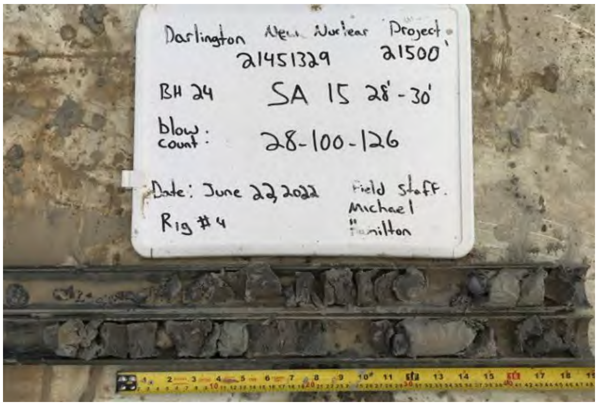
Note: SA8 is a Vane sample therefore no photo is available

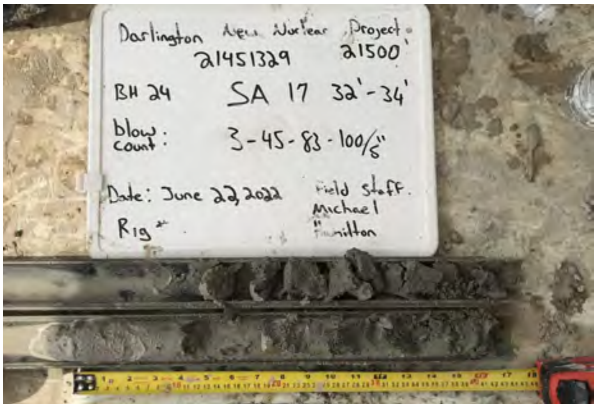
Date: October 2022
Project: 21451329

Prepared By: KL
Checked By: RV

SPT Sampling Photographs

Borehole BH24, Samples SA14 to SA19





SPT Sampling Photographs

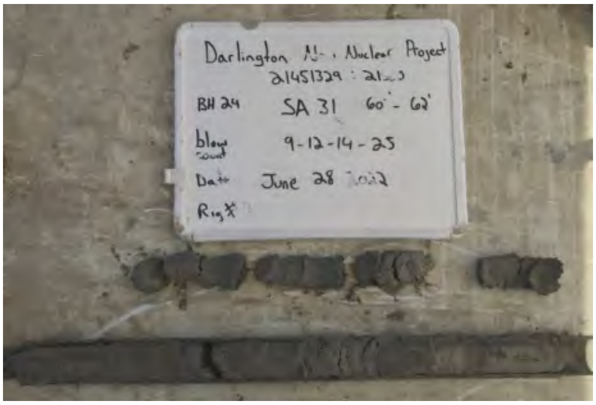
Borehole BH24, Samples SA20 to SA25

Date: October 2022
Project: 21451329

Prepared By: KL
Checked By: RV

SPT Sampling Photographs

Borehole BH24, Samples SA26 to SA33



Note: SA30 and SA32 are Pitcher Barrel samples therefore no photo is available

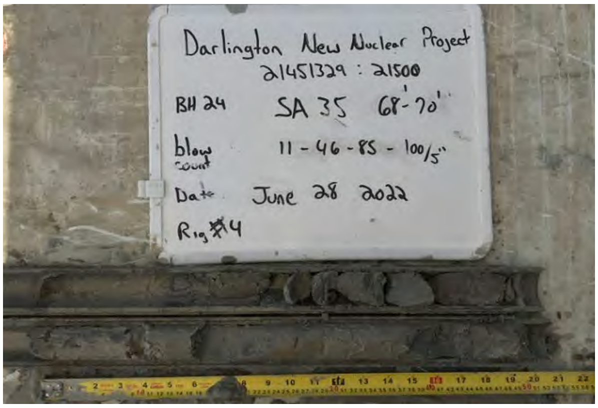
Date: October 2022
Project: 21451329

Prepared By: KL
Checked By: RV

SPT Sampling Photographs

Borehole BH24, Samples SA34 to SA39

SA34 Photo Damaged



SPT Sampling Photographs

Borehole BH24, Samples SA40 to SA41

SPT Sampling Photographs

Borehole BH25, Samples SA1 to SA6

Date: October 2022
Project: 21451329

wsp GOLDER

Prepared By: KL
Checked By: RV

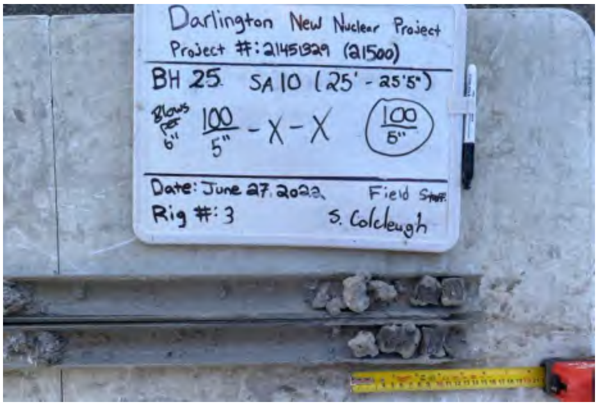
SPT Sampling Photographs

Borehole BH25, Samples SA7 to SA12

Darlington New Nuclear Project
Project #: 21451329 (21500)
BH 25 SA7 (15'6"-17')
3-2-13
Date: June 24, 2022 Field Staff
Rig #: 3 Reza V.

Darlington New Nuclear Project
Project #: 21451329 (21500)
BH 25 SA8 (17'6"-19')
3-4-11
Date: June 24, 2022 Field Staff
Rig #: 3 Reza V.

Darlington New Nuclear Project
Project #: 21451329 (21500)
BH 25 SA9 (20'-21'6")
21-19-38
Date: June 24, 2022 Field Staff
Rig #: 3 Reza V.



Darlington New Nuclear Project
Project #: 21451329 (21500)
BH 25 SA 10 (25'-25'5")
Blows per 6" 100/5" - X - X 100/5"
Date: June 27, 2022 Field Staff
Rig #: 3 S. Colcleugh

Darlington New Nuclear Project
Project #: 21451329 (21500)
BH 25 SA11 (30'-30'10")
Blows per 6" 69 - 100/4" - X 100/4"
Date: June 27, 2022 Field Staff
Rig #: 3 S. Colcleugh

Darlington New Nuclear Project
Project #: 21451329 (21500)
BH 25 SA12 (35'-35'11")
Blows per 6" 65 - 100/5" - X 100/5"
Date: June 27, 2022 Field Staff
Rig #: 3 S. Colcleugh

SPT Sampling Photographs

Borehole BH25, Samples SA13 to SA18

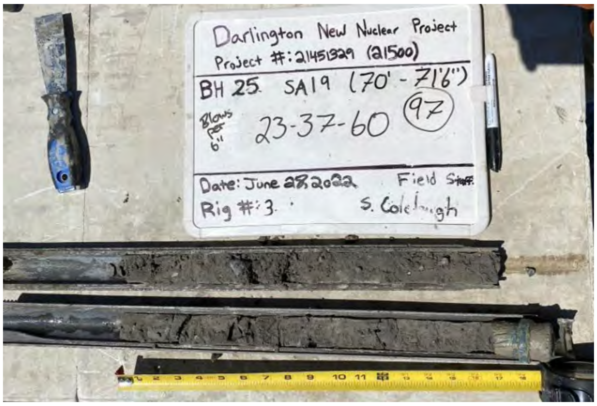
Date: October 2022
Project: 21451329

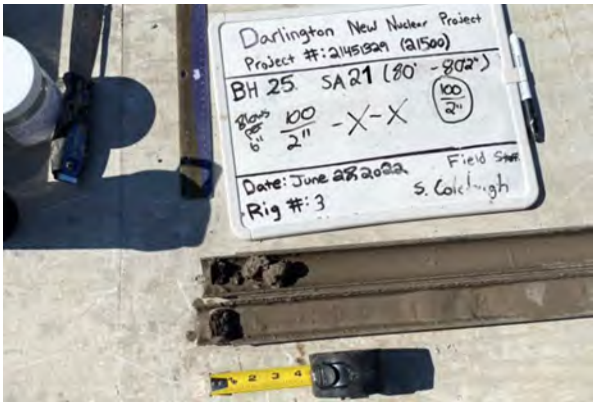
wsp GOLDER

Prepared By: KL
Checked By: RV

SPT Sampling Photographs

Borehole BH25, Samples SA19 to SA21



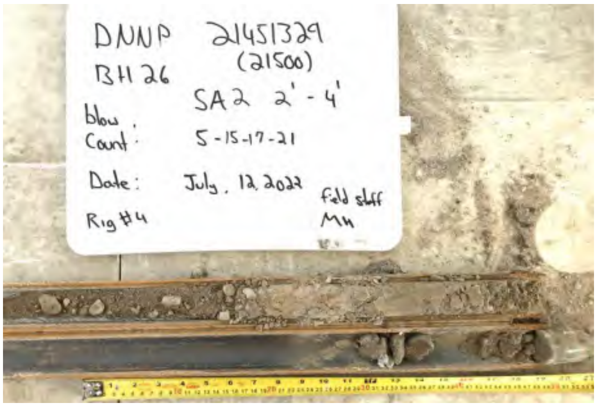


Date: October 2022
Project: 21451329

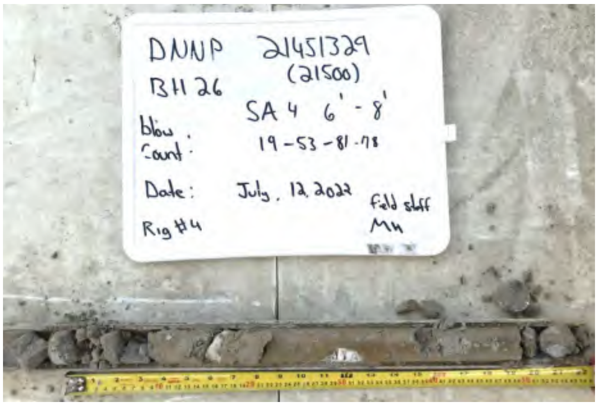
Prepared By: KL
Checked By: RV

SPT Sampling Photographs

Borehole BH26, Samples SA1 to SA6



SA3 Photo Damaged

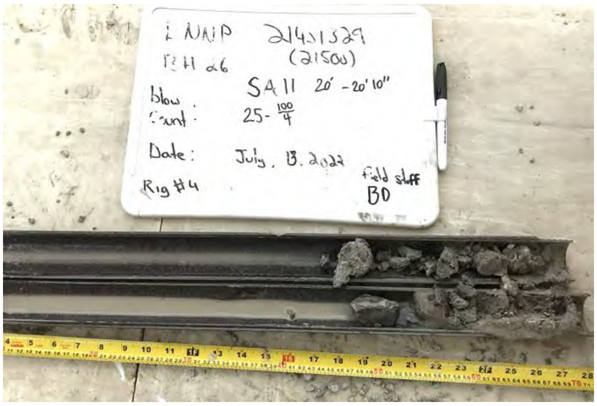


Date: October 2022
Project: 21451329

Prepared By: KL
Checked By: RV

SPT Sampling Photographs

Borehole BH26, Samples SA7 to SA12



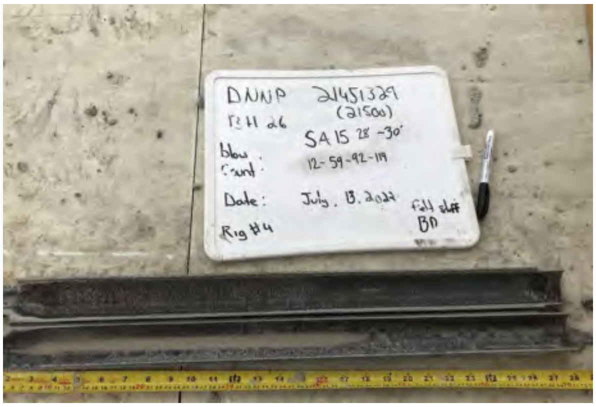
Date: October 2022
Project: 21451329

wsp GOLDER

Prepared By: KL
Checked By: RV

SPT Sampling Photographs

Borehole BH26, Samples SA13 to SA18



SA18 No Recovery

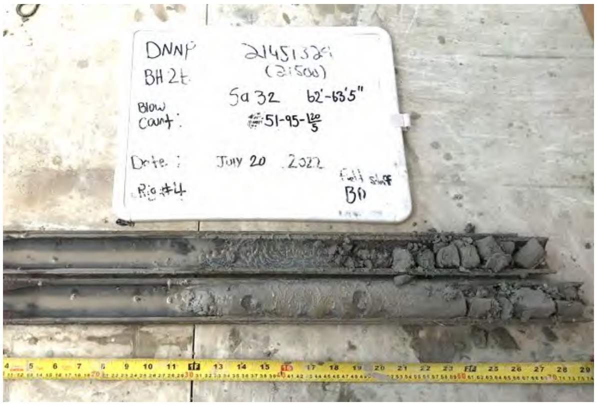
SPT Sampling Photographs

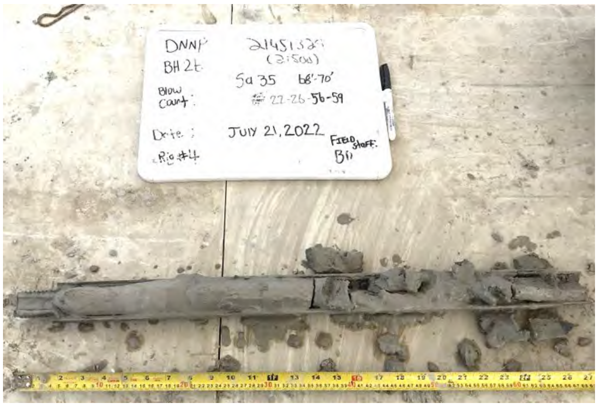
Borehole BH26, Samples SA19 to SA31

Note: SA23, SA24, SA25, SA27, SA28, SA29 and SA31 are Shelby Tube samples therefore no photo is available

SPT Sampling Photographs

Borehole BH26, Samples SA32 to SA37





SPT Sampling Photographs

Borehole BH26, Samples SA38

Date: October 2022

Project: 21451329

Prepared By: KL

Checked By: RV

SPT Sampling Photographs

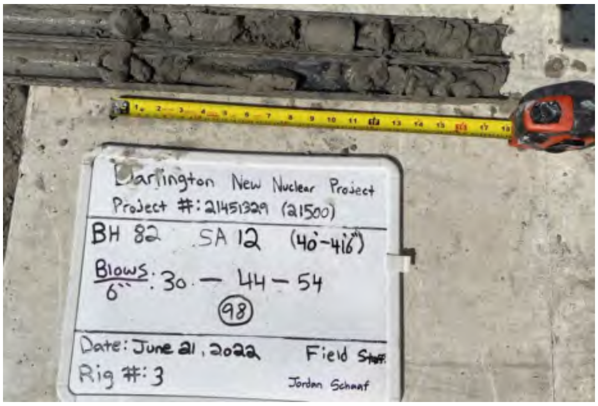
Borehole BH82, Samples SA1 to SA6

Date: October 2022
Project: 21451329

Prepared By: KL
Checked By: RV

SPT Sampling Photographs

Borehole BH82, Samples SA7 to SA13



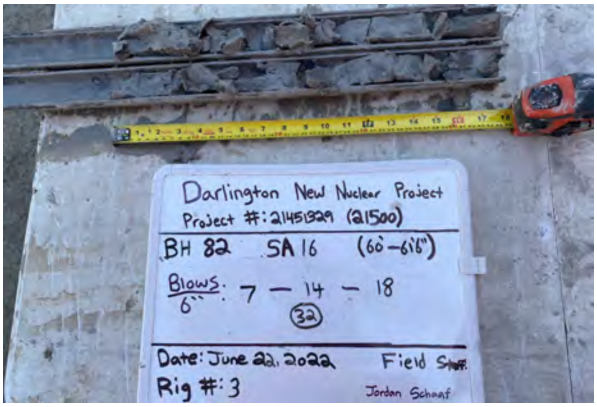
Note: SA7 is a Shelby Tube sample therefore no photo is available

SPT Sampling Photographs

Borehole BH82, Samples SA14 to SA19

Darlington New Nuclear Project
Project #: 21451329 (21500)
BH 82 SA 14 (50'–51'4.5")
$\frac{\text{Blows}}{6''}$: 40 — 81 — $\frac{100}{4.5''}$
$\frac{181}{10.5''}$
Date: June 22, 2022 Field Staff
Rig #: 3 Jordan Schaaf

Darlington New Nuclear Project
Project #: 21451329 (21500)
BH 82 SA 15 (55'–56'6")
$\frac{\text{Blows}}{6''}$: 22 — 41 — 33
74
Date: June 22, 2022 Field Staff
Rig #: 3 Jordan Schaaf



Darlington New Nuclear Project
Project #: 21451329 (21500)
BH 82 SA 16 (60'–61'6")
$\frac{\text{Blows}}{6''}$: 7 — 14 — 18
32
Date: June 22, 2022 Field Staff
Rig #: 3 Jordan Schaaf

Darlington New Nuclear Project
Project #: 21451329 (21500)
BH 82 SA 17 (65'–66'6")
$\frac{\text{Blows}}{6''}$: 9 — 14 — 20
34
Date: June 22, 2022 Field Staff
Rig #: 3 Jordan Schaaf

Darlington New Nuclear Project
Project #: 21451329 (21500)
BH 82 SA 18 (70'–71'6")
$\frac{\text{Blows}}{6''}$: 29 — 52 — 65
117
Date: June 22, 2022 Field Staff
Rig #: 3 Jordan Schaaf

Darlington New Nuclear Project
Project #: 21451329 (21500)
BH 82 SA 19 (75'–76'6")
$\frac{\text{Blows}}{6''}$: 14 — 23 — 34
57
Date: June 22, 2022 Field Staff
Rig #: 3 Jordan Schaaf

Date: October 2022
Project: 21451329

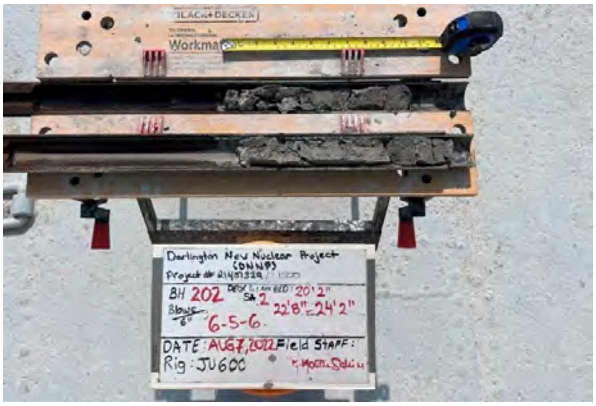
Prepared By: KL
Checked By: RV

SPT Sampling Photographs

Borehole BH82, Samples SA20 to SA21

SPT Sampling Photographs

Borehole BH202, Samples SA1 to SA6



SPT Sampling Photographs

Borehole BH202, Samples SA7 to SA12

Date: October 2022
Project: 21451329

Prepared By: KL
Checked By: RV

SPT Sampling Photographs

Borehole BH202, Samples SA13 to SA18

Date: October 2022

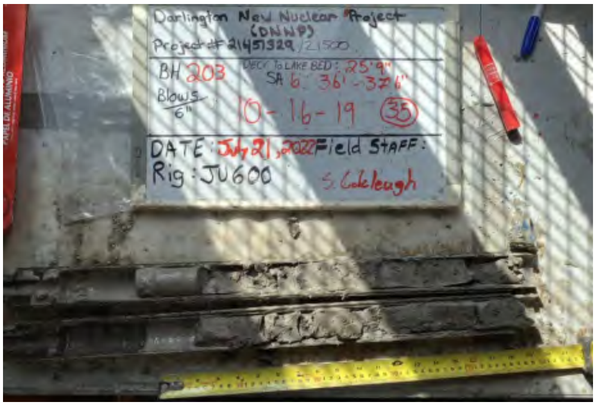
Project: 21451329

Prepared By: KL

Checked By: RV

SPT Sampling Photographs

Borehole BH203, Samples SA1 to SA6



Date: October 2022
Project: 21451329

Prepared By: KL
Checked By: RV

SPT Sampling Photographs

Borehole BH203, Samples SA7 to SA12

SA12 Photo Damaged

SPT Sampling Photographs

Borehole BH203, Samples SA13 to SA14

Date: October 2022

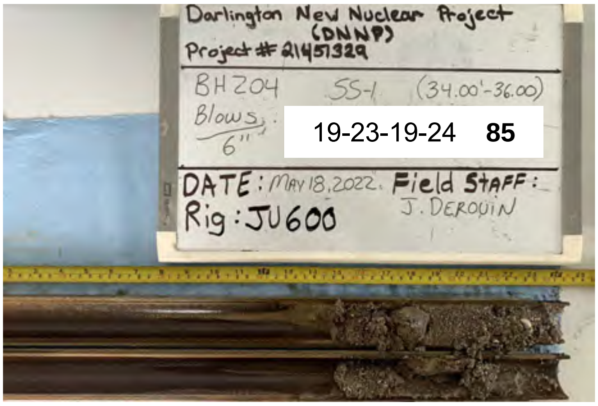
Project: 21451329

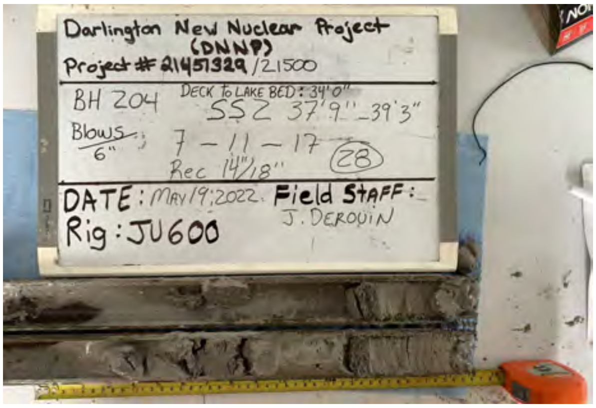
Prepared By: KL

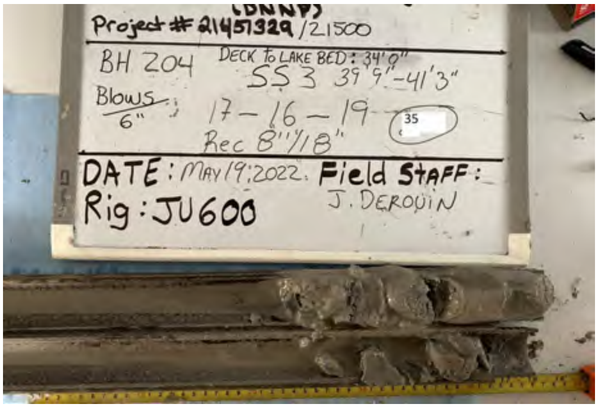
Checked By: RV

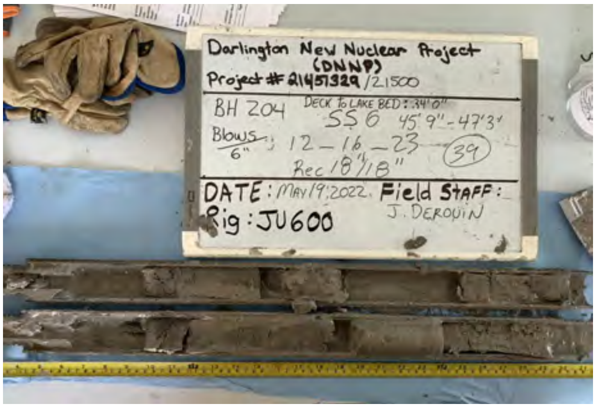
SPT Sampling Photographs

Borehole BH204, Samples SA1 to SA6



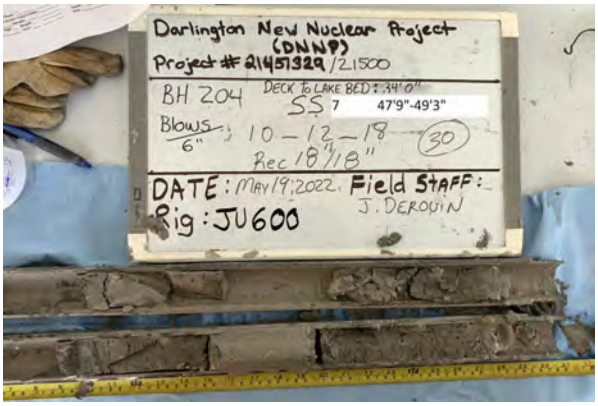


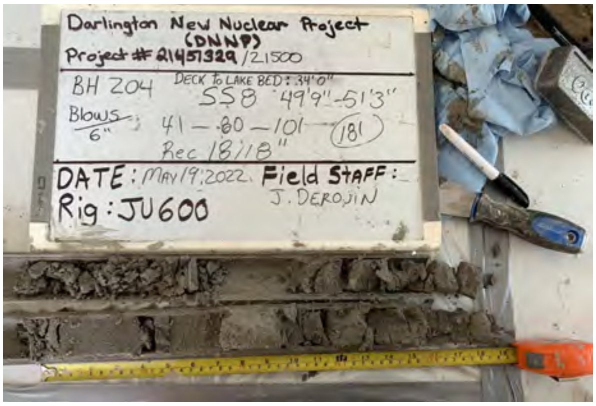




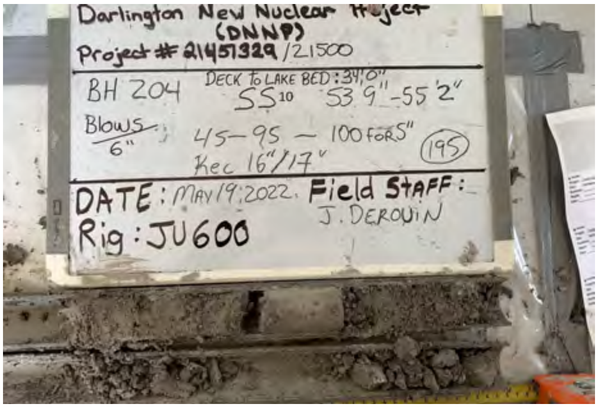
SPT Sampling Photographs

Borehole BH204, Samples SA7 to SA11





SA09 Photo Damaged

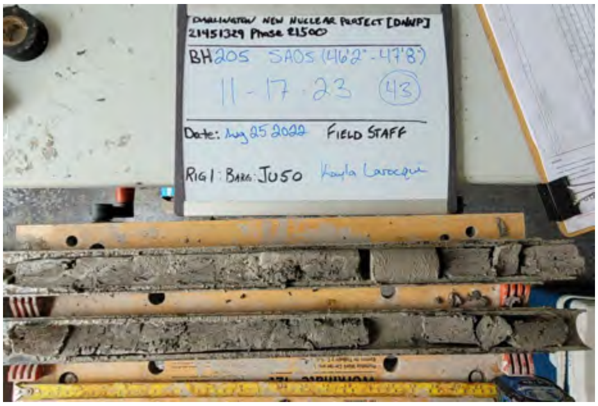


Date: October 2022
Project: 21451329

Prepared By: KL
Checked By: RV

SPT Sampling Photographs

Borehole BH205, Samples SA1 to SA6



SPT Sampling Photographs

Borehole BH205, Samples SA7 to SA9

Date: October 2022
Project: 21451329

Prepared By: KL
Checked By: RV

SPT Sampling Photographs

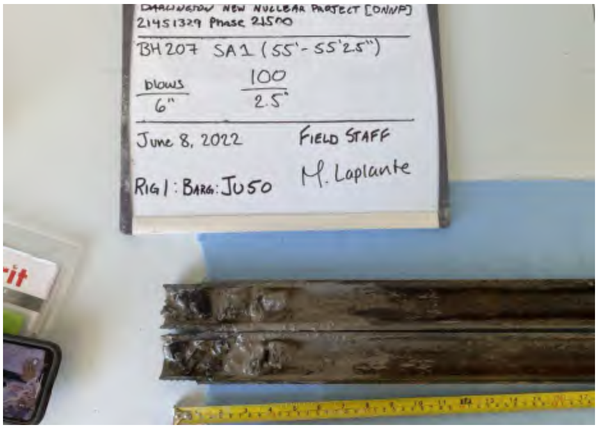
Borehole BH206, Samples SA1 to SA4

Date: October 2022
Project: 21451329

Prepared By: KL
Checked By: RV

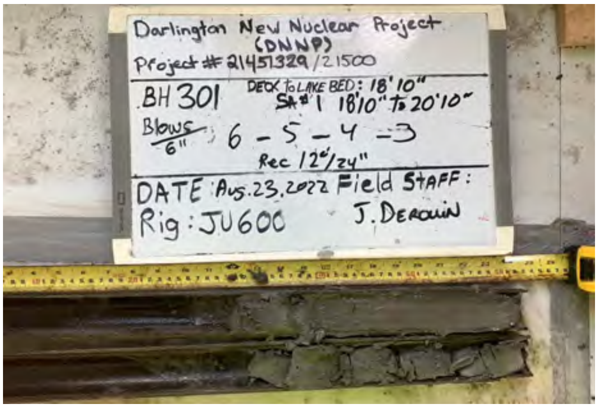
SPT Sampling Photographs

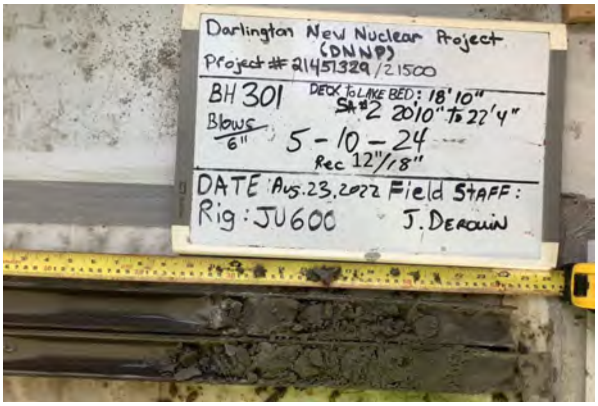
Borehole BH207, Sample SA1

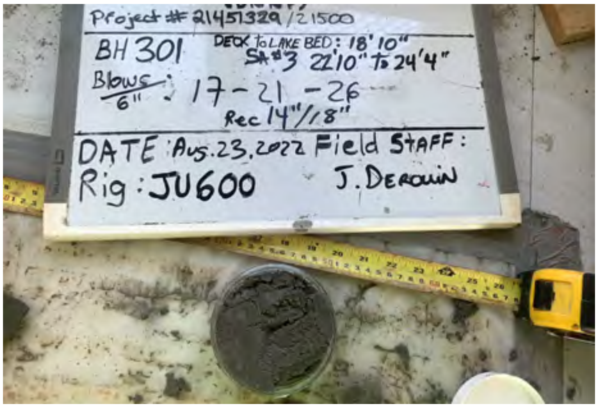


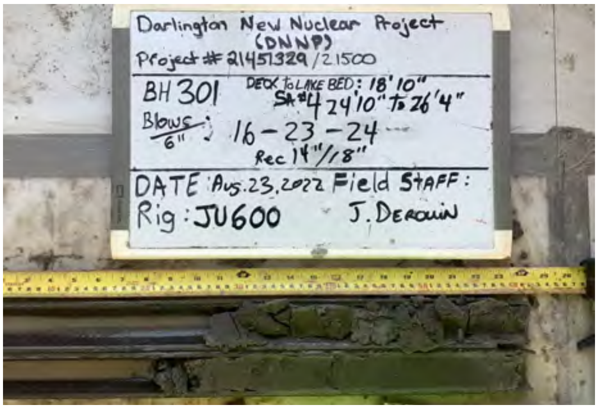
SPT Sampling Photographs

Borehole BH301, Samples SA1 to SA6







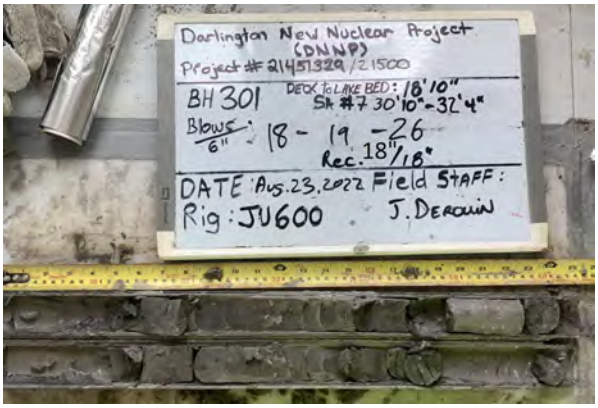


Date: October 2022
Project: 21451329

Prepared By: KL
Checked By: RV

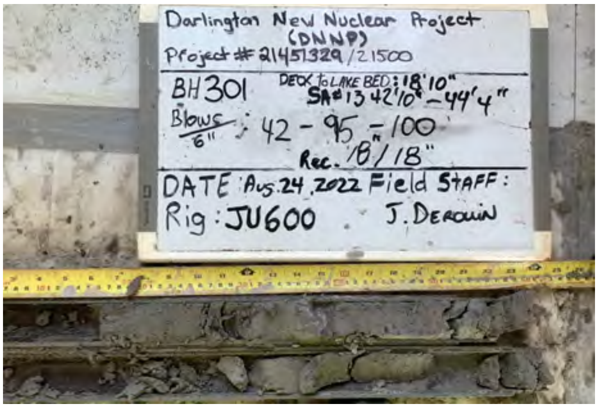
SPT Sampling Photographs

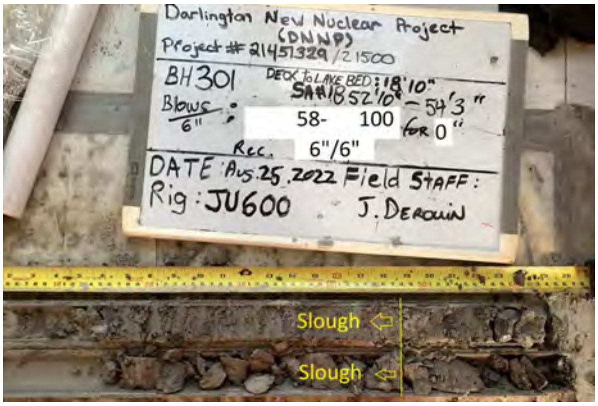
Borehole BH301, Samples SA7 to SA12



SPT Sampling Photographs

Borehole BH301, Samples SA13 to SA18





Date: October 2022
Project: 21451329

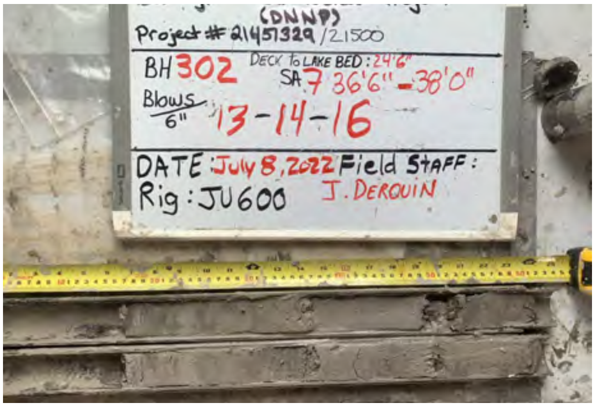
Prepared By: KL
Checked By: RV

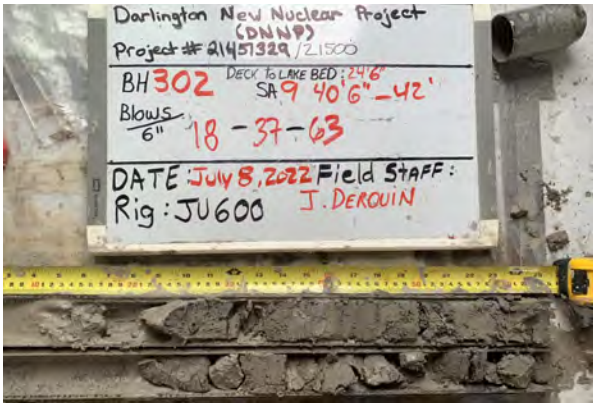
SPT Sampling Photographs

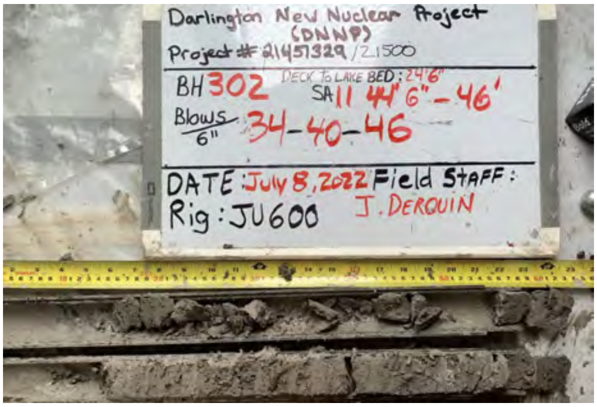
Borehole BH302, Samples SA1 to SA6

SPT Sampling Photographs

Borehole BH302, Samples SA7 to SA12

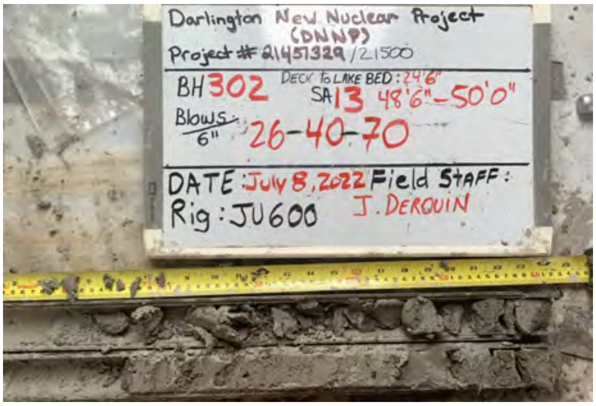


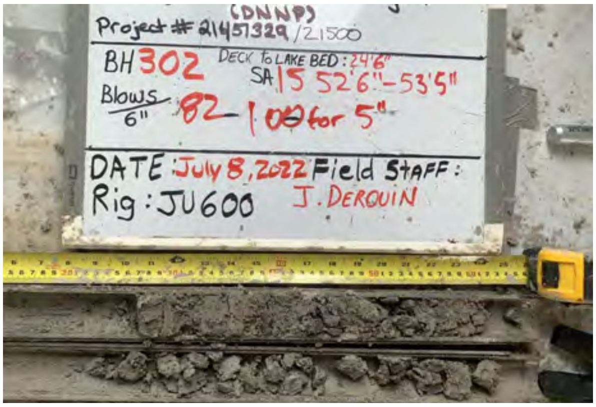




SPT Sampling Photographs

Borehole BH302, Samples SA13 to SA16





Date: October 2022

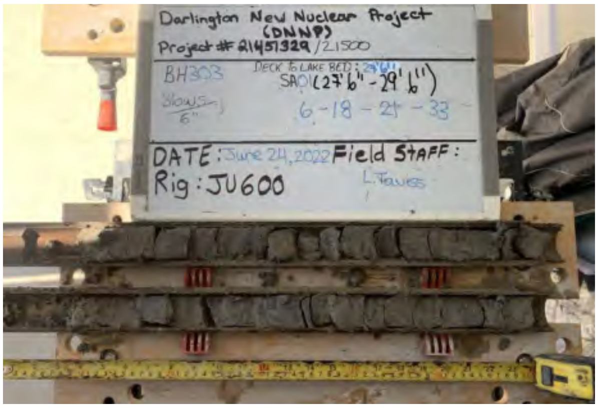
Project: 21451329

Prepared By: KL

Checked By: RV

SPT Sampling Photographs

Borehole BH303, Samples SA1 to SA6



SPT Sampling Photographs

Borehole BH303, Samples SA7 to SA12

Date: October 2022

Project: 21451329

Prepared By: KL

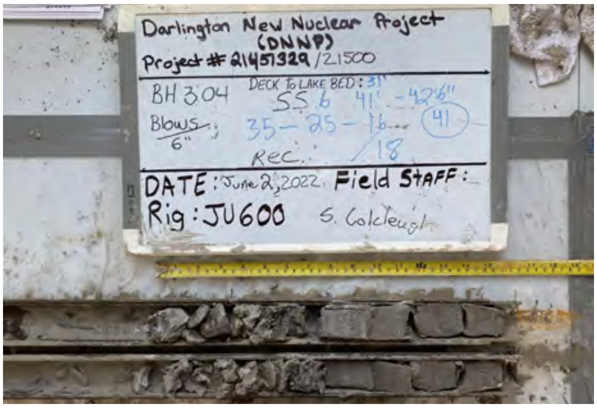
Checked By: RV

SPT Sampling Photographs

Borehole BH303, Sample SA13

SPT Sampling Photographs

Borehole BH304, Samples SA1 to SA6



Date: October 2022

Project: 21451329

Prepared By: KL

Checked By: RV

SPT Sampling Photographs

Borehole BH304, Samples SA7 to SA10

SPT Sampling Photographs

Borehole BH305, Samples SA1 to SA6

SA2 Photo Damaged

SPT Sampling Photographs

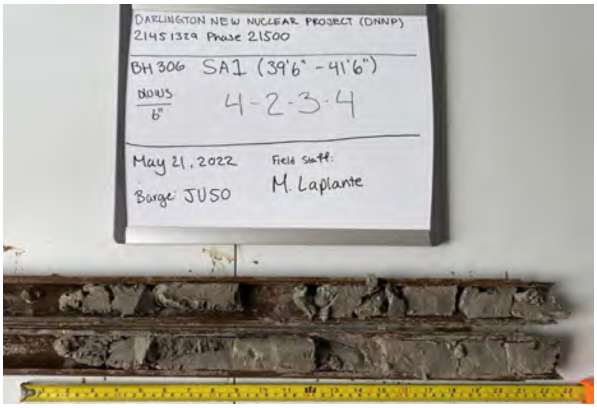
Borehole BH305, Samples SA7 to SA11

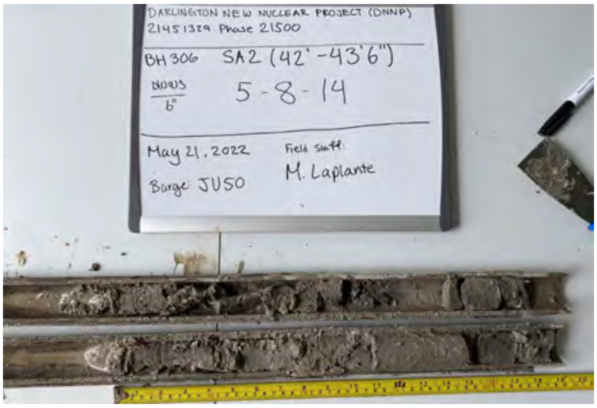
Date: October 2022
Project: 21451329

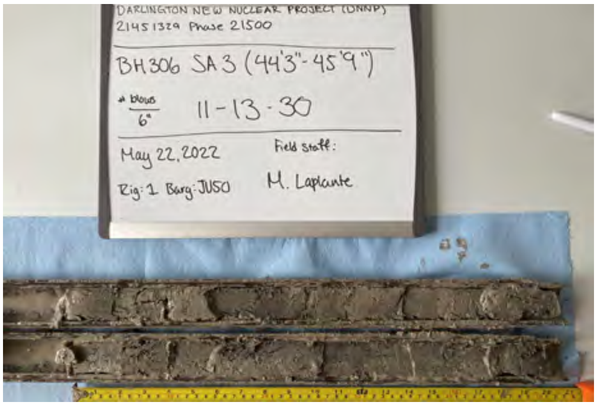
Prepared By: KL
Checked By: RV

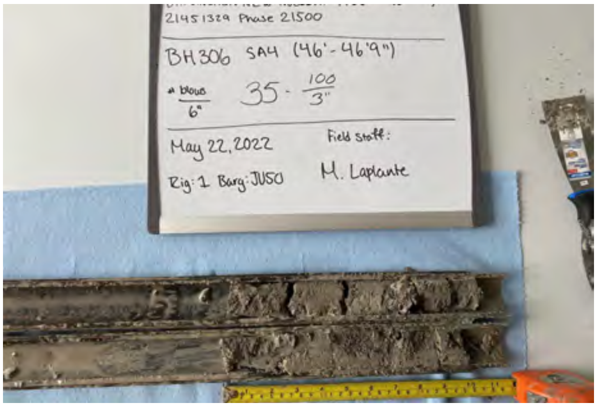
SPT Sampling Photographs

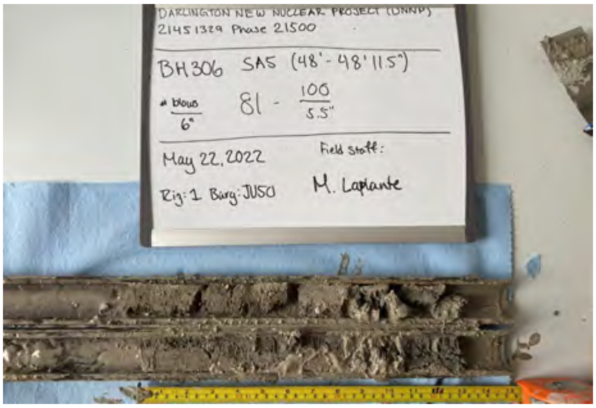
Borehole BH306, Samples SA1 to SA6

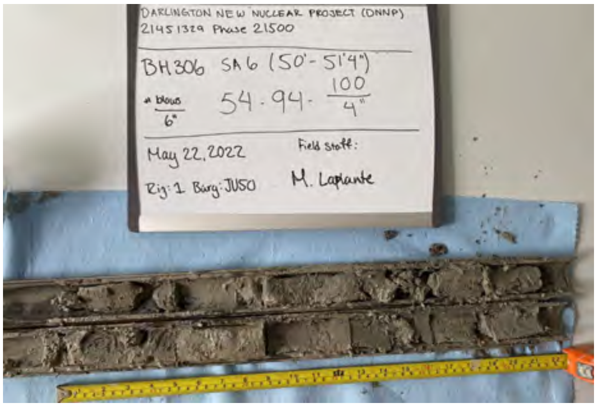










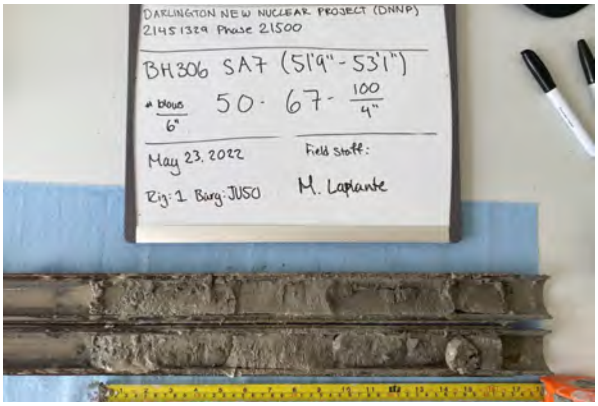


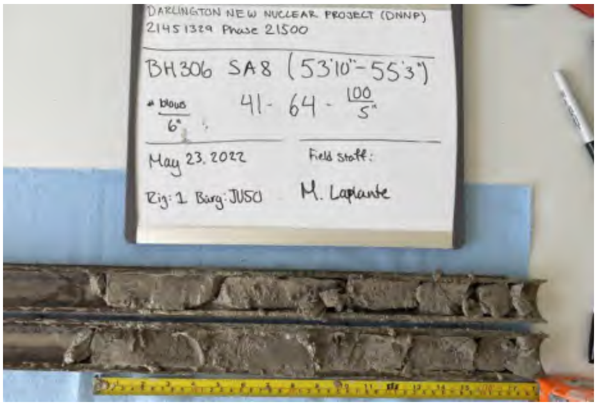
Date: October 2022
Project: 21451329

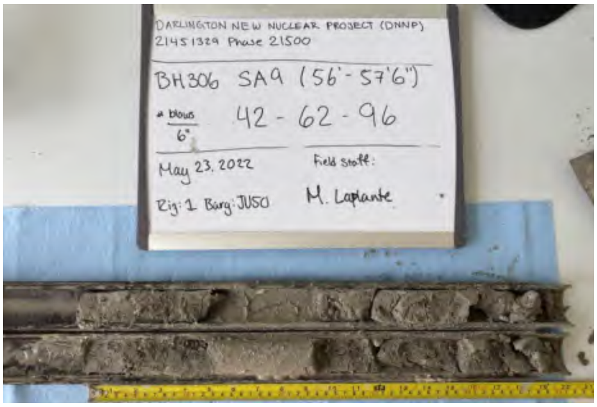
Prepared By: KL
Checked By: RV

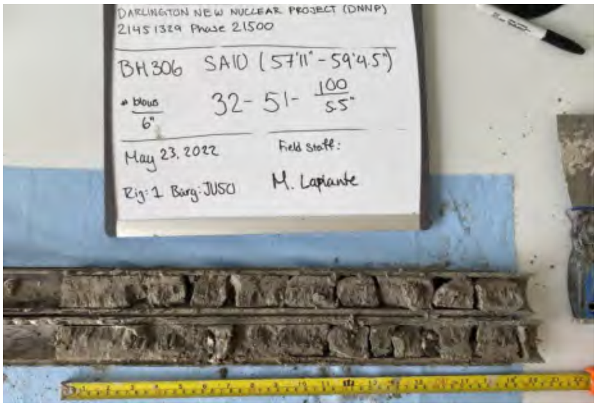
SPT Sampling Photographs

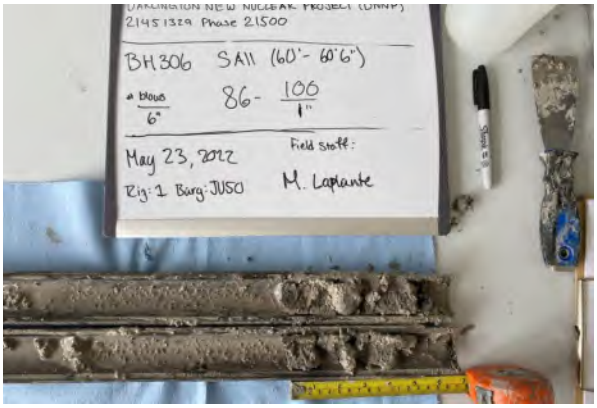
Borehole BH306, Samples SA7 to SA12

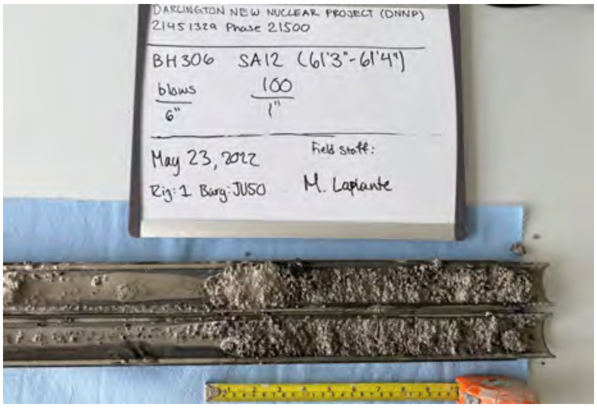










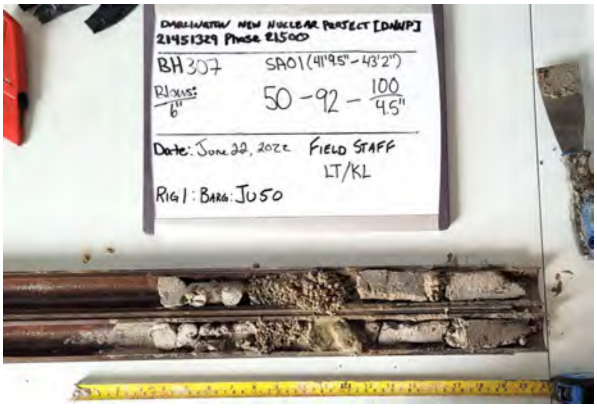


Date: October 2022
Project: 21451329

Prepared By: KL
Checked By: RV

SPT Sampling Photographs

Borehole BH307, Samples SA1 to SA6



Date: October 2022
Project: 21451329

Prepared By: KL
Checked By: RV

SPT Sampling Photographs

Borehole BH307, Samples SA7 to SA12

SPT Sampling Photographs

Borehole BH308, Samples SA1 to SA6

SA05 Photo Damaged

Date: October 2022
Project: 21451329

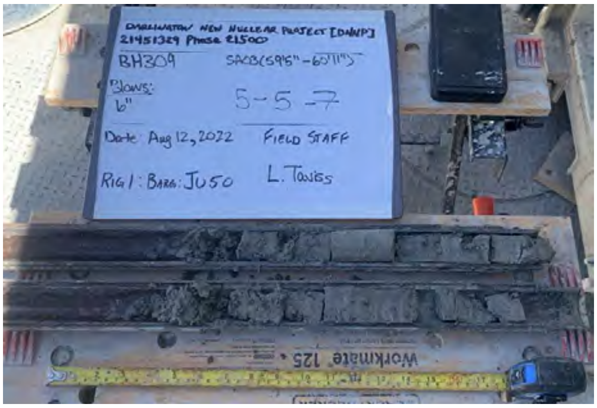
Prepared By: KL
Checked By: RV

SPT Sampling Photographs

Borehole BH308, Samples SA7 to SA12

SPT Sampling Photographs

Borehole BH309, Samples SA1 to SA5



APPENDIX C

Rock Core Photographs

Core Box Photographs
BH21

Box 1-5

Note: Inclined Borehole

24.64 m to 39.22 m

Wet

Date: August 2022

Project: 21451329

Drawn: KL

Chkd: AC

Core Box Photographs
BH21

Box 6-10

Note: Inclined Borehole

39.22 m to 53.72 m

Wet

Date: August 2022
Project: 21451329

Drawn: KL
Chkd: AC

Core Box Photographs
BH21

Box 11-15

Note: Inclined Borehole

53.72 m to 68.46 m

Wet

Date: August 2022

Project: 21451329

Drawn: KL

Chkd: AC

Core Box Photographs
BH21

Box 16-17

Note: Inclined Borehole

68.46 m to 71.67 m

Wet

Date: **August 2022**

Project: 21451329

Drawn: **KL**

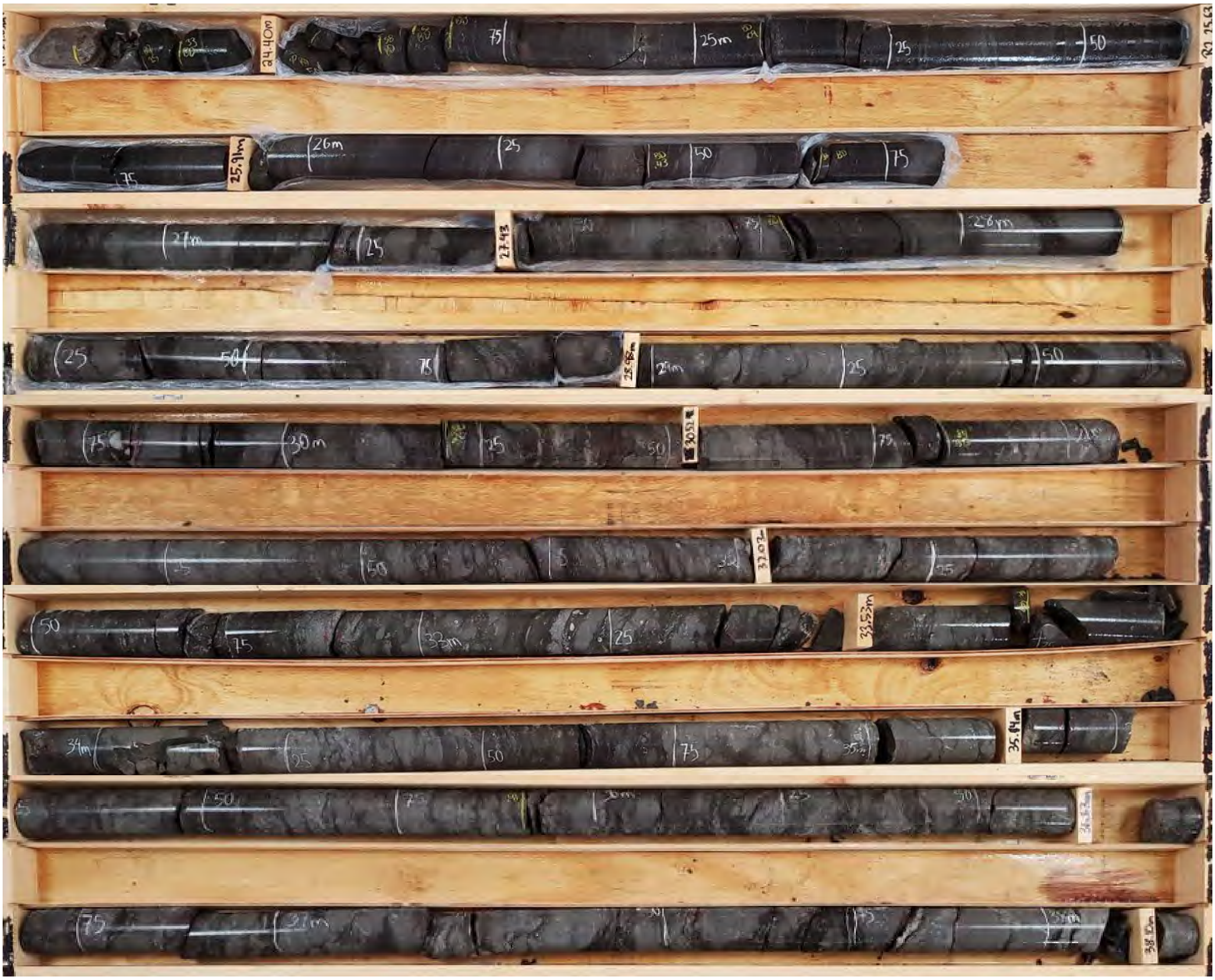
Chkd: **AC**

Core Box Photographs
BH22

Box 1-5

Note: Inclined Borehole

24.05 m to 38.15 m

Wet

Date: August 2022
Project: 21451329

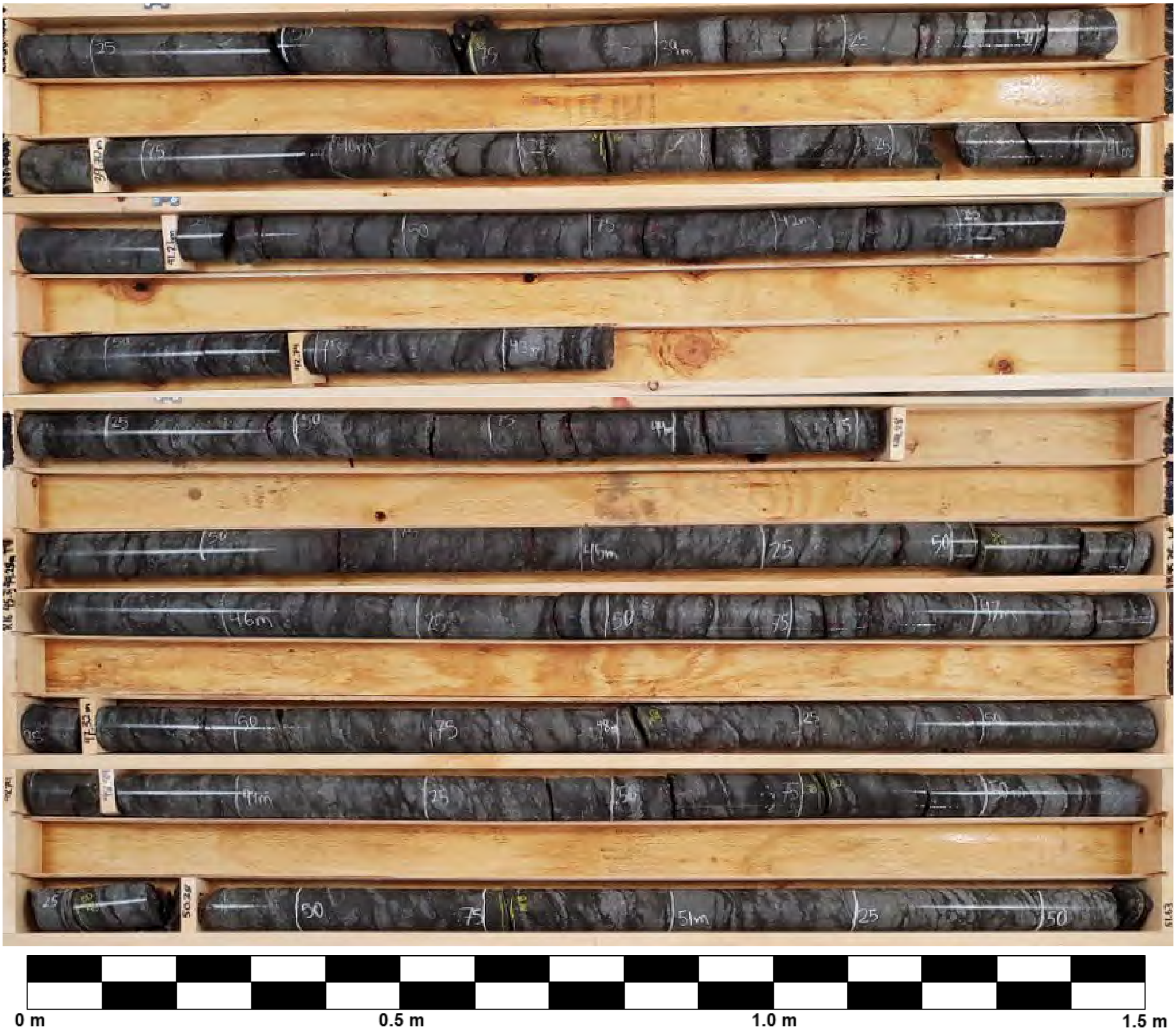
Drawn: KL
Chkd: AC

Core Box Photographs
BH22

Box 6-10

Note: Inclined Borehole

38.15 m to 51.63 m

Wet

Date: August 2022
Project: 21451329

Drawn: KL
Chkd: AC

Core Box Photographs
BH22

Box 11-15

Note: Inclined Borehole

51.63 m to 65.73 m

Wet

Date: August 2022

Project: 21451329

Drawn: KL

Chkd: AC

Core Box Photographs
BH22

Box 16-17

Note: Inclined Borehole

65.73 m to 70.32 m

Wet

Date: **August 2022**

Project: 21451329

Drawn: **KL**

Chkd: **AC**

Core Box Photographs
BH23

Box 1-5

22.78 m to 37.03 m

Wet

Date: August 2022
Project: 21451329

Drawn: KL
Chkd: AC

Core Box Photographs
BH23

Box 6-10

37.03 m to 51.39 m

Wet

Date: August 2022
Project: 21451329

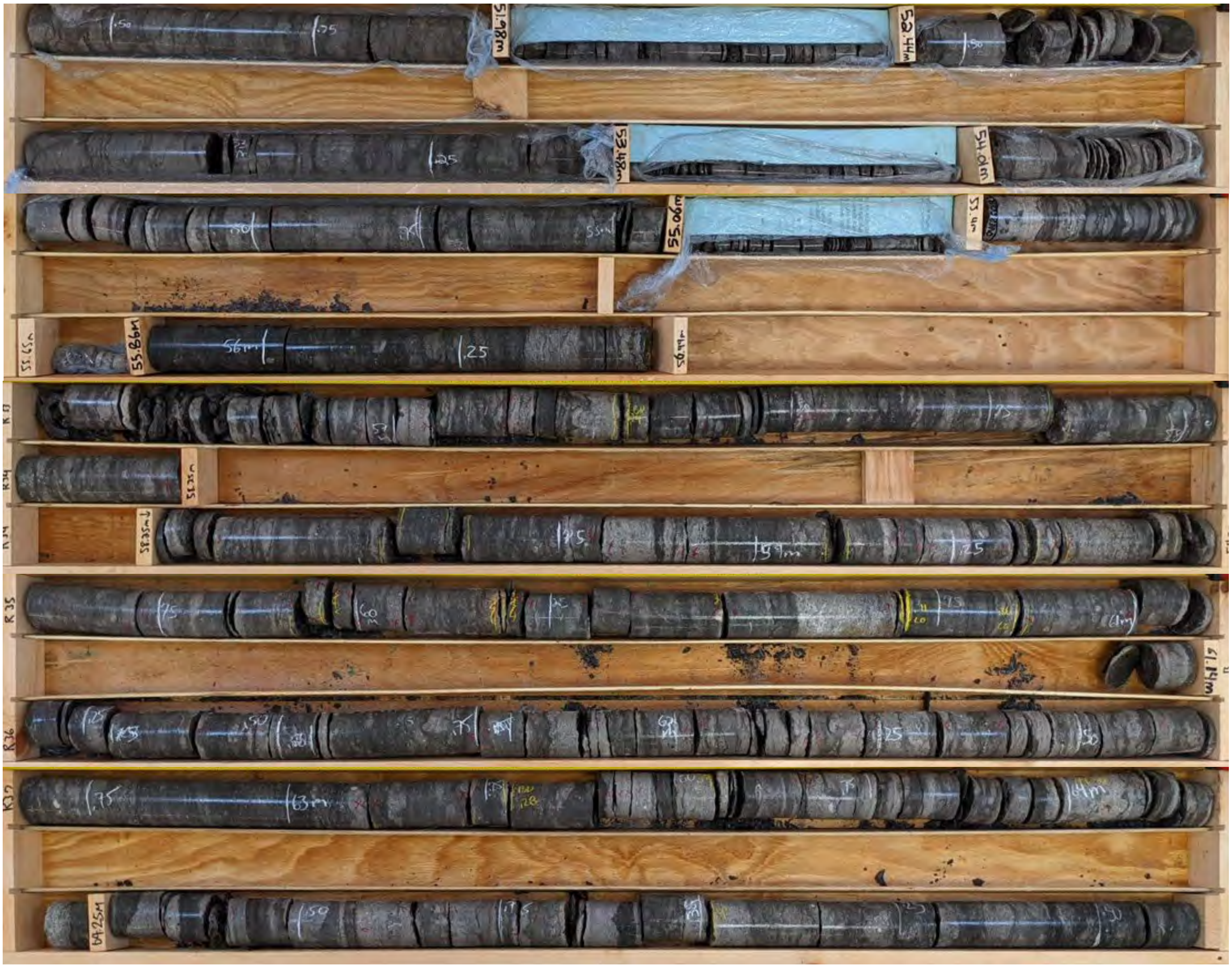
Drawn: KL
Chkd: AC

Core Box Photographs
BH23

Box 11-15

51.39 m to 65.62 m

Wet



Date: August 2022
Project: 21451329

Drawn: KL
Chkd: AC

Core Box Photographs
BH23

Box 16-20

65.62 m to 78.11 m

Wet

Date: August 2022
Project: 21451329

Drawn: KL
Chkd: AC

Core Box Photographs
BH24

Box 1-5

25.00 m to 38.46 m

Wet

Date: August 2022

Project: 21451329

Drawn: KL

Chkd: AC

Core Box Photographs
BH24

Box 6-10

38.46 m to 53.74 m

Wet

Date: August 2022

Project: 21451329

Drawn: KL

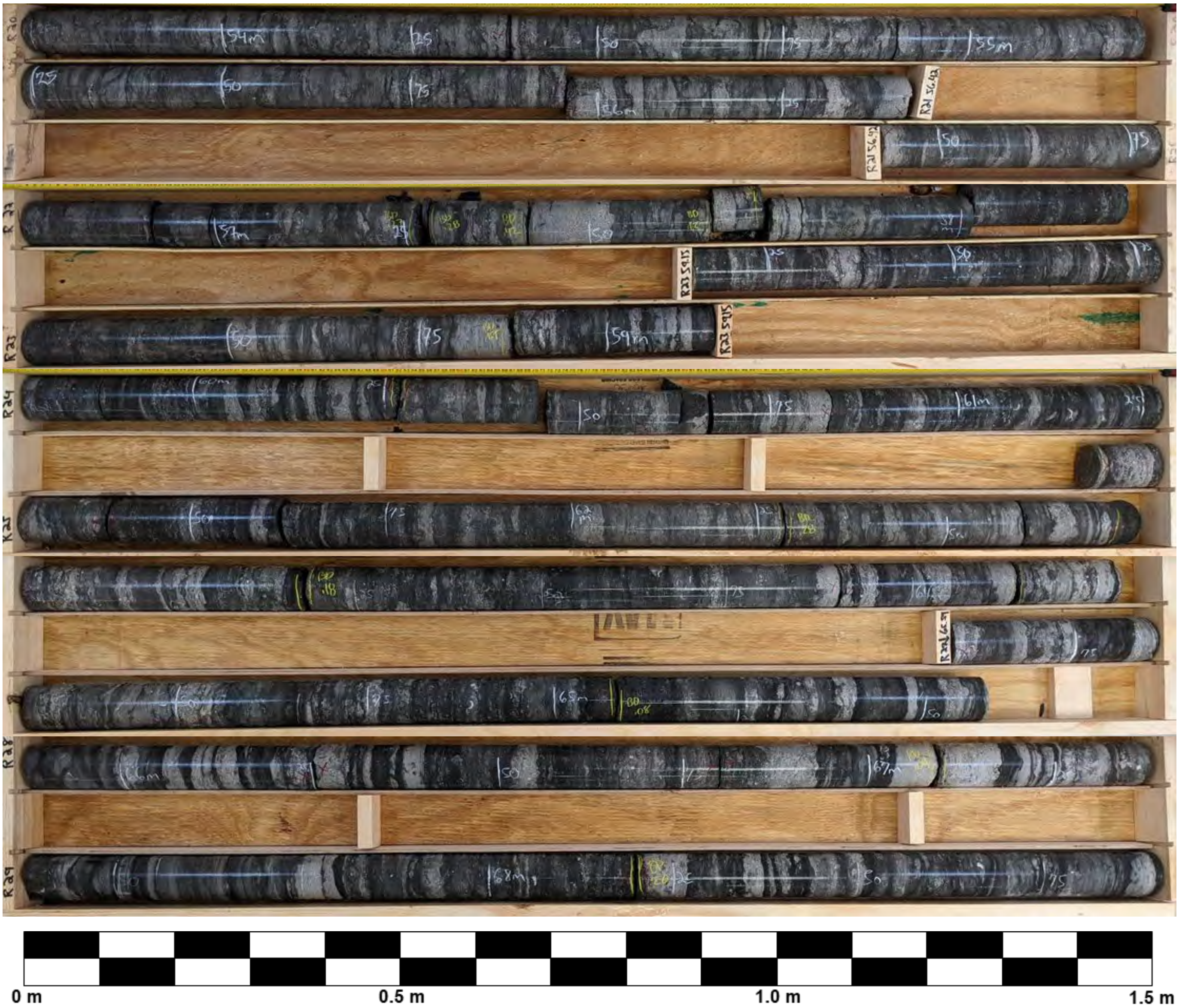
Chkd: AC

Core Box Photographs
BH24

Box 11-15

53.74 m to 68.91 m

Wet



Date: August 2022

Project: 21451329

Drawn: KL

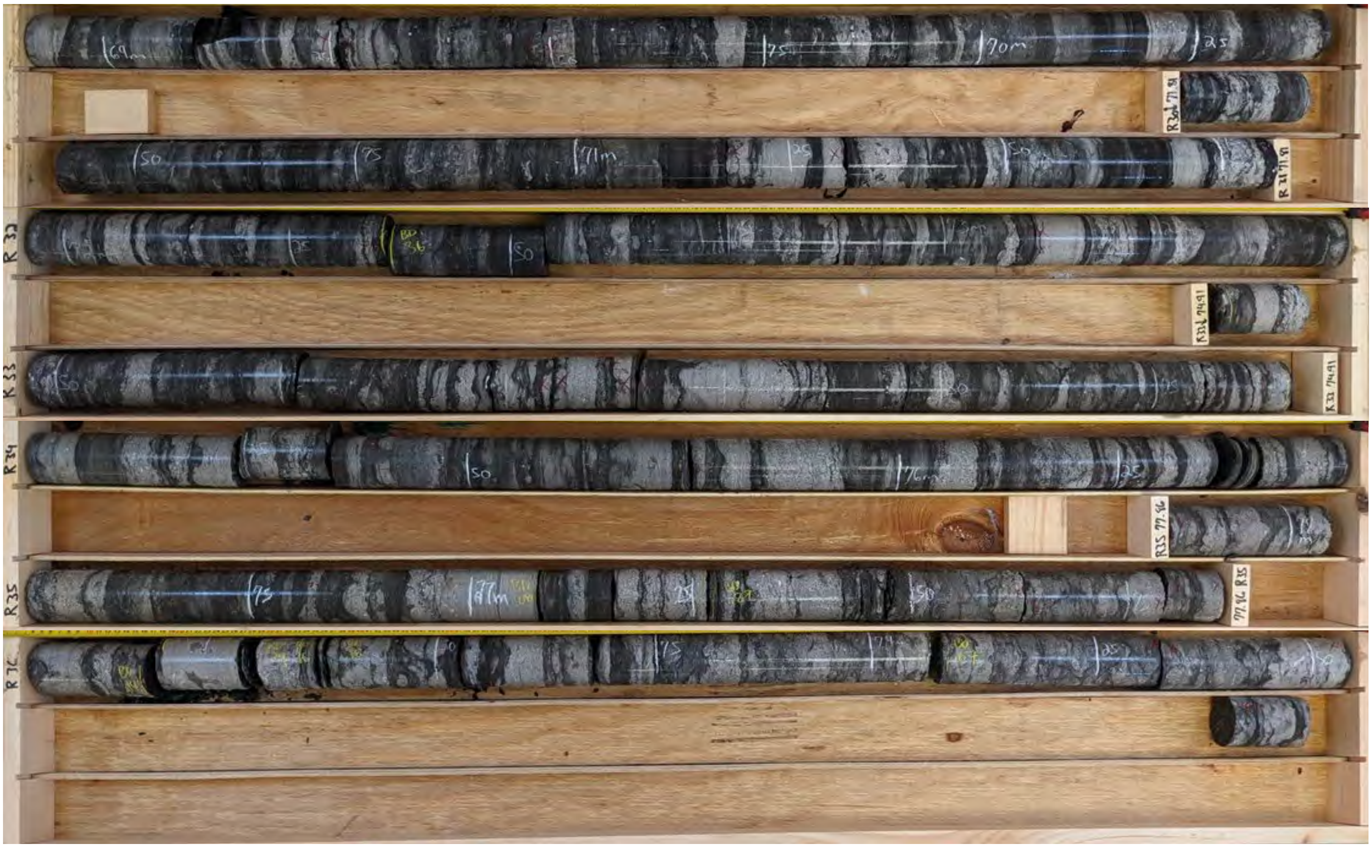
Chkd: AC

Core Box Photographs
BH24

Box 16-19

68.91 m to 79.63 m

Wet



Date: August 2022

Project: 21451329

Drawn: KL

Chkd: AC

Core Box Photographs
BH25

Box 1-2

24.05 m to 28.71 m

Wet

Date: August 2022

Project: 21451329

Drawn: KL

Chkd: AC

Core Box Photographs
BH26

Box 1-5

22.31 m to 36.58 m

Wet

Date: August 2022

Project: 21451329

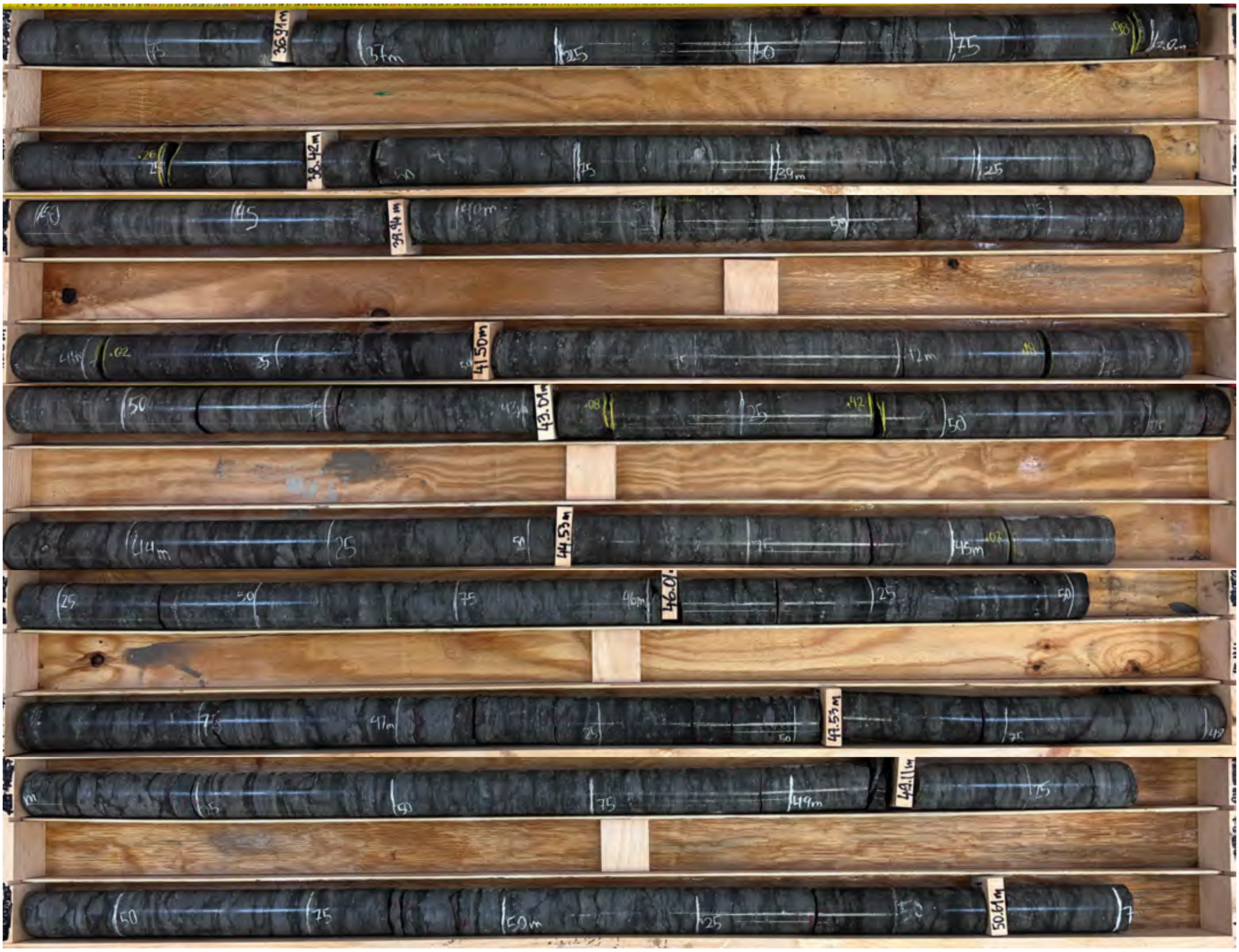
Drawn: KL

Chkd: AC

Core Box Photographs
BH26

Box 6-10

36.58 m to 50.76 m

Wet

Date: August 2022

Project: 21451329

Drawn: KL

Chkd: AC

Core Box Photographs
BH26

Box 11-15

50.76 m to 64.82 m

Wet

Date: August 2022

Project: 21451329

Drawn: KL

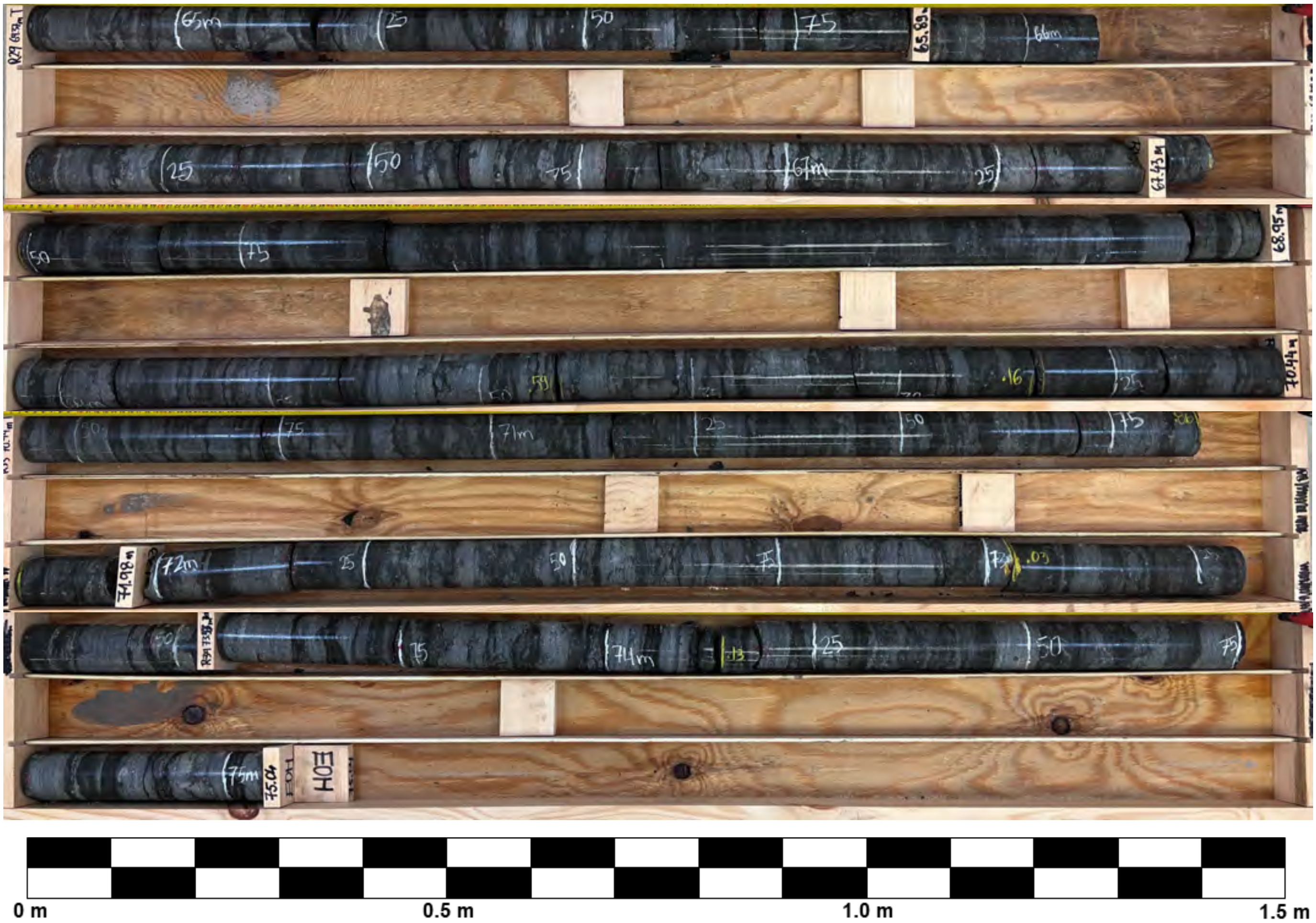
Chkd: AC

Core Box Photographs
BH26

Box 16-19

64.82 m to 75.04 m

Wet



Date: August 2022
Project: 21451329

Drawn: KL
Chkd: AC

Core Box Photographs
BH82

Box 1

25.80 m to 28.81 m

Wet

Date: August 2022

Project: 21451329

Drawn: KL

Chkd: AC

Core Box Photographs
BH202

Box 1-5

16.38 m to 30.49 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

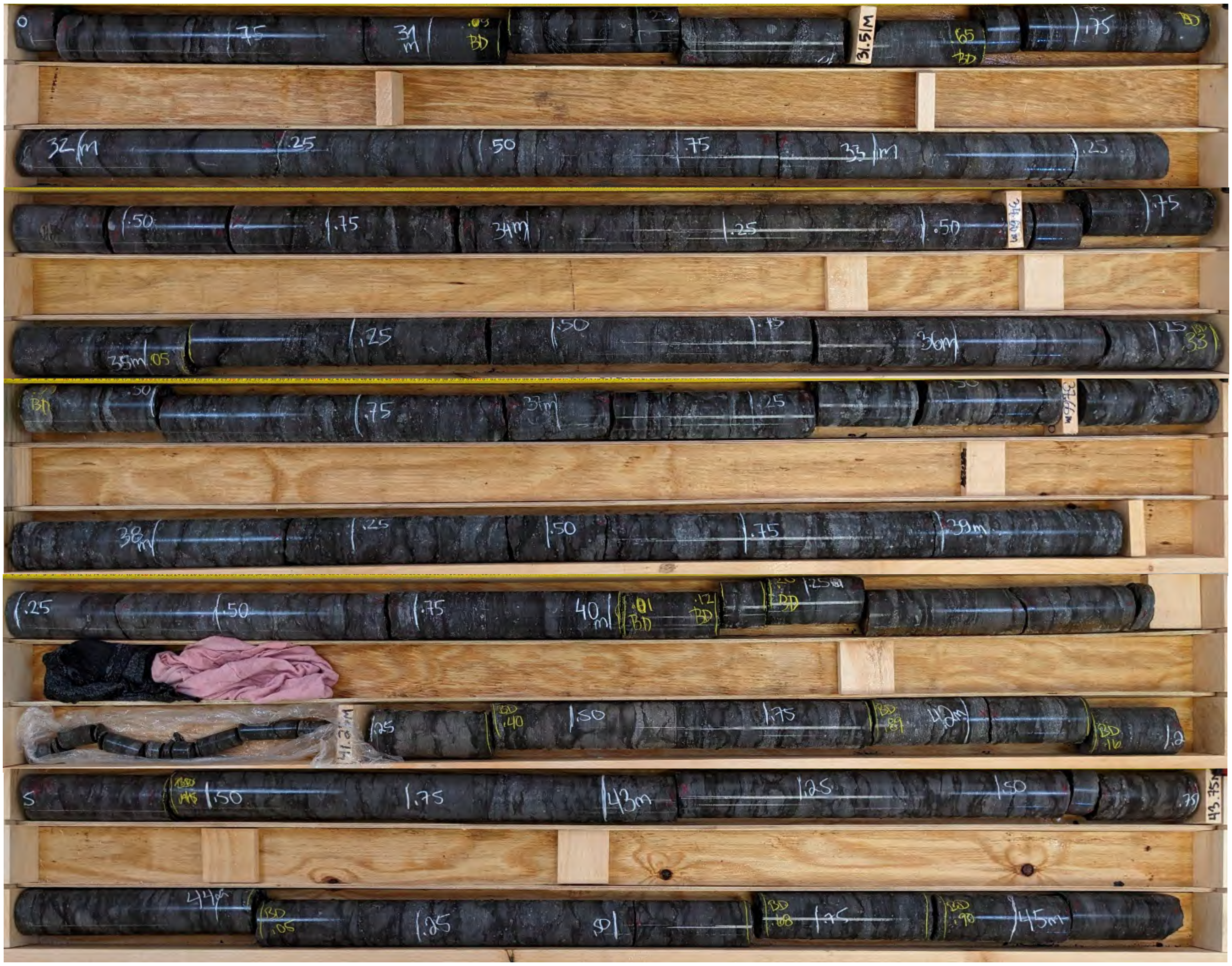
Chkd:

Core Box Photographs
BH202

Box 6-10

30.49 m to 45.21 m

Wet



Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

Core Box Photographs
BH202

Box 11-15

45.21 m to 59.92 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

Core Box Photographs
BH202

Box 16

59.92 m to 62.00 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

Core Box Photographs
BH203

Box 1-5

16.76 m to 31.16 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

Core Box Photographs
BH203

Box 6-10

31.16 m to 45.27 m

Wet

Date: July 2022
Project: 21451329

Drawn: KL
Chkd:

Core Box Photographs
BH203

Box 11-15

45.27 m to 58.98 m

Wet

Date: July 2022

Project: 21451329

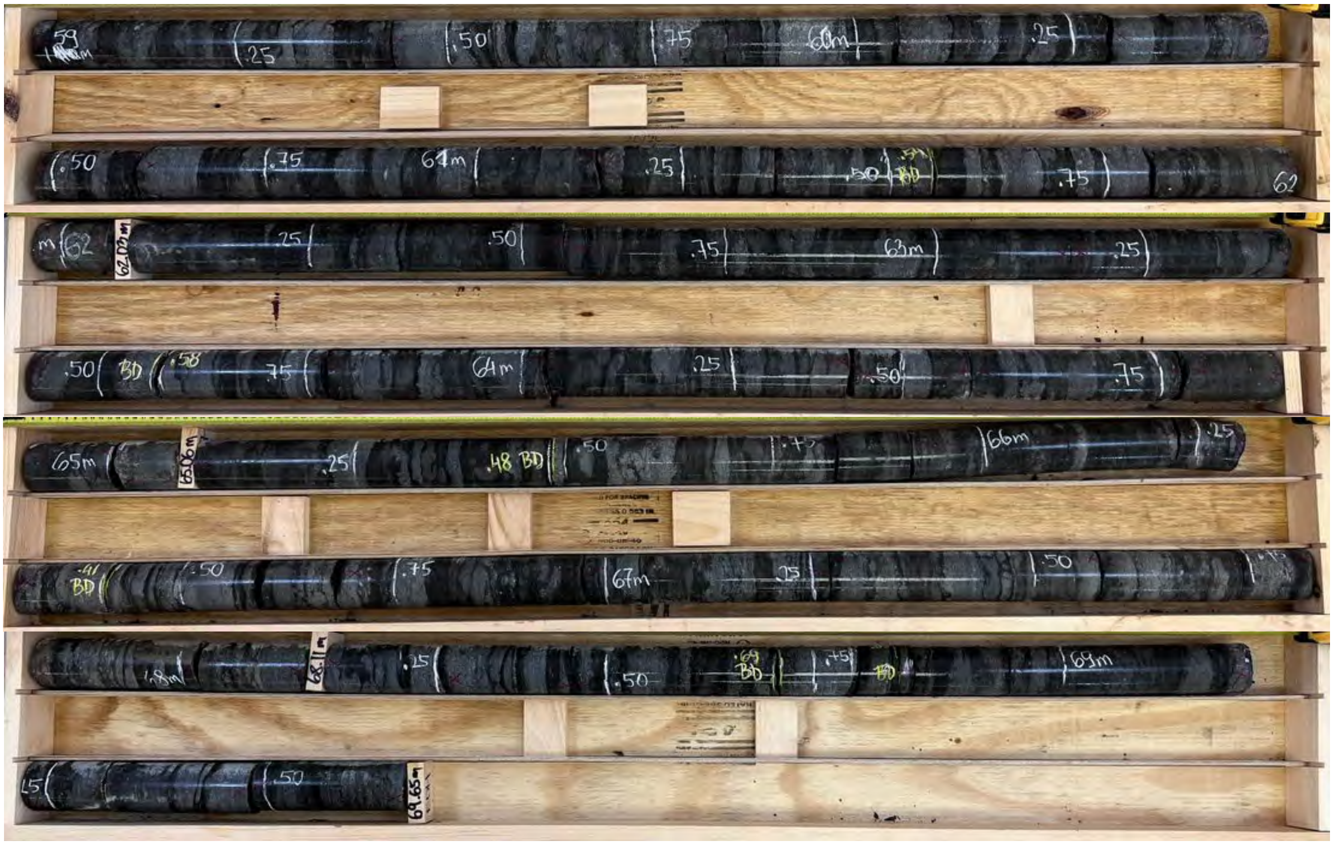
Drawn: KL

Chkd:

Core Box Photographs
BH203

Box 16-19

58.98 m to 69.65 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

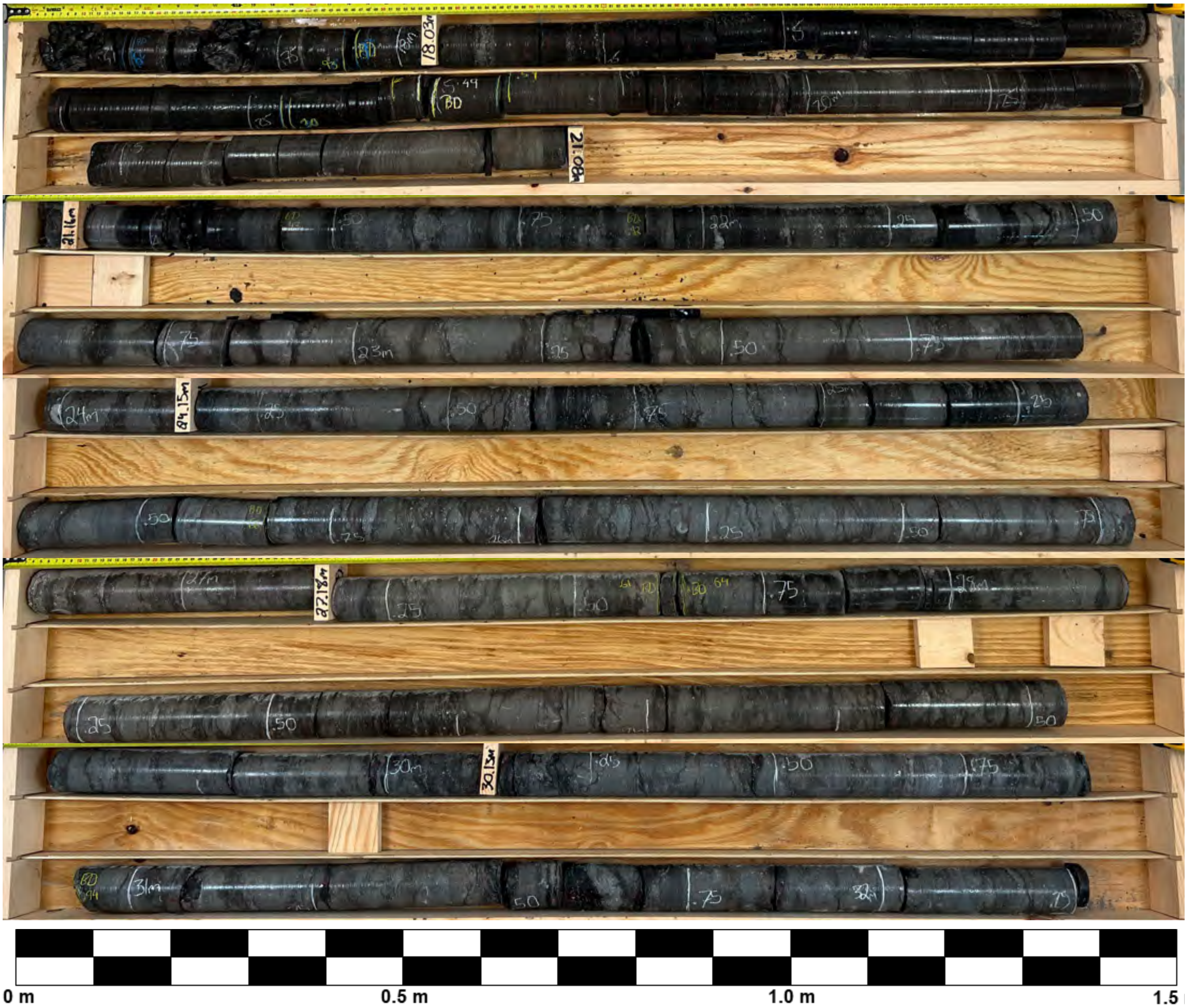
Chkd:

Core Box Photographs
BH204

Box 1-5

17.50 m to 32.27 m

Wet



Date: July 2022

Project: 21451329

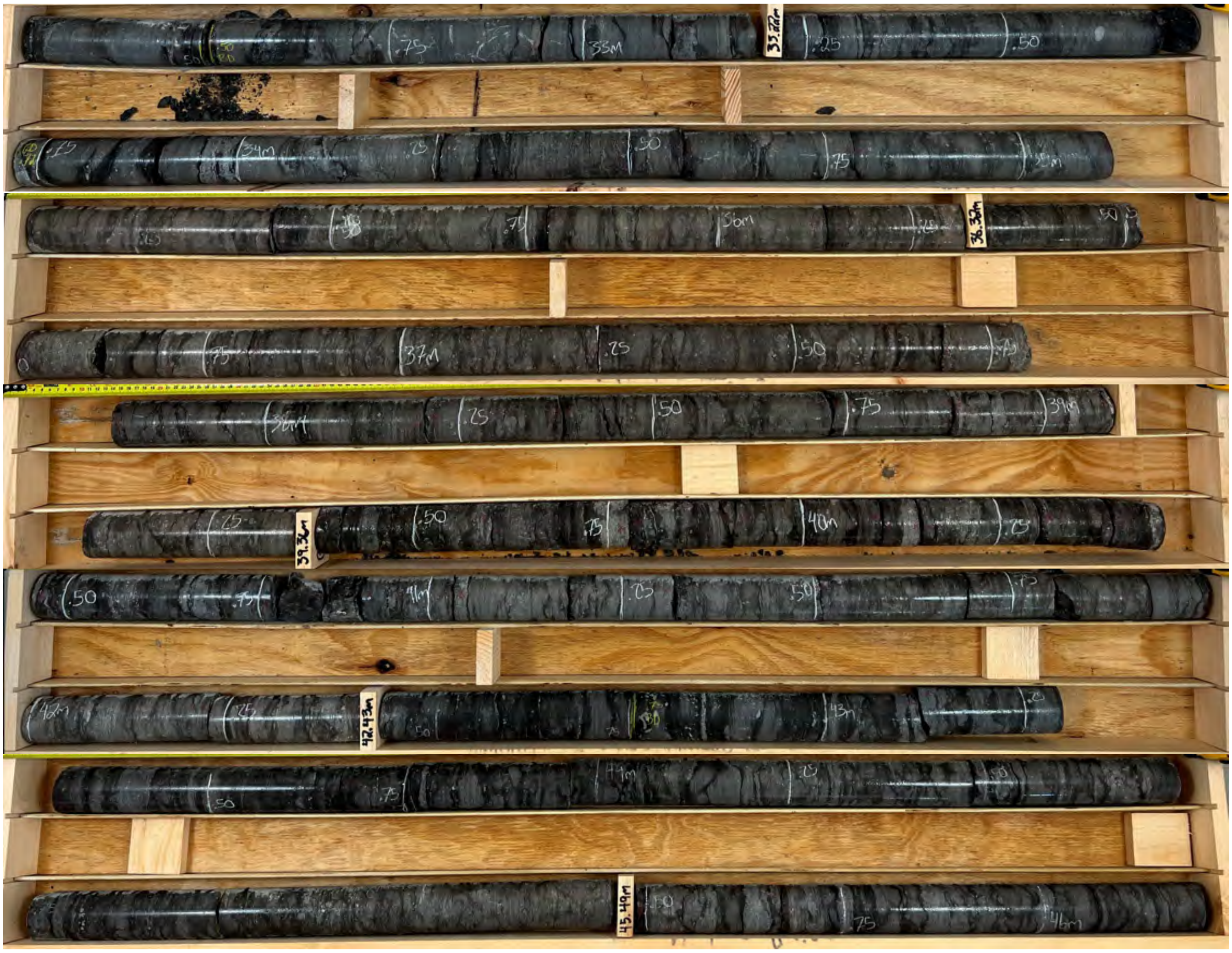
Drawn: KL

Chkd:

Core Box Photographs
BH204

Box 6-10

32.27 m to 46.21 m

Wet

Date: July 2022

Project: 21451329

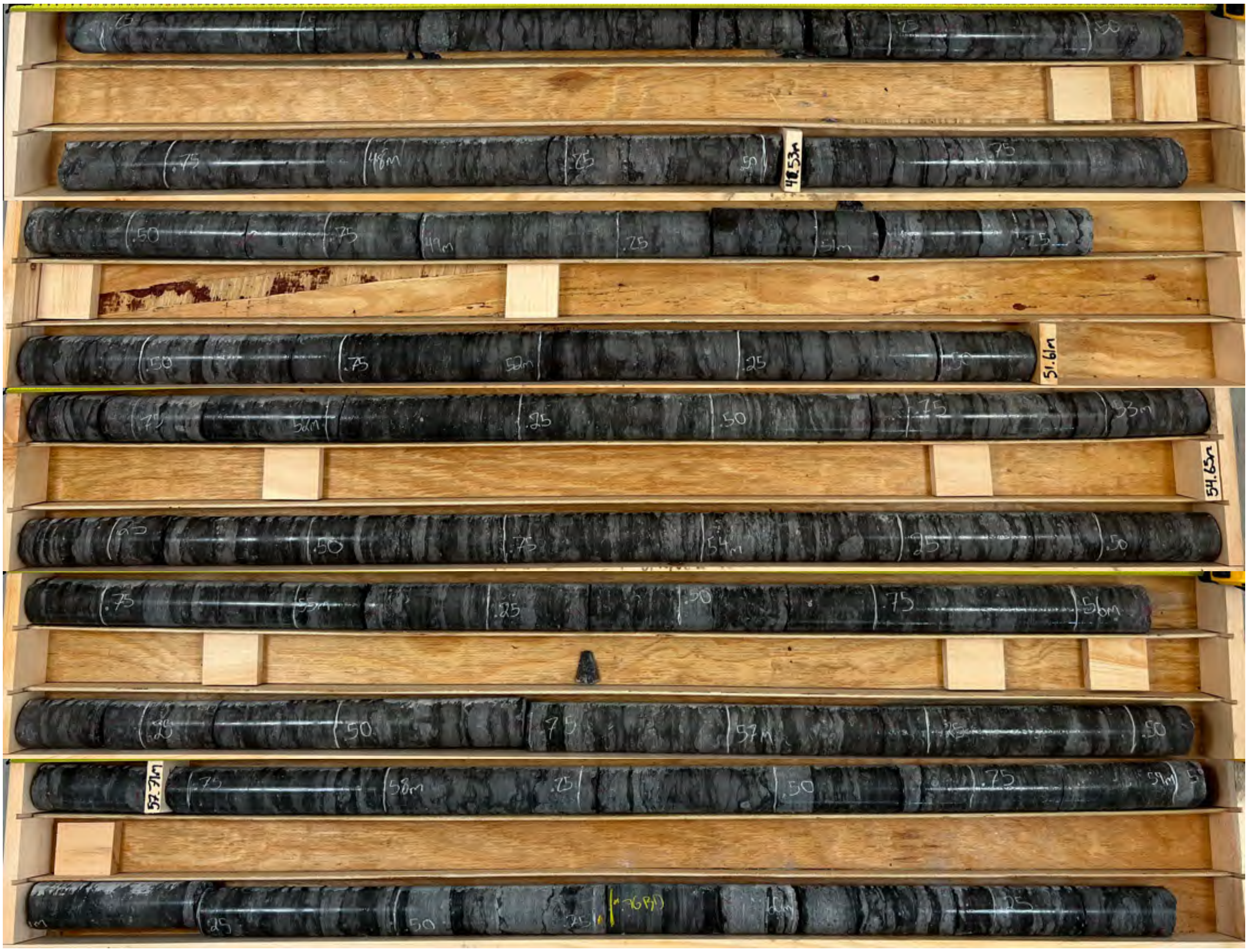
Drawn: KL

Chkd:

Core Box Photographs
BH204

Box 11-15

46.21 m to 60.49 m

Wet

Date: July 2022
Project: 21451329

Drawn: KL
Chkd:

Core Box Photographs
BH204

Box 16

60.49 m to 63.38 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

Core Box Photographs
BH205

Box 1-5

16.28 m to 31.55 m

Wet

wsp

Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

Core Box Photographs
BH205

Box 6-10

31.55 m to 46.32 m

Wet

Date: July 2022

Project: 21451329

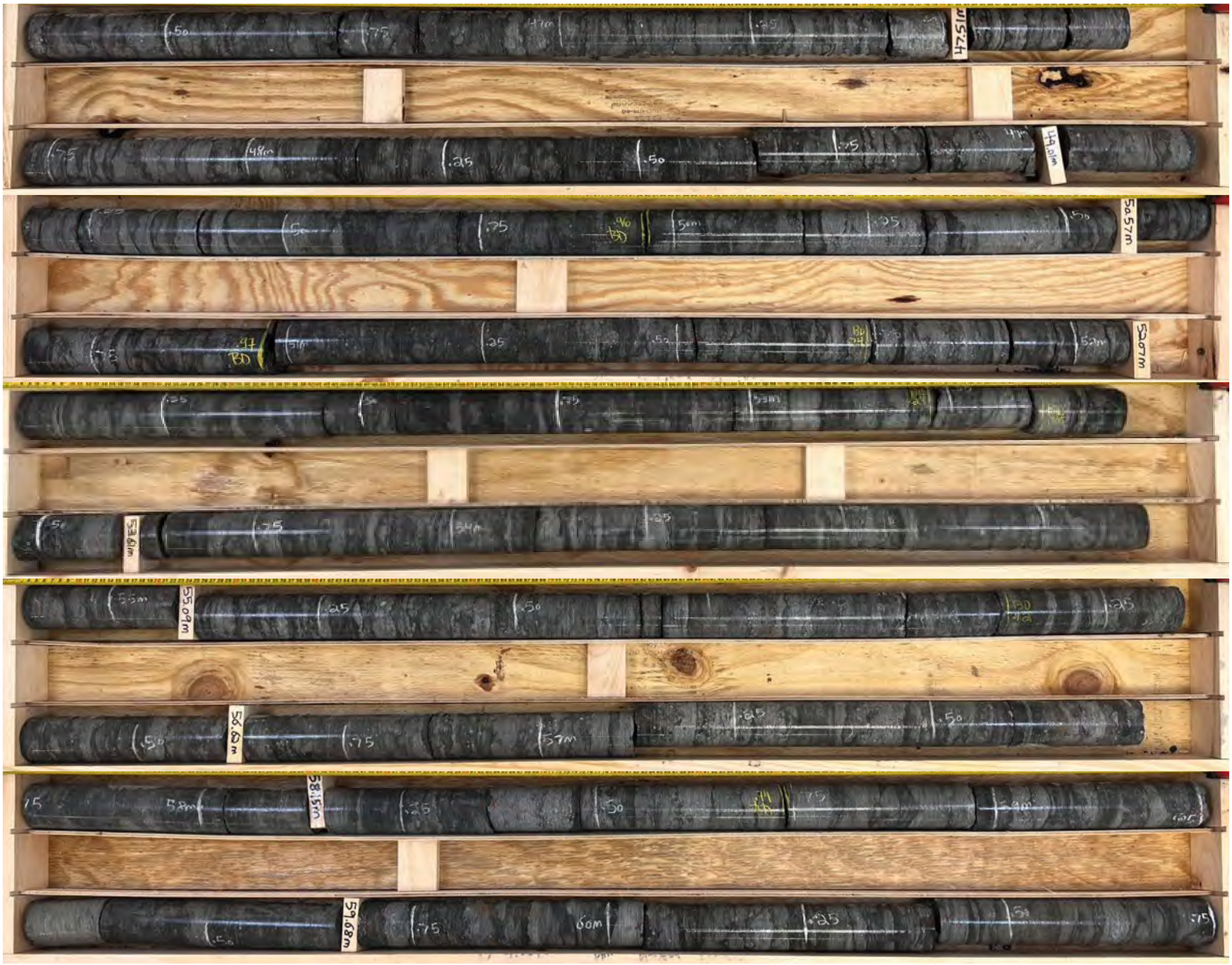
Drawn: KL

Chkd:

Core Box Photographs
BH205

Box 11-15

46.32 m to 60.75 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

Core Box Photographs
BH205

Box 16-19

60.75 m to 70.39 m

Wet

Date: July 2022

Project: 21451329

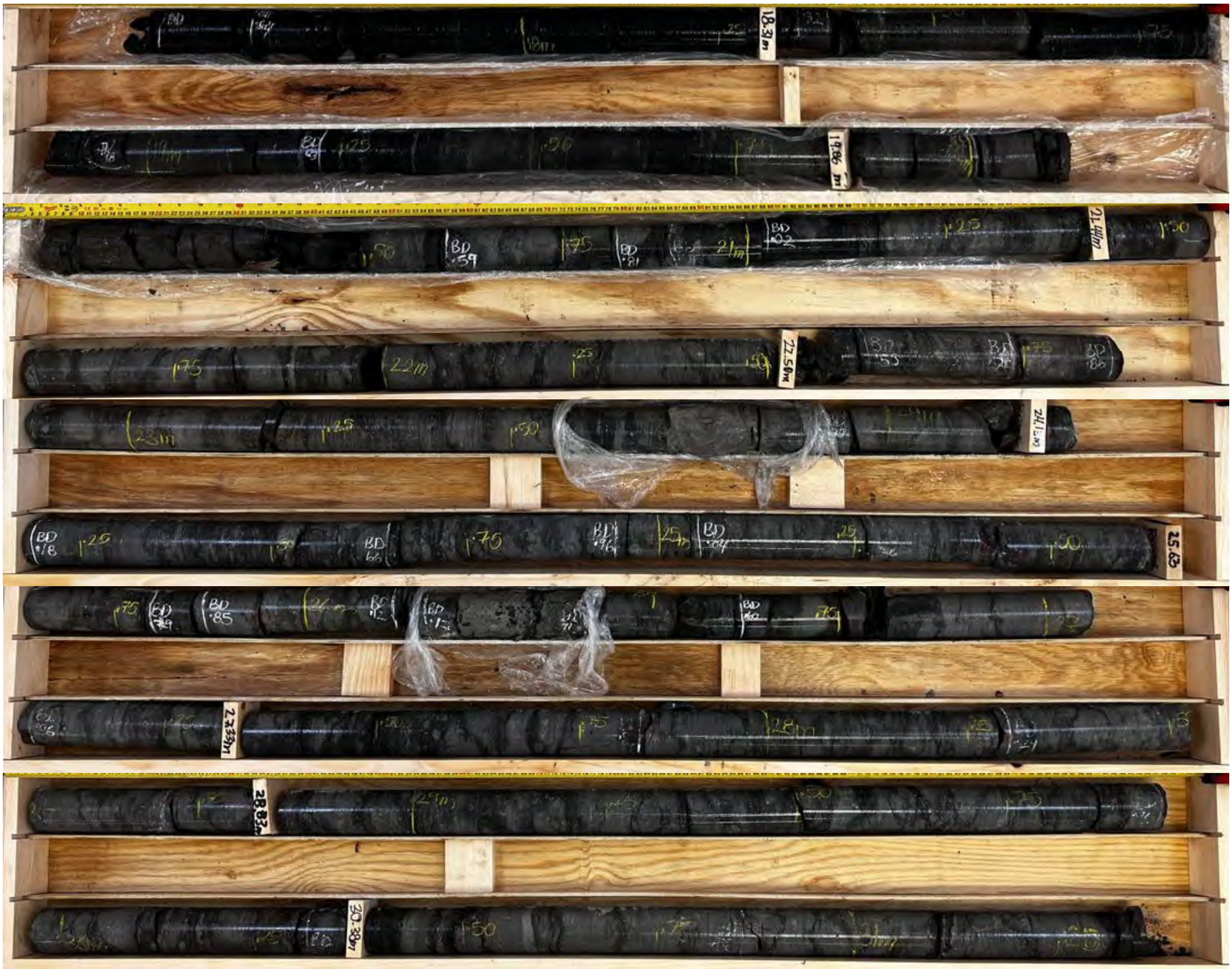
Drawn: KL

Chkd:

Core Box Photographs
BH206

Box 1-5

17.49 m to 31.36 m

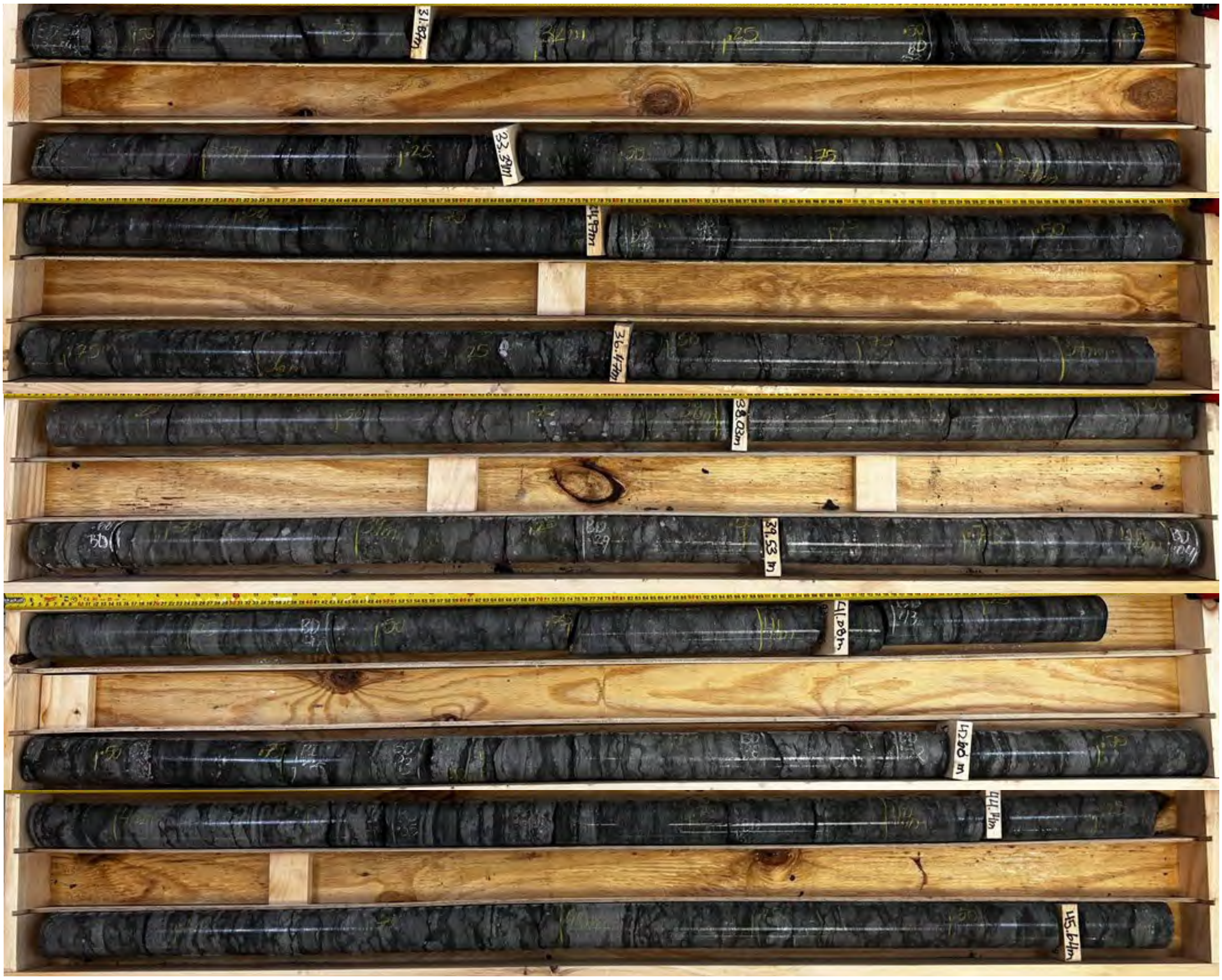
Wet

Date: July 2022
Project: 21451329

Drawn: KL
Chkd:

Core Box Photographs
BHZ206

Box 6-10

31.36 m to 45.74 m

Wet

Date: July 2022
Project: 21451329

Drawn: KL
Chkd:

Core Box Photographs
BH206

Box 11-15

45.74 m to 59.90 m

Wet

Date: July 2022
Project: 21451329

Drawn: KL
Chkd:

Core Box Photographs
BH206

Box 16

59.90 m to 60.87 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

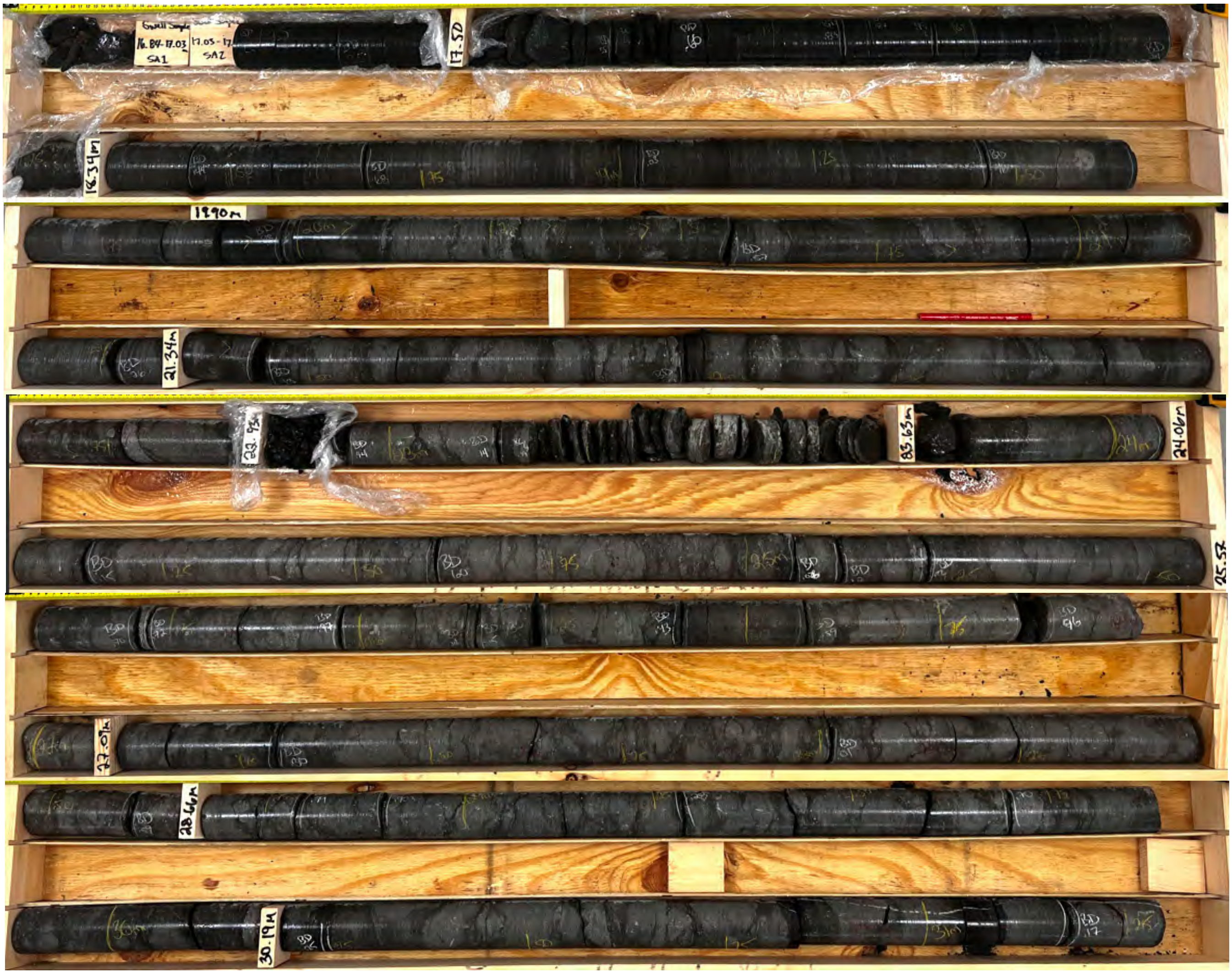
Chkd:

Core Box Photographs
BH207

Box 1-5

16.79 m to 31.30 m

Wet



Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

Core Box Photographs
BH207

Box 6-10

31.30 m to 45.64 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

Core Box Photographs
BH207

Box 11-15

45.64 m to 59.97 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

Core Box Photographs
BH207

Box 16-19

59.97 m to 71.38 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

Core Box Photographs
BH301

Box 1-5

16.26 m to 30.95 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

Core Box Photographs
BH301

Box 6-10

30.95 m to 45.66 m

Wet

Date: July 2022
Project: 21451329

Drawn: KL
Chkd:

Core Box Photographs
BH301

Box 11-15

45.66 m to 60.33 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

Core Box Photographs
BH301

Box 16

60.33 m to 60.64 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

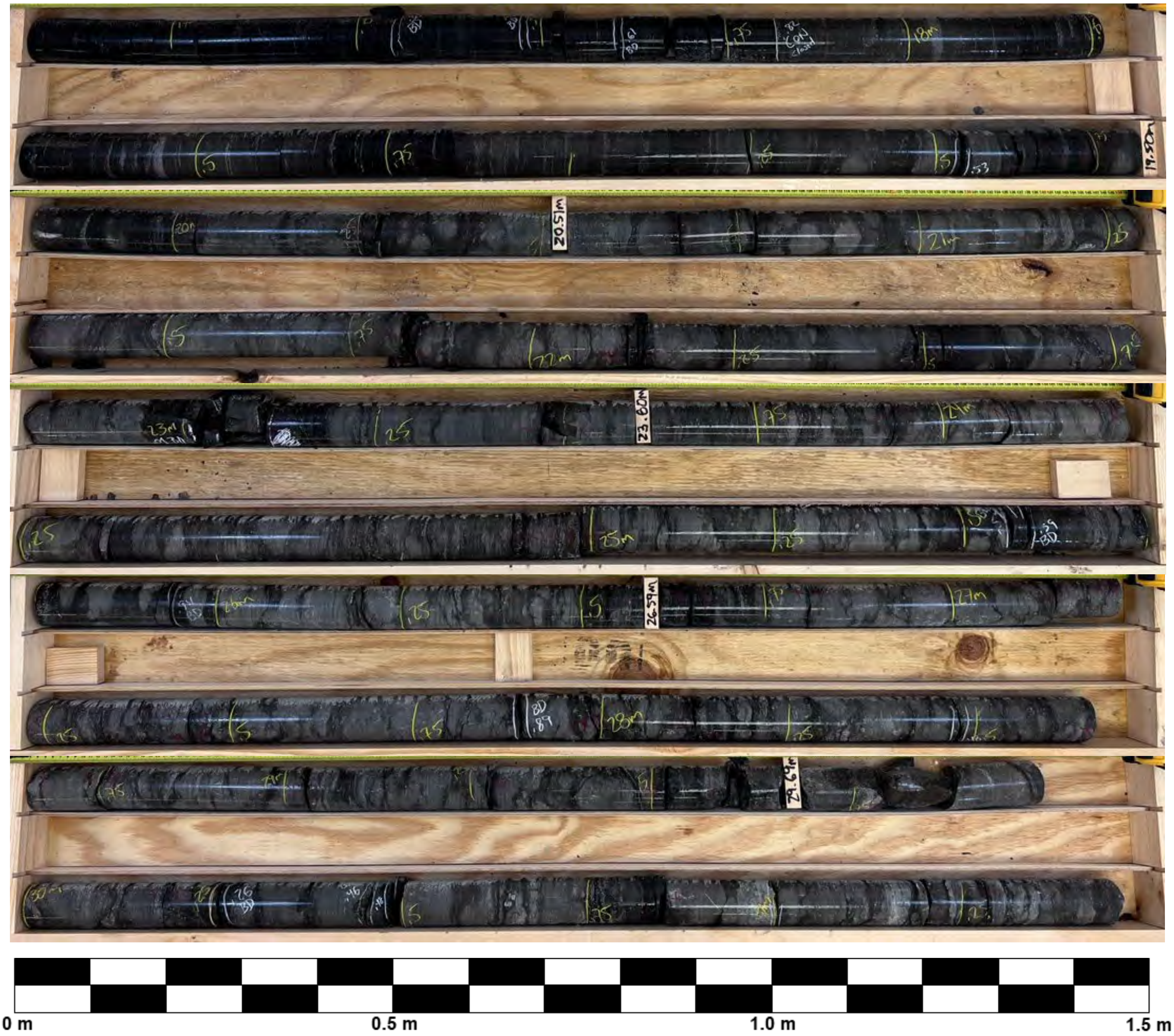
Chkd:

Core Box Photographs
BH302

Box 1-5

16.80 m to 31.46 m

Wet



wsp

Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

Core Box Photographs
BH302

Box 6-10

31.46 m to 45.94 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

Core Box Photographs
BH302

Box 11-15

45.94 m to 60.55 m

Wet

Date: July 2022
Project: 21451329

Drawn: KL
Chkd:

Core Box Photographs
BH302

Box 16-19

60.55 m to 70.88 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

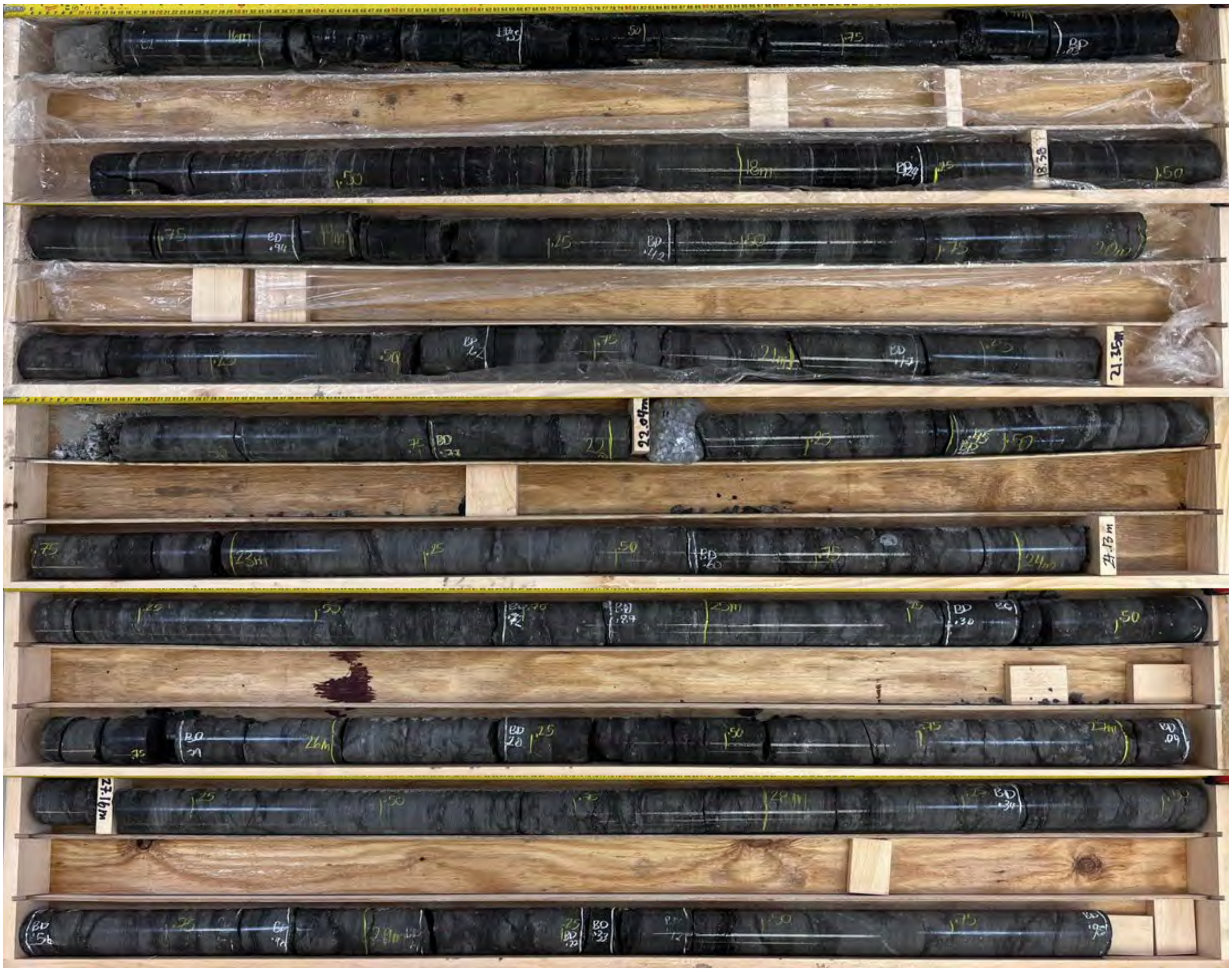
Chkd:

Core Box Photographs
BH303

Box 1-5

15.69 m to 29.95 m

Wet



Date: July 2022

Project: 21451329

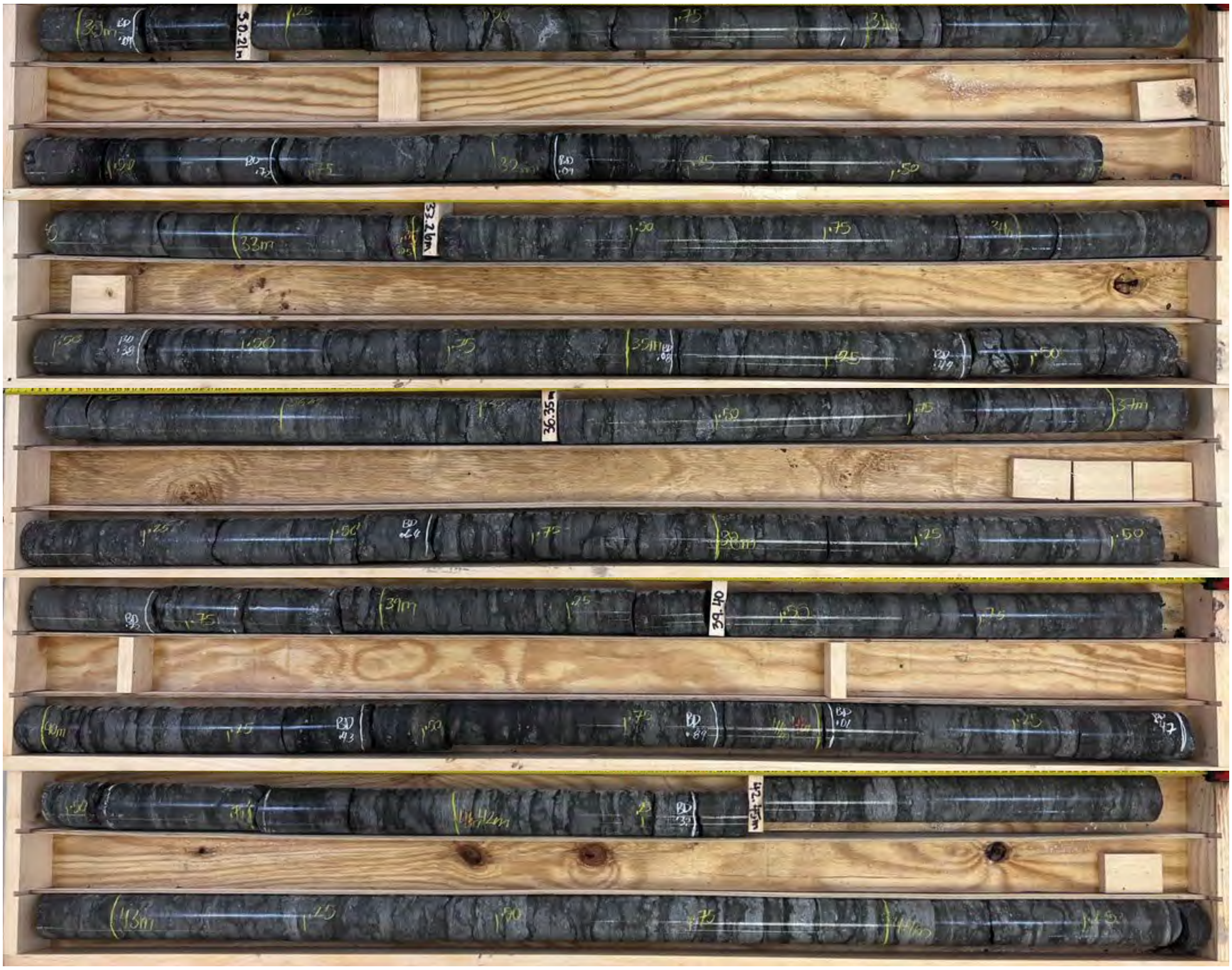
Drawn: KL

Chkd:

Core Box Photographs
BH303

Box 6-10

29.95 m to 44.37 m

Wet

Date: July 2022
Project: 21451329

Drawn: KL
Chkd:

Core Box Photographs
BH303

Box 11-15

44.37 m to 58.85 m

Wet

Date: July 2022
Project: 21451329

Drawn: KL
Chkd:

Core Box Photographs
BH303

Box 16

58.85 m to 61.69 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

Core Box Photographs
BH304

Box 1-5

15.49 m to 30.20 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

Core Box Photographs
BH304

Box 6-10

30.20 m to 44.46 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

Core Box Photographs
BH304

Box 11-15

44.46 m to 58.23 m

Wet

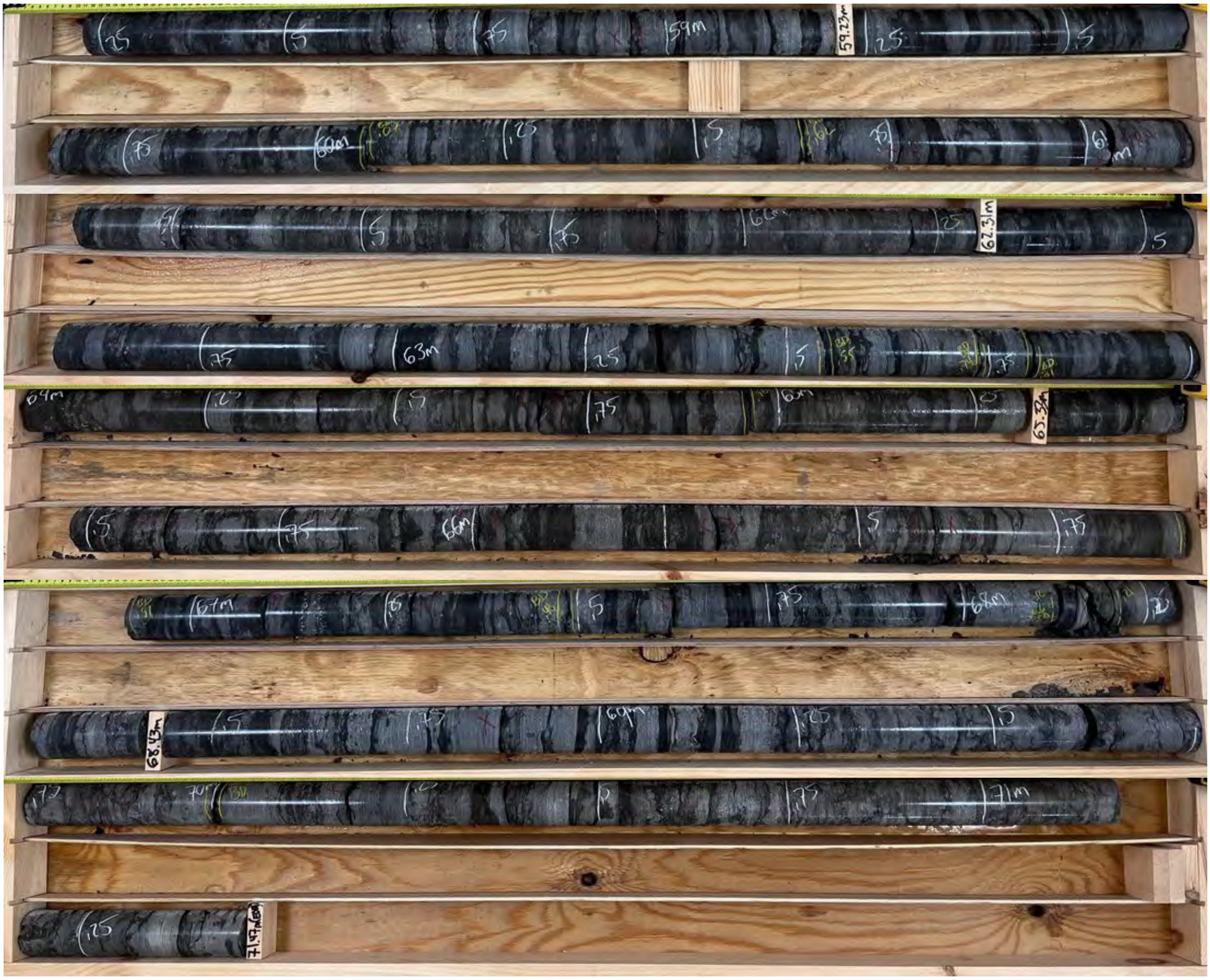
Date: July 2022
Project: 21451329

Drawn: KL
Chkd:

Core Box Photographs
BH304

Box 16-20

58.23 m to 71.47 m

Wet

Date: July 2022
Project: 21451329

Drawn: KL
Chkd:

Core Box Photographs
BH305

Box 1-5

16.20 m to 30.94 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

Core Box Photographs
BH305

Box 6-10

30.94 m to 45.60 m

Wet

Date: July 2022
Project: 21451329

Drawn: KL
Chkd:

Core Box Photographs
BH305

Box 11-15

45.60 m to 59.90 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

Core Box Photographs
BH305

Box 16

59.90 m to 60.62 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

Core Box Photographs
BH306

Box 1-5

18.69 m to 32.05 m

Wet

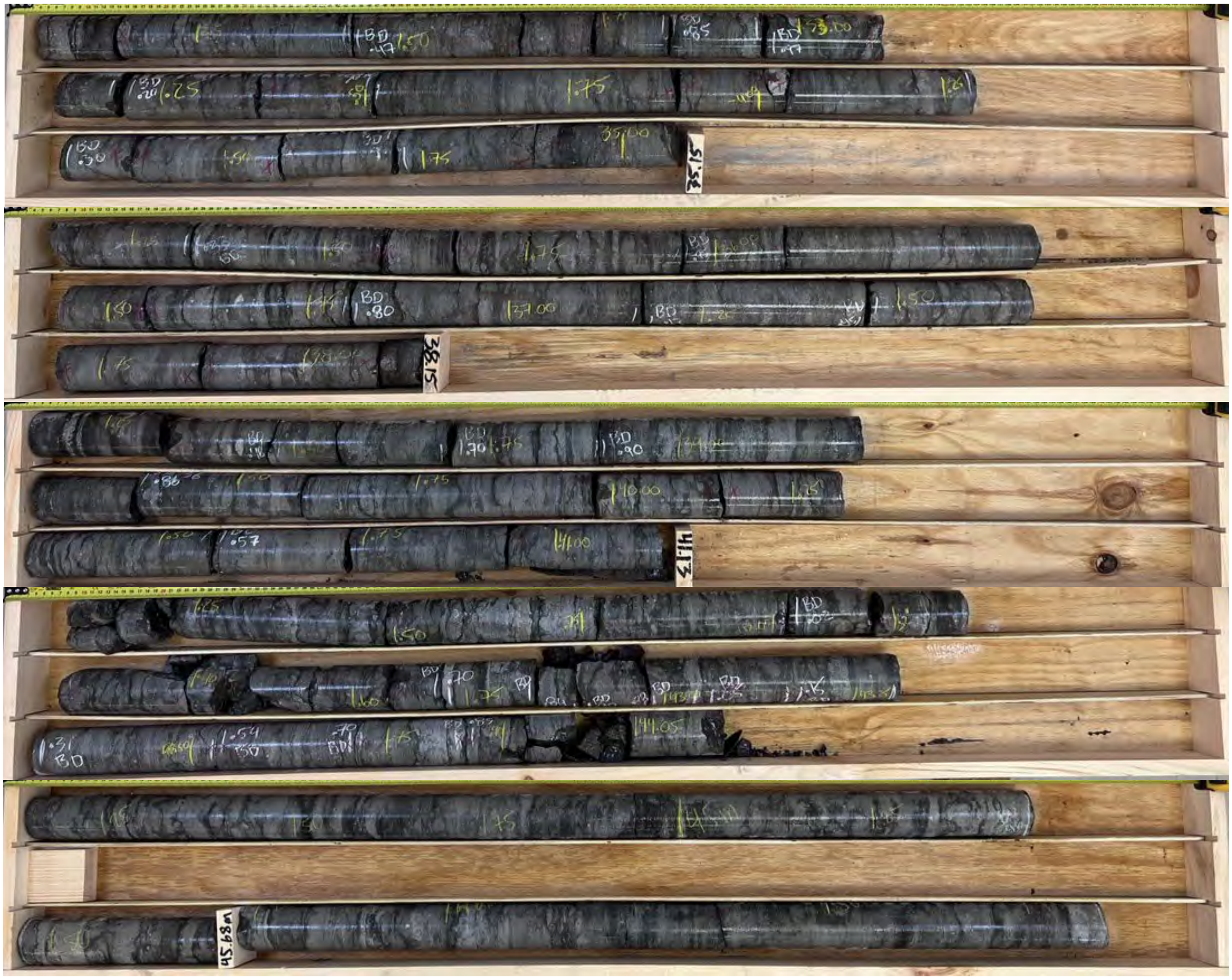
Date: July 2022
Project: 21451329

Drawn: KL
Chkd:

Core Box Photographs
BH306

Box 6-10

32.05 m to 46.85 m

Wet

Date: July 2022

Project: 21451329

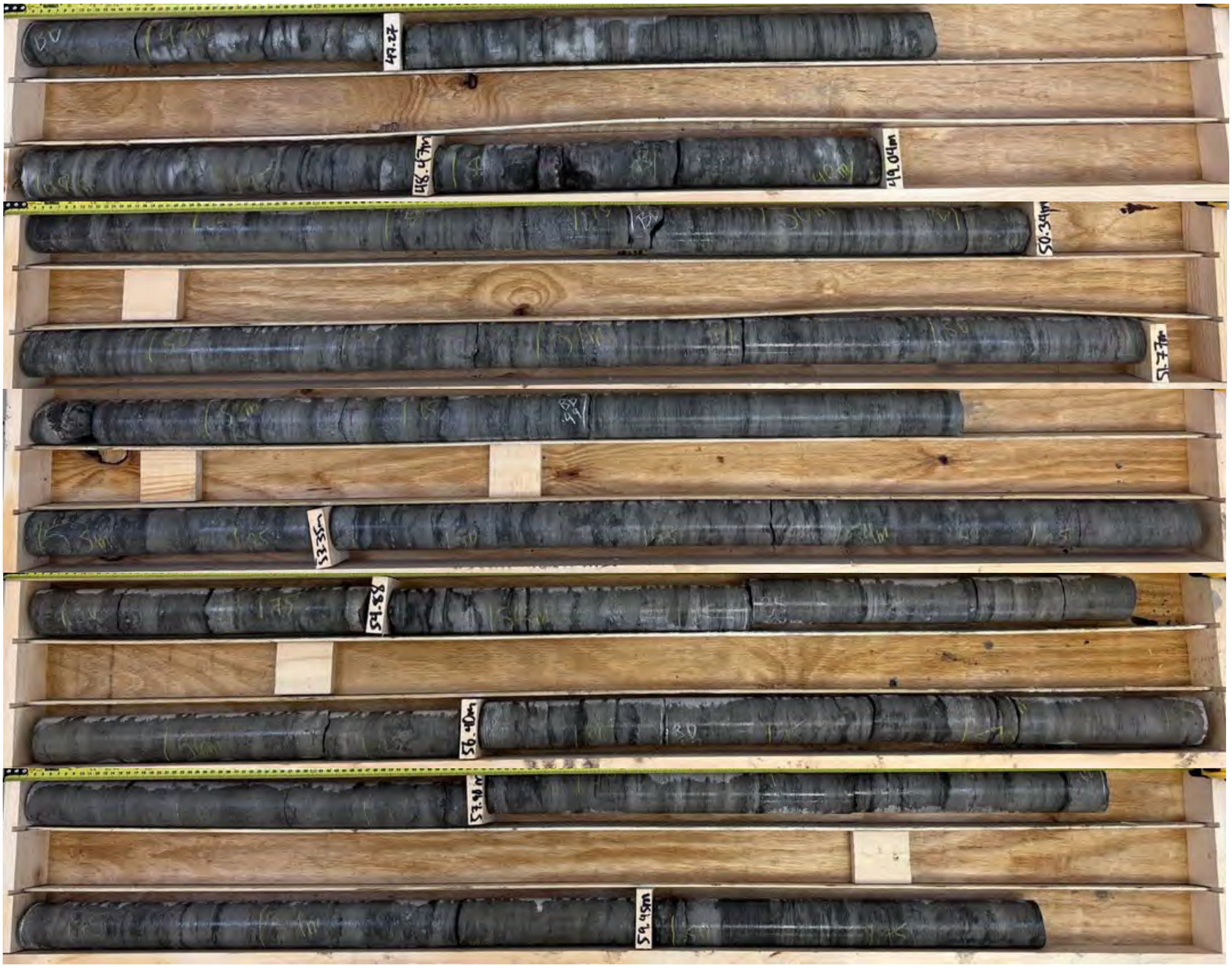
Drawn: KL

Chkd:

Core Box Photographs
BH306

Box 11-15

46.85 m to 59.97 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

Core Box Photographs
BH306

Box 16-19

59.97 m to 70.28 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

Core Box Photographs
BH307

Box 1-5

19.15 m to 34.34 m

Wet

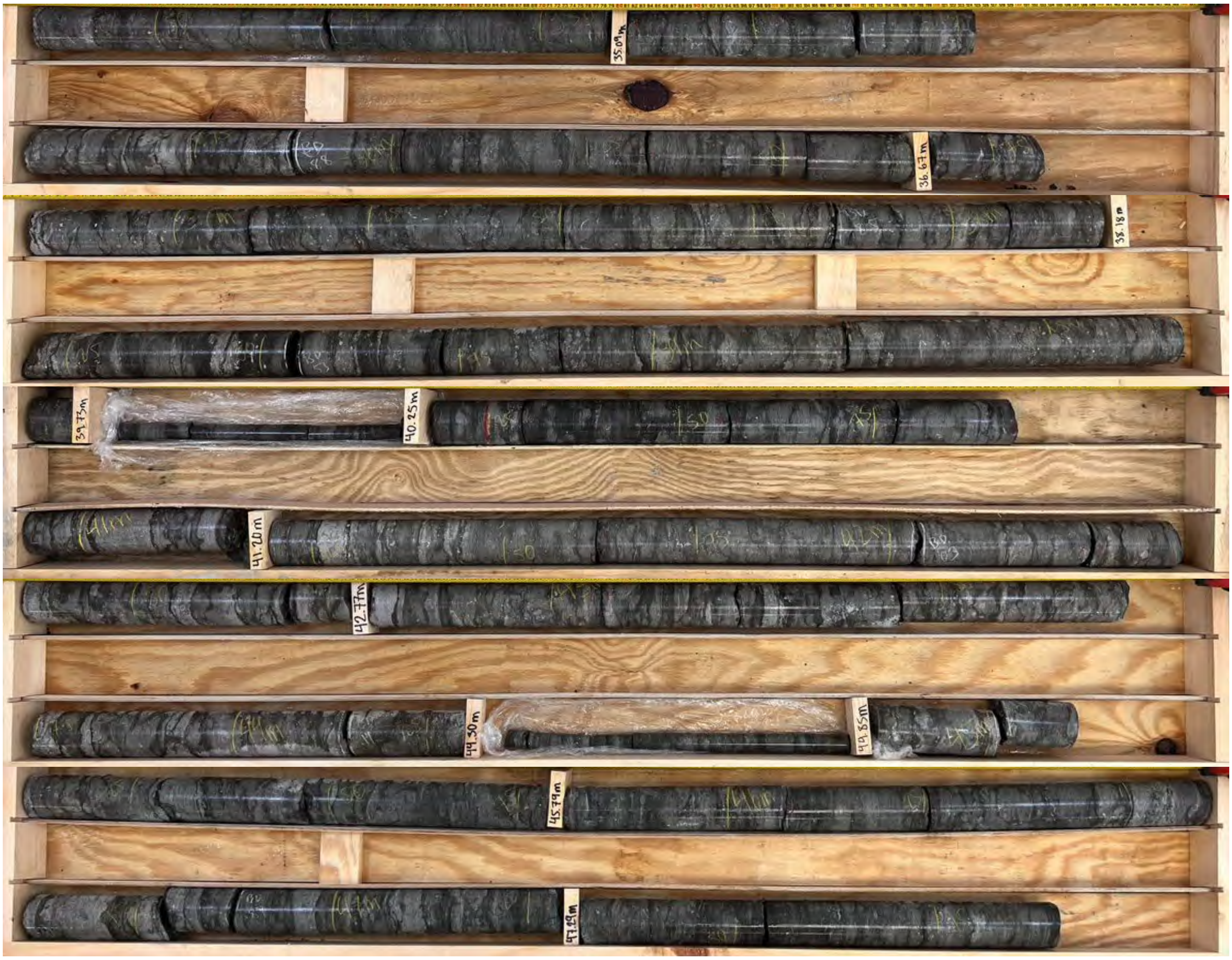
Date: July 2022
Project: 21451329

Drawn: KL
Chkd:

Core Box Photographs
BH307

Box 6-10

34.34 m to 47.90 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

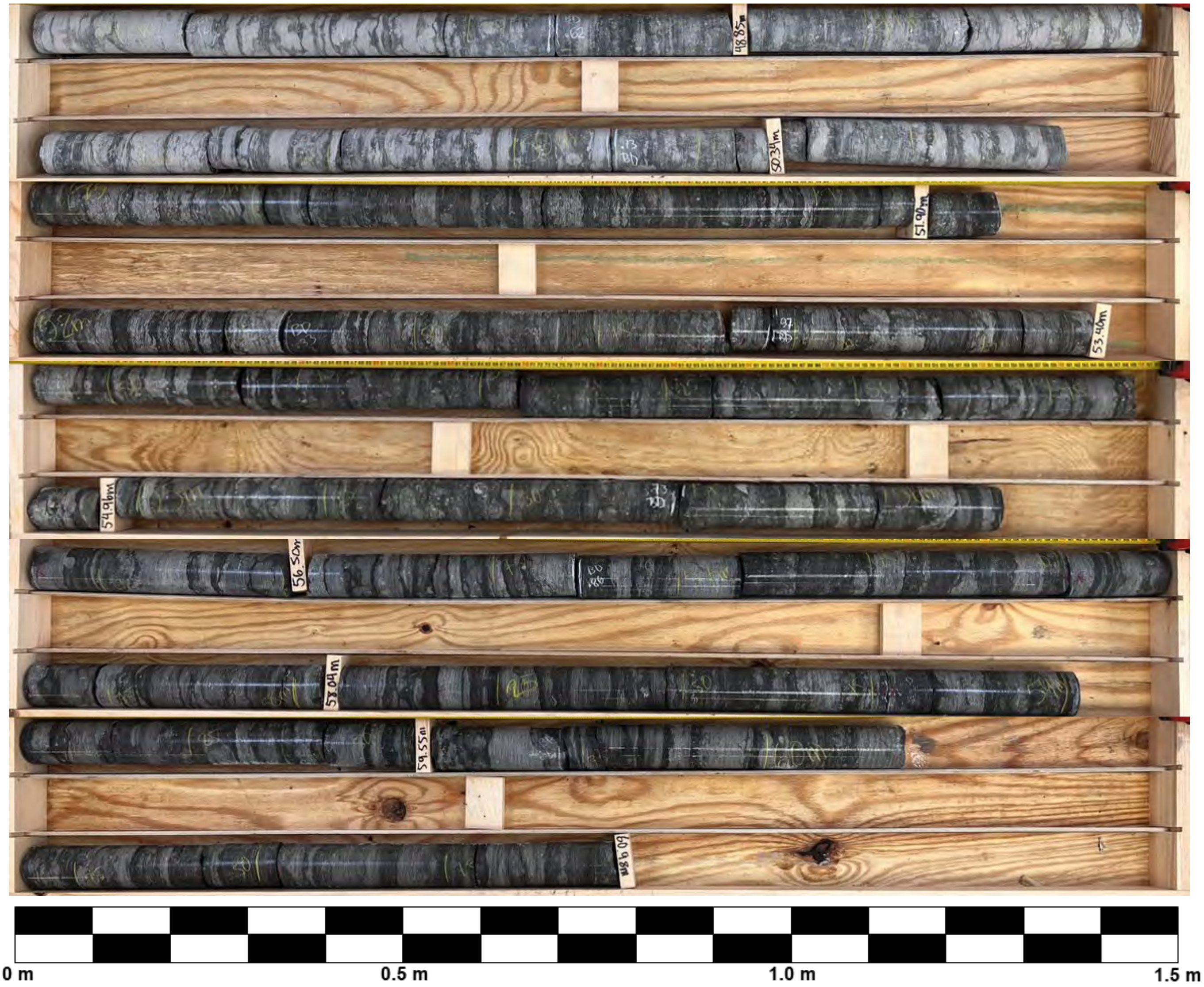
Chkd:

Core Box Photographs
BH307

Box 11-15

47.90 m to 60.98 m

Wet



Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

Core Box Photographs
BH308

Box 1-5

21.14 m to 35.89 m

Wet

Date: July 2022
Project: 21451329

Drawn: KL
Chkd:

Core Box Photographs
BH308

Box 6-10

35.89 m to 49.98 m

Wet

Date: July 2022
Project: 21451329

Drawn: KL
Chkd:

Core Box Photographs
BH308

Box 11-15

49.98 m to 64.23 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

Core Box Photographs
BH308

Box 16-17

64.23 m to 68.63 m

Wet

Date: July 2022
Project: 21451329

Drawn: KL
Chkd:

Core Box Photographs
BH309

Box 1-5

19.14 m to 33.63 m

Wet

Date: July 2022
Project: 21451329

Drawn: KL
Chkd:

Core Box Photographs
BH309

Box 6-10

33.63 m to 48.12 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

Core Box Photographs
BH309

Box 11-15

48.12 m to 60.85 m

Wet

Date: July 2022

Project: 21451329

Drawn: KL

Chkd:

APPENDIX D

Rock Laboratory Results

Rock Laboratory Testing Results

A report submitted to:
Alex Champigny
WSP Golder
6925 Century Avenue, Suite #100
Mississauga, Ontario
Canada L5N 7K2

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January 31, 2023
Project number: 21451329

Abstract

This document summarizes the results of rock laboratory testing, including 41 Uniaxial Compressive Strength (UCS) tests, 24 triaxial compressive strength tests, 30 Brazilian Disc (BD) tensile strength tests, 25 Point Load Tests (PLT), 27 ISRM Indentation Hardness (Punch Penetration) tests, 25 CERCHAR Abrasivity tests, and 20 Direct Shear tests. The results for each test type are presented in separate subsections herein.

In this document:

1 Uniaxial Compressive Strength Tests

1.1 Overview

This section summarizes the results of uniaxial compressive strength (UCS) testing. The testing was performed in Geomechanica's rock testing laboratory using a 150 ton (1.3 MN) Forney loading frame equipped with pressure-compensated control valve to maintain an axial displacement rate of approximately 0.05 to 0.15 mm/min (Figure 1). The preparation and testing procedure for each specimen included the following:

1. Unwrapping the core sample, inspecting it for damage, and re-wrapping it in electrical tape to minimize exposure to moisture and potential damage during subsequent specimen preparation.
2. Diamond cutting the core sample to obtain a cylindrical specimen with an appropriate length (length:diameter = 2:1) and nearly parallel end faces.
3. Diamond grinding of the specimen to obtain flat (within ±0.025 mm) and parallel end faces (within 0.25°).
4. Placing the specimen into the loading frame, applying a 1 kN axial load, and removing the electrical tape.
5. Axially loading the specimens to rupture while continuously recording axial force and axial and radial deformation to determine the peak strength (UCS), Young's modulus, and Poisson's ratio.

Figure 1: Forney loading frame setup for UCS testing.

Using a precision V-block mounted on the magnetic chuck of the surface grinder, test specimens met the end flatness, end parallelism, and perpendicularity criteria set out in ASTM D4543-19. The side straightness criteria, as checked with a feeler gauge, was met for all samples and the minimum length:diameter criteria was met for all specimens unless noted otherwise in Table 1. Testing of the specimens followed ASTM D7012-14 Method C or D.

1.2 Quantifying Poisson's ratio

To quantify the Poisson's ratio, the radial strain during UCS testing was recorded using a specially designed sensor consisting of a radial spring and non-contact displacement transducer (Figure 2). This sensor was calibrated by axially loading an aluminum cylinder with known elastic modulus and Poisson's ratio and having the same dimensions as the test specimens. By doing so, the output of the non-contact displacement transducer could be calibrated directly to the radial strain of the cylinder. The Poisson's ratio was measured over the same range of stresses as the tangent Young's modulus.

Figure 2: Radial strain sensor comprised of a radial spring and non-contact displacement transducer positioned on the aluminum calibration cylinder.

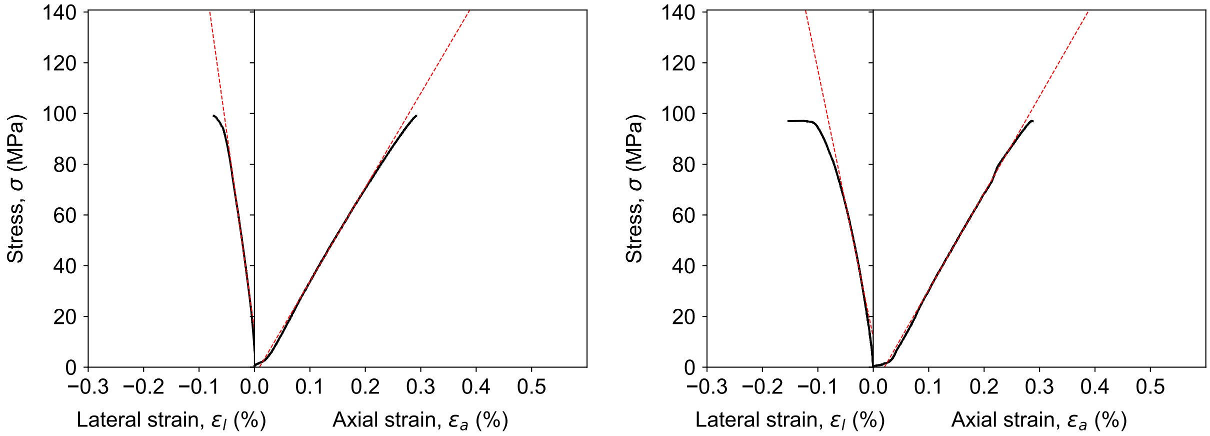
1.3 Results

The results of UCS testing are summarized in Table 1. The corresponding stress-strain curves are presented in Figures 3 to 8. In general, the Young's modulus is the tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength. However, some specimens displayed none linearities in the pre-peak stress-strain curves. In such cases, the moduli were calculated over a stress range where the specimen displayed a linear stress-strain response. The exact stress ranges considered for moduli determination for all specimens are provided in the summary spreadsheet that accompanies this report. The Poisson's ratio is defined as the ratio of the slope of the best-fit line through the radial strain curve to the Young's modulus over the same stress ranges.

Table 1: Summary of UCS test results.

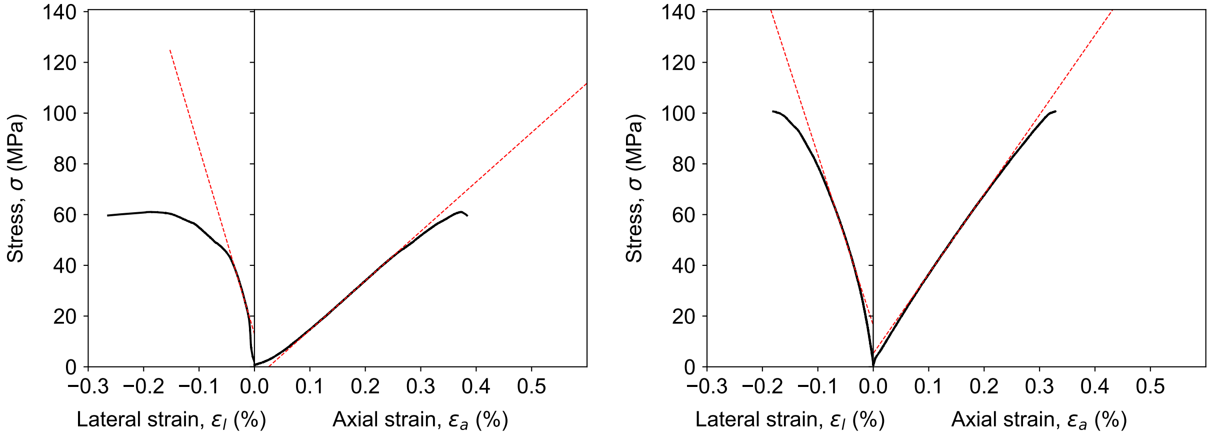
Sample	Depth (m)	Bulk density ρ (g/cm^3)	UCS (MPa)	Young's modulus E (GPa)	Poisson's ratio ν (-)	Lithology	Failure description
BH207-RS-SA6	33.66 - 33.96	2.675	99.1	37.1	0.24	Limestone/Shale	1, 2
BH207-RS-SA12	40.39 - 40.63	2.675	97.1	38.1	0.36	Limestone/Shale	1
BH304-RS-SA4	41.46 - 41.71	2.634	61.0	19.5	0.27	Limestone/Shale	1
BH204-RS-SA4	37.25 - 37.52	2.684	100.7	31.4	0.47	Limestone/Shale	3
BH204-RS-SA8	44.55 - 44.74	2.621	79.2	29.7	0.56	Limestone/Shale	3
BH306-RS-SA10	40.33 - 40.55	2.677	87.8	26.8	0.38	Limestone/Shale	3
BH302-RS-SA3	38.31 - 38.51	2.679	57.2	25.3	0.27	Limestone/Shale	1
BH203-RS-SA4	40.56 - 40.77	2.679	94.6	30.7	0.37	Limestone/Shale	3, 2
BH303-RS-SA2	35.24 - 35.44	2.750	70.0	37.4	0.46	Limestone/Shale	3
BH303-RS-SA4	39.75 - 39.97	2.681	83.4	28.0	0.44	Limestone/Shale	3
BH206-RS-SA3	38.03 - 38.27	2.665	86.7	37.1	0.26	Limestone/Shale	1, 2
BH26-RS-SA1	37.60 - 37.81	2.684	86.3	-	-	Limestone/Shale	4
BH26-RS-SA2	39.94 - 40.26	2.684	103.7	33.7	0.33	Limestone/Shale	3, 5
BH23-RS-SA1	39.18 - 39.35	2.677	101.2	36.1	0.35	Limestone/Shale	1
BH23-RS-SA3	46.35 - 46.61	2.657	71.4	-	-	Limestone/Shale	1, 2
BH24-RS-SA1	42.52 - 42.79	2.663	97.3	39.5	0.36	Limestone/Shale	1, 2
BH24-RS-SA2	45.55 - 45.76	2.679	99.0	-	-	Limestone/Shale	1, 6
BH24-RS-SA6	58.87 - 59.05	2.678	52.1	-	-	Limestone/Shale	1, 2
BH202-RS-SA1	29.49 - 29.68	2.690	106.9	53.9	0.44	Limestone/Shale	3
BH202-RS-SA7	37.48 - 37.66	2.670	69.4	33.4	0.31	Limestone/Shale	1
BH21-RS-SA1	37.57 - 37.73	2.679	55.7	44.1	0.33	Limestone/Shale	3
BH21-RS-SA7	49.73 - 49.93	2.688	77.4	-	-	Limestone/Shale	1, 7
BH22-RS-SA6	39.10 - 39.34	2.686	70.4	46.8	0.42	Limestone	1, 7, 5
BH22-RS-SA9	44.67 - 44.94	2.678	80.6	-	-	Limestone/Shale	1, 2
BH22-RS-SA14	53.25 - 53.47	2.692	85.2	38.6	0.40	Limestone/Shale	1
BH205-RS-SA12	40.14 - 40.39	2.689	105.1	37.8	0.50	Limestone/Shale	1, 2
BH307-RS-SA11	36.81 - 37.09	2.675	86.9	35.6	0.29	Limestone/Shale	3, 5
BH307-RS-SA15	42.37 - 42.69	2.677	87.6	35.1	0.28	Limestone/Shale	4
BH309-RS-SA8	44.95 - 45.18	2.668	70.4	29.3	0.34	Limestone/Shale	1, 2
BH308-RS-SA7	30.27 - 30.46	2.677	93.2	42.2	0.22	Limestone/Shale	3, 5
BH308-RS-SA21	46.67 - 46.86	2.678	68.1	33.7	0.33	Limestone/Shale	1
BH305-RS-SA3	35.36 - 35.61	2.672	102.5	30.9	0.42	Limestone/Shale	1, 2, 5
BH301-RS-SA3	37.43 - 37.69	2.684	79.0	37.7	0.25	Limestone/Shale	1, 2
BH24-RS-SA7	25.53 - 25.71	2.661	120.9	32.0	0.29	Brown Shale	1, 2
BH26-RS-SA5	23.21 - 23.40	2.665	134.1	31.0	0.31	Brown Shale	1
BH17-RS-04	44.55 - 44.81	2.671	84.6	30.1	0.26	Limestone/shale	1, 2
BH17-RS-06	36.42 - 36.67	2.664	79.4	-	-	Limestone/shale	1, 2
BH7-RS-04	40.11 - 40.37	2.664	50.3	23.6	0.23	Limestone/shale	1, 8
BH7-RS-05	51.08 - 51.33	2.685	111.8	-	-	Limestone/shale	1
BH75-RS-04	51.58 - 51.86	2.683	89.5	35.5	0.31	Limestone/shale	1
BH75-RS-08	44.77 - 45.02	2.679	77.8	-	-	Limestone/shale	1

[1] Inclined shear fracture and axial splitting failure
[2] Partial hourglass failure
[3] Axial splitting failure
[4] Inclined shear failure
[5] Localized crushing near platen
[6] Hourglass failure
[7] Failure partly along pre-existing structure
[8] Diffuse axial splitting



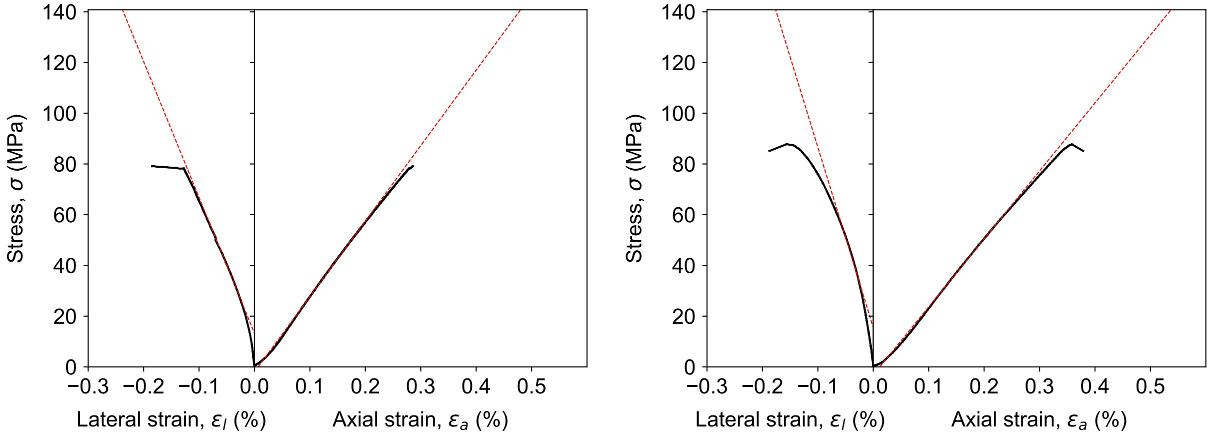
(a) BH207-RS-SA6

(b) BH207-RS-SA12



(c) BH304-RS-SA4

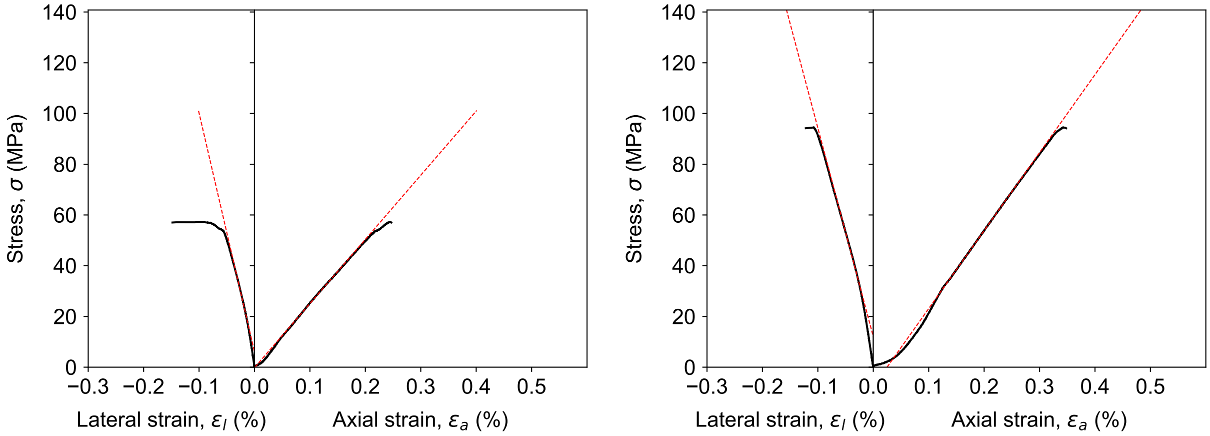
(d) BH204-RS-SA4



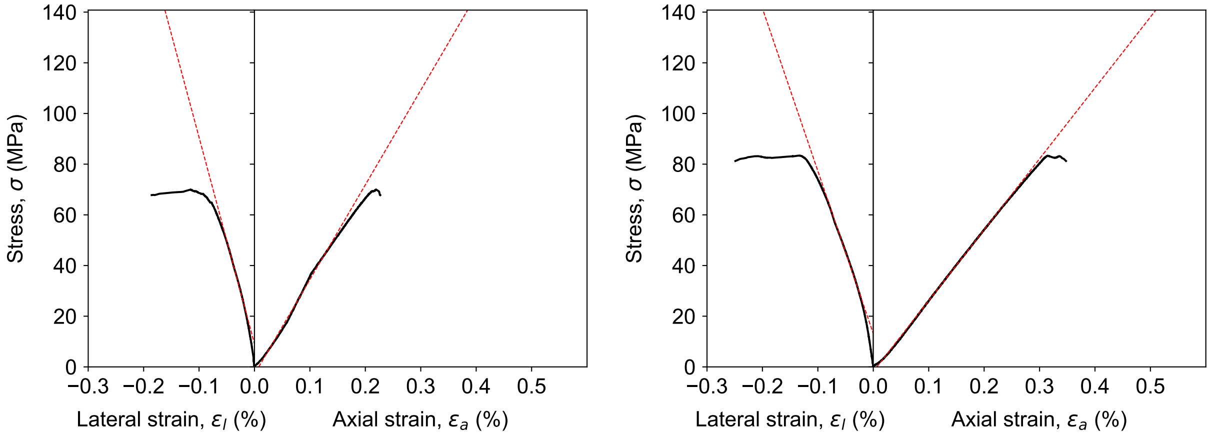
(e) BH204-RS-SA8

(f) BH306-RS-SA10

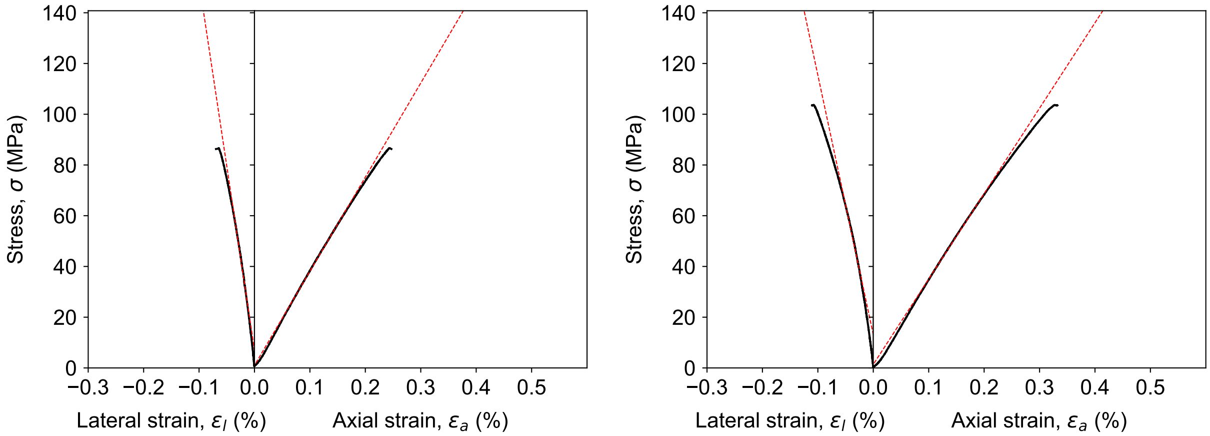
Figure 3: Measured stress-strain curves.



(a) BH302-RS-SA3 (b) BH203-RS-SA4

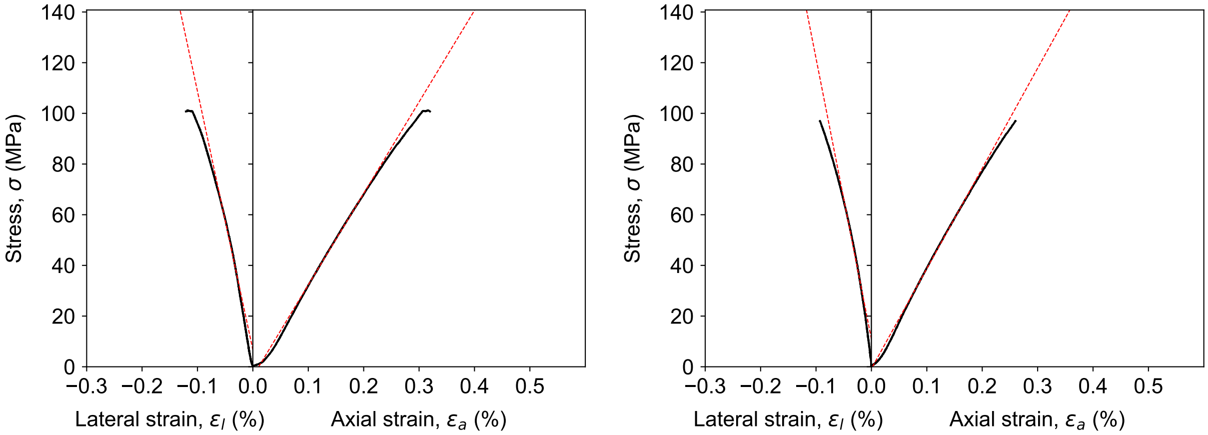


(c) BH303-RS-SA2 (d) BH303-RS-SA4



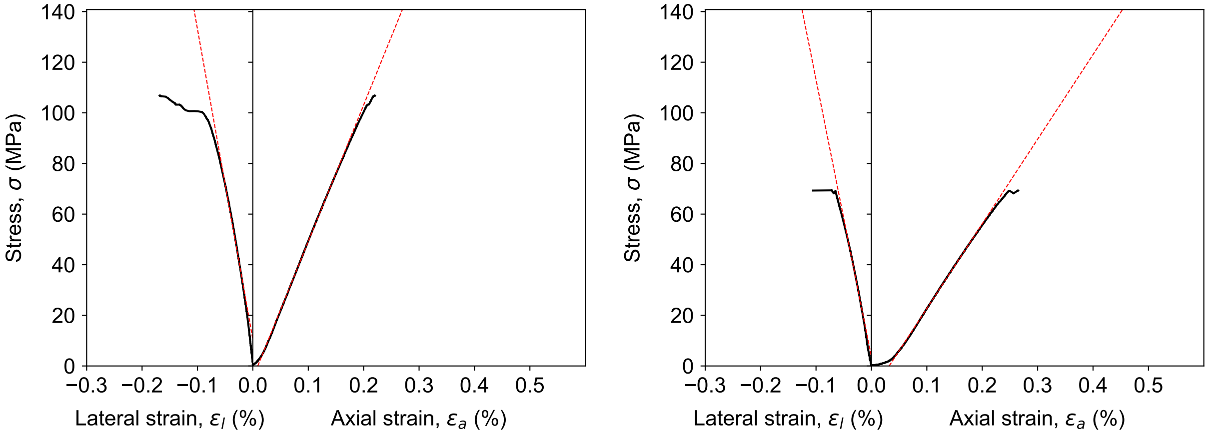
(e) BH206-RS-SA3 (f) BH26-RS-SA2

Figure 4: Measured stress-strain curves.



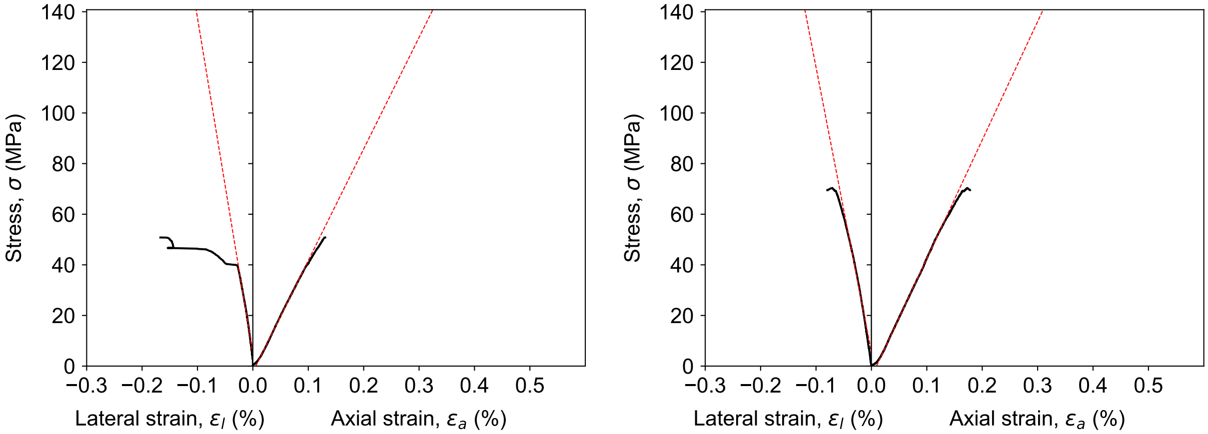
(a) BH23-RS-SA1

(b) BH24-RS-SA1



(c) BH202-RS-SA1

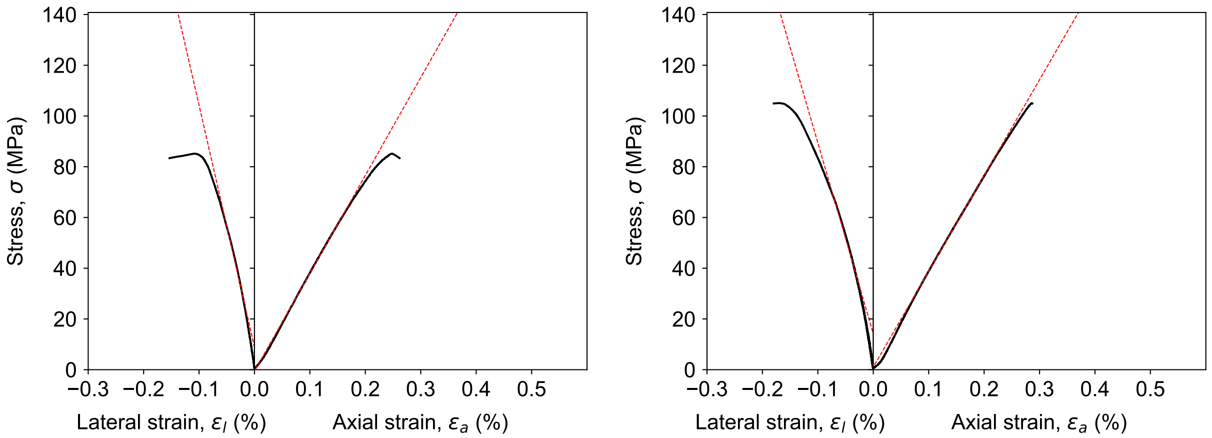
(d) BH202-RS-SA7



(e) BH21-RS-SA1

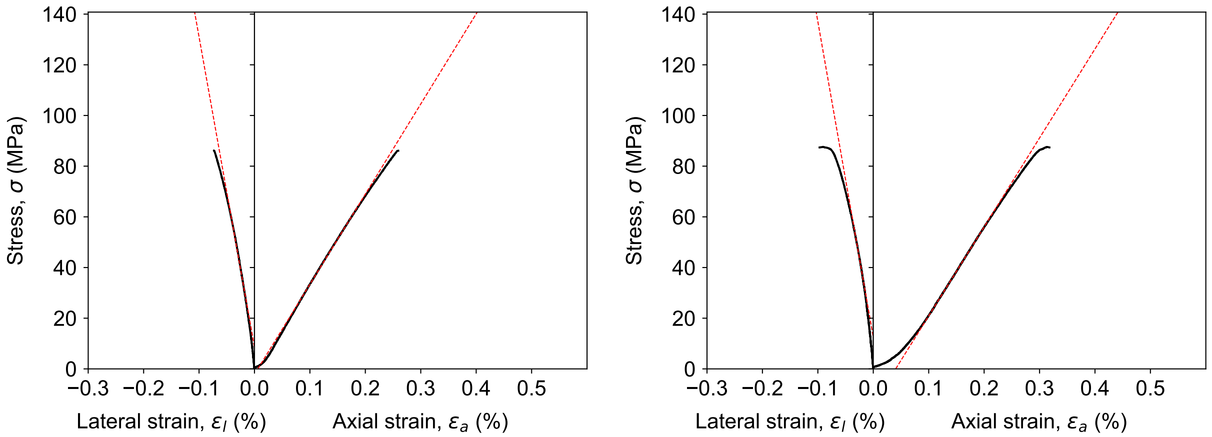
(f) BH22-RS-SA6

Figure 5: Measured stress-strain curves.



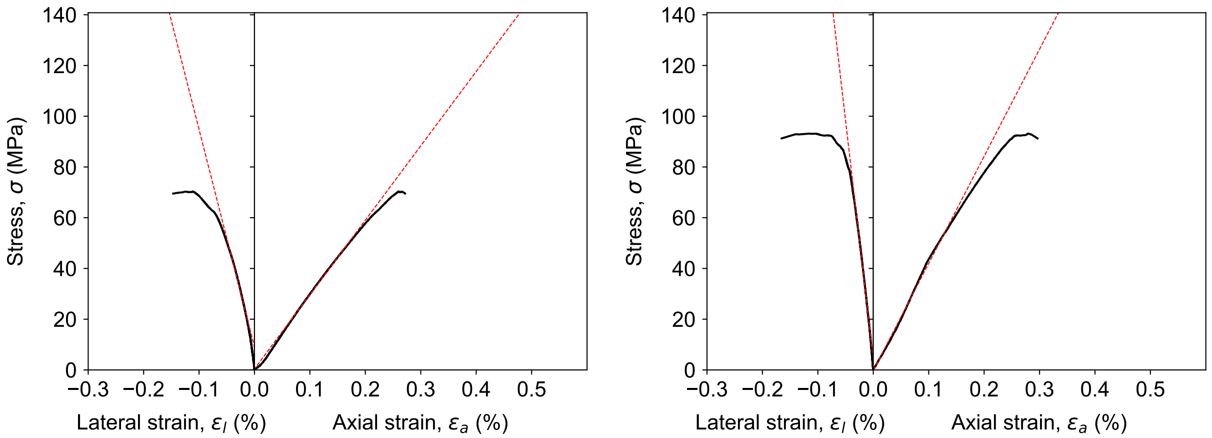
(a) BH22-RS-SA14

(b) BH205-RS-SA12



(c) BH307-RS-SA11

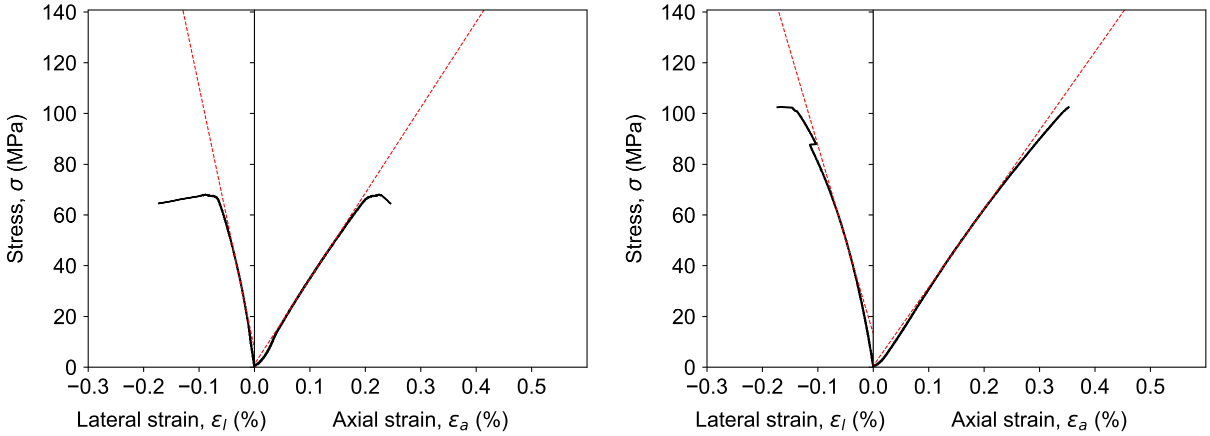
(d) BH307-RS-SA15



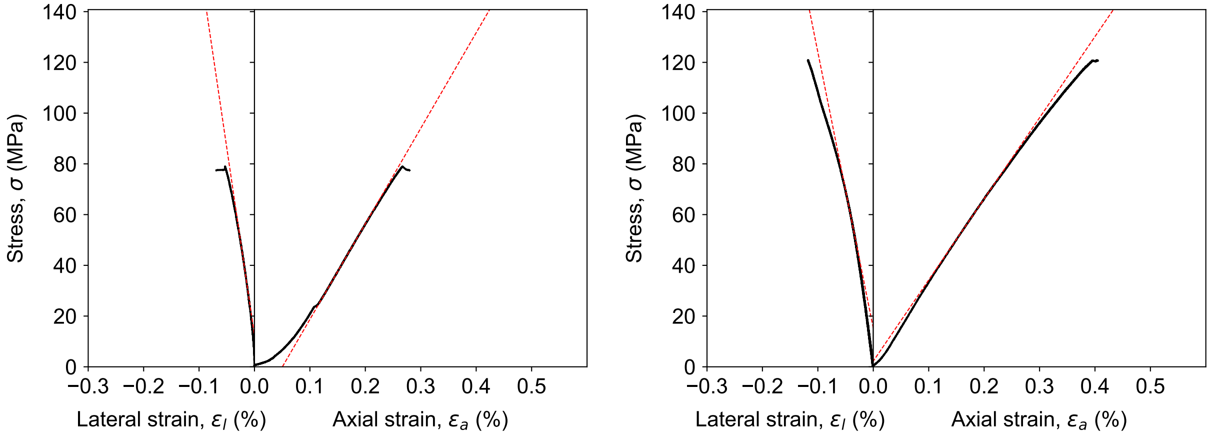
(e) BH309-RS-SA8

(f) BH308-RS-SA7

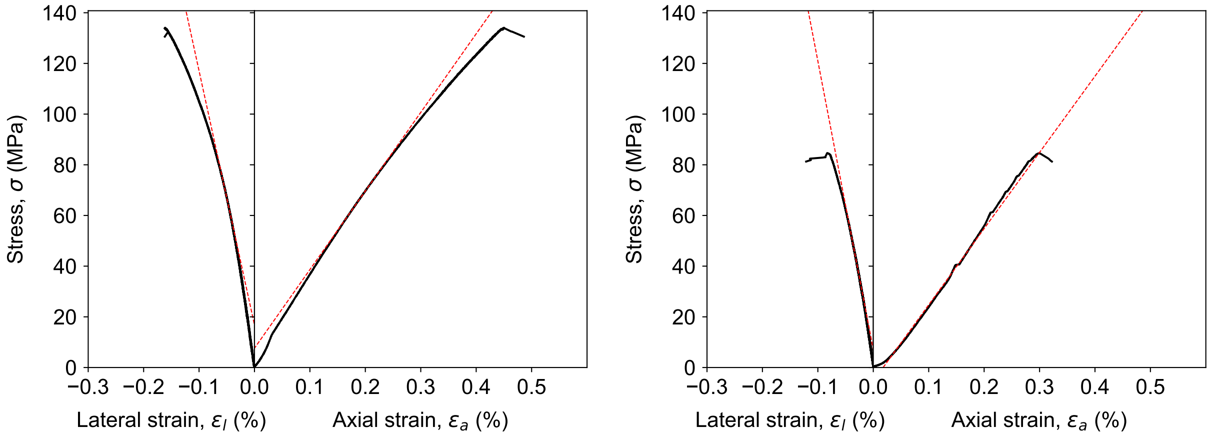
Figure 6: Measured stress-strain curves.



(a) BH308-RS-SA21 (b) BH305-RS-SA3

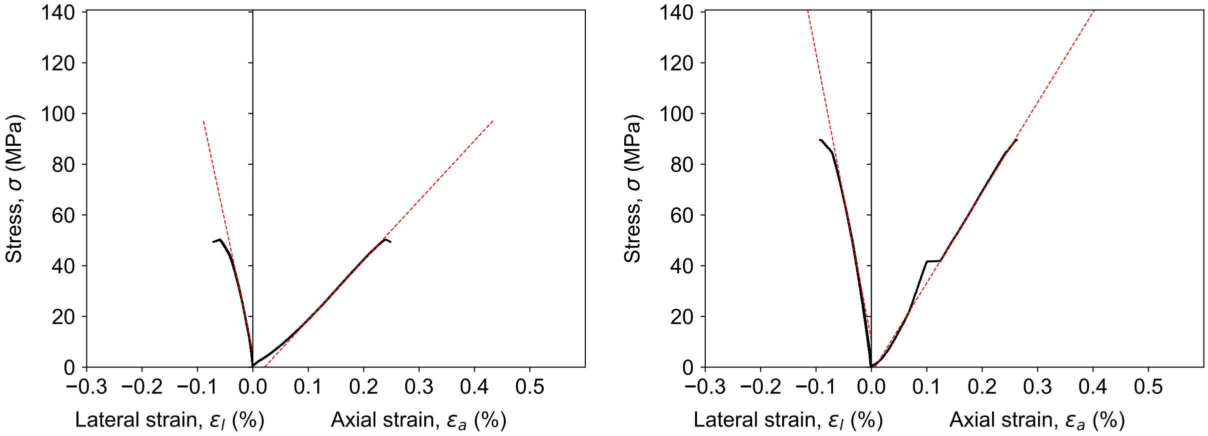


(c) BH301-RS-SA3 (d) BH24-RS-SA7



(e) BH26-RS-SA5 (f) BH17-RS-04

Figure 7: Measured stress-strain curves.



(a) BH7-RS-04

(b) BH75-RS-04

Figure 8: Measured stress-strain curves.

1.4 Specimen photographs

Photographs of the specimens before and after testing are presented in the Appendix of this report.

2 Triaxial Compressive Strength Tests

2.1 Overview

This section summarizes the results of triaxial compression testing. The testing was performed in Geomechanica's rock testing laboratory using a 150 ton (1.3 MN) Forney loading frame equipped with pressure-compensated control valve to maintain a pre-peak axial displacement rate of approximately 0.10 mm/min. The confining pressure was applied using a Vindum Engineering VP-6k metering pump coupled to a Hoek triaxial cell. The preparation and testing procedure for each triaxial specimen included:

1. Unwrapping the core sample, inspecting it for damage, and, if moisture sensitive, re-wrapping in electrical tape to minimize disturbance during subsequent specimen preparation.
2. Diamond cutting the core sample to obtain a cylindrical specimen with an appropriate length (length:diameter = 2:1) and nearly parallel end faces.
3. Surface grinding of specimen to obtain flat (within ±0.025 mm) and parallel end faces (within 0.25°).
4. Placing the test specimen into a Hoek cell and applying and maintaining a nearly constant confining pressure for the duration of the test. (Note that electrical tape was applied to specimen during testing to avoid issues with specimen breakage during insertion and removal from the Hoek cell).
5. Axially loading the test specimens until they experienced approximately 3 to 4 % axial strain and continuously recording the axial force, axial deformation, and confining pressure to determine the minimum and maximum principal stresses, σ_3 and σ_1, at failure.
6. Removing the test specimen from the Hoek cell, removing the electrical tape, and photographing the resulting failure patterns.

Using a precision V-block mounted on the magnetic chuck of the surface grinder, test specimens met the end flatness, end parallelism, and perpendicularity criteria set out in ASTM D4543-19. The side straightness criteria, as checked with a feeler gauge, was met for all samples and the minimum length:diameter criteria was met for all specimens unless noted otherwise in Table 1. Testing of the specimens followed ASTM D7012-14 with the following note:

- Triaxial tests included the measurement of axial strain, but not radial strain. This represents a hybrid between Methods A and B of ASTM D7012-14.

2.2 Results

The results of triaxial testing are summarized in Table 2. The corresponding stress-strain curves are shown in Figure 10 to 13. The Young's modulus is the tangent modulus, calculated as the slope of the best fit line

Figure 9: Triaxial test setup, including loading frame and Hoek cell.

through ±300 data points on either side of the point representing 50.0% of the peak strength. Additional details and measurements for the test specimens are included in the accompanying summary spreadsheet.

Table 2: Summary of Triaxial Compression test results.

Sample	Depth (m)	Bulk density ρ (g/cm^3)	σ_1 (MPa)	Young's modulus E (GPa)	σ_3 (MPa)	Lithology	Failure description
BH205-RS-SA1	28.24 - 28.51	2.670	111.1	31.4	3.7	Limestone/Shale	1
BH205-RS-SA2	28.51 - 28.73	2.675	149.0	47.7	7.6	Limestone/Shale	2, 3
BH205-RS-SA3	29.45 - 29.74	2.677	166.5	39.3	15.1	Limestone/Shale	2
BH205-RS-SA4	30.32 - 30.59	2.667	195.0	34.9	22.6	Limestone/Shale	2
BH205-RS-SA6	31.55 - 31.82	2.694	168.9	49.0	7.6	Limestone/Shale	1
BH205-RS-SA7	32.32 - 32.59	2.677	170.3	36.4	15.1	Limestone/Shale	2, 4
BH205-RS-SA9	34.26 - 34.47	2.688	134.5	36.3	3.8	Limestone/Shale	2, 3
BH205-RS-SA10	34.76 - 35.00	2.665	195.5	36.8	22.6	Limestone/Shale	2, 3
BH205-RS-SA14	43.18 - 43.46	2.680	144.8	37.6	15.1	Limestone/Shale	2
BH205-RS-SA16	46.41 - 46.71	2.680	120.9	33.9	7.6	Limestone/Shale	2
BH205-RS-SA17	48.40 - 48.65	2.658	94.9	23.4	3.7	Limestone/Shale	2
BH205-RS-SA18	49.73 - 49.96	2.664	156.2	24.4	22.6	Limestone/Shale	2
BH307-RS-SA1	23.75 - 24.02	2.671	193.1	31.4	22.6	Limestone/Shale	2
BH307-RS-SA4	27.39 - 27.68	2.671	178.3	42.1	15.1	Limestone/Shale	2
BH307-RS-SA6	31.42 - 31.68	2.675	132.3	36.3	7.6	Limestone/Shale	2, 3, 4
BH307-RS-SA7	32.02 - 32.35	2.668	134.1	40.0	3.8	Limestone/Shale	2, 3
BH307-RS-SA9	35.09 - 35.37	2.676	144.8	38.4	7.6	Limestone/Shale	2, 4

Continued on next page

Table 2 – Summary of Triaxial Compression test results. (continued from previous page)

Sample	Depth (m)	Bulk density ρ (g/cm^3)	σ_1 (MPa)	Young's modulus E (GPa)	σ_3 (MPa)	Lithology	Failure description
BH307-RS-SA10	36.01 - 36.33	2.662	146.3	26.4	15.1	Limestone/Shale	2
BH307-RS-SA16	43.45 - 43.73	2.684	185.7	38.4	22.6	Limestone/Shale	2
BH307-RS-SA18	45.47 - 45.79	2.681	119.0	34.9	3.8	Limestone/Shale	2, 3
BH307-RS-SA19	47.29 - 47.54	2.657	83.4	24.1	3.8	Limestone/Shale	2
BH307-RS-SA20	47.54 - 47.79	2.667	118.1	28.1	7.6	Limestone/Shale	2
BH307-RS-SA24	50.70 - 51.01	2.655	138.4	30.7	15.1	Limestone/Shale	2
BH307-RS-SA26	53.40 - 53.68	2.680	189.4	30.0	22.6	Limestone/Shale	2

[1] Inclined shear fracture and axial splitting failure

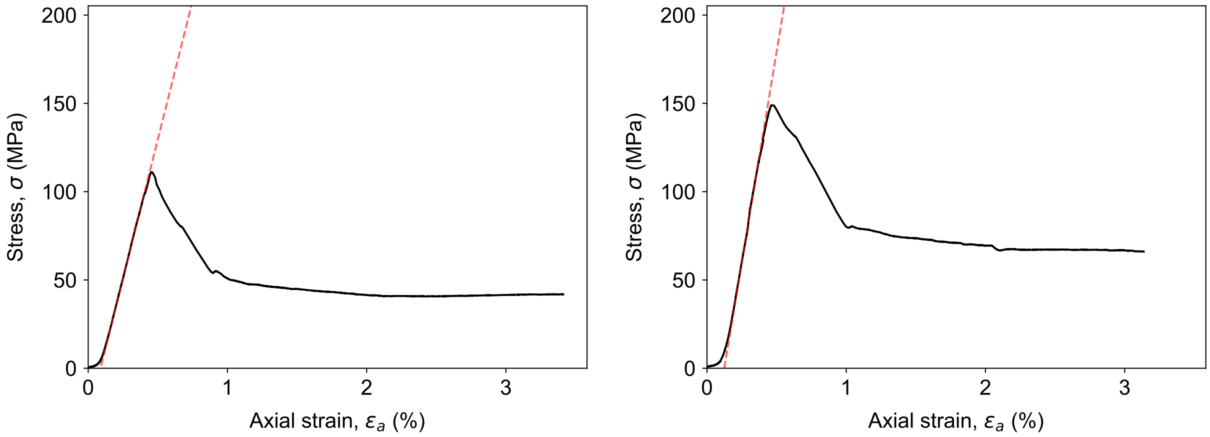
[2] Inclined shear failure

[3] Partial hourglass failure

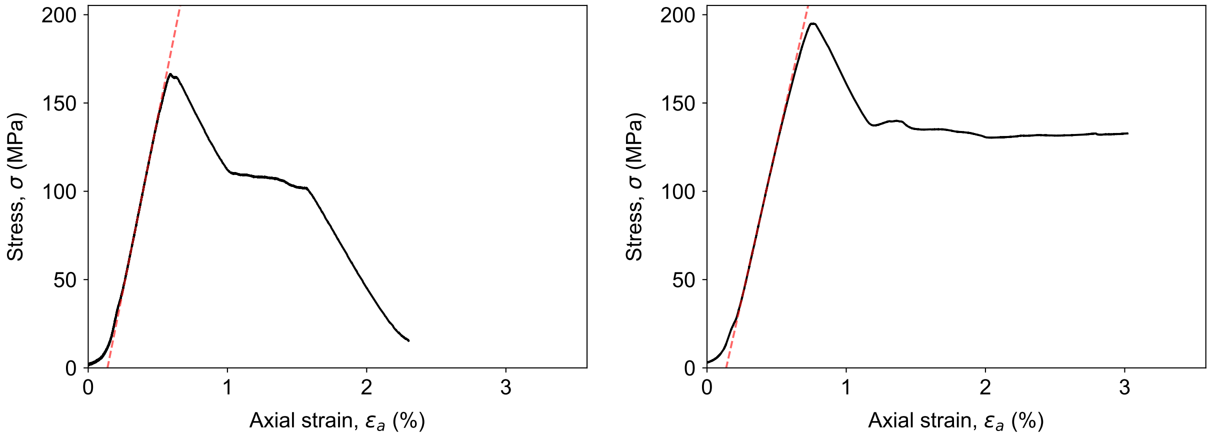
[4] Localized crushing near platen

2.3 Specimen photographs

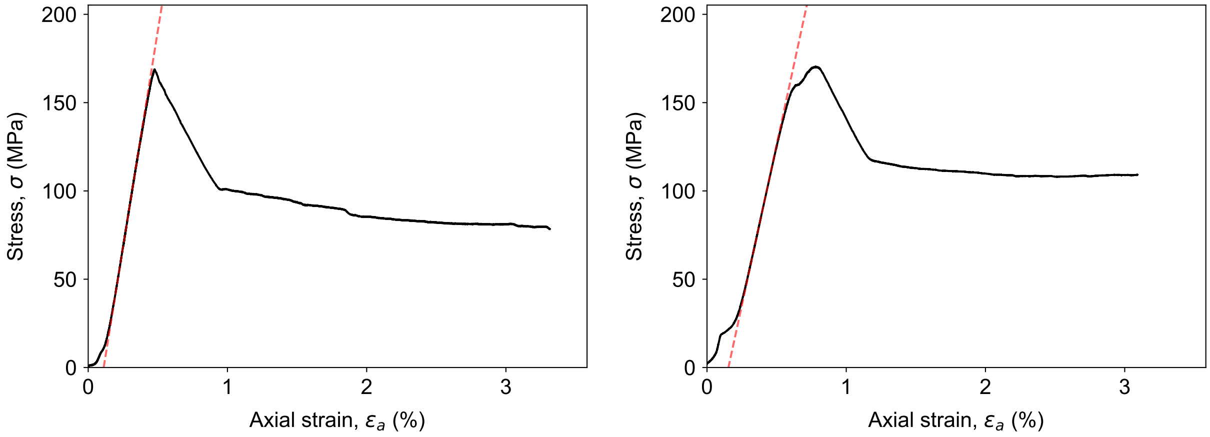
Photographs of the specimens after testing are presented in the Appendix of this report.



(a) BH205-RS-SA1 (b) BH205-RS-SA2

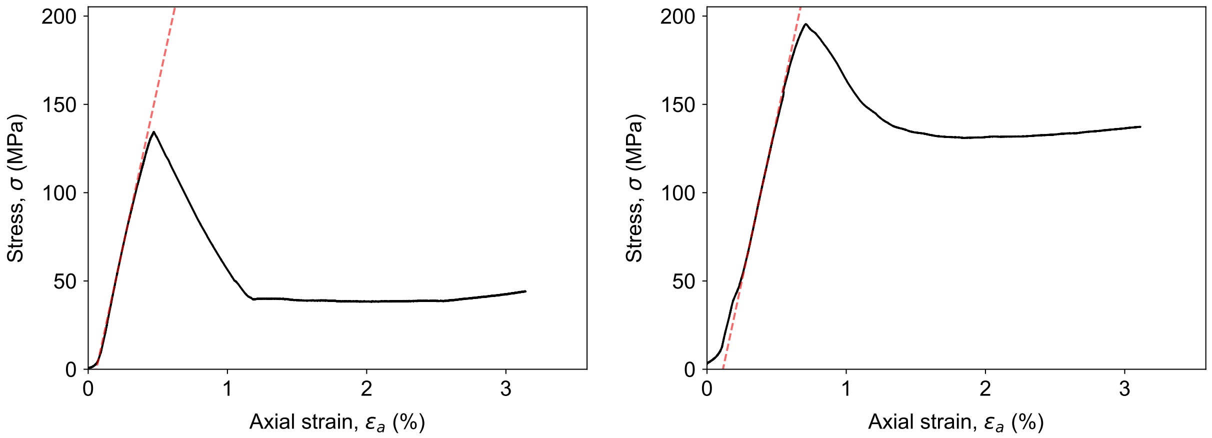


(c) BH205-RS-SA3 (d) BH205-RS-SA4



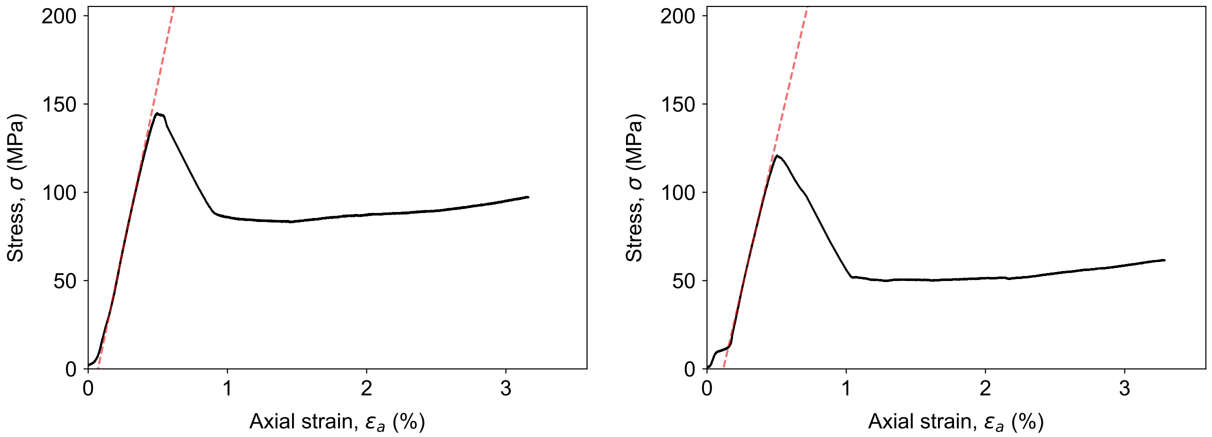
(e) BH205-RS-SA6 (f) BH205-RS-SA7

Figure 10: Measured stress-strain curves.



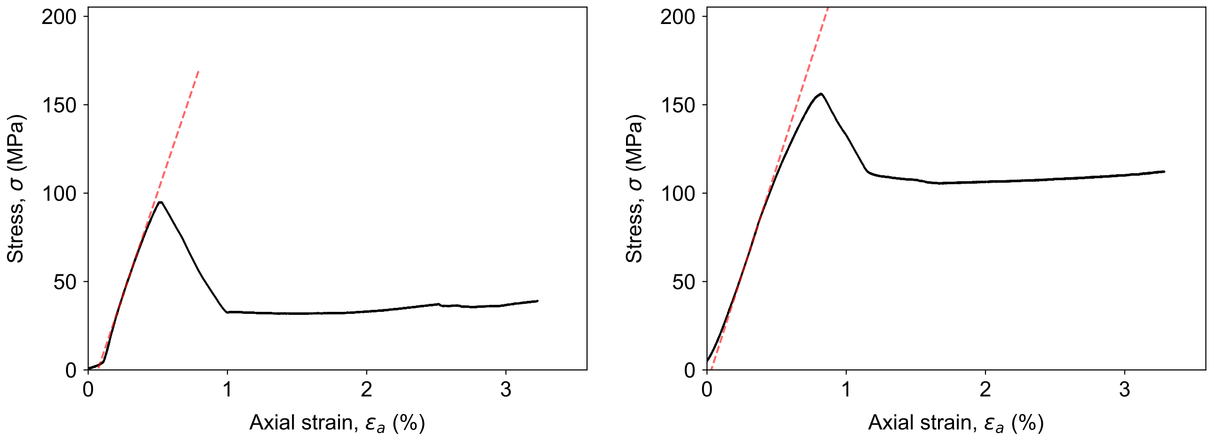
(a) BH205-RS-SA9

(b) BH205-RS-SA10



(c) BH205-RS-SA14

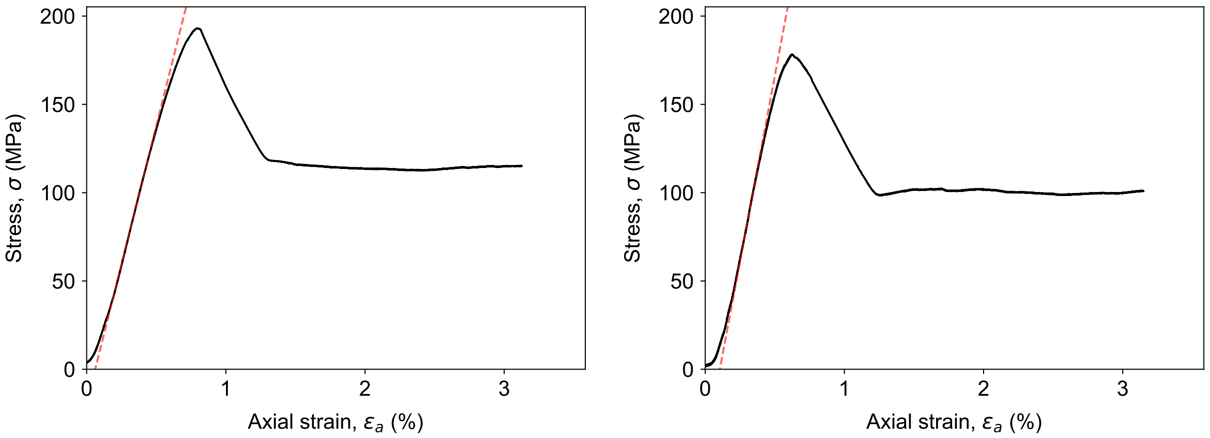
(d) BH205-RS-SA16



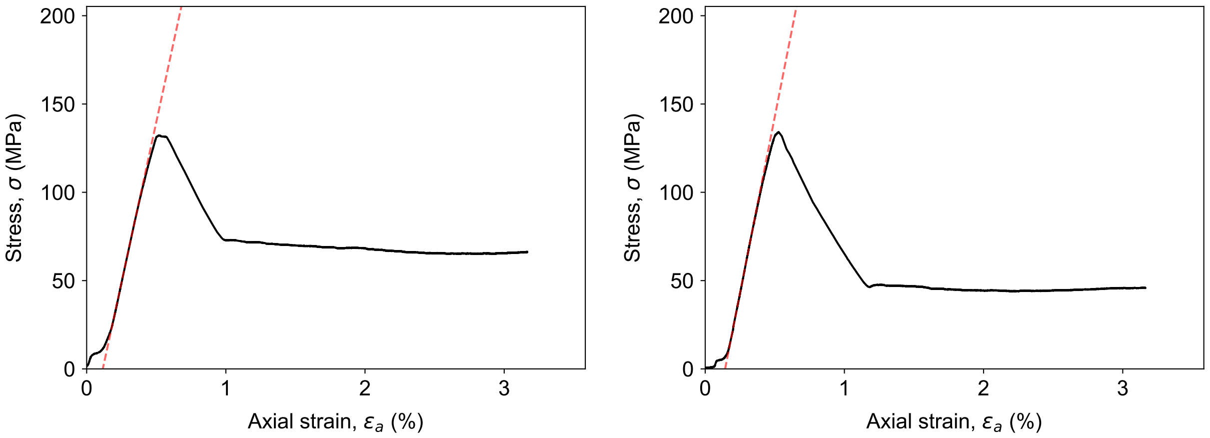
(e) BH205-RS-SA17

(f) BH205-RS-SA18

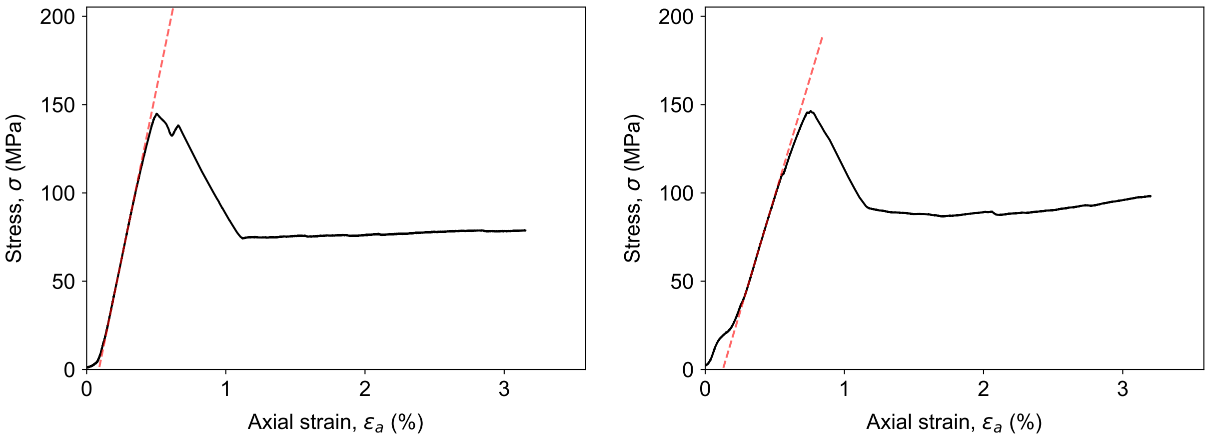
Figure 11: Measured stress-strain curves.



(a) BH307-RS-SA1 (b) BH307-RS-SA4

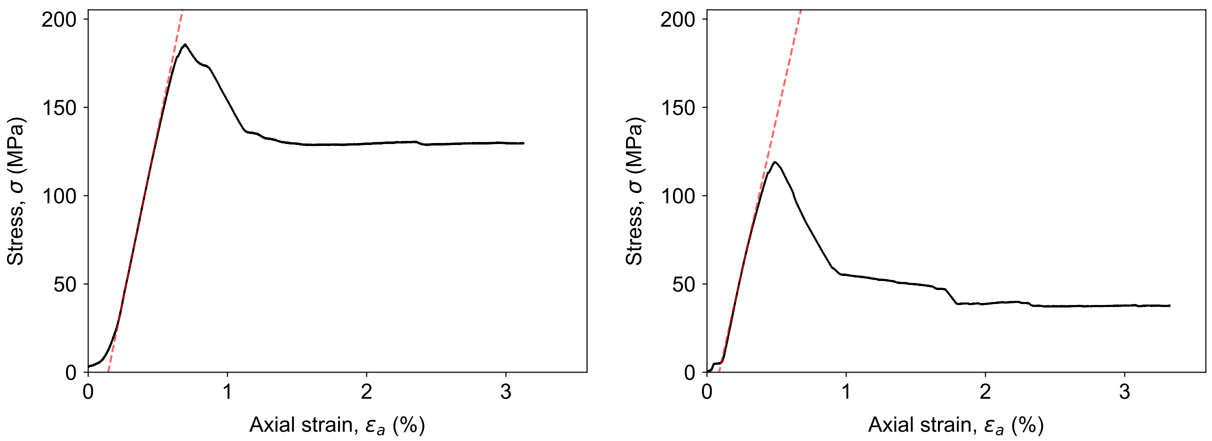


(c) BH307-RS-SA6 (d) BH307-RS-SA7

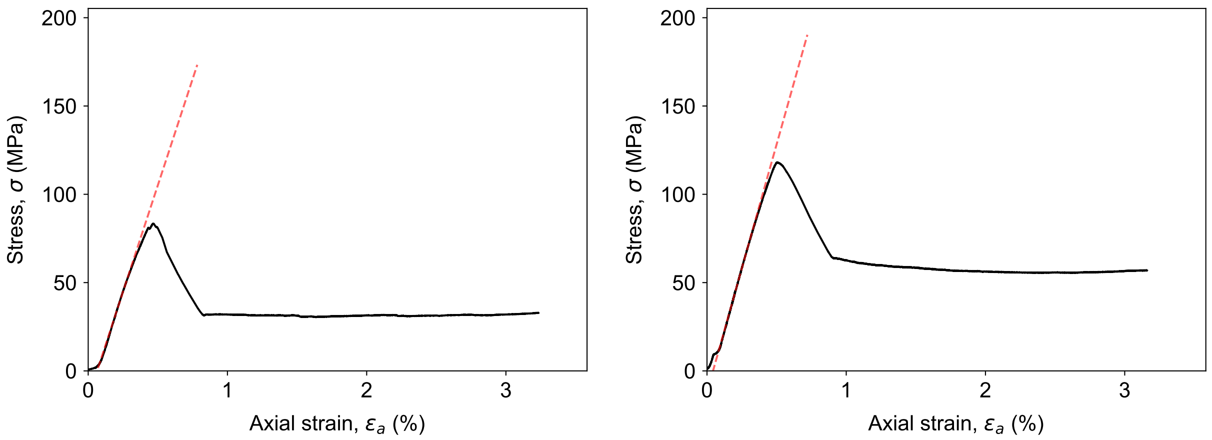


(e) BH307-RS-SA9 (f) BH307-RS-SA10

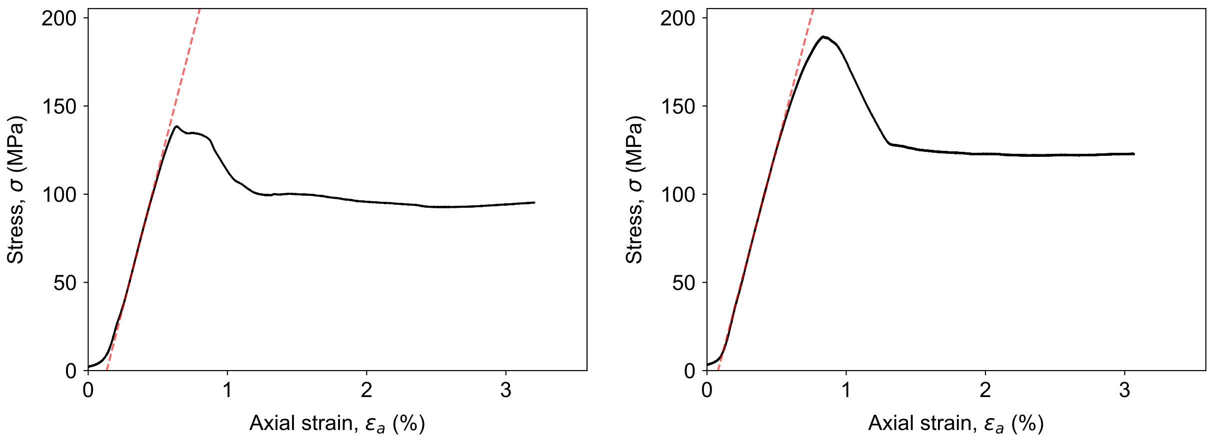
Figure 12: Measured stress-strain curves.



(a) BH307-RS-SA16 (b) BH307-RS-SA18



(c) BH307-RS-SA19 (d) BH307-RS-SA20



(e) BH307-RS-SA24 (f) BH307-RS-SA26

Figure 13: Measured stress-strain curves.

3 Brazilian Disc Tests

3.1 Overview

This section summarizes the results of Brazilian disc testing. The tests were performed using a 12 ton Carver hydraulic loading frame coupled to a SPX hydraulic pump fitted with a pressure-compensated flow control valve (Figure 14). A consistent displacement rate of approximately 0.20 mm/min was employed for all tests. The specimen preparation and testing procedure included the following:

1. Unwrapping of the core sample, inspecting it for damage, and re-wrapping it in electrical tape to minimize exposure to moisture and possible damage during subsequent specimen preparation.
2. Diamond cutting of the core sample to obtain disc specimens with nearly flat (within 0.5 mm) and parallel (within 0.5° end faces and a thickness approximately equal to the core radius. From each core, up to 5 discs were prepared and tested.
3. Diametric loading of the disc specimens to rupture using a hydraulic loading frame equipped with fixed flat loading platens. The applied force and diametric displacement were continuously measured to calculate the indirect tensile strength. Note that a strip of tape and cardboard was placed on the specimens at the platen contact points to act as a cushion to distribute the applied load over the thickness of the sample.

The above Brazilian disc testing procedure adhered to ASTM D3967-16.

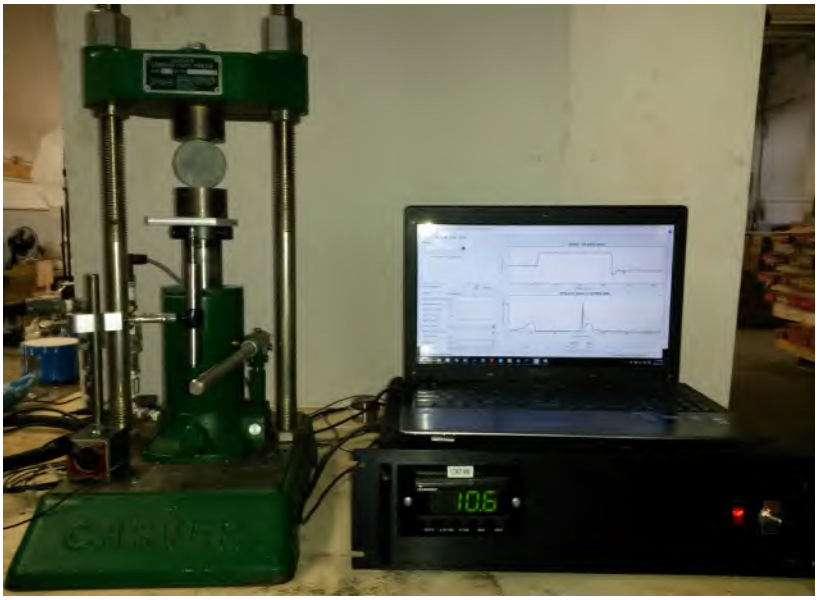


Figure 14: Brazilian Disc (BD) testing setup.

3.2 Results

A summary of the Brazilian disc testing results are provided in Table 3. Additional details and measurements for the test specimens are included in the accompanying summary spreadsheet. The indirect tensile strength, σ_t, was calculated, as:

$$\sigma_t = \frac{2P}{\pi D t} \tag{1}$$

where P is the peak diametric load; D is the specimen diameter; and t is the specimen thickness.

It must be noted that some BD specimena did not fail via diametric splitting. Some failed via a combination of diametric splitting and fissility delamination, while others simply failed at the platen contact points or along existing structure within the specimen. The failure mode of each disc is noted in the last column of the summary table.

Table 3: Summary of Brazilian Disc test results.

Borehole	Sample	Disc	Depth (m)	Bulk density ρ (g/cm^3)	Tensile strength (MPa)	Lithology	Failure description
BH207	BH207-RS-SA7	1	34.27 - 34.55	2.621	5.5	Limestone/Shale	1
		2		2.643	5.1	Limestone/Shale	2
		3		2.635	7.3	Limestone/Shale	2
		4		2.642	7.3	Limestone/Shale	2
		5		2.648	5.8	Limestone/Shale	2
			Average	2.638	6.2		
			Standard deviation	0.009	0.9		
BH304	BH304-RS-SA5	1	43.49 - 43.68	2.661	6.5	Limestone/Shale	2
		2		2.662	7.0	Limestone/Shale	2
		3		2.661	5.5	Limestone/Shale	2
		4		2.639	6.9	Limestone/Shale	2
			Average	2.656	6.5		
			Standard deviation	0.010	0.6		
BH204	BH204-RS-SA5	1	38.90 - 39.08	2.635	5.1	Limestone/Shale	2
		2		2.644	5.3	Limestone/Shale	2
		3		2.647	6.3	Limestone/Shale	2
		4		2.634	6.5	Limestone/Shale	2
		5		2.631	8.4	Limestone/Shale	2
			Average	2.638	6.3		
			Standard deviation	0.006	1.2		
BH306	BH306-RS-SA6	1	37.75 - 37.67	2.639	6.0	Limestone/Shale	2
		2		2.628	7.1	Limestone/Shale	2
		3		2.634	5.2	Limestone/Shale	2
		4		2.620	5.7	Limestone/Shale	2
		5		2.615	6.6	Limestone/Shale	2

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Table 3 – Summary of Brazilian Disc test results. (continued from previous page)

Borehole	Sample	Disc	Depth (m)	Bulk density ρ (g/cm^3)	Tensile strength (MPa)	Lithology	Failure description
			Average	2.627	6.1		
			Standard deviation	0.009	0.6		
BH306	BH306-RS-SA11	1	43.31 - 43.51	2.631	4.6	Limestone/Shale	2
		2		2.636	6.3	Limestone/Shale	2
		3		2.632	7.7	Limestone/Shale	2
		4		2.615	5.8	Limestone/Shale	2
		5		2.589	4.9	Limestone/Shale	2
			Average	2.620	5.9		
			Standard deviation	0.017	1.1		
BH302	BH302-RS-SA5	1	45.74 - 45.94	2.622	6.4	Limestone/Shale	2
		2		2.636	6.4	Limestone/Shale	2
		3		2.654	6.5	Limestone/Shale	2
		4		2.622	6.4	Limestone/Shale	2
		5		2.650	6.6	Limestone/Shale	2
			Average	2.637	6.5		
			Standard deviation	0.013	0.1		
BH203	BH203-RS-SA5	1	44.36 - 44.59	2.643	7.7	Limestone/Shale	1
		2		2.609	5.3	Limestone/Shale	2
		3		2.632	6.5	Limestone/Shale	2
		4		2.634	7.2	Limestone/Shale	2
		5		2.625	6.7	Limestone/Shale	2
			Average	2.629	6.7		
			Standard deviation	0.011	0.8		
BH303	BH303-RS-SA7	1	46.31 - 46.52	2.638	6.2	Limestone/Shale	2
		2		2.618	7.7	Limestone/Shale	2
		3		2.645	7.6	Limestone/Shale	2
		4		2.648	5.8	Limestone/Shale	2
		5		2.646	6.9	Limestone/Shale	2
			Average	2.639	6.8		
			Standard deviation	0.011	0.7		
BH206	BH206-RS-SA2	1	33.96 - 34.22	2.648	7.3	Limestone/Shale	2
		2		2.656	7.1	Limestone/Shale	2
		3		2.633	6.7	Limestone/Shale	2
		4		2.607	4.3	Limestone/Shale	2
		5		2.629	7.5	Limestone/Shale	2
			Average	2.634	6.6		
			Standard deviation	0.017	1.2		
BH202	BH202-RS-SA2	1	31.09 - 31.31	2.638	5.6	Limestone/Shale	1
		2		2.626	5.3	Limestone/Shale	2
		3		2.637	7.3	Limestone/Shale	2
		4		2.650	6.0	Limestone/Shale	2

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Table 3 – Summary of Brazilian Disc test results. (continued from previous page)

Borehole	Sample	Disc	Depth (m)	Bulk density ρ (g/cm^3)	Tensile strength (MPa)	Lithology	Failure description
		5		2.618	4.6	Limestone/Shale	1
			Average	2.634	5.8		
			Standard deviation	0.011	0.9		
BH202	BH202-RS-SA8	1	40.32 - 40.52	2.628	7.2	Limestone/Shale	2
		2		2.645	4.6	Limestone/Shale	1
		3		2.663	2.9	Limestone/Shale	1
		4		2.650	4.9	Limestone/Shale	2
		5		1.990	4.3	Limestone/Shale	2
			Average	2.515	4.8		
			Standard deviation	0.263	1.4		
BH205	BH205-RS-SA15	1	44.86 - 45.15	2.645	5.5	Limestone/Shale	2
		2		2.662	6.4	Limestone/Shale	2
		3		2.665	6.0	Limestone/Shale	2
		4		2.641	6.5	Limestone/Shale	2
		5		2.665	8.2	Limestone/Shale	2
			Average	2.656	6.5		
			Standard deviation	0.010	0.9		
BH307	BH307-RS-SA14	1	40.93 - 41.19	2.670	7.6	Limestone/Shale	2
		2		2.647	5.3	Limestone/Shale	2
		3		2.686	8.4	Limestone/Shale	2
		4		2.647	5.9	Limestone/Shale	2
		5		2.662	5.9	Limestone/Shale	2
			Average	2.662	6.6		
			Standard deviation	0.015	1.2		
BH307	BH307-RS-SA21	1	48.62 - 48.85	2.618	5.0	Limestone/Shale	2
		2		2.635	4.0	Limestone/Shale	2
		3		2.628	4.6	Limestone/Shale	2
		4		2.633	5.6	Limestone/Shale	2
		5		2.629	4.5	Limestone/Shale	2
			Average	2.628	4.7		
			Standard deviation	0.006	0.5		
BH309	BH309-RS-SA5	1	38.47 - 38.65	2.642	4.7	Limestone/Shale	2
		2		2.646	5.3	Limestone/Shale	2
		3		2.650	6.2	Limestone/Shale	2
		4		2.652	5.8	Limestone/Shale	2
		5		2.623	5.8	Limestone/Shale	2
			Average	2.643	5.6		
			Standard deviation	0.010	0.5		
BH308	BH308-RS-SA3	1	26.29 - 26.45	2.633	8.9	Limestone/Shale	2
		2		2.621	8.1	Limestone/Shale	2
		3		2.706	7.5	Limestone/Shale	2

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Table 3 – Summary of Brazilian Disc test results. (continued from previous page)

Borehole	Sample	Disc	Depth (m)	Bulk density ρ (g/cm^3)	Tensile strength (MPa)	Lithology	Failure description
		4		2.651	7.2	Limestone/Shale	2
			Average	2.653	7.9		
			Standard deviation	0.032	0.6		
BH308	BH308-RS-SA8	1	31.19 - 31.36	2.660	6.7	Limestone/Shale	2
		2		2.663	6.8	Limestone/Shale	2
		3		2.634	6.7	Limestone/Shale	1
		4		2.658	6.2	Limestone/Shale	2
			Average	2.654	6.6		
			Standard deviation	0.012	0.2		
BH308	BH308-RS-SA13	1	37.25 - 37.42	2.662	5.2	Limestone/Shale	2
		2		2.654	7.7	Limestone/Shale	2
		3		2.654	6.1	Limestone/Shale	2
		4		2.651	5.3	Limestone/Shale	2
			Average	2.655	6.1		
			Standard deviation	0.004	1.0		
BH308	BH308-RS-SA23	1	49.82 - 49.98	2.678	7.2	Limestone/Shale	2
		2		2.665	7.2	Limestone/Shale	2
		3		2.669	4.8	Limestone/Shale	2
		4		2.652	6.8	Limestone/Shale	2
			Average	2.666	6.5		
			Standard deviation	0.009	1.0		
BH305	BH305-RS-SA2	1	32.92 - 33.20	2.662	5.7	Limestone/Shale	2
		2		2.665	8.3	Limestone/Shale	2
		3		2.644	6.7	Limestone/Shale	2
		4		2.656	5.9	Limestone/Shale	2
		5		2.662	5.0	Limestone/Shale	2
			Average	2.658	6.3		
			Standard deviation	0.008	1.1		
BH301	BH301-RS-SA5	1	43.37 - 43.60	2.662	6.1	Limestone/Shale	2
		2		2.670	6.0	Limestone/Shale	2
		3		2.664	6.2	Limestone/Shale	2
		4		2.662	6.4	Limestone/Shale	2
		5		2.640	6.2	Limestone/Shale	2
			Average	2.659	6.2		
			Standard deviation	0.010	0.1		
BH23	BH23-RS-SA6	1	44.37 - 44.63	2.648	8.5	Limestone	2
		2		2.649	7.5	Limestone	2
		3		2.647	4.3	Limestone	2
		4		2.639	6.7	Limestone	2
		5		2.628	5.0	Limestone	1
			Average	2.642	6.4		

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Table 3 – Summary of Brazilian Disc test results. (continued from previous page)

Borehole	Sample	Disc	Depth (m)	Bulk density ρ (g/cm^3)	Tensile strength (MPa)	Lithology	Failure description
			Standard deviation	0.008	1.5		
BH24	BH24-RS-SA8	1	25.74 - 25.88	2.539	4.5	Shale	3
		2		2.587	5.8	Shale	1
		3		2.560	4.4	Shale	3
			Average	2.562	4.9		
			Standard deviation	0.020	0.6		
BH24	BH24-RS-SA9	1	41.26 - 41.48	2.653	8.1	Limestone	2
		2		2.629	8.2	Limestone	2
		3		2.647	8.2	Limestone	2
		4		2.638	6.3	Limestone	2
		5		2.640	6.4	Limestone	2
			Average	2.642	7.5		
			Standard deviation	0.008	0.9		
BH26	BH26-RS-SA6	1	23.49 - 23.61	2.588	5.2	Shale	2
		2		2.553	3.4	Shale	3
		3		2.545	6.0	Shale	1
			Average	2.562	4.9		
			Standard deviation	0.019	1.1		
BH26	BH26-RS-SA7	1	22.85 - 23.01	3.609	8.1	Shale	3
		2		2.574	8.7	Shale	2
		3		2.568	5.7	Shale	2
		4		2.535	7.9	Shale	1
			Average	2.822	7.6		
			Standard deviation	0.455	1.1		
BH207	BH207-RS-SA18	1	17.22 - 17.35	2.547	5.8	Shale	1
		2		2.556	7.5	Shale	3
		3		2.476	6.2	Shale	1
			Average	2.526	6.5		
			Standard deviation	0.036	0.7		
BH17	BH17-RS-07	1	48.18 - 48.39	2.638	6.8	Limestone	2
		2		2.633	10.3	Limestone	2
		3		2.652	5.2	Limestone	2
		4		2.661	6.9	Limestone	2
		5		2.654	6.8	Limestone	2
			Average	2.647	7.2		
			Standard deviation	0.011	1.7		
BH22	BH22-RS-SA1	1	24.91 - 25.09	2.582	1.6	Shale	3
		2		2.617	6.0	Shale	2
		3		2.626	5.8	Shale	2
		4		2.637	9.3	Shale	2

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Table 3 – Summary of Brazilian Disc test results. (continued from previous page)

Borehole	Sample	Disc	Depth (m)	Bulk density ρ (g/cm^3)	Tensile strength (MPa)	Lithology	Failure description
			Average	2.615	5.7		
			Standard deviation	0.020	2.7		
BH22	BH22-RS-SA2	1	25.95 - 26.15	2.609	8.7	Shale	2
		2		2.635	6.1	Shale	1
		3		2.615	6.6	Shale	1
		4		2.622	4.9	Shale	2
		5		2.648	6.3	Shale	2
			Average	2.626	6.5		
			Standard deviation	0.014	1.2		

[1] Partial diametric failure
[2] Diametric failure
[3] Non-diametric failure

3.3 Specimen photographs

Photographs of the BD specimens before and after testing are presented in the Appendix of this report.

4 Point Load Testing

4.1 Overview

This section summarizes the results of Point Load Testing (PLT). Tests were performed using a Carver 12-ton hydraulic press with point load test platens and equipped with a 0-5000 psi digital pressure gauge with a peak pressure holding capability (Figure 15). Testing was completed on rock core samples. Both axial and diametric tests were performed according to ASTM D5731-16.

Figure 15: Point load tester equipped with digital pressure gauge.

4.2 Results

The results of the PLT tests are summarized in Table 4. Note that the load, *P*, in kN was calculated from the measured peak pressure, as:

$$P = p \times A_{ram} \tag{2}$$

where, p is the peak pressure in kPa and A_{ram} is the effective cross-sectional area of the hydraulic ram in square metres. The effective diameter of the ram of the employed tester was 52 mm.

The uncorrected point load strength (I_s) is calculated as:

$$I_s = \frac{P}{{D_e}^2} \tag{3}$$

where, D_e is the equivalent core diameter in mm calculated as:

$$
\begin{aligned}
{D_e}^2 &= D^2 \quad \text{for diameteral tests} && (4)\\
&= \frac{4A}{\pi} \quad \text{for axial tests} && (5)
\end{aligned}
$$

where D is the distance between platens in mm and A is the minimum cross sectional area of a plane through the platen contact points. The value of A is given by:

$$A = W \times D \tag{6}$$

where W is the width of the specimen.

The size correction factor (F) is obtained from the expression:

$$F = \left(\frac{D_e}{50}\right)^{0.45} \tag{7}$$

and the size-corrected point load strength ($I_{s(50)}$) for a core with D = 50 mm was calculated as:

$$I_{s50} = F \times I_s. \tag{8}$$

Table 4: Summary of PLT results.

Sample	Depth (m)	Test type A-axial D-diametric	Distance Between Platens, D (mm)	Failure Load P (kN)	Effective Diameter De (mm)	Uncorrected Point Strength, Strength, I_s (MPa)	Size Correction Factor, F	Size-Corrected Point Load Strength, $I_{s(50)}$ (MPa)
BH207-RS-SA5	32.27 - 32.49	D [1]	60.00	5.12	60.00	1.42	1.09	1.55
		D [1]	60.00	3.32	60.00	0.92	1.09	1.00
		D [1]	60.00	0.16	60.00	0.04	1.09	0.05
		D [1]	60.00	8.64	60.00	2.40	1.09	2.60
		D [1]	60.00	2.97	60.00	0.83	1.09	0.90
		A [1]	46.00	8.32	59.34	2.36	1.08	2.55
		A [1]	40.00	12.23	55.33	3.99	1.05	4.18
		A [1]	34.00	7.97	51.02	3.06	1.01	3.09
		A [1]	21.00	8.23	40.09	5.12	0.91	4.64
		A [1]	25.00	8.42	43.75	4.40	0.94	4.14
				Axial Mean		3.79		3.72

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Table 4 – Summary of PLT results. (continued from previous page)

Sample	Depth (m)	Test type A-axial D-diametric	Distance Between Platens, D (mm)	Failure Load P (kN)	Effective Diameter De (mm)	Uncorrected Point Strength, Strength, I_s (MPa)	Size Correction Factor, F	Size-Corrected Point Load Strength, $I_{s(50)}$ (MPa)
					Diametric Mean	1.12		1.22
BH207-RS-SA9	37.11 - 37.34	D [1]	60.00	9.06	60.00	2.52	1.09	2.73
		D [1]	60.00	13.78	60.00	3.83	1.09	4.15
		D [1]	60.00	8.17	60.00	2.27	1.09	2.46
		D [1]	60.00	13.95	60.00	3.88	1.09	4.21
		A [1]	41.00	14.39	56.05	4.58	1.05	4.82
		A [1]	32.00	11.79	49.52	4.81	1.00	4.79
		A [1]	29.00	9.01	47.14	4.05	0.97	3.95
					Axial Mean	4.48		4.52
					Diametric Mean	3.12		3.39
BH207-RS-SA11	39.60 - 39.86	D [1]	60.00	5.51	60.00	1.53	1.09	1.66
		D [1]	60.00	1.99	60.00	0.55	1.09	0.60
		D [1]	60.00	12.01	60.00	3.34	1.09	3.62
		D [1]	60.00	4.58	60.00	1.27	1.09	1.38
		D [1]	60.00	12.07	60.00	3.35	1.09	3.64
		A [1]	37.00	11.41	53.27	4.02	1.03	4.14
		A [1]	37.00	10.34	53.27	3.64	1.03	3.75
		A [1]	31.00	13.47	48.76	5.67	0.99	5.60
		A [1]	36.00	11.33	52.55	4.10	1.02	4.20
		A [1]	32.00	11.35	49.54	4.62	1.00	4.60
					Axial Mean	4.41		4.46
					Diametric Mean	2.01		2.18
BH207-RS-SA14	42.35 - 42.60	D [1]	60.00	9.77	60.00	2.71	1.09	2.94
		D [1]	60.00	0.48	60.00	0.13	1.09	0.15
		D [1]	60.00	3.35	60.00	0.93	1.09	1.01
		D [1]	60.00	4.88	60.00	1.35	1.09	1.47
		D [1]	60.00	1.95	60.00	0.54	1.09	0.59
		A [1]	37.00	5.43	53.24	1.92	1.03	1.97
		A [1]	40.00	7.57	55.36	2.47	1.05	2.59
		A [1]	38.00	8.51	53.96	2.92	1.03	3.02
		A [1]	34.00	5.11	51.04	1.96	1.01	1.98
		A [1]	29.00	4.25	47.14	1.91	0.97	1.86
					Axial Mean	2.24		2.28
					Diametric Mean	1.13		1.23
BH207-RS-SA17	45.43 - 45.63	D [1]	60.00	2.09	60.00	0.58	1.09	0.63
		D [1]	60.00	9.84	60.00	2.73	1.09	2.97
		D [1]	60.00	11.99	60.00	3.33	1.09	3.62
		D [1]	60.00	3.05	60.00	0.85	1.09	0.92
		D [1]	60.00	7.34	60.00	2.04	1.09	2.21
		A [1]	43.00	16.97	57.44	5.14	1.06	5.48
		A [1]	46.00	14.91	59.41	4.22	1.08	4.56
		A [1]	35.00	11.76	51.82	4.38	1.02	4.45
		A [1]	28.00	11.76	46.35	5.47	0.97	5.29
		A [1]	25.00	9.27	43.80	4.83	0.94	4.55
					Axial Mean	4.81		4.87

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Table 4 – Summary of PLT results. (continued from previous page)

Sample	Depth (m)	Test type A-axial D-diametric	Distance Between Platens, D (mm)	Failure Load P (kN)	Effective Diameter De (mm)	Uncorrected Point Strength, Strength, I_s (MPa)	Size Correction Factor, F	Size-Corrected Point Load Strength, $I_{s(50)}$ (MPa)
				Diametric Mean		1.91		2.07
BH207-RS-SA19	17.76 - 17.83	D [2, 3]	60.00	0.59	60.00	0.16	1.09	0.18
		A [2, 3]	37.00	7.26	53.11	2.57	1.03	2.65
		A [2, 3]	39.00	13.93	54.53	4.68	1.04	4.87
				Axial Mean		3.63		3.76
				Diametric Mean		0.16		0.18
BH207-RS-SA20	19.83 - 17.87	A [2, 3]	33.00	6.30	50.20	2.50	1.00	2.50
				Axial Mean		2.50		2.50
BH207-RS-SA21	17.87 - 17.95	D [2, 3]	60.00	1.86	60.00	0.52	1.09	0.56
		A [2, 3]	45.00	10.48	58.60	3.05	1.07	3.28
		A [2, 3]	33.00	11.66	50.18	4.63	1.00	4.64
				Axial Mean		3.84		3.96
				Diametric Mean		0.52		0.56
BH207-RS-SA22	17.95 - 18.00	D [2, 3]	60.00	3.16	60.00	0.88	1.09	0.95
		A [2, 3]	39.00	11.38	54.50	3.83	1.04	3.98
		A [2, 3]	15.00	6.63	33.80	5.81	0.84	4.87
				Axial Mean		4.82		4.43
				Diametric Mean		0.88		0.95
BH207-RS-SA23	18.00 - 18.07	D [2, 3]	60.00	5.20	60.00	1.44	1.09	1.57
		A [2, 3]	36.00	11.90	52.37	4.34	1.02	4.43
		A [2, 3]	29.00	7.89	47.00	3.57	0.97	3.47
				Axial Mean		3.96		3.95
				Diametric Mean		1.44		1.57
BH306-RS-SA2	32.47 - 32.67	D [1]	60.00	2.36	60.00	0.65	1.09	0.71
		D [1]	60.00	6.75	60.00	1.88	1.09	2.04
		D [1]	60.00	4.06	60.00	1.13	1.09	1.22
		D [1]	60.00	1.58	60.00	0.44	1.09	0.48
		D [1]	60.00	2.12	60.00	0.59	1.09	0.64
		A [1]	43.00	14.95	57.13	4.58	1.06	4.86
		A [1]	46.00	12.71	59.09	3.64	1.08	3.92
		A [1]	37.00	15.08	53.00	5.37	1.03	5.51
		A [1]	32.00	10.26	49.29	4.23	0.99	4.20
		A [1]	28.00	11.07	46.10	5.21	0.96	5.02
				Axial Mean		4.60		4.70
				Diametric Mean		0.94		1.02
BH306-RS-SA5	35.33 - 35.56	D [1]	60.00	6.55	60.00	1.82	1.09	1.97
		D [1]	60.00	4.52	60.00	1.26	1.09	1.36
		D [1]	60.00	12.08	60.00	3.36	1.09	3.64
		D [1]	60.00	4.00	60.00	1.11	1.09	1.21
		D [1]	60.00	6.79	60.00	1.89	1.09	2.05
		A [1]	48.00	16.03	60.32	4.41	1.09	4.79

Continued on next page

Table 4 – Summary of PLT results. (continued from previous page)

Sample	Depth (m)	Test type A-axial D-diametric	Distance Between Platens, D (mm)	Failure Load P (kN)	Effective Diameter De (mm)	Uncorrected Point Strength, Strength, I_s (MPa)	Size Correction Factor, F	Size-Corrected Point Load Strength, $I_{s(50)}$ (MPa)
		A [1]	47.00	12.48	59.69	3.50	1.08	3.79
		A [1]	43.00	10.25	57.09	3.14	1.06	3.34
		A [1]	35.00	11.77	51.51	4.44	1.01	4.50
		A [1]	38.00	14.82	53.67	5.14	1.03	5.31
			Axial Mean			4.13		4.35
			Diametric Mean			1.89		2.05
BH306-RS-SA9	39.37 - 39.57	D [1]	60.00	4.85	60.00	1.35	1.09	1.46
		D [1]	60.00	1.61	60.00	0.45	1.09	0.49
		D [1]	60.00	5.48	60.00	1.52	1.09	1.65
		D [1]	60.00	2.18	60.00	0.61	1.09	0.66
		D [1]	60.00	0.67	60.00	0.19	1.09	0.20
		A [1]	36.00	8.60	52.34	3.14	1.02	3.20
		A [1]	37.00	6.57	53.06	2.33	1.03	2.40
		A [1]	41.00	8.95	55.86	2.87	1.05	3.01
		A [1]	35.00	9.58	51.61	3.60	1.01	3.65
		A [1]	34.00	7.57	50.87	2.93	1.01	2.95
			Axial Mean			2.97		3.04
			Diametric Mean			0.82		0.89
BH306-RS-SA12	44.53 - 44.76	D [1]	60.00	3.56	60.00	0.99	1.09	1.07
		D [1]	60.00	3.76	60.00	1.05	1.09	1.13
		D [1]	60.00	5.20	60.00	1.44	1.09	1.57
		D [1]	60.00	0.51	60.00	0.14	1.09	0.15
		D [1]	60.00	2.68	60.00	0.74	1.09	0.81
		A [1]	41.00	13.95	55.81	4.48	1.05	4.71
		A [1]	34.00	12.53	50.82	4.85	1.01	4.89
		A [1]	43.00	13.69	57.16	4.19	1.06	4.45
		A [1]	34.00	12.61	50.82	4.88	1.01	4.92
		A [1]	32.00	9.93	49.31	4.08	0.99	4.06
			Axial Mean			4.50		4.60
			Diametric Mean			0.87		0.95
BH306-RS-SA16	49.29 - 49.50	D [1]	60.00	3.35	60.00	0.93	1.09	1.01
		D [1]	60.00	1.33	60.00	0.37	1.09	0.40
		D [1]	60.00	3.84	60.00	1.07	1.09	1.16
		D [1]	60.00	2.18	60.00	0.61	1.09	0.66
		D [1]	60.00	1.99	60.00	0.55	1.09	0.60
		A [1]	47.00	10.03	59.96	2.79	1.09	3.03
		A [1]	39.00	10.18	54.62	3.41	1.04	3.55
		A [1]	36.00	7.16	52.48	2.60	1.02	2.66
		A [1]	31.00	7.12	48.70	3.00	0.99	2.97
		A [1]	28.00	6.81	46.28	3.18	0.97	3.07
			Axial Mean			3.00		3.05
			Diametric Mean			0.71		0.77
BH307-RS-SA2	24.59 - 24.82	D [1]	61.00	11.07	61.00	2.97	1.09	3.25
		D [1]	61.00	13.00	61.00	3.49	1.09	3.82
		D [1]	61.00	5.08	61.00	1.37	1.09	1.49

Continued on next page

Table 4 – Summary of PLT results. (continued from previous page)

Sample	Depth (m)	Test type A-axial D-diametric	Distance Between Platens, D (mm)	Failure Load P (kN)	Effective Diameter De (mm)	Uncorrected Point Strength, Strength, I_s (MPa)	Size Correction Factor, F	Size-Corrected Point Load Strength, $I_{s(50)}$ (MPa)
		D[1]	61.00	9.77	61.00	2.62	1.09	2.87
		D[1]	61.00	3.40	61.00	0.91	1.09	1.00
		A[1]	53.00	10.88	63.86	2.67	1.12	2.98
		A[1]	42.00	6.03	56.85	1.87	1.06	1.98
		A[1]	32.00	5.75	49.62	2.34	1.00	2.33
		A[1]	25.00	8.16	43.86	4.24	0.94	4.00
		A[1]	25.00	4.93	43.86	2.56	0.94	2.42
			Axial Mean			2.73		2.74
			Diametric Mean			2.27		2.49
BH307-RS-SA5	30.31 - 30.55	D[1]	60.00	12.71	60.00	3.53	1.09	3.83
		D[1]	60.00	3.29	60.00	0.92	1.09	0.99
		D[1]	60.00	4.80	60.00	1.33	1.09	1.45
		D[1]	60.00	3.88	60.00	1.08	1.09	1.17
		D[1]	60.00	2.11	60.00	0.59	1.09	0.64
		A[1]	37.00	15.83	53.23	5.59	1.03	5.75
		A[1]	36.00	14.77	52.51	5.36	1.02	5.48
		A[1]	32.00	9.27	49.50	3.78	1.00	3.77
		A[1]	23.00	7.85	41.97	4.46	0.92	4.12
		A[1]	20.00	5.61	39.14	3.66	0.90	3.28
			Axial Mean			4.57		4.48
			Diametric Mean			1.49		1.62
BH307-RS-SA8	32.90 - 33.12	D[1]	60.00	13.12	60.00	3.64	1.09	3.96
		D[1]	60.00	3.29	60.00	0.92	1.09	0.99
		D[1]	60.00	8.99	60.00	2.50	1.09	2.71
		D[1]	60.00	13.40	60.00	3.72	1.09	4.04
		D[1]	60.00	7.91	60.00	2.20	1.09	2.38
		A[1]	46.00	13.08	59.45	3.70	1.08	4.00
		A[1]	58.00	10.94	66.75	2.45	1.14	2.80
		A[1]	29.00	14.38	47.20	6.45	0.97	6.29
		A[1]	37.00	12.14	53.32	4.27	1.03	4.40
		A[1]	33.00	9.75	50.35	3.85	1.00	3.86
			Axial Mean			4.15		4.27
			Diametric Mean			2.59		2.82
BH307-RS-SA17	43.96 - 44.14	D[1]	60.00	7.31	60.00	2.03	1.09	2.20
		D[1]	60.00	4.80	60.00	1.33	1.09	1.45
		A[1]	29.00	6.37	46.99	2.88	0.97	2.81
		D[1]	60.00	11.01	60.00	3.06	1.09	3.32
		D[1]	60.00	8.77	60.00	2.44	1.09	2.64
		D[1]	60.00	12.27	60.00	3.41	1.09	3.70
		A[1]	34.00	10.97	50.88	4.24	1.01	4.27
		A[1]	30.00	7.09	47.79	3.10	0.98	3.04
		A[1]	34.00	12.27	50.88	4.74	1.01	4.78
		A[1]	31.00	8.55	48.58	3.62	0.99	3.58
		A[1]	29.00	14.25	46.99	6.45	0.97	6.27
			Axial Mean			4.17		4.12

Continued on next page

Table 4 – Summary of PLT results. (continued from previous page)

Sample	Depth (m)	Test type A-axial D-diametric	Distance Between Platens, D (mm)	Failure Load P (kN)	Effective Diameter De (mm)	Uncorrected Point Strength, Strength, I_s (MPa)	Size Correction Factor, F	Size-Corrected Point Load Strength, $I_{s(50)}$ (MPa)
			Diametric Mean			2.45		2.66
BH307-RS-SA22	49.13 - 49.36	D[1]	60.00	13.03	60.00	3.62	1.09	3.93
		D[1]	60.00	13.60	60.00	3.78	1.09	4.10
		A[1]	22.00	7.97	41.01	4.74	0.91	4.33
		D[1]	60.00	9.14	60.00	2.54	1.09	2.76
		D[1]	60.00	4.22	60.00	1.17	1.09	1.27
		D[1]	60.00	3.92	60.00	1.09	1.09	1.18
		D[1]	60.00	5.48	60.00	1.52	1.09	1.65
		A[1]	40.00	15.84	55.29	5.18	1.05	5.42
		A[1]	41.00	14.70	55.98	4.69	1.05	4.94
		A[1]	28.00	10.91	46.26	5.10	0.97	4.92
		A[1]	33.00	12.18	50.22	4.83	1.00	4.84
			Axial Mean			4.91		4.89
			Diametric Mean			2.29		2.48
BH308-RS-SA2	25.74 - 25.94	D[1]	60.00	3.78	60.00	1.05	1.09	1.14
		D[1]	60.00	2.55	60.00	0.71	1.09	0.77
		D[1]	60.00	2.28	60.00	0.63	1.09	0.69
		D[1]	60.00	1.23	60.00	0.34	1.09	0.37
		D[1]	60.00	0.56	60.00	0.15	1.09	0.17
		A[1]	46.00	10.94	59.28	3.11	1.08	3.36
		A[1]	21.00	5.46	40.05	3.40	0.91	3.08
		A[1]	29.00	10.37	47.07	4.68	0.97	4.55
		A[1]	24.00	5.49	42.82	2.99	0.93	2.79
		A[1]	24.00	4.73	42.82	2.58	0.93	2.41
			Axial Mean			3.35		3.24
			Diametric Mean			0.58		0.63
BH308-RS-SA6	30.12 - 30.27	D[1,4]	60.00	13.24	60.00	3.68	1.09	3.99
		D[1]	60.00	1.98	60.00	0.55	1.09	0.60
		D[1]	60.00	4.20	60.00	1.17	1.09	1.27
		D[1,4]	60.00	12.20	60.00	3.39	1.09	3.68
		A[1]	34.00	9.47	52.25	3.47	1.02	3.54
		A[1]	27.00	9.96	46.56	4.59	0.97	4.45
			Axial Mean			4.03		3.99
			Diametric Mean			2.20		2.38
BH308-RS-SA14	37.42 - 37.63	D[1]	60.00	14.96	60.00	4.16	1.09	4.51
		D[1]	60.00	7.31	60.00	2.03	1.09	2.20
		D[1]	60.00	13.95	60.00	3.88	1.09	4.21
		D[1]	60.00	13.72	60.00	3.81	1.09	4.14
		A[1]	41.00	17.10	55.99	5.46	1.05	5.74
		A[1]	35.00	16.96	51.73	6.34	1.02	6.43
		A[1]	38.00	14.03	53.90	4.83	1.03	4.99
		A[1]	33.00	11.01	50.23	4.36	1.00	4.37
		A[1]	36.00	14.98	52.46	5.44	1.02	5.56
		A[1]	29.00	12.72	47.09	5.74	0.97	5.59
			Axial Mean			5.36		5.45

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Table 4 – Summary of PLT results. (continued from previous page)

Sample	Depth (m)	Test type A-axial D-diametric	Distance Between Platens, D (mm)	Failure Load P (kN)	Effective Diameter De (mm)	Uncorrected Point Strength, Strength, I_s (MPa)	Size Correction Factor, F	Size-Corrected Point Load Strength, $I_{s(50)}$ (MPa)
			Diametric Mean			3.47		3.77
BH308-RS-SA20	45.14 - 45.36	D [1]	60.00	2.90	60.00	0.81	1.09	0.87
		D [1]	60.00	6.34	60.00	1.76	1.09	1.91
		D [1]	60.00	7.03	60.00	1.95	1.09	2.12
		D [1]	60.00	15.56	60.00	4.32	1.09	4.69
		D [1]	60.00	8.80	60.00	2.44	1.09	2.65
		A [1]	32.00	11.41	49.50	4.66	1.00	4.63
		A [1]	37.00	12.67	53.22	4.47	1.03	4.60
		A [1]	42.00	10.62	56.71	3.30	1.06	3.49
		A [1]	25.00	5.21	43.75	2.72	0.94	2.56
		A [1]	19.00	4.28	38.14	2.94	0.89	2.60
			Axial Mean			3.62		3.58
			Diametric Mean			2.26		2.45
BH308-RS-SA24	51.68 - 52.04	D [1]	60.00	10.10	60.00	2.81	1.09	3.05
		D [1]	60.00	3.59	60.00	1.00	1.09	1.08
		D [1]	60.00	4.23	60.00	1.18	1.09	1.28
		D [1]	60.00	4.26	60.00	1.18	1.09	1.28
		A [1]	46.00	10.73	59.36	3.05	1.08	3.29
		A [1]	42.00	14.04	56.72	4.36	1.06	4.62
		A [1]	35.00	10.02	51.78	3.74	1.02	3.80
		A [1]	29.00	6.79	47.13	3.06	0.97	2.98
		A [1]	26.00	7.97	44.63	4.00	0.95	3.80
			Axial Mean			3.64		3.70
			Diametric Mean			1.54		1.67

[1] Limestone with some shaly parting

[2] Short sample length. Limited testing possible

[3] Blue Mountain Formation - brown shale

[4] Longitudinal break (break along core axis). Limited testing possible.

5 ISRM Indentation hardness testing (Punch Penetration)

5.1 Introduction

This section summarizes the results of punch penetration testing according to the draft suggested method of the ISRM. The tests were performed using a 12 ton (107 kN) Carver hydraulic loading frame coupled to a SPX hydraulic pump fitted with a pressure-compensated flow control valve to maintain nearly constant rates of displacement (Figure 16a). A constant displacement rate of approximately 0.3 mm/min was employed for all tests. Specimen preparation proceeded as follows:

1. Core samples were unwrapped, inspected for damage, and re-wrapped in electric tape to avoid exposure to additional moisture when diamond cutting them to length.
2. Samples were cut to a length such that the length:diameter ratio was between 1:1 and 1.5:1.
3. After removing the electrical tape, the cut specimen was placed with the saw-cut surface facing downwards within a steel ring on top of a piece of plexiglass (Figure 16b). The steel rings were 3.5 inch long pieces of 5 inch diameter hollow structural tube with a wall thickness of 0.375 inches. The ends of these rings were subjected to precision grinding to ensure they were flat and parallel.
4. The steel rings were then filled with a high early strength gypsum mortar called Hydrostone manufactured by USG. The mortar was mixed with a water:cement ratio of 0.3 using an electric drill and mixing wand for total of 2 minutes before pouring. This material has a UCS strength of 30 to 35 MPa after 4 to 7 days of curing under ambient laboratory temperature and humidity.
5. The specimens were left to cure between 4 and 7 days before being tested.

Specimen testing proceeded as follows:

1. Cured test specimens were placed on the lower flat platen of the hydraulic loading frame with the saw-cut rock surface facing upwards and centered with respect to a pointed platen typically used for point load testing (Figure 16c).
2. The test specimens where then loaded at a constant displacement rate while continuously monitoring the applied load and penetration of the pointed platen. Loading was continued until a penetration of 1 mm was achieved or a load of 20 kN was reached.

5.2 Results

The results of the punch penetration tests are summarized in Table 5. The corresponding load-displacement curves for the punch penetration tests are presented in Figure 17 to Figure 21.

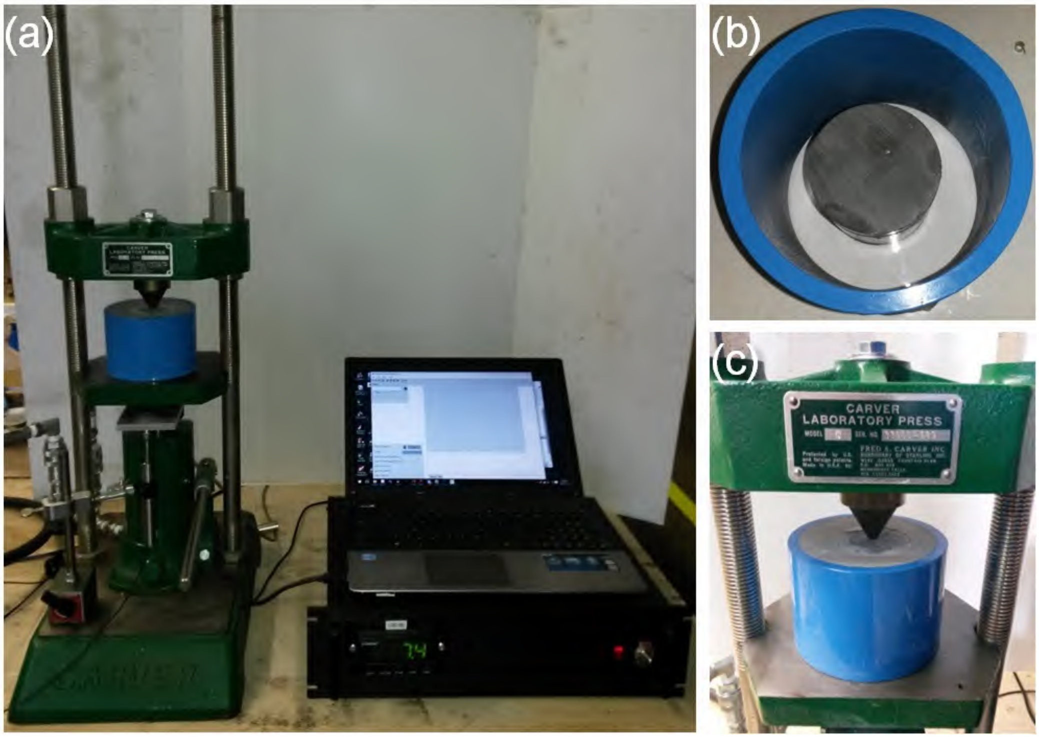

Figure 16: Punch penetration test setup: (a) Carver hydraulic loading frame; (b) steel casting ring; and (c) detailed view specimen positioned in the loading frame for testing.

The Indentation Hardness Index, IHI, was calculated, as:

$$IHI = \frac{L}{P} \tag{9}$$

where L and P are the load and penetration (displacement) corresponding to either the first peak in the load-displacement curve, 1 mm of penetration (i.e., when there is no peak with 1 mm of displacement), or at 20 kN of load (whichever is observed first).

Table 5: Summary of Punch Penetration test results.

Sample	Depth (m)	1st peak Penetration, P (mm)	1st peak Load, L (kN)	Indentation Hardness Index, IHI (kN/mm)	Lithology	Failure description
BH207-RS-SA10	38.21 - 38.43	0.31	8.68	27.75	Limestone	1
BH304-RS-SA1	38.85 - 33.06	0.26	7.38	27.92	Limestone/Shale	1
BH204-RS-SA3	36.32 - 36.51	0.32	10.55	32.97	Limestone/Shale	2
BH306-RS-SA4	34.04 - 34.27	0.23	8.01	34.83	Limestone/Shale	1
BH306-RS-SA14	47.98 - 48.24	0.83	18.67	22.49	Limestone/Shale	1
BH302-RS-SA1	32.71 - 32.94	0.39	10.20	26.15	Shale	1
BH203-RS-SA1	32.98 - 33.15	0.59	12.96	22.12	Shale	1

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Table 5 – Summary of Punch Penetration test results. (continued from previous page)

Sample	Depth (m)	1st peak Penetration, P (mm)	1st peak Load, L (kN)	Indentation Hardness Index, IHI (kN/mm)	Lithology	Failure description
BH303-RS-SA1	31.50 - 31.72	0.45	20.04	44.50	Limestone	3
BH206-RS-SA1	31.10 - 31.30	0.40	4.37	10.95	Limestone/Shale	1
BH202-RS-SA4	33.48 - 33.62	0.35	12.73	36.18	Limestone/Shale	2
BH202-RS-SA13	48.07 - 48.21	0.36	11.03	30.81	Limestone/Shale	4
BH21-RS-SA3	43.91 - 44.10	0.36	20.01	56.21	Limestone/Shale	5
BH21-RS-SA5	43.79 - 43.93	0.42	20.02	47.38	Limestone/Shale	6
BH21-RS-SA9	55.06 - 55.23	0.45	16.59	36.76	Limestone/Shale	2
BH22-RS-SA5	35.28 - 35.46	0.45	20.02	44.98	Limestone/Shale	5
BH22-RS-SA10	47.31 - 47.46	0.39	14.02	35.85	Limestone/Shale	2
BH22-RS-SA16	62.27 - 62.58	0.36	12.52	35.19	Limestone/Shale	2
BH205-RS-SA8	33.65 - 33.84	0.44	20.01	45.69	Limestone/Shale	6
BH307-RS-SA3	26.21 - 26.45	0.43	18.92	43.72	Limestone/Shale	2
BH307-RS-SA23	49.36 - 49.58	0.46	20.03	43.52	Limestone/Shale	6
BH309-RS-SA4	37.81 - 37.93	0.47	20.00	42.99	Limestone/Shale	3
BH308-RS-SA4	27.40 - 27.93	0.52	14.16	27.04	Limestone/Shale	4
BH308-RS-SA11	35.11 - 35.28	0.47	19.53	41.40	Limestone/Shale	4
BH308-RS-SA17	39.93 - 40.10	0.43	11.40	26.82	Shale	2
BH308-RS-SA19	43.52 - 43.72	0.65	17.41	26.89	Limestone/Shale	1
BH305-RS-SA1	30.16 - 30.40	0.45	19.80	43.53	Limestone/Shale	4
BH301-RS-SA2	32.91 - 33.13	0.33	12.98	38.96	Limestone/Shale	7

[1] Fine crushing/plastic deformation + brittle fracturing + radial fracturing

[2] Fine crushing/plastic deformation + brittle fracturing

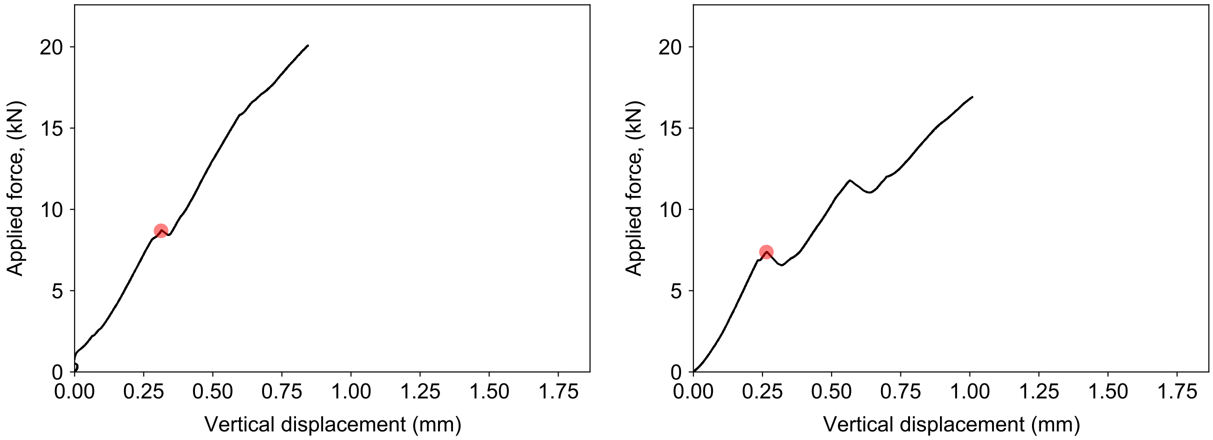
[3] Fine crushing/plastic deformation

[4] Fine crushing/plastic deformation + brittle fracturing + minor radial fracturing

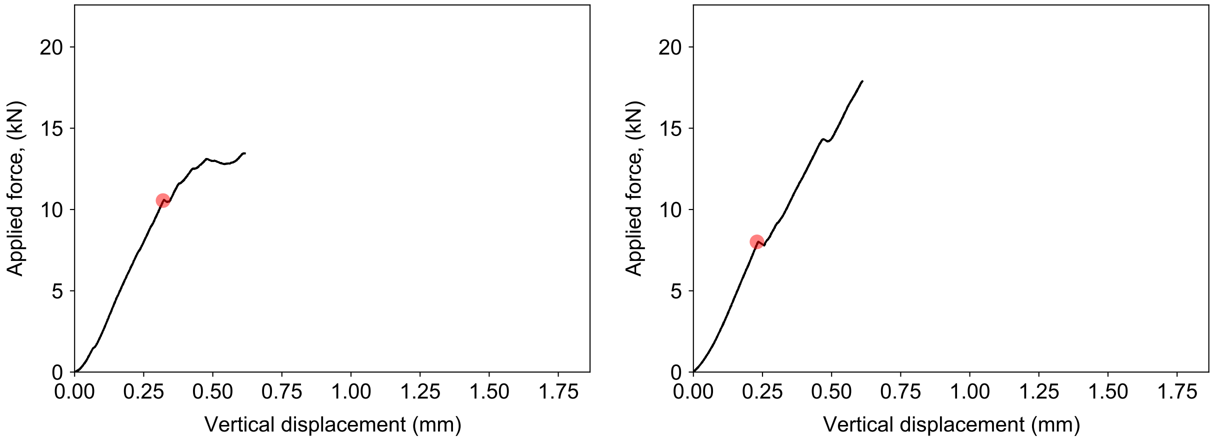
[5] Fine crushing/plastic deformation + minor radial fracturing

[6] Fine crushing/plastic deformation + minor brittle fracturing

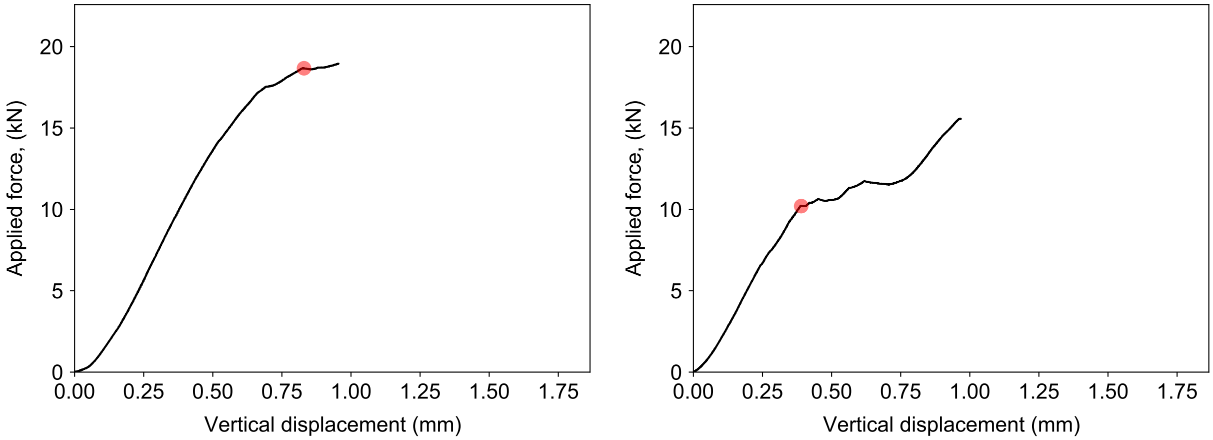
[7] Fine crushing/plastic deformation + minor brittle fracturing + minor radial fractures



(a) BH207-RS-SA10 (b) BH304-RS-SA1

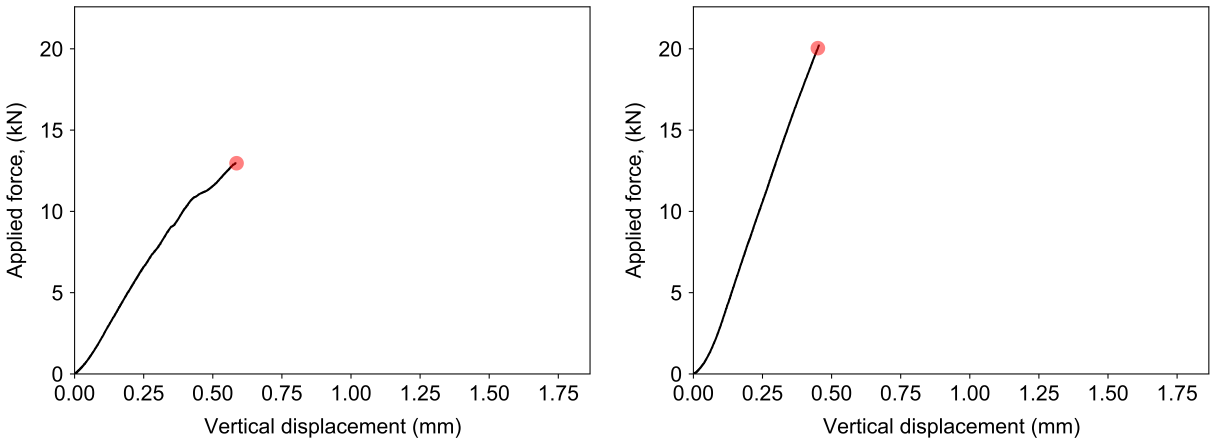


(c) BH204-RS-SA3 (d) BH306-RS-SA4

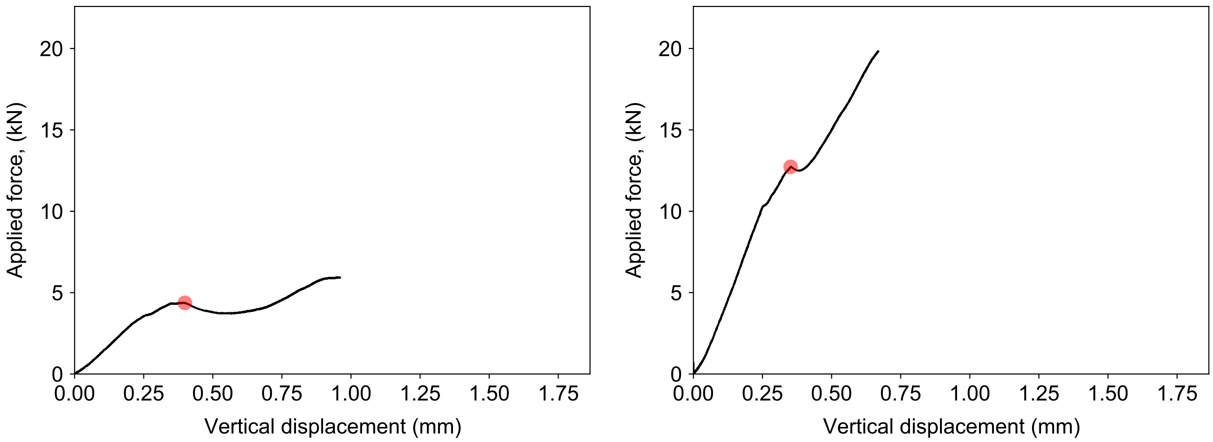


(e) BH306-RS-SA14 (f) BH302-RS-SA1

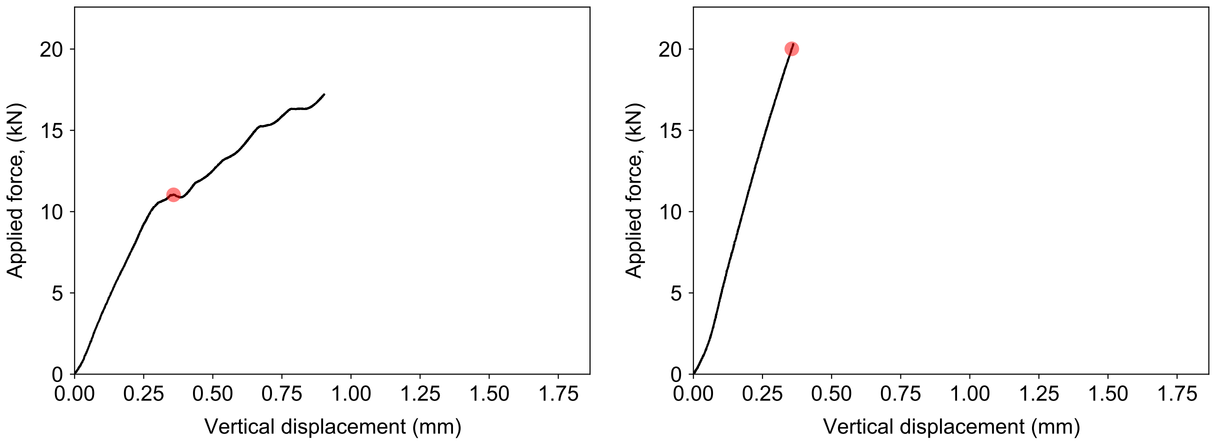
Figure 17: Punch penetration load-displacement curvess.



(a) BH203-RS-SA1 (b) BH303-RS-SA1

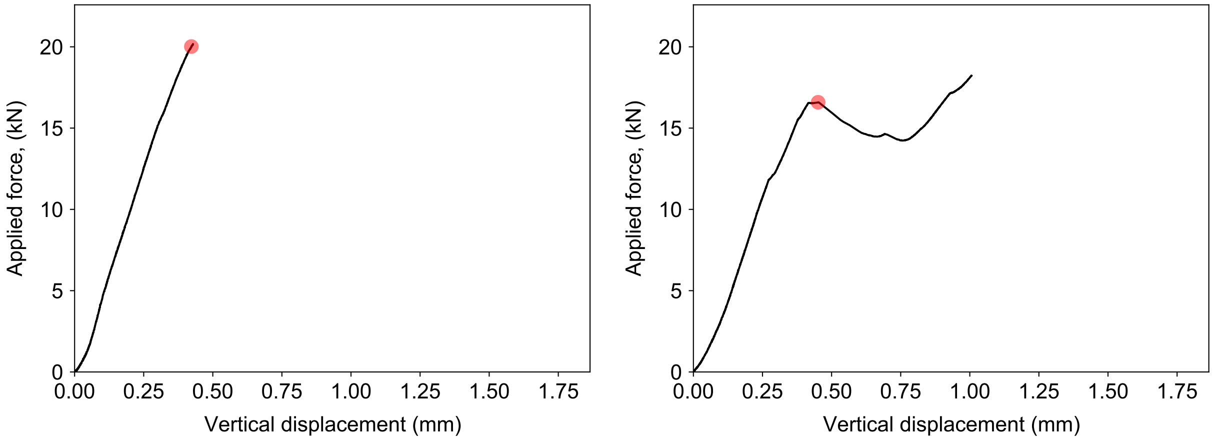


(c) BH206-RS-SA1 (d) BH202-RS-SA4

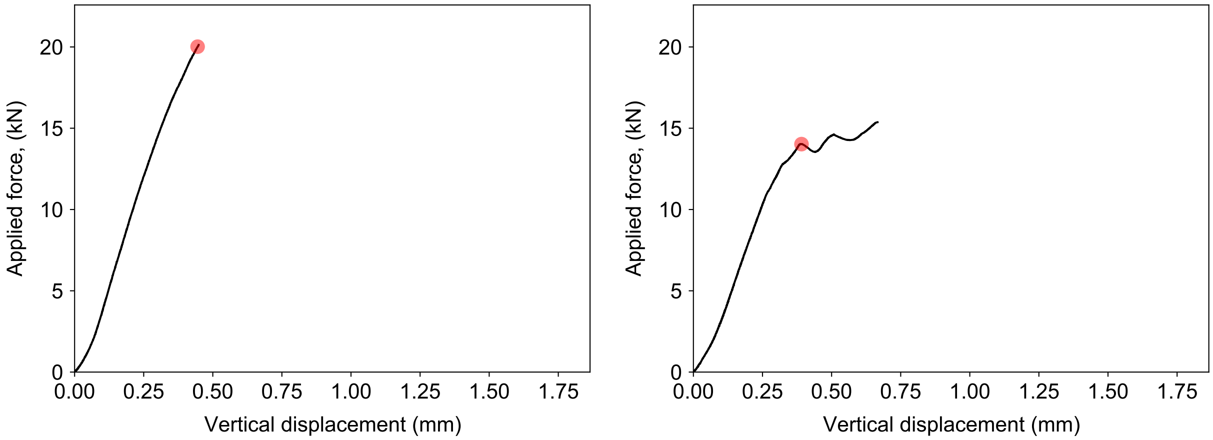


(e) BH202-RS-SA13 (f) BH21-RS-SA3

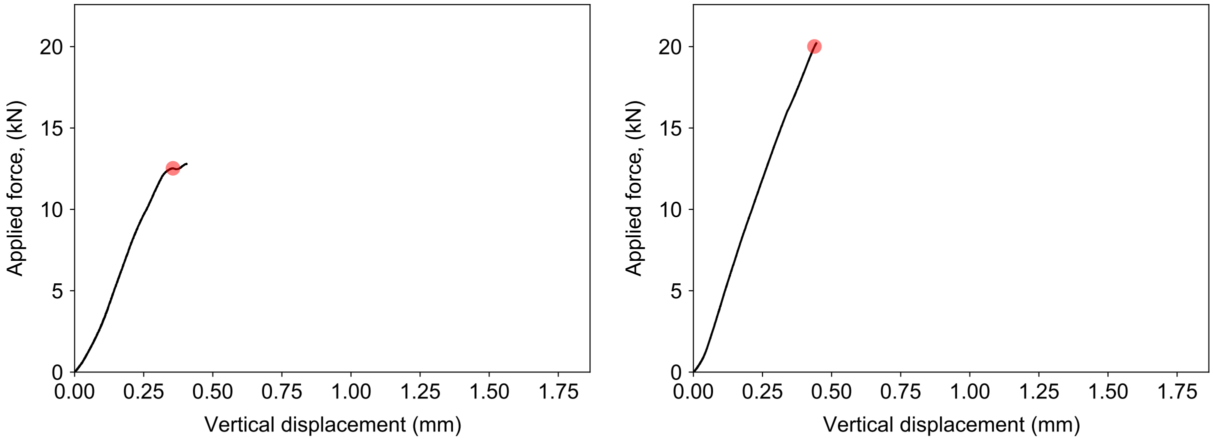
Figure 18: Punch penetration load-displacement curvess.



(a) BH21-RS-SA5 (b) BH21-RS-SA9

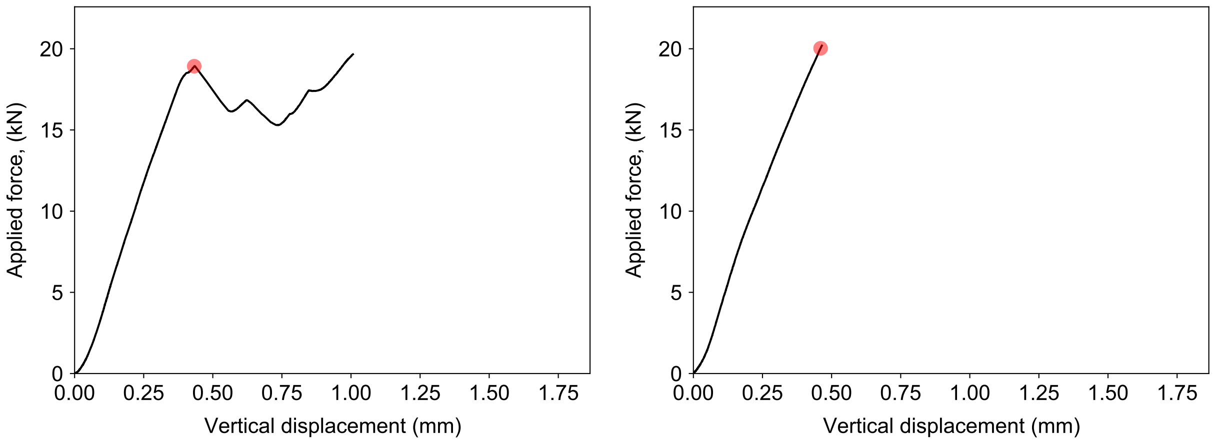


(c) BH22-RS-SA5 (d) BH22-RS-SA10

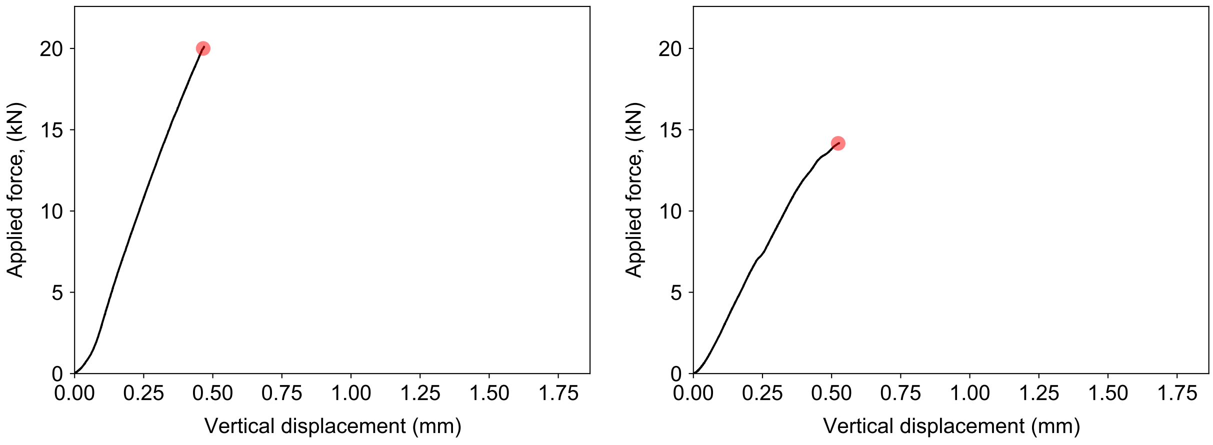


(e) BH22-RS-SA16 (f) BH205-RS-SA8

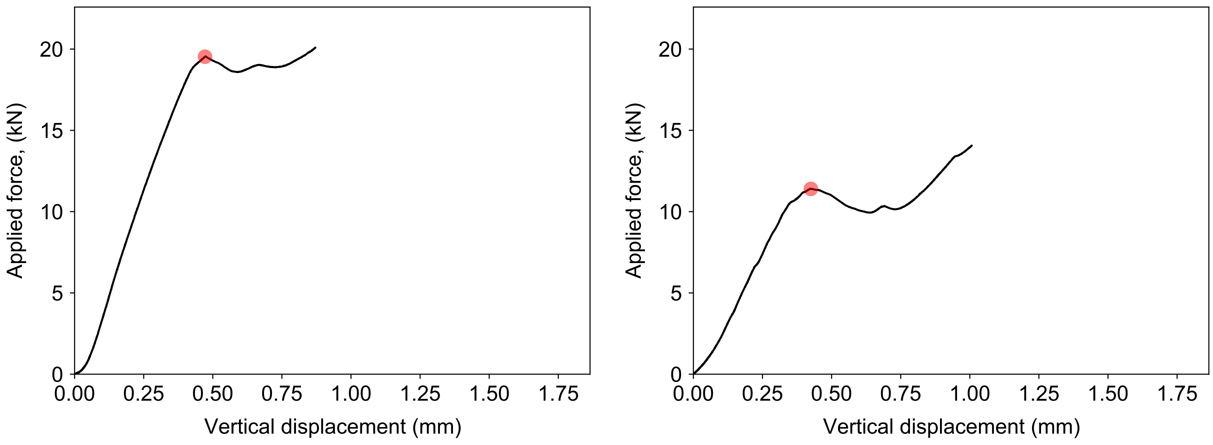
Figure 19: Punch penetration load-displacement curvess.



(a) BH307-RS-SA3 (b) BH307-RS-SA23

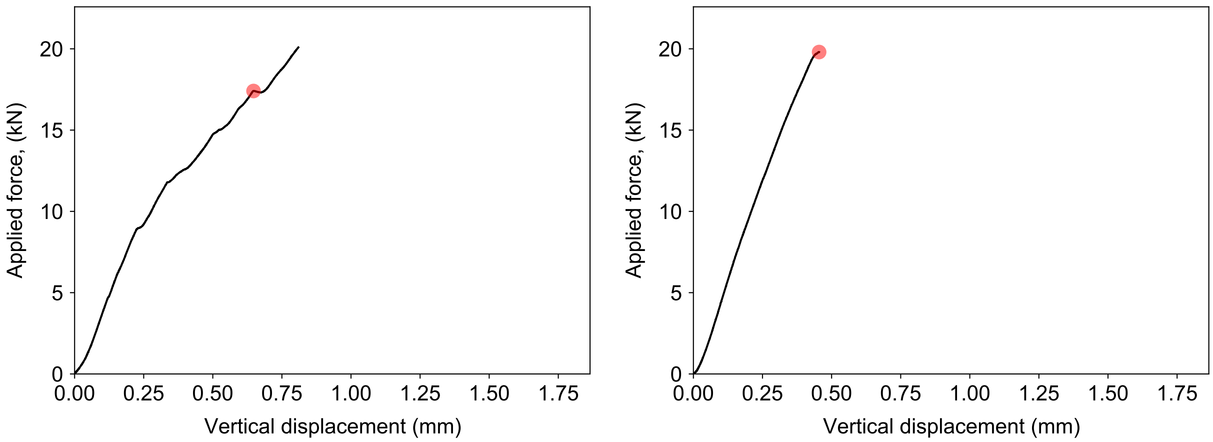


(c) BH309-RS-SA4 (d) BH308-RS-SA4



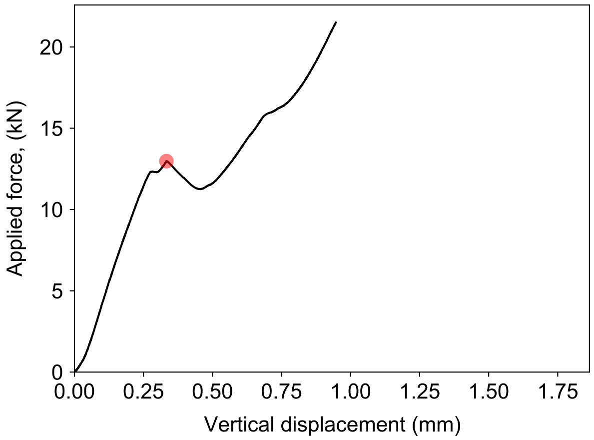
(e) BH308-RS-SA11 (f) BH308-RS-SA17

Figure 20: Punch penetration load-displacement curvess.



(a) BH308-RS-SA19

(b) BH305-RS-SA1



(c) BH301-RS-SA2

Figure 21: Punch penetration load-displacement curvess.

6 Slake Durability

6.1 Overview

This section summarizes the results of slake durability testing. The tests were performed using an M&L Testing Equipment Slake Durability apparatus capable of simultaneously performing four slake durability tests (Figure 22). The test was conducted using the following procedure:

1. The core was broken using a hammer and point load testing apparatus into 40-60 g lumps. The sharp edges of the lumps were removed by lightly hammering and/or filing the edges.
2. Approximately 10 lumps weighing 450-550 g were inserted into the drum and dried in the oven at 110 °C until reaching a constant mass.
3. The drum was removed from the oven and allowed to cool to room temperature, weighed, and subsequently rotated in room temperature distilled water at 20 revolutions per minute for 10 minutes.
4. The drum was returned to the oven to dry for approximately one day and weighed again.
5. Steps 3 and 4 were then repeated for a second cycle.
6. The drum was thoroughly cleaned, dried, and weighed.

The above slake durability testing procedure adhered to ASTM D4644-16.

Figure 22: Test setup showing the slake durability apparatus.

6.2 Results

The results of the tests are summarized in Table 6. Additional measurements and sample descriptions are provided the summary spreadsheet that accompanies this report. The slake durability index after one and two cycles was calculated as follows, respectively:

$$I_{d1} = \frac{B - D}{A - D} \times 100\% \tag{10}$$

$$I_{d2} = \frac{C - D}{A - D} \times 100\% \tag{11}$$

where A is the mass of the specimen and drum before the first test cycle, B is the mass of the specimen and drum after oven drying the first cycle, C is the mass of the specimen and drum after oven drying the second cycle and D is the mass of the drum.

Table 6: Summary of slake durability testing results.

Sample	Depth (m)	Moisture content (%)	Pre-First Cycle, A (g)	Post-First Cycle, B (g)	Post-Second Cycle, C (g)	Mass of Drum, D (g)	Slake Durability Index , (1st Cycle) I_{d1} (%)	Slake Durability Index (2nd Cycle), I_{d2} (%)	Lithology
BH303, SA6	44.15 - 44.36	0.52	1689.07	1686.12	1684.87	1132.49	99.5	99.2	Limestone/Shale
BH207, SA13	41.81 - 42.03	0.77	1668.21	1665.03	1663.04	1184.95	99.3	98.9	Limestone/Shale
BH204, SA6	39.41 - 39.59	0.72	1658.26	1655.32	1654.06	1152.23	99.4	99.2	Limestone/Shale
BH25-RS-SA1	25.94 - 26.06	0.74	1669.79	1667.76	1666.73	1132.45	99.6	99.4	Limestone/Shale
BH82-RS-SA1	26.21 - 26.31	1.00	1654.06	1647.30	1643.17	1152.18	98.7	97.8	Limestone/Shale
BH23-RS-SA4	50.20 - 50.36	0.61	1689.49	1686.52	1684.10	1138.88	99.5	99.0	Limestone/Shale
BH24-RS-SA4	49.67 - 49.78	1.33	1588.17	1584.02	1578.03	1036.18	99.2	98.2	Limestone/Shale
BH303-RS-SA6	36.19 - 36.33	0.54	1741.45	1739.04	1737.68	1245.62	99.5	99.2	Limestone/Shale
BH202-RS-SA10	43.63 - 43.75	0.47	1772.66	1769.60	1768.12	1184.72	99.5	99.2	Limestone/Shale
BH21-RS-SA8	52.30 - 52.46	1.19	1667.39	1662.54	1657.14	1132.31	99.1	98.1	Limestone/Shale
BH22-RS-SA11	48.49 - 48.74	0.74	1744.81	1741.81	1740.36	1151.97	99.5	99.2	Limestone/Shale
BH308-RS-SA10	33.66 - 33.83	0.45	1700.06	1697.32	1695.81	1138.66	99.5	99.2	Limestone/Shale
BH17-RS-05	46.86 - 47.07	0.72	1684.18	1681.85	1680.56	1132.29	99.6	99.3	Limestone
BH7-RS-06	49.57 - 49.79	1.02	1735.80	1732.40	1729.80	1184.65	99.4	98.9	Limestone
BH75-RS-05	47.40 - 47.62	1.19	1699.74	1696.20	1692.34	1151.91	99.4	98.6	Limestone

6.3 Specimen Photographs

Photographs of the specimens before testing and after testing are shown in Figure 23 to 26.

6.4 Specimen photographs

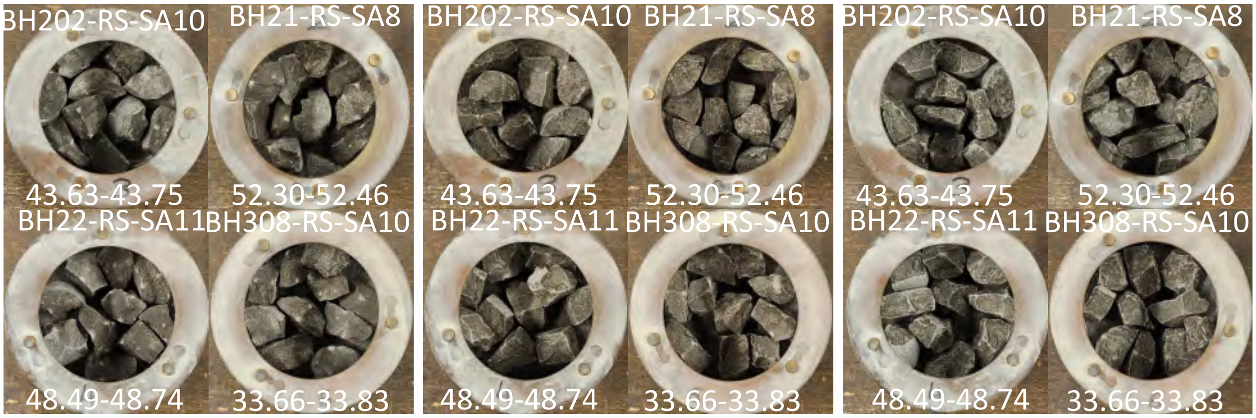
Photographs of the specimens before and after testing are presented in the Appendix of this report.

Before testing Following 1st slake cycle Following 2nd slake cycle

Figure 23: Photographs of slake durability specimen before and after testing.

Before testing Following 1st slake cycle Following 2nd slake cycle

Figure 24: Photographs of slake durability specimen before and after testing.



Before testing Following 1st slake cycle Following 2nd slake cycle

Figure 25: Photographs of slake durability specimen before and after testing.

Before testing Following 1st slake cycle Following 2nd slake cycle

Figure 26: Photographs of slake durability specimen before and after testing.

7 CERCHAR Abrasivity Tests

7.1 Overview

This section summarizes the results of CERCHAR abrasivity testing. The tests were performed using a Type-2 CERCHAR apparatus as shown in Figure 27a. The tips of the styluses were sharpened to a conical angle of 90° using the setup shown in Figure 27b. The styluses used to perform the tests are shown in Figure 27c-d (Rockwell hardness 55±1). A static force of 70 N was applied on top of the stylus by using a combination of weights. Details of the testing procedure are as follows:

1. The tips of the five styluses are sharpened using the grinding apparatus (Figure 27b).
2. The styluses are placed under a microscope (60x magnification) and three scaled photos (120° apart) are captured before the test is conducted to ensure the 90° point has been properly formed.
3. The test specimens are obtained by breaking core samples to expose a fresh fracture surface perpendicular to the core axis.
4. The specimen is secured in the cross-slide vise of the testing apparatus and the stylus is carefully lowered on to the surface of the rock.
5. A scratch measuring 10 mm in length is performed over a duration of 10 seconds. This process is repeated with all five styluses on undisturbed parts of the fracture surface (e.g., Figure 28a).
6. Lastly, the worn tips are re-examined under the microscope. From three scaled photos (120° apart), the wear flat, d, is measured (e.g., Figure 28c).

The length or the diameter of the wear flat, d, was measured from scaled microscope images using the image processing software Fiji (e.g., Figure 28b-c). The mean wear of the tip is calculated by taking the average d of all tests. The CERCHAR-Abrasivity-Index (CAI) of the sample is subsequently calculated by taking the mean wear and multiplying it by 10. The above testing procedure followed ASTM D7625.

7.2 Results

The results of the CERCHAR abrasivity tests are summarized in Table 7. Please note that additional specimen and testing details are available in the summary spreadsheet that accompanies this report.

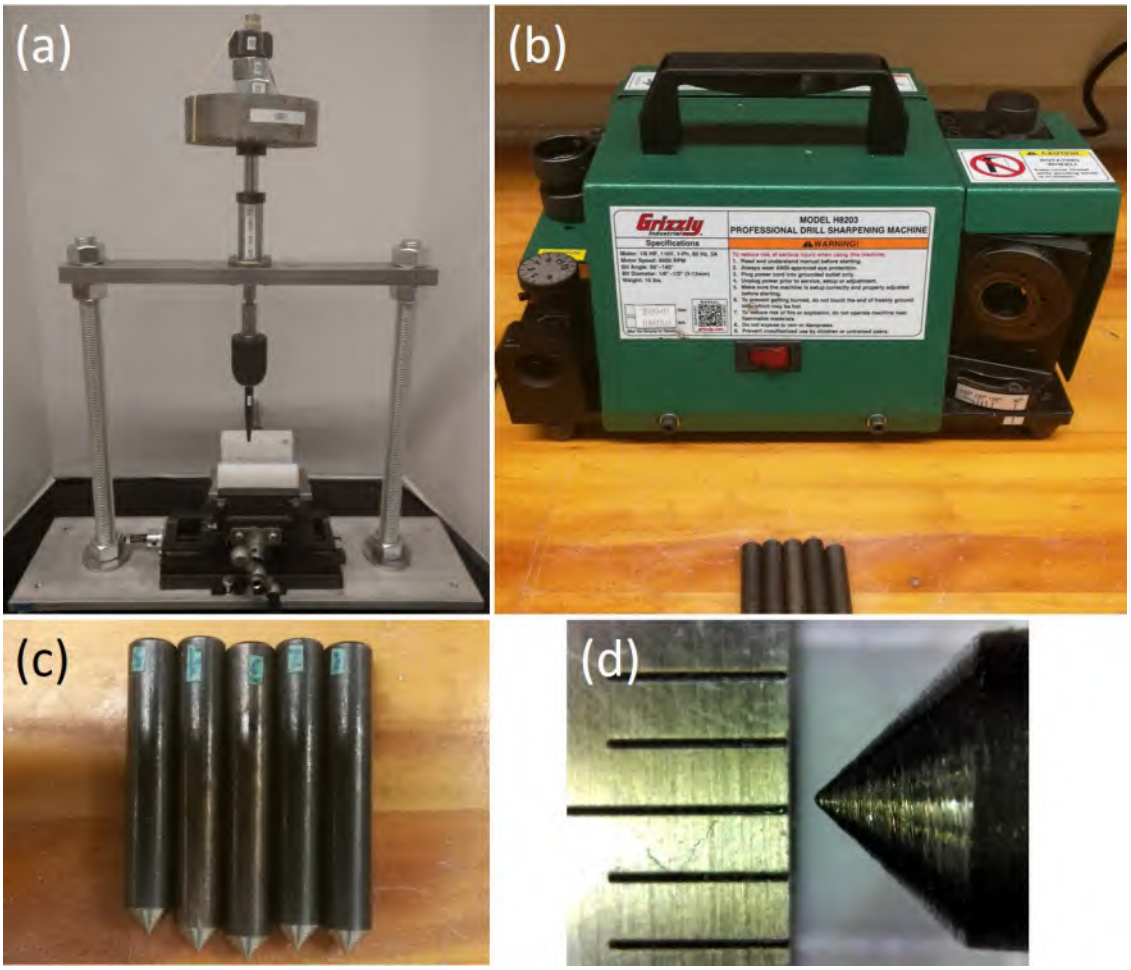
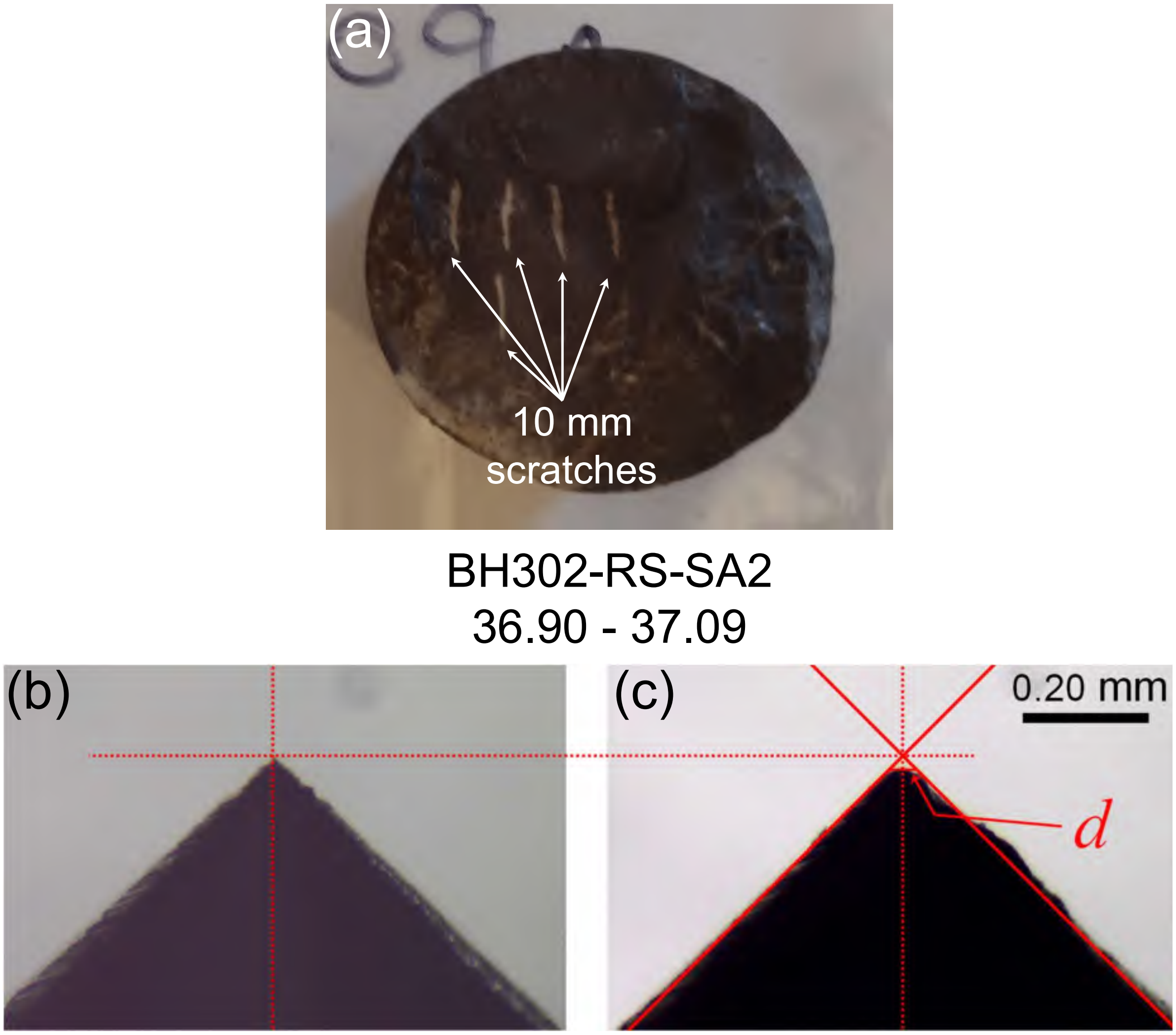


Figure 27: Photos showing (a) the CERCHAR apparatus, (b) tip sharpening setup, (c) the five styluses used to perform the test and (d) a microscope image of one of the stylus tips.



BH302-RS-SA2
36.90 - 37.09

BH302-RS-SA2
36.90 - 37.09
Stylus 3 pre-test @ 0°

BH302-RS-SA2
36.90 - 37.09
Stylus 3 post-test @ 0°

Figure 28: (a) Photograph showing an example of the five 10 mm scratches on a test specimen; (b) microscope image of select stylus prior to testing at the noted position; and (c) microscope image of the same stylus at the same position following testing with the wear flat, *d*, denoted.

Table 7: Summary of CERCHAR abrasivity test results.

Sample	Depth (m)	Test 1 Mean (mm)	Test 2 Mean (mm)	Test 3 Mean (mm)	Test 4 Mean (mm)	Test 5 Mean (mm)	Mean Wear (mm)	CAI	Lithology	ASTM Classification
BH303-RS-SA3	37.10-37.33	0.058	0.040	0.048	0.052	0.046	0.049	0.49	Shaly Limestone	Very Low
BH302-RS-SA2	36.90-37.09	0.057	0.119	0.051	0.057	0.097	0.076	0.76	Shaly Limestone	Low
BH204-RS-SA2	34.58-34.78	0.056	0.063	0.110	0.062	0.050	0.068	0.68	Shaly Limestone	Low
BH207-RS-SA3	28.90-29.11	0.075	0.075	0.091	0.058	0.205	0.101	1.01	Shaly Limestone	Low
BH203-RS-SA3	38.74-38.93	0.053	0.152	0.052	0.079	0.061	0.079	0.79	Shaly Limestone	Low
BH306-RS-SA3	33.52-33.72	0.089	0.061	0.090	0.047	0.030	0.063	0.63	Shaly Limestone	Low
BH304-RS-SA6	46.13-46.33	0.076	0.070	0.069	0.093	0.083	0.078	0.78	Shaly Limestone	Low
BH306-RS-SA8	38.40-38.56	0.044	0.043	0.062	0.056	0.061	0.053	0.53	Shale	Very Low
BH308-RS-SA16	39.08-39.20	0.055	0.044	0.051	0.048	0.049	0.049	0.495	Shale	Very Low
BH21-RS-SA10	56.66-56.75	0.051	0.046	0.040	0.052	0.043	0.046	0.464	Shale	Very Low
BH202-RS-SA3	33.25-33.30	0.059	0.044	0.045	0.055	0.043	0.049	0.493	Shale	Very Low
BH308-RS-SA12	35.77-35.91	0.038	0.040	0.043	0.070	0.048	0.048	0.477	Shaly limestone	Very Low
BH22-RS-SA13	49.57-49.92	0.044	0.048	0.037	0.033	0.041	0.041	0.405	Shale	Very Low
BH301-RS-SA4	39.95-40.30	0.096	0.094	0.052	0.041	0.055	0.068	0.675	Shaley Limestone	Low
BH205-RS-SA11	36.35-36.58	0.053	0.045	0.079	0.058	0.076	0.062	0.621	Shaley Limestone	Low
BH205-RS-SA19	52.98-53.23	0.037	0.036	0.029	0.071	0.064	0.047	0.474	Shale	Very Low
BH22-RS-SA15	56.07-56.27	0.051	0.076	0.057	0.061	0.086	0.066	0.661	Shaly Limestone	Low
BH305-RS-SA4	39.47-39.75	0.039	0.050	0.057	0.134	0.061	0.068	0.682	Shaly Limestone	Low
BH202-RS-SA9	41.84-42.03	0.038	0.040	0.041	0.040	0.061	0.044	0.441	Shaly Limestone	Very Low
BH21-RS-SA6	46.86-47.03	0.074	0.105	0.116	0.036	0.038	0.074	0.737	Shaly Limestone	Low
BH206-RS-SA5	43.53-43.79	0.067	0.041	0.039	0.050	0.050	0.050	0.495	Shaly Limestone	Very Low
BH308-RS-SA2	48.25-48.62	0.040	0.046	0.057	0.043	0.045	0.046	0.463	Shale	Very Low
BH305-RS-SA6	45.95-46.26	0.054	0.036	0.047	0.050	0.048	0.047	0.468	Shale	Very Low
BH307-RS-SA3	39.42-39.66	0.051	0.050	0.046	0.061	0.053	0.052	0.521	Shale	Very Low
BH308-RS-SA5	27.75-27.93	0.039	0.041	0.064	0.052	0.067	0.053	0.527	Shaly Limestone	Very Low

8 Specific Gravity Tests

8.1 Overview

This section summarizes the results of specific gravity testing according to ASTM D6473-15. The testing was performed in Geomechanica's rock testing laboratory using a Mettler Toledo 4000 g capacity balance setup for under balance weighing and BlueM laboratory oven set to 110 ^{o}C. The setup for measuring the submerged sample weights is illustrated in Figure 29). The preparation and testing of each specimen included the following:

1. Unwrapping of the core sample and preparing it for UCS or Triaxial testing.
2. Submerging the sample in room temperature water in a cooler for a period of 24±4 hours.
3. Placing the specimen in the hanging sample basket to obtain the saturated-submerged (buoyant) specimen mass, ***C***.
4. Allowing the specimen to achieve a surface dry conditions and obtaining the saturated-surface-dry mass, ***B***.
5. Placing the specimen in a laboratory oven at 110 ^{o}C for at least 24 hours and subsequently obtaining the oven-dry specimen mass ***A***.

It should be noted that, when possible, end cuts were included as part of the test specimen in order to maximize the mass of rock available. Nevertheless, due to the size of the samples provided, all specific gravity measurements were obtained using specimen masses less than the specified 1 kg minimum.

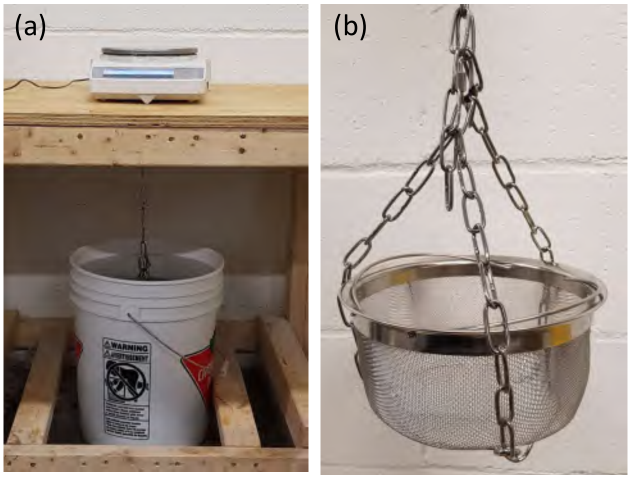


Figure 29: Measuring setup for submerged sample weighing: (a) balance setup and (b) sample basket.

8.2 Results

The results of specific gravity testing are summarized in Table 8.

Table 8: Summary of specific gravity test results.

Sample	Depth (m)	Lithology	Buoyant mass, C (g)	Saturated-surface dry mass, B (g)	Oven-dry mass, A (g)	Bulk specific gravity, $A/(B-C)$	Bulk specific gravity (SSD), $B/(B-C)$	Apparent specific gravity, $A/(A-C)$	Adsorption, %, $[(B-A)/A] \times 100$	Bulk volume, V (cm^3) $(B-C)/\rho_w$	Pore volume, V_v (cm^3) $(B-A)/rho_w$	Porosity, n, V_v/V
BH207-RS-SA4	31.47 - 31.73	Shale and Limestone	835.19	1330.10	1323.25	2.674	2.688	2.711	0.5%	0.495	0.007	0.014
BH304-RS-SA2	36.67 - 36.89	Shale and Limestone	699.12	1117.20	1111.51	2.659	2.672	2.695	0.5%	0.418	0.006	0.014
BH306-RS-SA7	37.88 - 38.08	Shale and Limestone	856.75	1365.24	1355.06	2.665	2.685	2.719	0.8%	0.508	0.010	0.020
BH303-RS-SA5	42.06 - 42.26	Shale and Limestone	843.15	1342.21	1332.88	2.671	2.689	2.722	0.7%	0.499	0.009	0.019
BH26-RS-SA4	46.13 - 46.45	Shale and Limestone	853.46	1364.75	1353.88	2.648	2.669	2.705	0.8%	0.511	0.011	0.021
BH23-RS-SA2	44.02 - 44.24	Shale and Limestone	848.65	1352.15	1346.00	2.673	2.686	2.706	0.5%	0.504	0.006	0.012
BH24-RS-SA4	51.29 - 51.51	Shale and Limestone	942.45	1499.00	1493.64	2.684	2.693	2.710	0.4%	0.557	0.005	0.010
BH202-RS-SA5	35.25 - 35.42	Shale and Limestone	850.84	1355.05	1349.47	2.676	2.687	2.706	0.4%	0.504	0.006	0.011
BH202-RS-SA12	47.90 - 48.07	Shale and Limestone	811.43	1294.47	1285.52	2.661	2.680	2.712	0.7%	0.483	0.009	0.019
BH21-RS-SA2	39.04 - 39.22	Shale and Limestone	868.97	1384.74	1378.34	2.672	2.685	2.706	0.5%	0.516	0.006	0.012
BH22-RS-SA8	43.48 - 43.68	Shale and Limestone	716.63	1142.31	1137.03	2.671	2.683	2.705	0.5%	0.426	0.005	0.012
BH205-RS-SA5	31.31 - 31.51	Shale and Limestone	872.61	1389.32	1385.12	2.681	2.689	2.703	0.3%	0.517	0.004	0.008
BH309-RS-SA3	34.89 - 35.08	Shale and Limestone	894.40	1426.39	1417.66	2.665	2.681	2.709	0.6%	0.532	0.009	0.016
BH308-RS-SA9	32.31 - 32.50	Shale and Limestone	923.57	1472.14	1464.89	2.670	2.684	2.706	0.5%	0.549	0.007	0.013
BH308-RS-SA18	40.13 - 40.31	Shale and Limestone	906.85	1444.66	1436.10	2.670	2.686	2.713	0.6%	0.538	0.009	0.016
BH301-RS-SA6	45.37 - 45.66	Shale and Limestone	889.53	1412.89	1408.28	2.691	2.700	2.715	0.3%	0.523	0.005	0.009

9 Direct Shear Tests

9.1 Overview

This section summarizes the results of single-stage direct shear testing under constant normal loads. The tests were performed using a Wykeman Farrance electro-mechanical shear testing machine (Figure 30). A constant shear displacement rate of 0.3 mm/min was employed for all test stages. The procedure for specimen preparation and testing included the following:

1. The core samples containing the discontinuities were cut to an appropriate length to fit within the height of the shear box.
2. If needed, the perimeter of the discontinuities to be tested were trimmed such that they fit in the shear box measuring 60 mm x 60 mm.
3. With the specimen placed in a casting box with the same dimensions as the shear box, the upper and lower half of the discontinuity was encapsulated in a high strength mortar. Paraffin wax was placed around the discontinuity perimeter to establish a mortar-free region.
4. When needed, the sides of the encapsulated samples were lightly sanded by hand using silicon carbide sandpaper to fit the test specimen in the shear box.
5. The specimen was then placed into the direct shear apparatus where the desired constant normal load was applied and the specimen was subjected to approximately 6 mm of shear displacement. The shear load and normal and shear displacements were measured continuously (every 0.2 seconds) for the duration of the test.

The above procedure followed ASTM D5607 with an exception regarding the number of vertical displacement measurements. The ASTM standard recommends displacement be measured at all four corners of the specimen half and to report the average vertical displacement versus shear displacement. In contrast, the dilation for the tests presented herein was measured at the centre of the top half of the specimen with a single displacement transducer because of space restrictions. Given the planar nature of the specimens, there is not expected to be any appreciable difference in the reported dilation response.

9.2 Results

The results of the direct shear testing are summarized in Table 9. The corresponding stress-displacement curves are presented in Appendix of this report.

The applied normal stress, σ_n, and shear stress, τ, was calculated as follows:

Figure 30: Direct Shear test setup.

$$\sigma_n = \frac{N}{A_{nom}} \tag{12}$$

$$\tau = \frac{T}{A_{nom}} \tag{13}$$

where N is the applied normal load, T is the measured shear load, and A_{nom} is nominal surface area of the discontinuity specimen. The nominal area was determined by analyzing aerial specimen photographs using the image processing software Fiji. To do so, the images were first scaled and then the discontinuity perimeter was traced manually and the enclosed area calculated. The change in contact area with shear displacement has been neglected from all stress calculations and stress-displacement plots.

Table 9: Summary of Direct Shear test results.

Sample	Depth (m)	Stage	Normal Load, N (kN)	Peak Shear Load, T_{max} (kN)	Nominal Area, A_{nom} (mm^2)	Normal Stress ,σ_n (kPa)	Peak Shear Stress, τ_{max} (kPa)	Instantaneous Peak Friction Angle (°)	Lithology
BH207-RS-SA15	42.87 - 43.08	1	0.71	0.71	2824	252	251	44.9	Limestone/Shale
BH204-RS-SA7	42.63 - 42.85	1	1.45	0.83	2897	500	286	29.8	Shale
BH306-RS-SA13	45.33 - 45.63	1	2.81	1.60	2811	1000	567	29.6	Shale
BH302-RS-SA4	44.14 - 44.49	1	5.73	3.59	2864	2001	1255	32.1	Limestone/shale
BH203-RS-SA2	36.10 - 36.41	1	0.73	0.55	2900	251	191	37.3	Limestone/shale
BH206-RS-SA4	41.57 - 41.93	1	1.45	1.97	2837	512	693	53.5	Limestone/shale
BH26-RS-SA3	42.01 - 42.35	1	2.82	1.76	2819	1000	623	31.9	Limestone/shale
BH23-RS-SA5	51.73 - 51.98	1	5.77	3.51	2887	1999	1215	31.3	Limestone/shale
BH24-RS-SA5	57.28 - 57.54	1	0.72	1.18	2856	251	415	58.8	Limestone/shale
BH202-RS-SA11	44.59 - 44.78	1	1.45	1.03	2909	500	355	35.4	Limestone/shale
BH21-RS-SA4	42.17 - 42.39	1	2.79	1.60	2790	1000	572	29.8	Limestone/shale
BH22-RS-SA12	49.42 - 49.57	1	5.96	7.02	2977	2001	2359	49.7	Limestone/shale

Continued on next page

Table 9 – Summary of Direct Shear test results. (continued from previous page)

Sample	Depth (m)	Stage	Normal Load, N (kN)	Peak Shear Load, T_{max} (kN)	Nominal Area, A_{nom} (mm^2)	Normal Stress ,σ_n (kPa)	Peak Shear Stress, τ_{max} (kPa)	Instantaneous Peak Friction Angle (°)	Lithology
BH205-RS-SA13	42.39 - 42.88	1	0.71	0.40	2818	251	141	29.4	Limestone/shale
BH307-RS-SA12	38.29 - 38.73	1	1.41	0.82	2838	498	289	30.1	Limestone/shale
BH309-RS-SA1	31.94 - 32.27	1	2.85	2.07	2857	998	724	36.0	Limestone/shale
BH309-RS-SA12	54.91 - 55.31	1	5.59	3.33	2793	2002	1191	30.8	Limestone/shale
BH305-RS-SA5	43.93 - 44.28	1	5.64	3.47	2820	2000	1230	31.6	Limestone/shale
BH17-RS-03	43.90 - 44.25	1	0.71	0.94	2806	252	335	53.0	Limestone/shale
BH7-RS-02	42.23 - 42.46	1	1.48	1.77	2968	500	596	50.0	Limestone/shale
BH75-RS-03	53.03 - 53.33	1	2.89	2.21	2881	1002	767	37.4	Limestone/shale

9.3 Specimen Photographs

Photographs of the direct shear specimens before and after testing are shown in the Appendix of this report.

Appendices

A UCS Specimen Sheets

- BH207-RS-SA6
- BH207-RS-SA12
- BH304-RS-SA4
- BH204-RS-SA4
- BH204-RS-SA8
- BH306-RS-SA10
- BH302-RS-SA3
- BH203-RS-SA4
- BH303-RS-SA2
- BH303-RS-SA4
- BH206-RS-SA3
- BH26-RS-SA1
- BH26-RS-SA2
- BH23-RS-SA1
- BH23-RS-SA3
- BH24-RS-SA1
- BH24-RS-SA2
- BH24-RS-SA6
- BH202-RS-SA1
- BH202-RS-SA7
- BH21-RS-SA1
- BH21-RS-SA7
- BH22-RS-SA6
- BH22-RS-SA9
- BH22-RS-SA14
- BH205-RS-SA12
- BH307-RS-SA11
- BH307-RS-SA15

- BH309-RS-SA8
- BH308-RS-SA7
- BH308-RS-SA21
- BH305-RS-SA3
- BH301-RS-SA3
- BH24-RS-SA7
- BH26-RS-SA5
- BH17-RS-04
- BH17-RS-06
- BH7-RS-04
- BH7-RS-05
- BH75-RS-04
- BH75-RS-08

Uniaxial Compression Test

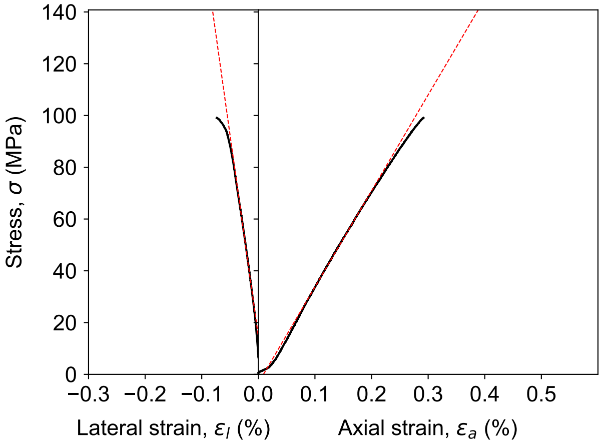
Client	WSP Golder	**Project**	21451329
Sample	BH207-RS-SA6	**Depth**	33.66 - 33.96

Specimen parameters	
Diameter (mm) [a]	60.16
Length (mm) [a]	129.59
Bulk density ρ (g/cm^3)	2.675
UCS (MPa)	99.1
Young's modulus E (GPa) [b]	37.1
Poisson's ratio ν (-) [b]	0.24
Lithology	Limestone/Shale
Failure description [c]	1, 2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [1] Inclined shear fracture and axial splitting failure; [2] Partial hourglass failure;

Prior to testing

After testing



Remarks: Loading rate: 0.15 mm/min.

Performed by	MB/EM	**Date**	2022-08-18

Uniaxial Compression Test

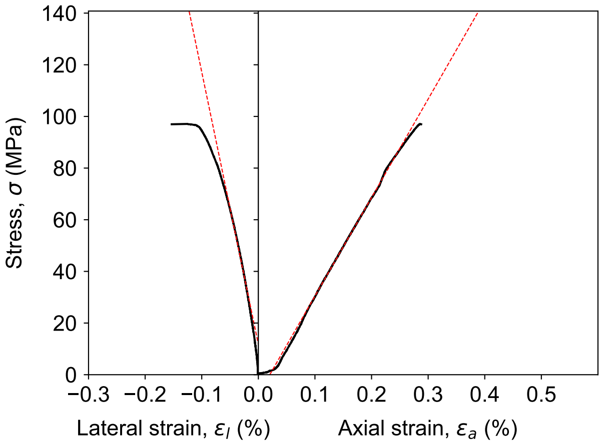
Client	WSP Golder	**Project**	21451329
Sample	BH207-RS-SA12	**Depth**	40.39 - 40.63

Specimen parameters	
Diameter (mm) [a]	60.25
Length (mm) [a]	129.30
Bulk density ρ (g/cm^3)	2.675
UCS (MPa)	97.1
Young's modulus E (GPa) [b]	38.1
Poisson's ratio ν (-) [b]	0.36
Lithology	Limestone/Shale
Failure description [c]	1

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [1] Inclined shear fracture and axial splitting failure;

Prior to testing

After testing



Remarks: Loading rate: 0.15 mm/min.

Performed by	MB/EM	**Date**	2022-08-18

Uniaxial Compression Test

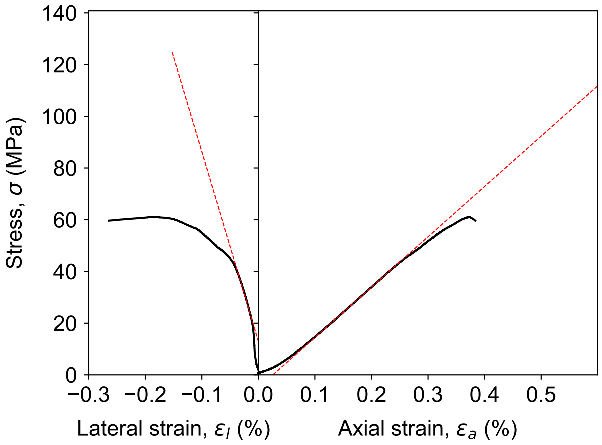
Client	WSP Golder	**Project**	21451329
Sample	BH304-RS-SA4	**Depth**	41.46 - 41.71

Specimen parameters	
Diameter (mm) [a]	61.04
Length (mm) [a]	126.46
Bulk density ρ (g/cm^3)	2.634
UCS (MPa)	61.0
Young's modulus E (GPa) [b]	19.5
Poisson's ratio ν (-) [b]	0.27
Lithology	Limestone/Shale
Failure description [c]	1

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [1] Inclined shear fracture and axial splitting failure;

Prior to testing

After testing



Remarks: Loading rate: 0.15 mm/min.

Performed by	MB/EM	**Date**	2022-08-18

Uniaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH204-RS-SA4	**Depth**	37.25 - 37.52

Specimen parameters	
Diameter (mm) [a]	60.53
Length (mm) [a]	129.94
Bulk density ρ (g/cm^3)	2.684
UCS (MPa)	100.7
Young's modulus E (GPa) [b]	31.4
Poisson's ratio ν (-) [b]	0.47
Lithology	Limestone/Shale
Failure description [c]	3

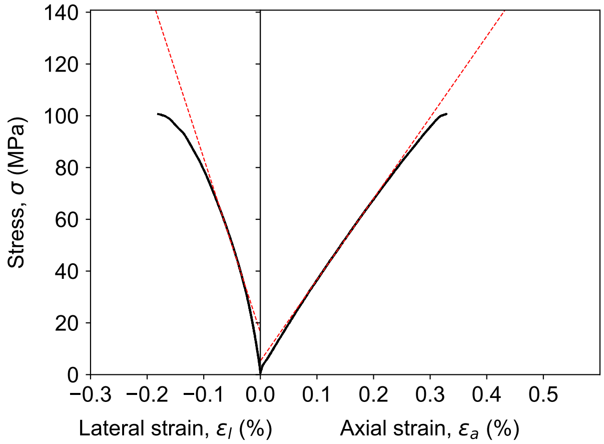
[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.

[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.

[c] Failure description: [3] Axial splitting failure;

Prior to testing

After testing



Remarks: Loading rate: 0.15 mm/min.

Performed by	MB/EM	**Date**	2022-08-18

Uniaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH204-RS-SA8	**Depth**	44.55 - 44.74

Specimen parameters	
Diameter (mm) [a]	60.92
Length (mm) [a]	130.08
Bulk density ρ (g/cm^3)	2.621
UCS (MPa)	79.2
Young's modulus E (GPa) [b]	29.7
Poisson's ratio ν (-) [b]	0.56
Lithology	Limestone/Shale
Failure description [c]	3

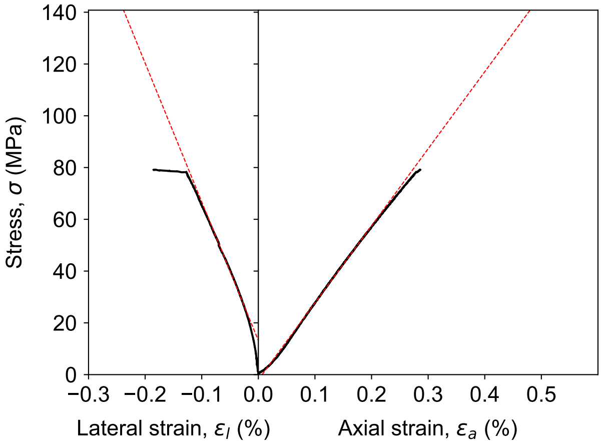
[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.

[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.

[c] Failure description: ^{3} Axial splitting failure;

Prior to testing

After testing



Remarks: Loading rate: 0.15 mm/min.

hspace-12pt Notable non-linear radial strain response resulting in higher than expected Poisson's ratio.

Performed by	MB/EM	**Date**	2022-08-18

Uniaxial Compression Test

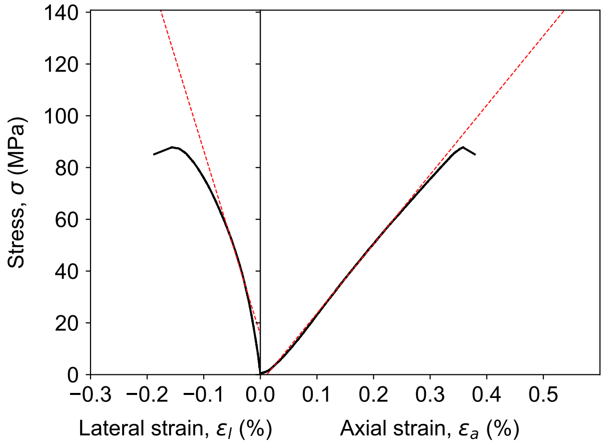
Client	WSP Golder	**Project**	21451329
Sample	BH306-RS-SA10	**Depth**	40.33 - 40.55

Specimen parameters	
Diameter (mm) [a]	59.75
Length (mm) [a]	126.17
Bulk density ρ (g/cm^3)	2.677
UCS (MPa)	87.8
Young's modulus E (GPa) [b]	26.8
Poisson's ratio ν (-) [b]	0.38
Lithology	Limestone/Shale
Failure description [c]	3

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [3] Axial splitting failure;

Prior to testing

After testing



Remarks: Loading rate: 0.15 mm/min.

Performed by	MB/EM	**Date**	2022-08-19

Uniaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH302-RS-SA3	**Depth**	38.31 - 38.51

Specimen parameters

Diameter (mm) [a]	60.64
Length (mm) [a]	130.29
Bulk density ρ (g/cm^3)	2.679
UCS (MPa)	57.2
Young's modulus E (GPa) [b]	25.3
Poisson's ratio ν (-) [b]	0.27
Lithology	Limestone/Shale
Failure description [c]	1

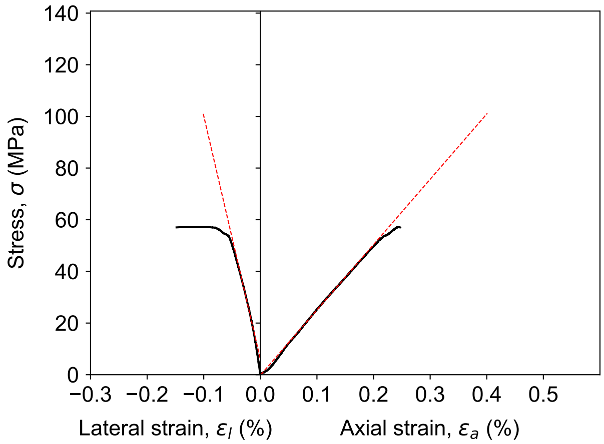
[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.

[b] Tangent modulus, calculated as the slope of the best fit line through ±242 data points on either side of the point representing 50.0% of the peak strength.

[c] Failure description: [1] Inclined shear fracture and axial splitting failure;

Prior to testing

After testing



Remarks: Loading rate: 0.15 mm/min.

Performed by	MB/EM	**Date**	2022-08-19

Uniaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH203-RS-SA4	**Depth**	40.56 - 40.77

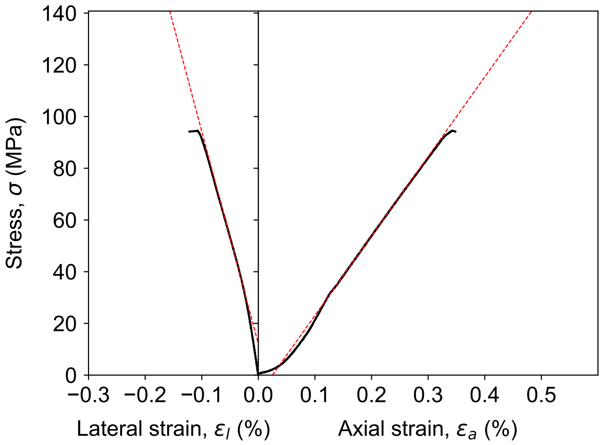
Specimen parameters

Diameter (mm) [a]	60.70
Length (mm) [a]	130.60
Bulk density ρ (g/cm^3)	2.679
UCS (MPa)	94.6
Young's modulus E (GPa) [b]	30.7
Poisson's ratio ν (-) [b]	0.37
Lithology	Limestone/Shale
Failure description [c]	3, 2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [3] Axial splitting failure; [2] Partial hourglass failure;

Prior to testing

After testing



Remarks: Loading rate: 0.15 mm/min.

Performed by	MB/EM	**Date**	2022-08-19

Uniaxial Compression Test

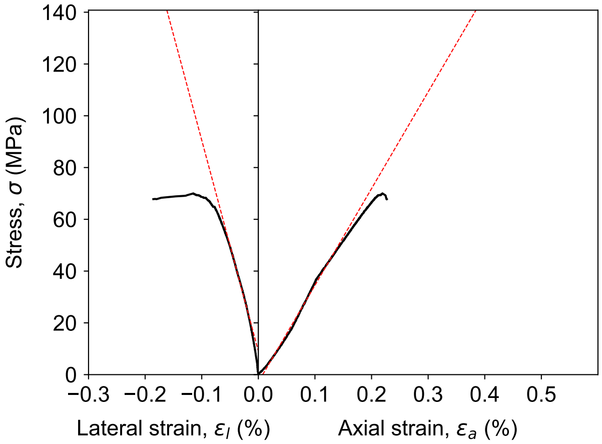
Client	WSP Golder	**Project**	21451329
Sample	BH303-RS-SA2	**Depth**	35.24 - 35.44

Specimen parameters	
Diameter (mm) [a]	60.01
Length (mm) [a]	129.62
Bulk density ρ (g/cm^3)	2.750
UCS (MPa)	70.0
Young's modulus E (GPa) [b]	37.4
Poisson's ratio ν (-) [b]	0.46
Lithology	Limestone/Shale
Failure description [c]	3

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±208 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: ^{3} Axial splitting failure;

Prior to testing

After testing



Remarks: Loading rate: 0.15 mm/min.

Performed by	MB/EM	**Date**	2022-08-19

Uniaxial Compression Test

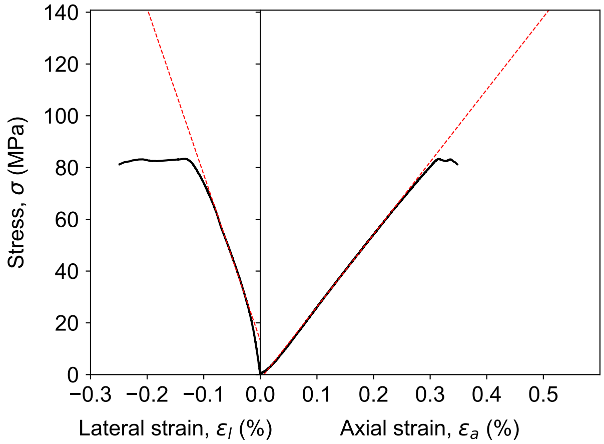
Client	WSP Golder	**Project**	21451329
Sample	BH303-RS-SA4	**Depth**	39.75 - 39.97

Specimen parameters	
Diameter (mm) [a]	60.72
Length (mm) [a]	129.99
Bulk density ρ (g/cm^3)	2.681
UCS (MPa)	83.4
Young's modulus E (GPa) [b]	28.0
Poisson's ratio ν (-) [b]	0.44
Lithology	Limestone/Shale
Failure description [c]	3

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: ^{3} Axial splitting failure;

Prior to testing

After testing



Remarks: Loading rate: 0.15 mm/min.

Performed by	MB/EM	**Date**	2022-08-19

Uniaxial Compression Test

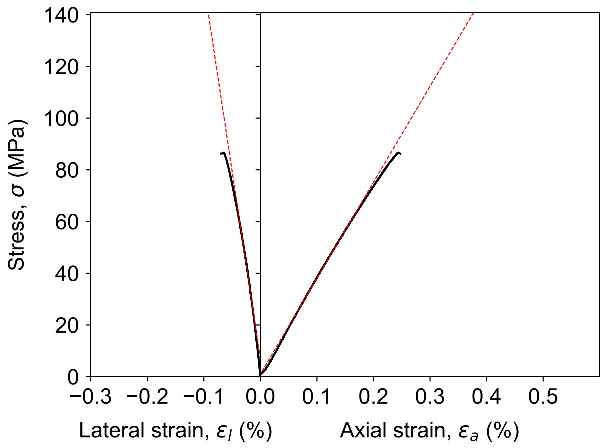
Client	WSP Golder	**Project**	21451329
Sample	BH206-RS-SA3	**Depth**	38.03 - 38.27

Specimen parameters	
Diameter (mm) [a]	60.33
Length (mm) [a]	127.88
Bulk density ρ (g/cm^3)	2.665
UCS (MPa)	86.7
Young's modulus E (GPa) [b]	37.1
Poisson's ratio ν (-) [b]	0.26
Lithology	Limestone/Shale
Failure description [c]	1, 2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±278 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [1] Inclined shear fracture and axial splitting failure; [2] Partial hourglass failure;

Prior to testing

After testing



Remarks: Loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-10-27

Uniaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH26-RS-SA1	**Depth**	37.60 - 37.81

Specimen parameters	
Diameter (mm) [a]	60.32
Length (mm) [a]	128.28
Bulk density ρ (g/cm^3)	2.684
UCS (MPa)	86.3
Lithology	Limestone/Shale
Failure description [b]	4

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [4] Inclined shear failure;

Prior to testing

After testing

Remarks: Loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-10-27

Uniaxial Compression Test

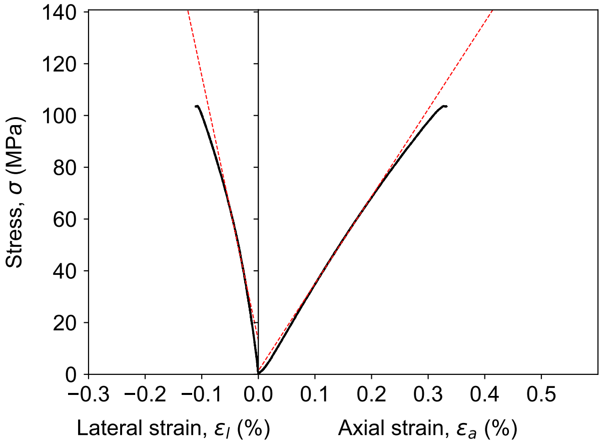
Client	WSP Golder	**Project**	21451329
Sample	BH26-RS-SA2	**Depth**	39.94 - 40.26

Specimen parameters	
Diameter (mm) [a]	60.18
Length (mm) [a]	127.55
Bulk density ρ (g/cm^3)	2.684
UCS (MPa)	103.7
Young's modulus E (GPa) [b]	33.7
Poisson's ratio ν (-) [b]	0.33
Lithology	Limestone/Shale
Failure description [c]	3, 5

Prior to testing

After testing

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [3] Axial splitting failure; [5] Localized crushing near platen;



Remarks: Loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-10-27

Uniaxial Compression Test

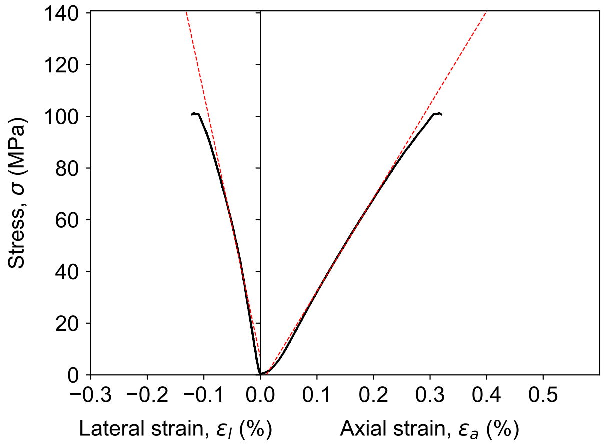
Client	WSP Golder	**Project**	21451329
Sample	BH23-RS-SA1	**Depth**	39.18 - 39.35

Specimen parameters	
Diameter (mm) [a]	60.82
Length (mm) [a]	127.66
Bulk density ρ (g/cm^3)	2.677
UCS (MPa)	101.2
Young's modulus E (GPa) [b]	36.1
Poisson's ratio ν (-) [b]	0.35
Lithology	Limestone/Shale
Failure description [c]	1

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: ^{1} Inclined shear fracture and axial splitting failure;

Prior to testing

After testing



Remarks: Loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-10-27

Uniaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH23-RS-SA3	**Depth**	46.35 - 46.61

Specimen parameters

Diameter (mm) [a]	60.80
Length (mm) [a]	127.92
Bulk density ρ (g/cm^3)	2.657
UCS (MPa)	71.4
Lithology	Limestone/Shale
Failure description [b]	1, 2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Inclined shear fracture and axial splitting failure; [2] Partial hourglass failure;

Prior to testing

After testing

Remarks: Loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-10-27

Uniaxial Compression Test

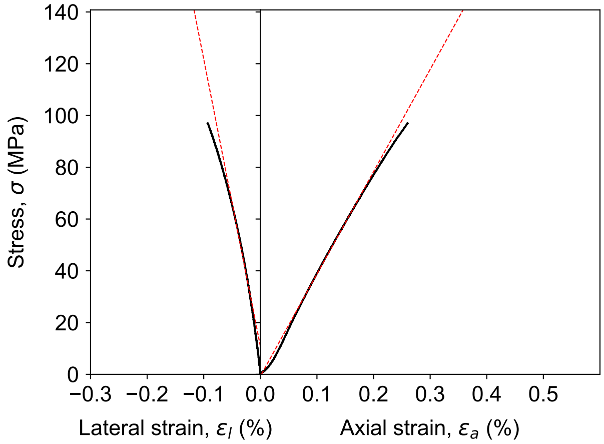
Client	WSP Golder	**Project**	21451329
Sample	BH24-RS-SA1	**Depth**	42.52 - 42.79

Specimen parameters	
Diameter (mm) [a]	61.06
Length (mm) [a]	128.08
Bulk density ρ (g/cm^3)	2.663
UCS (MPa)	97.3
Young's modulus E (GPa) [b]	39.5
Poisson's ratio ν (-) [b]	0.36
Lithology	Limestone/Shale
Failure description [c]	1, 2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [1] Inclined shear fracture and axial splitting failure; [2] Partial hourglass failure;

Prior to testing

After testing



Remarks: Loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-10-27

Uniaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH24-RS-SA2	**Depth**	45.55 - 45.76

Specimen parameters	
Diameter (mm) [a]	60.85
Length (mm) [a]	128.34
Bulk density ρ (g/cm^3)	2.679
UCS (MPa)	99.0
Lithology	Limestone/Shale
Failure description [b]	1, 6

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.

[b] Failure description: [1] Inclined shear fracture and axial splitting failure; [6] Hourglass failure;

Prior to testing

After testing

Remarks: Loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-10-27

Uniaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH24-RS-SA6	**Depth**	58.87 - 59.05

Specimen parameters	
Diameter (mm) [a]	60.82
Length (mm) [a]	128.06
Bulk density ρ (g/cm^3)	2.678
UCS (MPa)	52.1
Lithology	Limestone/Shale
Failure description [b]	1, 2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Inclined shear fracture and axial splitting failure; [2] Partial hourglass failure;

Prior to testing

After testing

Remarks: Loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-10-27

Uniaxial Compression Test

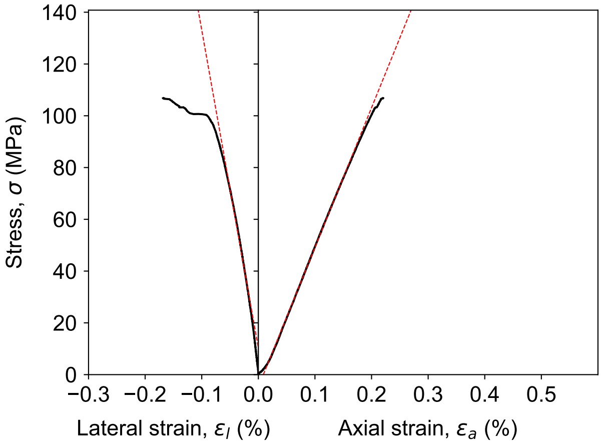
Client	WSP Golder	**Project**	21451329
Sample	BH202-RS-SA1	**Depth**	29.49 - 29.68

Specimen parameters	
Diameter (mm) [a]	60.89
Length (mm) [a]	128.38
Bulk density ρ (g/cm^3)	2.690
UCS (MPa)	106.9
Young's modulus E (GPa) [b]	53.9
Poisson's ratio ν (-) [b]	0.44
Lithology	Limestone/Shale
Failure description [c]	3

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±274 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: ^{3} Axial splitting failure;

Prior to testing

After testing



Remarks: Loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-10-27

Uniaxial Compression Test

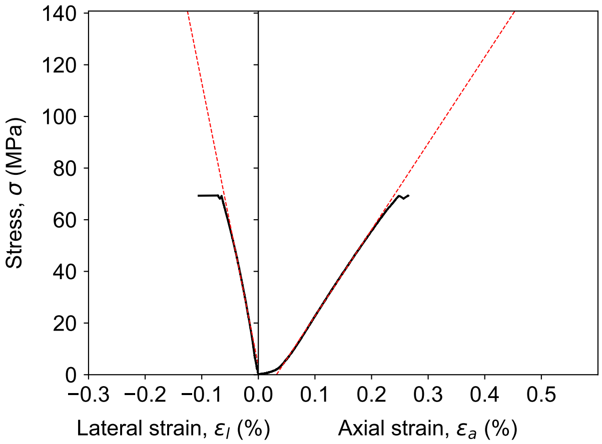
Client	WSP Golder	**Project**	21451329
Sample	BH202-RS-SA7	**Depth**	37.48 - 37.66

Specimen parameters	
Diameter (mm) [a]	60.91
Length (mm) [a]	128.46
Bulk density ρ (g/cm^3)	2.670
UCS (MPa)	69.4
Young's modulus E (GPa) [b]	33.4
Poisson's ratio ν (-) [b]	0.31
Lithology	Limestone/Shale
Failure description [c]	1

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [1] Inclined shear fracture and axial splitting failure;

Prior to testing

After testing



Remarks: Loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-10-27

Uniaxial Compression Test

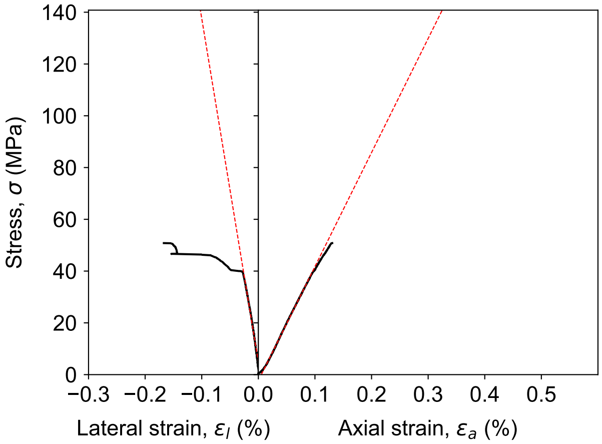
Client	WSP Golder	**Project**	21451329
Sample	BH21-RS-SA1	**Depth**	37.57 - 37.73

Specimen parameters	
Diameter (mm) [a]	60.25
Length (mm) [a]	128.30
Bulk density ρ (g/cm^3)	2.679
UCS (MPa)	55.7
Young's modulus E (GPa) [b]	44.1
Poisson's ratio ν (-) [b]	0.33
Lithology	Limestone/Shale
Failure description [c]	3

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±183 data points on either side of the point representing 40.0% of the peak strength.
[c] Failure description: [3] Axial splitting failure;

Prior to testing

After testing



Remarks: Loading rate: 0.10 mm/min. Specimen experienced pre-peak localized failure(s).

Performed by	MB/MB	**Date**	2022-10-27

Uniaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH21-RS-SA7	**Depth**	49.73 - 49.93

Specimen parameters	
Diameter (mm) [a]	60.26
Length (mm) [a]	128.53
Bulk density ρ (g/cm^3)	2.688
UCS (MPa)	77.4
Lithology	Limestone/Shale
Failure description [b]	1, 7

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Inclined shear fracture and axial splitting failure; [7] Failure partly along pre-existing structure;

Prior to testing

After testing

Remarks: Loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-10-27

Uniaxial Compression Test

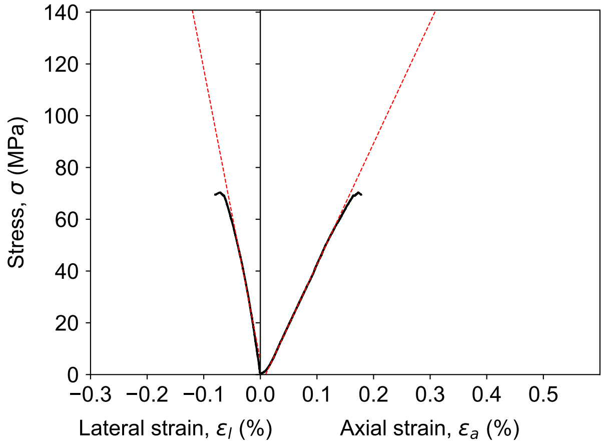
Client	WSP Golder	**Project**	21451329
Sample	BH22-RS-SA6	**Depth**	39.10 - 39.34

Specimen parameters	
Diameter (mm) [a]	60.28
Length (mm) [a]	128.49
Bulk density ρ (g/cm^3)	2.686
UCS (MPa)	70.4
Young's modulus E (GPa) [b]	46.8
Poisson's ratio ν (-) [b]	0.42
Lithology	Limestone
Failure description [c]	1, 7, 5

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±217 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [1] Inclined shear fracture and axial splitting failure; [7] Failure partly along pre-existing structure; [5] Localized crushing near platen;

Prior to testing

After testing



Remarks: Loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-10-27

Uniaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH22-RS-SA9	**Depth**	44.67 - 44.94

Specimen parameters

Diameter (mm) [a]	60.21
Length (mm) [a]	128.53
Bulk density ρ (g/cm^3)	2.678
UCS (MPa)	80.6
Lithology	Limestone/Shale
Failure description [b]	1, 2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Inclined shear fracture and axial splitting failure; [2] Partial hourglass failure;

Prior to testing

After testing

Remarks: Loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-10-27

Uniaxial Compression Test

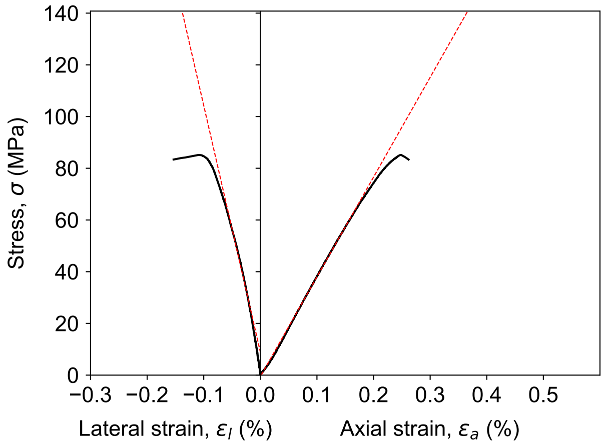
Client	WSP Golder	**Project**	21451329
Sample	BH22-RS-SA14	**Depth**	53.25 - 53.47

Specimen parameters	
Diameter (mm) [a]	60.35
Length (mm) [a]	128.31
Bulk density ρ (g/cm^3)	2.692
UCS (MPa)	85.2
Young's modulus E (GPa) [b]	38.6
Poisson's ratio ν (-) [b]	0.40
Lithology	Limestone/Shale
Failure description [c]	1

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±267 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: ^{1} Inclined shear fracture and axial splitting failure;

Prior to testing

After testing



Remarks: Loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-10-27

Uniaxial Compression Test

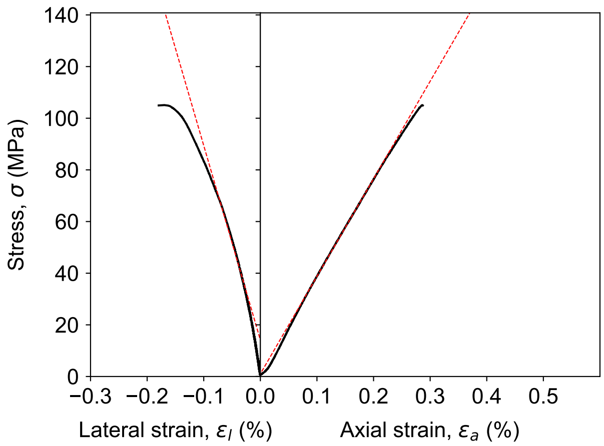
Client	WSP Golder	**Project**	21451329
Sample	BH205-RS-SA12	**Depth**	40.14 - 40.39

Specimen parameters	
Diameter (mm) [a]	60.38
Length (mm) [a]	128.42
Bulk density ρ (g/cm^3)	2.689
UCS (MPa)	105.1
Young's modulus E (GPa) [b]	37.8
Poisson's ratio ν (-) [b]	0.50
Lithology	Limestone/Shale
Failure description [c]	1, 2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [1] Inclined shear fracture and axial splitting failure; [2] Partial hourglass failure;

Prior to testing

After testing



Remarks: Loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-10-27

Uniaxial Compression Test

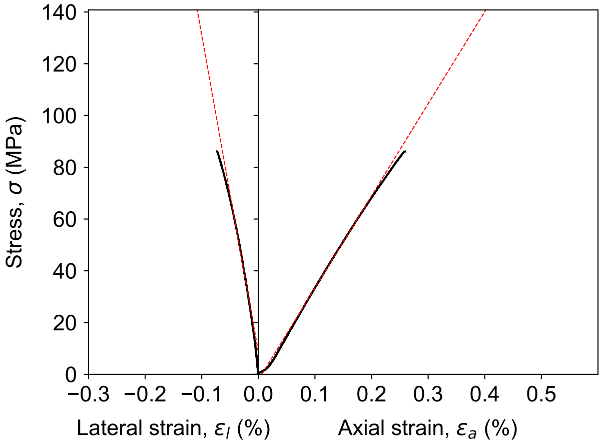
Client	WSP Golder	**Project**	21451329
Sample	BH307-RS-SA11	**Depth**	36.81 - 37.09

Specimen parameters	
Diameter (mm) [a]	60.20
Length (mm) [a]	128.60
Bulk density ρ (g/cm^3)	2.675
UCS (MPa)	86.9
Young's modulus E (GPa) [b]	35.6
Poisson's ratio ν (-) [b]	0.29
Lithology	Limestone/Shale
Failure description [c]	3, 5

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: ^{3} Axial splitting failure; ^{5} Localized crushing near platen;

Prior to testing

After testing



Remarks: Loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-10-27

Uniaxial Compression Test

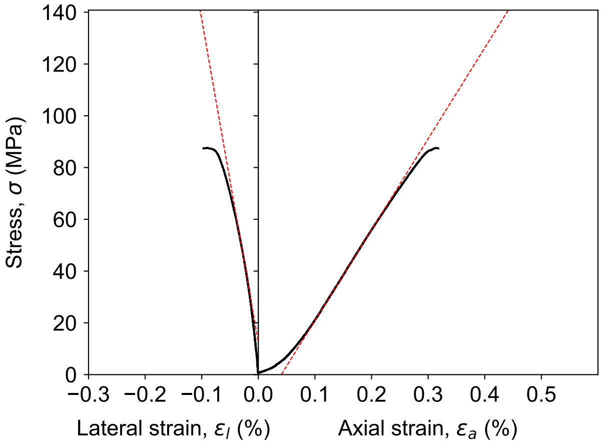
Client	WSP Golder	**Project**	21451329
Sample	BH307-RS-SA15	**Depth**	42.37 - 42.69

Specimen parameters	
Diameter (mm) [a]	59.99
Length (mm) [a]	128.43
Bulk density ρ (g/cm^3)	2.677
UCS (MPa)	87.6
Young's modulus E (GPa) [b]	35.1
Poisson's ratio ν (-) [b]	0.28
Lithology	Limestone/Shale
Failure description [c]	4

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [4] Inclined shear failure;

Prior to testing

After testing



Remarks: Loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-10-27

Uniaxial Compression Test

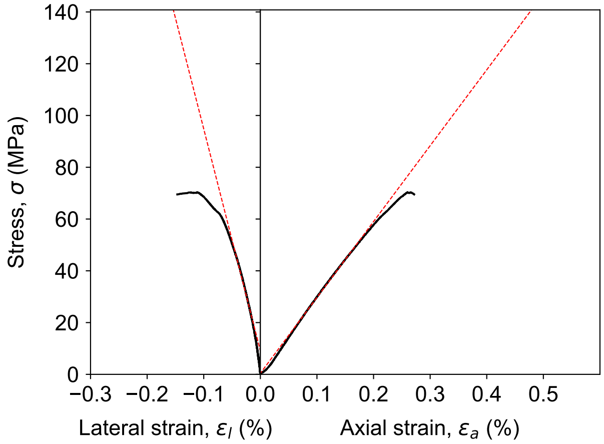
Client	WSP Golder	**Project**	21451329
Sample	BH309-RS-SA8	**Depth**	44.95 - 45.18

Specimen parameters	
Diameter (mm) [a]	60.31
Length (mm) [a]	128.55
Bulk density ρ (g/cm^3)	2.668
UCS (MPa)	70.4
Young's modulus E (GPa) [b]	29.3
Poisson's ratio ν (-) [b]	0.34
Lithology	Limestone/Shale
Failure description [c]	1, 2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±269 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [1] Inclined shear fracture and axial splitting failure; [2] Partial hourglass failure;

Prior to testing

After testing



Remarks: Loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-10-27

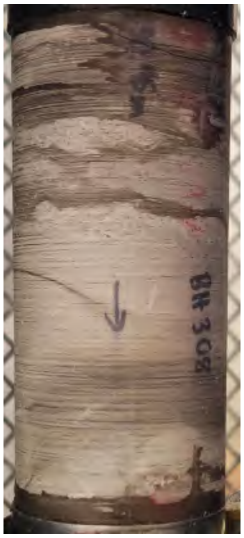
Uniaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH308-RS-SA7	**Depth**	30.27 - 30.46

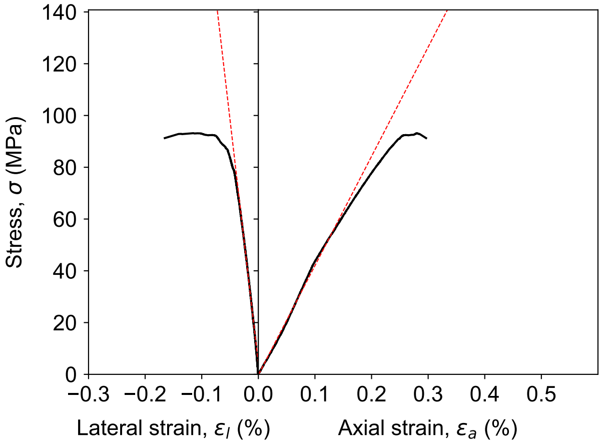
Specimen parameters	
Diameter (mm) [a]	60.06
Length (mm) [a]	128.24
Bulk density ρ (g/cm^3)	2.677
UCS (MPa)	93.2
Young's modulus E (GPa) [b]	42.2
Poisson's ratio ν (-) [b]	0.22
Lithology	Limestone/Shale
Failure description [c]	3, 5

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±289 data points on either side of the point representing 40.0% of the peak strength.
[c] Failure description: [3] Axial splitting failure; [5] Localized crushing near platen;

Prior to testing



After testing



Remarks: Loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-10-27

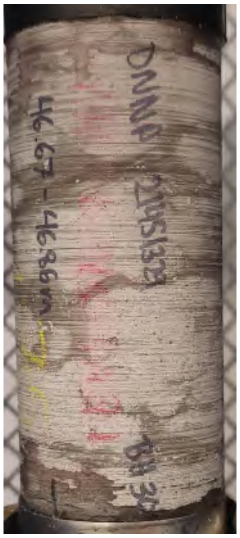
Uniaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH308-RS-SA21	**Depth**	46.67 - 46.86

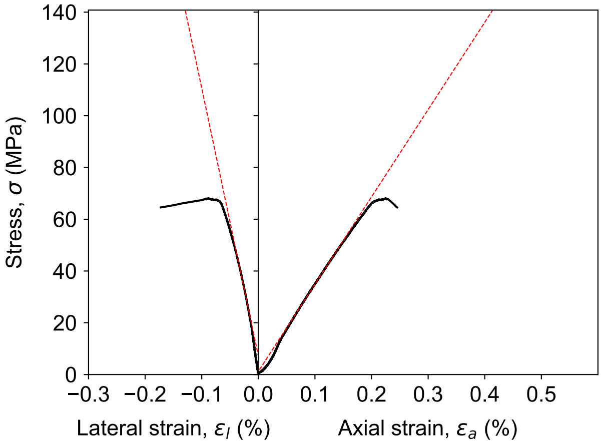
Specimen parameters	
Diameter (mm) [a]	60.12
Length (mm) [a]	128.62
Bulk density ρ (g/cm^3)	2.678
UCS (MPa)	68.1
Young's modulus E (GPa) [b]	33.7
Poisson's ratio ν (-) [b]	0.33
Lithology	Limestone/Shale
Failure description [c]	1

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [1] Inclined shear fracture and axial splitting failure;

Prior to testing



After testing



Remarks: Loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-10-27

Uniaxial Compression Test

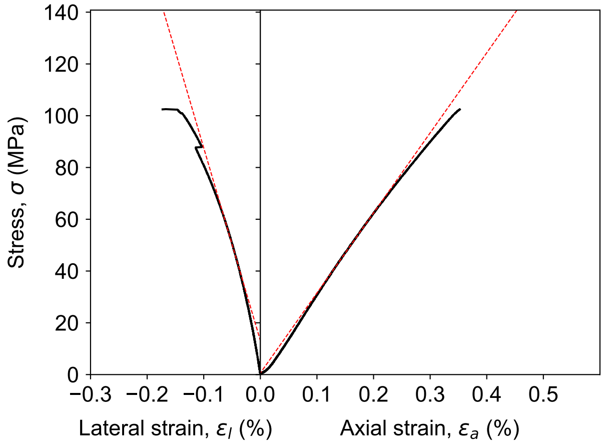
Client	WSP Golder	**Project**	21451329
Sample	BH305-RS-SA3	**Depth**	35.36 - 35.61

Specimen parameters	
Diameter (mm) [a]	61.03
Length (mm) [a]	128.11
Bulk density ρ (g/cm^3)	2.672
UCS (MPa)	102.5
Young's modulus E (GPa) [b]	30.9
Poisson's ratio ν (-) [b]	0.42
Lithology	Limestone/Shale
Failure description [c]	1, 2, 5

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [1] Inclined shear fracture and axial splitting failure; [2] Partial hourglass failure; [5] Localized crushing near platen;

Prior to testing

After testing



Remarks: Loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-10-27

Uniaxial Compression Test

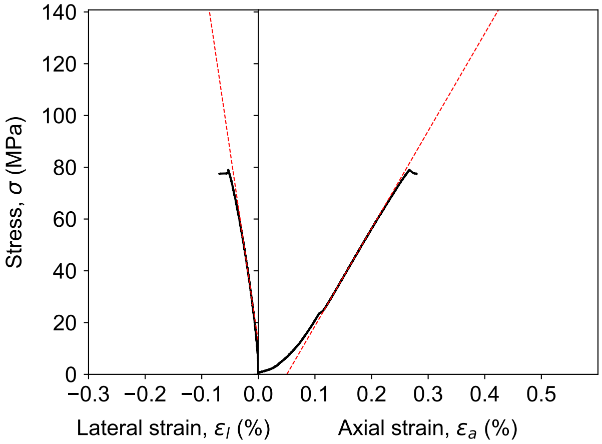
Client	WSP Golder	**Project**	21451329
Sample	BH301-RS-SA3	**Depth**	37.43 - 37.69

Specimen parameters	
Diameter (mm) [a]	60.96
Length (mm) [a]	128.54
Bulk density ρ (g/cm^3)	2.684
UCS (MPa)	79.0
Young's modulus E (GPa) [b]	37.7
Poisson's ratio ν (-) [b]	0.25
Lithology	Limestone/Shale
Failure description [c]	1, 2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [1] Inclined shear fracture and axial splitting failure; [2] Partial hourglass failure;

Prior to testing

After testing



Remarks: Loading rate of: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-10-27

Uniaxial Compression Test

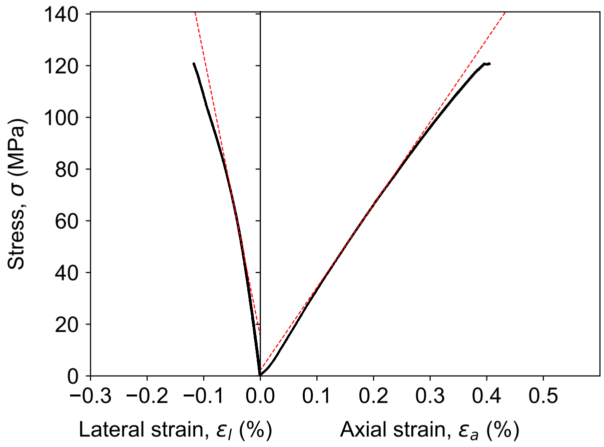
Client	WSP Golder	**Project**	21451329
Sample	BH24-RS-SA7	**Depth**	25.53 - 25.71

Specimen parameters	
Diameter (mm) [a]	60.61
Length (mm) [a]	128.30
Bulk density ρ (g/cm^3)	2.661
UCS (MPa)	120.9
Young's modulus E (GPa) [b]	32.0
Poisson's ratio ν (-) [b]	0.29
Lithology	Brown Shale
Failure description [c]	1, 2

Prior to testing

After testing

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [1] Inclined shear fracture and axial splitting failure; [2] Partial hourglass failure;



Remarks: Loading rate: 0.05 mm/min.

Performed by	EM/MB	**Date**	2022-12-22

Uniaxial Compression Test

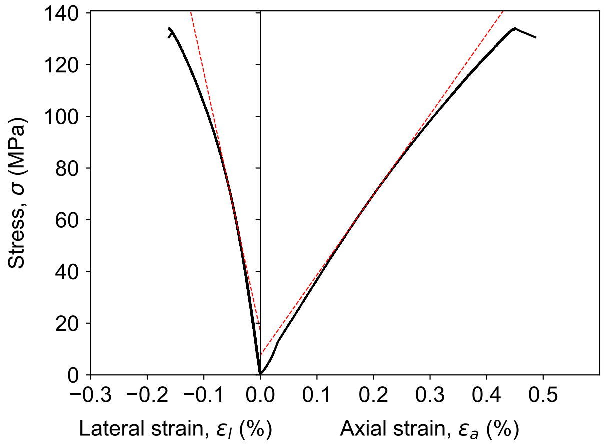
Client	WSP Golder	**Project**	21451329
Sample	BH26-RS-SA5	**Depth**	23.21 - 23.40

Specimen parameters	
Diameter (mm) [a]	59.95
Length (mm) [a]	128.26
Bulk density ρ (g/cm^3)	2.665
UCS (MPa)	134.1
Young's modulus E (GPa) [b]	31.0
Poisson's ratio ν (-) [b]	0.31
Lithology	Brown Shale
Failure description [c]	1

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [1] Inclined shear fracture and axial splitting failure;

Prior to testing

After testing



Remarks: Loading rate: 0.05 mm/min.

Performed by	EM/MB	**Date**	2022-12-22

Uniaxial Compression Test

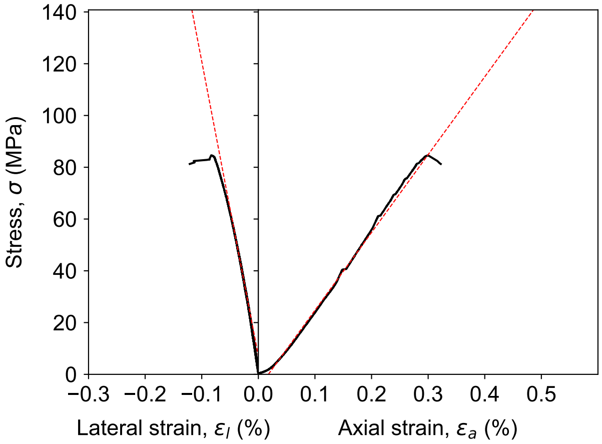
Client	WSP Golder	**Project**	21451329
Sample	BH17-RS-04	**Depth**	44.55 - 44.81

Specimen parameters	
Diameter (mm) [a]	60.65
Length (mm) [a]	127.42
Bulk density ρ (g/cm^3)	2.671
UCS (MPa)	84.6
Young's modulus E (GPa) [b]	30.1
Poisson's ratio ν (-) [b]	0.26
Lithology	Limestone/shale
Failure description [c]	1, 2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [1] Inclined shear fracture and axial splitting failure; [2] Partial hourglass failure;

Prior to testing

After testing



Remarks: Loading rate: 0.05 mm/min.

Performed by	EM/MB	**Date**	2022-12-22

Uniaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH17-RS-06	**Depth**	36.42 - 36.67

Specimen parameters

Diameter (mm) [a]	60.61
Length (mm) [a]	127.81
Bulk density ρ (g/cm^3)	2.664
UCS (MPa)	79.4
Lithology	Limestone/shale
Failure description [b]	1, 2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.

[b] Failure description: [1] Inclined shear fracture and axial splitting failure; [2] Partial hourglass failure;

Prior to testing

After testing

Remarks: Loading rate: 0.05 mm/min.

Performed by	EM/MB	**Date**	2022-12-22

Uniaxial Compression Test

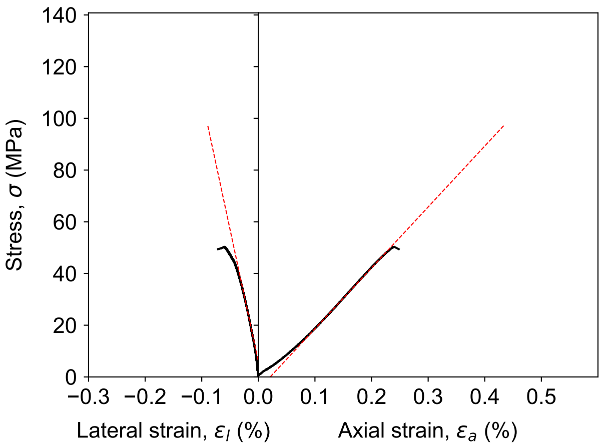
Client	WSP Golder	**Project**	21451329
Sample	BH7-RS-04	**Depth**	40.11 - 40.37

Specimen parameters	
Diameter (mm) [a]	60.29
Length (mm) [a]	127.84
Bulk density ρ (g/cm^3)	2.664
UCS (MPa)	50.3
Young's modulus E (GPa) [b]	23.6
Poisson's ratio ν (-) [b]	0.23
Lithology	Limestone/shale
Failure description [c]	1, 8

Prior to testing

After testing

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [1] Inclined shear fracture and axial splitting failure; [8] Diffuse axial splitting;



Remarks: Loading rate: 0.05 mm/min.

Performed by	EM/MB	**Date**	2022-12-22

Uniaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH7-RS-05	**Depth**	51.08 - 51.33

Specimen parameters

Diameter (mm) [a]	60.14
Length (mm) [a]	126.68
Bulk density ρ (g/cm^3)	2.685
UCS (MPa)	111.8
Lithology	Limestone/shale
Failure description [b]	1

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Inclined shear fracture and axial splitting failure;

Prior to testing

After testing

Remarks: Loading rate: 0.05 mm/min.

Performed by	EM/MB	**Date**	2022-12-22

Uniaxial Compression Test

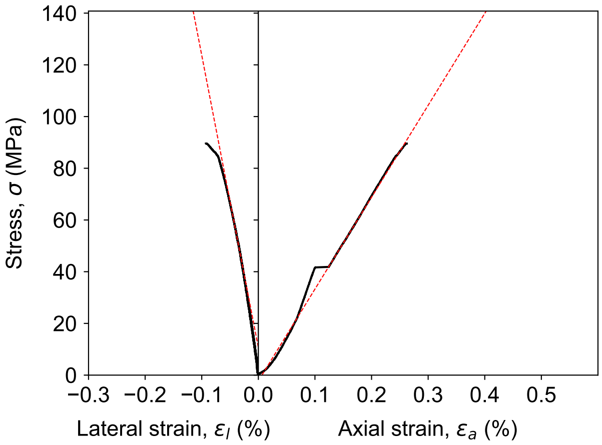
Client	WSP Golder	**Project**	21451329
Sample	BH75-RS-04	**Depth**	51.58 - 51.86

Specimen parameters	
Diameter (mm) [a]	60.50
Length (mm) [a]	127.06
Bulk density ρ (g/cm^3)	2.683
UCS (MPa)	89.5
Young's modulus E (GPa) [b]	35.5
Poisson's ratio ν (-) [b]	0.31
Lithology	Limestone/shale
Failure description [c]	1

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 59.0% of the peak strength.
[c] Failure description: [1] Inclined shear fracture and axial splitting failure;

Prior to testing

After testing



Remarks: Loading rate: 0.05 mm/min.

Performed by	EM/MB	**Date**	2022-12-22

Uniaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH75-RS-08	**Depth**	44.77 - 45.02

Specimen parameters	
Diameter (mm) [a]	60.50
Length (mm) [a]	127.85
Bulk density ρ (g/cm^3)	2.679
UCS (MPa)	77.8
Lithology	Limestone/shale
Failure description [b]	1

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Inclined shear fracture and axial splitting failure;

Prior to testing

After testing

Remarks: Loading rate: 0.05 mm/min.

Performed by	EM/MB	**Date**	2022-12-22

B Triaxial Specimen Sheets

- BH205-RS-SA1
- BH205-RS-SA2
- BH205-RS-SA3
- BH205-RS-SA4
- BH205-RS-SA6
- BH205-RS-SA7
- BH205-RS-SA9
- BH205-RS-SA10
- BH205-RS-SA14
- BH205-RS-SA16
- BH205-RS-SA17
- BH205-RS-SA18
- BH307-RS-SA1
- BH307-RS-SA4
- BH307-RS-SA6
- BH307-RS-SA7
- BH307-RS-SA9
- BH307-RS-SA10
- BH307-RS-SA16
- BH307-RS-SA18
- BH307-RS-SA19
- BH307-RS-SA20
- BH307-RS-SA24
- BH307-RS-SA26

Triaxial Compression Test

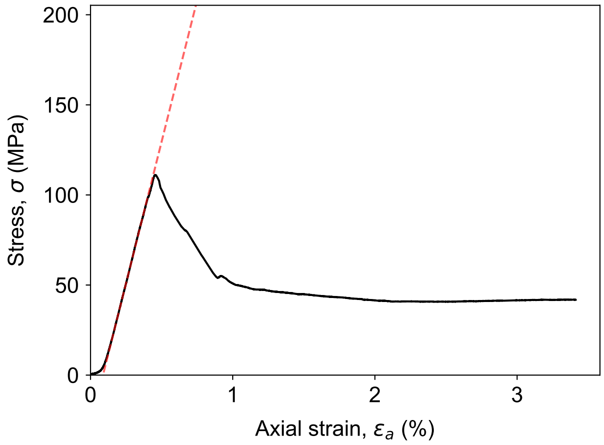
Client	WSP Golder	**Project**	21451329
Sample	BH205-RS-SA1	**Depth**	28.24 - 28.51

Specimen parameters

Diameter (mm) [a]	60.53
Length (mm) [a]	127.60
Bulk density ρ (g/cm^3)	2.670
σ_1 (MPa)	111.1
σ_3 (MPa)	3.7
Young's modulus E (GPa) [b]	31.4
Lithology	Limestone/Shale
Failure description [c]	1

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [1] Inclined shear fracture and axial splitting failure;

After testing



Remarks: pre-peak loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-11-21

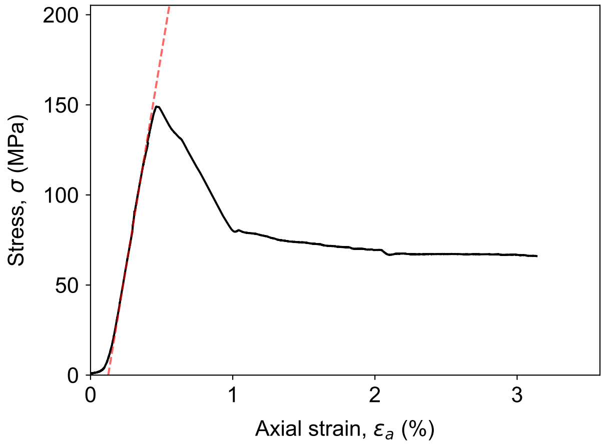
Triaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH205-RS-SA2	**Depth**	28.51 - 28.73

Specimen parameters	
Diameter (mm) [a]	60.55
Length (mm) [a]	127.66
Bulk density ρ (g/cm^3)	2.675
σ_1 (MPa)	149.0
σ_3 (MPa)	7.6
Young's modulus E (GPa) [b]	47.7
Lithology	Limestone/Shale
Failure description [c]	2, 3

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [2] Inclined shear failure; [3] Partial hourglass failure;

After testing



Remarks: pre-peak loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-11-22

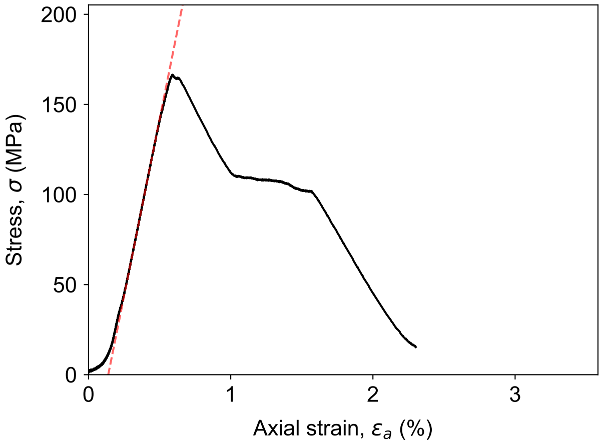
Triaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH205-RS-SA3	**Depth**	29.45 - 29.74

Specimen parameters	
Diameter (mm) [a]	60.53
Length (mm) [a]	127.68
Bulk density ρ (g/cm^3)	2.677
σ_1 (MPa)	166.5
σ_3 (MPa)	15.1
Young's modulus E (GPa) [b]	39.3
Lithology	Limestone/Shale
Failure description [c]	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [2] Inclined shear failure;

After testing



Remarks: pre-peak loading rate: 0.10 mm/min. Cell pressure lost in the post-peak.

Performed by	MB/MB	**Date**	2022-11-23

Triaxial Compression Test

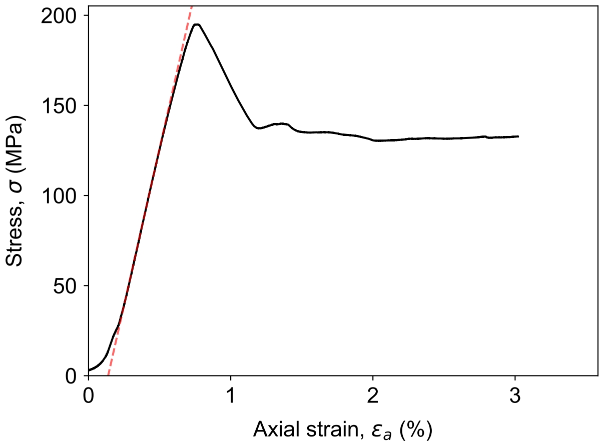
Client	WSP Golder	**Project**	21451329
Sample	BH205-RS-SA4	**Depth**	30.32 - 30.59

Specimen parameters

Diameter (mm) [a]	60.54
Length (mm) [a]	127.59
Bulk density ρ (g/cm^3)	2.667
σ_1 (MPa)	195.0
σ_3 (MPa)	22.6
Young's modulus E (GPa) [b]	34.9
Lithology	Limestone/Shale
Failure description [c]	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: ^{2} Inclined shear failure;

After testing



Remarks: pre-peak loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-11-23

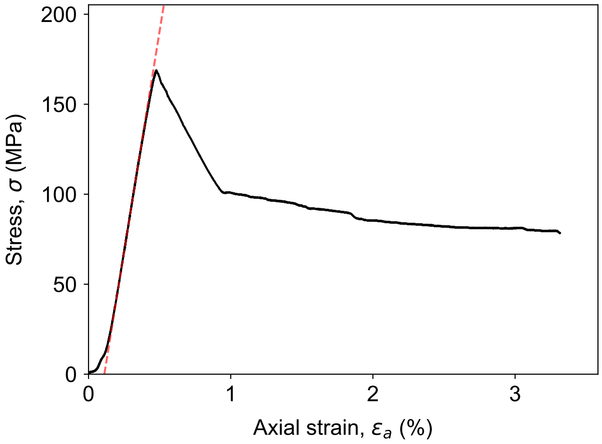
Triaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH205-RS-SA6	**Depth**	31.55 - 31.82

Specimen parameters	
Diameter (mm) [a]	60.46
Length (mm) [a]	127.39
Bulk density ρ (g/cm^3)	2.694
σ_1 (MPa)	168.9
σ_3 (MPa)	7.6
Young's modulus E (GPa) [b]	49.0
Lithology	Limestone/Shale
Failure description [c]	1

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [1] Inclined shear fracture and axial splitting failure;

After testing



Remarks: pre-peak loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-11-22

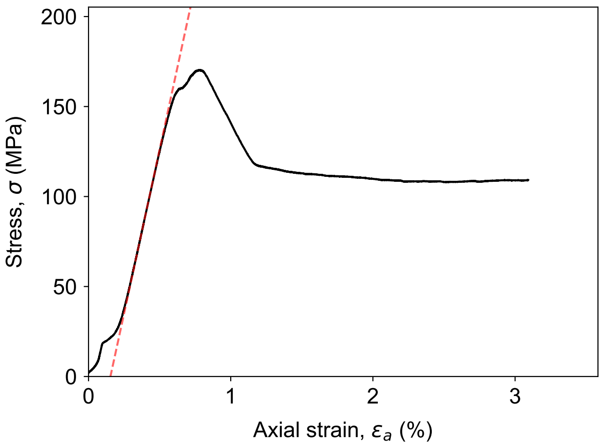
Triaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH205-RS-SA7	**Depth**	32.32 - 32.59

Specimen parameters	
Diameter (mm) [a]	60.54
Length (mm) [a]	127.84
Bulk density ρ (g/cm^3)	2.677
σ_1 (MPa)	170.3
σ_3 (MPa)	15.1
Young's modulus E (GPa) [b]	36.4
Lithology	Limestone/Shale
Failure description [c]	2, 4

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: ^{2} Inclined shear failure; ^{4} Localized crushing near platen;

After testing



Remarks: pre-peak loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-11-23

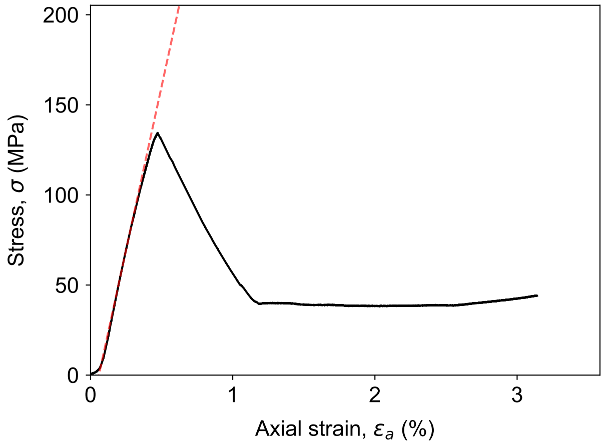
Triaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH205-RS-SA9	**Depth**	34.26 - 34.47

Specimen parameters	
Diameter (mm) [a]	60.44
Length (mm) [a]	127.28
Bulk density ρ (g/cm^3)	2.688
σ_1 (MPa)	134.5
σ_3 (MPa)	3.8
Young's modulus E (GPa) [b]	36.3
Lithology	Limestone/Shale
Failure description [c]	2, 3

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [2] Inclined shear failure; [3] Partial hourglass failure;

After testing



Remarks: pre-peak loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-11-21

Triaxial Compression Test

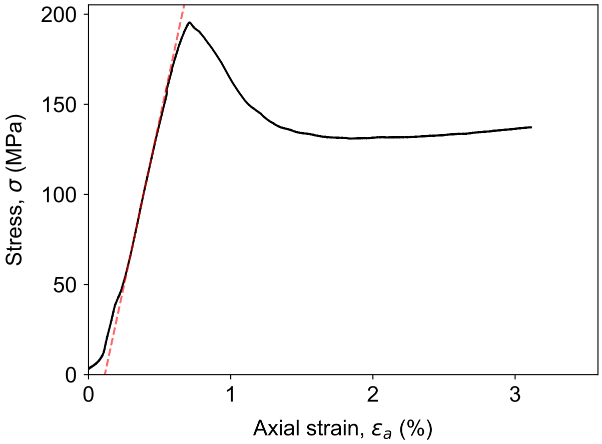
Client	WSP Golder	**Project**	21451329
Sample	BH205-RS-SA10	**Depth**	34.76 - 35.00

Specimen parameters

Diameter (mm) [a]	60.69
Length (mm) [a]	127.73
Bulk density ρ (g/cm^3)	2.665
σ_1 (MPa)	195.5
σ_3 (MPa)	22.6
Young's modulus E (GPa) [b]	36.8
Lithology	Limestone/Shale
Failure description [c]	2, 3

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [2] Inclined shear failure; [3] Partial hourglass failure;

After testing



Remarks: pre-peak loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-11-23

Triaxial Compression Test

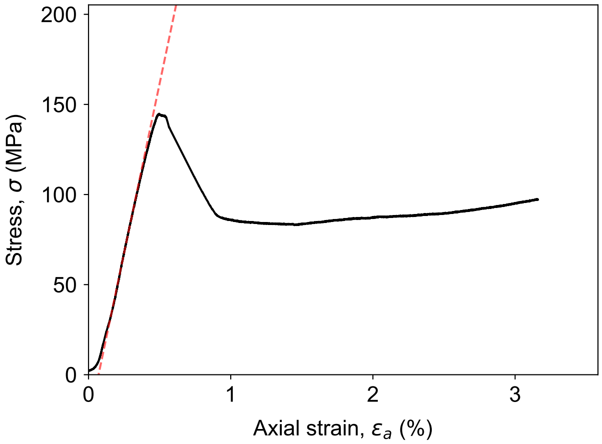
Client	WSP Golder	**Project**	21451329
Sample	BH205-RS-SA14	**Depth**	43.18 - 43.46

Specimen parameters

Diameter (mm) [a]	60.52
Length (mm) [a]	127.49
Bulk density ρ (g/cm^3)	2.680
σ_1 (MPa)	144.8
σ_3 (MPa)	15.1
Young's modulus E (GPa) [b]	37.6
Lithology	Limestone/Shale
Failure description [c]	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [2] Inclined shear failure;

After testing



Remarks: pre-peak loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-11-23

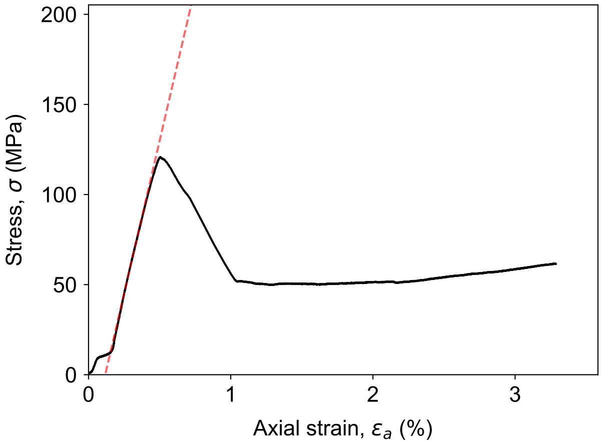
Triaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH205-RS-SA16	**Depth**	46.41 - 46.71

Specimen parameters	
Diameter (mm) [a]	60.50
Length (mm) [a]	127.78
Bulk density ρ (g/cm^3)	2.680
σ_1 (MPa)	120.9
σ_3 (MPa)	7.6
Young's modulus E (GPa) [b]	33.9
Lithology	Limestone/Shale
Failure description [c]	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [2] Inclined shear failure;

After testing



Remarks: pre-peak loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-11-22

Triaxial Compression Test

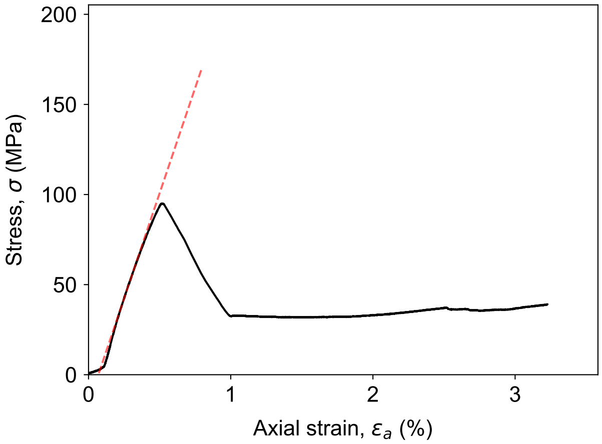
Client	WSP Golder	**Project**	21451329
Sample	BH205-RS-SA17	**Depth**	48.40 - 48.65

Specimen parameters

Diameter (mm) [a]	60.59
Length (mm) [a]	127.65
Bulk density ρ (g/cm^3)	2.658
σ_1 (MPa)	94.9
σ_3 (MPa)	3.7
Young's modulus E (GPa) [b]	23.4
Lithology	Limestone/Shale
Failure description [c]	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: ^{2} Inclined shear failure;

After testing



Remarks: pre-peak loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-11-22

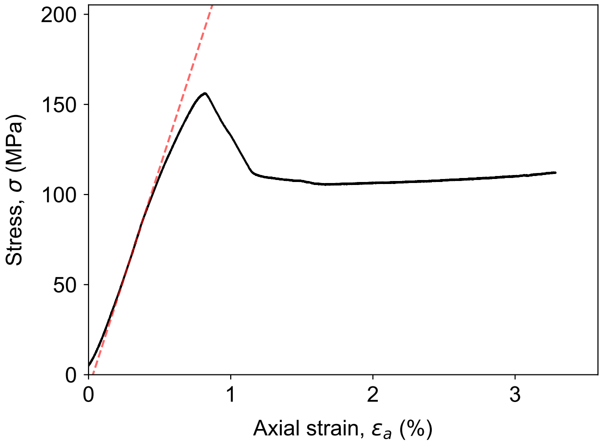
Triaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH205-RS-SA18	**Depth**	49.73 - 49.96

Specimen parameters	
Diameter (mm) [a]	60.48
Length (mm) [a]	127.85
Bulk density ρ (g/cm^3)	2.664
σ_1 (MPa)	156.2
σ_3 (MPa)	22.6
Young's modulus E (GPa) [b]	24.4
Lithology	Limestone/Shale
Failure description [c]	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: ^{2} Inclined shear failure;

After testing



Remarks: pre-peak loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-11-24

Triaxial Compression Test

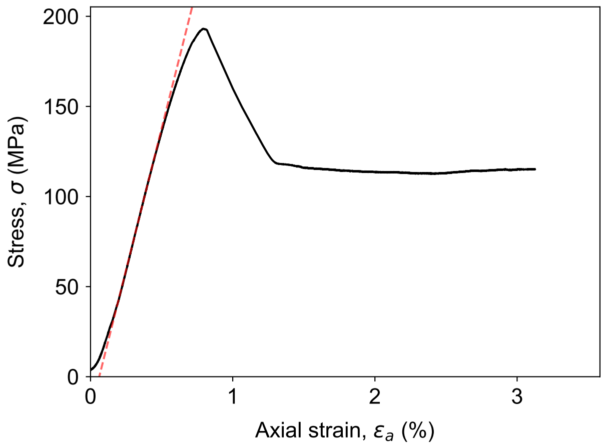
Client	WSP Golder	**Project**	21451329
Sample	BH307-RS-SA1	**Depth**	23.75 - 24.02

Specimen parameters

Diameter (mm) [a]	60.58
Length (mm) [a]	127.77
Bulk density ρ (g/cm^3)	2.671
σ_1 (MPa)	193.1
σ_3 (MPa)	22.6
Young's modulus E (GPa) [b]	31.4
Lithology	Limestone/Shale
Failure description [c]	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: ^{2} Inclined shear failure;

After testing



Remarks: pre-peak loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-11-24

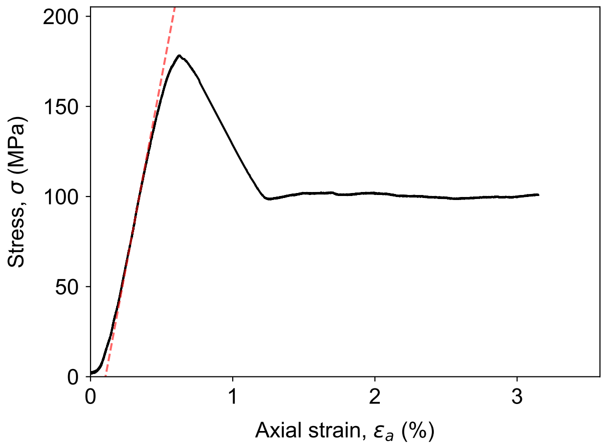
Triaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH307-RS-SA4	**Depth**	27.39 - 27.68

Specimen parameters	
Diameter (mm) [a]	60.42
Length (mm) [a]	127.29
Bulk density ρ (g/cm^3)	2.671
σ_1 (MPa)	178.3
σ_3 (MPa)	15.1
Young's modulus E (GPa) [b]	42.1
Lithology	Limestone/Shale
Failure description [c]	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [2] Inclined shear failure;

After testing



Remarks: pre-peak loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-11-23

Triaxial Compression Test

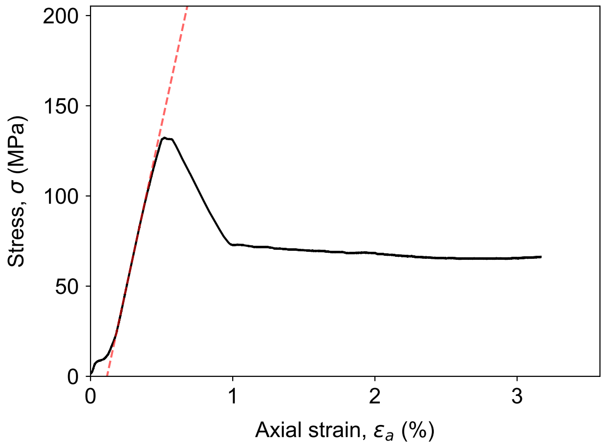
Client	WSP Golder	**Project**	21451329
Sample	BH307-RS-SA6	**Depth**	31.42 - 31.68

Specimen parameters

Diameter (mm) [a]	60.26
Length (mm) [a]	127.96
Bulk density ρ (g/cm^3)	2.675
σ_1 (MPa)	132.3
σ_3 (MPa)	7.6
Young's modulus E (GPa) [b]	36.3
Lithology	Limestone/Shale
Failure description [c]	2, 3, 4

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: ^{2} Inclined shear failure; ^{3} Partial hourglass failure; ^{4} Localized crushing near platen;

After testing



Remarks: pre-peak loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-11-22

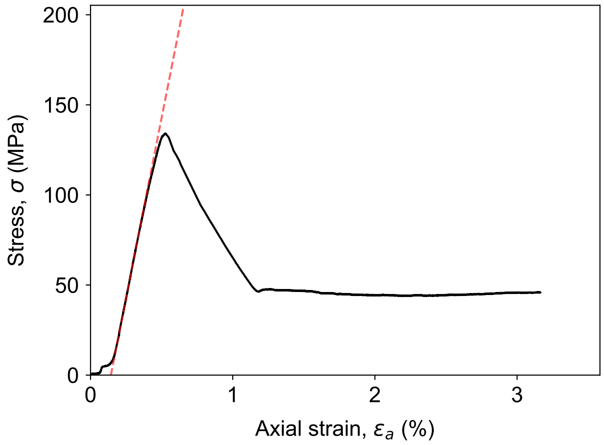
Triaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH307-RS-SA7	**Depth**	32.02 - 32.35

Specimen parameters	
Diameter (mm) [a]	60.33
Length (mm) [a]	127.56
Bulk density ρ (g/cm^3)	2.668
σ_1 (MPa)	134.1
σ_3 (MPa)	3.8
Young's modulus E (GPa) [b]	40.0
Lithology	Limestone/Shale
Failure description [c]	2, 3

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [2] Inclined shear failure; [3] Partial hourglass failure;

After testing



Remarks: pre-peak loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-11-22

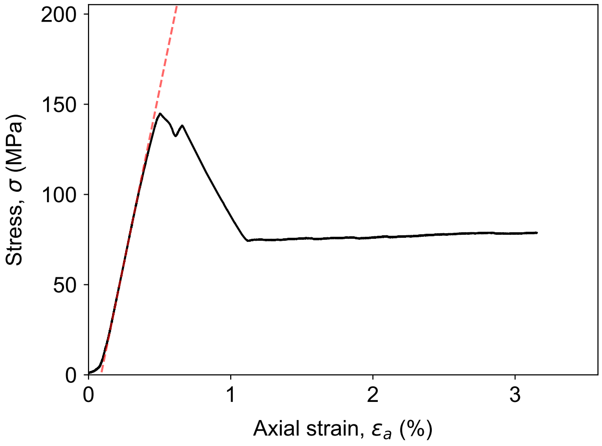
Triaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH307-RS-SA9	**Depth**	35.09 - 35.37

Specimen parameters	
Diameter (mm) [a]	60.15
Length (mm) [a]	127.89
Bulk density ρ (g/cm^3)	2.676
σ_1 (MPa)	144.8
σ_3 (MPa)	7.6
Young's modulus E (GPa) [b]	38.4
Lithology	Limestone/Shale
Failure description [c]	2, 4

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [2] Inclined shear failure; [4] Localized crushing near platen;

After testing



Remarks: pre-peak loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-11-22

Triaxial Compression Test

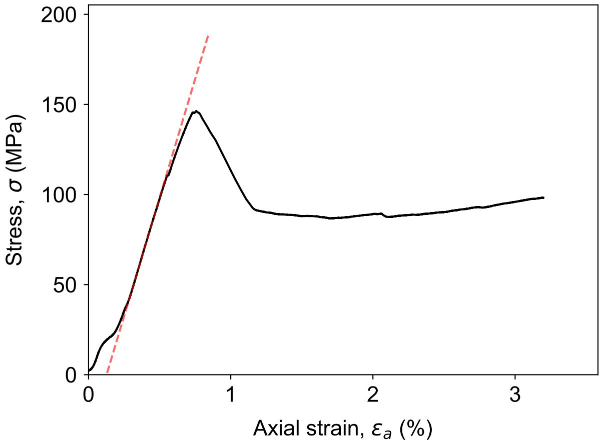
Client	WSP Golder	**Project**	21451329
Sample	BH307-RS-SA10	**Depth**	36.01 - 36.33

Specimen parameters

Diameter (mm) [a]	60.28
Length (mm) [a]	127.46
Bulk density ρ (g/cm^3)	2.662
σ_1 (MPa)	146.3
σ_3 (MPa)	15.1
Young's modulus E (GPa) [b]	26.4
Lithology	Limestone/Shale
Failure description [c]	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: ^{2} Inclined shear failure;

After testing



Remarks: pre-peak loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-11-23

Triaxial Compression Test

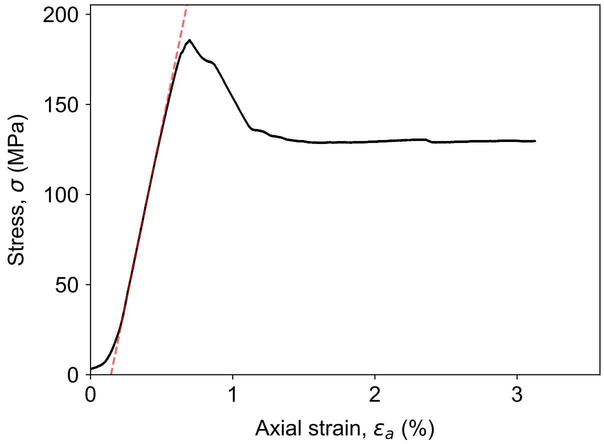
Client	WSP Golder	**Project**	21451329
Sample	BH307-RS-SA16	**Depth**	43.45 - 43.73

Specimen parameters

Diameter (mm) [a]	59.83
Length (mm) [a]	127.73
Bulk density ρ (g/cm^3)	2.684
σ_1 (MPa)	185.7
σ_3 (MPa)	22.6
Young's modulus E (GPa) [b]	38.4
Lithology	Limestone/Shale
Failure description [c]	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [2] Inclined shear failure;

After testing



Remarks: pre-peak loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-11-24

Triaxial Compression Test

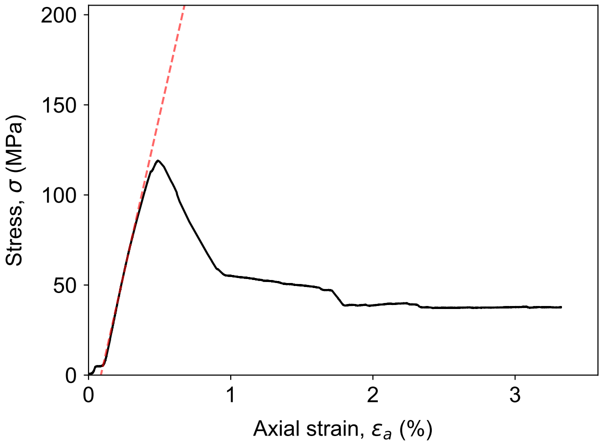
Client	WSP Golder	**Project**	21451329
Sample	BH307-RS-SA18	**Depth**	45.47 - 45.79

Specimen parameters

Diameter (mm) [a]	59.88
Length (mm) [a]	127.97
Bulk density ρ (g/cm^3)	2.681
σ_1 (MPa)	119.0
σ_3 (MPa)	3.8
Young's modulus E (GPa) [b]	34.9
Lithology	Limestone/Shale
Failure description [c]	2, 3

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [2] Inclined shear failure; [3] Partial hourglass failure;

After testing



Remarks: pre-peak loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-11-22

Triaxial Compression Test

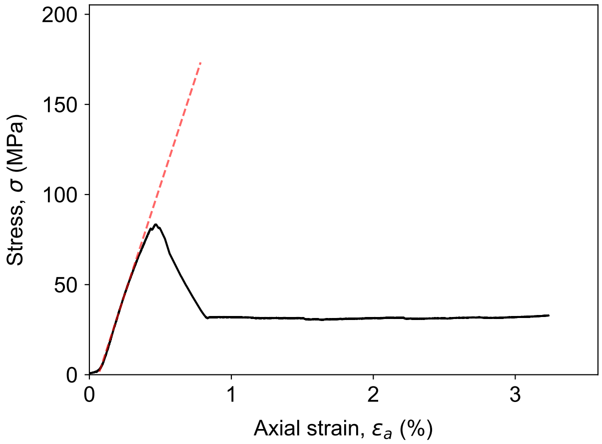
Client	WSP Golder	**Project**	21451329
Sample	BH307-RS-SA19	**Depth**	47.29 - 47.54

Specimen parameters

Diameter (mm) [a]	59.84
Length (mm) [a]	127.86
Bulk density ρ (g/cm^3)	2.657
σ_1 (MPa)	83.4
σ_3 (MPa)	3.8
Young's modulus E (GPa) [b]	24.1
Lithology	Limestone/Shale
Failure description [c]	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [2] Inclined shear failure;

After testing



Remarks: pre-peak loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-11-22

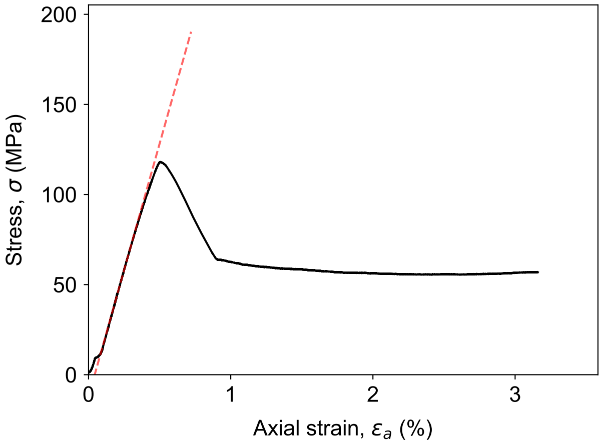
Triaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH307-RS-SA20	**Depth**	47.54 - 47.79

Specimen parameters	
Diameter (mm) [a]	59.91
Length (mm) [a]	127.49
Bulk density ρ (g/cm^3)	2.667
σ_1 (MPa)	118.1
σ_3 (MPa)	7.6
Young's modulus E (GPa) [b]	28.1
Lithology	Limestone/Shale
Failure description [c]	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: ^{2} Inclined shear failure;

After testing



Remarks: pre-peak loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-11-23

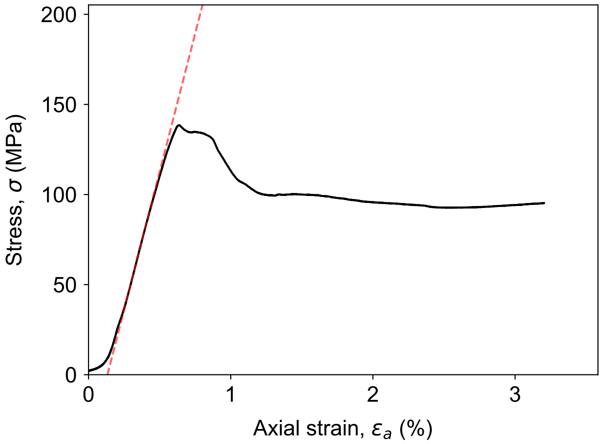
Triaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH307-RS-SA24	**Depth**	50.70 - 51.01

Specimen parameters	
Diameter (mm) [a]	60.20
Length (mm) [a]	127.59
Bulk density ρ (g/cm^3)	2.655
σ_1 (MPa)	138.4
σ_3 (MPa)	15.1
Young's modulus E (GPa) [b]	30.7
Lithology	Limestone/Shale
Failure description [c]	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [2] Inclined shear failure;

After testing



Remarks: pre-peak loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-11-23

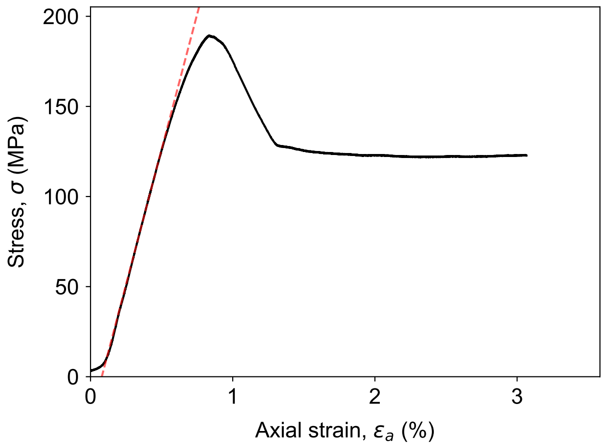
Triaxial Compression Test

Client	WSP Golder	**Project**	21451329
Sample	BH307-RS-SA26	**Depth**	53.40 - 53.68

Specimen parameters	
Diameter (mm) [a]	59.89
Length (mm) [a]	127.77
Bulk density ρ (g/cm^3)	2.680
σ_1 (MPa)	189.4
σ_3 (MPa)	22.6
Young's modulus E (GPa) [b]	30.0
Lithology	Limestone/Shale
Failure description [c]	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [2] Inclined shear failure;

After testing



Remarks: pre-peak loading rate: 0.10 mm/min.

Performed by	MB/MB	**Date**	2022-11-24

C BD Specimen Sheets

- BH207-RS-SA7
- BH304-RS-SA5
- BH204-RS-SA5
- BH306-RS-SA6
- BH306-RS-SA11
- BH302-RS-SA5
- BH203-RS-SA5
- BH303-RS-SA7
- BH206-RS-SA2
- BH202-RS-SA2
- BH202-RS-SA8
- BH205-RS-SA15
- BH307-RS-SA14
- BH307-RS-SA21
- BH309-RS-SA5
- BH308-RS-SA3
- BH308-RS-SA8
- BH308-RS-SA13
- BH308-RS-SA23
- BH305-RS-SA2
- BH301-RS-SA5
- BH23-RS-SA6
- BH24-RS-SA8
- BH24-RS-SA9
- BH26-RS-SA6
- BH26-RS-SA7
- BH207-RS-SA18
- BH17-RS-07
- BH22-RS-SA1
- BH22-RS-SA2

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH207-RS-SA7	**Depth**	34.27 - 34.55

Specimen parameters

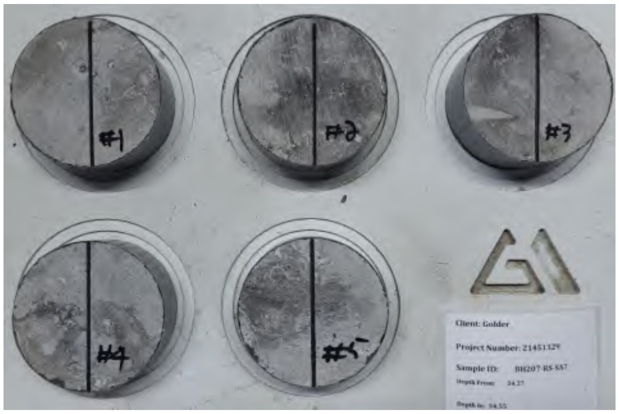
Disc	1	2	3	4	5
Thickness (mm) [a]	32.09	31.99	31.94	32.09	31.97
Diameter (mm) [a]	60.26	60.27	60.26	60.26	60.25
Tensile strength (MPa)	5.5	5.1	7.3	7.3	5.8
Lithology			Limestone/Shale		
Failure description [b]	1	2	2	2	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.

[b] Failure description: [1] Partial diametric failure; [2] Diametric failure;

Average tensile strength (MPa)	**6.2**

Prior to testing



After testing

Remarks: Loading rate: 0.2 mm/min. Disc 1 and 3: Specimen experienced pre-peak local failure.

Performed by	EM/MB	**Date**	2022-08-19

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH304-RS-SA5	**Depth**	43.49 - 43.68

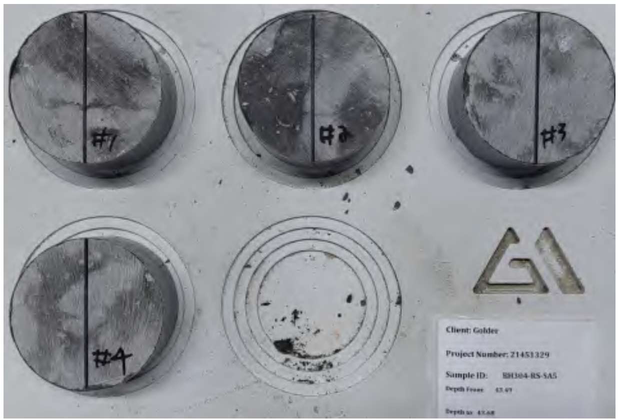
Specimen parameters

Disc	1	2	3	4
Thickness (mm) [a]	32.05	31.87	32.01	32.01
Diameter (mm) [a]	60.84	60.86	60.85	60.86
Tensile strength (MPa)	6.5	7.0	5.5	6.9
Lithology	Limestone/Shale			
Failure description [b]	2	2	2	2

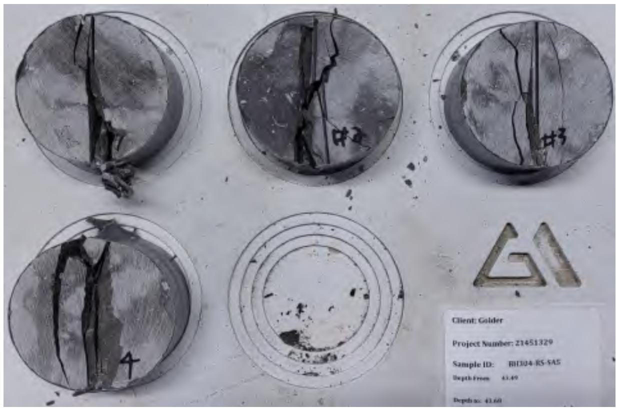
[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Diametric failure;

Average tensile strength (MPa)	**6.5**

Prior to testing



After testing



Remarks: Loading rate: 0.2 mm/min. Disc 4: Specimen experienced pre-peak local failure.

Performed by	EM/MB	**Date**	2022-08-19

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH204-RS-SA5	**Depth**	38.90 - 39.08

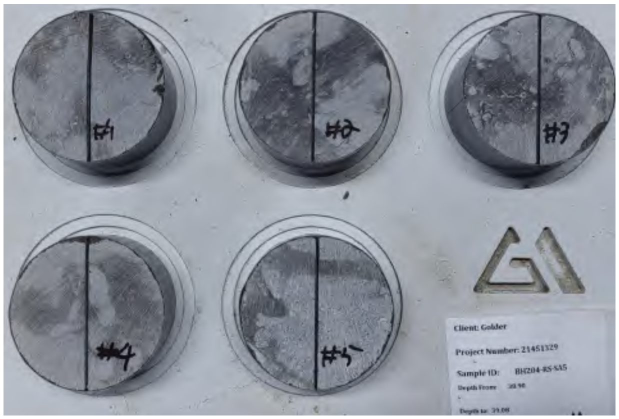
Specimen parameters

Disc	1	2	3	4	5
Thickness (mm) [a]	31.28	31.99	32.06	32.10	32.23
Diameter (mm) [a]	60.72	60.69	60.67	60.73	60.71
Tensile strength (MPa)	5.1	5.3	6.3	6.5	8.4
Lithology	Limestone/Shale				
Failure description [b]	2	2	2	2	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Diametric failure;

Average tensile strength (MPa)	**6.3**

Prior to testing



After testing

Remarks: Loading rate: 0.2 mm/min. Disc 4: Specimen experienced pre-peak local failure.

Performed by	EM/MB	**Date**	2022-08-19

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH306-RS-SA6	**Depth**	37.75 - 37.67

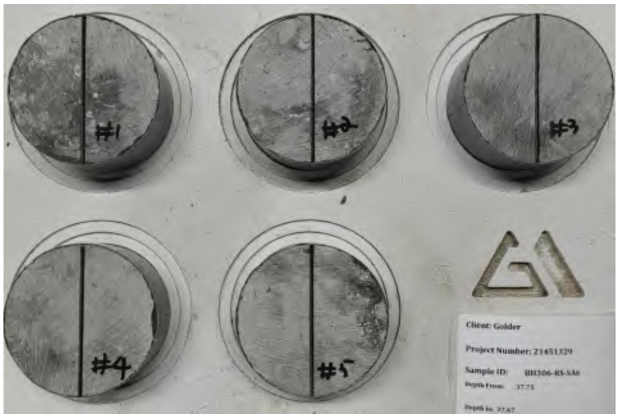
Specimen parameters

Disc	1	2	3	4	5
Thickness (mm) [a]	32.19	32.16	32.13	32.06	32.85
Diameter (mm) [a]	59.42	59.51	59.43	59.60	59.61
Tensile strength (MPa)	6.0	7.1	5.2	5.7	6.6
Lithology	Limestone/Shale				
Failure description [b]	2	2	2	2	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Diametric failure;

Average tensile strength (MPa)	**6.1**

Prior to testing



After testing

Remarks: Loading rate: 0.2 mm/min. Disc 2 and 3: Specimen experienced pre-peak local failure.

Performed by	EM/MB	**Date**	2022-08-19

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH306-RS-SA11	**Depth**	43.31 - 43.51

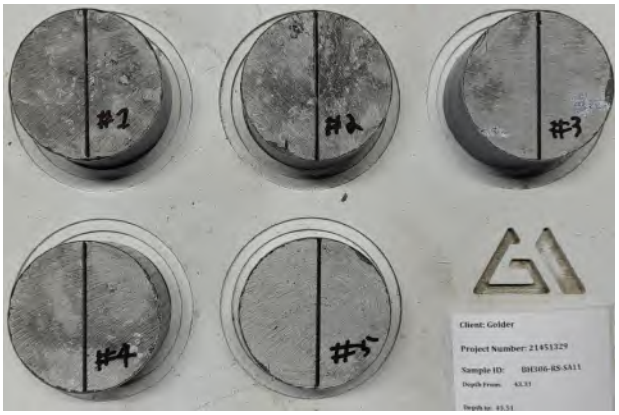
Specimen parameters

Disc	1	2	3	4	5
Thickness (mm) [a]	32.05	31.89	32.02	32.23	32.44
Diameter (mm) [a]	60.09	60.04	59.98	60.07	60.02
Tensile strength (MPa)	4.6	6.3	7.7	5.8	4.9
Lithology			Limestone/Shale		
Failure description [b]	2	2	2	2	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Diametric failure;

Average tensile strength (MPa)	**5.9**

Prior to testing



After testing

Remarks: Loading rate: 0.2 mm/min. Disc 1 and 3: Specimen experienced pre-peak local failure.

Performed by	EM/MB	**Date**	2022-08-19

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH302-RS-SA5	**Depth**	45.74 - 45.94

Specimen parameters

Disc	1	2	3	4	5
Thickness (mm) [a]	32.27	32.11	32.13	32.18	32.10
Diameter (mm) [a]	60.83	60.83	60.81	60.83	60.82
Tensile strength (MPa)	6.4	6.4	6.5	6.4	6.6
Lithology	Limestone/Shale				
Failure description [b]	2	2	2	2	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Diametric failure;

Average tensile strength (MPa)	**6.5**

Prior to testing

After testing

Remarks: Loading rate: 0.2 mm/min. Disc 2 and 5: Specimen experienced pre-peak local failure.

Performed by	EM/MB	**Date**	2022-08-22

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH203-RS-SA5	**Depth**	44.36 - 44.59

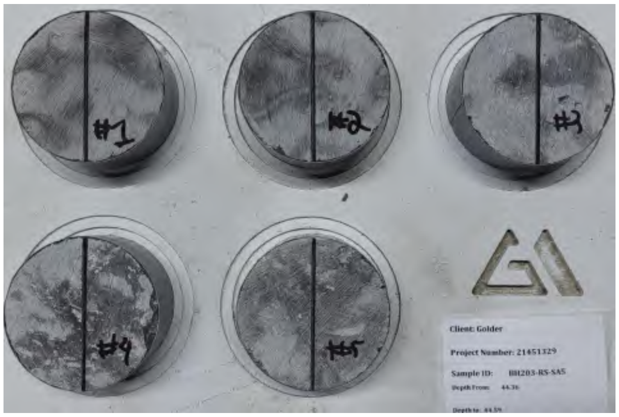
Specimen parameters

Disc	1	2	3	4	5
Thickness (mm) [a]	32.29	32.47	32.23	32.14	32.10
Diameter (mm) [a]	60.81	60.81	60.80	60.83	60.82
Tensile strength (MPa)	7.7	5.3	6.5	7.2	6.7
Lithology			Limestone/Shale		
Failure description [b]	1	2	2	2	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Partial diametric failure; [2] Diametric failure;

Average tensile strength (MPa)	**6.7**

Prior to testing



After testing

Remarks: Loading rate: 0.2 mm/min. Disc 3: Specimen experienced pre-peak local failure.

Performed by	EM/MB	**Date**	2022-08-22

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH303-RS-SA7	**Depth**	46.31 - 46.52

Specimen parameters

Disc	1	2	3	4	5
Thickness (mm) [a]	32.16	32.15	32.20	32.16	32.24
Diameter (mm) [a]	60.83	60.83	60.82	60.84	60.84
Tensile strength (MPa)	6.2	7.7	7.6	5.8	6.9
Lithology			Limestone/Shale		
Failure description [b]	2	2	2	2	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Diametric failure;

Average tensile strength (MPa)	**6.8**

Prior to testing

After testing

Remarks: Loading rate: 0.2 mm/min.

Performed by	EM/MB	**Date**	2022-08-22

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH206-RS-SA2	**Depth**	33.96 - 34.22

Specimen parameters

Disc	1	2	3	4	5
Thickness (mm) [a]	32.34	32.32	32.29	32.37	32.43
Diameter (mm) [a]	60.27	60.23	60.27	60.25	60.30
Tensile strength (MPa)	7.3	7.1	6.7	4.3	7.5
Lithology			Limestone/Shale		
Failure description [b]	2	2	2	2	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Diametric failure;

Average tensile strength (MPa)	**6.6**

Prior to testing

After testing

Remarks: Loading rate: 0.20 mm/min. Disc 3: specimen experienced pre-peak local failure(s).

Performed by	MB/MB	**Date**	2022-11-14

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH202-RS-SA2	**Depth**	31.09 - 31.31

Specimen parameters

Disc	1	2	3	4	5
Thickness (mm) [a]	32.58	32.51	32.64	32.53	32.43
Diameter (mm) [a]	60.97	60.90	60.91	60.97	60.97
Tensile strength (MPa)	5.6	5.3	7.3	6.0	4.6
Lithology	Limestone/Shale				
Failure description [b]	1	2	2	2	1

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Partial diametric failure; [2] Diametric failure;

Average tensile strength (MPa)	**5.8**

Prior to testing

After testing

Remarks: Loading rate: 0.20 mm/min. Disc 1: specimen experienced pre-peak local failure(s).

Performed by	MB/MB	**Date**	2022-11-14

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH202-RS-SA8	**Depth**	40.32 - 40.52

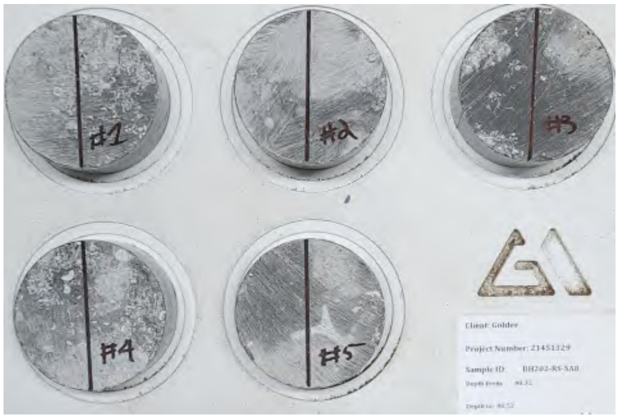
Specimen parameters

Disc	1	2	3	4	5
Thickness (mm) [a]	32.45	32.18	31.49	32.35	40.86
Diameter (mm) [a]	60.94	60.94	60.94	60.95	60.91
Tensile strength (MPa)	7.2	4.6	2.9	4.9	4.3
Lithology	Limestone/Shale				
Failure description [b]	2	1	1	2	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Diametric failure; [1] Partial diametric failure;

Average tensile strength (MPa)	**4.8**

Prior to testing



After testing

Remarks: Loading rate: 0.20 mm/min. Disc 2 and 4: specimen experienced pre-peak local failure(s).

Performed by	MB/MB	**Date**	2022-11-14

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH205-RS-SA15	**Depth**	44.86 - 45.15

Specimen parameters

Disc	1	2	3	4	5
Thickness (mm) [a]	32.52	32.38	32.68	32.61	32.47
Diameter (mm) [a]	60.51	60.54	60.46	60.46	60.55
Tensile strength (MPa)	5.5	6.4	6.0	6.5	8.2
Lithology	Limestone/Shale				
Failure description [b]	2	2	2	2	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Diametric failure;

Average tensile strength (MPa)	**6.5**

Prior to testing

After testing

Remarks: Loading rate: 0.20 mm/min. Disc 1: specimen experienced pre-peak local failure(s).

Performed by	MB/MB	**Date**	2022-11-14

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH307-RS-SA14	**Depth**	40.93 - 41.19

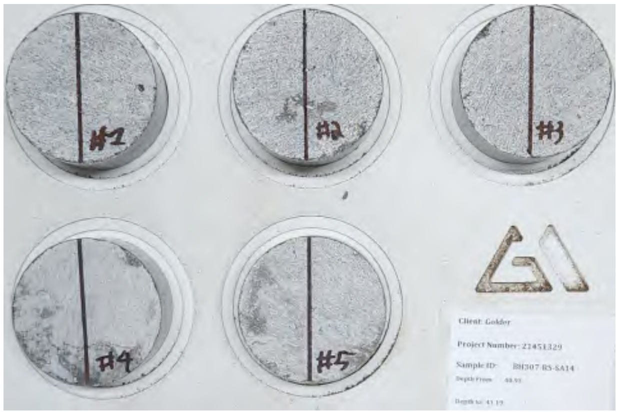
Specimen parameters

Disc	1	2	3	4	5
Thickness (mm) [a]	32.49	32.39	32.39	32.41	32.44
Diameter (mm) [a]	60.09	60.10	60.07	60.07	60.07
Tensile strength (MPa)	7.6	5.3	8.4	5.9	5.9
Lithology	Limestone/Shale				
Failure description [b]	2	2	2	2	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Diametric failure;

Average tensile strength (MPa)	**6.6**

Prior to testing



After testing

Remarks: Loading rate: 0.20 mm/min.

Performed by	MB/MB	**Date**	2022-11-14

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH307-RS-SA21	**Depth**	48.62 - 48.85

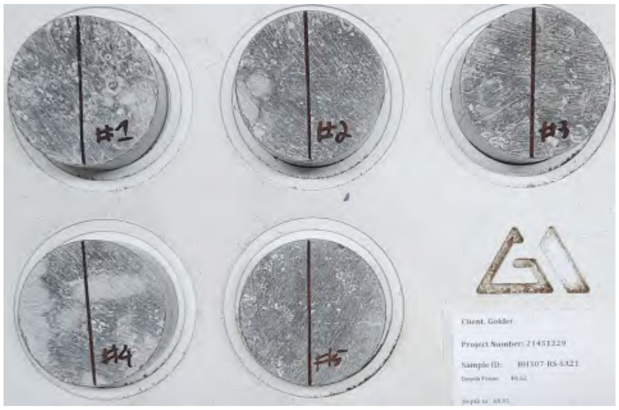
Specimen parameters

Disc	1	2	3	4	5
Thickness (mm) [a]	32.61	32.37	32.46	32.40	32.45
Diameter (mm) [a]	59.91	59.78	59.86	59.83	59.79
Tensile strength (MPa)	5.0	4.0	4.6	5.6	4.5
Lithology	Limestone/Shale				
Failure description [b]	2	2	2	2	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Diametric failure;

Average tensile strength (MPa)	**4.7**

Prior to testing



After testing

Remarks: Loading rate: 0.20 mm/min. Disc 5: specimen experienced pre-peak local failure(s).

Performed by	MB/MB	**Date**	2022-11-14

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH309-RS-SA5	**Depth**	38.47 - 38.65

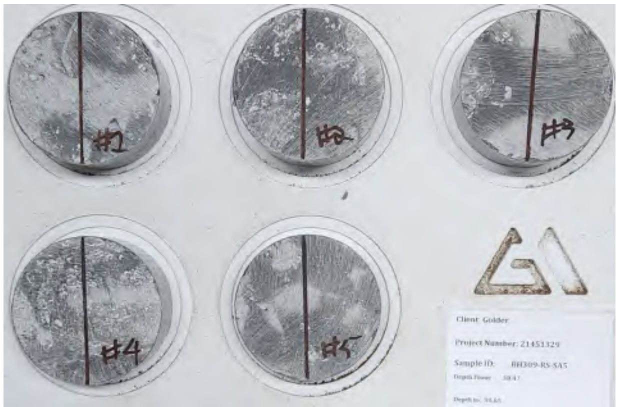
Specimen parameters

Disc	1	2	3	4	5
Thickness (mm) [a]	32.73	32.38	32.42	32.50	24.62
Diameter (mm) [a]	60.27	60.32	60.31	60.27	60.29
Tensile strength (MPa)	4.7	5.3	6.2	5.8	5.8
Lithology	Limestone/Shale				
Failure description [b]	2	2	2	2	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Diametric failure;

Average tensile strength (MPa)	**5.6**

Prior to testing



After testing

Remarks: Loading rate: 0.20 mm/min. Disc 1, 2, and 3: specimen experienced pre-peak local failure(s).

Performed by	MB/MB	**Date**	2022-11-14

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH308-RS-SA3	**Depth**	26.29 - 26.45

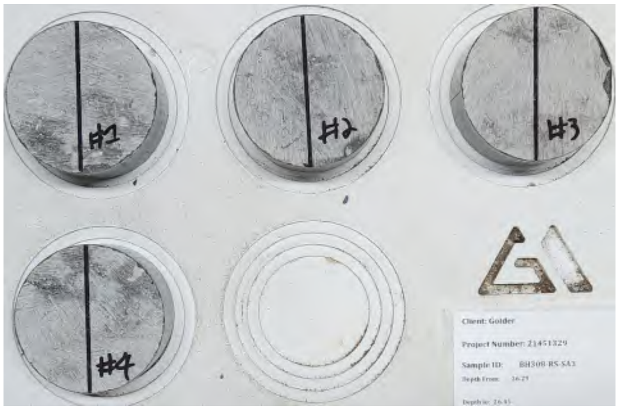
Specimen parameters

Disc	1	2	3	4
Thickness (mm) [a]	32.62	32.81	32.51	32.70
Diameter (mm) [a]	60.10	60.08	60.05	60.12
Tensile strength (MPa)	8.9	8.1	7.5	7.2
Lithology	Limestone/Shale			
Failure description [b]	2	2	2	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Diametric failure;

Average tensile strength (MPa)	**7.9**

Prior to testing



After testing

Remarks: Loading rate: 0.20 mm/min.

Performed by	MB/MB	**Date**	2022-11-15

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH308-RS-SA8	**Depth**	31.19 - 31.36

Specimen parameters

Disc	1	2	3	4
Thickness (mm) [a]	32.65	32.91	32.58	32.59
Diameter (mm) [a]	60.02	60.01	59.99	60.01
Tensile strength (MPa)	6.7	6.8	6.7	6.2
Lithology	Limestone/Shale			
Failure description [b]	2	2	1	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Diametric failure; [1] Partial diametric failure;

Average tensile strength (MPa)	**6.6**

Prior to testing

After testing

Remarks: Loading rate: 0.20 mm/min. Disc 1: specimen experienced pre-peak local failure(s).

Performed by	MB/MB	**Date**	2022-11-15

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH308-RS-SA13	**Depth**	37.25 - 37.42

Specimen parameters

Disc	1	2	3	4
Thickness (mm) [a]	32.59	32.59	32.64	32.54
Diameter (mm) [a]	60.05	60.05	60.07	60.06
Tensile strength (MPa)	5.2	7.7	6.1	5.3
Lithology	Limestone/Shale			
Failure description [b]	2	2	2	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Diametric failure;

Average tensile strength (MPa)	**6.1**

Prior to testing

After testing

Remarks: Loading rate: 0.20 mm/min. Disc 1: specimen experienced pre-peak local failure(s).

Performed by	MB/MB	**Date**	2022-11-15

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH308-RS-SA23	**Depth**	49.82 - 49.98

Specimen parameters

Disc	1	2	3	4
Thickness (mm) [a]	32.61	32.61	32.52	31.30
Diameter (mm) [a]	60.17	60.13	60.11	60.07
Tensile strength (MPa)	7.2	7.2	4.8	6.8
Lithology	Limestone/Shale			
Failure description [b]	2	2	2	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Diametric failure;

Average tensile strength (MPa)	**6.5**

Prior to testing

After testing

Remarks: Loading rate: 0.20 mm/min. Disc 4: specimen experienced pre-peak local failure(s).

Performed by	MB/MB	**Date**	2022-11-15

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH305-RS-SA2	**Depth**	32.92 - 33.20

Specimen parameters

Disc	1	2	3	4	5
Thickness (mm) [a]	32.64	32.56	32.68	32.70	32.58
Diameter (mm) [a]	61.02	61.03	61.04	61.02	61.05
Tensile strength (MPa)	5.7	8.3	6.7	5.9	5.0
Lithology	Limestone/Shale				
Failure description [b]	2	2	2	2	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.

[b] Failure description: [2] Diametric failure;

Average tensile strength (MPa)	**6.3**

Prior to testing

After testing

Remarks: Loading rate: 0.20 mm/min.

Performed by	MB/MB	**Date**	2022-11-15

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH301-RS-SA5	**Depth**	43.37 - 43.60

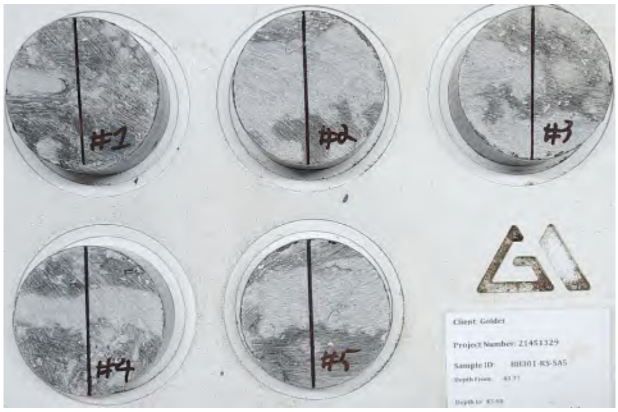
Specimen parameters

Disc	1	2	3	4	5
Thickness (mm) [a]	32.72	32.84	32.67	32.74	32.64
Diameter (mm) [a]	60.97	60.97	60.98	60.98	60.97
Tensile strength (MPa)	6.1	6.0	6.2	6.4	6.2
Lithology			Limestone/Shale		
Failure description [b]	2	2	2	2	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Diametric failure;

Average tensile strength (MPa)	**6.2**

Prior to testing



After testing

Remarks: Loading rate: 0.20 mm/min. Disc 1 and 3: specimen experienced pre-peak local failure(s).

Performed by	MB/MB	**Date**	2022-11-15

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH23-RS-SA6	**Depth**	44.37 - 44.63

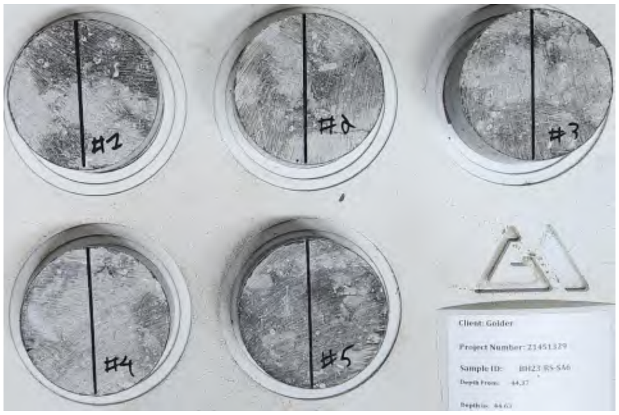
Specimen parameters

Disc	1	2	3	4	5
Thickness (mm) [a]	30.27	30.14	30.20	30.06	30.26
Diameter (mm) [a]	60.78	60.80	60.82	60.80	60.84
Tensile strength (MPa)	8.5	7.5	4.3	6.7	5.0
Lithology			Limestone		
Failure description [b]	2	2	2	2	1

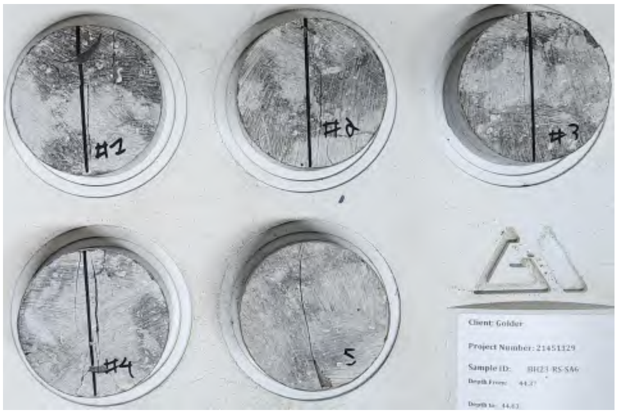
[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Diametric failure; [1] Partial diametric failure;

Average tensile strength (MPa)	**6.4**

Prior to testing



After testing



Remarks: Loading rate: 0.20 mm/min. Disc 1: experienced pre-peak failure.

Performed by	MB/MB	**Date**	2022-12-27

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH24-RS-SA8	**Depth**	25.74 - 25.88

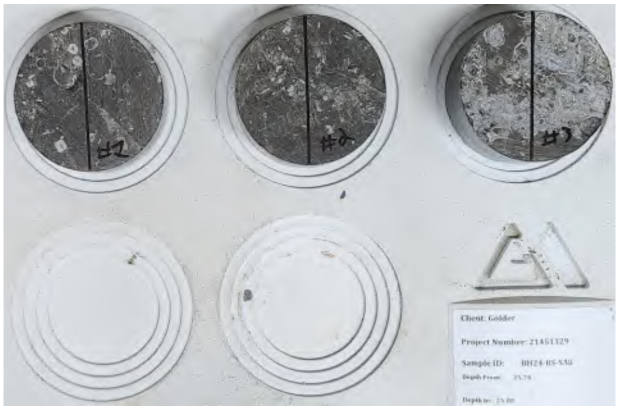
Specimen parameters

Disc	1	2	3
Thickness (mm) [a]	30.19	30.09	30.85
Diameter (mm) [a]	60.41	60.38	60.51
Tensile strength (MPa)	4.5	5.8	4.4
Lithology		Shale	
Failure description [b]	3	1	3

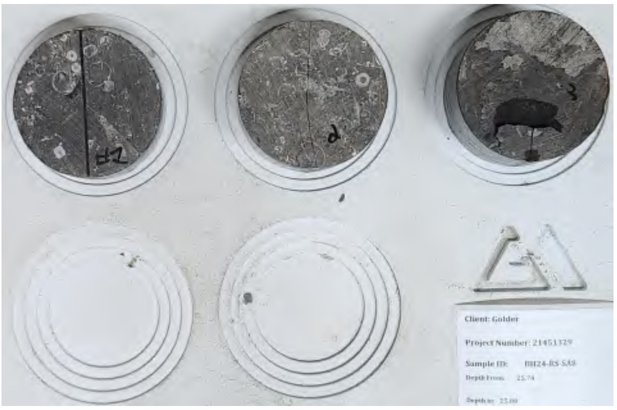
[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [3] Non-diametric failure; [1] Partial diametric failure;

Average tensile strength (MPa)	**4.9**

Prior to testing



After testing



Remarks: Loading rate: 0.20 mm/min. Disc 1: experienced pre-peak failure.

Performed by	MB/MB	**Date**	2022-12-27

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH24-RS-SA9	**Depth**	41.26 - 41.48

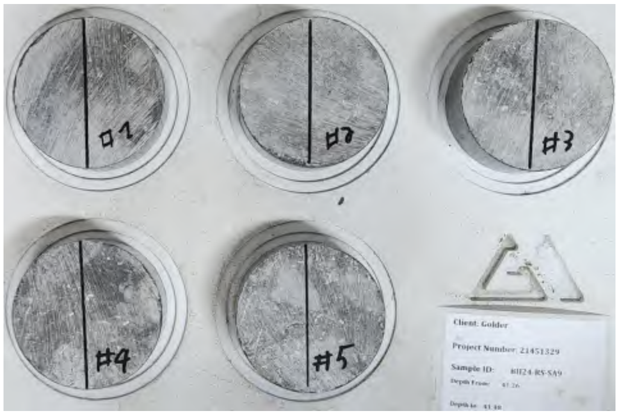
Specimen parameters

Disc	1	2	3	4	5
Thickness (mm) [a]	30.55	30.32	30.27	30.31	30.16
Diameter (mm) [a]	60.82	60.84	60.82	60.80	60.82
Tensile strength (MPa)	8.1	8.2	8.2	6.3	6.4
Lithology			Limestone		
Failure description [b]	2	2	2	2	2

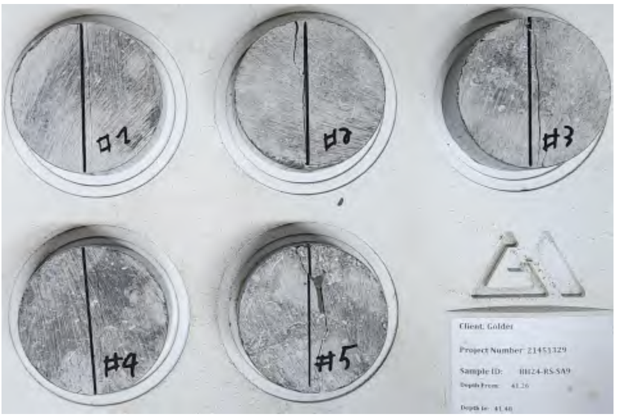
[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Diametric failure;

Average tensile strength (MPa)	**7.4**

Prior to testing



After testing



Remarks: Loading rate: 0.20 mm/min. Disc 5: experienced pre-peak failure.

Performed by	MB/MB	**Date**	2022-12-27

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH26-RS-SA6	**Depth**	23.49 - 23.61

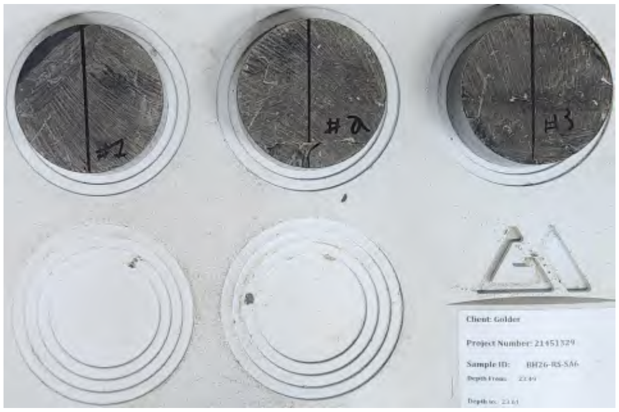
Specimen parameters

Disc	1	2	3
Thickness (mm) [a]	29.37	30.05	30.28
Diameter (mm) [a]	59.94	59.97	60.09
Tensile strength (MPa)	5.2	3.4	6.0
Lithology		Shale	
Failure description [b]	2	3	1

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Diametric failure; [3] Non-diametric failure; [1] Partial diametric failure;

Average tensile strength (MPa)	**4.9**

Prior to testing



After testing

Remarks: Loading rate: 0.20 mm/min. Disc 2: experienced pre-peak failure.

Performed by	MB/MB	**Date**	2022-12-27

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH26-RS-SA7	**Depth**	22.85 - 23.01

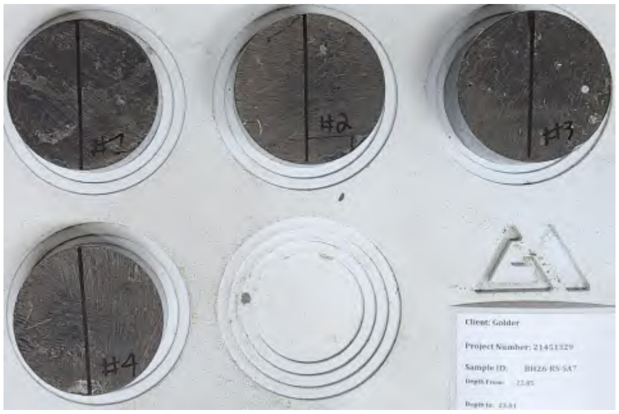
Specimen parameters

Disc	1	2	3	4
Thickness (mm) [a]	30.27	30.29	30.12	30.10
Diameter (mm) [a]	50.19	60.27	60.22	60.32
Tensile strength (MPa)	8.1	8.7	5.7	7.9
Lithology	Shale			
Failure description [b]	3	2	2	1

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [3] Non-diametric failure; [2] Diametric failure; [1] Partial diametric failure;

Average tensile strength (MPa)	**7.6**

Prior to testing



After testing

Remarks: Loading rate: 0.20 mm/min.

Performed by	MB/MB	**Date**	2022-12-27

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH207-RS-SA18	**Depth**	17.22 - 17.35

Specimen parameters

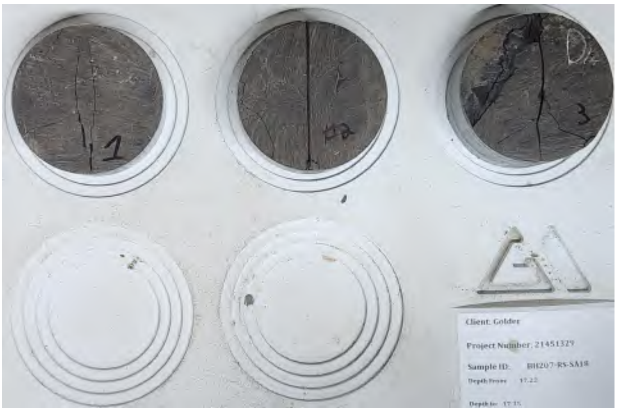
Disc	1	2	3
Thickness (mm) [a]	29.92	30.29	29.95
Diameter (mm) [a]	59.93	59.94	60.03
Tensile strength (MPa)	5.8	7.5	6.2
Lithology		Shale	
Failure description [b]	1	3	1

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Partial diametric failure; [3] Non-diametric failure;

Average tensile strength (MPa)	**6.5**

Prior to testing

After testing



Remarks: Loading rate: 0.20 mm/min.

Performed by	MB/MB	**Date**	2022-12-27

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH17-RS-07	**Depth**	48.18 - 48.39

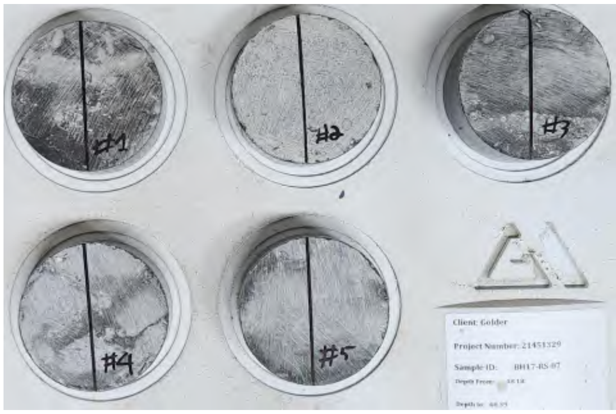
Specimen parameters

Disc	1	2	3	4	5
Thickness (mm) [a]	30.25	30.30	30.56	30.26	30.45
Diameter (mm) [a]	60.61	60.64	60.58	60.60	60.64
Tensile strength (MPa)	6.8	10.3	5.2	6.9	6.8
Lithology			Limestone		
Failure description [b]	2	2	2	2	2

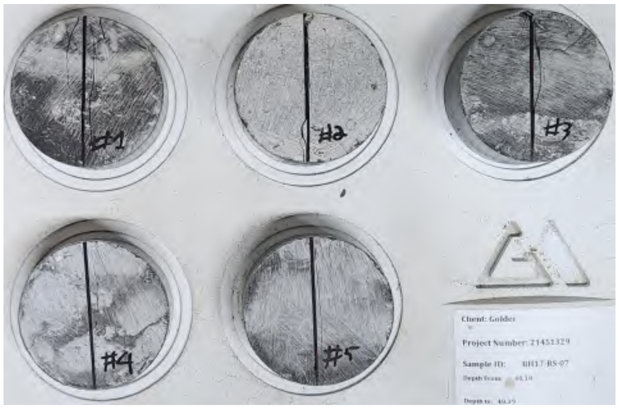
[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Diametric failure;

Average tensile strength (MPa)	**7.2**

Prior to testing



After testing



Remarks: Loading rate: 0.20 mm/min.

Performed by	MB/MB	**Date**	2022-12-27

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH22-RS-SA1	**Depth**	24.91 - 25.09

Specimen parameters

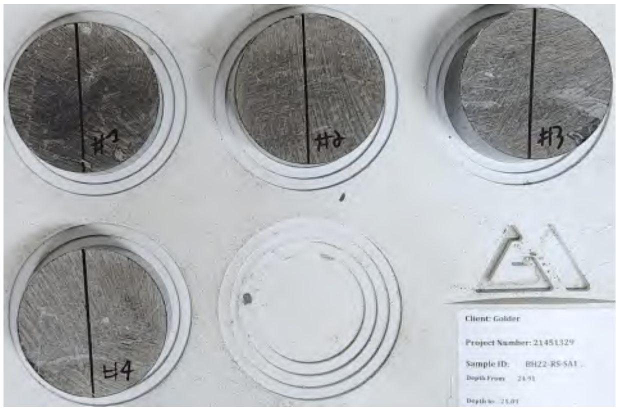
Disc	1	2	3	4
Thickness (mm) [a]	30.23	30.36	30.38	30.55
Diameter (mm) [a]	60.26	60.28	60.25	60.25
Tensile strength (MPa)	1.6	6.0	5.8	9.3
Lithology	Shale			
Failure description [b]	3	2	2	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.

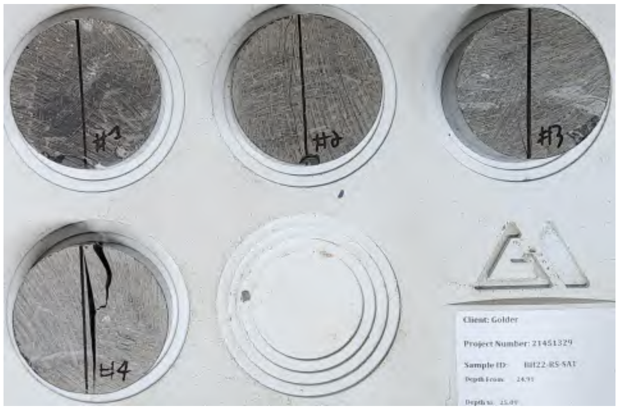
[b] Failure description: [3] Non-diametric failure; [2] Diametric failure;

Average tensile strength (MPa)	**5.7**

Prior to testing



After testing



Remarks: Loading rate: 0.20 mm/min.

Performed by	MB/MB	**Date**	2022-12-27

Brazilian Disc Test

Client	WSP Golder	**Project**	21451329
Sample	BH22-RS-SA2	**Depth**	25.95 - 26.15

Specimen parameters

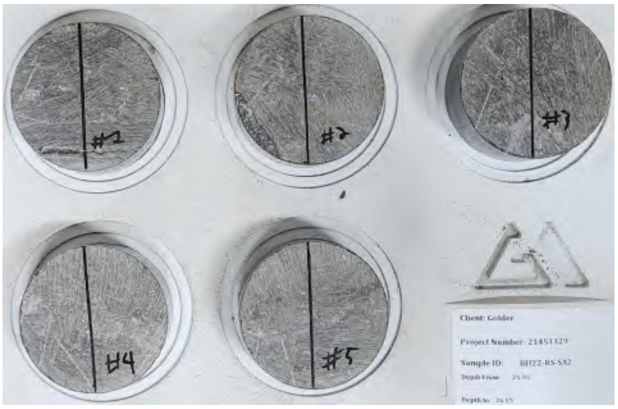
Disc	1	2	3	4	5
Thickness (mm) [a]	30.30	30.35	30.37	30.44	30.35
Diameter (mm) [a]	60.20	60.21	60.28	60.27	60.25
Tensile strength (MPa)	8.7	6.1	6.6	4.9	6.3
Lithology			Shale		
Failure description [b]	2	1	1	2	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.

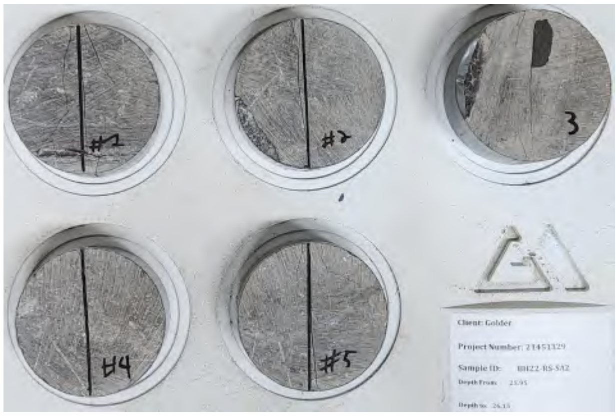
[b] Failure description: [2] Diametric failure; [1] Partial diametric failure;

Average tensile strength (MPa)	**6.5**

Prior to testing



After testing



Remarks: Loading rate: 0.20 mm/min.

Performed by	MB/MB	**Date**	2022-12-27

D ISRM Punch Penetration Specimen Sheets

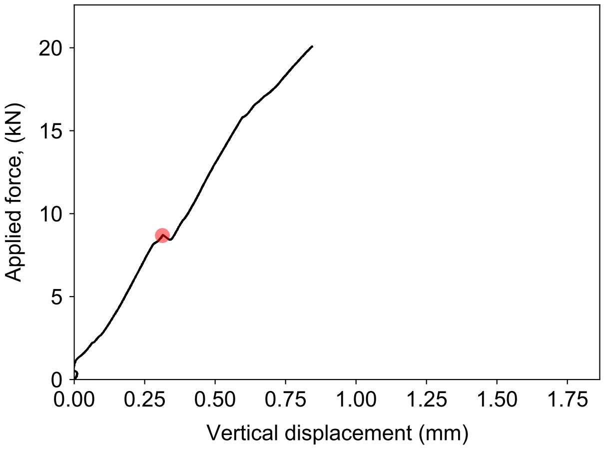
- BH207-RS-SA10
- BH304-RS-SA1
- BH204-RS-SA3
- BH306-RS-SA4
- BH306-RS-SA14
- BH302-RS-SA1
- BH203-RS-SA1
- BH303-RS-SA1
- BH206-RS-SA1
- BH202-RS-SA4
- BH202-RS-SA13
- BH21-RS-SA3
- BH21-RS-SA5
- BH21-RS-SA9
- BH22-RS-SA5
- BH22-RS-SA10
- BH22-RS-SA16
- BH205-RS-SA8
- BH307-RS-SA3
- BH307-RS-SA23
- BH309-RS-SA4
- BH308-RS-SA4
- BH308-RS-SA11
- BH308-RS-SA17
- BH308-RS-SA19
- BH305-RS-SA1
- BH301-RS-SA2

Punch Penetration Test

Client	WSP Golder	**Project**	21451329
Sample	BH207-RS-SA10	**Depth**	38.21 - 38.43

Specimen parameters

Diameter (mm) [a]	61.50
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.31
1st peak Load, L (kN)	8.68
Indentation Hardness Index, IHI (kN/mm)	27.75
Lithology	Limestone
Failure description [b]	1



[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Fine crushing/plastic deformation + brittle fracturing + radial fracturing;

Prior to testing

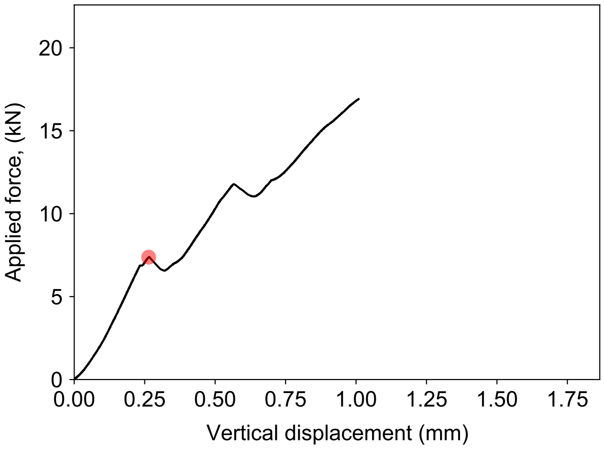
After testing

Performed by	BSAT	**Date**	2022-08-31

Punch Penetration Test

Client	WSP Golder	**Project**	21451329
Sample	BH304-RS-SA1	**Depth**	38.85 - 33.06

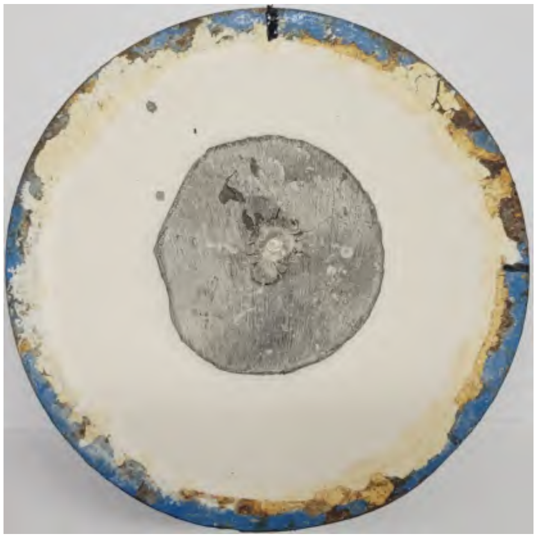
Specimen parameters	
Diameter (mm) [a]	61.50
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.26
1st peak Load, L (kN)	7.38
Indentation Hardness Index, IHI (kN/mm)	27.92
Lithology	Limestone/Shale
Failure description [b]	1



[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Fine crushing/plastic deformation + brittle fracturing + radial fracturing;

Prior to testing

After testing



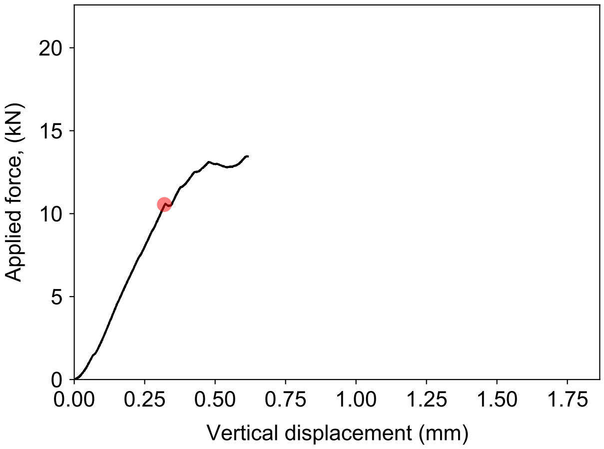
Performed by	BSAT	**Date**	2022-08-31

Punch Penetration Test

Client	WSP Golder	**Project**	21451329
Sample	BH204-RS-SA3	**Depth**	36.32 - 36.51

Specimen parameters

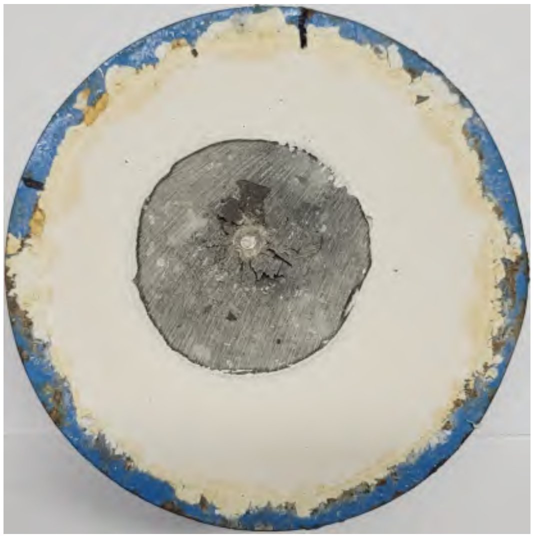
Diameter (mm) [a]	61.50
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.32
1st peak Load, L (kN)	10.55
Indentation Hardness Index, IHI (kN/mm)	32.97
Lithology	Limestone/Shale
Failure description [b]	2



[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Fine crushing/plastic deformation + brittle fracturing;

Prior to testing

After testing

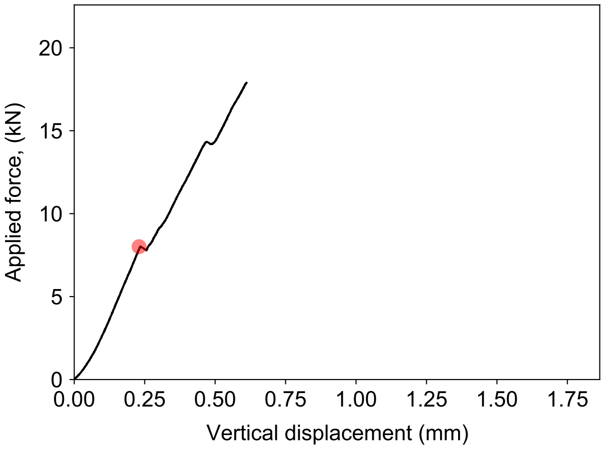


Performed by	BSAT	**Date**	2022-08-31

Punch Penetration Test

Client	WSP Golder	**Project**	21451329
Sample	BH306-RS-SA4	**Depth**	34.04 - 34.27

Specimen parameters	
Diameter (mm) [a]	61.50
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.23
1st peak Load, L (kN)	8.01
Indentation Hardness Index, IHI (kN/mm)	34.83
Lithology	Limestone/Shale
Failure description [b]	1



[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Fine crushing/plastic deformation + brittle fracturing + radial fracturing;

Prior to testing

After testing

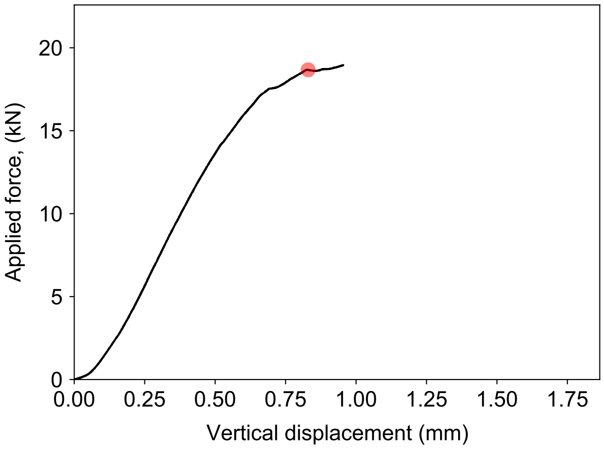
Performed by	BSAT	**Date**	2022-08-31

Punch Penetration Test

Client	WSP Golder	**Project**	21451329
Sample	BH306-RS-SA14	**Depth**	47.98 - 48.24

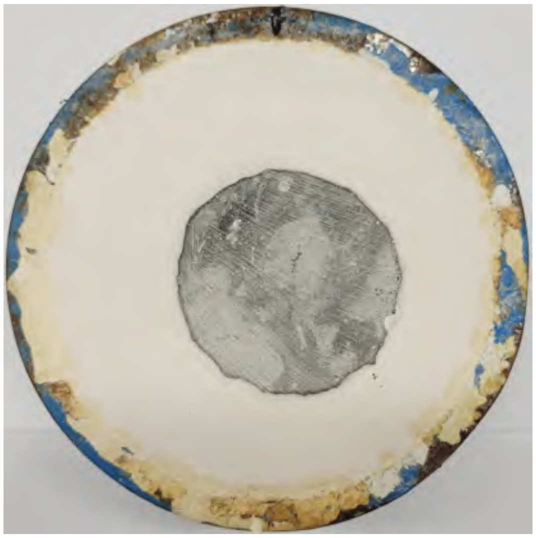
Specimen parameters

Diameter (mm) [a]	61.50
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.83
1st peak Load, L (kN)	18.67
Indentation Hardness Index, IHI (kN/mm)	22.49
Lithology	Limestone/Shale
Failure description [b]	1



[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Fine crushing/plastic deformation + brittle fracturing + radial fracturing;

Prior to testing



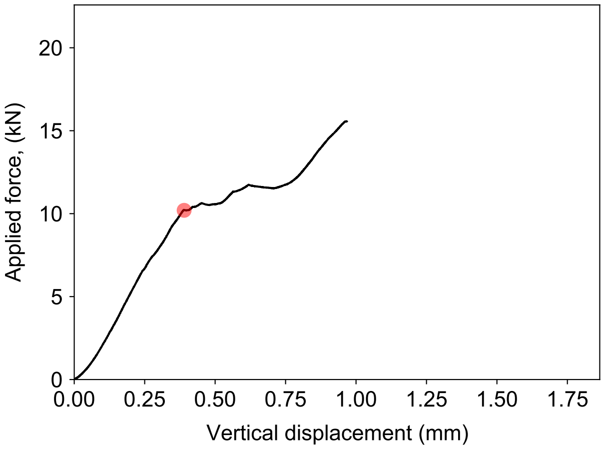
After testing

Performed by	BSAT	**Date**	2022-08-31

Punch Penetration Test

Client	WSP Golder	**Project**	21451329
Sample	BH302-RS-SA1	**Depth**	32.71 - 32.94

Specimen parameters	
Diameter (mm) [a]	61.50
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.39
1st peak Load, L (kN)	10.20
Indentation Hardness Index, IHI (kN/mm)	26.15
Lithology	Shale
Failure description [b]	1



[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Fine crushing/plastic deformation + brittle fracturing + radial fracturing;

Prior to testing

After testing

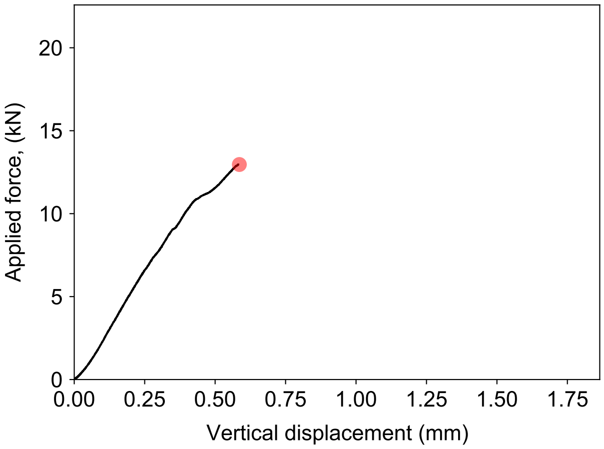
Performed by	BSAT	**Date**	2022-08-31

Punch Penetration Test

Client	WSP Golder	**Project**	21451329
Sample	BH203-RS-SA1	**Depth**	32.98 - 33.15

Specimen parameters

Diameter (mm) [a]	61.50
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.59
1st peak Load, L (kN)	12.96
Indentation Hardness Index, IHI (kN/mm)	22.12
Lithology	Shale
Failure description [b]	1



[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.

[b] Failure description: [1] Fine crushing/plastic deformation + brittle fracturing + radial fracturing;

Prior to testing

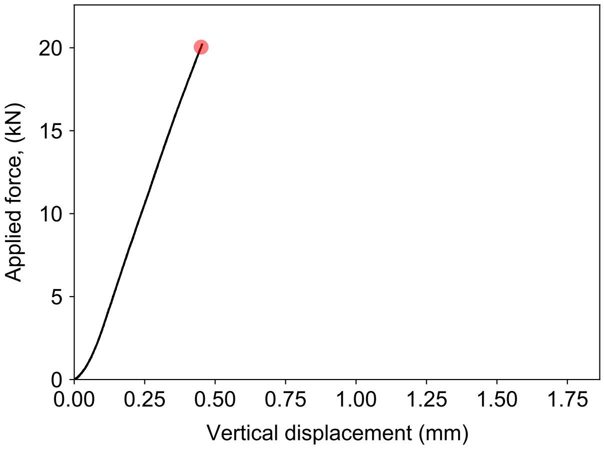
After testing

Performed by	BSAT	**Date**	2022-08-31

Punch Penetration Test

Client	WSP Golder	**Project**	21451329
Sample	BH303-RS-SA1	**Depth**	31.50 - 31.72

Specimen parameters	
Diameter (mm) [a]	61.50
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.45
1st peak Load, L (kN)	20.04
Indentation Hardness Index, IHI (kN/mm)	44.50
Lithology	Limestone
Failure description [b]	3



[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [3] Fine crushing/plastic deformation;

Prior to testing

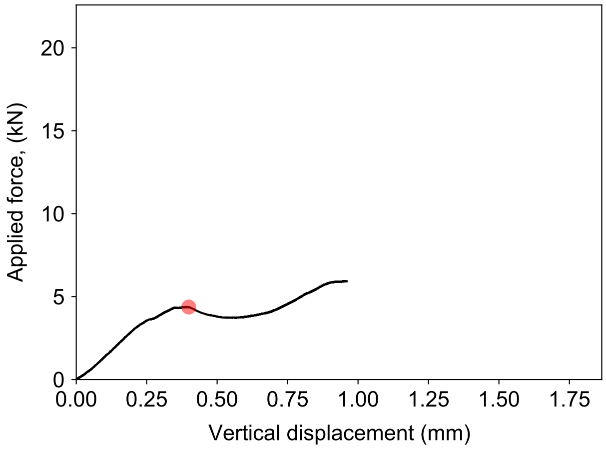
After testing

Performed by	BSAT	**Date**	2022-08-31

Punch Penetration Test

Client	WSP Golder	**Project**	21451329
Sample	BH206-RS-SA1	**Depth**	31.10 - 31.30

Specimen parameters	
Diameter (mm) [a]	61.00
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.40
1st peak Load, L (kN)	4.37
Indentation Hardness Index, IHI (kN/mm)	10.95
Lithology	Limestone/Shale
Failure description [b]	1



[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Fine crushing/plastic deformation + brittle fracturing + radial fracturing;

Prior to testing

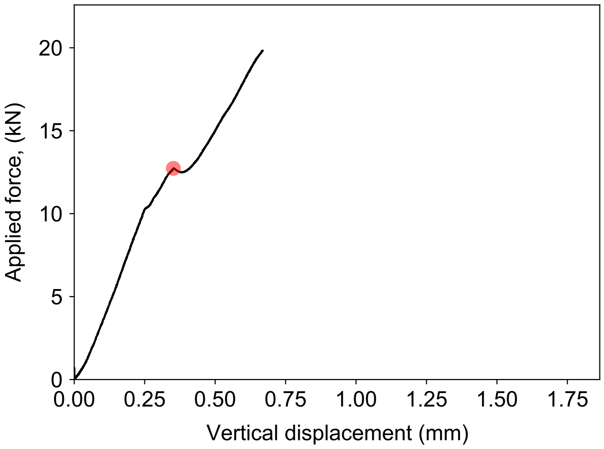
After testing

Performed by	BSAT	**Date**	2022-11-04

Punch Penetration Test

Client	WSP Golder	**Project**	21451329
Sample	BH202-RS-SA4	**Depth**	33.48 - 33.62

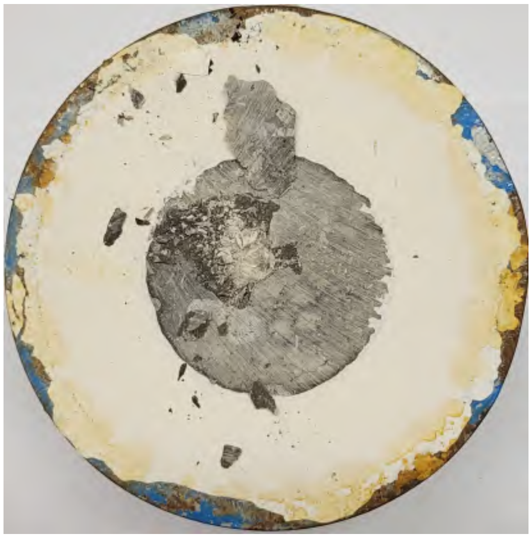
Specimen parameters	
Diameter (mm) [a]	61.00
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.35
1st peak Load, L (kN)	12.73
Indentation Hardness Index, IHI (kN/mm)	36.18
Lithology	Limestone/Shale
Failure description [b]	2



[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Fine crushing/plastic deformation + brittle fracturing;

Prior to testing

After testing

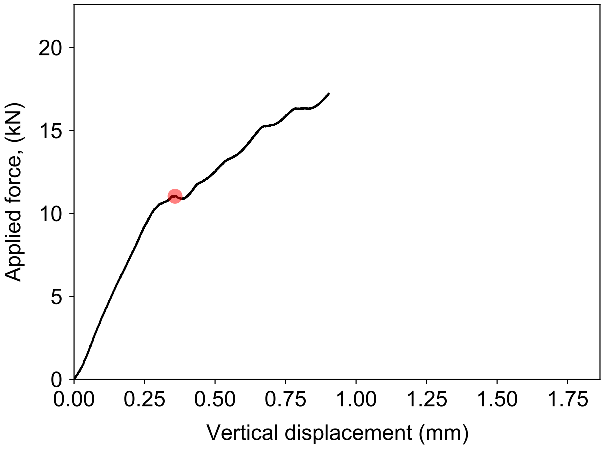


Performed by	BSAT	**Date**	2022-11-04

Punch Penetration Test

Client	WSP Golder	**Project**	21451329
Sample	BH202-RS-SA13	**Depth**	48.07 - 48.21

Specimen parameters	
Diameter (mm) [a]	61.00
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.36
1st peak Load, L (kN)	11.03
Indentation Hardness Index, IHI (kN/mm)	30.81
Lithology	Limestone/Shale
Failure description [b]	4



[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [4] Fine crushing/plastic deformation + brittle fracturing + minor radial fracturing;

Prior to testing

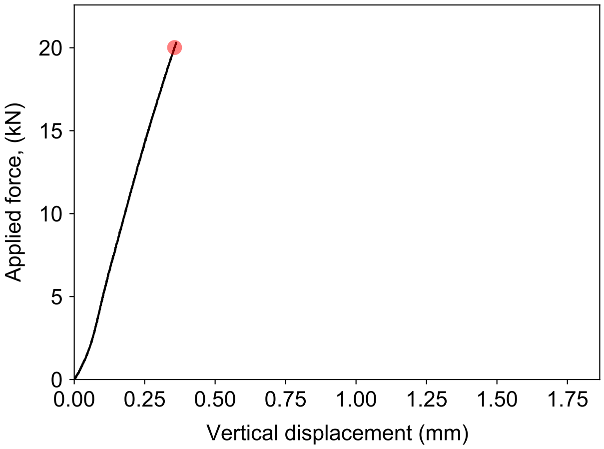
After testing

Performed by	BSAT	**Date**	2022-11-04

Punch Penetration Test

Client	WSP Golder	**Project**	21451329
Sample	BH21-RS-SA3	**Depth**	43.91 - 44.10

Specimen parameters	
Diameter (mm) [a]	61.00
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.36
1st peak Load, L (kN)	20.01
Indentation Hardness Index, IHI (kN/mm)	56.21
Lithology	Limestone/Shale
Failure description [b]	5



[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [5] Fine crushing/plastic deformation + minor radial fracturing;

Prior to testing

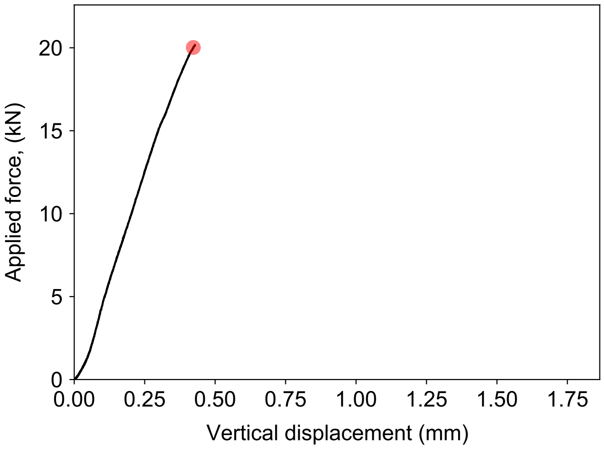
After testing

Performed by	BSAT	**Date**	2022-11-04

Punch Penetration Test

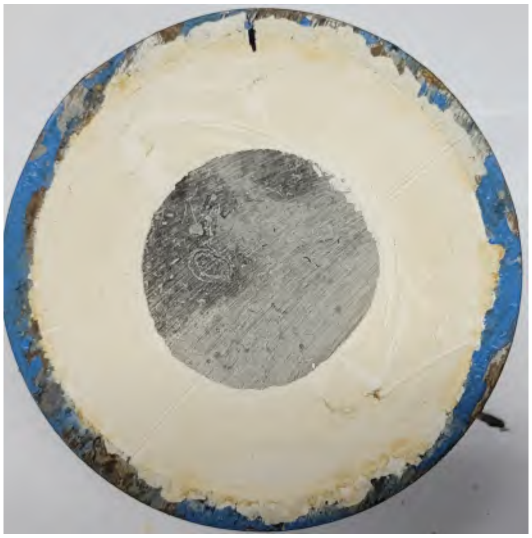
Client	WSP Golder	**Project**	21451329
Sample	BH21-RS-SA5	**Depth**	43.79 - 43.93

Specimen parameters	
Diameter (mm) [a]	61.00
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.42
1st peak Load, L (kN)	20.02
Indentation Hardness Index, IHI (kN/mm)	47.38
Lithology	Limestone/Shale
Failure description [b]	6

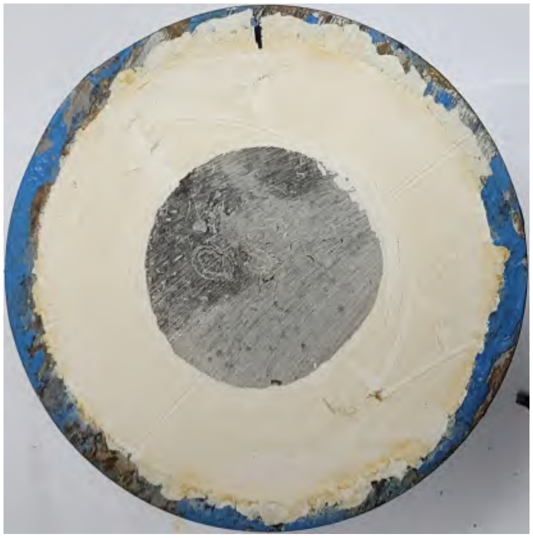


[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [6] Fine crushing/plastic deformation + minor brittle fracturing;

Prior to testing



After testing

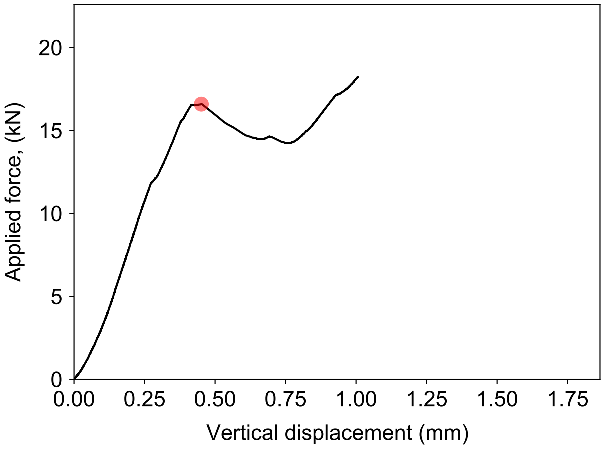


Performed by	BSAT	**Date**	2022-11-04

Punch Penetration Test

Client	WSP Golder	**Project**	21451329
Sample	BH21-RS-SA9	**Depth**	55.06 - 55.23

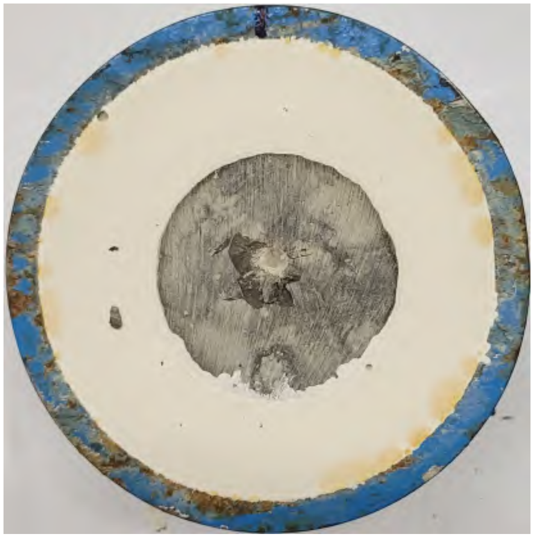
Specimen parameters	
Diameter (mm) [a]	61.00
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.45
1st peak Load, L (kN)	16.59
Indentation Hardness Index, IHI (kN/mm)	36.76
Lithology	Limestone/Shale
Failure description [b]	2



[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Fine crushing/plastic deformation + brittle fracturing;

Prior to testing

After testing

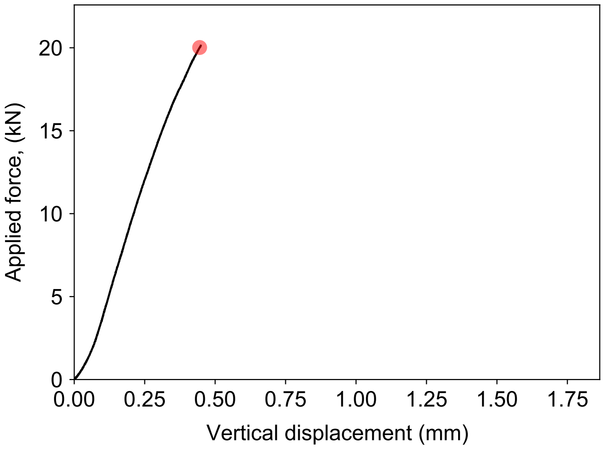


Performed by	BSAT	**Date**	2022-11-04

Punch Penetration Test

Client	WSP Golder	**Project**	21451329
Sample	BH22-RS-SA5	**Depth**	35.28 - 35.46

Specimen parameters	
Diameter (mm) [a]	61.00
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.45
1st peak Load, L (kN)	20.02
Indentation Hardness Index, IHI (kN/mm)	44.98
Lithology	Limestone/Shale
Failure description [b]	5



[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [5] Fine crushing/plastic deformation + minor radial fracturing;

Prior to testing

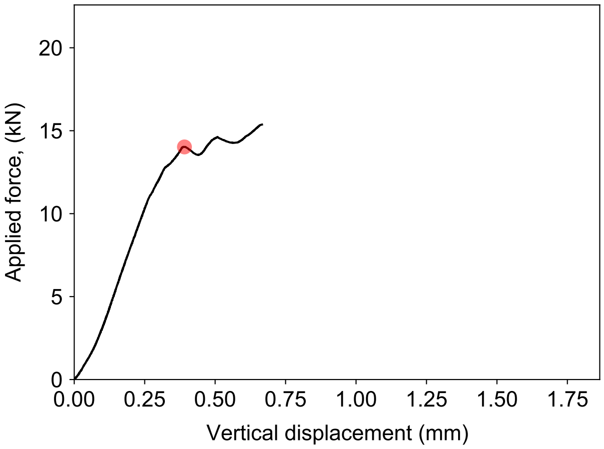
After testing

Performed by	BSAT	**Date**	2022-11-04

Punch Penetration Test

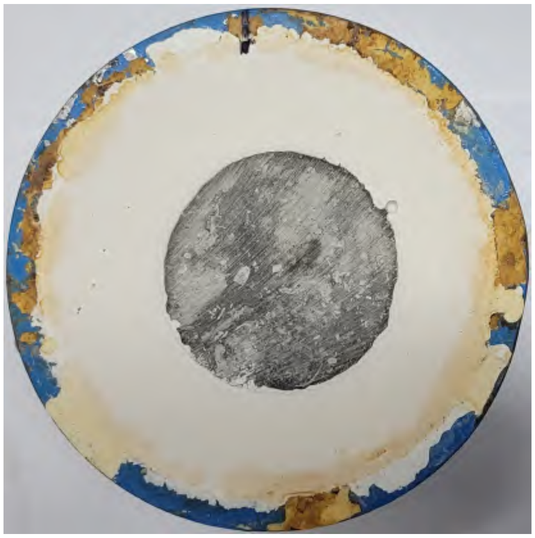
Client	WSP Golder	**Project**	21451329
Sample	BH22-RS-SA10	**Depth**	47.31 - 47.46

Specimen parameters	
Diameter (mm) [a]	61.00
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.39
1st peak Load, L (kN)	14.02
Indentation Hardness Index, IHI (kN/mm)	35.85
Lithology	Limestone/Shale
Failure description [b]	2



[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Fine crushing/plastic deformation + brittle fracturing;

Prior to testing



After testing

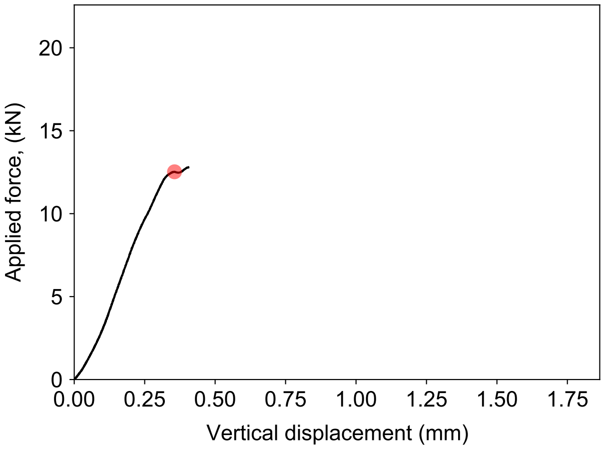
Performed by	BSAT	**Date**	2022-11-04

Punch Penetration Test

Client	WSP Golder	**Project**	21451329
Sample	BH22-RS-SA16	**Depth**	62.27 - 62.58

Specimen parameters

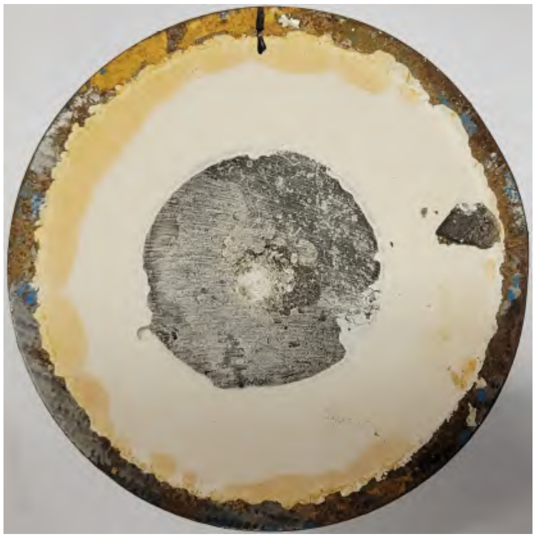
Diameter (mm) [a]	61.00
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.36
1st peak Load, L (kN)	12.52
Indentation Hardness Index, IHI (kN/mm)	35.19
Lithology	Limestone/Shale
Failure description [b]	2



[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Fine crushing/plastic deformation + brittle fracturing;

Prior to testing

After testing



Performed by	BSAT	**Date**	2022-11-04

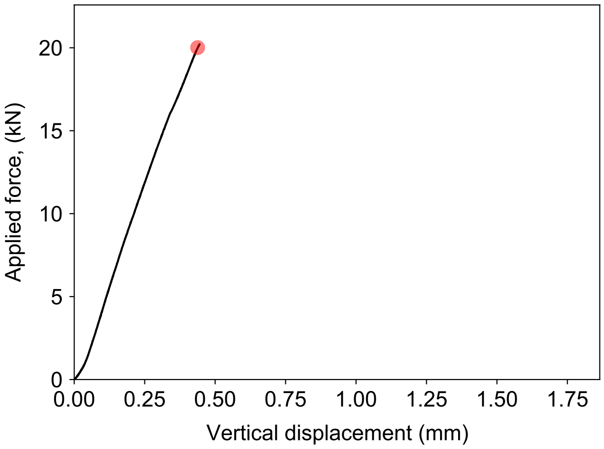
Punch Penetration Test

Client	WSP Golder	**Project**	21451329
Sample	BH205-RS-SA8	**Depth**	33.65 - 33.84

Specimen parameters

Diameter (mm) [a]	61.00
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.44
1st peak Load, L (kN)	20.01
Indentation Hardness Index, IHI (kN/mm)	45.69
Lithology	Limestone/Shale
Failure description [b]	6

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [6] Fine crushing/plastic deformation + minor brittle fracturing;



Prior to testing

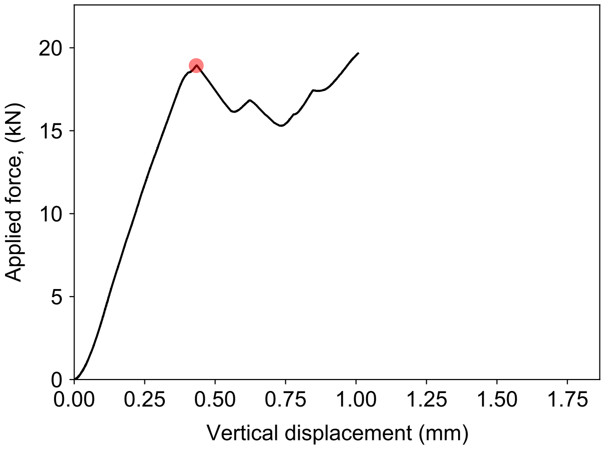
After testing

Performed by	BSAT	**Date**	2022-11-16

Punch Penetration Test

Client	WSP Golder	**Project**	21451329
Sample	BH307-RS-SA3	**Depth**	26.21 - 26.45

Specimen parameters	
Diameter (mm) [a]	61.00
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.43
1st peak Load, L (kN)	18.92
Indentation Hardness Index, IHI (kN/mm)	43.72
Lithology	Limestone/Shale
Failure description [b]	2



[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Fine crushing/plastic deformation + brittle fracturing;

Prior to testing

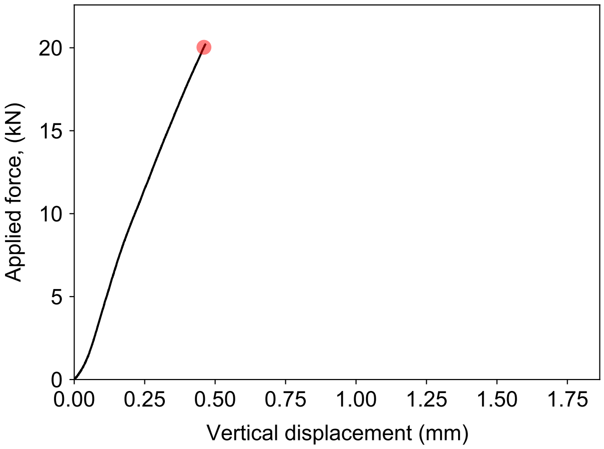
After testing

Performed by	BSAT	**Date**	2022-11-16

Punch Penetration Test

Client	WSP Golder	**Project**	21451329
Sample	BH307-RS-SA23	**Depth**	49.36 - 49.58

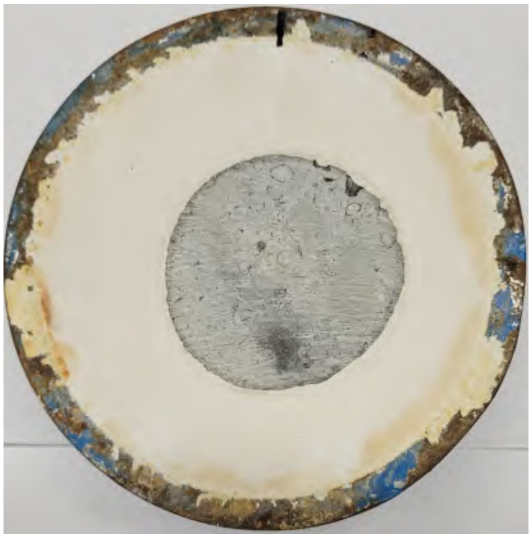
Specimen parameters	
Diameter (mm) [a]	61.00
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.46
1st peak Load, L (kN)	20.03
Indentation Hardness Index, IHI (kN/mm)	43.52
Lithology	Limestone/Shale
Failure description [b]	6



[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [6] Fine crushing/plastic deformation + minor brittle fracturing;

Prior to testing

After testing

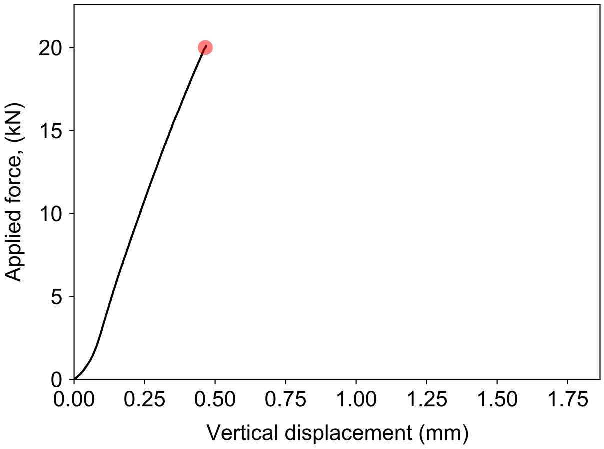


Performed by	BSAT	**Date**	2022-11-16

Punch Penetration Test

Client	WSP Golder	**Project**	21451329
Sample	BH309-RS-SA4	**Depth**	37.81 - 37.93

Specimen parameters	
Diameter (mm) [a]	61.00
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.47
1st peak Load, L (kN)	20.00
Indentation Hardness Index, IHI (kN/mm)	42.99
Lithology	Limestone/Shale
Failure description [b]	3



[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [3] Fine crushing/plastic deformation;

Prior to testing

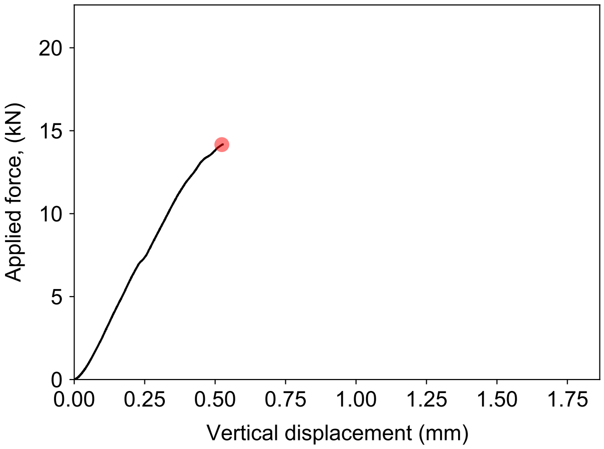
After testing

Performed by	BSAT	**Date**	2022-11-16

Punch Penetration Test

Client	WSP Golder	**Project**	21451329
Sample	BH308-RS-SA4	**Depth**	27.40 - 27.93

Specimen parameters	
Diameter (mm) [a]	61.00
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.52
1st peak Load, L (kN)	14.16
Indentation Hardness Index, IHI (kN/mm)	27.04
Lithology	Limestone/Shale
Failure description [b]	4



[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [4] Fine crushing/plastic deformation + brittle fracturing + minor radial fracturing;

Prior to testing

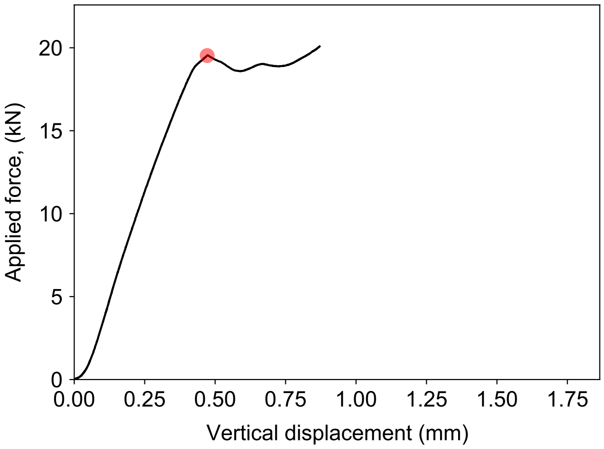
After testing

Performed by	BSAT	**Date**	2022-11-16

Punch Penetration Test

Client	WSP Golder	**Project**	21451329
Sample	BH308-RS-SA11	**Depth**	35.11 - 35.28

Specimen parameters	
Diameter (mm) [a]	61.00
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.47
1st peak Load, L (kN)	19.53
Indentation Hardness Index, IHI (kN/mm)	41.40
Lithology	Limestone/Shale
Failure description [b]	4



[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [4] Fine crushing/plastic deformation + brittle fracturing + minor radial fracturing;

Prior to testing

After testing

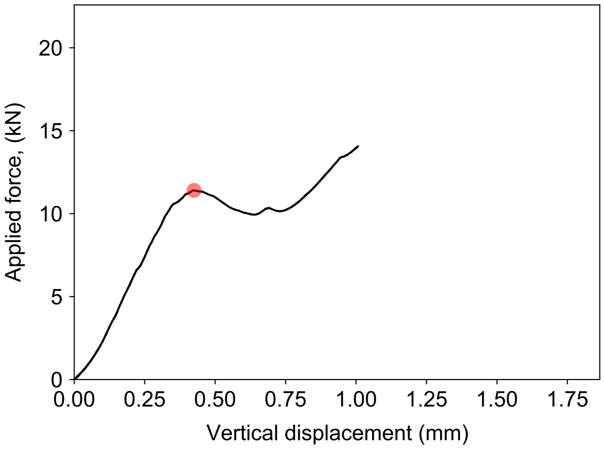
Performed by	BSAT	**Date**	2022-11-16

Punch Penetration Test

Client	WSP Golder	**Project**	21451329
Sample	BH308-RS-SA17	**Depth**	39.93 - 40.10

Specimen parameters

Diameter (mm) [a]	61.00
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.43
1st peak Load, L (kN)	11.40
Indentation Hardness Index, IHI (kN/mm)	26.82
Lithology	Shale
Failure description [b]	2



[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.

[b] Failure description: ^{2} Fine crushing/plastic deformation + brittle fracturing;

Prior to testing

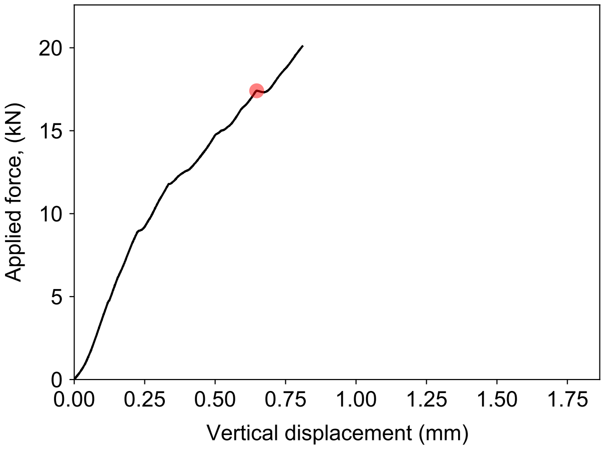
After testing

Performed by	BSAT	**Date**	2022-11-16

Punch Penetration Test

Client	WSP Golder	**Project**	21451329
Sample	BH308-RS-SA19	**Depth**	43.52 - 43.72

Specimen parameters	
Diameter (mm) [a]	61.00
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.65
1st peak Load, L (kN)	17.41
Indentation Hardness Index, IHI (kN/mm)	26.89
Lithology	Limestone/Shale
Failure description [b]	1



[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Fine crushing/plastic deformation + brittle fracturing + radial fracturing;

Prior to testing

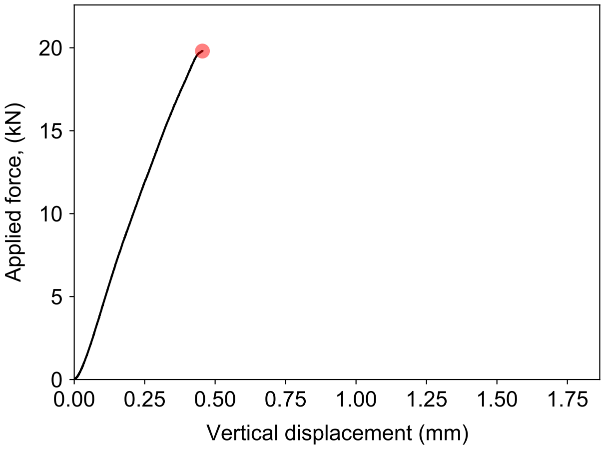
After testing

Performed by	BSAT	**Date**	2022-11-16

Punch Penetration Test

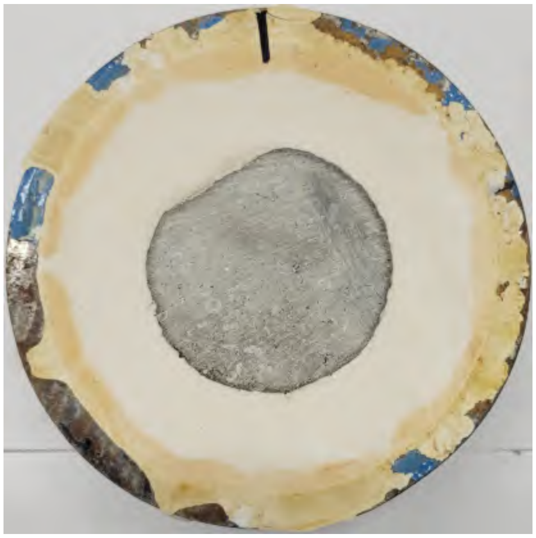
Client	WSP Golder	**Project**	21451329
Sample	BH305-RS-SA1	**Depth**	30.16 - 30.40

Specimen parameters	
Diameter (mm) [a]	61.00
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.45
1st peak Load, L (kN)	19.80
Indentation Hardness Index, IHI (kN/mm)	43.53
Lithology	Limestone/Shale
Failure description [b]	4

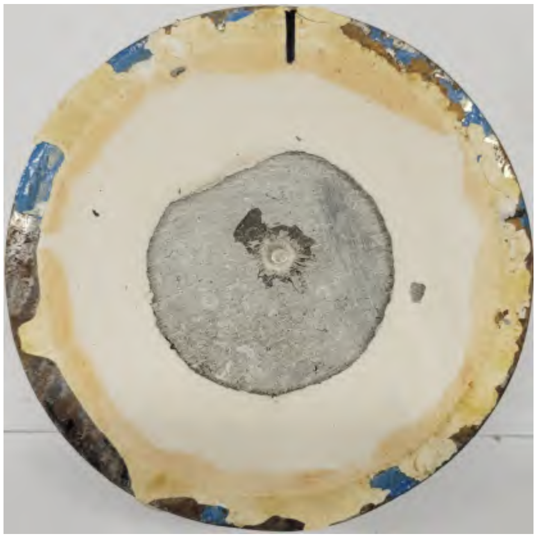


[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [4] Fine crushing/plastic deformation + brittle fracturing + minor radial fracturing;

Prior to testing



After testing

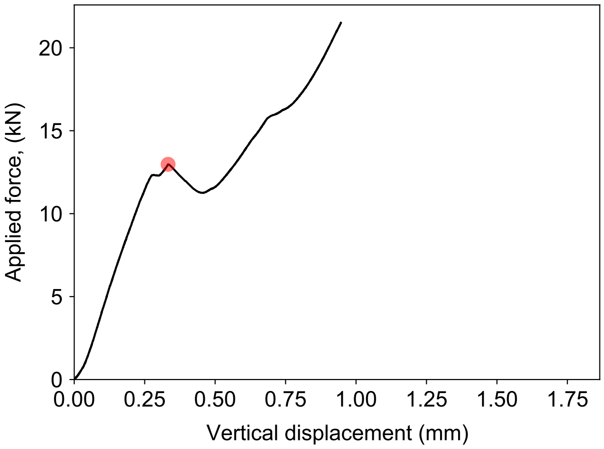


Performed by	BSAT	**Date**	2022-11-16

Punch Penetration Test

Client	WSP Golder	**Project**	21451329
Sample	BH301-RS-SA2	**Depth**	32.91 - 33.13

Specimen parameters	
Diameter (mm) [a]	61.00
Length (mm) [a]	75.00
1st peak Penetration, P (mm)	0.33
1st peak Load, L (kN)	12.98
Indentation Hardness Index, IHI (kN/mm)	38.96
Lithology	Limestone/Shale
Failure description [b]	7



[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [7] Fine crushing/plastic deformation + minor brittle fracturing + minor radial fractures;

Prior to testing

After testing

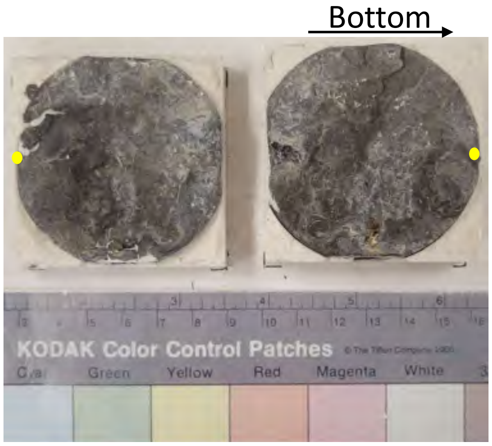
Performed by	BSAT	**Date**	2022-11-16

E Direct Shear Specimen Sheets

- BH207-RS-SA15
- BH204-RS-SA7
- BH306-RS-SA13
- BH302-RS-SA4
- BH203-RS-SA2
- BH206-RS-SA4
- BH26-RS-SA3
- BH23-RS-SA5
- BH24-RS-SA5
- BH202-RS-SA11
- BH21-RS-SA4
- BH22-RS-SA12
- BH205-RS-SA13
- BH307-RS-SA12
- BH309-RS-SA1
- BH309-RS-SA12
- BH305-RS-SA5
- BH17-RS-03
- BH7-RS-02
- BH75-RS-03

Direct Shear Test

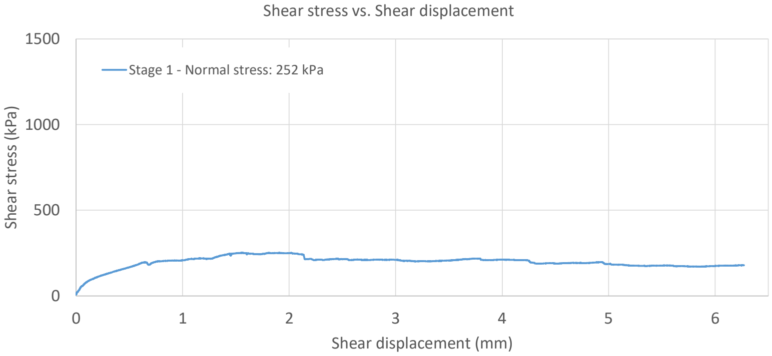
Client	WSP Golder	**Project**	21451329

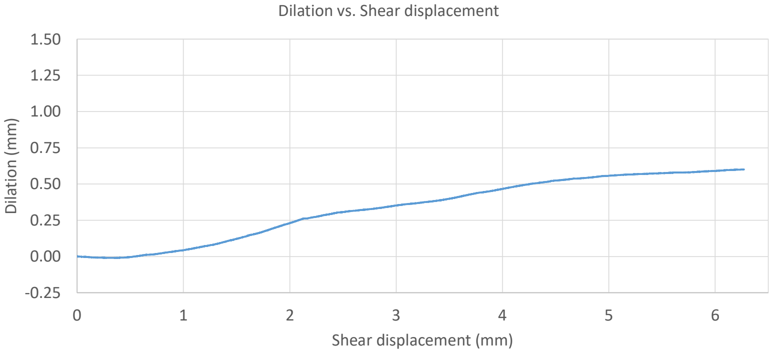


Pre-test

Post-Test
σ_n = 252 kPa

Sample: BH207-RS-SA15
Depth: 42.87 - 43.08 m





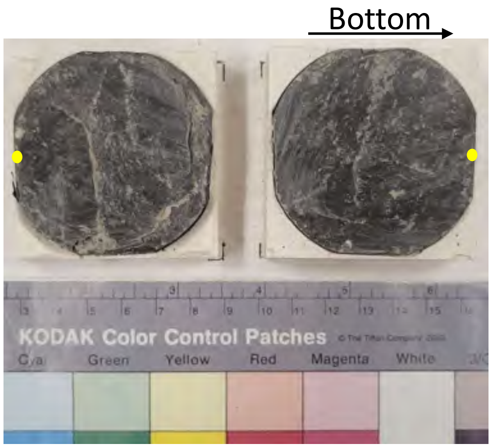
Remarks:

Performed by	BSAT	**Date**	2022-11-29

GEOMECHANICA

Direct Shear Test

Client	WSP Golder	**Project**	21451329



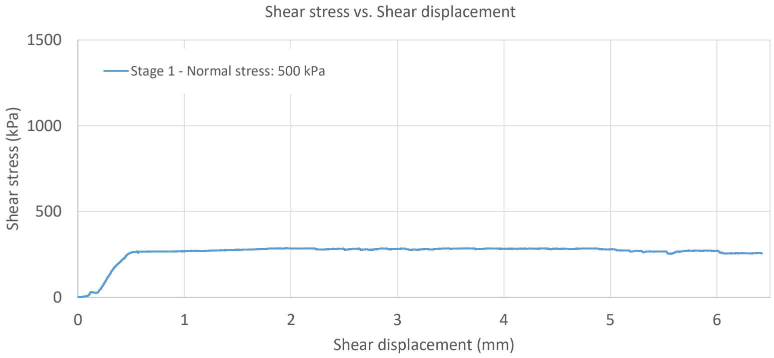
Pre-test

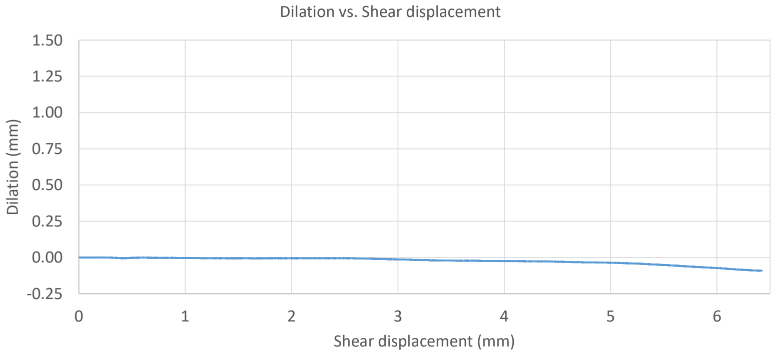
Post-Test

σ_n = 500 kPa

Sample: BH204-RS-SA7

Depth: 42.63 - 42.85 m



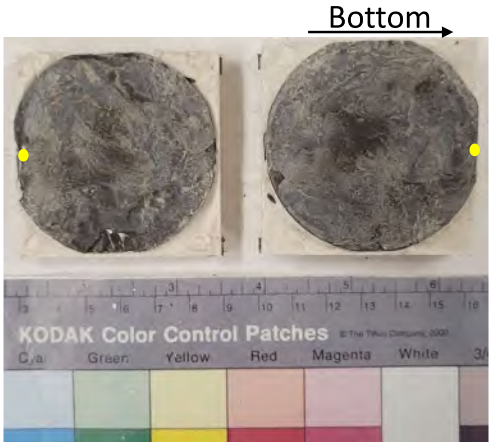


Remarks:

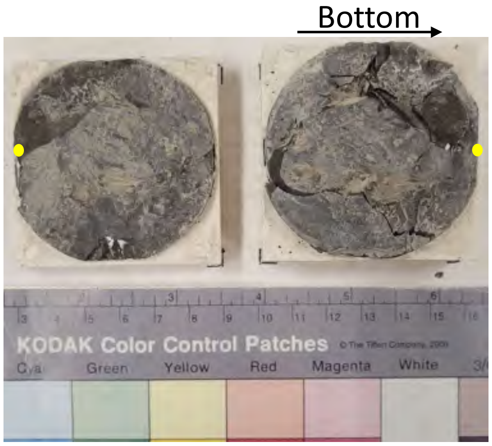
Performed by	BSAT	**Date**	2022-11-29

Direct Shear Test

Client	WSP Golder	**Project**	21451329

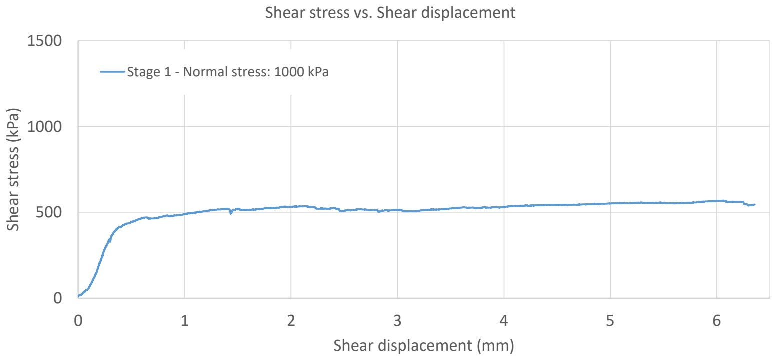


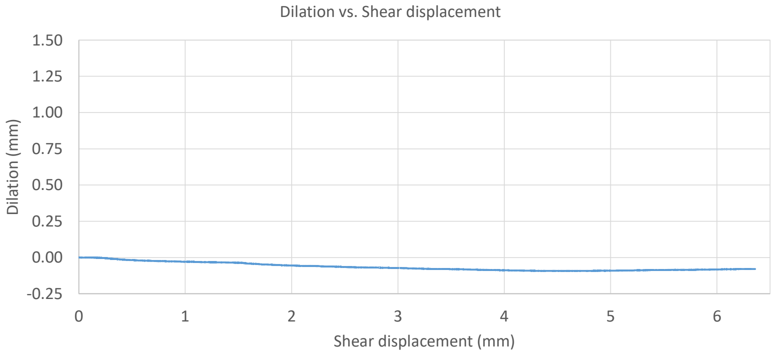
Pre-test



Post-Test
σ_n = 1000 kPa

Sample: BH306-RS-SA13
Depth: 45.33 -45.63 m



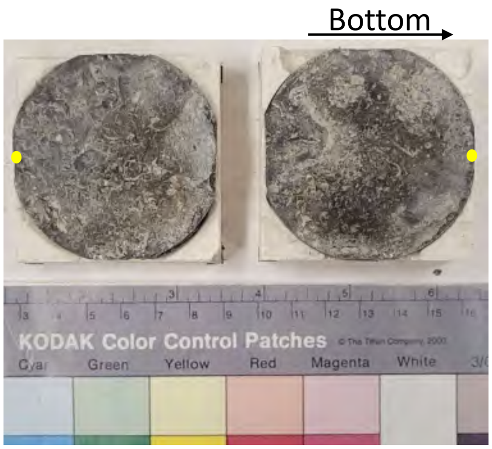


Remarks:

Performed by	BSAT	**Date**	2022-11-29

Direct Shear Test

Client	WSP Golder	**Project**	21451329

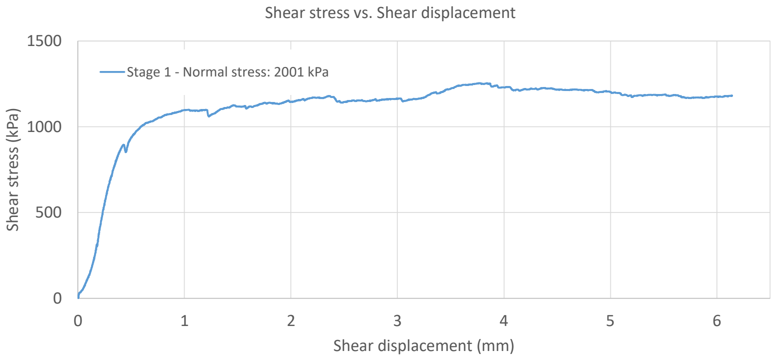


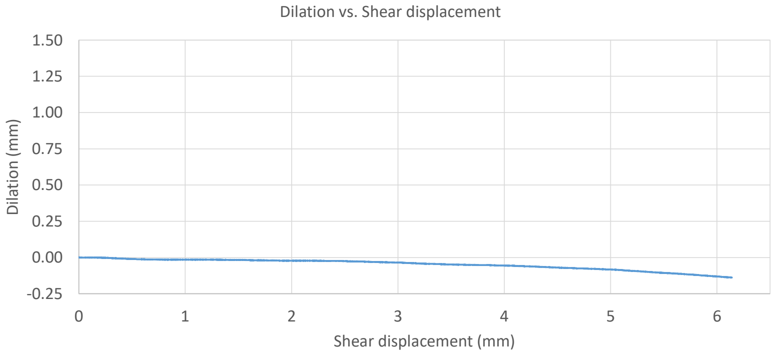
Pre-test

Post-Test

σ_n = 2001 kPa

Sample: BH302-RS-SA4
Depth: 44.14 - 44.49 m



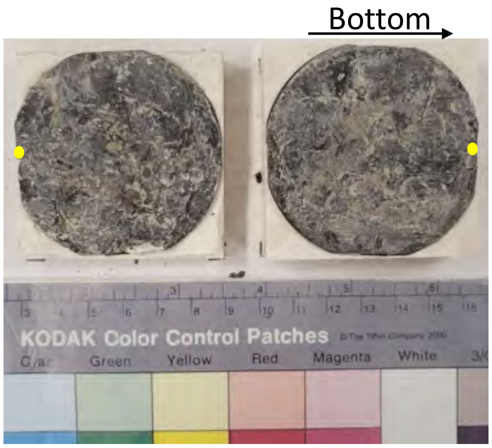


Remarks:

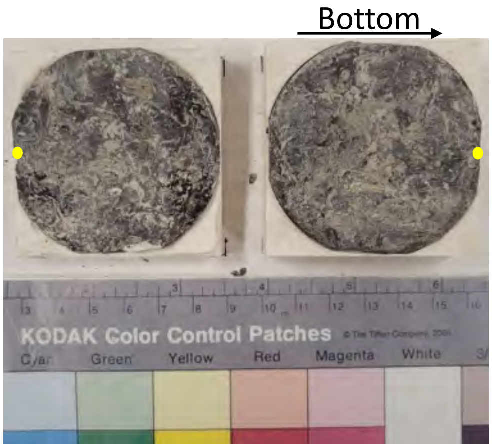
Performed by	BSAT	**Date**	2022-11-29

Direct Shear Test

Client	WSP Golder	**Project**	21451329

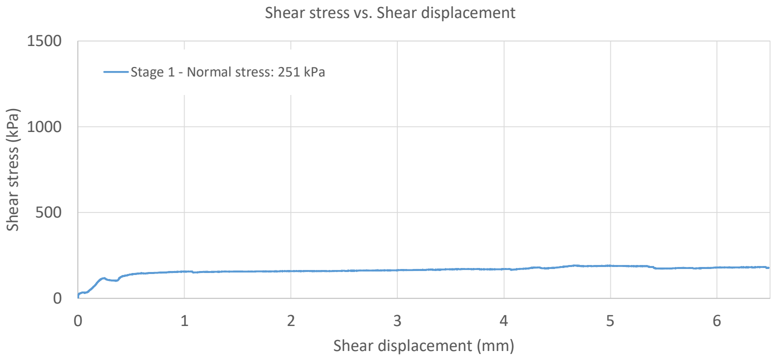


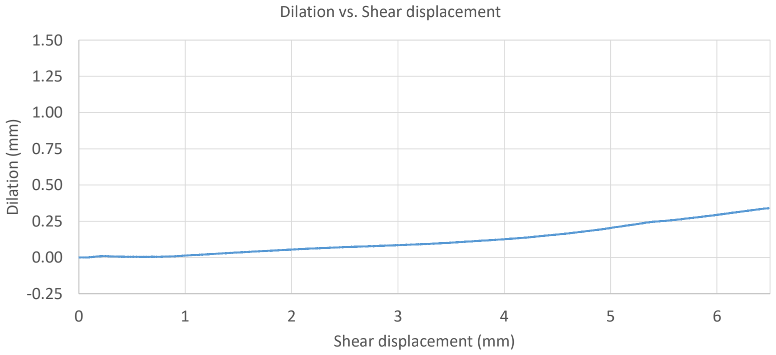
Pre-test



Post-Test
σ_n = 251 kPa

Sample: BH203-RS-SA2
Depth: 36.10 - 36.41 m



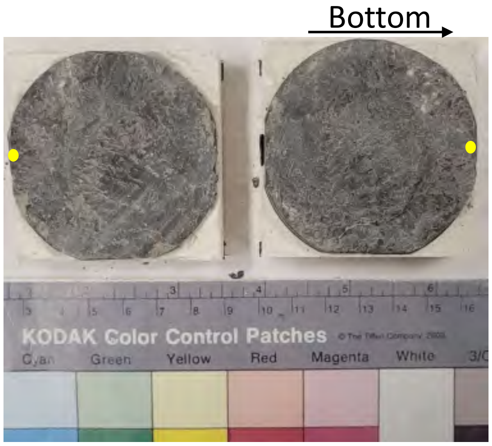


Remarks:

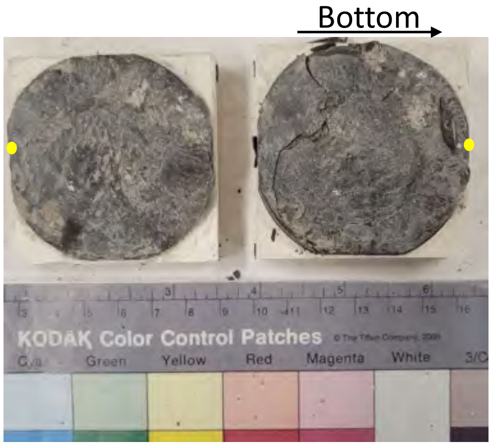
Performed by	BSAT	**Date**	2022-11-29

Direct Shear Test

Client	WSP Golder	**Project**	21451329

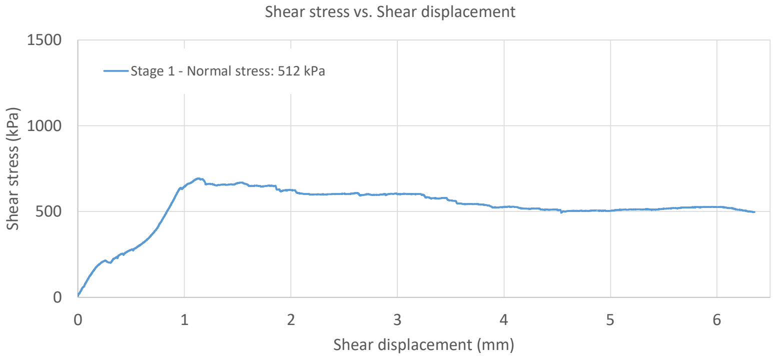


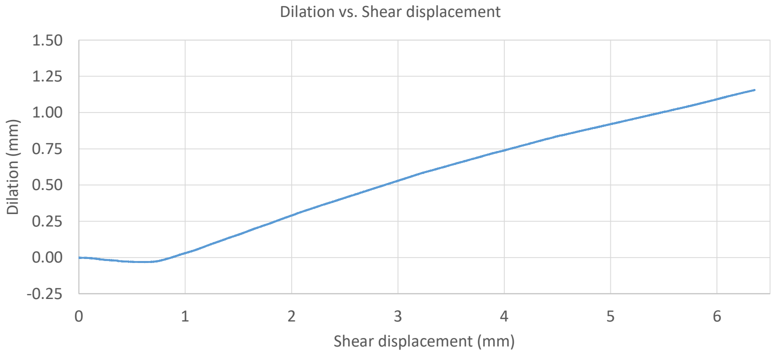
Pre-test



Post-Test
σ_n = 512 kPa

Sample: BH206-RS-SA4
Depth: 41.57 - 41.93 m


Shear stress vs. Shear displacement

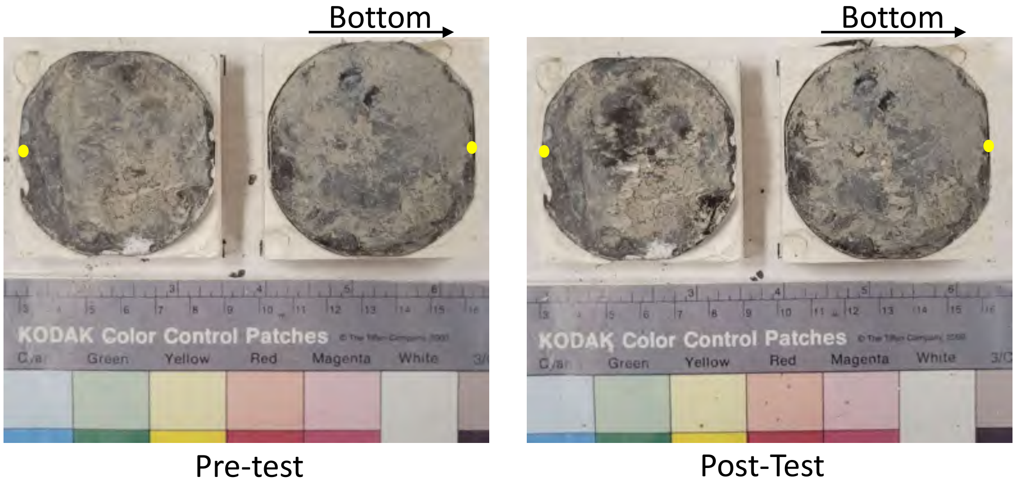

Dilation vs. Shear displacement

Remarks:

Performed by	BSAT	**Date**	2022-11-29

Direct Shear Test

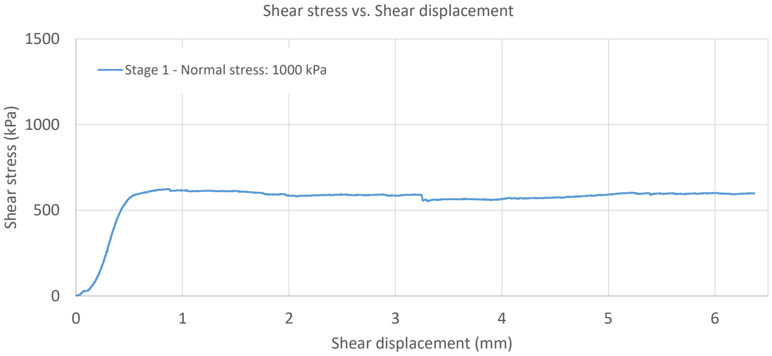
Client	WSP Golder	**Project**	21451329

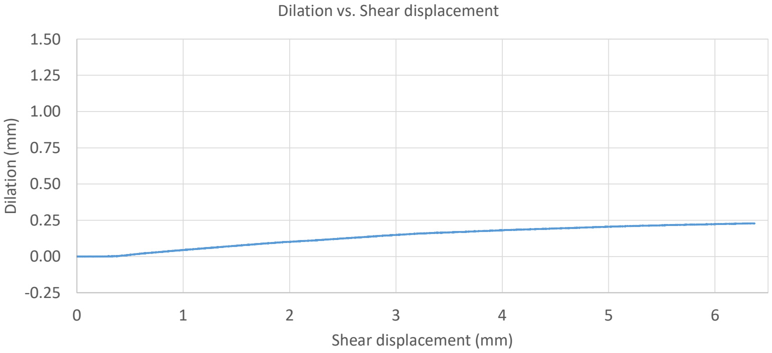


Pre-test

Post-Test
σ_n = 1000 kPa

Sample: BH26-RS-SA3
Depth: 42.01 - 42.35 m



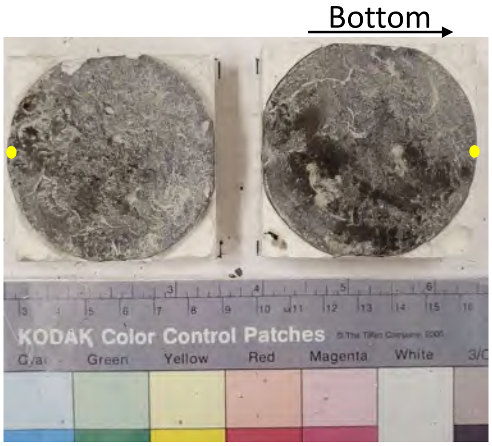


Remarks:

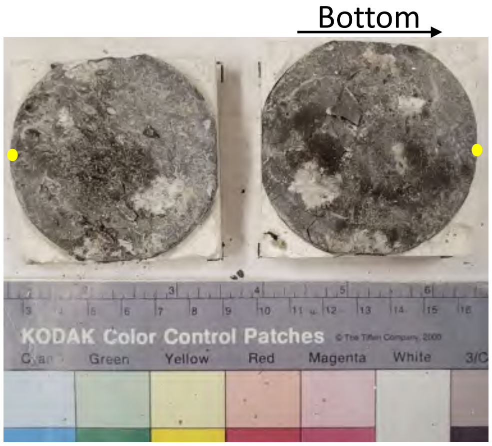
Performed by	BSAT	**Date**	2022-11-29

Direct Shear Test

Client	WSP Golder	**Project**	21451329



Pre-test

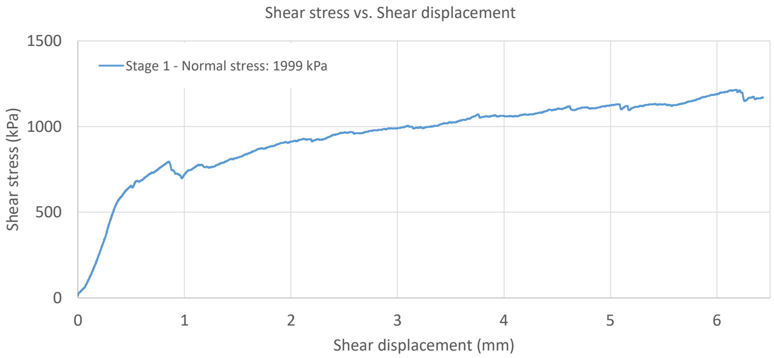


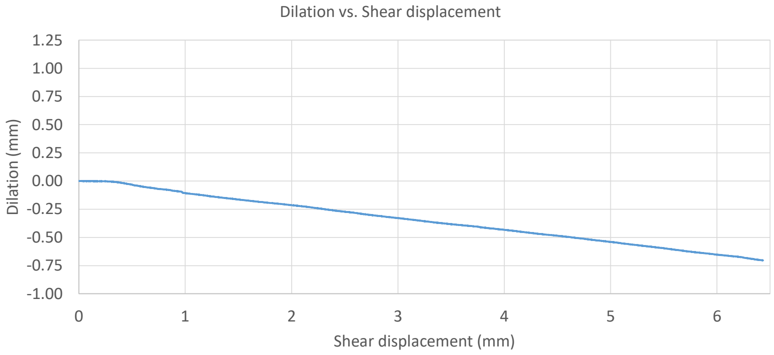
Post-Test

σ_n = 1999 kPa

Sample: BH23-RS-SA5

Depth: 51.73 - 51.98 m





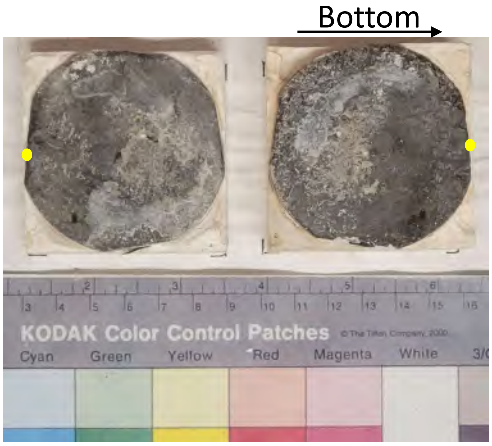
Remarks:

Performed by	BSAT	**Date**	2022-11-29

Direct Shear Test

Client	WSP Golder	**Project**	21451329

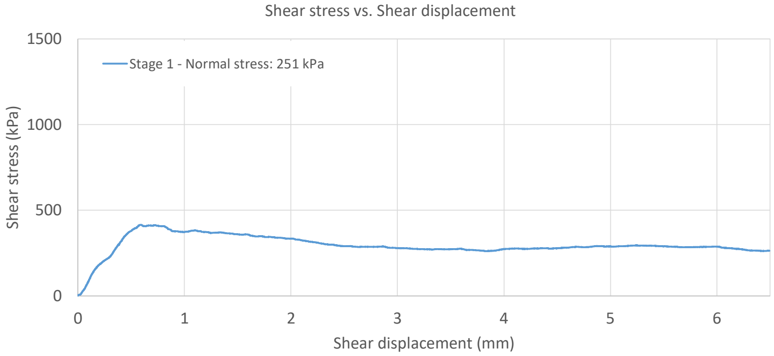
Pre-test

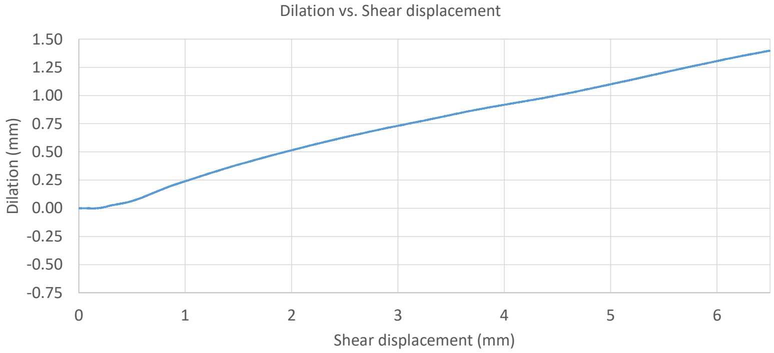


Post-Test

σ_n = 251 kPa

Sample: BH24-RS-SA5
Depth: 57.28 – 57.54 m





Remarks:

Performed by	BSAT	**Date**	2022-12-19

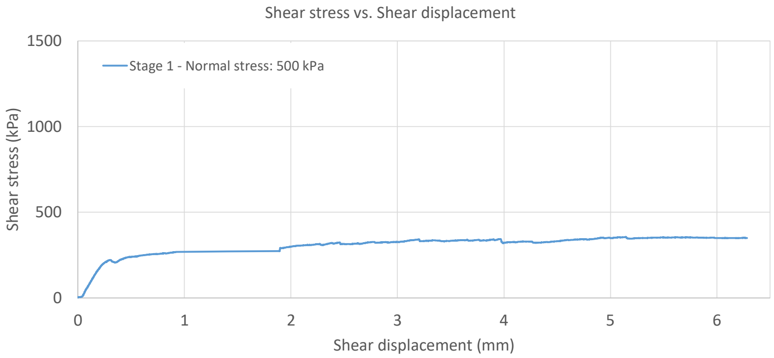
Direct Shear Test

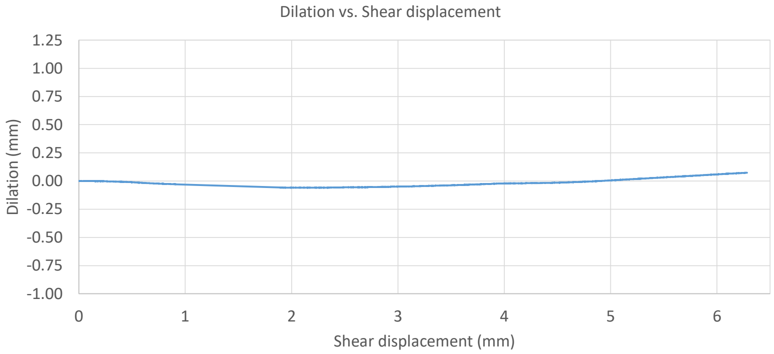
Client	WSP Golder	**Project**	21451329

Pre-test

Post-Test
σ_n = 500 kPa

Sample: BH202-RS-SA11
Depth: 44.59 – 44.78 m



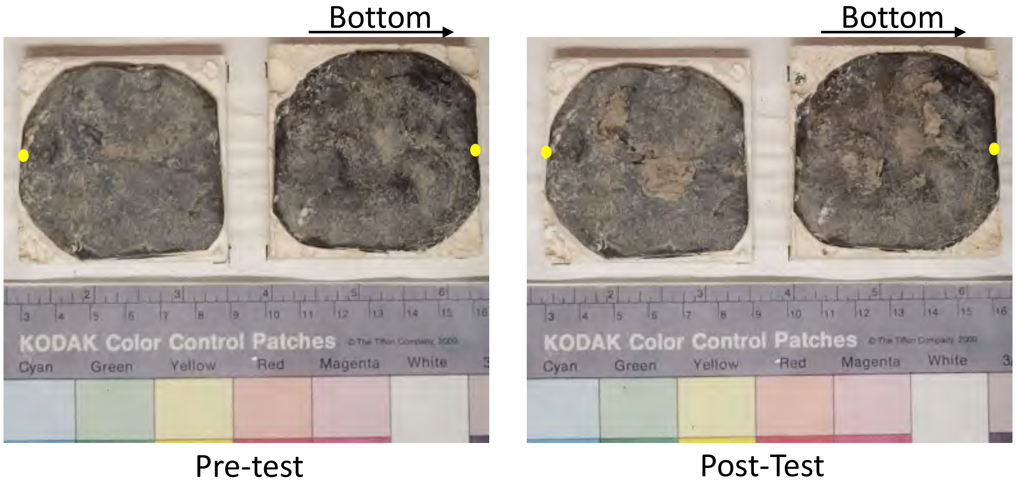


Remarks:

Performed by	BSAT	**Date**	2022-12-19

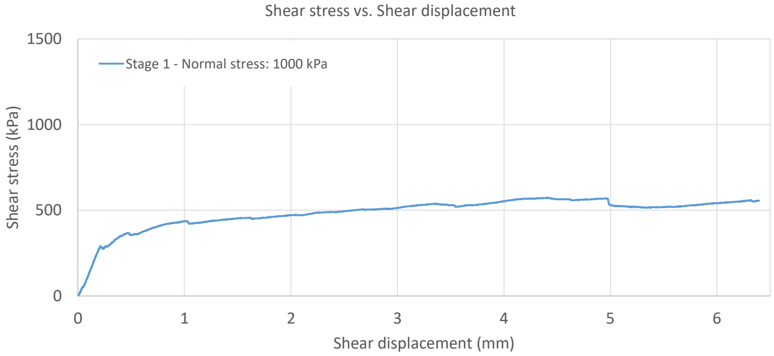
Direct Shear Test

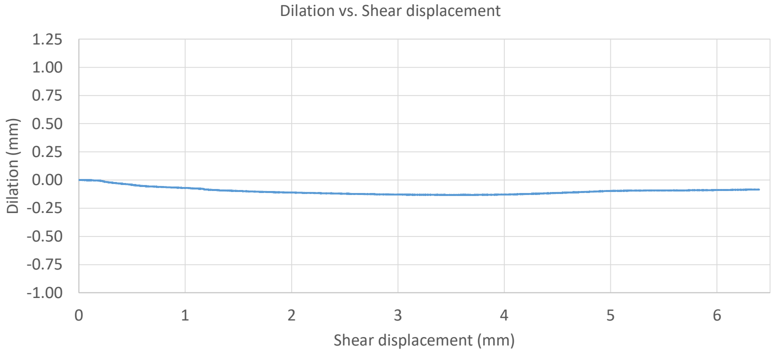
Client	WSP Golder	**Project**	21451329



σ_n = 1000 kPa

Sample: BH21-RS-SA4
Depth: 42.17 -42.39 m



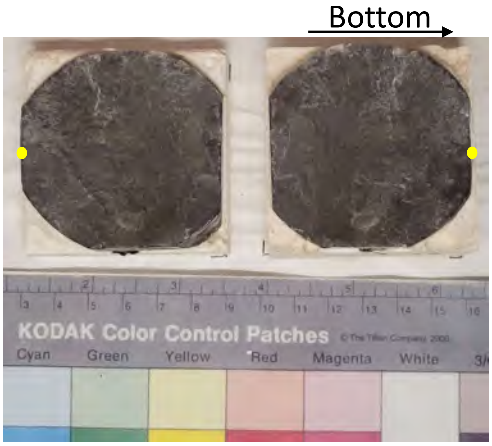


Remarks:

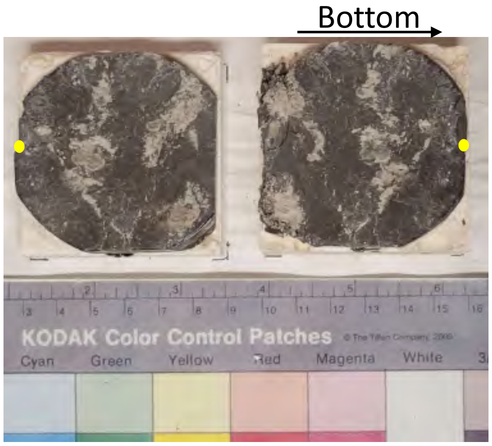
Performed by	BSAT	**Date**	2022-12-19

Direct Shear Test

Client	WSP Golder	**Project**	21451329



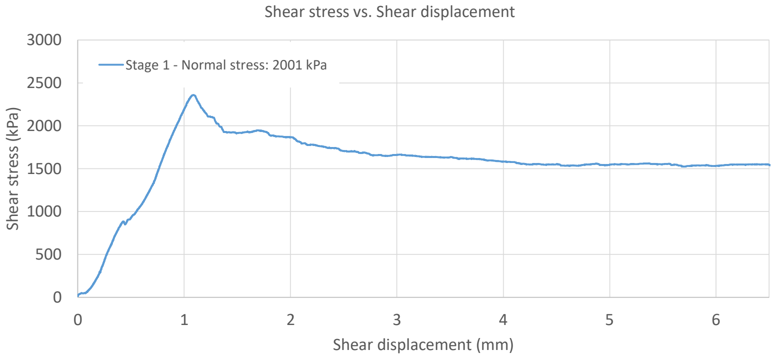
Pre-test

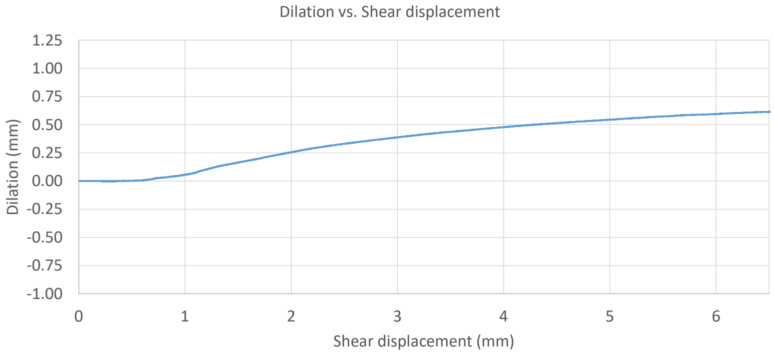


Post-Test

σ_n = 2001 kPa

Sample: BH22-RS-SA12
Depth: 49.42 - 49.57 m





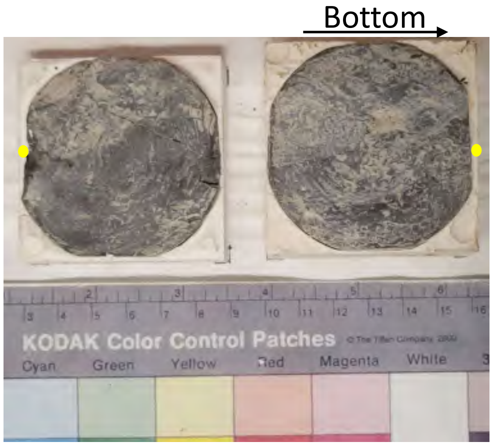
Remarks:

Performed by	BSAT	**Date**	2022-12-19

Direct Shear Test

Client	WSP Golder	**Project**	21451329

Pre-test



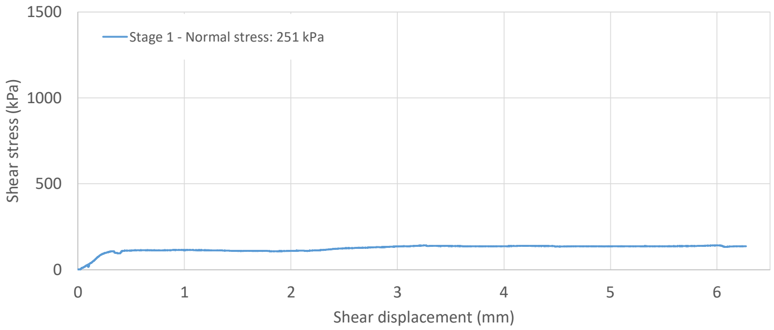
Post-Test

σ_n = 251 kPa

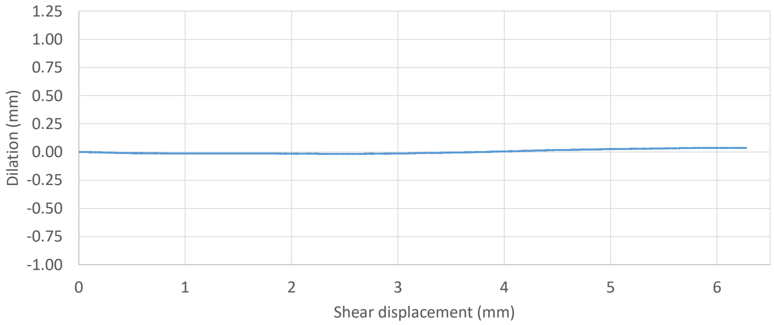
Sample: BH205-RS-SA13

Depth: 42.39 – 42.88 m

Shear stress vs. Shear displacement



Dilation vs. Shear displacement

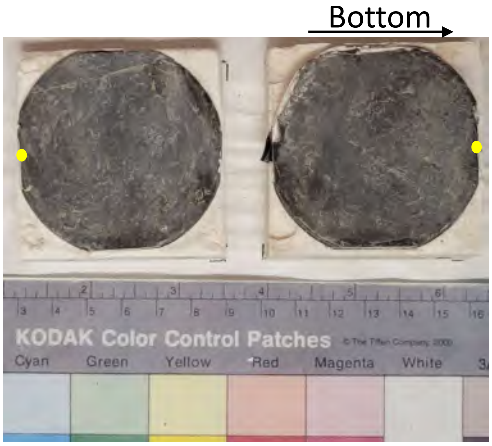


Remarks:

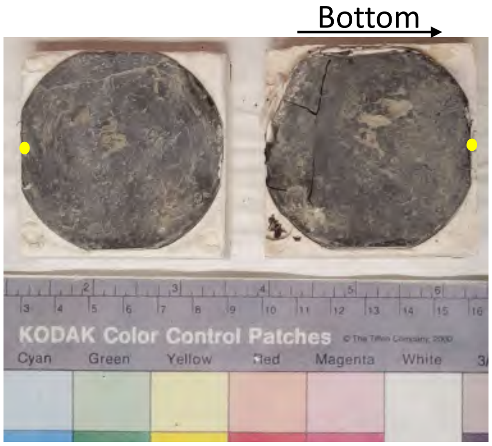
Performed by	BSAT	**Date**	2022-12-19

Direct Shear Test

Client	WSP Golder	**Project**	21451329



Pre-test

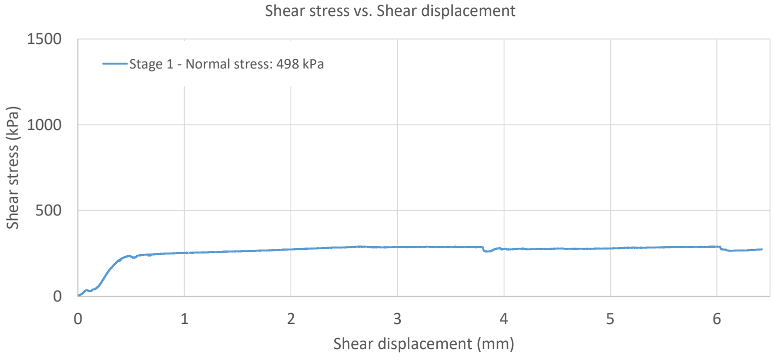


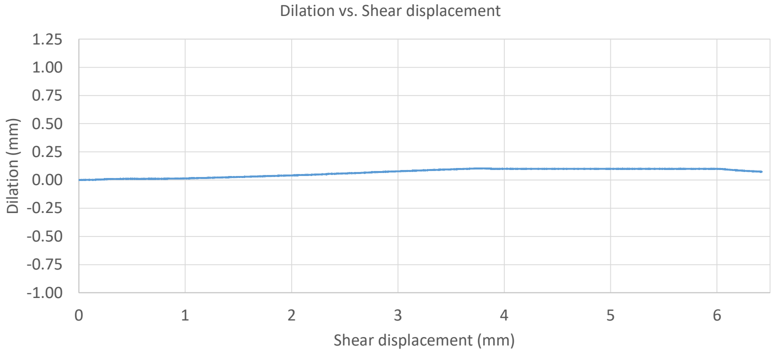
Post-Test

σ_n = 498 kPa

Sample: BH307-RS-SA12

Depth: 38.29 – 38.73 m





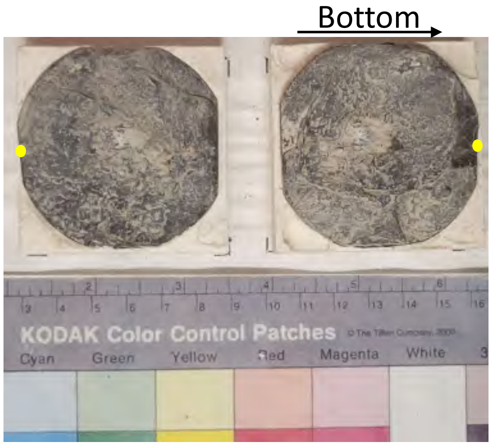
Remarks:

Performed by	BSAT	**Date**	2022-12-19

Direct Shear Test

Client	WSP Golder	**Project**	21451329

Pre-test

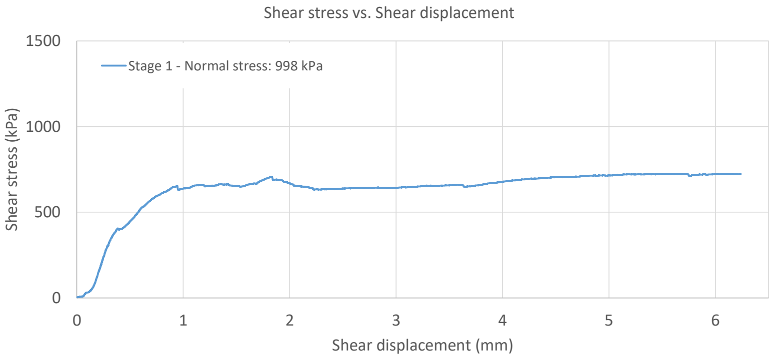


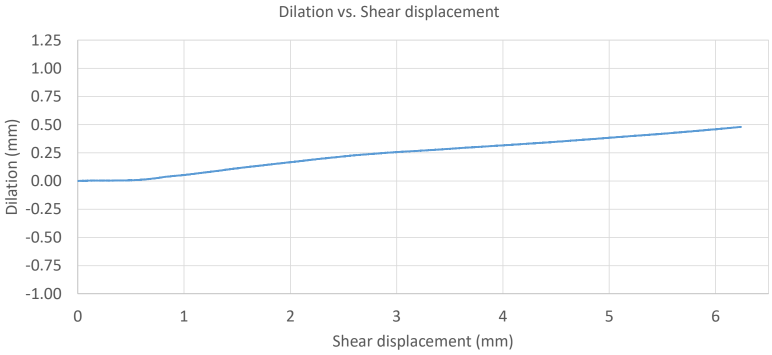
Post-Test

σ_n = 998 kPa

Sample: BH309-RS-SA1

Depth: 31.94 – 32.27 m


Shear stress vs. Shear displacement

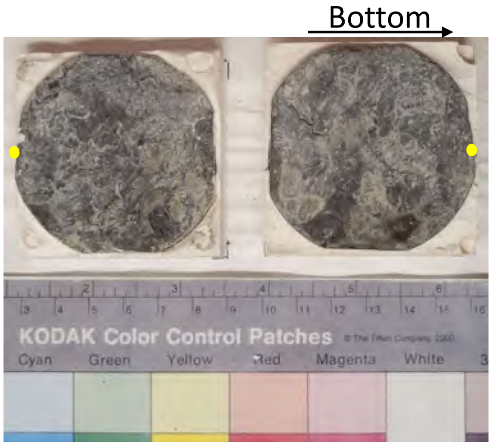

Dilation vs. Shear displacement

Remarks:

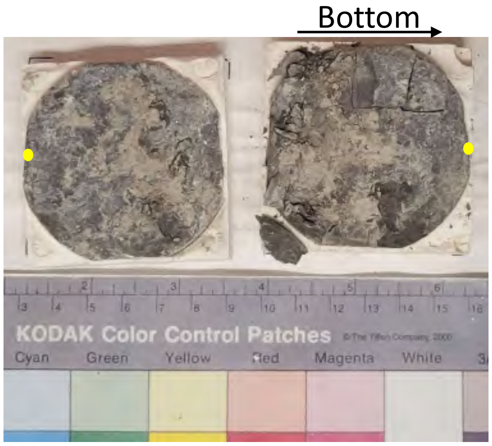
Performed by	BSAT	**Date**	2022-12-19

Direct Shear Test

Client	WSP Golder	**Project**	21451329



Pre-test



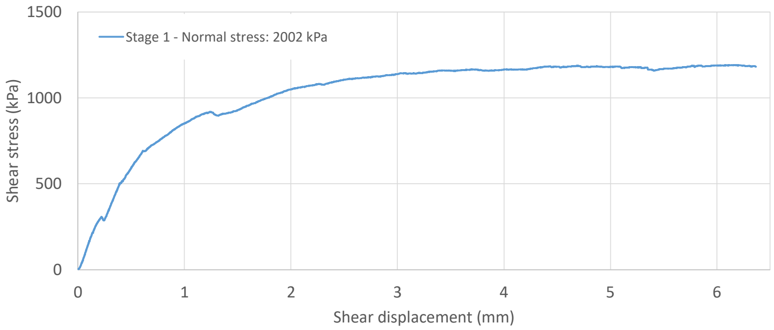
Post-Test

σ_n = 2002 kPa

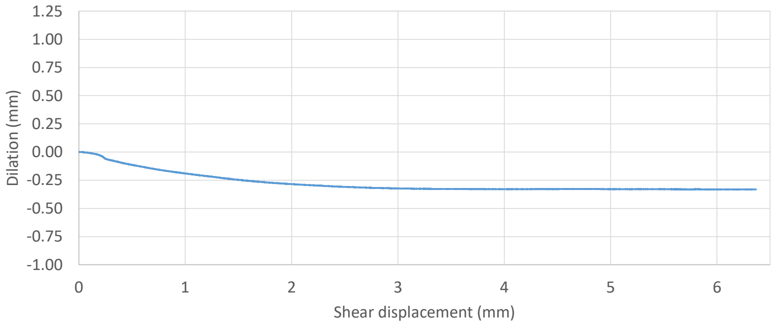
Sample: BH309-RS-SA12

Depth: 54.91- 55.31 m

Shear stress vs. Shear displacement



Dilation vs. Shear displacement

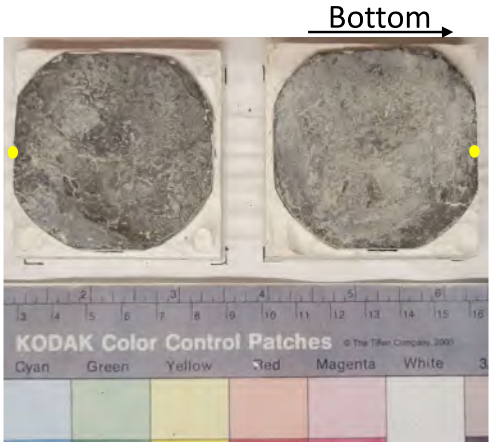


Remarks:

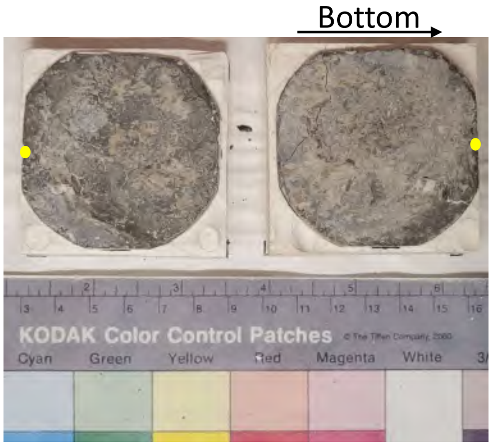
Performed by	BSAT	**Date**	2022-12-19

Direct Shear Test

Client	WSP Golder	**Project**	21451329



Pre-test

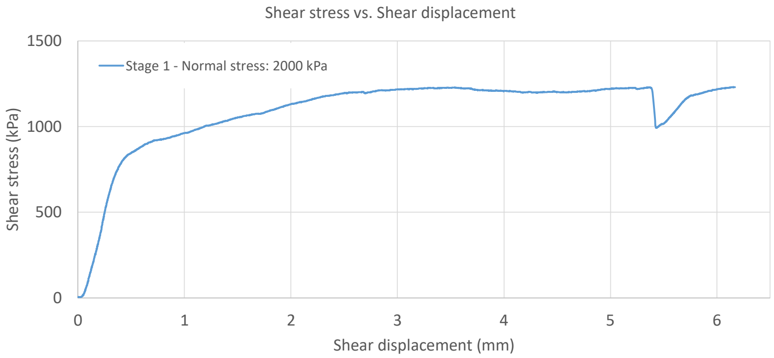


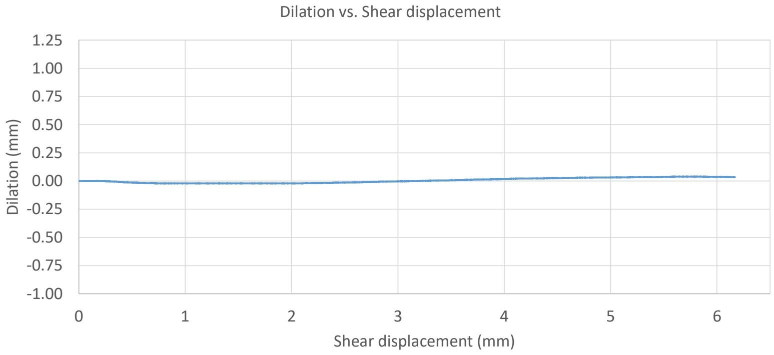
Post-Test

σ_n = 2000 kPa

Sample: BH305-RS-SA5

Depth: 43.93 – 44.28 m



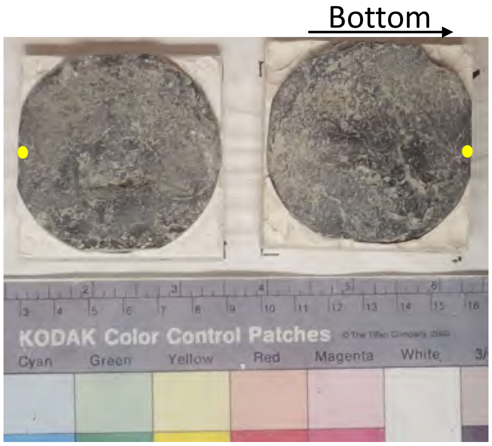


Remarks:

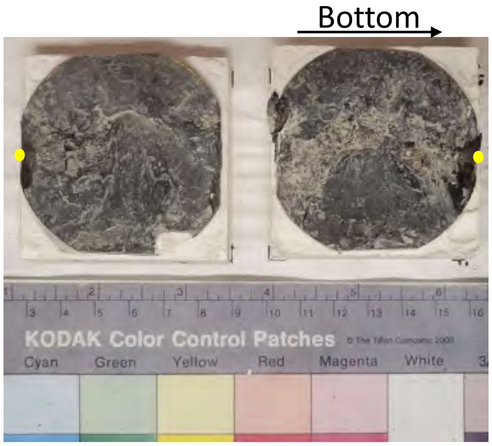
Performed by	BSAT	**Date**	2022-12-19

Direct Shear Test

Client	WSP Golder	**Project**	21451329

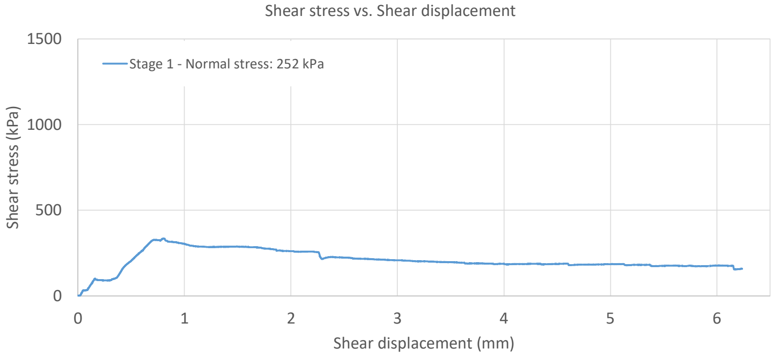


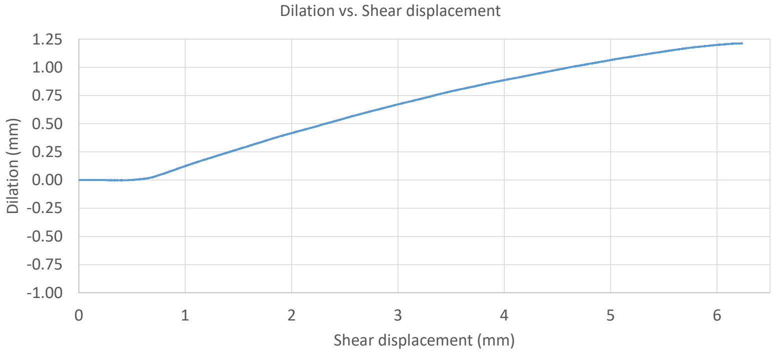
Pre-test



Post-Test
σ_n = 252 kPa

Sample: BH17-RS-03
Depth: 43.90 – 44.25 m



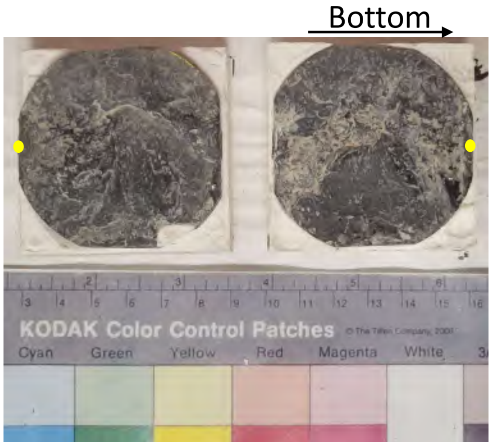


Remarks:

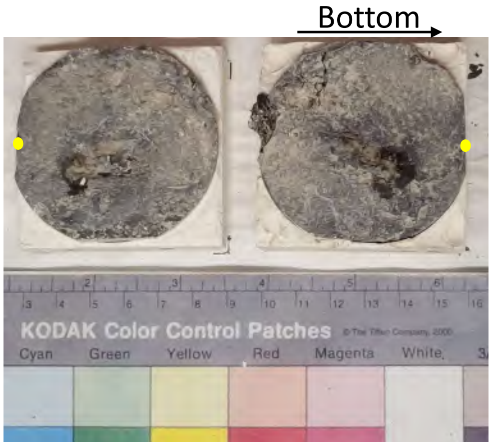
Performed by	BSAT	**Date**	2022-12-19

Direct Shear Test

Client	WSP Golder	**Project**	21451329

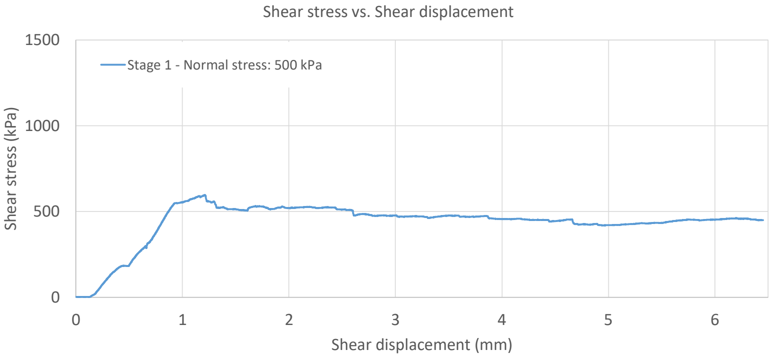


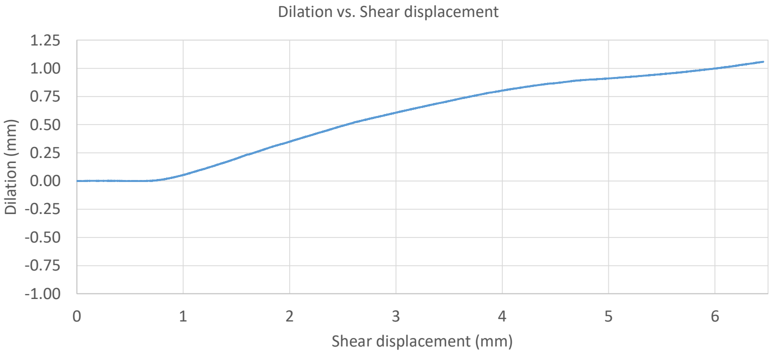
Pre-test



Post-Test
σ_n = 596 kPa

Sample: BH7-RS-02
Depth: 42.23 – 42.46 m



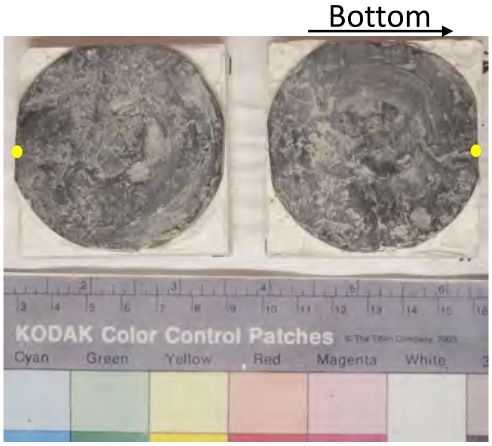


Remarks:

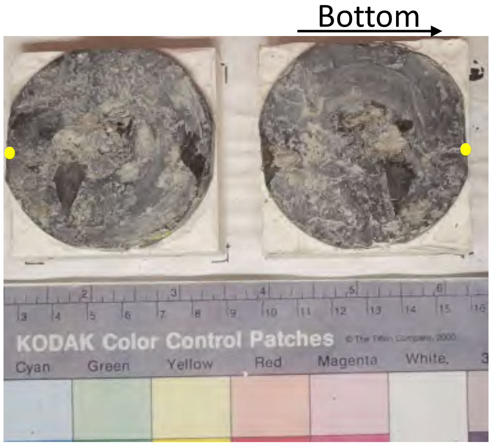
Performed by	BSAT	**Date**	2022-12-19

Direct Shear Test

Client	WSP Golder	**Project**	21451329



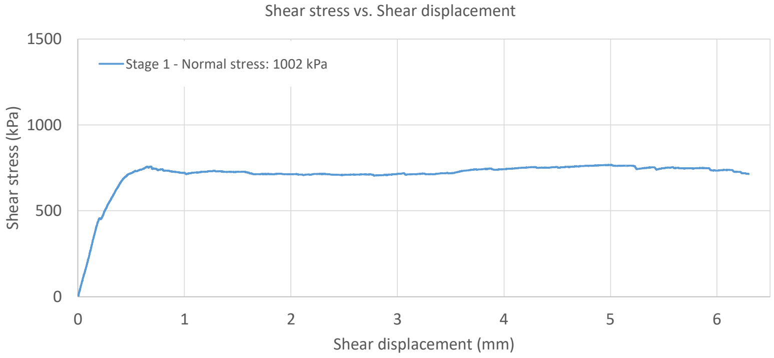
Pre-test

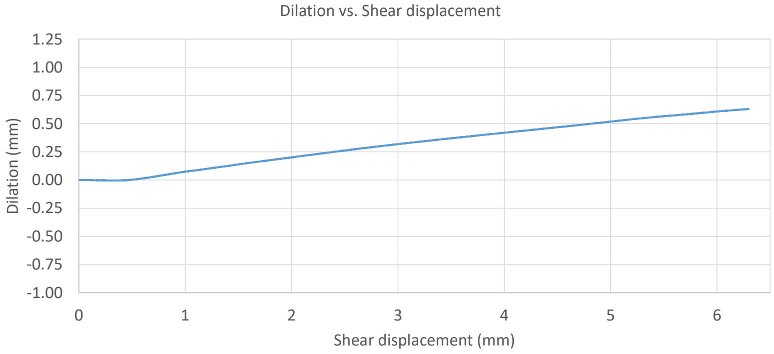


Post-Test

σ_n = 1002 kPa

Sample: BH75-RS-03
Depth: 53.03 – 53.33 m


Shear stress vs. Shear displacement


Dilation vs. Shear displacement

Remarks:

Performed by	BSAT	**Date**	2022-12-19

FACTUAL REPORT

Results of Laboratory Swell Tests on Rock Samples

Darlington New Nuclear Project (DNNP) – Phase 2

Bowmanville, Ontario

(Golder Project No.: 21451329/21600/620)

BH203, BH205, BH207 & BH308

Prepared for:
Golder Associates Ltd.
6925 Century Avenue, Suite #100
Mississauga, ON
L5N 7K2

K. Y. Lo Inc.

March 22, 2023

TABLE OF CONTENT

1. Introduction

K.Y. Lo Inc. was retained by Golder Associates. (The Client) to test the swelling characteristics of rock cores of Blue Mountain Formation from boreholes BH203, BH205, BH207 and BH308 drilled for the Darlington New Nuclear Project (DNNP) – Phase 2 in Bowmanville, ON. The following swell tests were requested by the Client to be performed on the received rock cores:

- Two (2) free swell tests (FST)
- Two (2) semi-confined swell tests – vertical direction (SCSTV)
- Two (2) semi-confined swell tests – horizontal direction (SCSTH)
- Two (2) null swell test – vertical direction (NSTV)
- Two (2) null swell tests – horizontal direction (NSTH)

This report presents factual laboratory results of swell tests completed on the received rock samples. The results of water content, pore water salinity and calcite content tests done on the same rock samples are also included.

2. Received Rock Samples

The rock samples received from the Client are listed in Table 1 attached in Appendix A. Table 1 includes the borehole ID, the date of rock core received, the depth and the length of cores. The table also includes information about conditions of samples upon their opening as well as information for which swell test they are used.

A total of eight (8) HQ3 rock cores (i.e. diameter ~ 61.1 mm) were recovered from boreholes BH203, BH205, BH207 and BH308. Rock cores from BH203, BH207 and BH308 were received on August 17, 2022 while cores from BH205 were received on October 20, 2022

All of the cores received were wrapped with electrical tape and bubble wrap and then placed in a plastic tube. The cores recovered were sedimentary rocks of Blue Mountain Formation. Photographs C1 to C8 attached in Appendix C show the cores as received as well as upon their opening. Swell test specimens were obtained from all received rock cores.

3. Laboratory Testing Program

The number and type of proposed and performed swell tests on the received samples are shown in Table 2 in Appendix A. All requested swell tests were performed.

The laboratory testing program for BH203, BH205, BH207 and BH308 consisted of the following swell tests:

- Two (2) free swell tests (FST)
- Two (2) semi-confined swell tests – vertical direction (SCSTV)
- Two (2) semi-confined swell tests – horizontal direction (SCSTH)
- Two (2) null swell test – vertical direction (NSTV)
- Two (2) null swell tests – horizontal direction (NSTH)

A summary of swell tests performed on each received rock core is presented in Table 1 in Appendix A.

The specimen for the horizontal SCSTs and NSTs was obtained by coring perpendicularly available vertical cores using a laboratory coring machine. The laboratory cored specimens were approximately 29.7 mm to 30.8 mm in diameter. In vertical SCSTs and NSTs, measurements were taken perpendicular to rock beddings, while in horizontal SCSTs and NSTs, measurements were taken parallel to rock beddings.

4. Methodology of Testing

4.1 Free Swell Tests

Free swell test was performed using the method developed by Lo et al. (1978). In free swell tests, freshly trimmed rock specimen is permitted to deform unrestrictedly in all directions. A typical specimen for a free swell test is shown on Figure 1(a) in Appendix B. The diameter-ratio of the cylindrical sample should be approximately one to one.

Three orthogonal dimensional changes of the specimen preserved under constant temperature (~20^o) and 100% relative humidity with direct access to fresh (tap) water, are measured with time. The “UWO deformation gauge” shown on Figure 1(a) is used to measure the dimensions of two horizontal (X and Y) and vertical (axial/Z) directions for 100 days. Test data were plotted as strain vs. logarithm (to the base of 10) of elapsed time. The slope between 10 and 100 days is referred to as the vertical and horizontal swelling potentials.

4.2 Semi-confined Swell Tests

The method of semi-confined swell test used to evaluate the stress-dependent swelling behaviour of shales was described in Lo et al. (1978) and Lo and Lee (1990). In this type of test, the rock specimen was submerged in tap water and the strain changes in only one direction, either vertical or horizontal, were monitored by a dial gauge reading. A constant pressure was applied to the rock sample in the direction of measurement while deformations in perpendicular directions remained unrestricted. The selected applied pressures between 0.04 MPa to 0.08 MPa. A typical setup is shown on Figure 1(b) in Appendix B.

Similarly to that for the free swell test, test data from semi-confined swell tests were analyzed by plotting strain vs. logarithm (to the base of 10) of elapsed time. The average slope of a plot was taken as an index of the “swelling potential” of the rock being tested under the constant applied stress. The values were evaluated from the log-cycle of time between 10 and 100 days.

4.3 Null Swell Tests

Null swell tests were included in the testing program to measure the critical pressure required to completely suppress swelling in the vertical or horizontal direction. A typical setup is shown in Figure 1(c) in Appendix B. This test arrangement consists of the loading support frame, the load cell and loading–cap assembly, deformation monitoring system and container where sample is submerged in tap water. The procedure and method of interpretation for null swell tests have been discussed in Lo (1989) and Lo and Lee (1990).

4.4 Water Content, Salinity and Calcite Content Tests

The gravimetric method was used to measure water content of the rock sample. In this method the measurement of water content is direct, being simply the mass of water lost on drying in a convection oven at a temperature of 105°C until the mass remains constant. It was experimentally established that shales need four (4) days of drying to reach constant dry mass.

The salinity of rock pore fluid was determined by adding distilled water to the powdered rock sample and then centrifuging the mixture. The electrical conductivity of the supernatant of the centrifuged solution was measured using a conductivity meter (WTW TetraCon 325), and then converted to the salinity (salt concentration) expressed in grams per litre of pore water, NaCl equivalent.

Water content and salinity of each swell test specimen were measured before and after the test (after 100 days of swelling). Before a swell test, water content and salinity were measured on rock pieces adjacent to the swell test specimen. After swell test, water content and salinity tests were performed on the actual swell test specimen.

The gasometric method using the Chittick apparatus (Dreimanis, 1962) was used to estimate the amount of calcite in the rock samples after swell test. The calcite content was measured on the actual specimen upon the swell test was terminated.

5. Results of Laboratory Testing

The results of swell tests are presented on the attached graphs in Appendix D. The results of calcite content, water content, and salinity tests performed before and after swell tests are presented on the insert in each graph. These results are also summarized in Table 3 in Appendix A.

We appreciate the opportunity to work with you on this project.

K.Y. Lo Inc.

Prepared by

Silvana Micic, Ph.D., P.Eng.

Reviewed by

Kwan Yee Lo, Ph.D., P.Eng., FEIC

6. References

Dreimanis, A. 1962. Quantitative Gasometric Determination of Calcite and Dolomite Using Chittick Apparatus. Journal of Sedimentary Petrology, Vol. 32, pp. 520-529.

Lo, K.Y. 1978. Regional Distribution of In-situ Horizontal Stresses in Rocks of Southern Ontario. Canadian Geotechnical Journal, Vol. 15, pp. 371-381.

Lo, K.Y. 1989. Recent Advances in Design and Evaluation of Performance of Underground Structures in Rocks. Tunneling and Underground Space Technology, Vol. 4, No. 2, pp. 171-183.

Lo, K.Y. and Lee, Y.N. 1990. Time-dependent Deformation Behaviour of Queenston Shale. Canadian Geotechnical Journal, Vol. 27, No. 3, pp. 461-471.

Lo, K.Y., Wai, R.S.C., Palmer, J.H.L. and Quigley, R.M. 1978. Time-dependent Deformation of Shaley Rocks in Southern Ontario. Canadian Geotechnical Journal, Vol. 15, pp. 537-547.

Appendix A - Tables

Table 1. Summary of received rock cores and obtained swell test specimens as per the laboratory testing program

Received Rock Samples					Swell Test Specimens			
Borehole ID	**Received at UWO**	**Sample No**	**Depth (m)**	**Length (m)**	**Specimen ID**	**Specimen Depth (m)**	**Applied Pressure (MPa)**	**Remarks**
BH203	17-Aug-22	RS1	17.17 - 17.39	0.22	SCSTV-203-RS1-1	17.34 - 17.37	0.08	Intact, dark grey and brown, Blue Mountain Formation, shale with thin limestone interbeds
	17-Aug-22	RS2	17.77 - 18.03	0.26	FST-203-RS2-2 SCSTH-203-RS2-1	17.79 - 17.85 17.97 - 18.00	N/A 0.08	Intact, dark grey and brown, Blue Mountain Formation, shaly with limestone interbeds
	17-Aug-22	RS3	18.03 - 18.37	0.34	NSTV-203-RS3-1 NSTH-203-RS3-1	18.15 - 18.19 18.30 - 18.33	N/A	Intact, dark grey and brown, Blue Mountain Formation, shaly with limestone interbeds
BH205	20-Oct-22	RS-SA1	17.69 - 17.91	0.22	NSTV-205-RS-SA1-2	17.86 - 17.90	N/A	Blue Mountain Formation, broken into 3 pieces, shaly with limestone interbeds
	20-Oct-22	RS-SA2	18.09 - 18.29	0.20	NSTH-205-RS-SA2-2	18.24 - 18.27	N/A	Intact Blue Mountain Formation, dark grey
BH207	17-Aug-22	RS-SA1	16.84 - 17.03	0.19	SCSTV-207-RS-SA1-2	16.97 - 17.01	0.05	Blue Mountain Formation, intact, very hard, dark brown and grey, thin limestone interbeds
	17-Aug-22	RS-SA2	17.03 - 17.22	0.19	SCSTH-207-RS-SA2-2	17.18 - 17.21	0.04	Intact, dark grey and brown, Blue Mountain Formation with thin limestone interbeds
BH308	17-Aug-22	RS-SA1	21.23 - 21.49	0.26	FST-308-RS-SA1-1	21.27 - 21.49	N/A	Intact, dark grey and brown, Blue Mountain Formation, shaly with limestone interbeds throughout core

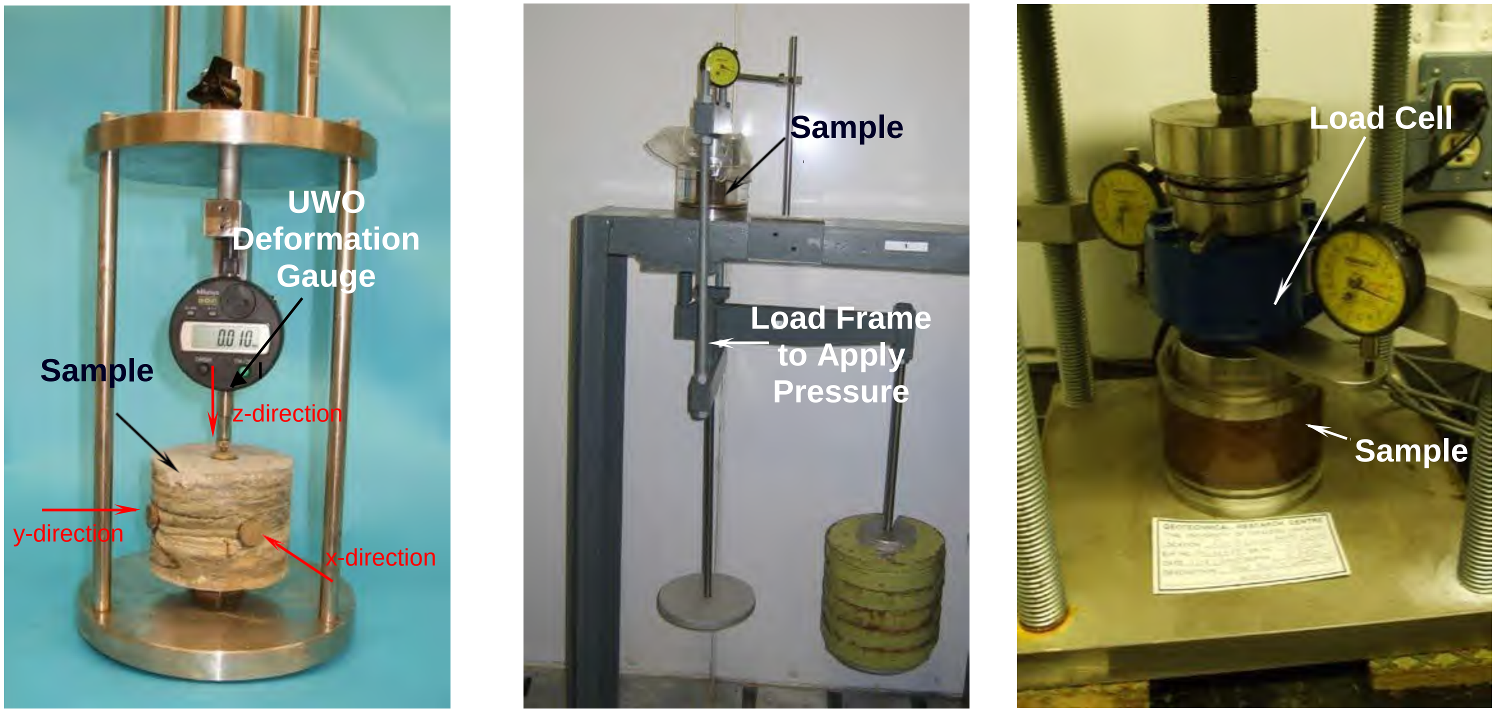
Table 2. Numbers of proposed and performed swell tests

Test	Number of Tests	
	Proposed by Client	**Performed**
Free Swell Test (FST)	2	2
Semi-Confined Swell Test - Vertical (SCSTV)	2	2
Semi-Confined Swell Test - Horizontal (SCSTH)	2	2
Null Swell Test - Vertical (NSTV)	2	2
Null Swell Test - Horizontal (NSTH)	2	2

Table 3. Summary of water content, salinity, and calcite content tests performed on swell test

Test	Depth (m)		Water Content (%)		Salinity (g/L)		Calcite Content (%)
	From	To	Initial	Final	Initial	Final	
FST-308-SA1-1	21.27	21.33	1.1	1.3	61.5	28.9	44.7
FST-203-RS2-2	17.79	17.85	0.9	0.9	43.7	42.0	4.9
SCSTV-203-RS1-1	17.34	17.37	1.4	1.4	54.0	27.4	1.9
SCSTV-207-SA1-2	16.97	17.01	1.3	1.3	61.1	30.3	16.7
SCSTH-203-RS2-1	17.97	18.00	0.9	1.4	43.7	28.0	<1.0
SCSTH-207-SA2-2	17.18	17.21	1.2	1.6	85.3	22.2	7.6
NSTV-203-RS3-1	18.15	18.19	1.6	1.6	43.0	32.4	43.8
NSTV-205-RS-SA1-2	17.86	17.90	1.2	1.2	29.9	27.8	<1.0
NSTH-203-RS3-1	18.30	18.33	1.6	1.6	43.0	33.2	38.3
NSTH-205-RS-SA2-2	18.24	18.27	1.0	1.5	35.2	25.8	<1.0

Appendix B - Figures



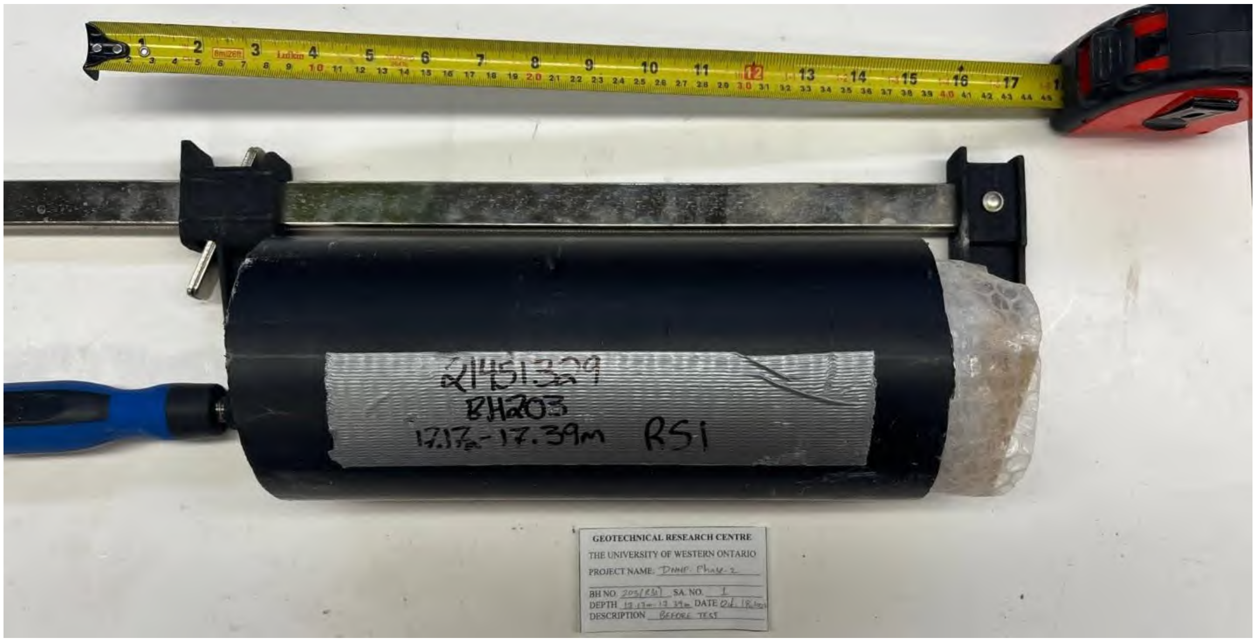
(a) Free Swell Test

(b) Semi-confined Swell Test

(c) Null Swell Test

Figure 1. Typical set up for swell tests

Appendix C – Photographs of Received Rock Cores



GEOTECHNICAL RESEARCH CENTRE
THE UNIVERSITY OF WESTERN ONTARIO
PROJECT NAME: DNNP. Phase-2
BH NO. 203(RS1) SA. NO. 1
DEPTH 17.17m-17.39m DATE Oct. 18,20
DESCRIPTION BEFORE TEST

(a) BH203 RS1 prior to opening

GEOTECHNICAL RESEARCH CENTRE
THE UNIVERSITY OF WESTERN ONTARIO
PROJECT NAME: DNNP. Phase-2
BH NO. 203(RS1) SA. NO. 1
DEPTH 17.17m-17.39m DATE Oct. 18,20
DESCRIPTION BEFORE TEST

(b) BH203 RS1 upon opening

Photograph C1. BH203 RS1 (17.17 m – 17.39 m) – Received rock samples

(a) BH203 RS2 prior to opening

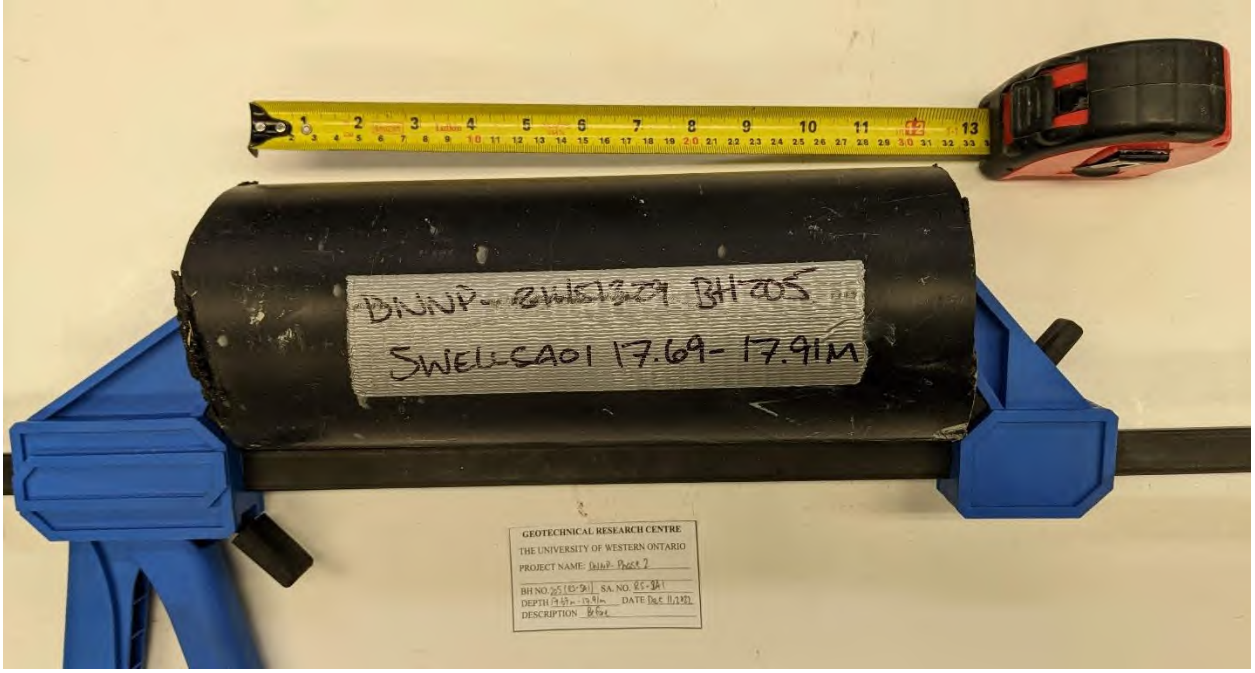
(b) BH203 RS2 upon opening

Photograph C2. BH203 RS2 (17.77 m – 18.03 m) – Received rock samples

(a) BH203 RS3 prior to opening

(b) BH203 RS3 upon opening

Photograph C3. BH203 RS3 (18.03 m – 18.37 m) – Received rock samples



(a) BH205 RS-SA1 prior to opening

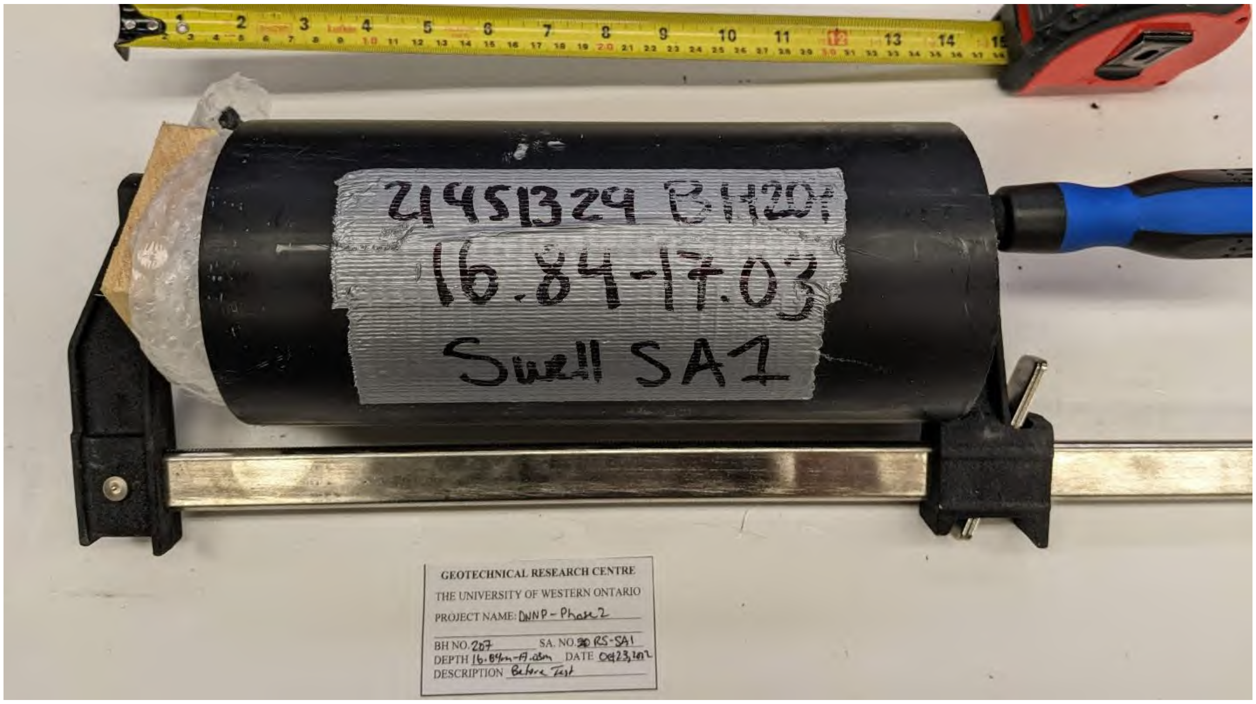
(b) BH205 RS-SA1 upon opening

Photograph C4. BH205 RS-SA1 (17.69 m – 17.91 m) – Received rock samples

(a) BH205 RS-SA2 prior to opening

(b) BH205 RS-SA2 upon opening

Photograph C5. BH205 RS-SA2 (18.09 m – 18.29 m) – Received rock samples



(a) BH207 RS-SA1 prior to opening

(b) BH207 RS-SA1 upon opening

Photograph C6. BH207 RS-SA1 (16.84 m – 17.03 m) – Received rock samples

(a) BH207 RS-SA2 prior to opening

(b) BH207 RS-SA2 upon opening

Photograph C7. BH207 RS-SA2 (17.03 m – 17.22 m) – Received rock samples

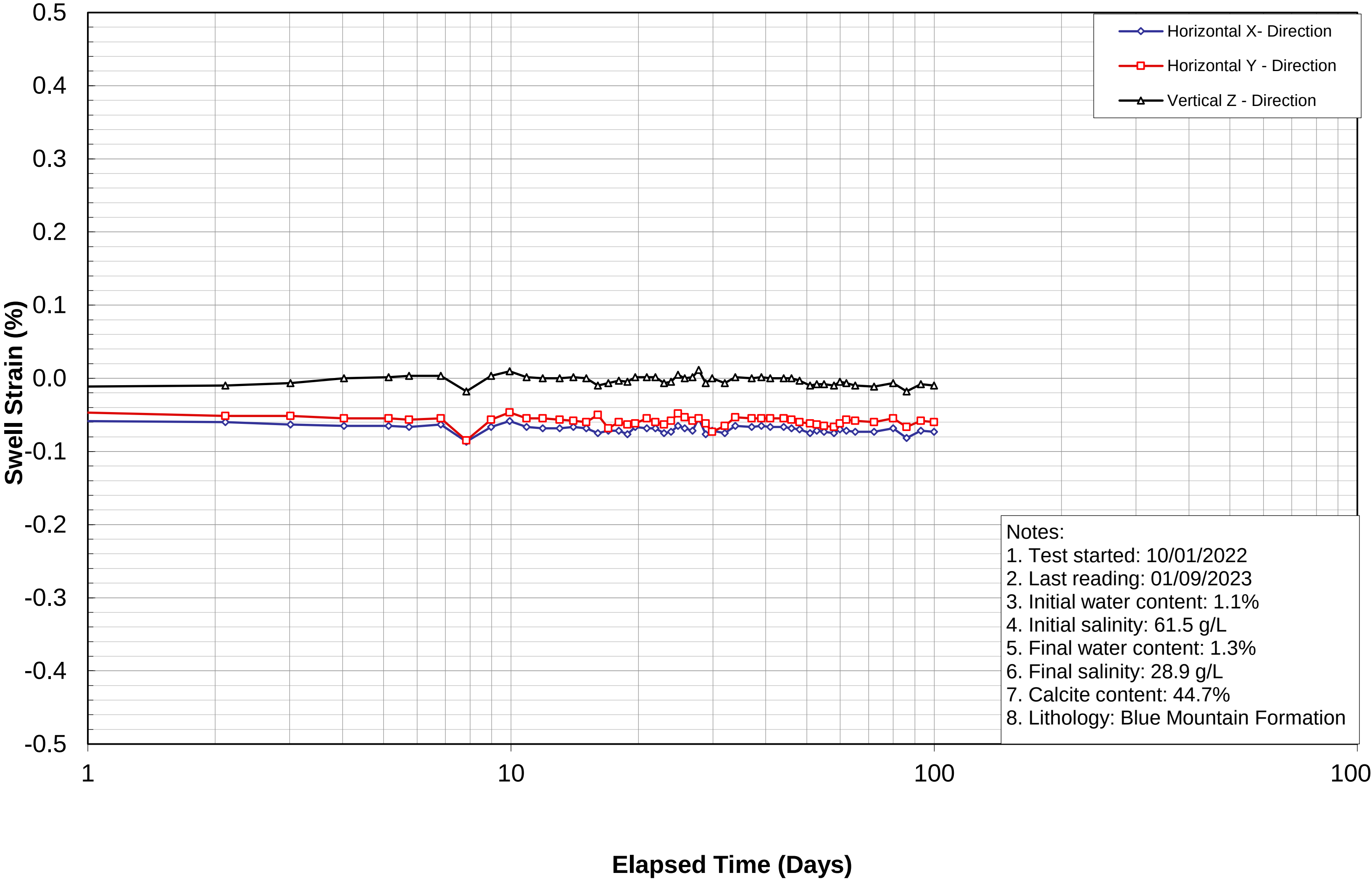
(a) BH308 RS-SA1 prior to opening

(b) BH308 RS-SA1 upon opening

Photograph C8. BH308 RS-SA1 (21.23 m – 21.49 m) – Received rock samples

Appendix D – Results of Swell Tests

Free Swell Test
Darlington New Nuclear Project - Phase 2
FST-308-RS-SA1-1
BH: BH308; **Sample No.**: RS-SA1; **Depth**: 21.27m - 21.33m



Notes:
1. Test started: 10/01/2022
2. Last reading: 01/09/2023
3. Initial water content: 1.1%
4. Initial salinity: 61.5 g/L
5. Final water content: 1.3%
6. Final salinity: 28.9 g/L
7. Calcite content: 44.7%
8. Lithology: Blue Mountain Formation

Free Swell Test
Darlington New Nuclear Project - Phase 2
FST-203-RS2-2
BH: BH203; **Sample No.**: RS2; **Depth**: 17.79m - 17.85m

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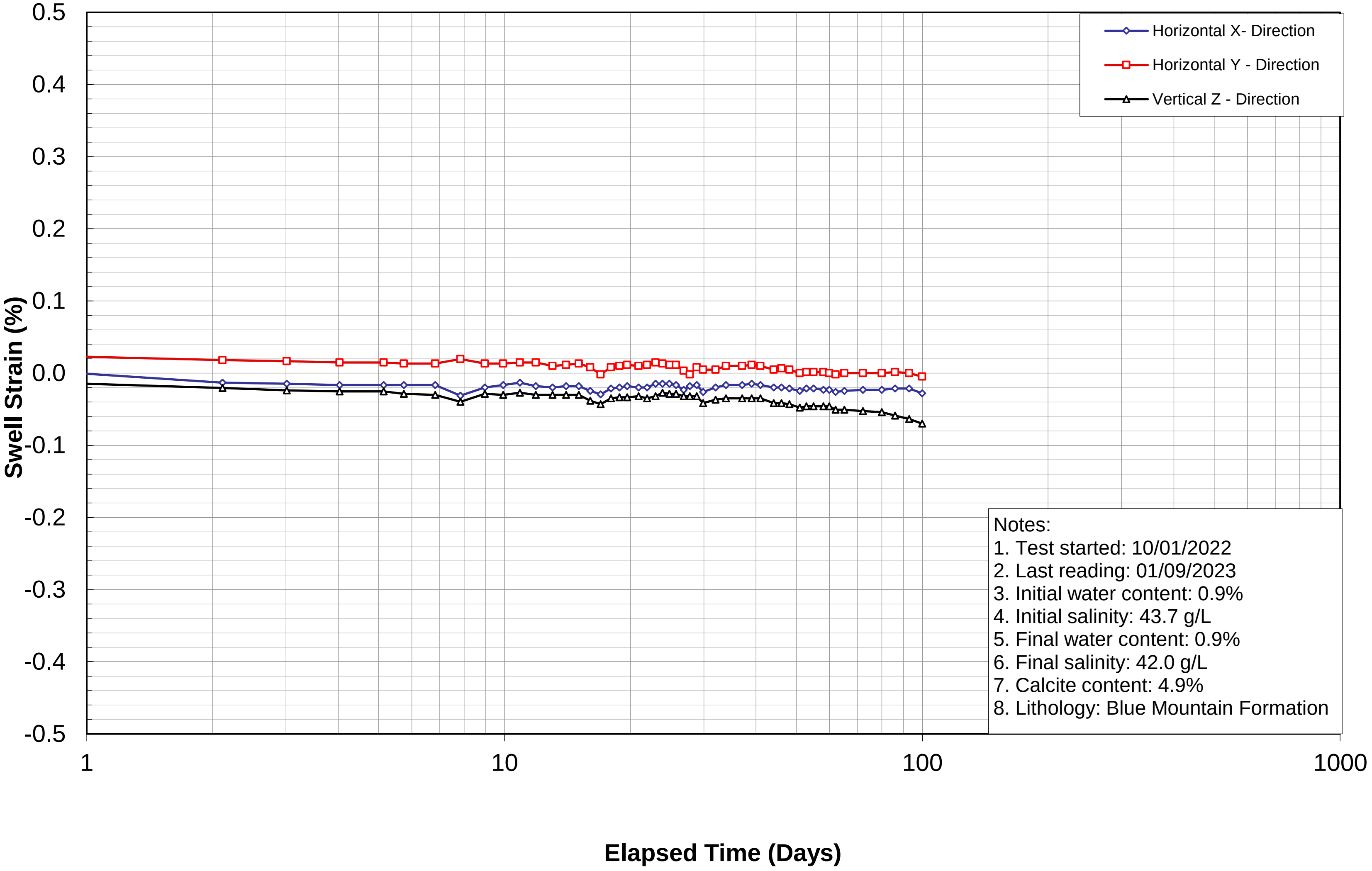
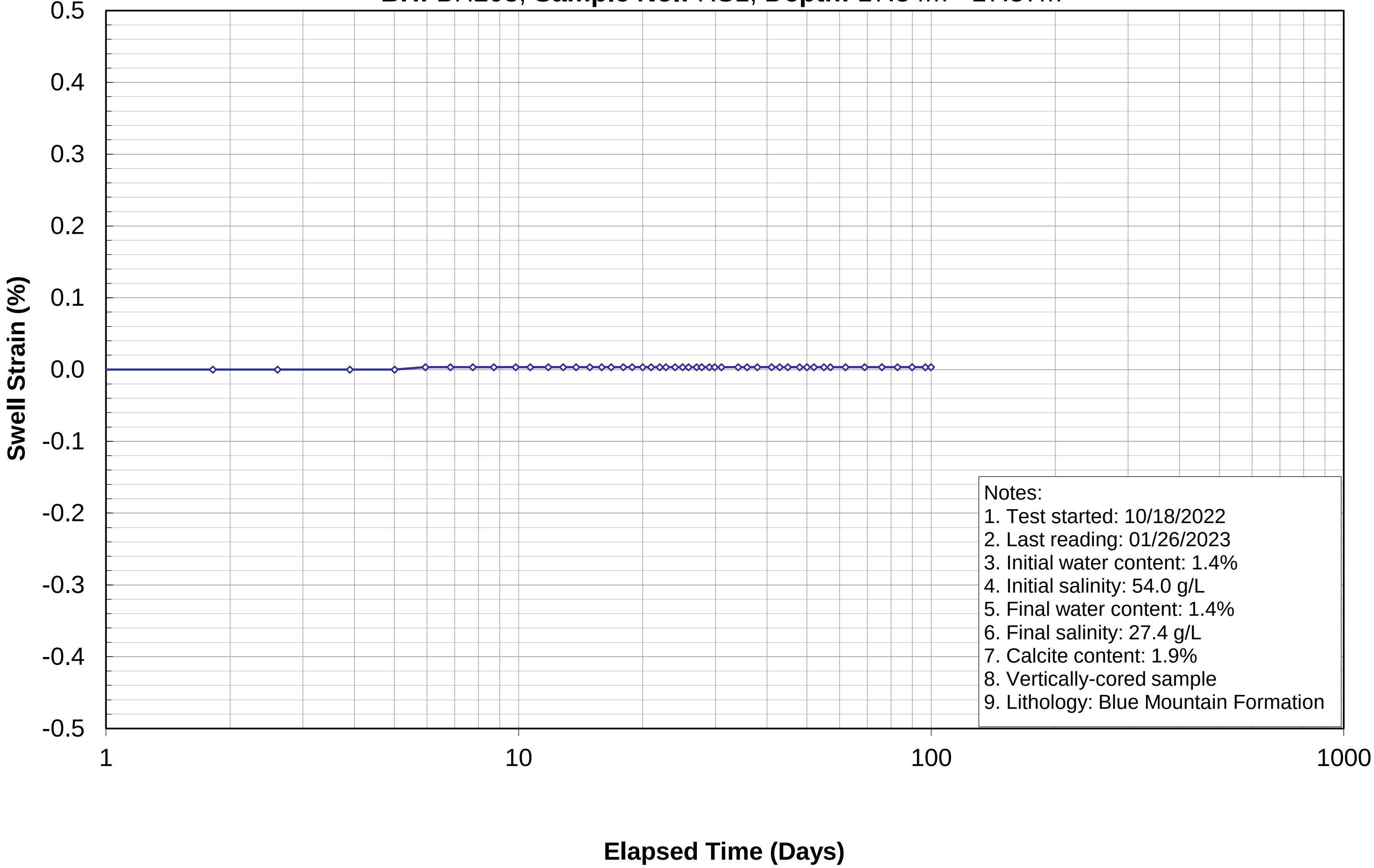


Notes:
1. Test started: 10/01/2022
2. Last reading: 01/09/2023
3. Initial water content: 0.9%
4. Initial salinity: 43.7 g/L
5. Final water content: 0.9%
6. Final salinity: 42.0 g/L
7. Calcite content: 4.9%
8. Lithology: Blue Mountain Formation

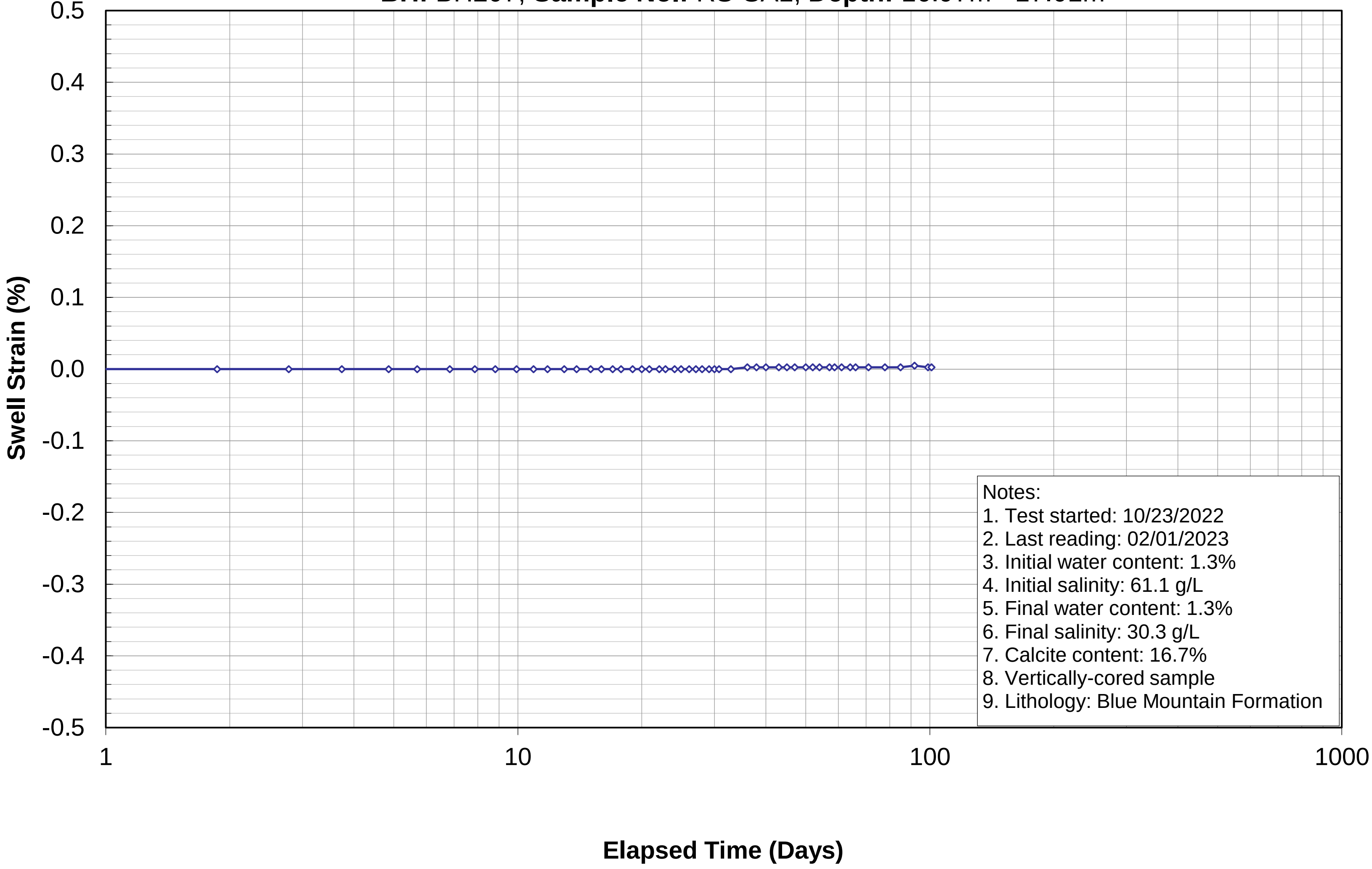
K.Y. Lo Inc.

Semi-Confined Swell Test - Vertical
Darlington New Nuclear Project - Phase 2
SCSTV-203-RS1-1
Applied Pressure: 0.08 MPa
BH: BH203; **Sample No.:** RS1; **Depth:** 17.34m - 17.37m



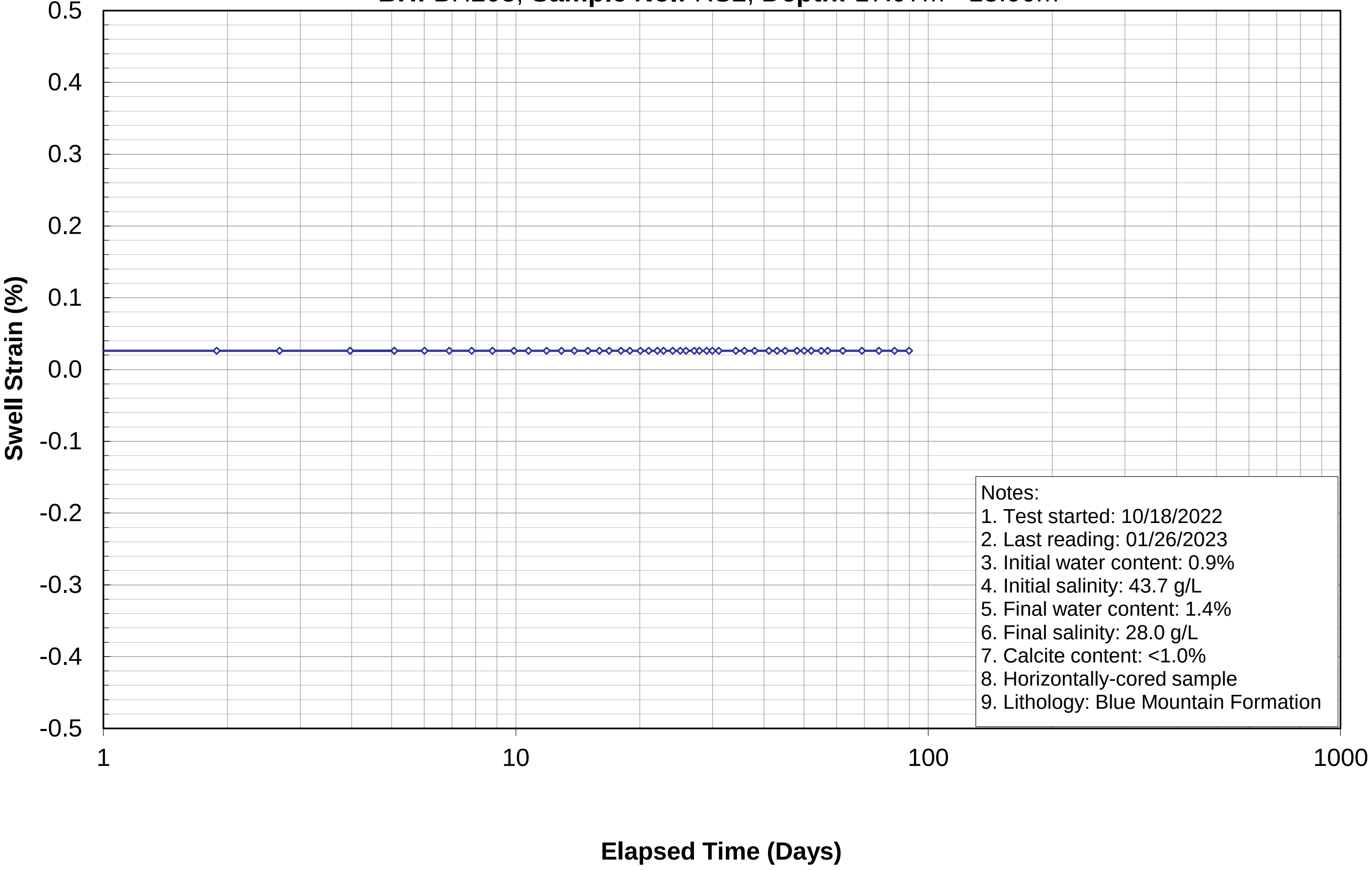
Notes:
1. Test started: 10/18/2022
2. Last reading: 01/26/2023
3. Initial water content: 1.4%
4. Initial salinity: 54.0 g/L
5. Final water content: 1.4%
6. Final salinity: 27.4 g/L
7. Calcite content: 1.9%
8. Vertically-cored sample
9. Lithology: Blue Mountain Formation

Semi-Confined Swell Test - Vertical
Darlington New Nuclear Project - Phase 2
SCSTV-207-RS-SA1-2
Applied Pressure: 0.05 MPa
BH: BH207; **Sample No.:** RS-SA1; **Depth:** 16.97m - 17.01m



Notes:
1. Test started: 10/23/2022
2. Last reading: 02/01/2023
3. Initial water content: 1.3%
4. Initial salinity: 61.1 g/L
5. Final water content: 1.3%
6. Final salinity: 30.3 g/L
7. Calcite content: 16.7%
8. Vertically-cored sample
9. Lithology: Blue Mountain Formation

Semi-Confined Swell Test - Horizontal
Darlington New Nuclear Project - Phase 2
SCSTH-203-RS2-1
Applied Pressure: 0.08 MPa
BH: BH203; **Sample No.:** RS2; **Depth:** 17.97m - 18.00m



Notes:
1. Test started: 10/18/2022
2. Last reading: 01/26/2023
3. Initial water content: 0.9%
4. Initial salinity: 43.7 g/L
5. Final water content: 1.4%
6. Final salinity: 28.0 g/L
7. Calcite content: <1.0%
8. Horizontally-cored sample
9. Lithology: Blue Mountain Formation

Semi-Confined Swell Test - Horizontal
Darlington New Nuclear Project - Phase 2
SCSTH-207-RS-SA2-2
Applied Pressure: 0.04 MPa
BH: BH207; **Sample No.:** RS-SA2; **Depth:** 17.18m - 17.21m

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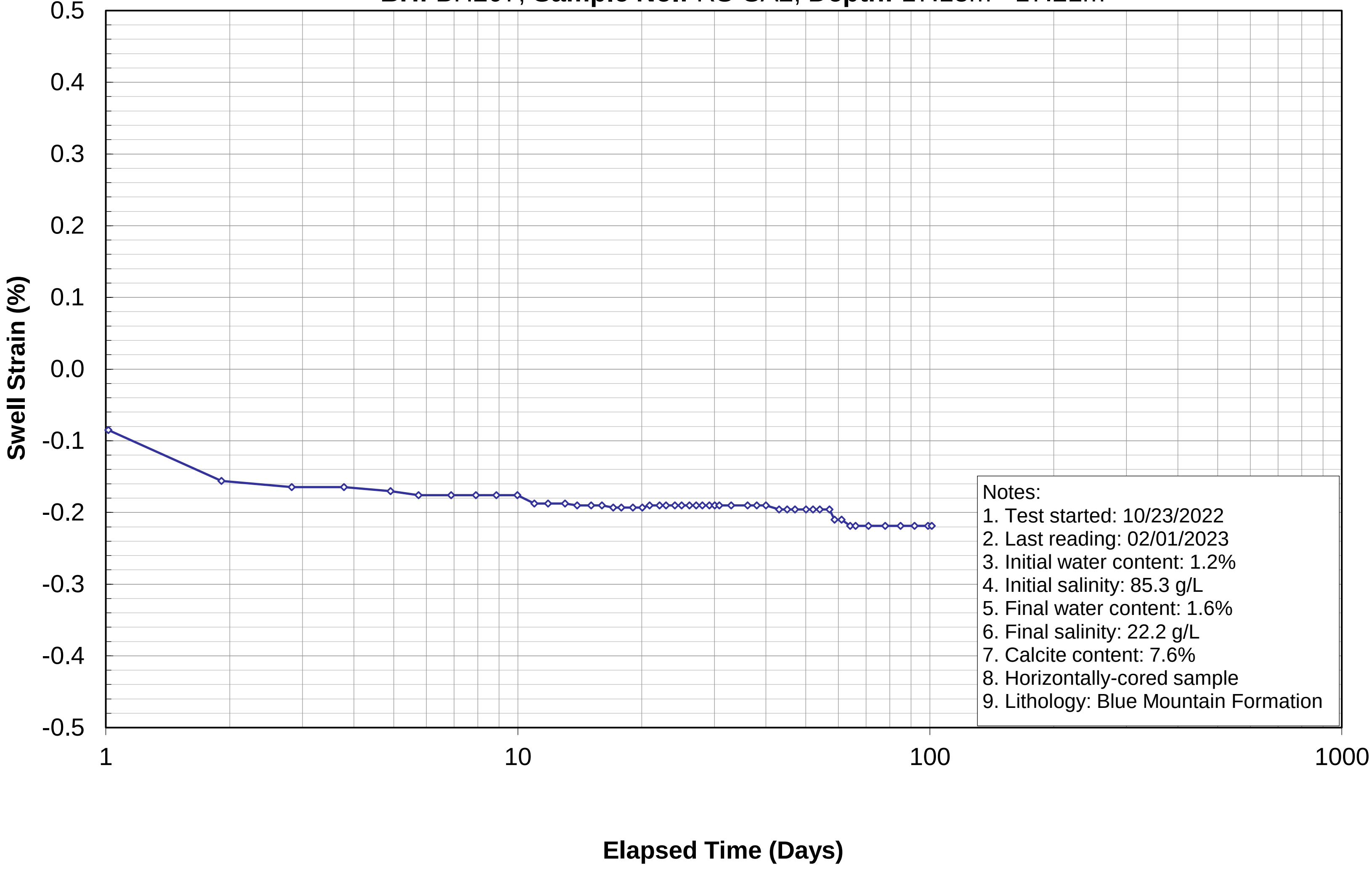
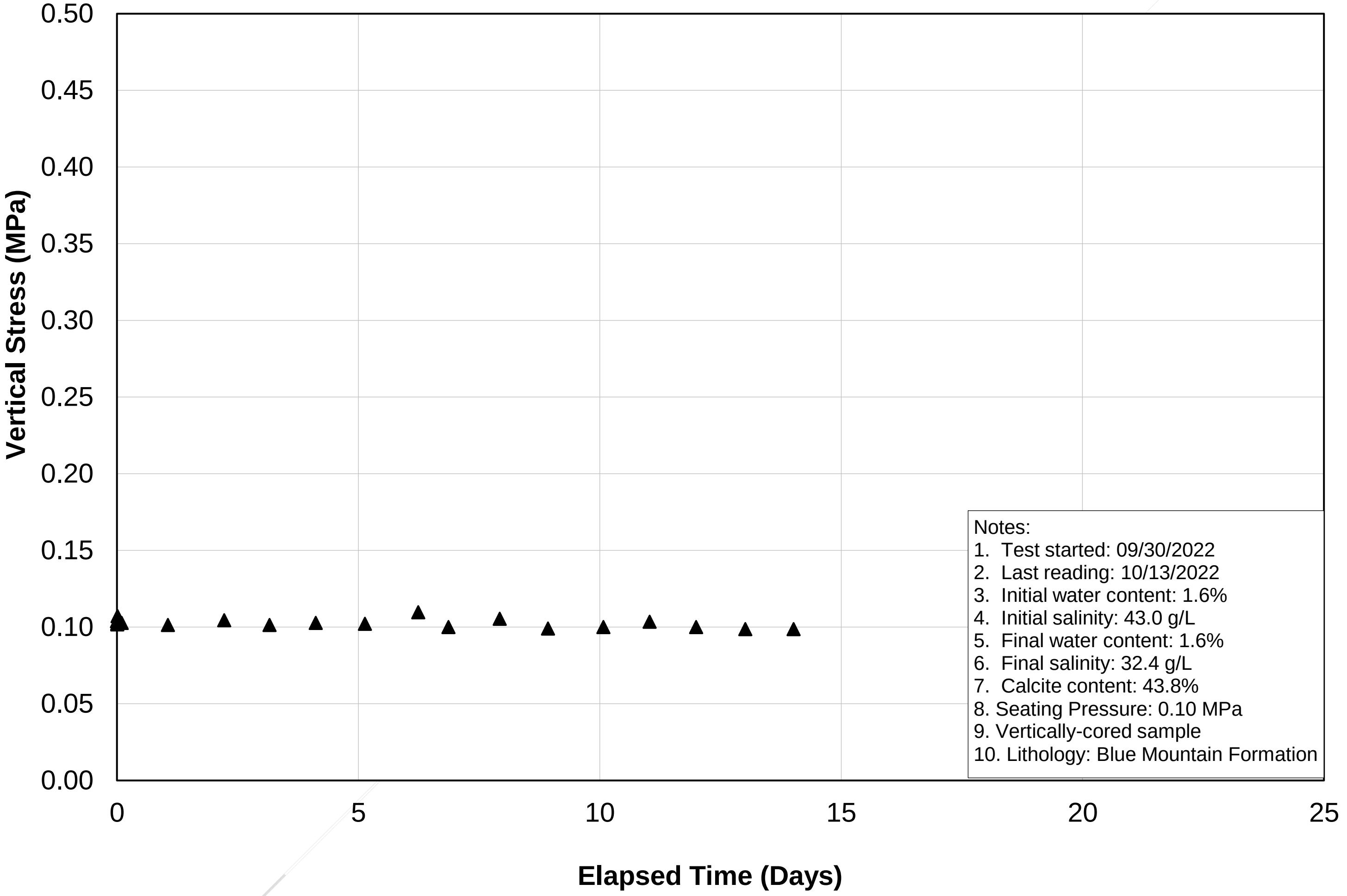


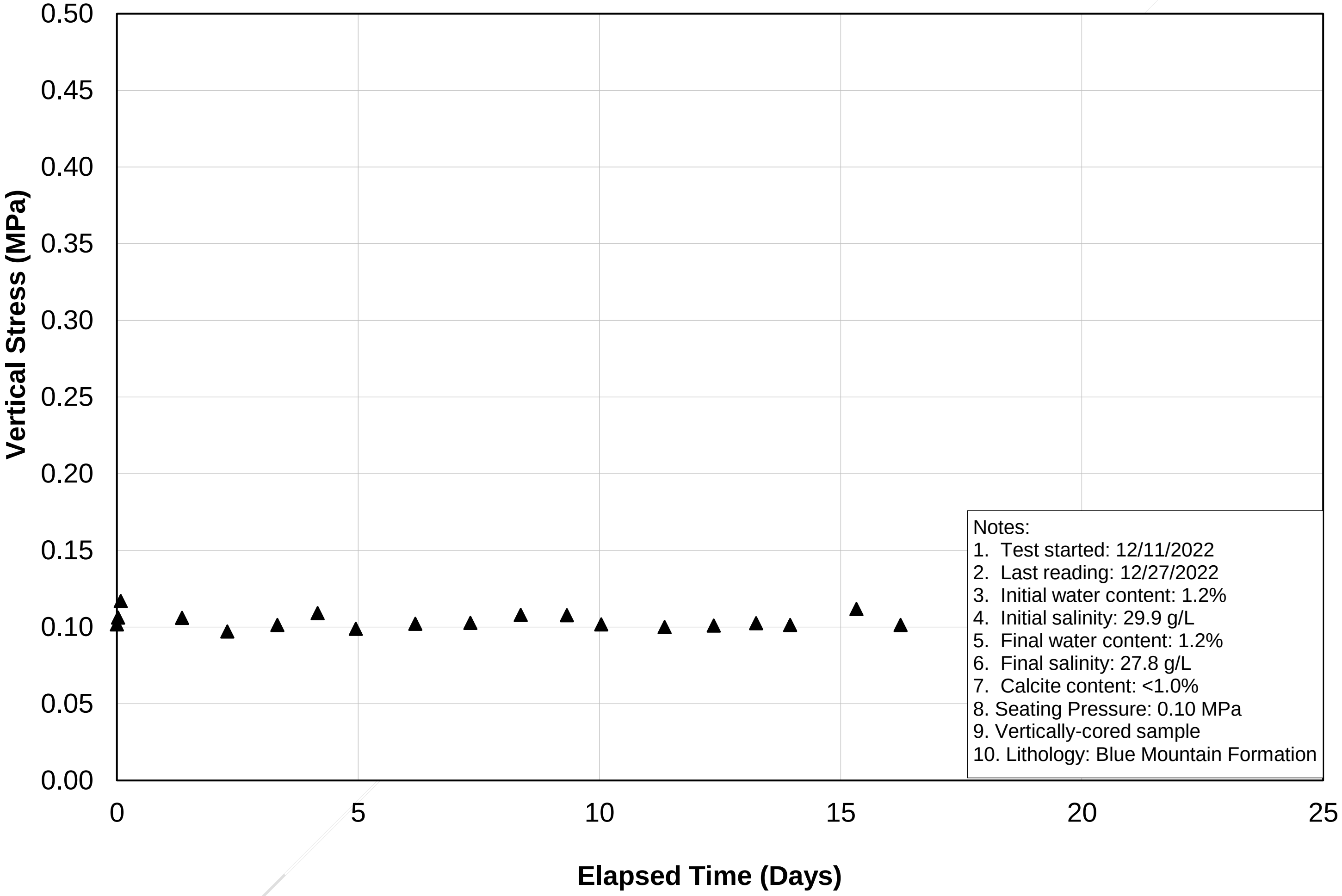
Notes:
1. Test started: 10/23/2022
2. Last reading: 02/01/2023
3. Initial water content: 1.2%
4. Initial salinity: 85.3 g/L
5. Final water content: 1.6%
6. Final salinity: 22.2 g/L
7. Calcite content: 7.6%
8. Horizontally-cored sample
9. Lithology: Blue Mountain Formation

Null Swell Test - Vertical
Darlington New Nuclear Project - Phase 2
NSTV-203-RS3-1
BH: BH203; **Sample No.**: RS3; **Depth**: 18.15m - 18.19m



Notes:
1. Test started: 09/30/2022
2. Last reading: 10/13/2022
3. Initial water content: 1.6%
4. Initial salinity: 43.0 g/L
5. Final water content: 1.6%
6. Final salinity: 32.4 g/L
7. Calcite content: 43.8%
8. Seating Pressure: 0.10 MPa
9. Vertically-cored sample
10. Lithology: Blue Mountain Formation

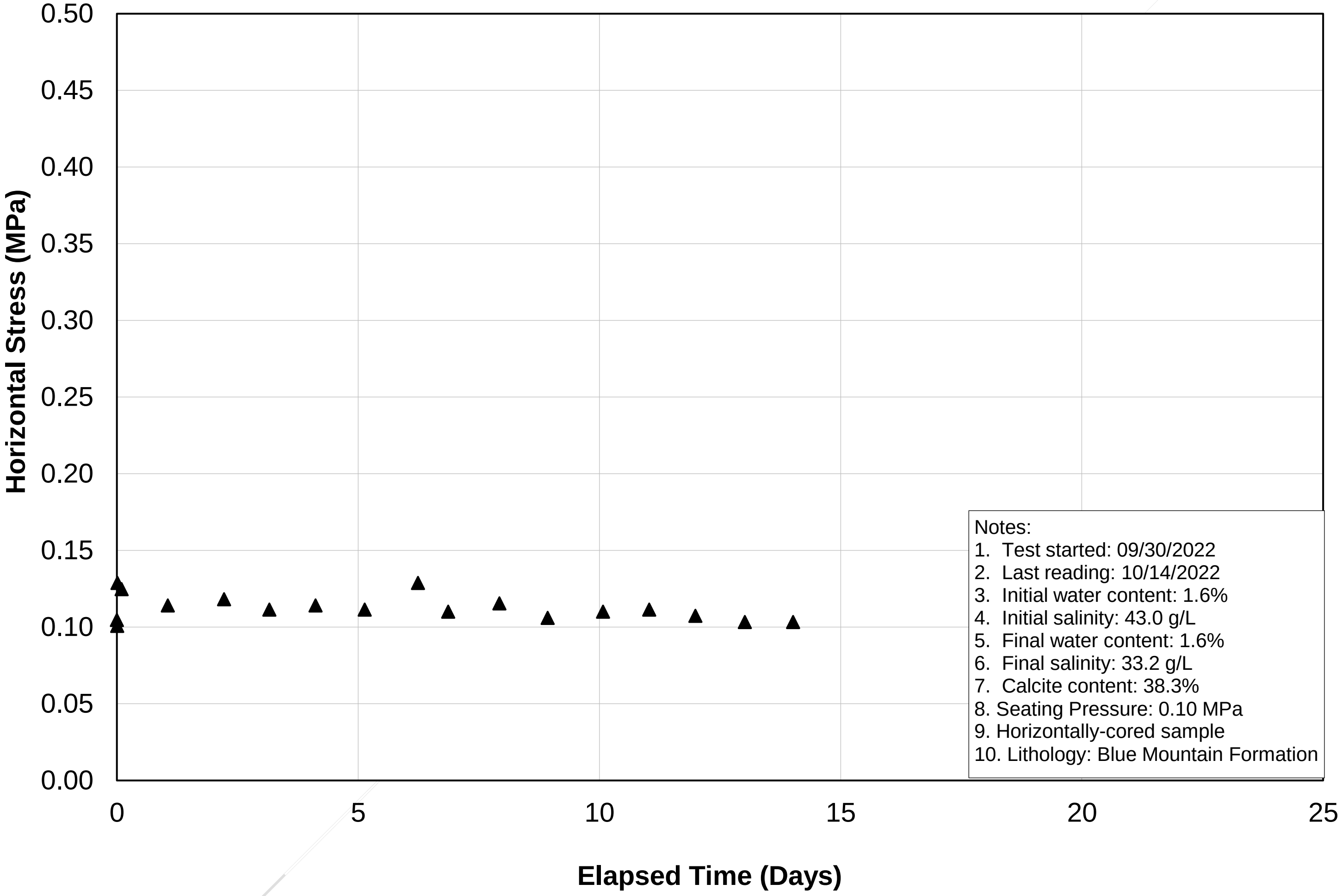
Null Swell Test - Vertical
Darlington New Nuclear Project - Phase 2
NSTV-205-RS-SA1-2
BH: BH205; **Sample No.**: RS-SA1; **Depth**: 17.86m - 17.90m



Notes:
1. Test started: 12/11/2022
2. Last reading: 12/27/2022
3. Initial water content: 1.2%
4. Initial salinity: 29.9 g/L
5. Final water content: 1.2%
6. Final salinity: 27.8 g/L
7. Calcite content: <1.0%
8. Seating Pressure: 0.10 MPa
9. Vertically-cored sample
10. Lithology: Blue Mountain Formation

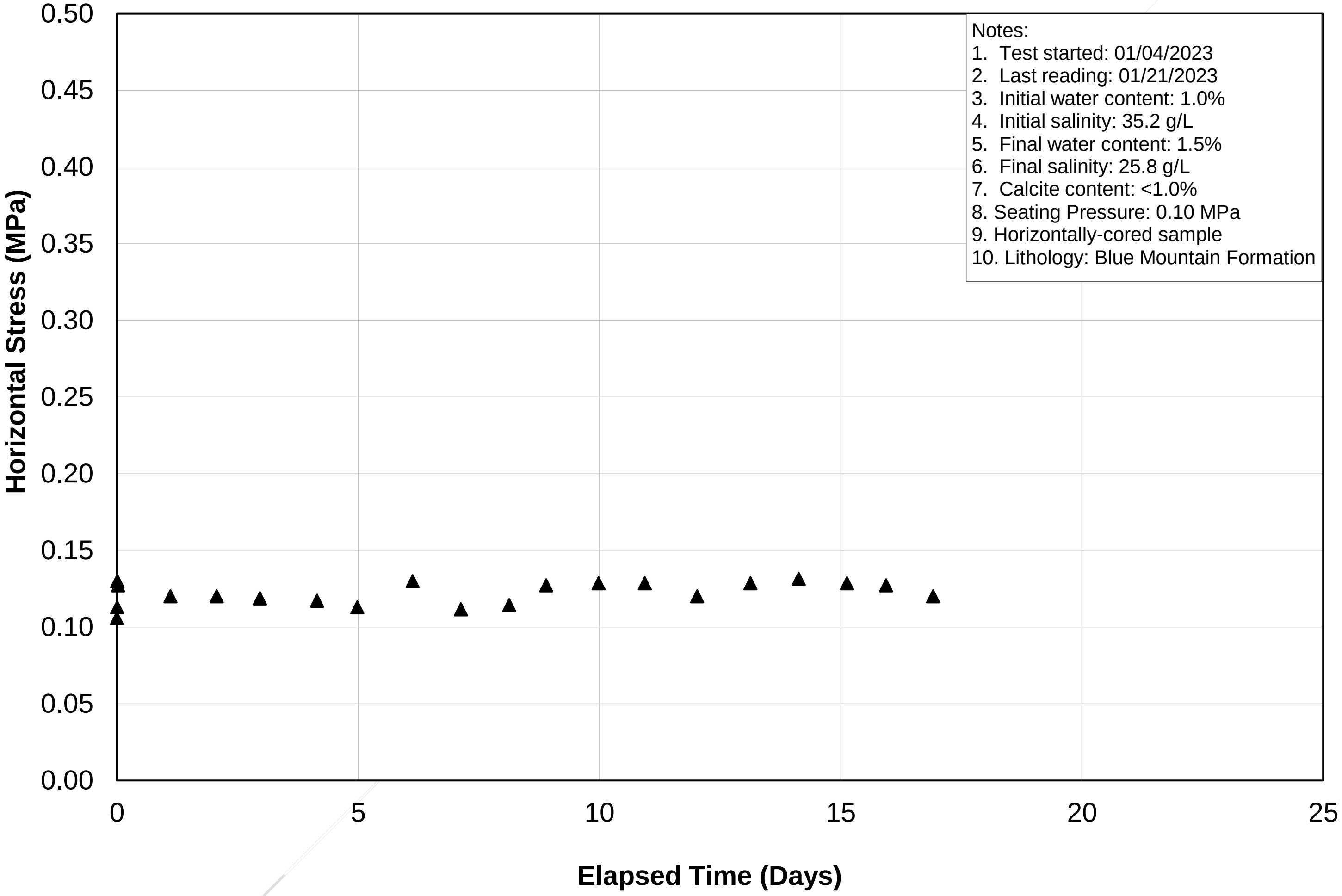
K.Y. Lo Inc.

Null Swell Test - Horizontal
Darlington New Nuclear Project - Phase 2
NSTH-203-RS3-1
BH: BH203; **Sample No.**: RS3; **Depth**: 18.30m - 18.33m



Notes:
1. Test started: 09/30/2022
2. Last reading: 10/14/2022
3. Initial water content: 1.6%
4. Initial salinity: 43.0 g/L
5. Final water content: 1.6%
6. Final salinity: 33.2 g/L
7. Calcite content: 38.3%
8. Seating Pressure: 0.10 MPa
9. Horizontally-cored sample
10. Lithology: Blue Mountain Formation

Null Swell Test - Horizontal
Darlington New Nuclear Project - Phase 2
NSTH-205-RS-SA2-2
BH: BH205; **Sample No.**: RS-SA2; **Depth**: 18.24m - 18.27m



Notes:
1. Test started: 01/04/2023
2. Last reading: 01/21/2023
3. Initial water content: 1.0%
4. Initial salinity: 35.2 g/L
5. Final water content: 1.5%
6. Final salinity: 25.8 g/L
7. Calcite content: <1.0%
8. Seating Pressure: 0.10 MPa
9. Horizontally-cored sample
10. Lithology: Blue Mountain Formation

PETROGRAPHIC EXAMINATION OF ROCK SAMPLE IN THIN-SECTION

CSA A23.2-15A / ASTM C295

Golder Associates Ltd. a Member of WSP
6929 Century Avenue, Suite 100
Mississauga, ON L5N 7K2

Project Number: 21451329-21600
February 15, 2023

ATTENTION: Mr. Alexander Champigny, B.A.Sc., P.Eng.

PROJECT: DNNP Rock Core Petrographic Thin Section Analysis 2022

Sample#	From Depth (m)	To Depth (m)	Total Length (m)	Lithology	Comments
BH204-RS-Sa01	**31.27**	**31.48**	**0.21**	**Limestone/Shale**	**Lindsay Formation**

Date sampled: May 22 to 27, 2022

Sampled by: SC (WSP Golder)

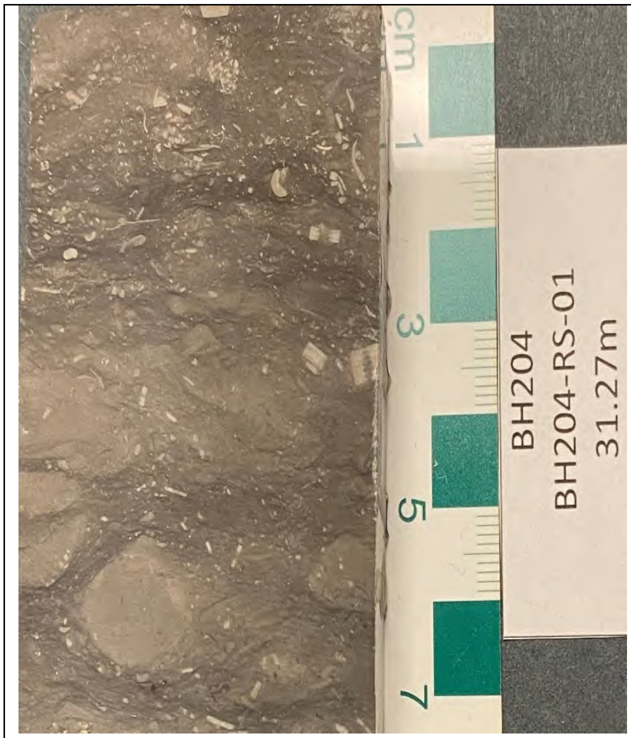
PETROGRAPHIC DESCRIPTION
Micritic Limestone – fine-grained, finely bedded/interbedded with evidence of bioturbation including shell fragments. Grain sizes from 0.02 to 0.18mm. Color is medium to dark grey/brown.
In Thin-Section – fine-grained calcareous shale/micritic limestone with finely bedded silt layers/lenses. Bioturbation evidence with shell and flora fossil fragments.

Chemical analysis by XRD with Rietveld refinement of the rock sample provided the following results:

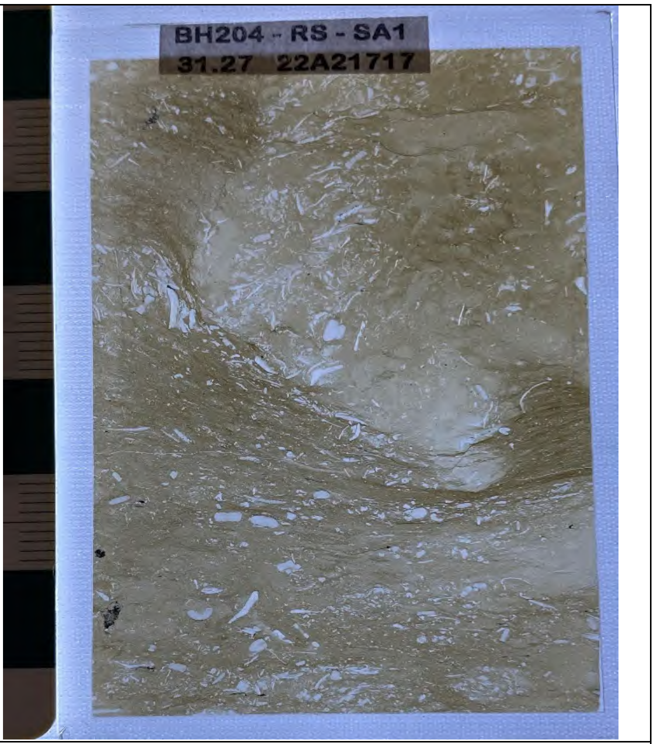
Interpreted mineral	%	Interpreted mineral	%
Quartz	6.2	Kaolinite	1.9
Illite/muscovite	1.1	Dolomite	5.2
Calcite	83.6	Chlorite	0.9
Plagioclase Feldspar	0.4		
Orthoclase Feldspar	0.7		

These data indicate significant terrigenous sediment contribution – 88.8% Calcite and Dolomite, with a further 3.9% of clay minerals.

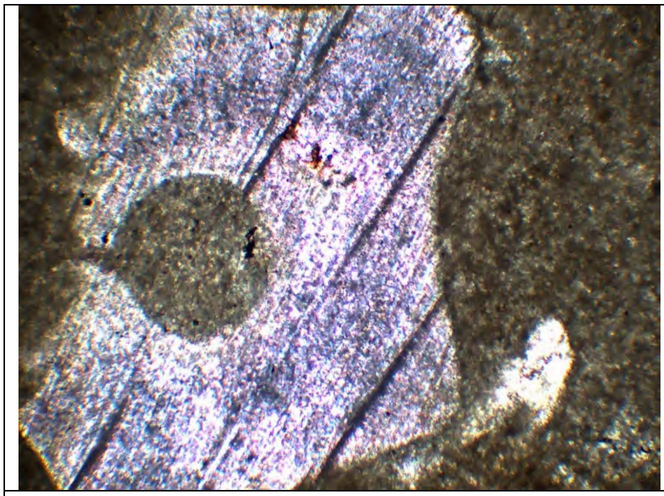
The XRD data differs from the in-hand observations and microscopic examination in terms of calcite content.



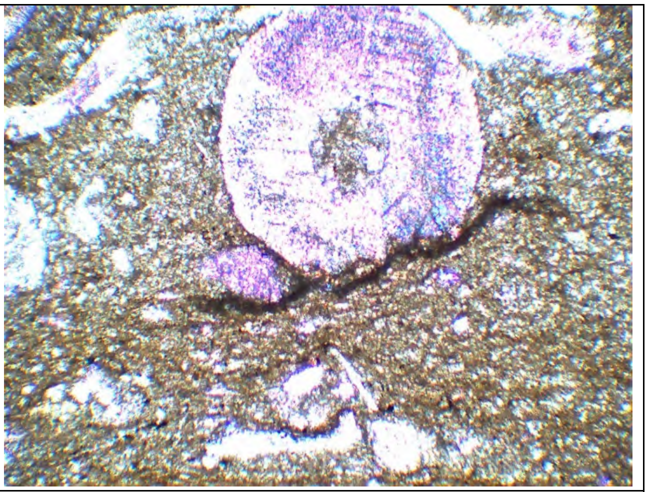
Photograph 1: *Sawn rock sample illustrating bioturbation layers of the shale. Field of view is approximately 60 mm across.*



Photograph 2: *Thin-section viewed in plane light, no magnification. Field of view is about 45 mm across.*



Photograph 3*: Thin-section viewed in cross-polarized light showing a Crinoid Stem fossil in fine grained calcareous shale/mudstone. Magnification 100x.*



Photograph 4*: Thin-section viewed in cross-polarized light showing a Crinoid Stem fossil in fine-grained calcareous shale/mudstone. Magnification 100X*

Reviewed by:

John M. Taylor, M.Sc.

T. Reynolds, P.Eng.

WSP Canada Inc.

PETROGRAPHIC EXAMINATION OF ROCK SAMPLE IN THIN-SECTION

CSA A23.2-15A / ASTM C295

Golder Associates Ltd. a Member of WSP
6929 Century Avenue, Suite 100
Mississauga, ON L5N 7K2

Project Number: 21451329-21600
February 17, 2023

ATTENTION: Mr. Alexander Champigny, B.A.Sc., P.Eng.

PROJECT: DNNP Rock Core Petrographic Thin Section Analysis 2022

Sample#	From Depth (m)	To Depth (m)	Total Length (m)	Lithology	Comments
BH204-RS-Sa09	**48.81**	**48.99**	**0.18**	**Limestone/Shale**	**Lindsay Formation**

Date sampled: May 22 to 27, 2022

Sampled by: SC (WSP Golder)

PETROGRAPHIC DESCRIPTION
Micritic Limestone – fine-grained, finely bedded/interbedded with evidence of bioturbation including shell fragments. Grain sizes from 0.02 to 0.18mm. Color is medium to dark grey/brown.
In Thin-Section – fine-grained calcareous shale/micritic limestone with finely bedded silt layers/lenses. Bioturbation evidence with shell and flora fossil fragments.

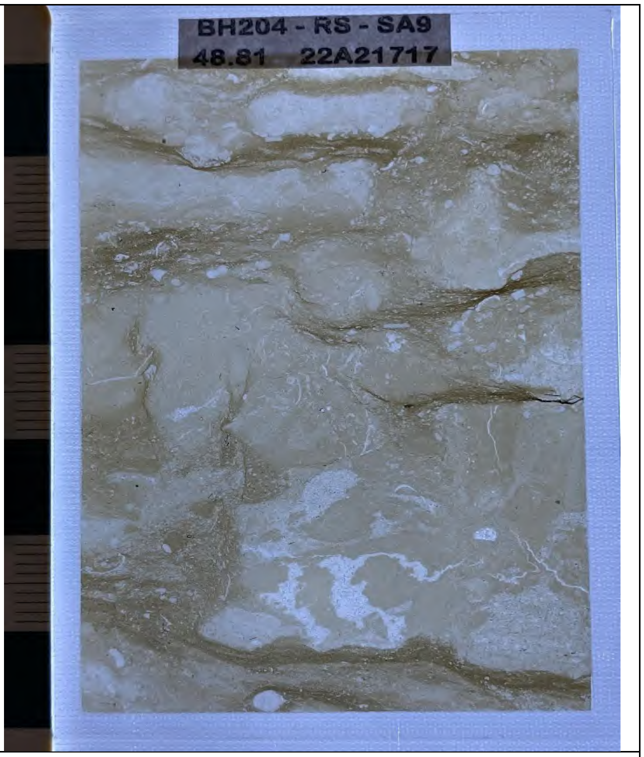
Chemical analysis by XRD with Rietveld refinement of the rock sample provided the following results:

Interpreted mineral	%	Interpreted mineral	%
Quartz	5.9	Kaolinite	1.8
Illite/muscovite	1.3	Dolomite	5.8
Calcite	83.1	Chlorite	0.9
Plagioclase Feldspar	0.4		
Orthoclase Feldspar	0.8		

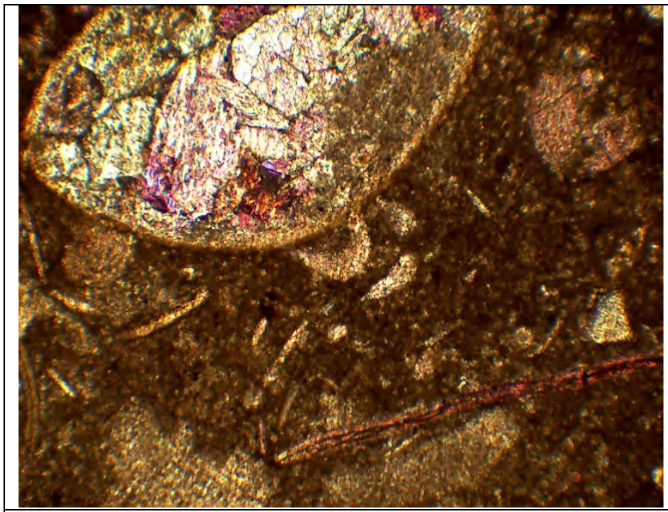
These data indicate significant terrigenous sediment contribution – 88.9% Calcite and Dolomite, with a further 4.0% of clay minerals.

The XRD data differs from the in-hand observations and microscopic examination in terms of calcite content.

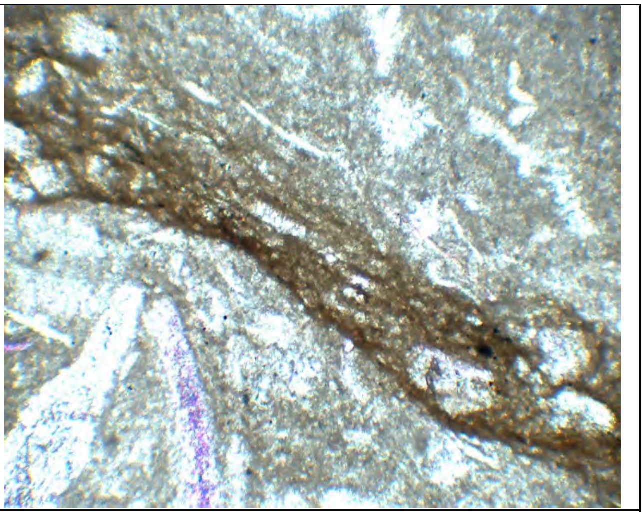
Photograph 1: *Sawn rock sample illustrating bioturbation layers of the shale. Field of view is approximately 60 mm across.*



Photograph 2: *Thin-section viewed in plane light, no magnification. Field of view is about 45 mm across.*



Photograph 3*:. Thin-section viewed in cross-polarized light showing fossils in fine grained calcareous shale/mudstone. Magnification 100x*



Photograph 4*: Thin-section viewed in cross-polarized light showing fine grained calcareous shale/mudstone vein between limestone layers. Magnification 100x*

Reviewed by:

John M. Taylor, M.Sc.

T. Reynolds, P.Eng.

PETROGRAPHIC EXAMINATION
OF ROCK SAMPLE IN THIN-SECTION
CSA A23.2-15A / ASTM C295

Golder Associates Ltd. a Member of WSP
6929 Century Avenue, Suite 100
Mississauga, ON L5N 7K2

Project Number: 21451329-21600
February 17, 2023

ATTENTION: Mr. Alexander Champigny, B.A.Sc., P.Eng.

PROJECT: DNNP Rock Core Petrographic Thin Section Analysis 2022

Sample#	From Depth (m)	To Depth (m)	Total Length (m)	Lithology	Comments
BH207-RS-Sa08	**36.7**	**36.95**	**0.25**	**Limestone/Shale**	**Lindsay Formation**

Date sampled: June 8 to 18, 2022 **Sampled by:** SC (WSP Golder)

PETROGRAPHIC DESCRIPTION
Micritic Limestone – fine-grained, finely bedded/interbedded with evidence of bioturbation including shell fragments. Grain sizes from 0.02 to 0.18mm. Color is medium to dark grey/brown.
In Thin-Section – fine-grained calcareous shale/micritic limestone with finely bedded silt layers/lenses. Bioturbation evidence with shell and flora fossil fragments.

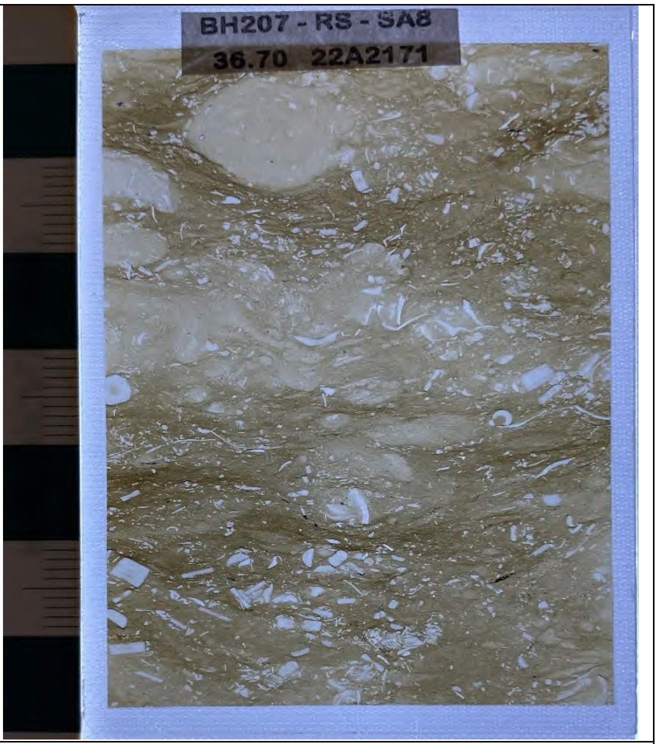
Chemical analysis by XRD with Rietveld refinement of the rock sample provided the following results:

Interpreted mineral	%	Interpreted mineral	%
Quartz	8.8	Kaolinite	0.8
Illite/muscovite	2.5	Dolomite	6.3
Calcite	77.6	Chlorite	1.0
Plagioclase Feldspar	1.3	Gypsum	0.8
Orthoclase Feldspar	0.9		

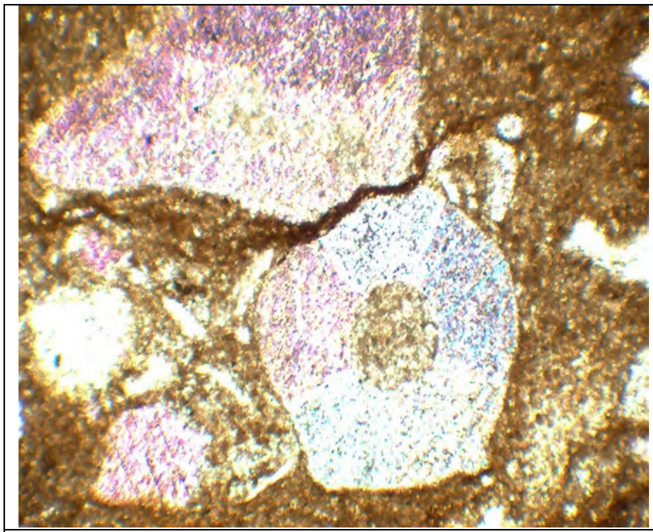
These data indicate significant terrigenous sediment contribution – 83.9% Calcite and Dolomite, with a further 4.3% of clay minerals, and Gypsum at 0.8%.

The XRD data differs from the in-hand observations and microscopic examination in terms of calcite content.

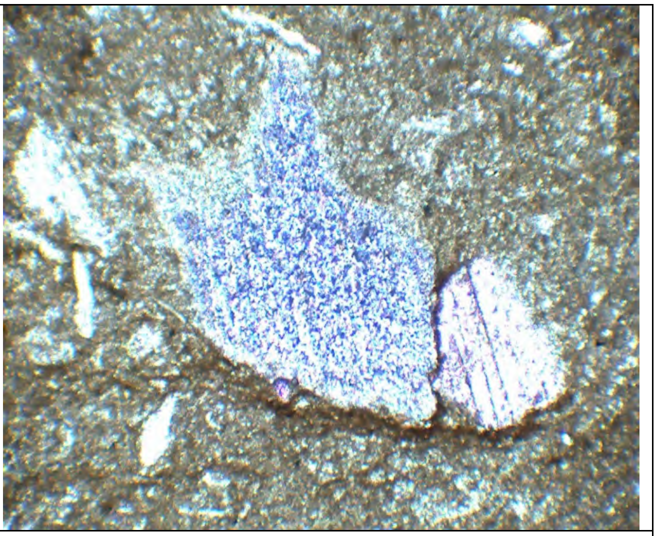
Photograph 1: *Sawn rock sample illustrating bioturbation layers of the shale. Field of view is approximately 60 mm across.*



Photograph 2: *Thin-section viewed in plane light, no magnification. Field of view is about 45 mm across.*



Photograph 3*:. Thin-section viewed in cross-polarized light showing a Crinoid Stem fossil in fine grained calcareous shale/mudstone. Magnification 100x*



Photograph 4*: Thin-section viewed in cross-polarized light showing a fossil in fine grained calcareous shale/mudstone. Magnification 100x*

Reviewed by:

John M. Taylor, M.Sc.

T. Reynolds, P.Eng.

PETROGRAPHIC EXAMINATION
OF ROCK SAMPLE IN THIN-SECTION
CSA A23.2-15A / ASTM C295

Golder Associates Ltd. a Member of WSP
6929 Century Avenue, Suite 100
Mississauga, ON L5N 7K2

Project Number: 21451329-21600
February 17, 2023

ATTENTION: Mr. Alexander Champigny, B.A.Sc., P.Eng.

PROJECT: DNNP Rock Core Petrographic Thin Section Analysis 2022

Sample#	From Depth (m)	To Depth (m)	Total Length (m)	Lithology	Comments
BH207-RS-Sa16	**44.5**	**44.75**	**0.25**	**Limestone/Shale**	**Lindsay Formation**

Date sampled: June 8 to 18, 2022 **Sampled by:** SC (WSP Golder)

PETROGRAPHIC DESCRIPTION
Micritic Limestone – fine-grained, finely bedded/interbedded with evidence of bioturbation including shell fragments. Grain sizes from 0.02 to 0.18mm. Color is medium to dark grey/brown.
In Thin-Section – fine-grained calcareous shale/micritic limestone with finely bedded silt layers/lenses. Bioturbation evidence with shell and flora fossil fragments.

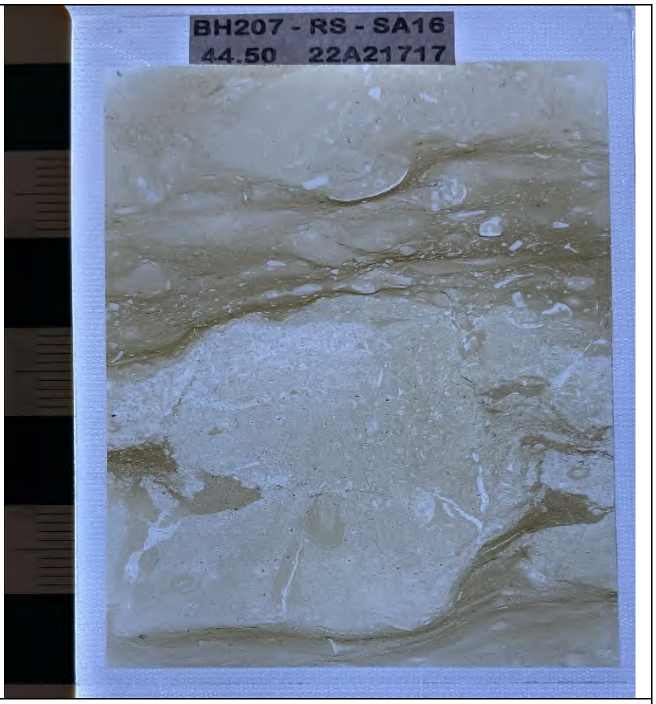
Chemical analysis by XRD with Rietveld refinement of the rock sample provided the following results:

Interpreted mineral	%	Interpreted mineral	%
Quartz	6.9	Kaolinite	1.7
Illite/muscovite	5.2	Dolomite	5.3
Calcite	78.6	Chlorite	0.7
Plagioclase Feldspar	1.0		
Orthoclase Feldspar	0.6		

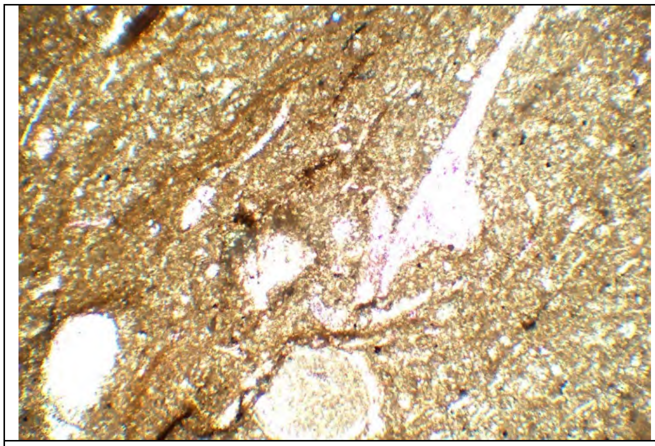
These data indicate significant terrigenous sediment contribution – 83.9% Calcite and Dolomite, with a further 7.6% of clay minerals.

The XRD data differs from the in-hand observations and microscopic examination in terms of calcite content.

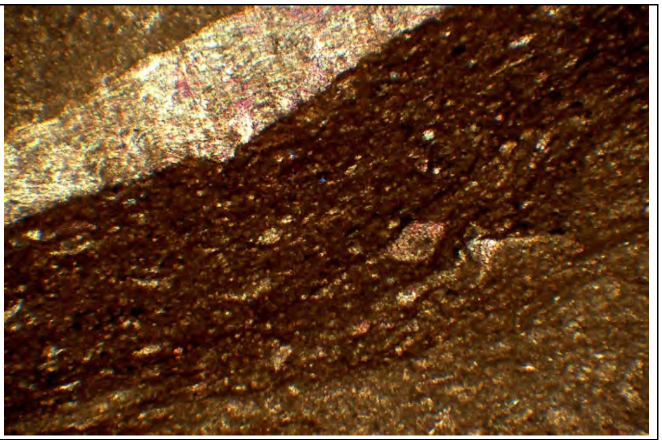
Photograph 1: *Sawn rock sample illustrating bioturbation layers of the shale. Field of view is approximately 60 mm across.*



Photograph 2: *Thin-section viewed in plane light, no magnification. Field of view is about 45 mm across.*



***Photograph 3**:. Thin-section viewed in cross-polarized light showing fossil pieces in fine grained calcareous shale/mudstone. Magnification 100x*



***Photograph 4**: Thin-section viewed in cross-polarized light showing fine-grained shale/mudstone above limestone and below a shell fossil. Magnification 100x*

Reviewed by:

John M. Taylor, M.Sc.

T. Reynolds, P.Eng.

PETROGRAPHIC EXAMINATION
OF ROCK SAMPLE IN THIN-SECTION
CSA A23.2-15A / ASTM C295

Golder Associates Ltd. a Member of WSP
6929 Century Avenue, Suite 100
Mississauga, ON L5N 7K2

Project Number: 21451329-21600
February 17, 2023

ATTENTION: Mr. Alexander Champigny, B.A.Sc., P.Eng.

PROJECT: DNNP Rock Core Petrographic Thin Section Analysis 2022

Sample#	From Depth (m)	To Depth (m)	Total Length (m)	Lithology	Comments
BH304-RS-Sa03	**38.6**	**38.83**	**0.23**	**Limestone/Shale**	**Lindsay Formation**

Date sampled: June 4, 2022 **Sampled by:** SC (WSP Golder)

PETROGRAPHIC DESCRIPTION
Micritic Limestone – fine-grained, finely bedded/interbedded with evidence of bioturbation including shell fragments. Grain sizes from 0.02 to 0.18mm. Color is medium to dark grey/brown.
In Thin-Section – fine-grained calcareous shale/micritic limestone with finely bedded silt layers/lenses. Bioturbation evidence with shell and flora fossil fragments.

Chemical analysis by XRD with Rietveld refinement of the rock sample provided the following results:

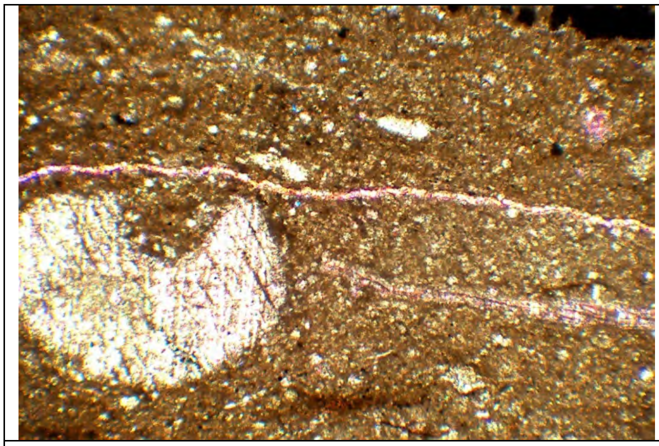
Interpreted mineral	%	Interpreted mineral	%
Quartz	5.5	Kaolinite	1.6
Illite/muscovite	0.5	Dolomite	5.4
Calcite	85.4	Chlorite	0.8
Plagioclase Feldspar	0.3		
Orthoclase Feldspar	0.5		

These data indicate significant terrigenous sediment contribution – 90.8% Calcite and Dolomite, with a further 2.9% of clay minerals.

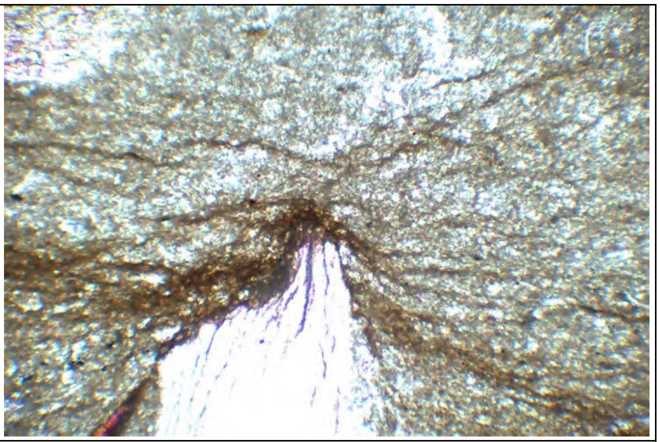
The XRD data differs from the in-hand observations and microscopic examination in terms of calcite content.

Photograph 1: *Sawn rock sample illustrating bioturbation layers of the shale. Field of view is approximately 60 mm across.*

Photograph 2: *Thin-section viewed in plane light, no magnification. Field of view is about 45 mm across.*



***Photograph 3**:. Thin-section viewed in cross-polarized light showing a shell fossil in fine grained calcareous shale/mudstone. Magnification 100x*



***Photograph 4**: Thin-section viewed in cross-polarized light showing a fossil with fine grained calcareous shale/mudstone. Magnification 100x*

Reviewed by:

John M. Taylor, M.Sc.

T. Reynolds, P.Eng.

PETROGRAPHIC EXAMINATION OF ROCK SAMPLE IN THIN-SECTION

CSA A23.2-15A / ASTM C295

Golder Associates Ltd. a Member of WSP
6929 Century Avenue, Suite 100
Mississauga, ON L5N 7K2

Project Number: 21451329-21600
February 17, 2023

ATTENTION: Mr. Alexander Champigny, B.A.Sc., P.Eng.

PROJECT: DNNP Rock Core Petrographic Thin Section Analysis 2022

Sample#	From Depth (m)	To Depth (m)	Total Length (m)	Lithology	Comments
BH304-RS-Sa07	**47.66**	**47.9**	**0.24**	**Limestone/Shale**	**Lindsay Formation**

Date sampled: June 4, 2022

Sampled by: SC (WSP Golder)

PETROGRAPHIC DESCRIPTION
Micritic Limestone – fine-grained, finely bedded/interbedded with evidence of bioturbation including shell fragments. Grain sizes from 0.02 to 0.18mm. Color is medium to dark grey/brown.
In Thin-Section – fine-grained calcareous shale/micritic limestone with finely bedded silt layers/lenses. Bioturbation evidence with shell and flora fossil fragments.

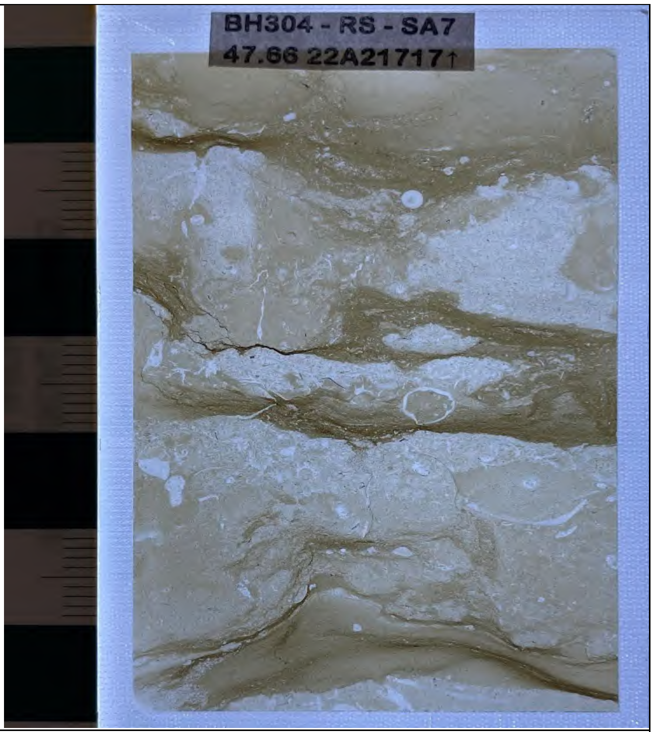
Chemical analysis by XRD with Rietveld refinement of the rock sample provided the following results:

Interpreted mineral	%	Interpreted mineral	%
Quartz	6.2	Kaolinite	1.9
Illite/muscovite	1.1	Dolomite	5.2
Calcite	83.6	Chlorite	0.9
Plagioclase Feldspar	0.4		
Orthoclase Feldspar	0.7		

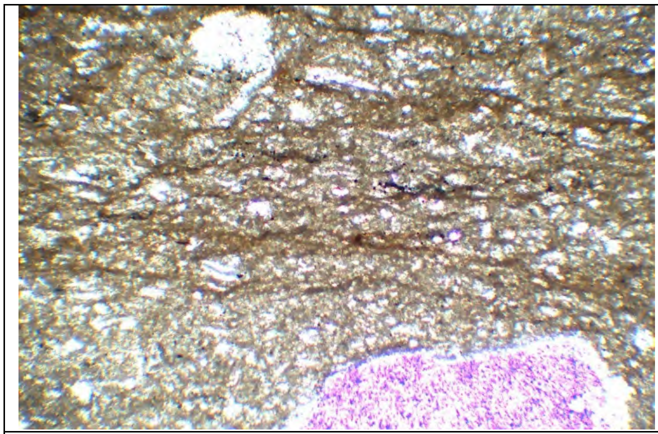
These data indicate significant terrigenous sediment contribution – 88.8% Calcite and Dolomite, with a further 3.9% of clay minerals.

The XRD data differs from the in-hand observations and microscopic examination in terms of calcite content.

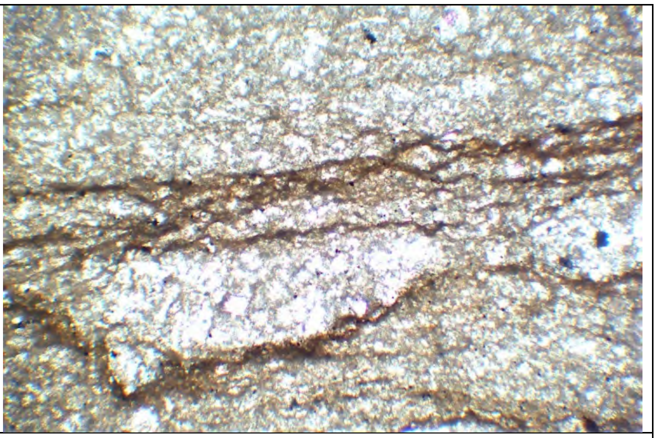
Photograph 1: *Sawn rock sample illustrating bioturbation layers of the shale. Field of view is approximately 60 mm across.*



Photograph 2: *Thin-section viewed in plane light, no magnification. Field of view is about 45 mm across.*



***Photograph 3**:. Thin-section viewed in cross-polarized light showing a fossil piece below fine-grained calcareous shale/mudstone. Magnification 100x*



***Photograph 4**: Thin-section viewed in cross-polarized light showing a fossil piece in fine grained calcareous shale/mudstone. Magnification 100x*

Reviewed by:

John M. Taylor, M.Sc.

T. Reynolds, P.Eng.

PETROGRAPHIC EXAMINATION OF ROCK SAMPLE IN THIN-SECTION

CSA A23.2-15A / ASTM C295

Golder Associates Ltd. a Member of WSP
6929 Century Avenue, Suite 100
Mississauga, ON L5N 7K2

Project Number: 21451329-21600
February 17, 2023

ATTENTION: Mr. Alexander Champigny, B.A.Sc., P.Eng.

PROJECT: DNNP Rock Core Petrographic Thin Section Analysis 2022

Sample#	From Depth (m)	To Depth (m)	Total Length (m)	Lithology	Comments
BH306-RS-Sa01	**29.48**	**29.65**	**0.17**	**Limestone/Shale**	**Lindsay Formation**

Date sampled: May 23 to June 2, 2022 **Sampled by:** SC (WSP Golder)

PETROGRAPHIC DESCRIPTION
Micritic Limestone – fine-grained, finely bedded/interbedded with evidence of bioturbation including shell fragments. Grain sizes from 0.02 to 0.18mm. Color is medium to dark grey/brown.
In Thin-Section – fine-grained calcareous shale/micritic limestone with finely bedded silt layers/lenses. Bioturbation evidence with shell and flora fossil fragments.

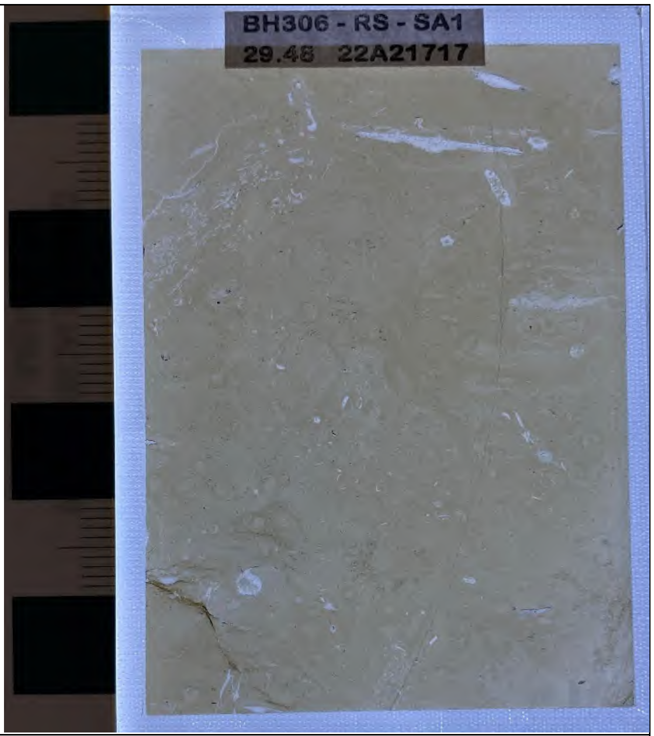
Chemical analysis by XRD with Rietveld refinement of the rock sample provided the following results:

Interpreted mineral	%	Interpreted mineral	%
Quartz	6.7	Kaolinite	2.0
Illite/muscovite	2.1	Dolomite	6.1
Calcite	80.2	Chlorite	1.1
Plagioclase Feldspar	0.8	Talc	0.3
Orthoclase Feldspar	0.7		

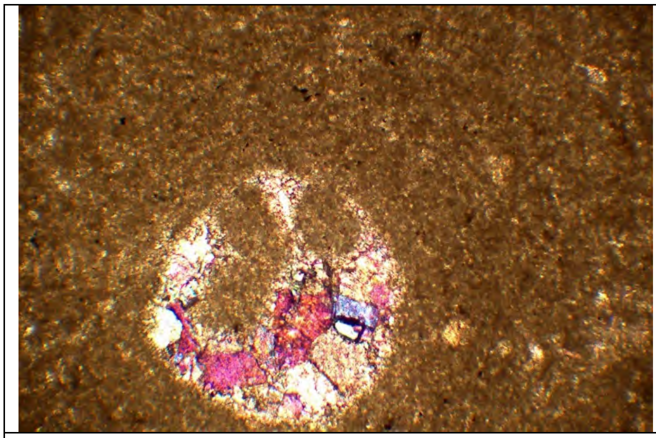
These data indicate significant terrigenous sediment contribution – 86.3% Calcite and Dolomite, with a further 5.5% of clay minerals.

The XRD data differs from the in-hand observations and microscopic examination in terms of calcite content.

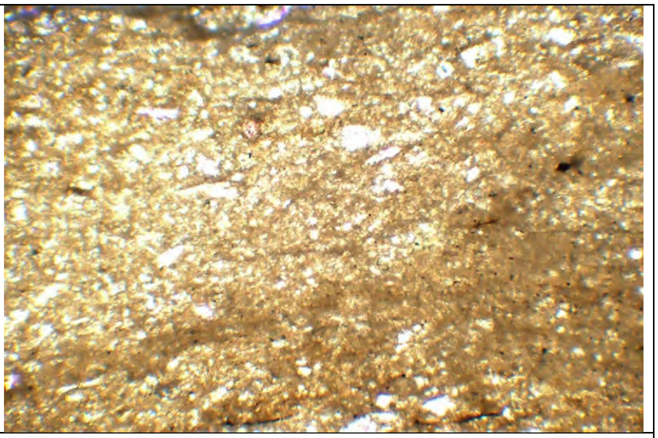
Photograph 1: *Sawn rock sample illustrating bioturbation layers of the shale. Field of view is approximately 60 mm across.*



Photograph 2: *Thin-section viewed in plane light, no magnification. Field of view is about 45 mm across.*



Photograph 3*:. Thin-section viewed in cross-polarized light showing a fossil in fine grained calcareous shale/mudstone. Magnification 100x*



Photograph 4*: Thin-section viewed in cross-polarized light showing fine grained calcareous shale/mudstone. Magnification 100x*

Reviewed by:

John M. Taylor, M.Sc.

T. Reynolds, P.Eng.

PETROGRAPHIC EXAMINATION OF ROCK SAMPLE IN THIN-SECTION

CSA A23.2-15A / ASTM C295

Golder Associates Ltd. a Member of WSP
6929 Century Avenue, Suite 100
Mississauga, ON L5N 7K2

Project Number: 21451329-21600
February 17, 2023

ATTENTION: Mr. Alexander Champigny, B.A.Sc., P.Eng.

PROJECT: DNNP Rock Core Petrographic Thin Section Analysis 2022

Sample#	From Depth (m)	To Depth (m)	Total Length (m)	Lithology	Comments
BH306-RS-Sa15	**48.79**	**49.02**	**0.23**	**Limestone/Shale**	**Lindsay Formation**

Date sampled: May 23 to June 2, 2022 **Sampled by:** SC (WSP Golder)

PETROGRAPHIC DESCRIPTION
Micritic Limestone – fine-grained, finely bedded/interbedded with evidence of bioturbation including shell fragments. Grain sizes from 0.02 to 0.18mm. Color is medium to dark grey/brown.
In Thin-Section – fine-grained calcareous shale/micritic limestone with finely bedded silt layers/lenses. Bioturbation evidence with shell and flora fossil fragments.

Chemical analysis by XRD with Rietveld refinement of the rock sample provided the following results:

Interpreted mineral	%	Interpreted mineral	%
Quartz	11.4	Kaolinite	1.4
Illite/muscovite	9.7	Dolomite	7.4
Calcite	65.7	Chlorite	0.6
Plagioclase Feldspar	1.1	Siderite	0.2
Orthoclase Feldspar	2.5		

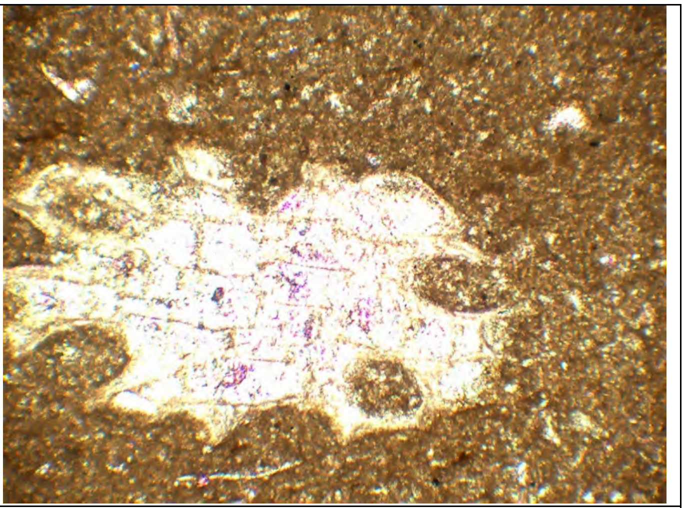
These data indicate significant terrigenous sediment contribution – 73.1% Calcite and Dolomite, with a further 11.7% of clay minerals.

The XRD data differs from the in-hand observations and microscopic examination in terms of calcite content.

Photograph 1: *Sawn rock sample illustrating bioturbation layers of the shale. Field of view is approximately 60 mm across.*

Photograph 2: *Thin-section viewed in plane light, no magnification. Field of view is about 45 mm across.*

Photograph 3*:. Thin-section viewed in cross-polarized light showing fossil pieces in fine grained limestone. Magnification 100x*



Photograph 4*: Thin-section viewed in cross-polarized light showing a fossil in fine grained calcareous shale/mudstone. Magnification 100x*

Reviewed by:

John M. Taylor, M.Sc.

T. Reynolds, P.Eng.

APPENDIX E

Rock Dilatometer Results

In-Depth
Geotechnical Inc.

In-Situ Rock Dilatometer Testing
DNNP Project, Bowmanville, Ontario
Borehole Nos. BH-207-, 302-, and 307-DMP

Project No. IDG 220668

Revised on March 30, 2023

Prepared for:
Ms. Sarah Poot, P.Eng.
Golder Associates Ltd.
6925 Century Avenue, Suite #100
Mississauga, Ontario
L5N 7K2

In-Depth Geotechnical Inc.
20 Ravenscliffe Avenue
Hamilton, Ontario
L8P 3M4
Phone: (905) 541 9937
Fax: (877) 624 0140

Table of Contents

1. Introduction

In-Depth Geotechnical Inc. was retained by Golder Associates Ltd. to conduct Rock Dilatometer testing in relation to their Geotechnical Investigation for the second phase Darlington New Nuclear Plant (DNNP) Project, in Bowmanville, Ontario.

This report presents the results of rock dilatometer testing (DMP), carried out at three off-shore corehole locations with the purpose of evaluating the elastic moduli of encountered rock materials. DMP testing was completed on HQ size coreholes using a Roctest DMP95 unit (Roctest Flexible Rock Dilatometer).

Multiple methods are available for interpretation of this data to estimate engineering properties of rocks but such methods are not discussed or included in this report.

2. Field Testing Procedures

Rock dilatometer testing was performed in nine borehole locations, namely Boreholes Nos. BH203-, 302-, and 307-DMP. Details of the tested boreholes are provided below:

Borehole Number	Deck Elevation masl	Depth to Bedrock m	Borehole Depth m	Number of Tests	Date of Testing (D/M/Y)
BH 203	78.62	Unknown	69.04	27	3/08/2022
BH 302	78.82	Unknown	70.27	34	16/07/2022
BH 307	78.90	Unknown	60.37	26	7/07/2022

Barge Deck elevation are presented as provide by Golder Representatives.

Deck to top of Bedrock represents the approximate depth below Deck surface (unknown).

Number of Tests indicates the number of completed DMP tests, as not all attempts were successful.

Off-shore drilling and coring procedures were completed ahead of our DMP testing. PW casing was advanced/installed onto the top of the existing bedrock. The underlying rock masses were cored using oversize HQ size double-barrel coring equipment to those depths indicated above.

In-situ testing work took place in the months of July to August 2022, as indicated above. Prior to lowering the probe into the coreholes, drilling staff had flushed the corehole with fresh water to eliminate, as much as possible, “rock flour” particles in suspension within the flooded hole. A total number of 87 DMP tests were completed on these locations.

Rock flexible dilatometer testing was completed using the Roctest DMP95 system. We have used the loading procedure similar to the rock pressuremeter system Probex. That is, a monotonic, step-wise, uploading progress of applied pressure. This DMP95 system uses compressed nitrogen gas to deliver pressure to the probe's membrane. The loading procedure is therefore stress-controlled (or pressure-controlled). A delay of 15 seconds was used at each pressure step, to allow for pressure stabilization within the hoses and the probe and the rock along the corehole wall.

Based on the available commercial nitrogen tanks, the maximum pressure attainable is about 10.0 MPa. The DMP95 system is capable of handling up to 18 MPa of probe pressure.

The DMP95 equipment delivers controlled pressure to the probe, and the membrane/rock wall diametral (or horizontal) deformations are measured at three sensor locations, at the center length of the rubber membrane. These three sensors, namely D1 (top), D2 (middle), and D3 (bottom), measure directly the expansion of the corehole using three frequency-based displacement transducers. Values of the cavity expansion, as a function of applied contact pressure, are calculated as the average of these three radial displacements.

3. Rock Dilatometer Test Results

Rock flexible dilatometer test results, in terms of radial expansion versus applied pressure, are presented in Appendix One. The summary of DMP test results and corresponding Young's Moduli E_R, are presented in the pages below (Table and Graph formats).

In-Situ Flexible Rock Dilatometer Test Results for Corehole BH203-DMP

Testing Date	Test No.	Test		E_Y		Testing Date	Test No.	Test		E_Y
		Depth	Elevation					Depth	Elevation	
		[m]	[m]	[MPa]				[m]	[m]	[MPa]
August 3, 2022	1	69.04	9.6	***15610***						
	2	67.52	11.1	***14591***						
	3	65.99	12.6	***15033***						
	4	64.47	14.2	***15124***						
	5	62.94	15.7	***14260***						
	6	61.42	17.2	***14570***						
	7	59.90	18.7	***14318***						
	8	58.37	20.2	***13447***						
	9	56.85	21.8	***16406***						
	10	55.32	23.30	***13188***						
	11	53.80	24.82	***12434***						
	12	52.28	26.34	***14661***						
	13	50.75	27.87	***12084***						
	14	49.23	29.39	***12409***						
	15	47.70	30.92	***13092***						
	16	46.18	32.44	***12299***						
	17	44.66	33.96	***11768***						
	18	43.13	35.49	***12250***						
	19	41.61	37.01	***11544***						
	20	40.08	38.54	***11759***						
	21	38.56	40.06	***11497***						
	22	37.04	41.58	***9333***						
	23	35.51	43.11	***9633***						
	24	33.99	44.63	***9356***						
	25	32.46	46.16	***12133***						
	26	30.94	47.68	***8961***						
	27	29.4	49.20	***8580***						

Additional Notes:

1. Test Depths are measured from Barge Deck (El. 78.62 m) to center of the membrane.
2. Bottom of the corehole 69.65 m below Barge Deck, at elevation El. 8.97 m

In-Situ Flexible Rock Dilatometer Test Results for Corehole BH302-DMP

Testing Date	Test No.	Test		E_Y		Testing Date	Test No.	Test		E_Y
		Depth	Elevation					Depth	Elevation	
		[m]	[m]	[MPa]				[m]	[m]	[MPa]
July 16, 2022	1	70.27	8.6	***18330***		July 16, 2022	32	23.0	55.79	***12243***
	2	68.75	10.1	***16757***			33	21.5	57.32	***8741***
	3	67.22	11.6	***19681***			34	20.0	58.84	***9052***
	4	65.70	13.1	***18919***						
	5	64.17	14.6	***17038***						
	6	62.65	16.2	***17560***						
	7	61.13	17.7	***17294***						
	8	59.60	19.2	***15304***						
	9	58.08	20.7	***19409***						
	10	56.55	22.27	***13423***						
	11	55.03	23.79	***17537***						
	12	53.51	25.31	***17954***						
	13	51.98	26.84	***18265***						
	14	50.46	28.36	***16996***						
	15	48.93	29.89	***17182***						
	16	47.41	31.41	***18399***						
	17	45.89	32.93	***15100***						
	18	44.36	34.46	***15290***						
	19	42.84	35.98	***16784***						
	20	41.31	37.51	***16052***						
	21	39.79	39.03	***13984***						
	22	38.27	40.55	***15953***						
	23	36.74	42.08	***12489***						
	24	35.22	43.60	***12584***						
	25	33.69	45.13	***10864***						
	26	32.17	46.65	***14789***						
	27	30.65	48.17	***11975***						
	28	29.12	49.70	***13171***						
	29	27.60	51.22	***12790***						
	30	26.07	52.75	***12745***						
	31	24.55	54.27	***9788***						

Additional Notes:

1. Test Depths are measured from Barge Deck (El. 78.82 m) to center of the membrane.
2. Bottom of the corehole 70.87 m below Barge Deck, at elevation El. 7.95 m

In-Situ Flexible Rock Dilatometer Test Results for Corehole BH307-DMP

Testing Date	Test No.	Test		E_Y		Testing Date	Test No.	Test		E_Y
		Depth	Elevation					Depth	Elevation	
		[m]	[m]	[MPa]				[m]	[m]	[MPa]
July 7, 2022	1	60.37	18.5	***17049***						
	2	58.84	20.1	***14625***						
	3	57.32	21.6	***17911***						
	4	55.80	23.1	***17783***						
	5	54.27	24.6	***15020***						
	6	52.75	26.2	***14860***						
	7	51.22	27.7	***14448***						
	8	49.70	29.2	***16288***						
	9	48.18	30.7	***16030***						
	10	46.65	32.25	***15900***						
	11	45.13	33.77	***13201***						
	12	43.60	35.30	***15349***						
	13	42.08	36.82	***13447***						
	14	40.56	38.34	***15685***						
	15	39.03	39.87	***12991***						
	16	37.51	41.39	***13067***						
	17	35.98	42.92	***14227***						
	18	34.46	44.44	***13040***						
	19	32.94	45.96	***13202***						
	20	31.41	47.49	***10924***						
	21	29.89	49.01	***12487***						
	22	28.36	50.54	***9978***						
	23	26.84	52.06	***10513***						
	24	25.32	53.58	***10992***						
	25	23.79	55.11	***12077***						
	26	22.27	56.63	***11427***						

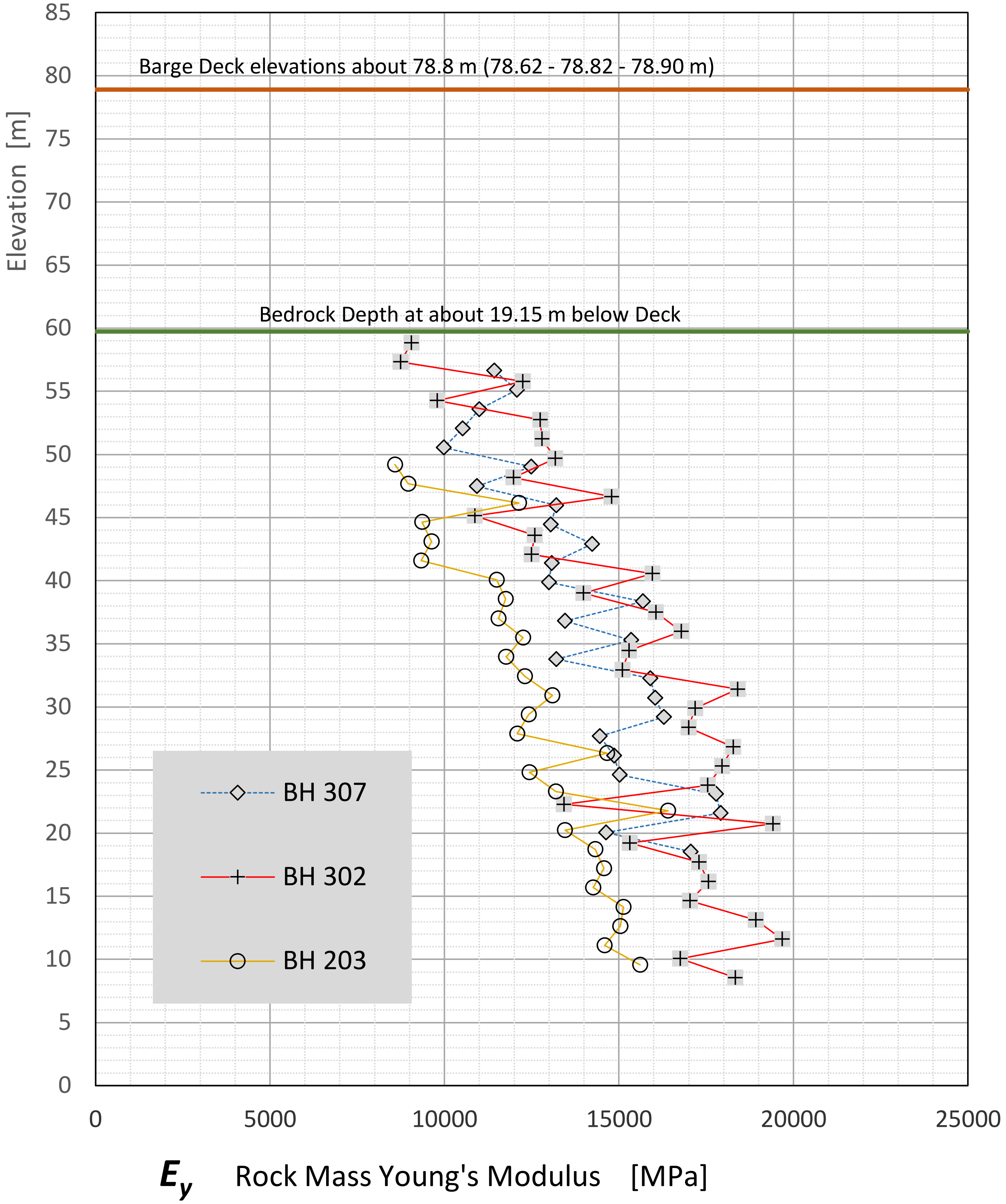
Additional Notes:

1. Test Depths are measured fromBarge Deck (El. 78.90 m) to center of the membrane.

2.Not known

3. Not known

4. Bottom of the corehole 60.98 m below Barge Deck, at elevation El. 17.94 m


Barge Deck elevations about 78.8 m (78.62 - 78.82 - 78.90 m)
Bedrock Depth at about 19.15 m below Deck
Elevation [m]
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
5000
10000
15000
20000
25000
BH 307
BH 302
BH 203
E_y Rock Mass Young's Modulus [MPa]

2. Closure

The rock mass elastic modulus values presented in this report are based on in-situ DMP testing and interpretation procedures. It should be noted that rock conditions may vary within the site and interpreted data may not be entirely representative of conditions at locations away from the tested coreholes. Therefore, care should be exercised when extrapolating or inferring subsurface conditions away from the explored location.

We trust that the present report fulfills your requirements. Should you have any question, please feel free to contact the undersigned.

Sincerely,

In-Depth Geotechnical Inc.

LICENSED PROFESSIONAL ENGINEER
G. SEDRAN
March 30th, 2023
PROVINCE OF ONTARIO

Gabriel Sedran, P.Eng., Ph.D.
President

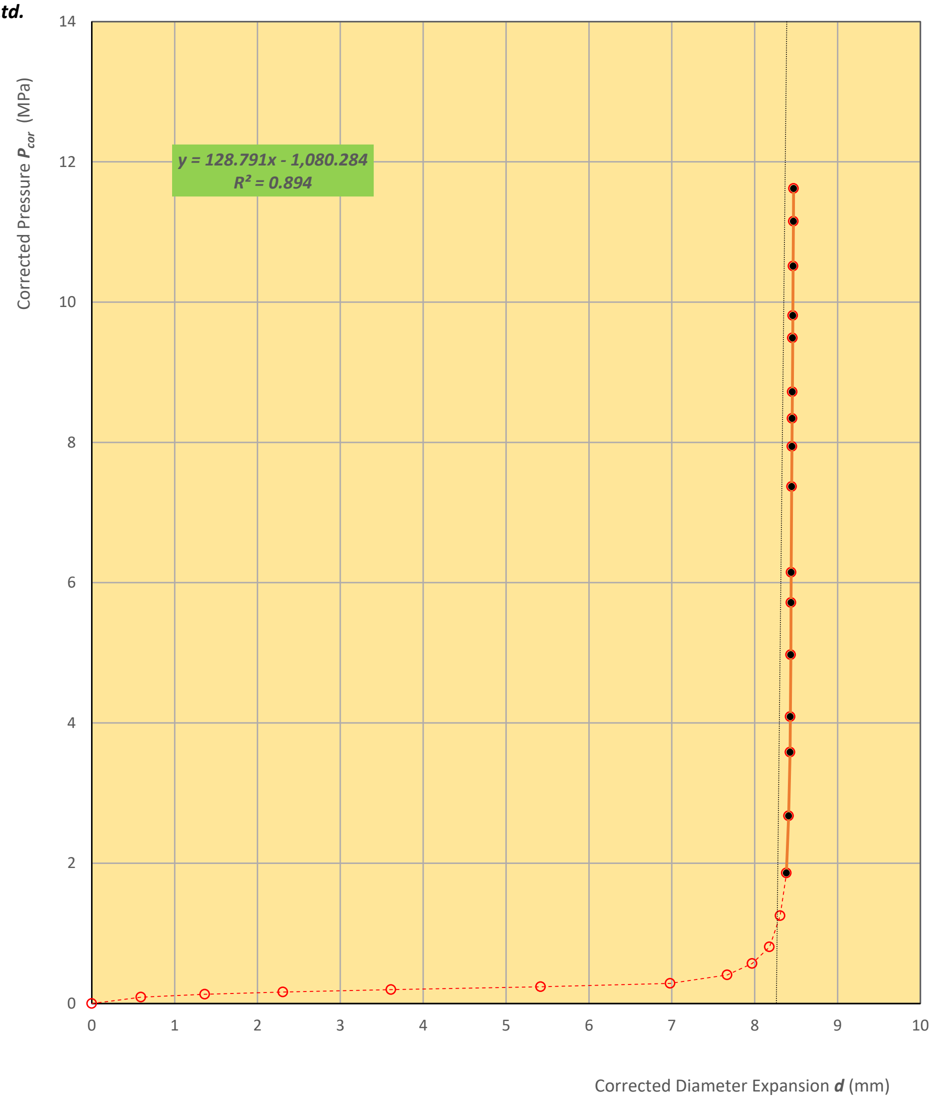
Appendix One

Rock Dilatometer Results - DMP Data

BH 203-DMP	pages	1	to	27
BH 302-DMP	pages	28	to	61
BH 307-DMP	pages	62	to	87

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH203-DMP***
Test No.: ***1***
Test Depth (m): 69.04
Client: ***Golder Associates Ltd.***

Field Data	
Pressure	Diameter Expansion
P_{cor} MPa	d_{avg} mm
0.000	0.000
0.090	0.594
0.131	1.364
0.163	2.307
0.199	3.611
0.239	5.417
0.286	6.980
0.408	7.669
0.569	7.969
0.808	8.179
1.251	8.308
1.860	8.384
2.676	8.410
3.584	8.427
4.090	8.430
4.972	8.436
5.716	8.439
6.148	8.441
7.370	8.447
7.942	8.450
8.342	8.452
8.720	8.455
9.490	8.457
9.808	8.461
10.514	8.464
11.152	8.468
11.620	8.470



$$E = (1+\nu)D_0\,{}^{P}\!/_{d}$$

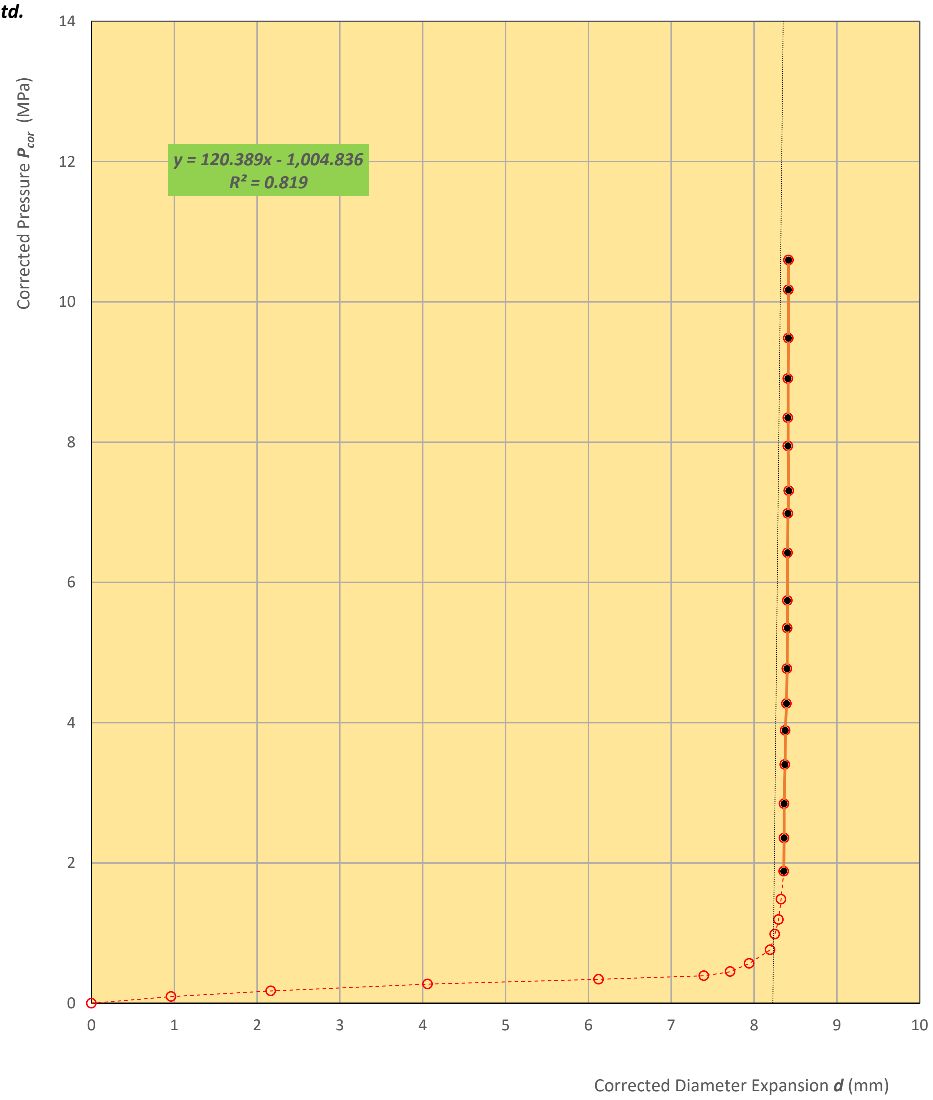
Elastic Modulus (Young's Mod)

μ	=	0.20		*Poisson's ratio*
D_0	=	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}			*MPa*	*Corrected Pressure for the elastic deformations*
P/d	=	*128.791*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *15609.5* *MPa*

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.: **BH203-DMP**
Test No.: **2**
Test Depth (m): 67.52
Client: **Golder Associates Ltd.**

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.096	0.962
0.176	2.165
0.274	4.059
0.342	6.125
0.391	7.396
0.450	7.713
0.568	7.943
0.761	8.196
0.986	8.251
1.193	8.297
1.483	8.327
1.881	8.360
2.357	8.363
2.843	8.364
3.404	8.374
3.888	8.378
4.273	8.393
4.769	8.399
5.350	8.402
5.741	8.405
6.422	8.406
6.982	8.410
7.306	8.422
7.946	8.411
8.347	8.411
8.905	8.411
9.482	8.415
10.172	8.416
10.596	8.418



$$E = (1+\nu)D_0 \, {}^{P}\!/_{d}$$

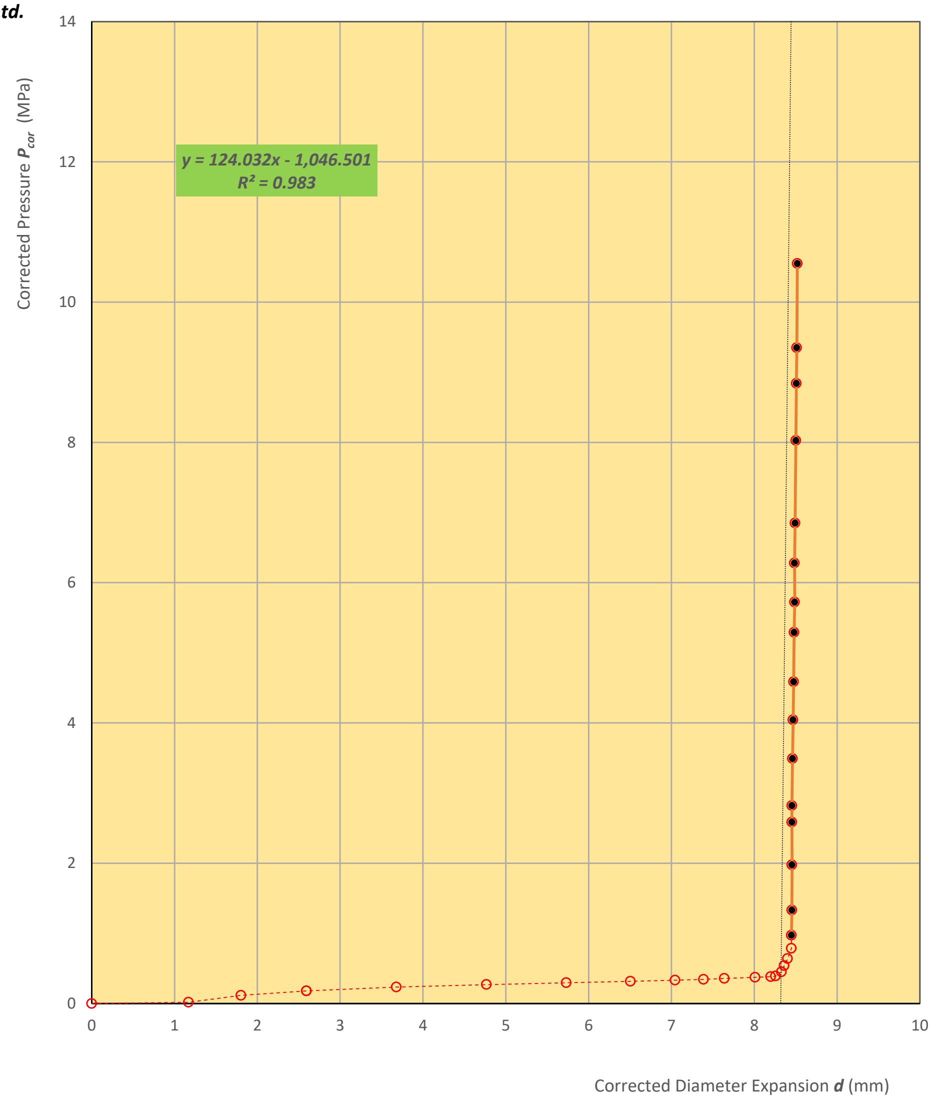
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	120.389	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *14591.1* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH203-DMP***
Test No.: ***3***
Test Depth (m): 65.99
Client: ***Golder Associates Ltd.***

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.018	1.169
0.115	1.802
0.179	2.592
0.179	2.592
0.234	3.679
0.270	4.766
0.296	5.731
0.317	6.505
0.332	7.044
0.345	7.388
0.357	7.639
0.373	8.011
0.382	8.200
0.392	8.258
0.450	8.329
0.540	8.362
0.640	8.403
0.786	8.449
0.973	8.448
1.332	8.454
1.978	8.455
2.587	8.454
2.821	8.454
3.491	8.462
4.044	8.469
4.587	8.476
5.293	8.481
5.724	8.488
6.280	8.486
6.851	8.493
8.027	8.502
8.842	8.509
9.351	8.513
10.549	8.520



$$E = (1+\nu)D_0 \, {}^{P}\!/_{d}$$

Elastic Modulus (Young's Mod)

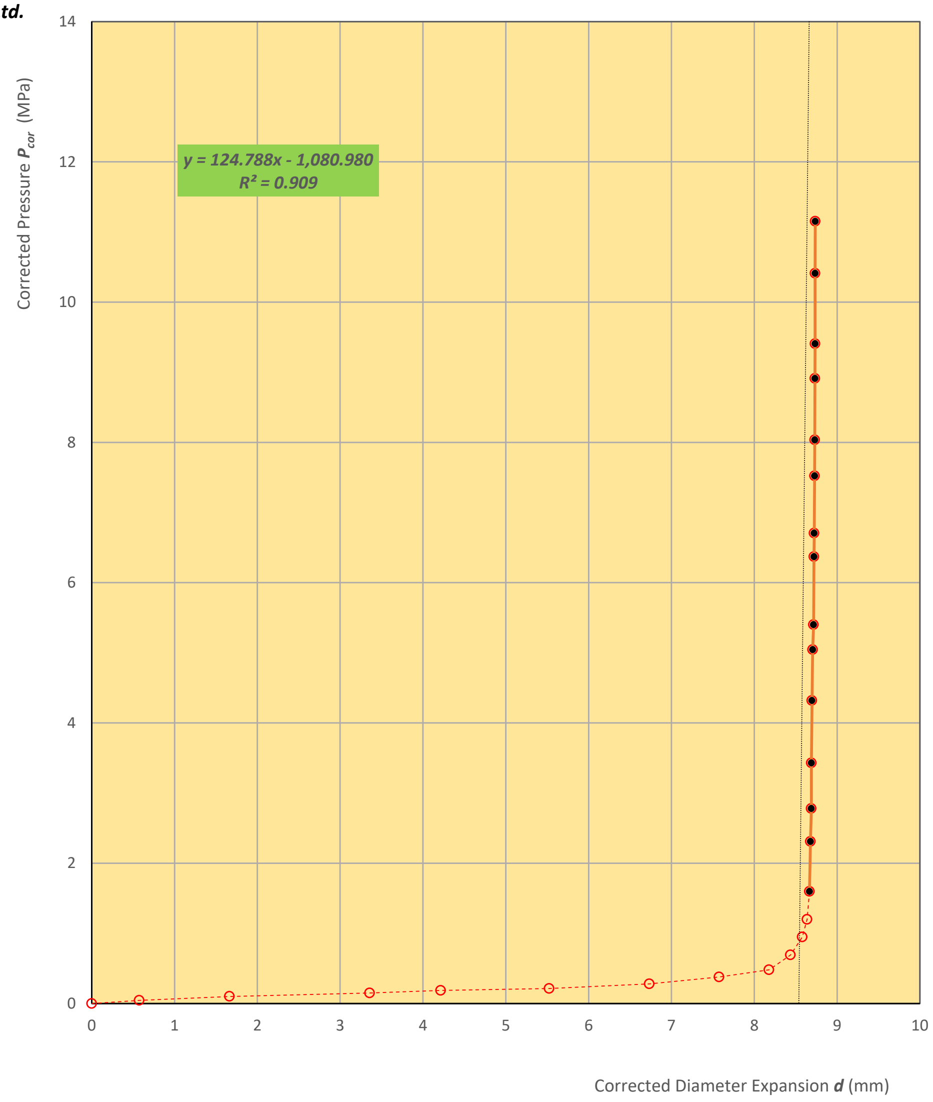
μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*124.032*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *15032.7* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH203-DMP***
Test No.: ***4***
Test Depth (m): 64.47
Client: ***Golder Associates Ltd.***

Field Data

Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.045	0.573
0.101	1.664
0.150	3.356
0.187	4.214
0.213	5.523
0.280	6.734
0.378	7.576
0.480	8.179
0.692	8.438
0.948	8.580
1.199	8.638
1.598	8.667
2.311	8.678
2.780	8.689
3.431	8.690
4.321	8.697
5.046	8.706
5.401	8.716
6.371	8.721
6.706	8.724
7.524	8.729
8.036	8.731
8.913	8.732
9.407	8.734
10.411	8.735
11.153	8.737



$$E = (1+\nu)D_0 \, {}^{P}\!/_{d}$$

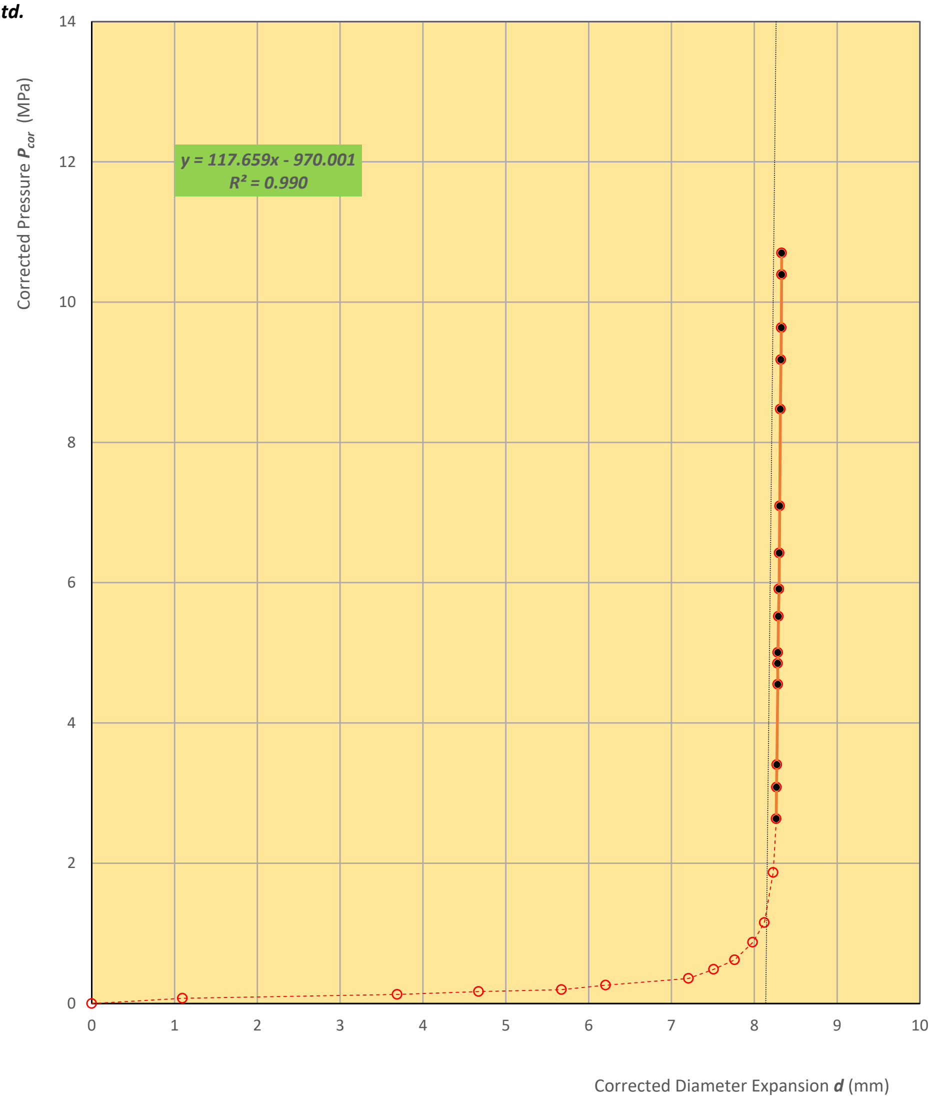
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*124.788*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *15124.4* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH203-DMP***
Test No.: ***5***
Test Depth (m): 62.94
Client: ***Golder Associates Ltd.***

Field Data	
Pressure	Diameter Expansion
P_{cor}	d_{avg}
MPa	mm
0.000	0.000
0.075	1.096
0.129	3.689
0.170	4.672
0.199	5.672
0.261	6.205
0.358	7.207
0.487	7.509
0.622	7.762
0.874	7.982
1.153	8.122
1.868	8.228
2.635	8.266
3.083	8.269
3.405	8.272
4.551	8.284
4.848	8.283
5.005	8.285
5.520	8.292
5.909	8.299
6.424	8.302
7.094	8.308
8.474	8.316
9.178	8.322
9.635	8.326
10.394	8.330
10.701	8.332



$$E = (1+\nu)D_0 \, {}^{P}\!/_{d}$$

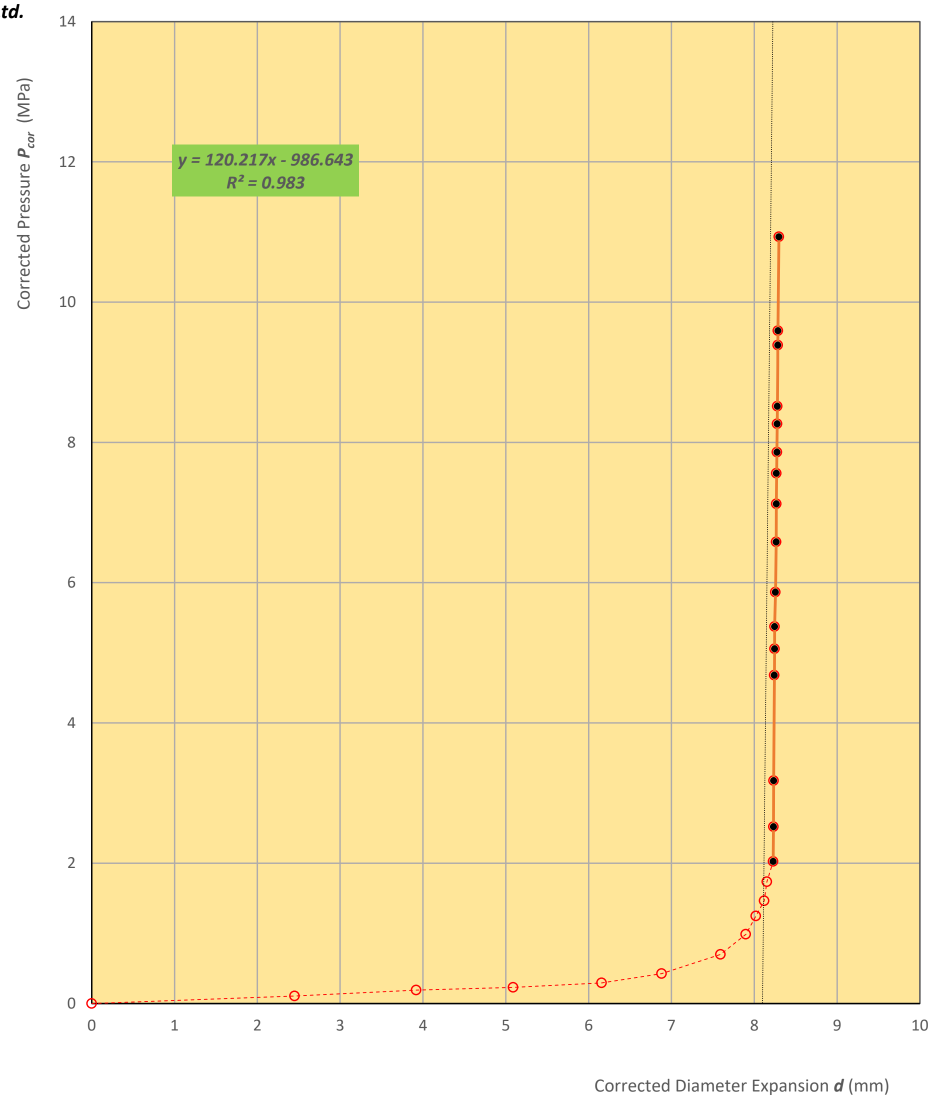
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*117.659*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *14260.3* *MPa*

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.: **BH203-DMP**
Test No.: **6**
Test Depth (m): 61.42
Client: **Golder Associates Ltd.**

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.107	2.450
0.191	3.919
0.230	5.089
0.295	6.157
0.425	6.881
0.700	7.593
0.988	7.899
1.248	8.020
1.463	8.120
1.736	8.153
2.026	8.229
2.520	8.232
3.177	8.234
4.682	8.243
5.057	8.245
5.373	8.246
5.866	8.256
6.581	8.265
7.124	8.266
7.560	8.268
7.861	8.275
8.264	8.277
8.516	8.279
9.387	8.284
9.592	8.287
10.930	8.299



$$E = (1 + \nu) D_0 \, {}^{P}/_{d}$$

Elastic Modulus (Young's Mod)

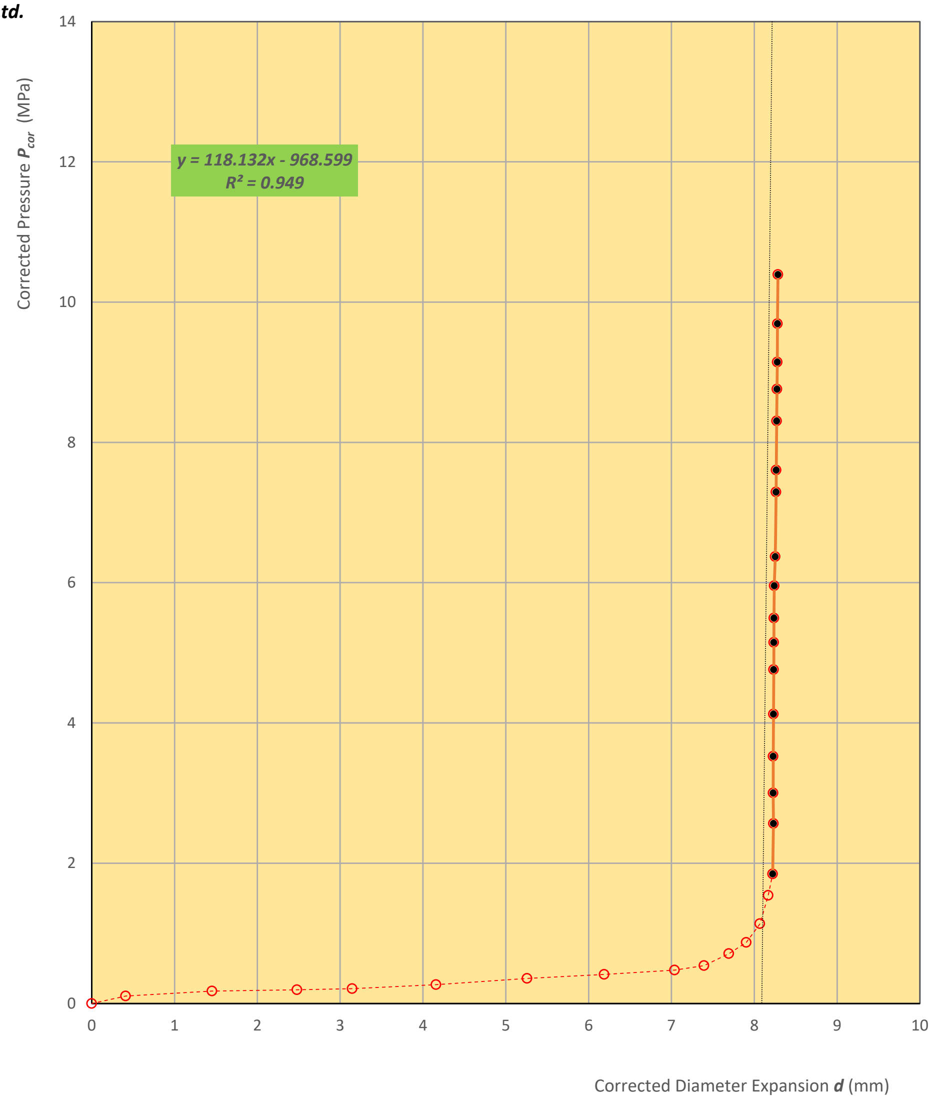
μ	=	0.20		*Poisson's ratio*
D_0	=	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}			*MPa*	*Corrected Pressure for the elastic deformations*
P/d	=	*120.217*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *14570.3* *MPa*

Project:	**DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.:	**BH203-DMP**
Test No.:	**7**
Test Depth (m):	59.90
Client:	**Golder Associates Ltd.**

Field Data

Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.106	0.410
0.178	1.453
0.196	2.479
0.212	3.146
0.269	4.157
0.358	5.257
0.415	6.189
0.477	7.039
0.541	7.394
0.711	7.694
0.870	7.904
1.138	8.069
1.542	8.169
1.848	8.223
2.566	8.232
3.001	8.228
3.525	8.228
4.127	8.233
4.760	8.235
5.149	8.236
5.496	8.238
5.955	8.242
6.371	8.253
7.292	8.263
7.604	8.266
8.305	8.271
8.759	8.274
9.145	8.278
9.692	8.281
10.392	8.287



$$E = (1+\nu)D_0 \, {}^{P}\!/_{d}$$

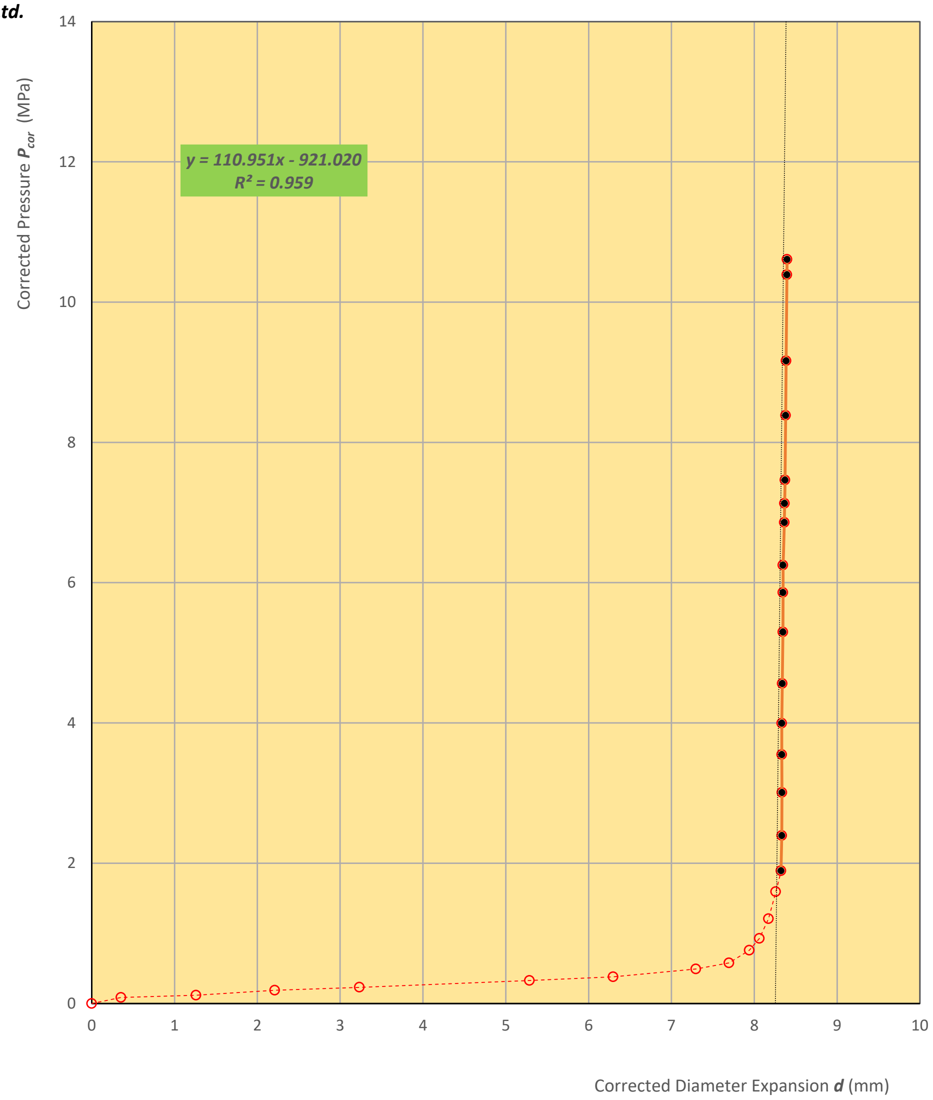
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*118.132*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *14317.6* *MPa*

Project:	**DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.:	**BH203-DMP**
Test No.:	**8**
Test Depth (m):	58.37
Client:	**Golder Associates Ltd.**

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.087	0.353
0.118	1.260
0.188	2.210
0.231	3.233
0.329	5.287
0.381	6.296
0.492	7.295
0.580	7.695
0.759	7.940
0.928	8.062
1.209	8.172
1.593	8.260
1.893	8.324
2.394	8.332
3.008	8.334
3.549	8.332
3.997	8.333
4.563	8.339
5.296	8.346
5.861	8.347
6.250	8.347
6.858	8.363
7.131	8.366
7.463	8.372
8.386	8.379
9.164	8.385
10.391	8.395
10.609	8.397



$$E = (1+\nu) D_0 \, {}^{P}\!/_{d}$$

Elastic Modulus (Young's Mod)

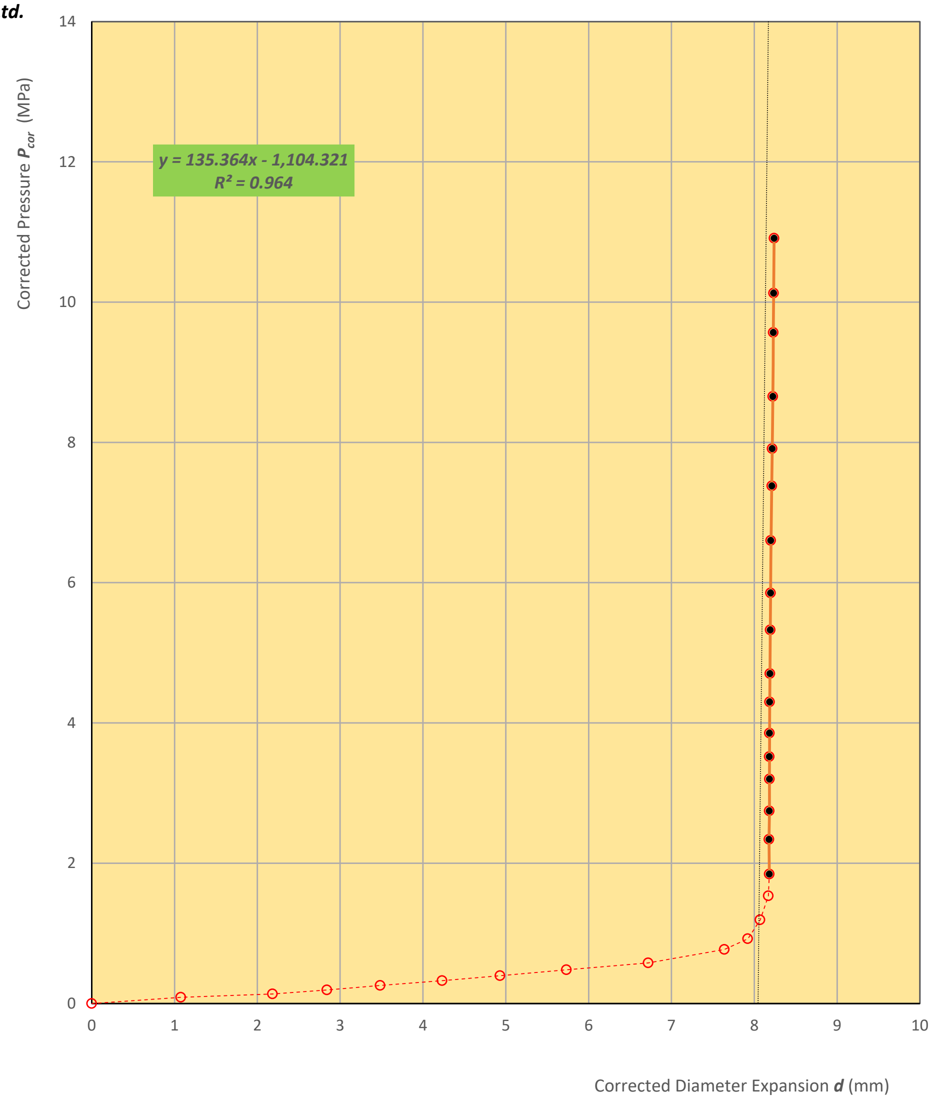
μ	=	0.20		*Poisson's ratio*
D_0	=	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}			*MPa*	*Corrected Pressure for the elastic deformations*
P/d	=	*110.951*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *13447.2* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH203-DMP***
Test No.: ***9***
Test Depth (m): 56.85
Client: ***Golder Associates Ltd.***

Field Data

Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.088	1.077
0.136	2.184
0.193	2.840
0.258	3.483
0.326	4.231
0.397	4.931
0.481	5.732
0.578	6.719
0.770	7.639
0.924	7.922
1.193	8.071
1.535	8.171
1.845	8.182
2.339	8.178
2.745	8.183
3.199	8.184
3.519	8.183
3.855	8.184
4.300	8.187
4.703	8.189
5.326	8.194
5.854	8.197
6.602	8.200
7.380	8.213
7.911	8.217
8.654	8.224
9.567	8.230
10.128	8.234
10.910	8.240



$$E = (1+\nu)D_0 \, {}^{P}/_{d}$$

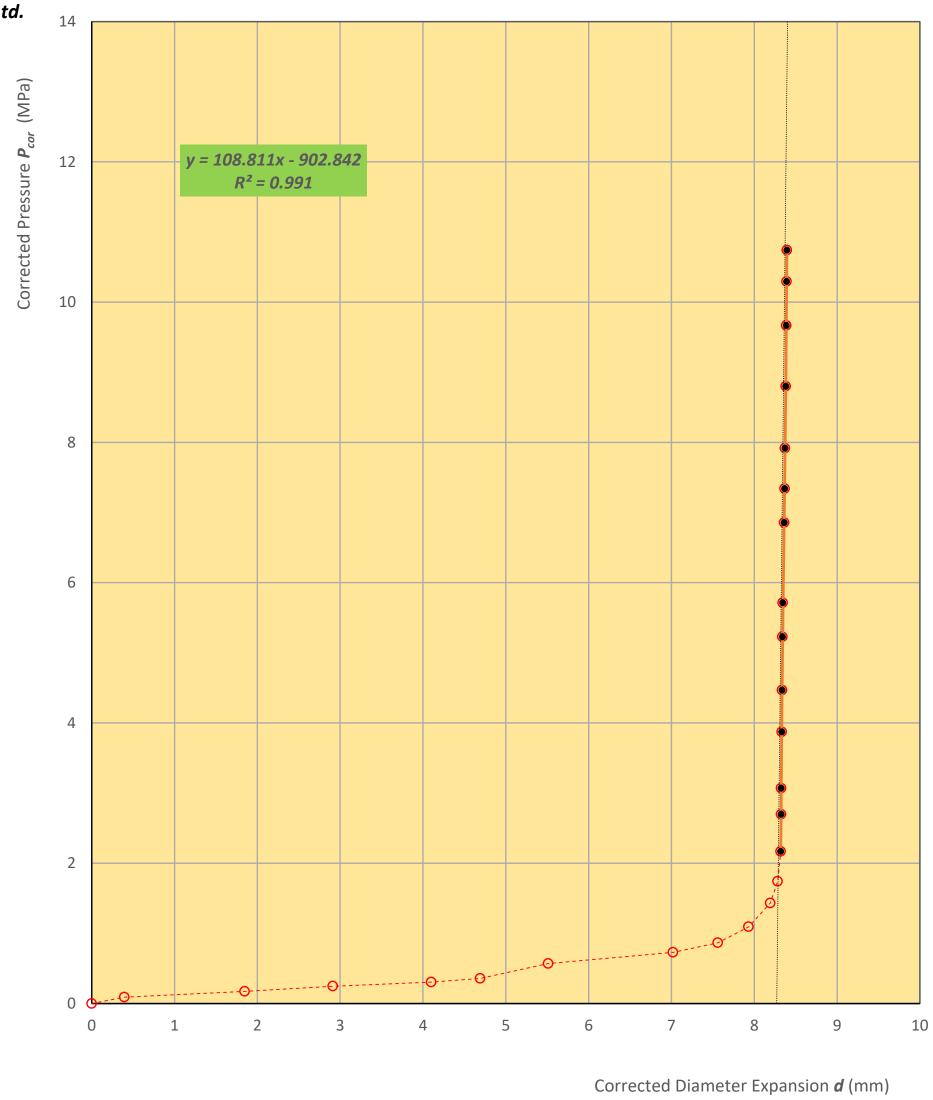
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*135.364*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *16406.1* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH203-DMP***
Test No.: ***10***
Test Depth (m): 55.32
Client: ***Golder Associates Ltd.***

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.090	0.394
0.172	1.847
0.247	2.911
0.306	4.099
0.358	4.691
0.569	5.513
0.730	7.019
0.867	7.561
1.093	7.931
1.433	8.193
1.742	8.282
2.170	8.320
2.699	8.325
3.070	8.326
3.874	8.332
4.469	8.337
5.227	8.341
5.715	8.345
6.856	8.362
7.341	8.367
7.917	8.371
8.800	8.381
9.667	8.387
10.295	8.391
10.741	8.394



$$E = (1+\nu)D_0 \, {}^{P}\!/_{d}$$

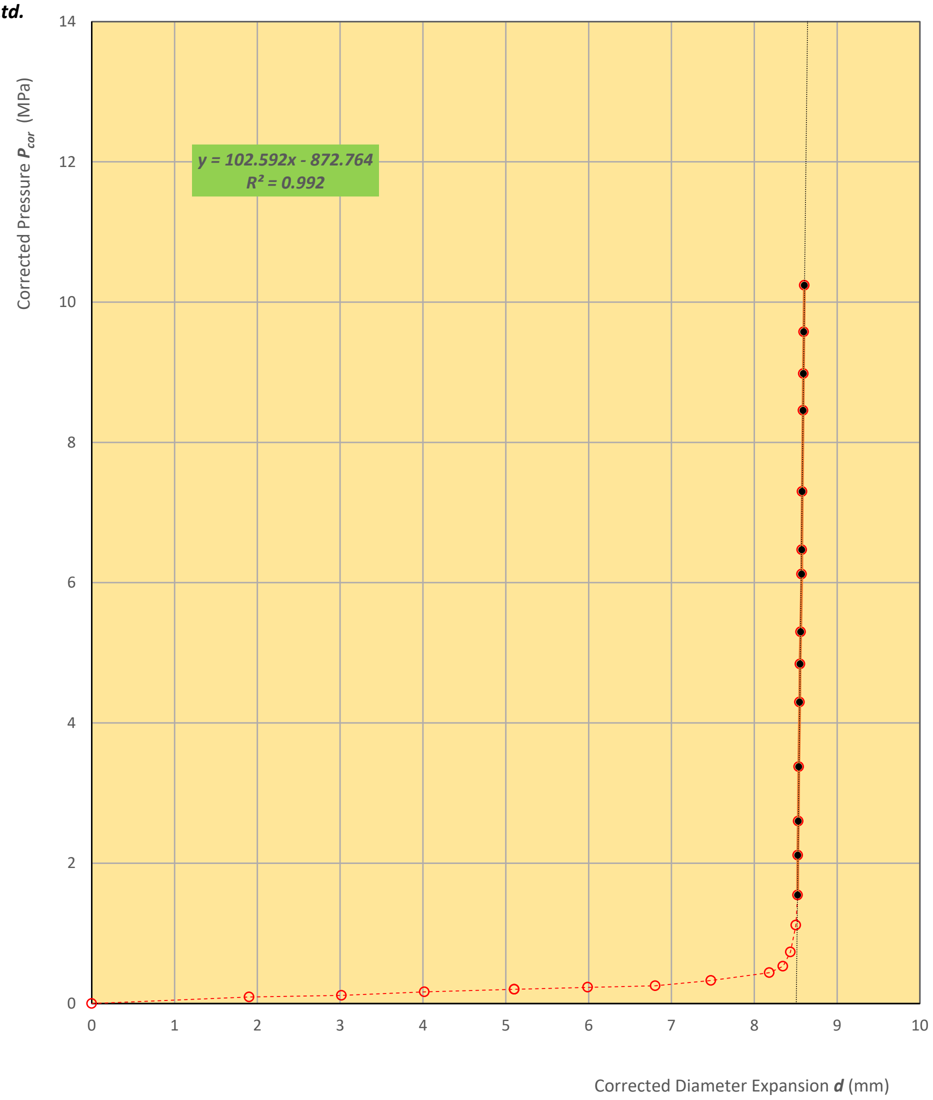
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*108.811*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = 13187.9 MPa

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH203-DMP***
Test No.: ***11***
Test Depth (m): 53.80
Client: ***Golder Associates Ltd.***

Field Data	
Pressure	Diameter Expansion
P_{cor} MPa	d_{avg} mm
0.000	0.000
0.094	1.902
0.115	3.016
0.167	4.017
0.203	5.102
0.203	5.102
0.231	5.990
0.252	6.804
0.329	7.477
0.439	8.182
0.531	8.347
0.733	8.437
1.118	8.502
1.546	8.524
2.114	8.526
2.599	8.531
3.376	8.538
4.298	8.548
4.840	8.553
5.299	8.560
6.123	8.573
6.468	8.574
7.299	8.579
8.455	8.589
8.980	8.593
9.577	8.598
10.240	8.605



$$E = (1+\nu)D_0 \, {}^{P}\!/_{d}$$

Elastic Modulus (Young's Mod)

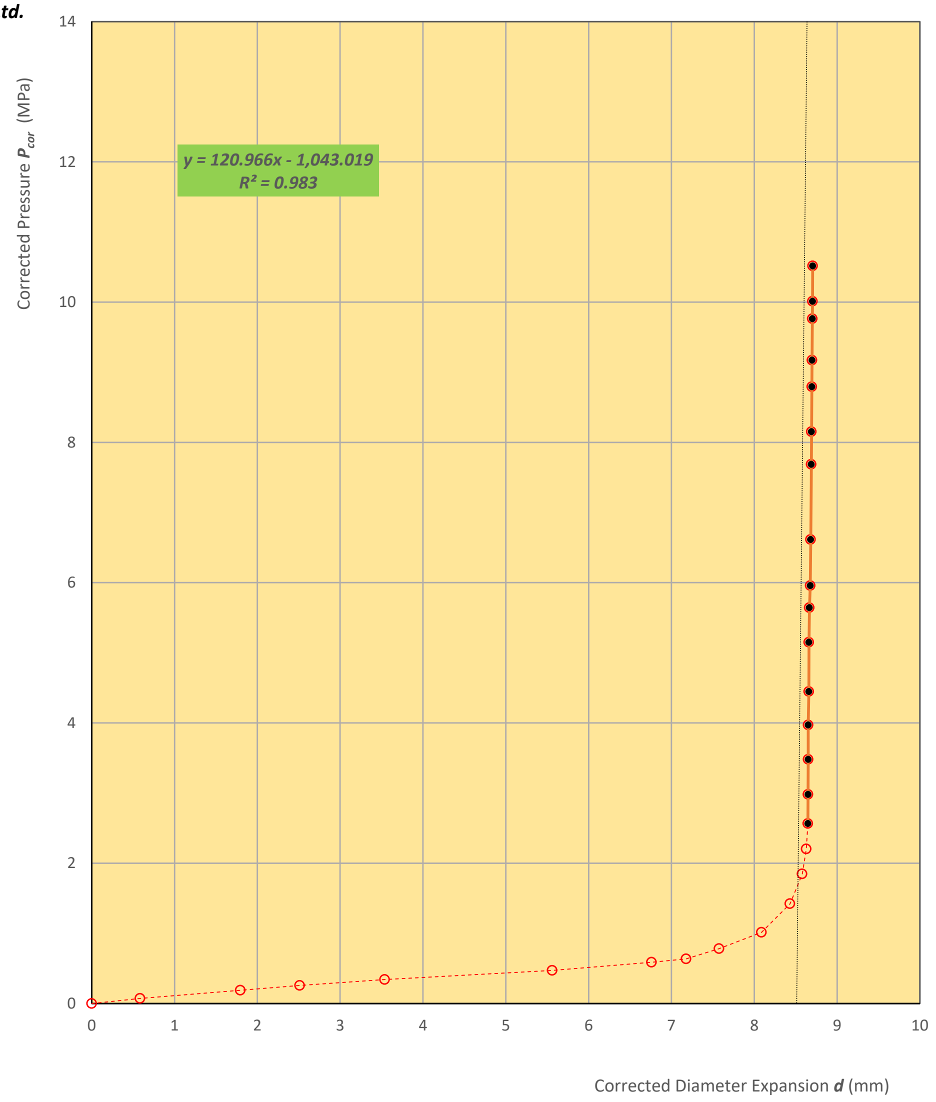
μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*102.592*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *12434.2* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH203-DMP***
Test No.: ***12***
Test Depth (m): 52.28
Client: ***Golder Associates Ltd.***

Field Data

Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.073	0.584
0.188	1.795
0.258	2.511
0.341	3.537
0.471	5.560
0.588	6.760
0.636	7.177
0.782	7.576
1.014	8.087
1.423	8.432
1.848	8.579
2.204	8.628
2.566	8.647
2.980	8.649
3.480	8.651
3.971	8.651
4.447	8.659
5.150	8.660
5.643	8.666
5.959	8.676
6.615	8.681
7.687	8.689
8.152	8.691
8.794	8.696
9.172	8.698
9.763	8.702
10.012	8.704
10.517	8.706



$$E = (1+\nu)D_0\, {}^{P}\!/_{d}$$

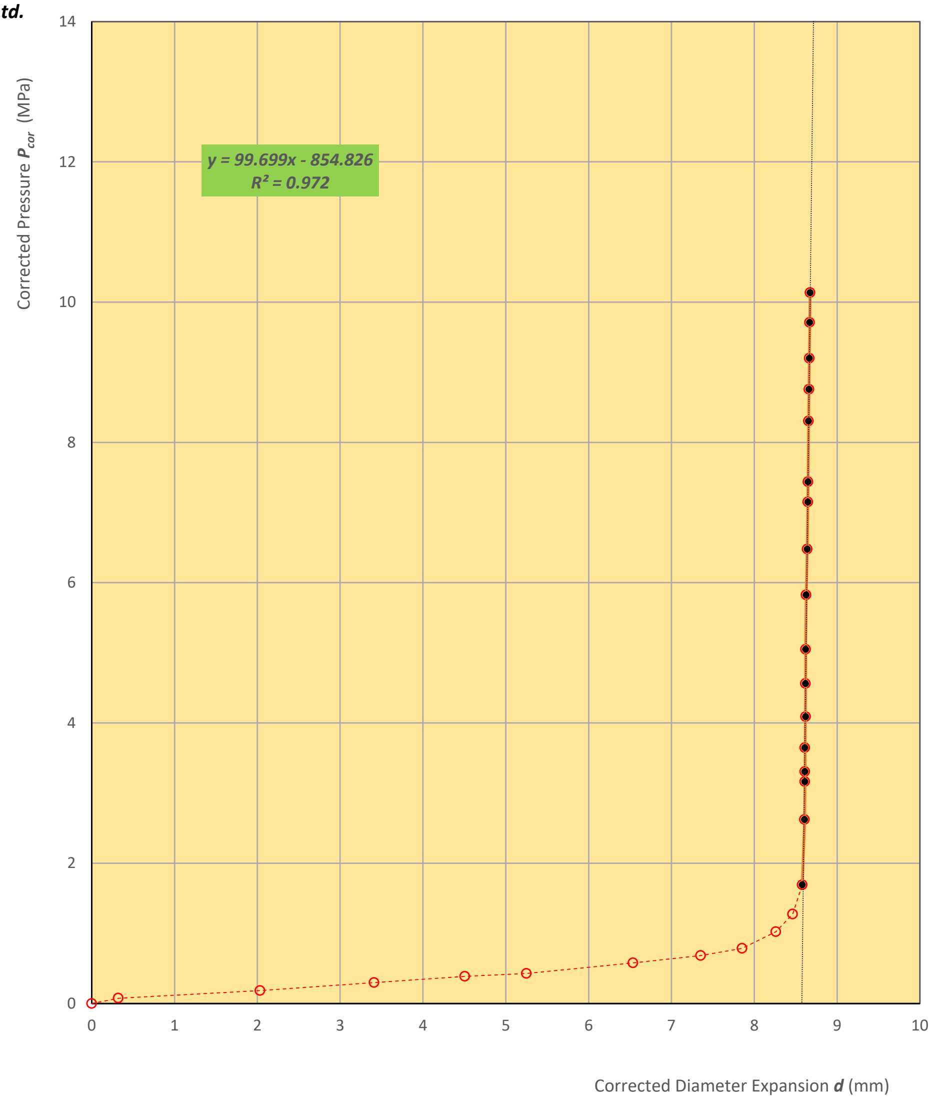
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*120.966*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *14661.1* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH203-DMP***
Test No.: ***13***
Test Depth (m): 50.75
Client: ***Golder Associates Ltd.***

Field Data	
Pressure	Diameter Expansion
P_{cor} MPa	d_{avg} mm
0.000	0.000
0.076	0.321
0.184	2.032
0.299	3.411
0.388	4.505
0.428	5.250
0.578	6.536
0.684	7.353
0.787	7.854
1.024	8.261
1.275	8.464
1.693	8.580
2.623	8.608
3.163	8.612
3.307	8.612
3.648	8.612
4.089	8.620
4.563	8.618
5.050	8.621
5.826	8.627
6.477	8.640
7.150	8.647
7.438	8.650
8.305	8.656
8.757	8.661
9.200	8.665
9.710	8.670
10.135	8.674



$$E = (1+\nu)D_0 {}^{P}/_{d}$$

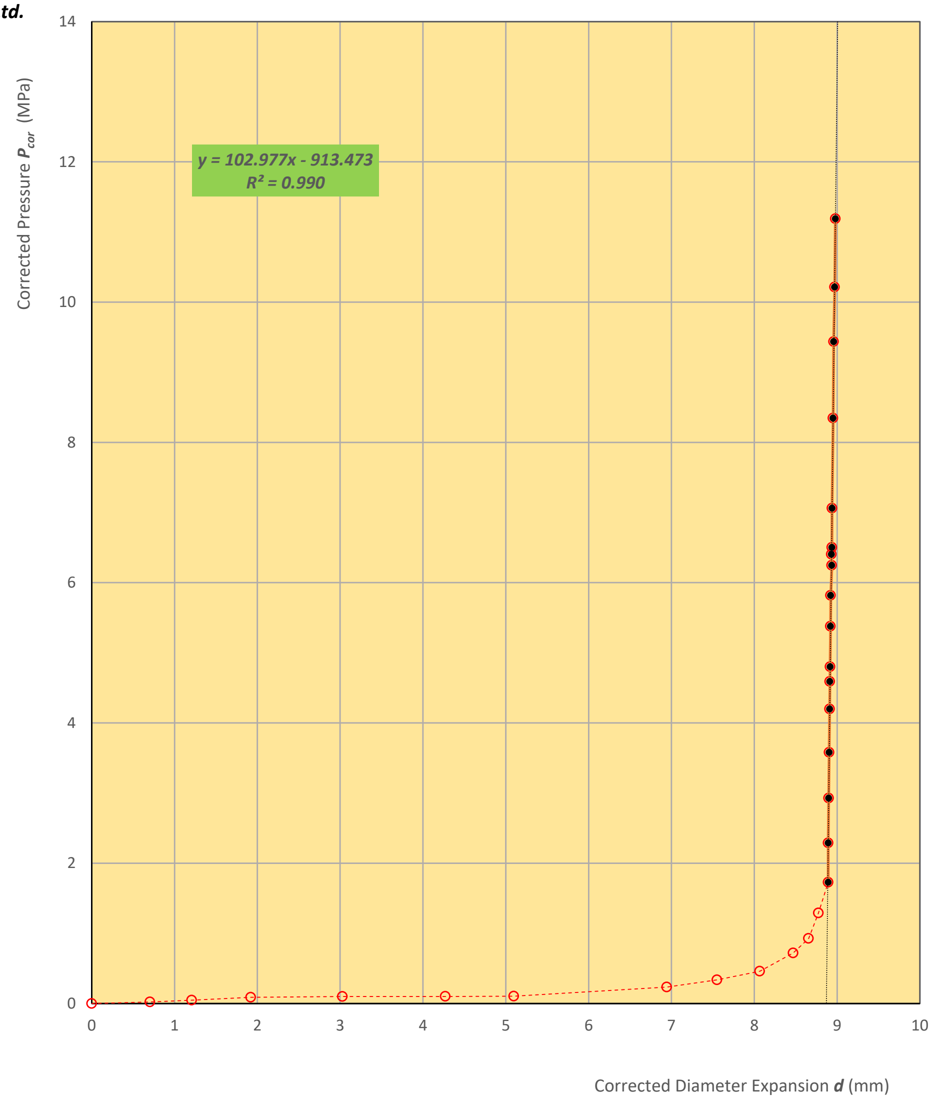
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*99.699*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *12083.6* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH203-DMP***
Test No.: ***14***
Test Depth (m): 49.23
Client: ***Golder Associates Ltd.***

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.022	0.704
0.047	1.208
0.089	1.921
0.100	3.027
0.101	4.269
0.104	5.096
0.235	6.943
0.338	7.550
0.461	8.067
0.721	8.470
0.929	8.656
1.290	8.775
1.729	8.893
2.290	8.893
2.929	8.899
3.580	8.905
4.199	8.910
4.591	8.913
4.802	8.916
5.378	8.921
5.818	8.923
6.247	8.936
6.406	8.932
6.503	8.937
7.063	8.939
8.347	8.952
9.437	8.958
10.214	8.971
11.190	8.981



$$E = (1+\nu)D_0 \, {}^{P}/_{d}$$

Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*102.977*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *12480.8* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***

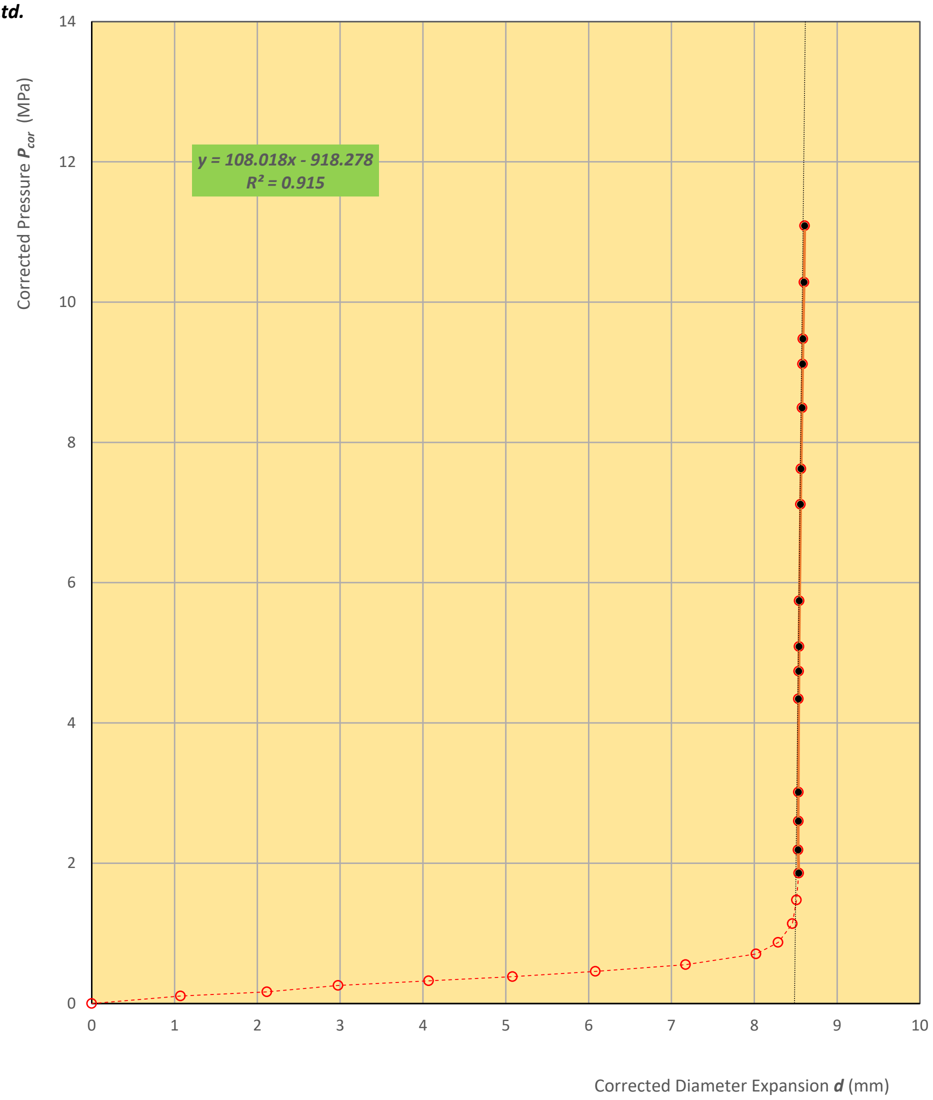
Corehole No.: ***BH203-DMP***

Test No.: ***15***

Test Depth (m): 47.70

Client: ***Golder Associates Ltd.***

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.107	1.072
0.167	2.115
0.258	2.976
0.324	4.068
0.383	5.082
0.458	6.082
0.554	7.171
0.706	8.021
0.870	8.289
1.138	8.460
1.476	8.510
1.858	8.538
2.189	8.530
2.599	8.533
3.014	8.533
4.344	8.533
4.738	8.538
5.088	8.542
5.742	8.544
7.118	8.559
7.624	8.565
8.492	8.578
9.118	8.585
9.476	8.588
10.284	8.601
11.088	8.609



$$E = (1+\nu) D_0 \, {}^{P}/_{d}$$

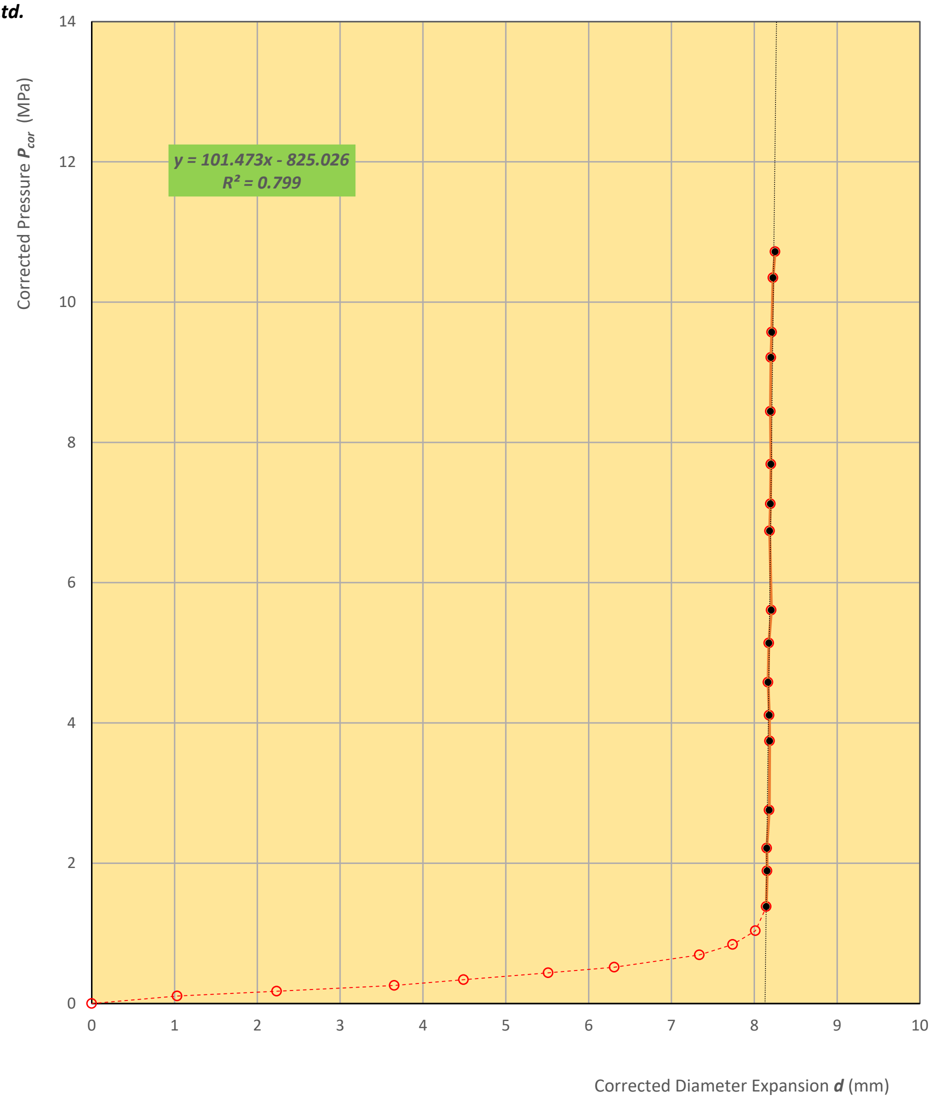
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*108.018*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *13091.8* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH203-DMP***
Test No.: ***16***
Test Depth (m): 46.18
Client: ***Golder Associates Ltd.***

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.106	1.031
0.175	2.234
0.258	3.653
0.339	4.489
0.439	5.512
0.517	6.310
0.694	7.337
0.841	7.739
1.037	8.015
1.382	8.146
1.890	8.156
2.214	8.151
2.758	8.181
3.744	8.186
4.110	8.181
4.579	8.166
5.139	8.176
5.610	8.206
6.739	8.186
7.123	8.196
7.690	8.201
8.443	8.196
9.211	8.201
9.571	8.211
10.347	8.226
10.718	8.251



$$E = (1+\nu) D_0 \, {}^{P}\!/_{d}$$

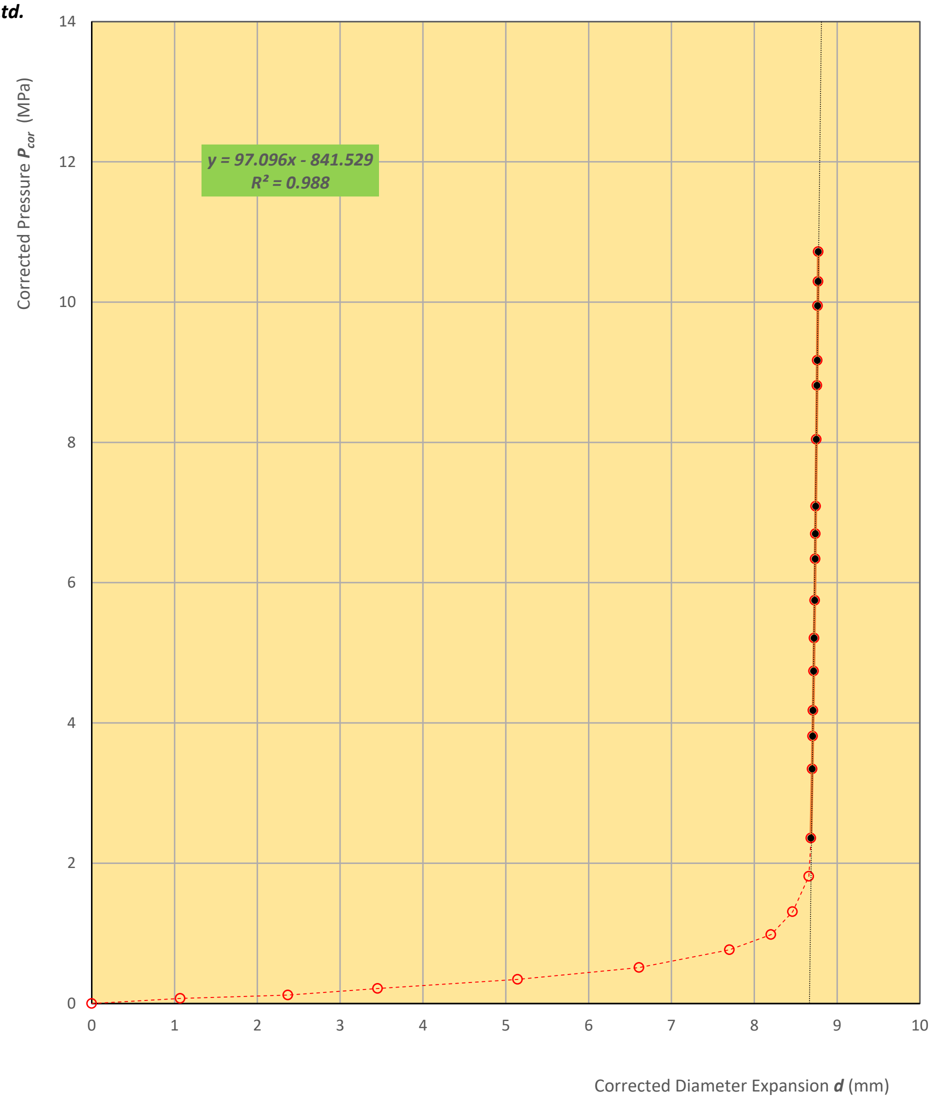
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*101.473*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *12298.5* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH203-DMP***
Test No.: ***17***
Test Depth (m): 44.66
Client: ***Golder Associates Ltd.***

Field Data	
Pressure	Diameter Expansion
P_{cor}	d_{avg}
MPa	mm
0.000	0.000
0.072	1.069
0.120	2.369
0.213	3.453
0.345	5.143
0.512	6.610
0.765	7.701
0.983	8.202
1.308	8.463
1.814	8.659
2.358	8.685
3.344	8.700
3.811	8.705
4.179	8.710
4.739	8.718
5.209	8.724
5.748	8.730
6.339	8.736
6.697	8.738
7.089	8.742
8.043	8.751
8.811	8.758
9.171	8.761
9.947	8.766
10.294	8.771
10.720	8.773



$$E = (1+\nu) D_0 \, {}^{P}\!/_{d}$$

Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*97.096*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *11768.1* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***

Corehole No.: ***BH203-DMP***

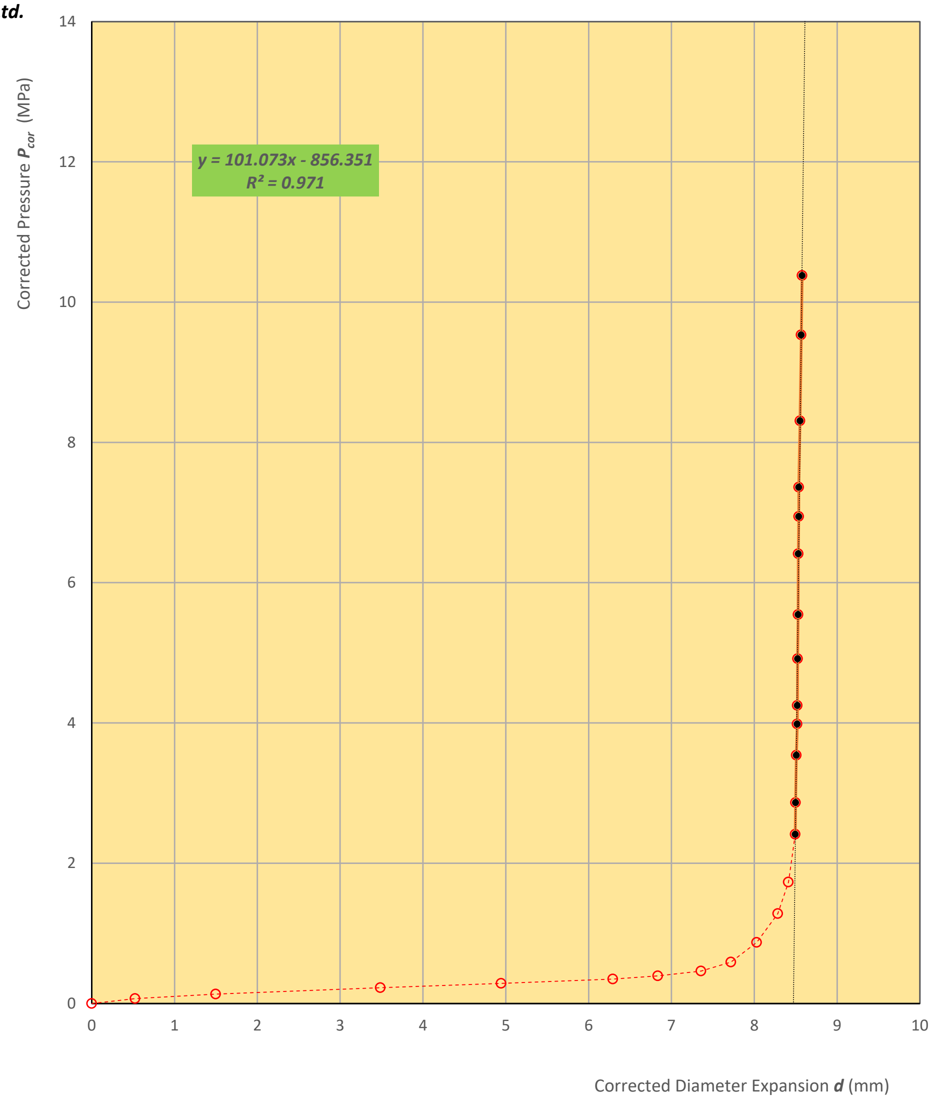
Test No.: ***18***

Test Depth (m): 43.13

Client: ***Golder Associates Ltd.***

Field Data

Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.071	0.524
0.134	1.497
0.226	3.485
0.287	4.944
0.348	6.292
0.394	6.835
0.463	7.357
0.591	7.719
0.870	8.029
1.282	8.284
1.730	8.413
2.412	8.495
2.865	8.499
3.539	8.508
3.985	8.519
4.249	8.521
4.916	8.524
5.545	8.529
6.411	8.531
6.944	8.537
7.361	8.538
8.308	8.553
9.532	8.567
10.380	8.579



$$E = (1+\nu)D_0 \, {}^{P}/_{d}$$

Elastic Modulus (Young's Mod)

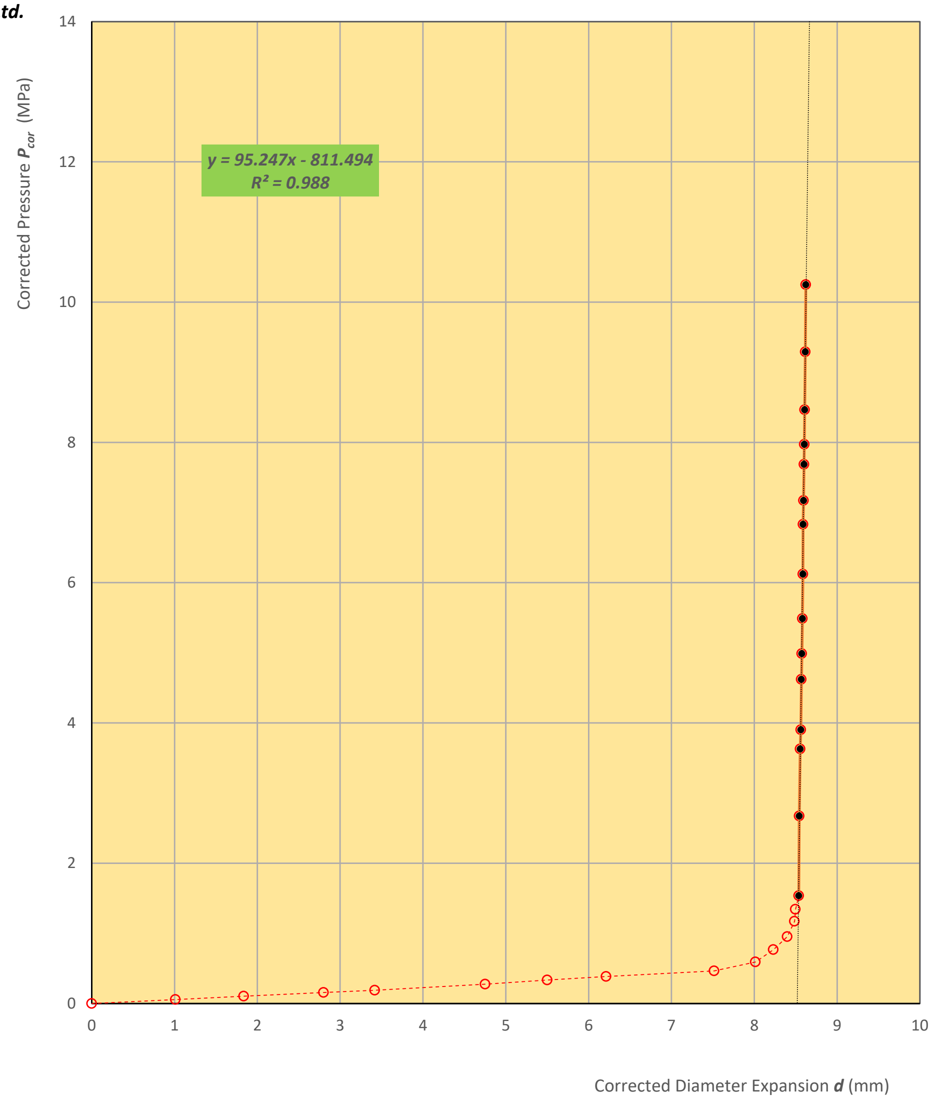
μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*101.073*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *12250.1* *MPa*

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.: **BH203-DMP**
Test No.: **19**
Test Depth (m): 41.61
Client: **Golder Associates Ltd.**

Field Data

Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.056	1.010
0.104	1.835
0.157	2.799
0.189	3.417
0.275	4.750
0.335	5.501
0.385	6.212
0.465	7.516
0.592	8.015
0.769	8.231
0.952	8.398
1.172	8.486
1.344	8.498
1.537	8.537
2.672	8.543
3.630	8.555
3.902	8.562
4.622	8.569
4.988	8.575
5.489	8.582
6.123	8.588
6.832	8.590
7.171	8.595
7.687	8.601
7.972	8.605
8.464	8.609
9.290	8.617
10.249	8.622



$$E = (1+\nu) D_0 \, {}^{P}\!/_{d}$$

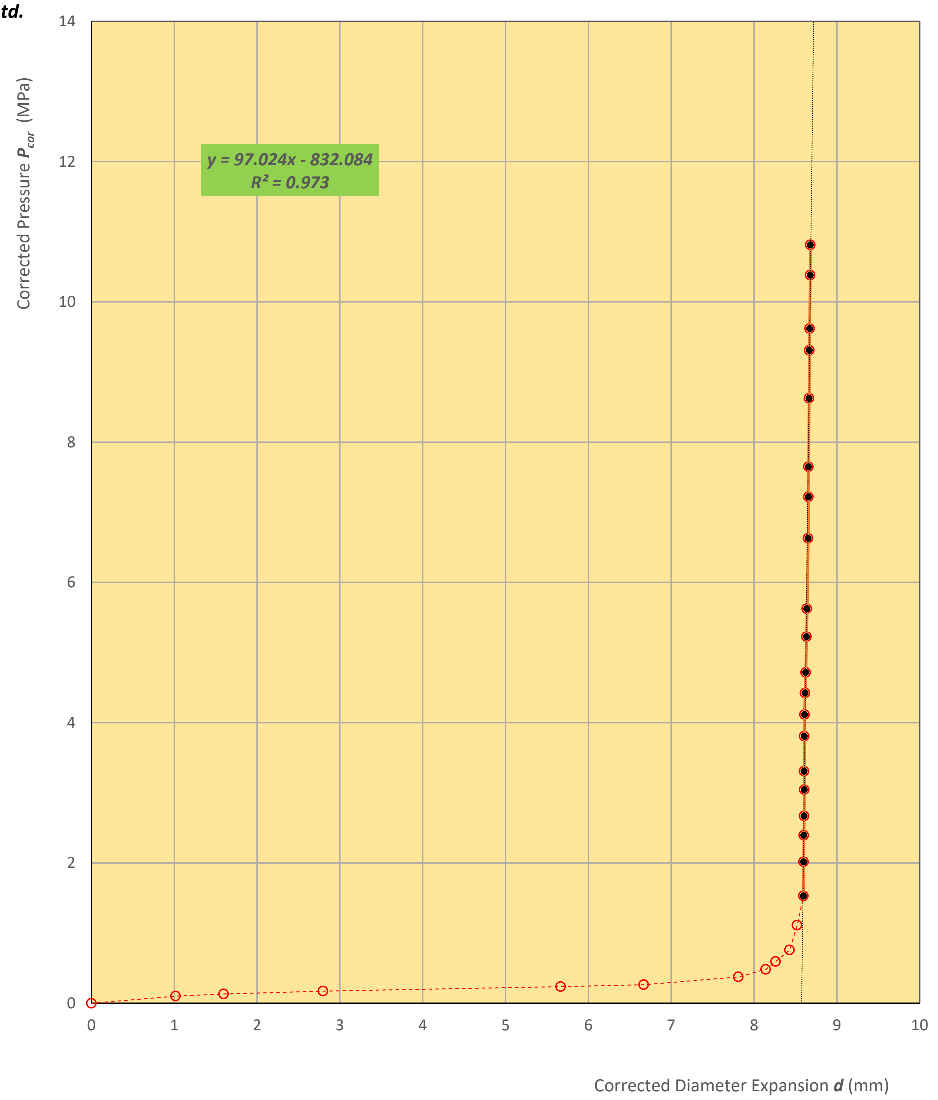
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*95.247*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *11543.9* *MPa*

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.: **BH203-DMP**
Test No.: **20**
Test Depth (m): 40.08
Client: **Golder Associates Ltd.**

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.102	1.017
0.132	1.595
0.172	2.795
0.236	5.667
0.265	6.670
0.375	7.812
0.483	8.141
0.595	8.261
0.760	8.430
1.112	8.521
1.531	8.597
2.016	8.600
2.395	8.602
2.670	8.605
3.046	8.607
3.308	8.606
3.806	8.608
4.115	8.611
4.422	8.616
4.718	8.625
5.225	8.634
5.624	8.639
6.628	8.654
7.219	8.658
7.649	8.658
8.624	8.666
9.310	8.669
9.620	8.672
10.381	8.679
10.812	8.681



$$E = (1+\nu)D_0 \, {}^{P}\!/_{d}$$

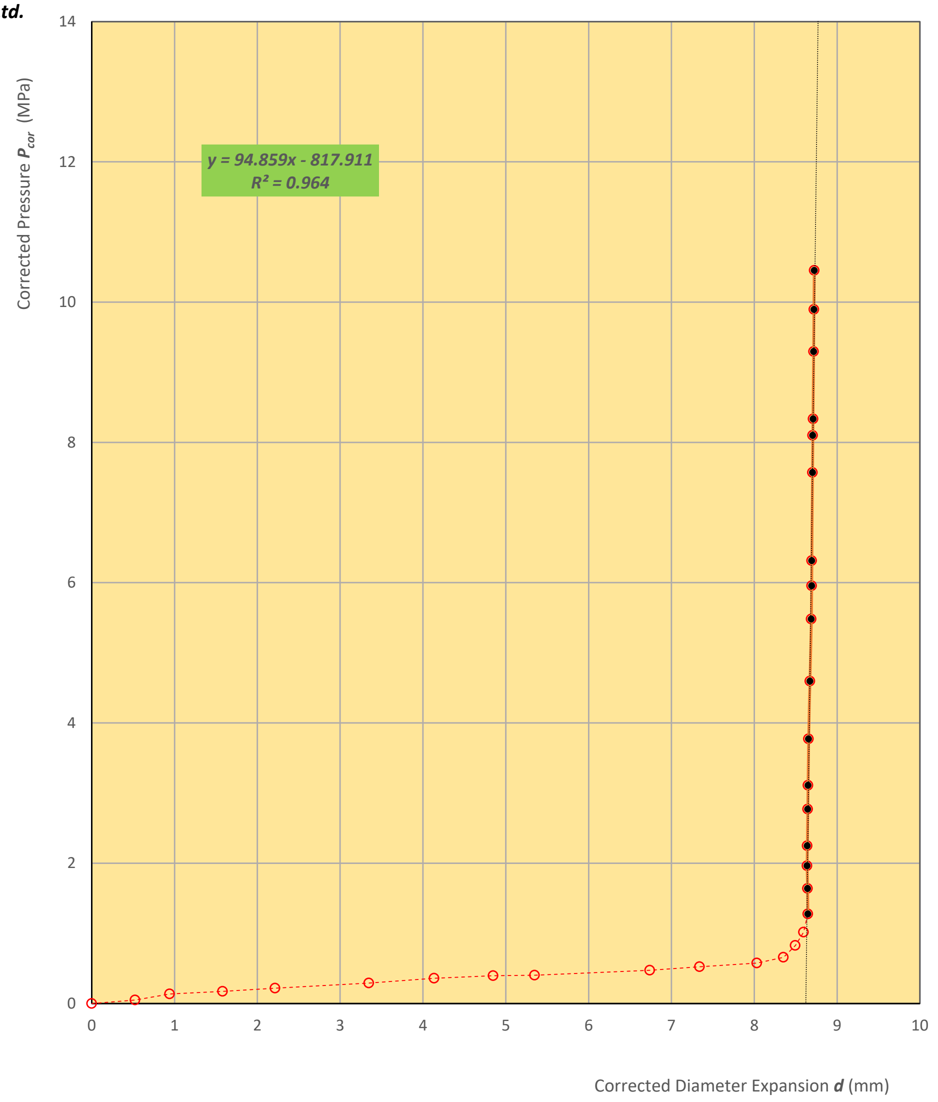
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*97.024*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *11759.3* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH203-DMP***
Test No.: ***21***
Test Depth (m): 38.56
Client: ***Golder Associates Ltd.***

Field Data	
Pressure	Diameter Expansion
P_{cor}	d_{avg}
MPa	mm
0.000	0.000
0.050	0.524
0.137	0.940
0.172	1.580
0.218	2.214
0.292	3.347
0.359	4.135
0.397	4.847
0.403	5.348
0.475	6.738
0.524	7.339
0.576	8.032
0.659	8.353
0.828	8.496
1.017	8.595
1.276	8.648
1.640	8.644
1.964	8.638
2.249	8.641
2.772	8.646
3.112	8.650
3.772	8.656
4.595	8.673
5.481	8.689
5.955	8.694
6.315	8.695
7.570	8.704
8.099	8.706
8.336	8.711
9.295	8.717
9.896	8.721
10.451	8.726



$$E = (1+\nu)D_0 \, {}^{P}\!/_{d}$$

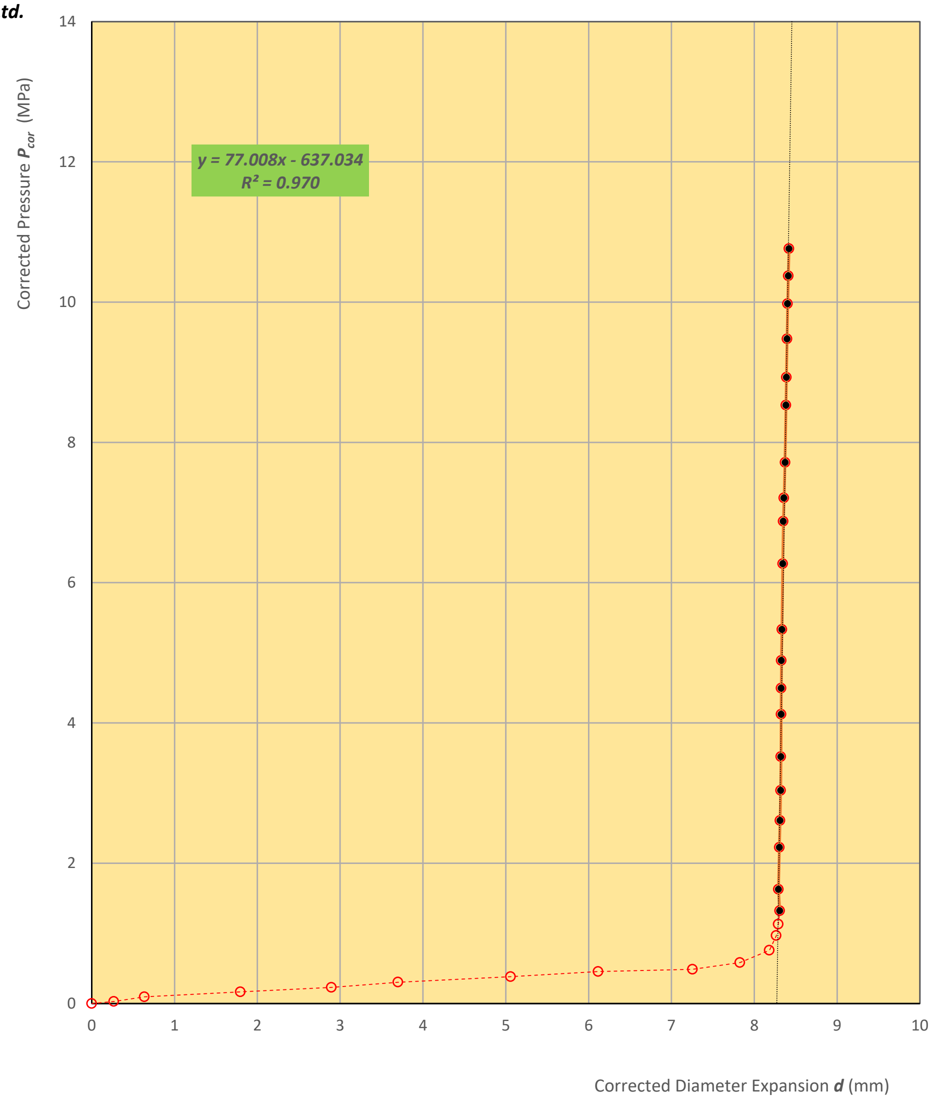
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*94.859*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *11496.9* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH203-DMP***
Test No.: ***22***
Test Depth (m): 37.04
Client: ***Golder Associates Ltd.***

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.029	0.267
0.095	0.635
0.166	1.795
0.230	2.895
0.304	3.698
0.383	5.058
0.456	6.114
0.488	7.254
0.584	7.827
0.759	8.183
0.968	8.266
1.132	8.290
1.322	8.307
1.628	8.293
2.226	8.303
2.610	8.311
3.037	8.320
3.519	8.321
4.125	8.325
4.495	8.326
4.890	8.328
5.332	8.334
6.271	8.344
6.874	8.351
7.208	8.358
7.714	8.373
8.532	8.383
8.928	8.388
9.475	8.397
9.978	8.403
10.375	8.412
10.763	8.419



$$E = (1+\nu)D_0 \, {}^{P}\!/_{d}$$

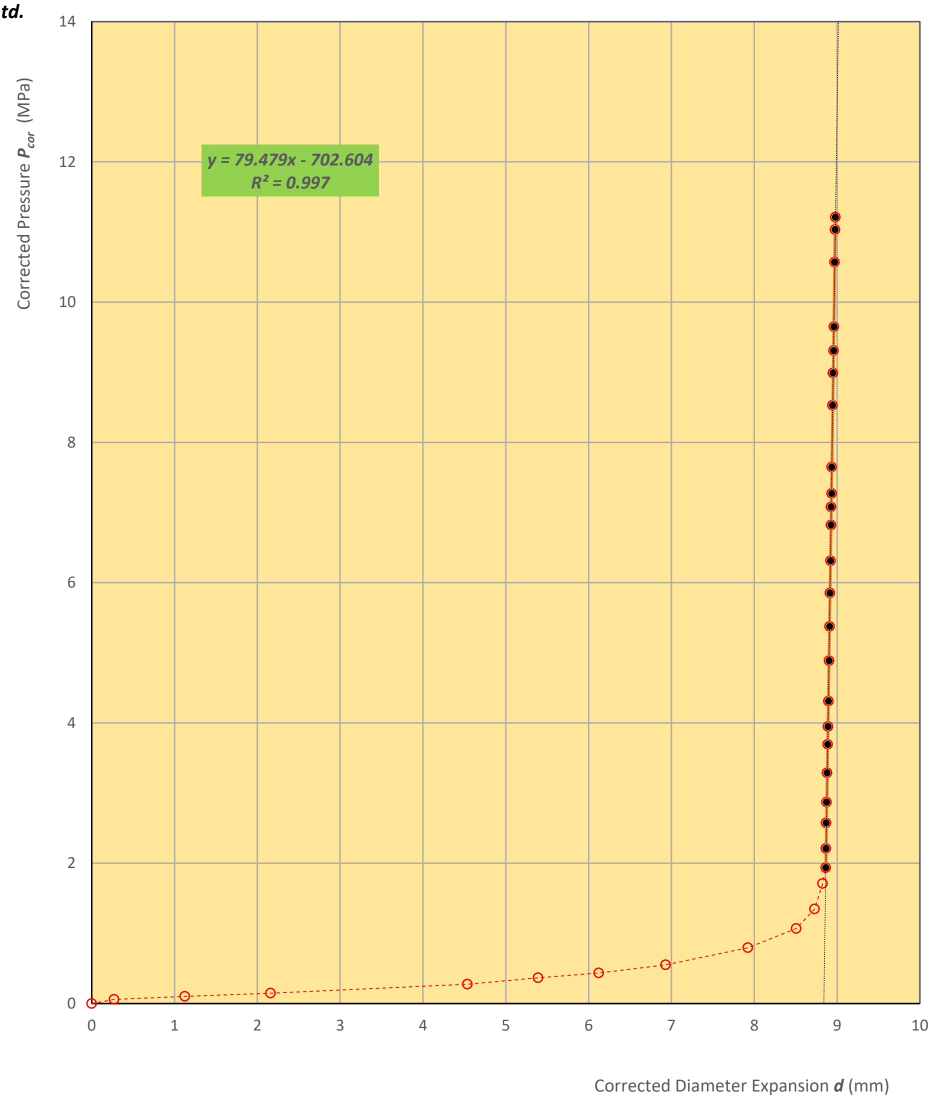
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*77.008*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *9333.3* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH203-DMP***
Test No.: ***23***
Test Depth (m): 35.51
Client: ***Golder Associates Ltd.***

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.059	0.271
0.102	1.124
0.147	2.160
0.276	4.536
0.366	5.391
0.436	6.123
0.551	6.930
0.795	7.923
1.069	8.506
1.347	8.729
1.710	8.825
1.936	8.865
2.211	8.867
2.574	8.869
2.872	8.873
3.288	8.879
3.696	8.887
3.948	8.891
4.312	8.897
4.888	8.904
5.377	8.911
5.853	8.915
6.312	8.922
6.822	8.927
7.080	8.928
7.272	8.935
7.649	8.936
8.529	8.945
8.990	8.951
9.310	8.958
9.648	8.963
10.571	8.971
11.033	8.976
11.211	8.981



$$E = (1+\nu)D_0\,{}^{P}/_{d}$$

Elastic Modulus (Young's Mod)

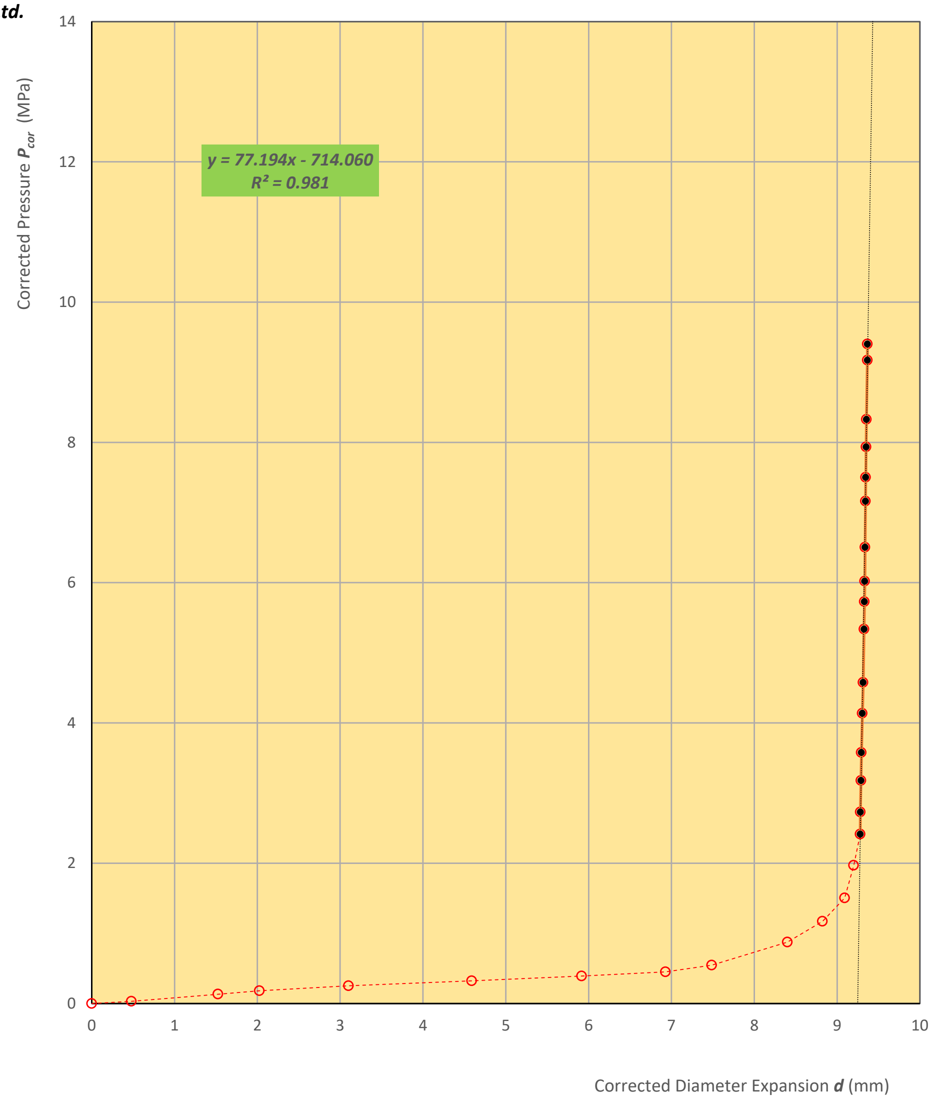
μ =	0.20		*Poisson's ratio*
D_0 =	101	mm	*Initial corehole diameter (before expansion)*
P_{cor}		MPa	*Corrected Pressure for the elastic deformations*
P/d =	79.479	MPa / mm	*Test gradient from Linear elastic portion*

E_Y = *9632.9* MPa

Project:	**DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.:	**BH203-DMP**
Test No.:	**24**
Test Depth (m):	33.99
Client:	**Golder Associates Ltd.**

Field Data

Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.032	0.480
0.133	1.524
0.182	2.024
0.252	3.100
0.323	4.588
0.392	5.915
0.452	6.928
0.547	7.486
0.875	8.400
1.172	8.824
1.504	9.092
1.971	9.201
2.416	9.279
2.731	9.281
3.179	9.289
3.578	9.294
4.138	9.305
4.577	9.315
5.338	9.326
5.731	9.330
6.022	9.334
6.506	9.338
7.162	9.343
7.502	9.346
7.935	9.351
8.328	9.354
9.173	9.366
9.403	9.367



$$E = (1+\nu) D_0 \, {}^{P}\!/_{d}$$

Elastic Modulus (Young's Mod)

μ =	0.20		Poisson's ratio
D_0 =	101	mm	Initial corehole diameter (before expansion)
P_{cor}		MPa	Corrected Pressure for the elastic deformations
P/d =	77.194	MPa / mm	Test gradient from Linear elastic portion

E_Y = 9355.9 MPa

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***

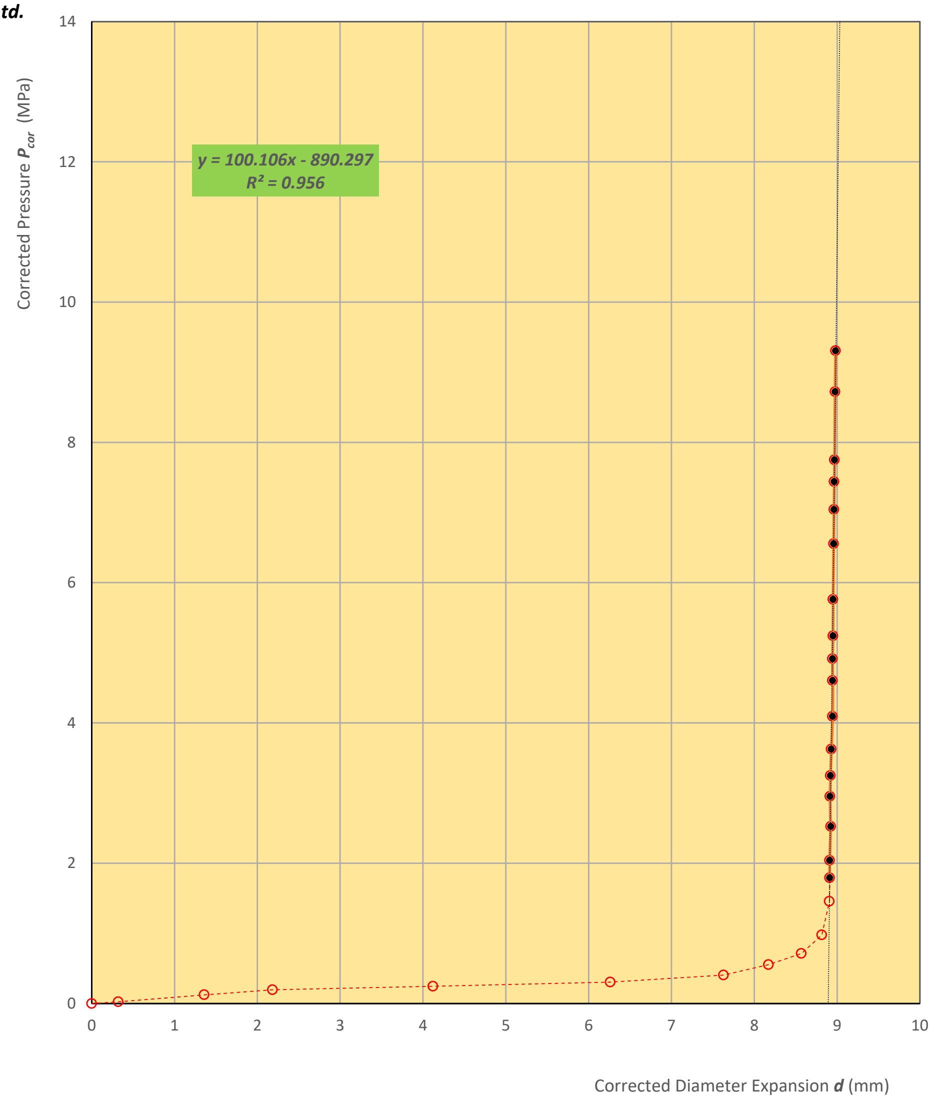
Corehole No.: ***BH203-DMP***

Test No.: ***25***

Test Depth (m): 32.46

Client: ***Golder Associates Ltd.***

Field Data	
Pressure	Diameter Expansion
P_{cor}	d_{avg}
MPa	mm
0.000	0.000
0.024	0.320
0.124	1.358
0.196	2.184
0.246	4.122
0.305	6.262
0.406	7.630
0.554	8.172
0.714	8.569
0.977	8.815
1.458	8.907
1.792	8.911
2.040	8.911
2.524	8.924
2.953	8.915
3.250	8.921
3.627	8.929
4.095	8.946
4.605	8.946
4.915	8.945
5.242	8.951
5.761	8.952
6.556	8.959
7.044	8.963
7.440	8.965
7.752	8.969
8.722	8.976
9.306	8.982



$$E = (1+\nu)D_0 \, {}^{P}\!/_{d}$$

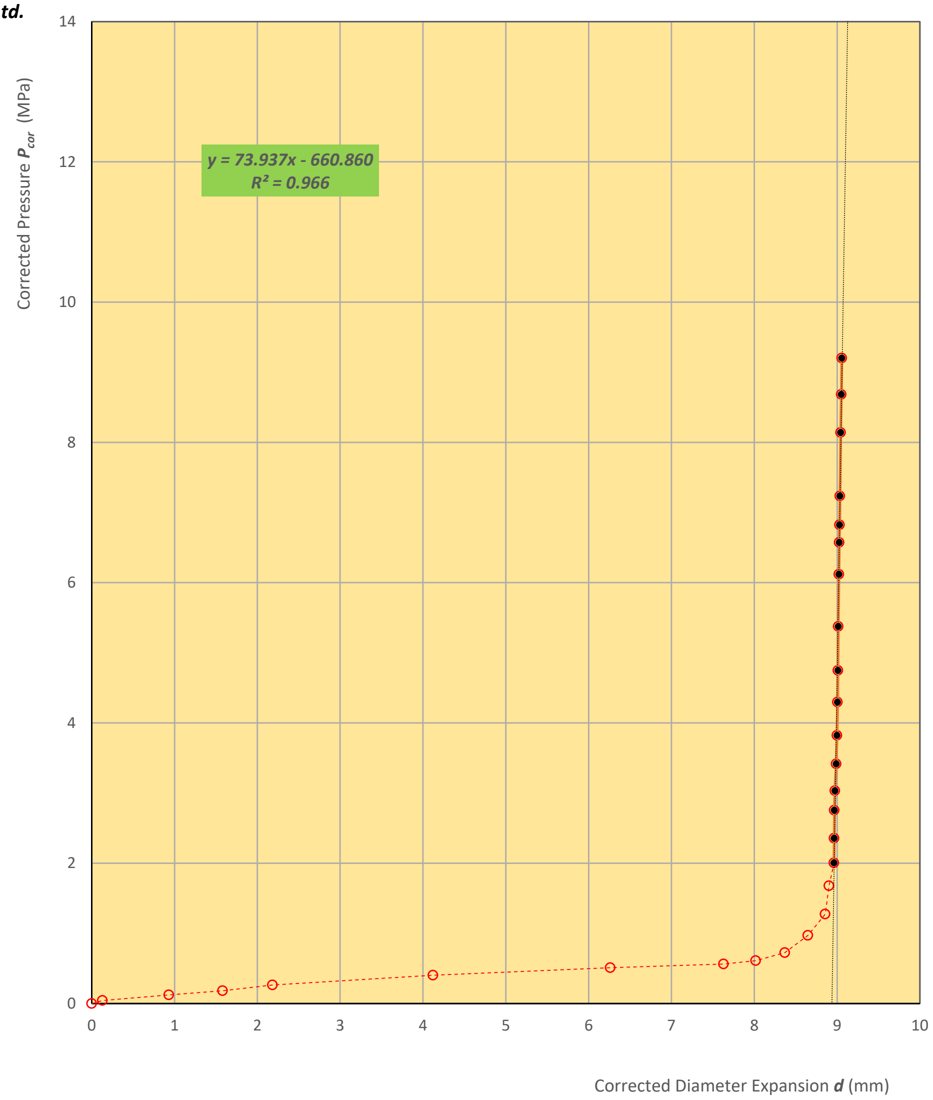
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*100.106*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *12132.9* *MPa*

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.: **BH203-DMP**
Test No.: **26**
Test Depth (m): 30.94
Client: **Golder Associates Ltd.**

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.042	0.130
0.122	0.932
0.182	1.580
0.264	2.184
0.403	4.122
0.511	6.262
0.562	7.630
0.610	8.017
0.726	8.369
0.971	8.647
1.275	8.857
1.679	8.902
2.004	8.963
2.356	8.965
2.756	8.967
3.033	8.974
3.416	8.990
3.822	8.999
4.298	9.006
4.748	9.011
5.377	9.014
6.119	9.022
6.574	9.027
6.825	9.030
7.235	9.035
8.141	9.043
8.685	9.051
9.202	9.057



$$E = (1+\nu)D_0\,{}^{P}\!/_{d}$$

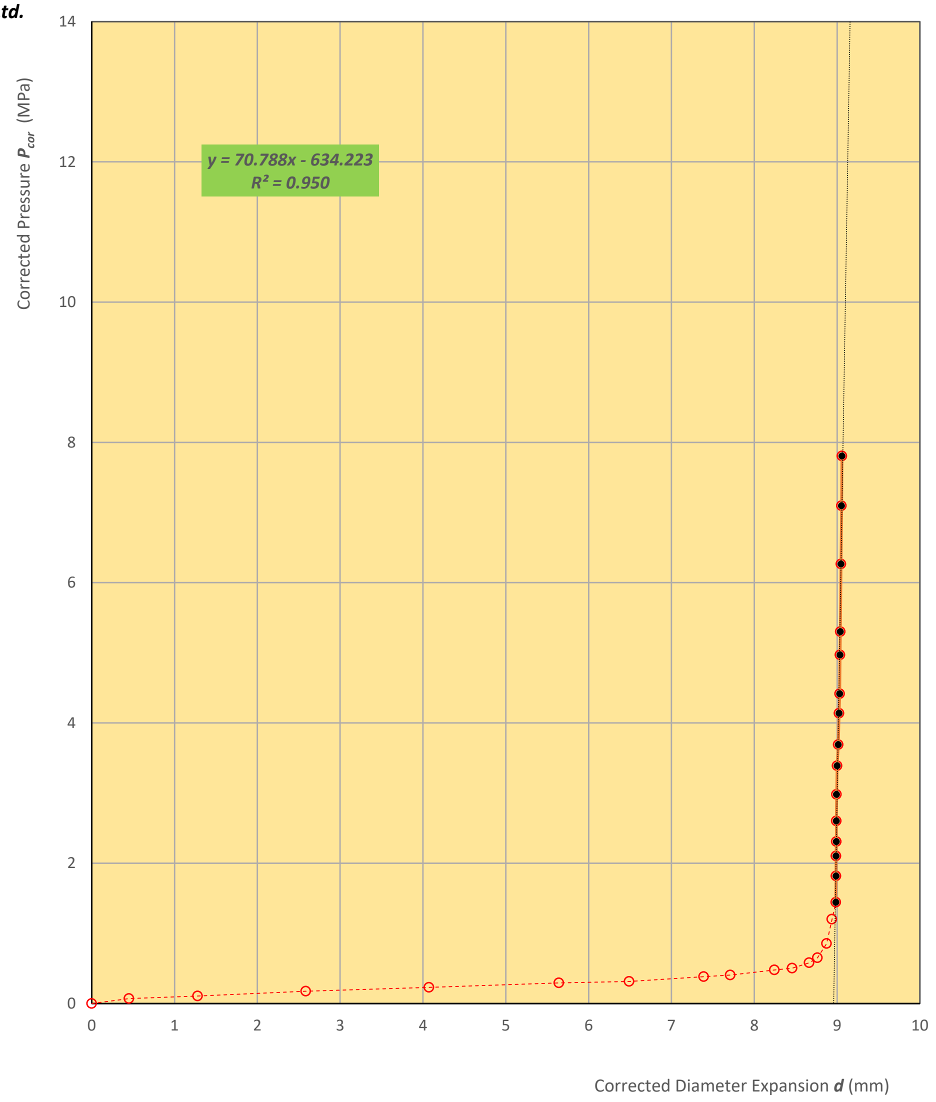
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*73.937*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *8961.2* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH203-DMP***
Test No.: ***27***
Test Depth (m): 29.42
Client: ***Golder Associates Ltd.***

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.070	0.450
0.106	1.279
0.176	2.586
0.230	4.072
0.294	5.641
0.314	6.490
0.382	7.391
0.405	7.710
0.479	8.244
0.503	8.458
0.582	8.664
0.652	8.764
0.856	8.873
1.202	8.938
1.444	8.985
1.818	8.987
2.102	8.988
2.308	8.991
2.602	8.991
2.980	8.994
3.390	9.001
3.691	9.015
4.138	9.024
4.416	9.032
4.970	9.036
5.300	9.040
6.265	9.047
7.096	9.054
7.806	9.059



$$E = (1+\nu)D_0\,{}^{P}\!/_{d}$$

Elastic Modulus (Young's Mod)

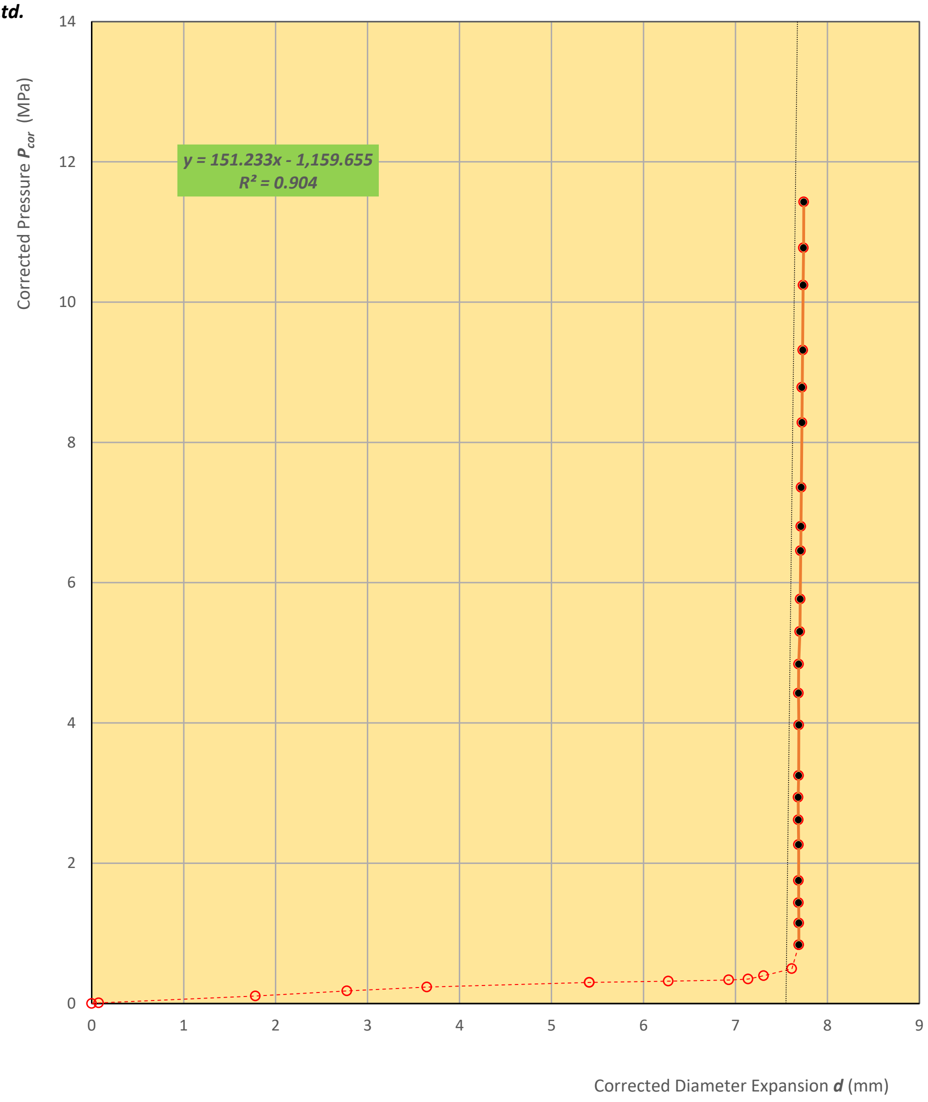
μ	=	0.20		*Poisson's ratio*
D_0	=	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}			*MPa*	*Corrected Pressure for the elastic deformations*
P/d	=	*70.788*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *8579.5* *MPa*

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.: **BH302-DMP**
Test No.: **1**
Test Depth (m): 70.27
Client: **Golder Associates Ltd.**

Field Data

Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.009	0.076
0.106	1.780
0.180	2.775
0.235	3.645
0.301	5.411
0.301	5.411
0.319	6.270
0.336	6.927
0.349	7.138
0.396	7.307
0.497	7.613
0.837	7.689
1.146	7.689
1.437	7.686
1.753	7.686
2.265	7.686
2.618	7.684
2.939	7.682
3.251	7.687
3.971	7.689
4.426	7.685
4.839	7.687
5.303	7.700
5.766	7.704
6.455	7.709
6.802	7.712
7.359	7.716
8.283	7.724
8.785	7.723
9.317	7.732
10.243	7.736
10.774	7.740
11.428	7.743



$$E = (1 + \nu) D_0 \, {}^{P}/_{d}$$

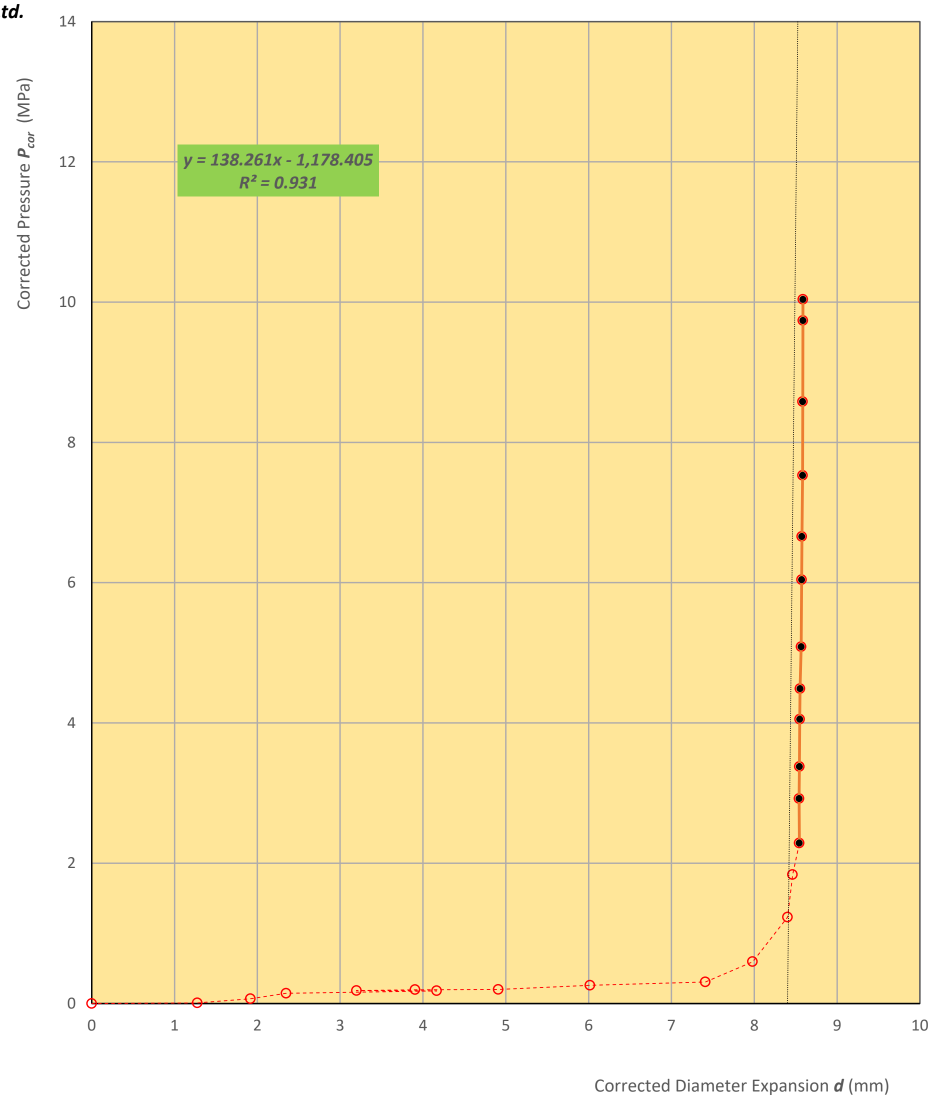
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*151.233*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *18329.5* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH302-DMP***
Test No.: ***2***
Test Depth (m): 68.75
Client: ***Golder Associates Ltd.***

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.009	1.276
0.069	1.916
0.145	2.347
0.181	4.165
0.185	3.197
0.197	3.905
0.201	4.909
0.259	6.016
0.308	7.410
0.596	7.980
1.232	8.402
1.837	8.463
2.288	8.544
2.921	8.541
3.378	8.545
4.054	8.549
4.488	8.553
5.087	8.566
6.043	8.572
6.658	8.575
7.529	8.584
8.582	8.585
9.739	8.587
10.040	8.588



$$E = (1+\nu)D_0\, {}^{P}\!/_{d}$$

Elastic Modulus (Young's Mod)

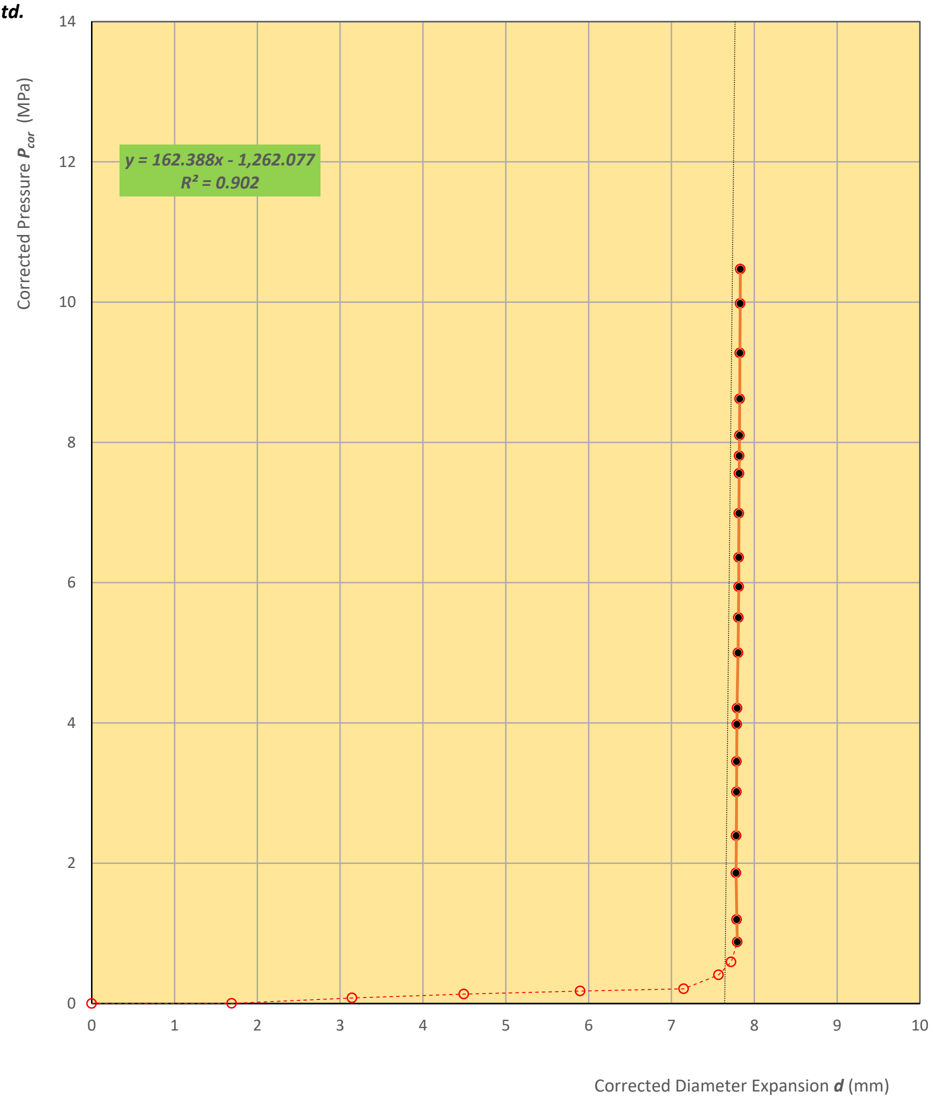
μ	=	0.20		*Poisson's ratio*
D_0	=	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}			*MPa*	*Corrected Pressure for the elastic deformations*
P/d	=	*138.261*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *16757.2* *MPa*

Project:	**DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.:	**BH302-DMP**
Test No.:	**3**
Test Depth (m):	67.22
Client:	**Golder Associates Ltd.**

Field Data

Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.001	1.690
0.079	3.143
0.135	4.494
0.177	5.898
0.209	7.148
0.407	7.570
0.593	7.721
0.877	7.795
1.196	7.789
1.862	7.780
2.392	7.783
3.017	7.786
3.450	7.787
3.981	7.790
4.211	7.794
5.001	7.805
5.502	7.809
5.941	7.813
6.360	7.813
6.990	7.815
7.558	7.817
7.807	7.819
8.099	7.823
8.620	7.824
9.274	7.827
9.980	7.831
10.470	7.833



$$E = (1 + \nu) D_0 \, {}^{P}\!/_{d}$$

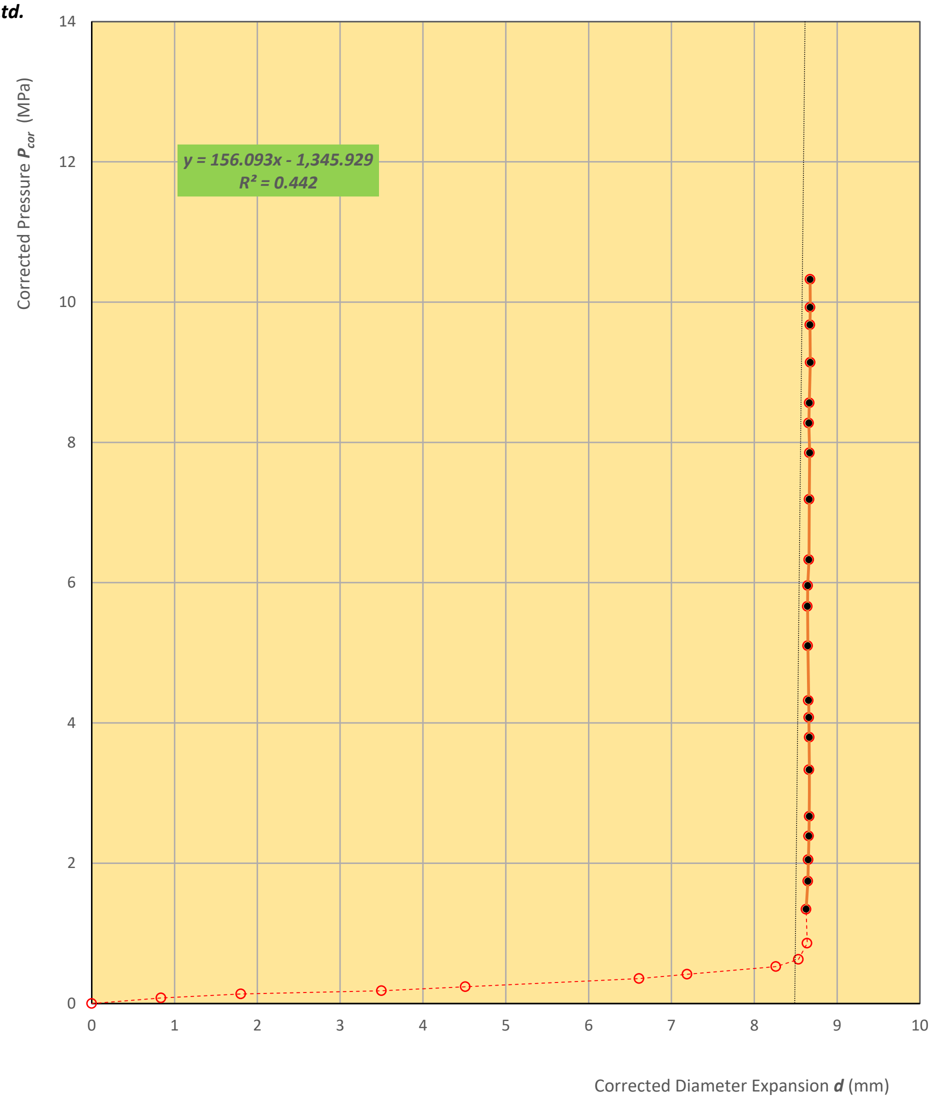
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*162.388*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *19681.4* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH302-DMP***
Test No.: ***4***
Test Depth (m): 65.70
Client: ***Golder Associates Ltd.***

Field Data	
Pressure	Diameter Expansion
P_{cor} MPa	d_{avg} mm
0.000	0.000
0.079	0.836
0.137	1.800
0.182	3.498
0.240	4.512
0.356	6.609
0.416	7.190
0.527	8.262
0.630	8.534
0.860	8.639
1.344	8.626
1.744	8.648
2.050	8.652
2.388	8.658
2.669	8.665
3.332	8.662
3.795	8.665
4.078	8.659
4.321	8.654
5.100	8.646
5.662	8.642
5.957	8.645
6.327	8.659
7.187	8.663
7.851	8.668
8.276	8.658
8.563	8.665
9.140	8.676
9.677	8.672
9.925	8.675
10.324	8.674



$$E = (1+\nu)D_0 \, {}^{P}\!/_{d}$$

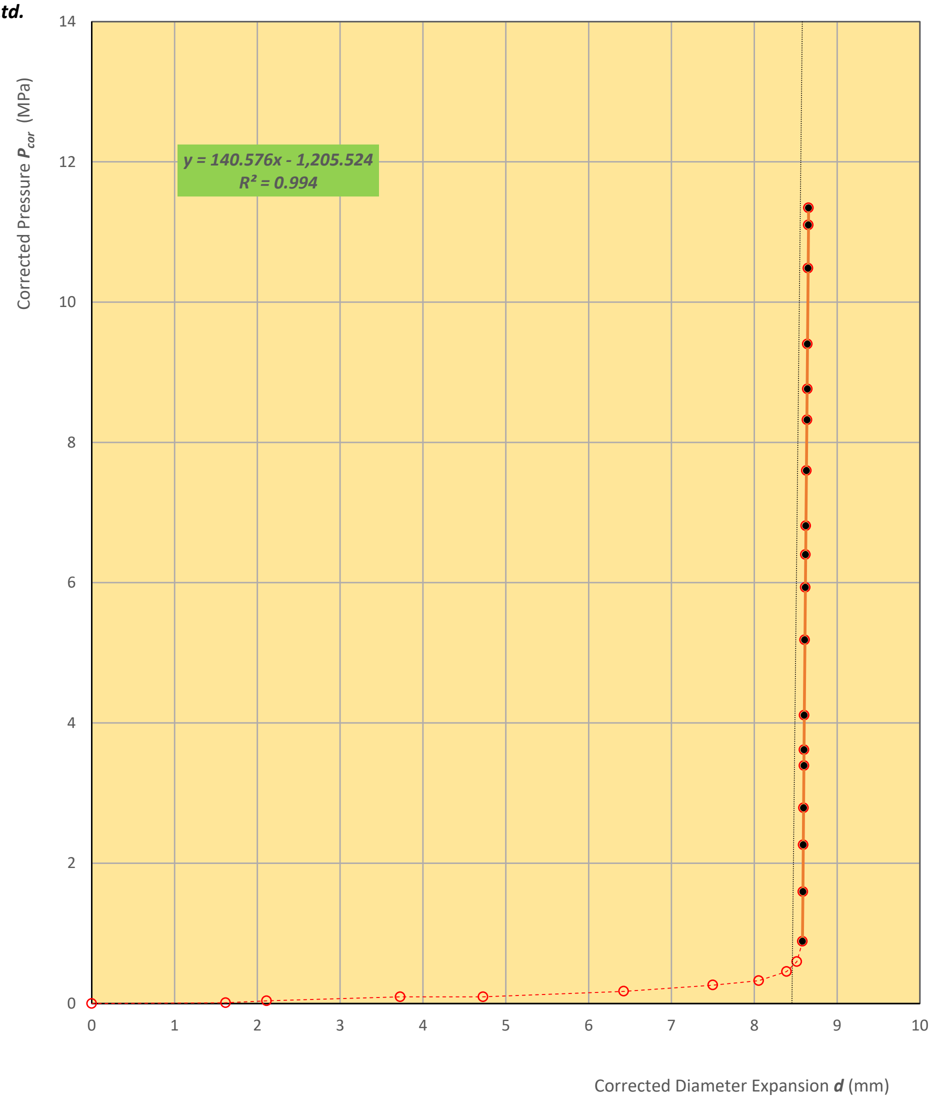
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*156.093*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *18918.5* *MPa*

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.: **BH302-DMP**
Test No.: **5**
Test Depth (m): 64.17
Client: **Golder Associates Ltd.**

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.011	1.617
0.039	2.111
0.095	3.725
0.095	4.725
0.174	6.424
0.263	7.501
0.325	8.054
0.456	8.390
0.597	8.514
0.887	8.583
1.595	8.588
2.263	8.592
2.790	8.596
3.391	8.601
3.617	8.602
4.110	8.603
5.185	8.610
5.933	8.616
6.401	8.619
6.811	8.622
7.599	8.630
8.321	8.638
8.762	8.642
9.402	8.642
10.483	8.650
11.099	8.654
11.343	8.655



$$E = (1+\nu)D_0 \, {}^{P}/_{d}$$

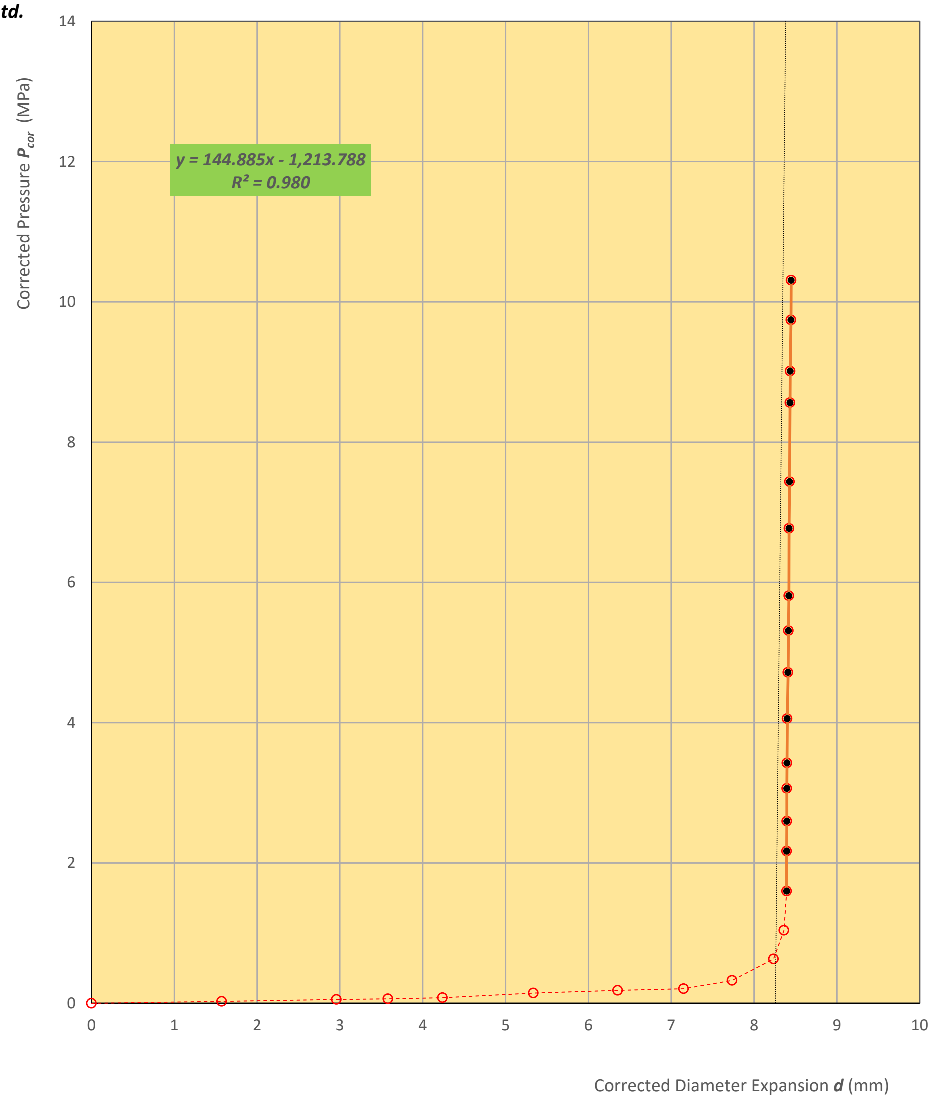
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*140.576*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *17037.8* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH302-DMP***
Test No.: ***6***
Test Depth (m): 62.65
Client: ***Golder Associates Ltd.***

Field Data	
Pressure	Diameter Expansion
P_{cor} MPa	d_{avg} mm
0.000	0.000
0.026	1.573
0.054	2.958
0.064	3.580
0.079	4.238
0.146	5.337
0.184	6.355
0.208	7.151
0.326	7.735
0.631	8.236
1.040	8.362
1.598	8.394
2.170	8.395
2.596	8.396
3.062	8.396
3.426	8.398
4.058	8.401
4.717	8.411
5.312	8.415
5.810	8.422
6.769	8.423
7.436	8.429
8.563	8.435
9.012	8.437
9.742	8.447
10.309	8.449



$$E = (1+\nu)D_0 \, {}^{P}\!/_{d}$$

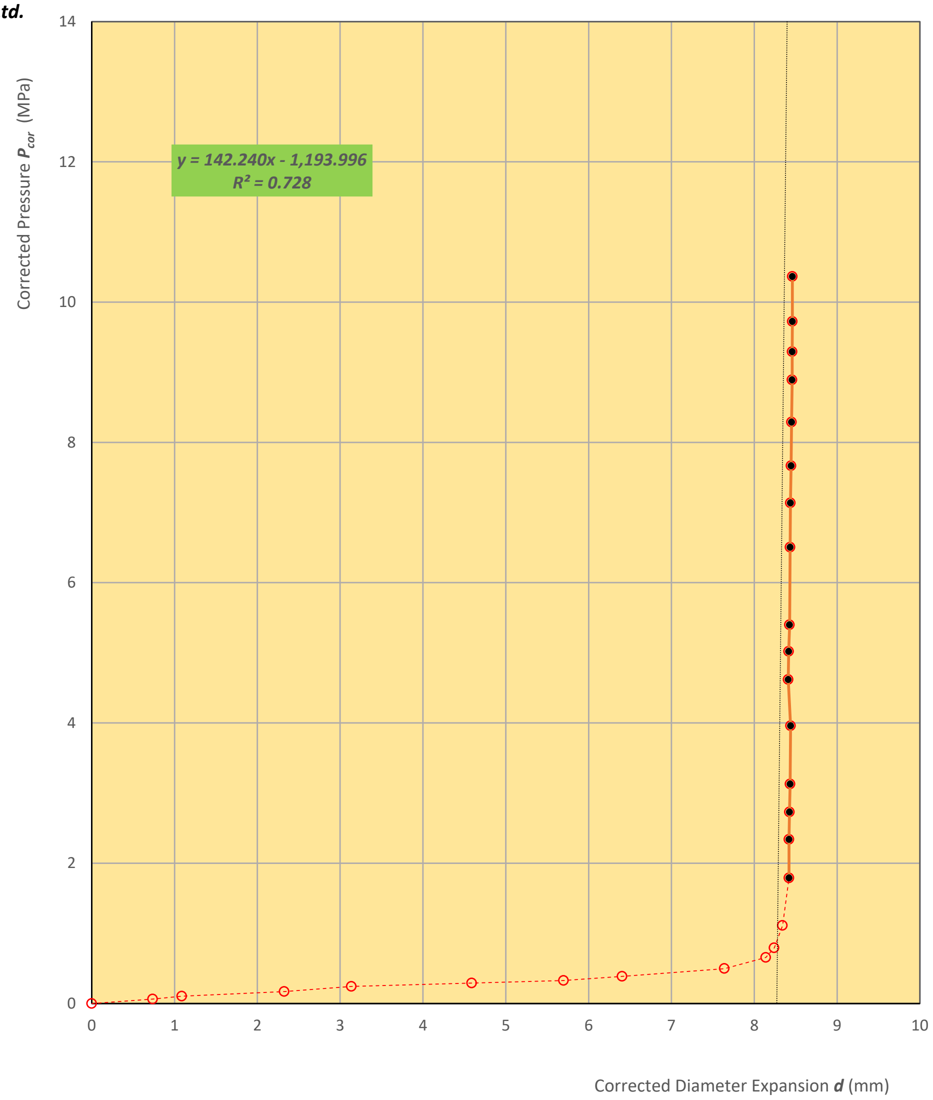
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*144.885*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *17560.0* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH302-DMP***
Test No.: ***7***
Test Depth (m): 61.13
Client: ***Golder Associates Ltd.***

Field Data	
Pressure	Diameter Expansion
P_{cor}	d_{avg}
MPa	mm
0.000	0.000
0.064	0.737
0.104	1.087
0.171	2.325
0.244	3.136
0.292	4.589
0.328	5.697
0.388	6.405
0.498	7.640
0.657	8.140
0.794	8.241
1.112	8.341
1.791	8.419
2.340	8.420
2.731	8.425
3.129	8.433
3.960	8.439
4.619	8.411
5.021	8.415
5.399	8.426
6.506	8.433
7.137	8.437
7.666	8.444
8.290	8.450
8.891	8.457
9.294	8.458
9.725	8.461
10.366	8.461



$$E = (1+\nu)D_0 \,{}^{P}\!/_{d}$$

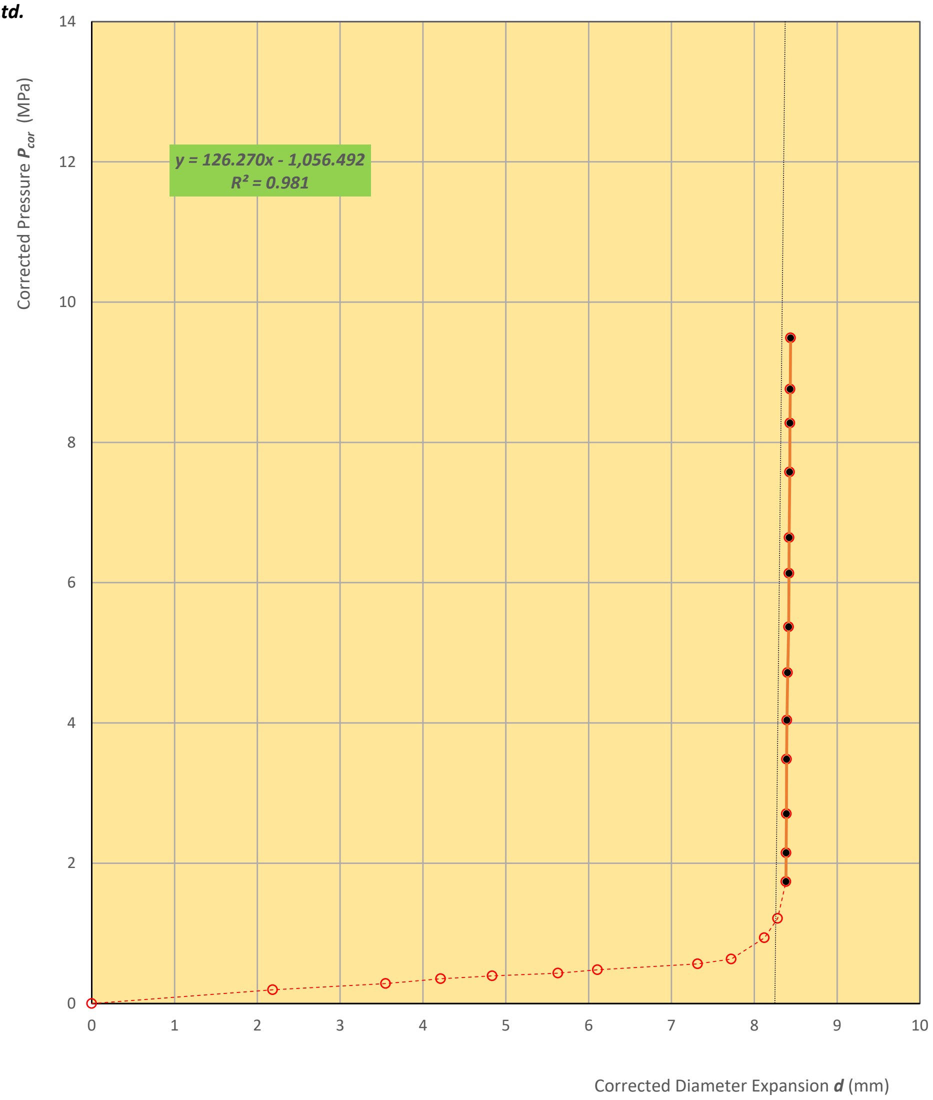
Elastic Modulus (Young's Mod)

μ	=	0.20		*Poisson's ratio*
D_0	=	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}			*MPa*	*Corrected Pressure for the elastic deformations*
P/d	=	*142.240*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = 17239.5 MPa

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.: **BH302-DMP**
Test No.: **8**
Test Depth (m): 59.60
Client: **Golder Associates Ltd.**

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.196	2.186
0.285	3.550
0.354	4.213
0.395	4.836
0.434	5.630
0.480	6.108
0.566	7.316
0.634	7.722
0.937	8.123
1.212	8.283
1.738	8.383
2.149	8.385
2.706	8.388
3.483	8.391
4.040	8.395
4.718	8.403
5.369	8.415
6.134	8.419
6.642	8.421
7.578	8.428
8.275	8.431
8.760	8.434
9.489	8.440



$$E = (1 + \nu) D_0 \, {}^{P}\!/_{d}$$

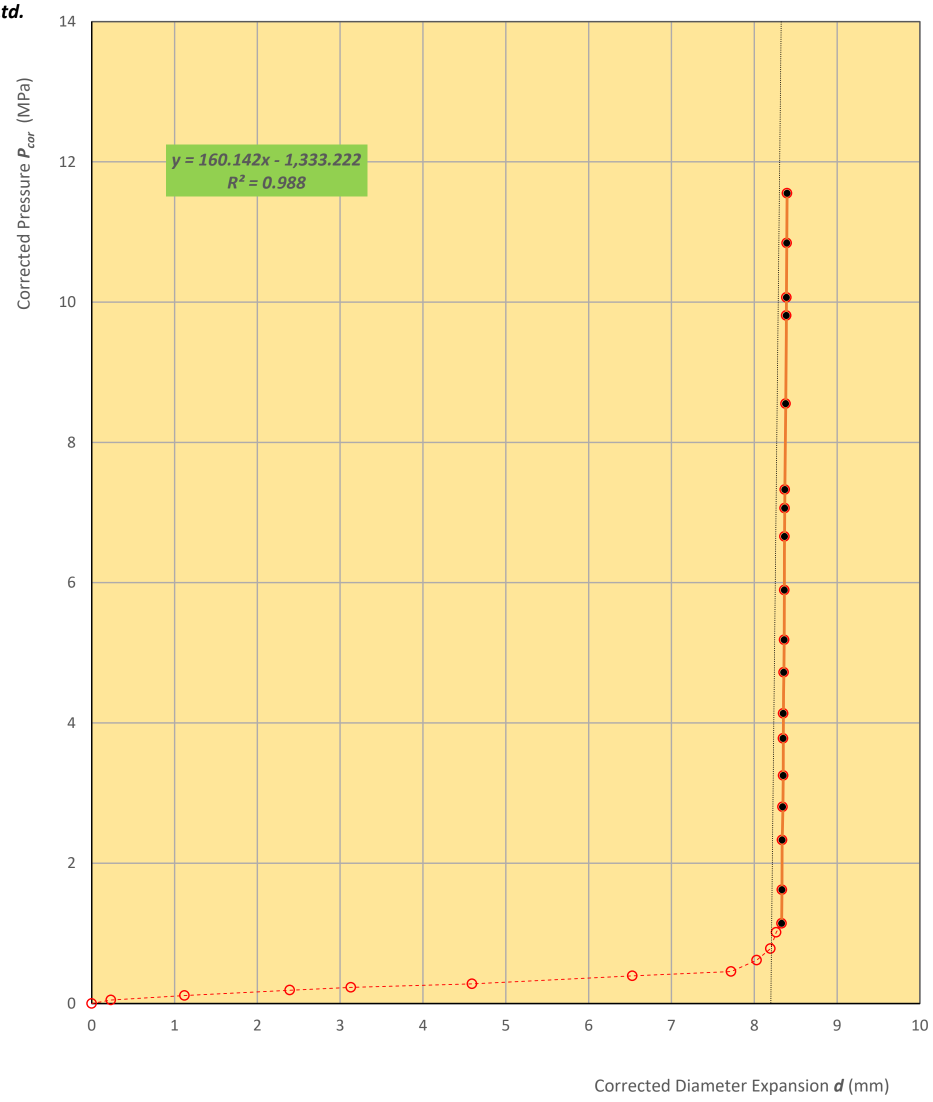
Elastic Modulus (Young's Mod)

μ	=	0.20		*Poisson's ratio*
D_0	=	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}			*MPa*	*Corrected Pressure for the elastic deformations*
P/d	=	*126.270*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *15303.9* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH302-DMP***
Test No.: ***9***
Test Depth (m): 58.08
Client: ***Golder Associates Ltd.***

Field Data	
Pressure	Diameter Expansion
P_{cor}	d_{avg}
MPa	mm
0.000	0.000
0.050	0.231
0.114	1.120
0.190	2.392
0.229	3.129
0.280	4.593
0.395	6.529
0.456	7.720
0.618	8.029
0.783	8.195
1.014	8.265
1.143	8.331
1.622	8.335
2.330	8.336
2.804	8.343
3.250	8.351
3.780	8.349
4.135	8.351
4.721	8.357
5.185	8.361
5.894	8.363
6.658	8.365
7.061	8.367
7.326	8.369
8.552	8.380
9.809	8.387
10.066	8.388
10.841	8.392
11.551	8.396



$$E = (1+\nu)D_0 \, {}^{P}\!/_{d}$$

Elastic Modulus (Young's Mod)

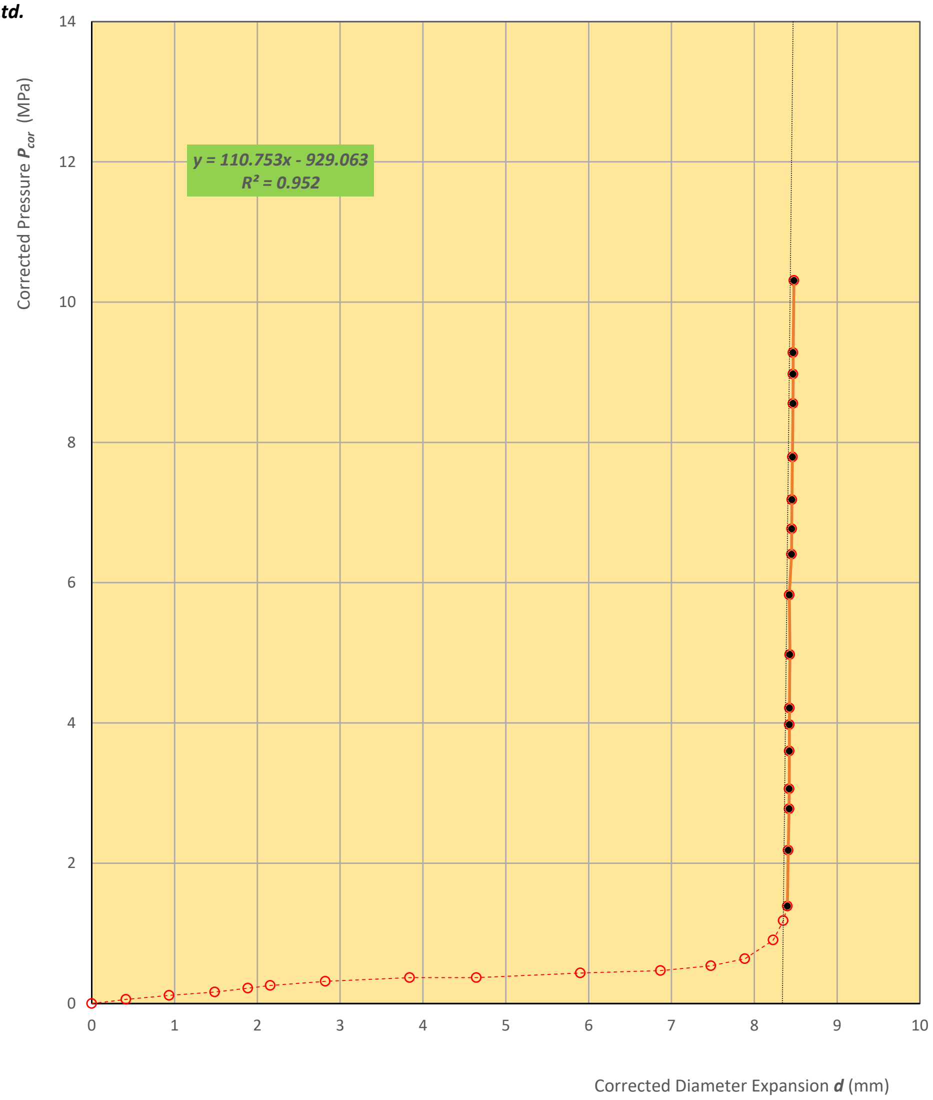
μ	=	0.20		*Poisson's ratio*
D_0	=	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}			*MPa*	*Corrected Pressure for the elastic deformations*
P/d	=	*160.142*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *19409.2* *MPa*

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.: **BH302-DMP**
Test No.: **10**
Test Depth (m): 56.55
Client: **Golder Associates Ltd.**

Field Data

Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.059	0.414
0.116	0.935
0.164	1.486
0.219	1.885
0.258	2.156
0.316	2.821
0.369	3.838
0.369	4.645
0.436	5.900
0.470	6.868
0.537	7.477
0.638	7.886
0.904	8.228
1.180	8.350
1.388	8.401
2.184	8.410
2.776	8.421
3.060	8.421
3.599	8.423
3.976	8.424
4.214	8.426
4.974	8.430
5.826	8.424
6.406	8.451
6.767	8.453
7.182	8.454
7.792	8.462
8.555	8.468
8.974	8.468
9.280	8.469
10.308	8.479



$$E = (1+\nu)D_0 \, {}^{P}\!/_{d}$$

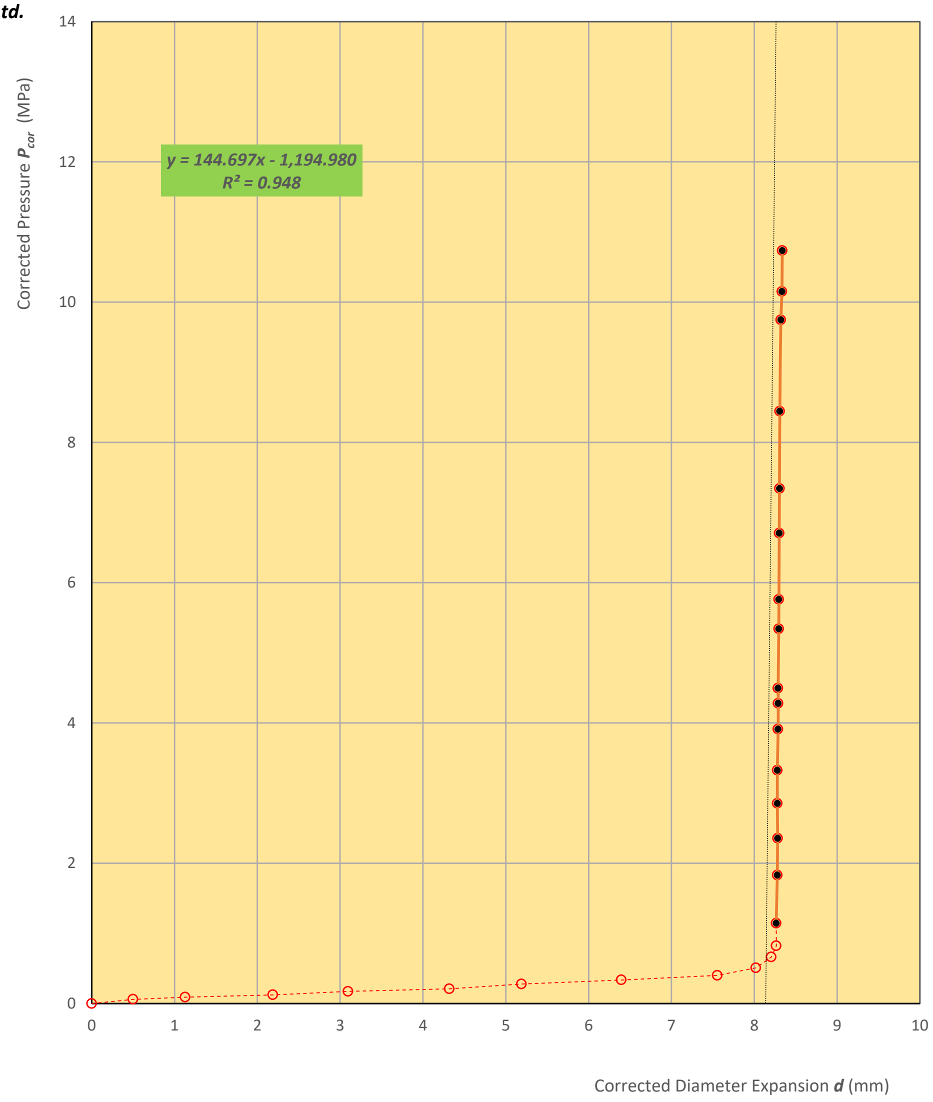
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*110.753*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *13423.3* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH302-DMP***
Test No.: ***11***
Test Depth (m): 55.03
Client: ***Golder Associates Ltd.***

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.060	0.499
0.091	1.129
0.124	2.188
0.173	3.095
0.209	4.318
0.277	5.189
0.336	6.395
0.401	7.554
0.509	8.020
0.663	8.206
0.822	8.266
1.144	8.265
1.832	8.279
2.357	8.283
2.854	8.279
3.326	8.278
3.911	8.287
4.280	8.289
4.496	8.287
5.342	8.296
5.762	8.296
6.707	8.302
7.342	8.305
8.445	8.308
9.747	8.321
10.150	8.334
10.735	8.338



$$E = (1 + \nu) D_0 \, {}^{P}/_{d}$$

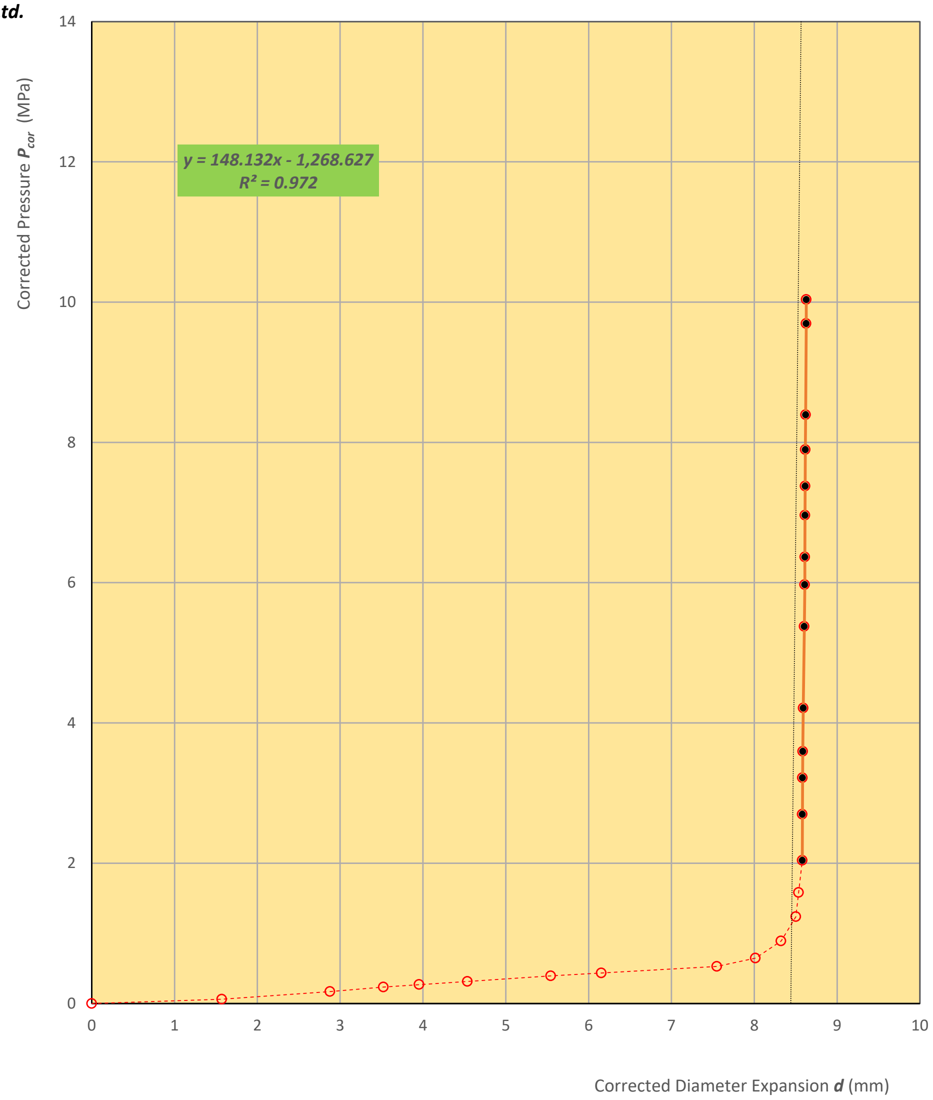
Elastic Modulus (Young's Mod)

μ =	0.20			*Poisson's ratio*
D_0 =	101	*mm*		*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*		*Corrected Pressure for the elastic deformations*
P/d =	*144.697*	*MPa / mm*		*Test gradient from Linear elastic portion*

E_Y = *17537.3* *MPa*

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.: **BH302-DMP**
Test No.: **12**
Test Depth (m): 53.51
Client: **Golder Associates Ltd.**

Field Data	
Pressure	Diameter Expansion
P_{cor}	d_{avg}
MPa	mm
0.000	0.000
0.062	1.570
0.171	2.877
0.234	3.523
0.270	3.953
0.314	4.536
0.394	5.543
0.436	6.154
0.529	7.549
0.647	8.015
0.892	8.324
1.239	8.502
1.582	8.535
2.041	8.580
2.698	8.581
3.219	8.583
3.595	8.586
4.212	8.591
5.376	8.604
5.971	8.610
6.367	8.611
6.961	8.613
7.378	8.614
7.897	8.616
8.394	8.620
9.694	8.627
10.036	8.628



$$E = (1+\nu)D_0\,{}^{P}/_{d}$$

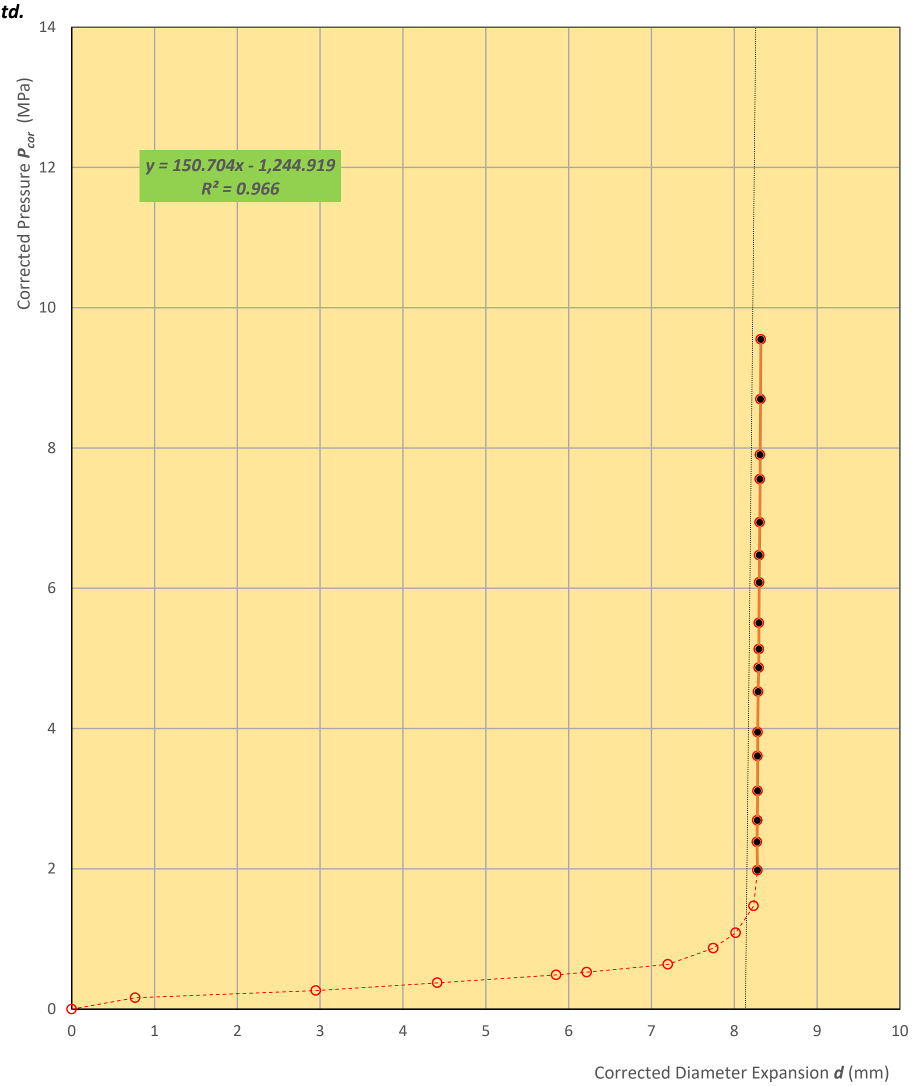
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*148.132*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *17953.6* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH302-DMP***
Test No.: ***13***
Test Depth (m): 51.98
Client: ***Golder Associates Ltd.***

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.161	0.766
0.264	2.948
0.375	4.415
0.487	5.851
0.527	6.219
0.639	7.198
0.869	7.747
1.087	8.018
1.471	8.234
1.980	8.281
2.383	8.275
2.691	8.279
3.111	8.282
3.608	8.281
3.948	8.282
4.525	8.289
4.869	8.296
5.131	8.298
5.506	8.298
6.083	8.302
6.471	8.303
6.942	8.308
7.556	8.310
7.903	8.313
8.695	8.318
9.548	8.322



$$E = (1+\nu)D_0\, {}^{P}\!/_{d}$$

Elastic Modulus (Young's Mod)

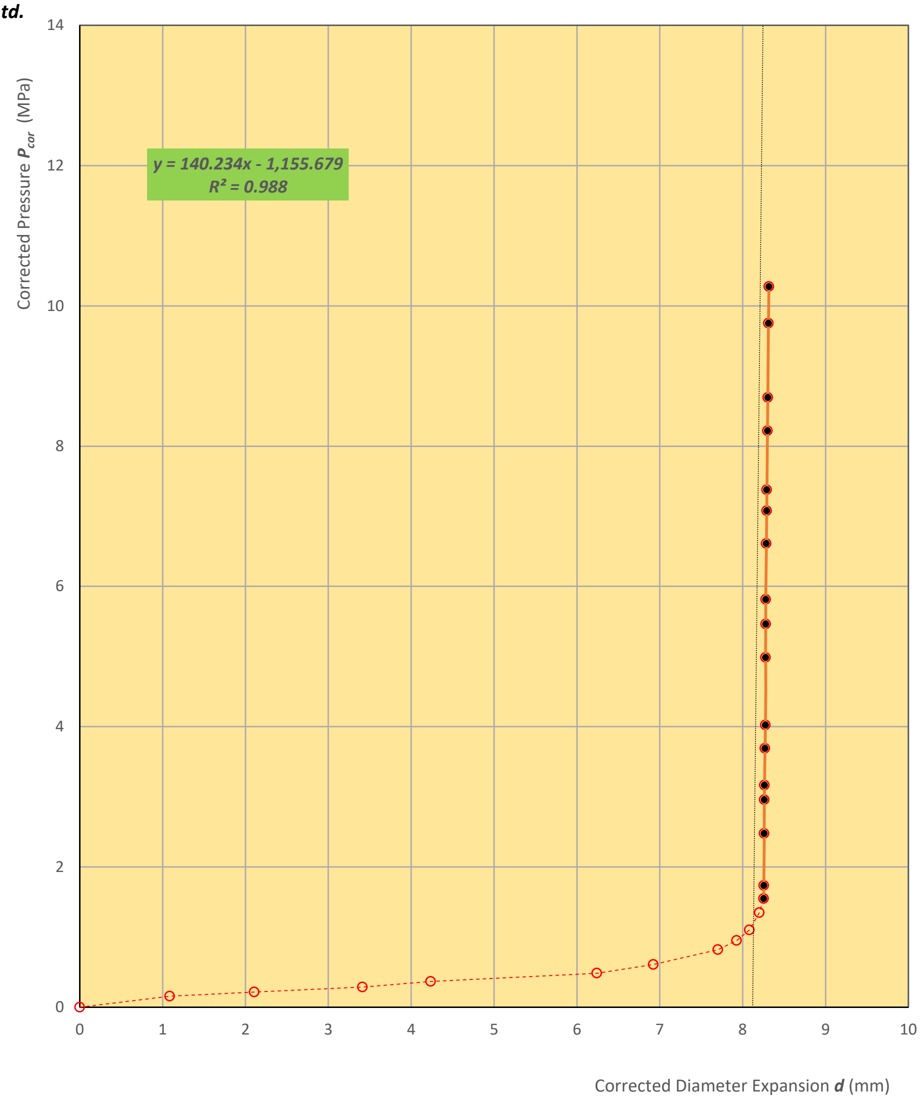
μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*150.704*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *18265.3* *MPa*

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.: **BH302-DMP**
Test No.: **14**
Test Depth (m): 50.46
Client: **Golder Associates Ltd.**

Field Data

Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.157	1.086
0.217	2.106
0.288	3.412
0.368	4.235
0.485	6.241
0.609	6.923
0.822	7.702
0.951	7.928
1.102	8.082
1.349	8.201
1.549	8.253
1.737	8.255
2.478	8.260
2.959	8.261
3.167	8.263
3.692	8.270
4.025	8.274
4.986	8.276
5.463	8.278
5.815	8.279
6.610	8.285
7.078	8.291
7.377	8.291
8.220	8.300
8.695	8.303
9.753	8.312



$$E = (1+\nu)D_0 \, {}^{P}\!/_{d}$$

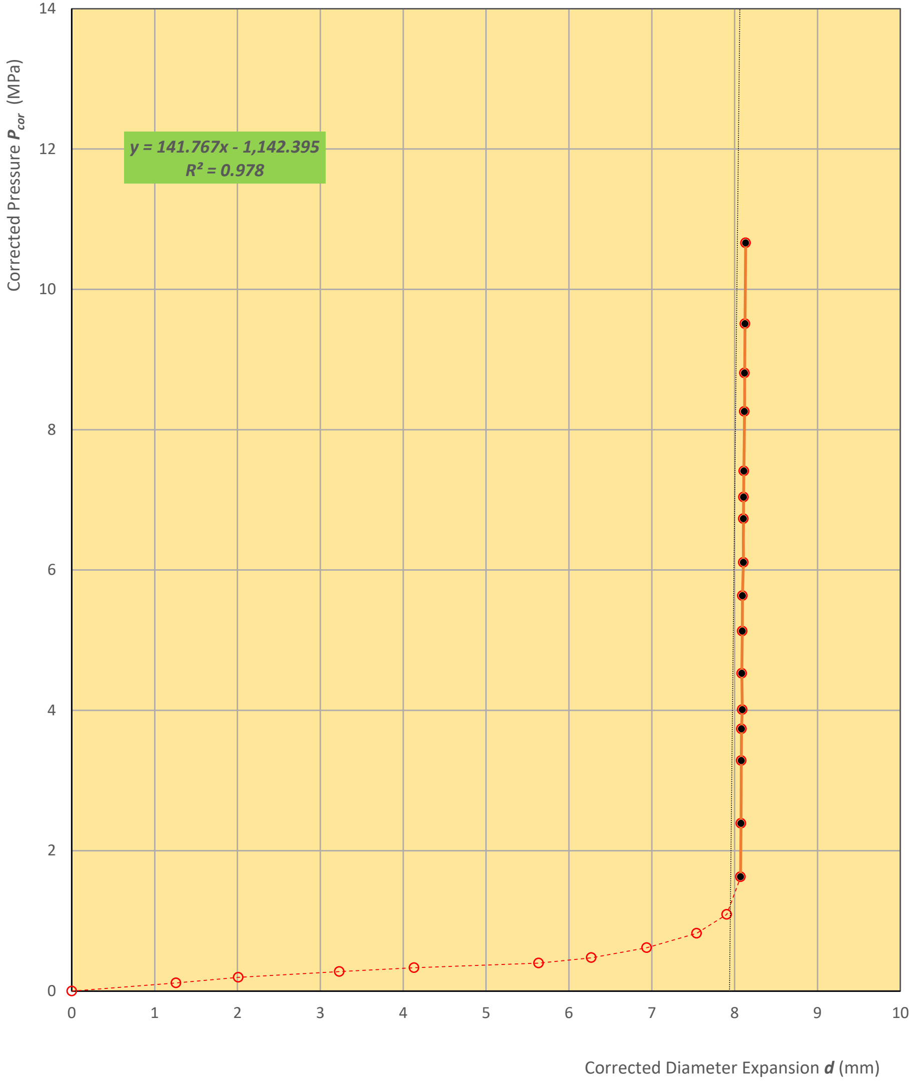
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*140.234*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *16996.3* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH302-DMP***
Test No.: ***15***
Test Depth (m): 48.93
Client: ***Golder Associates Ltd.***

Field Data	
Pressure	Diameter Expansion
P_{cor} MPa	d_{avg} mm
0.000	0.000
0.115	1.259
0.195	2.011
0.278	3.229
0.333	4.131
0.398	5.635
0.475	6.270
0.617	6.939
0.822	7.542
1.093	7.904
1.628	8.072
2.390	8.077
3.285	8.080
3.735	8.083
4.009	8.092
4.527	8.086
5.129	8.092
5.633	8.094
6.108	8.106
6.731	8.106
7.039	8.107
7.411	8.111
8.260	8.118
8.807	8.120
9.509	8.125
10.661	8.132



$$E = (1+\nu)D_0\,{}^{P}\!/_{d}$$

Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*141.767*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = 17182.2 MPa

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***

Corehole No.: ***BH302-DMP***

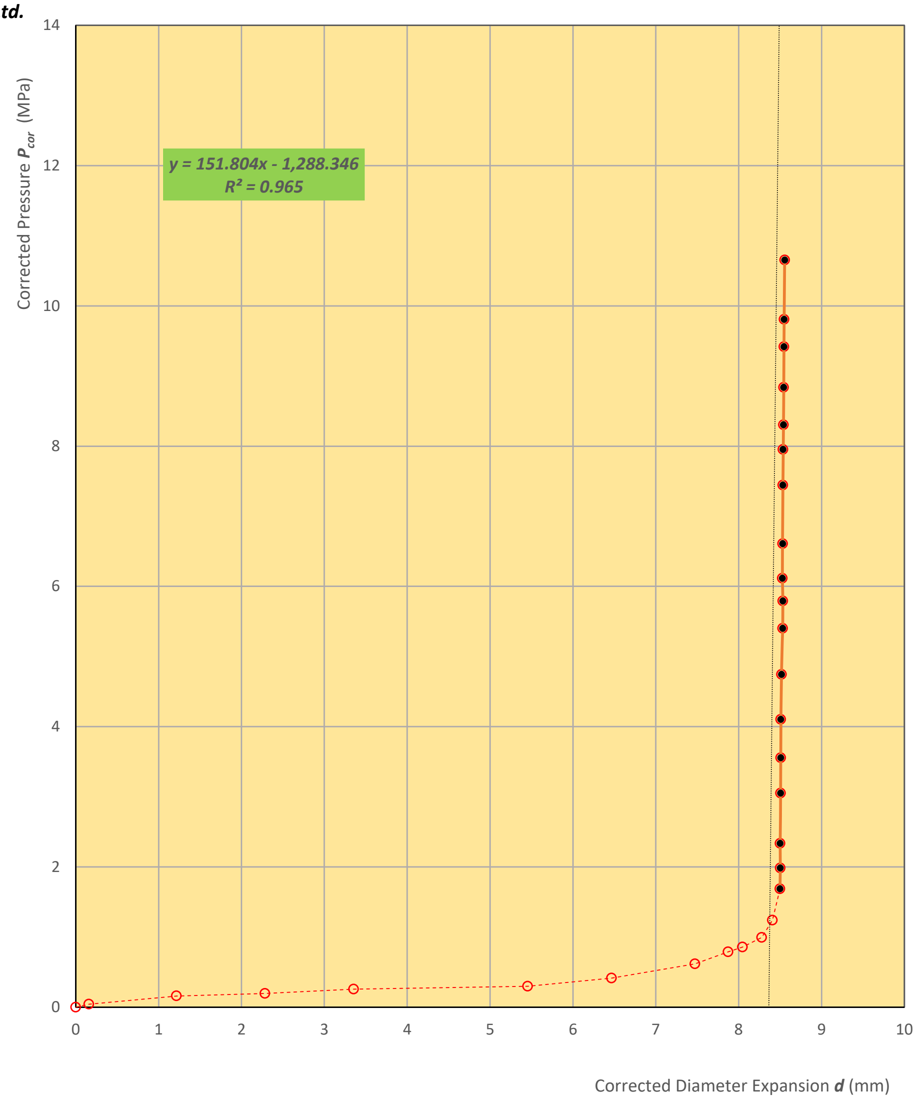
Test No.: ***16***

Test Depth (m): 47.41

Client: ***Golder Associates Ltd.***

Field Data

Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.043	0.159
0.161	1.216
0.197	2.283
0.258	3.354
0.299	5.455
0.415	6.466
0.619	7.473
0.789	7.873
0.858	8.047
0.995	8.278
1.241	8.408
1.688	8.499
1.985	8.503
2.336	8.500
3.053	8.506
3.557	8.509
4.103	8.509
4.744	8.518
5.401	8.531
5.793	8.533
6.115	8.527
6.608	8.531
7.443	8.534
7.952	8.536
8.303	8.542
8.838	8.544
9.416	8.547
9.807	8.549
10.653	8.556



$$E = (1 + \nu) D_0 \, {}^{P}/_{d}$$

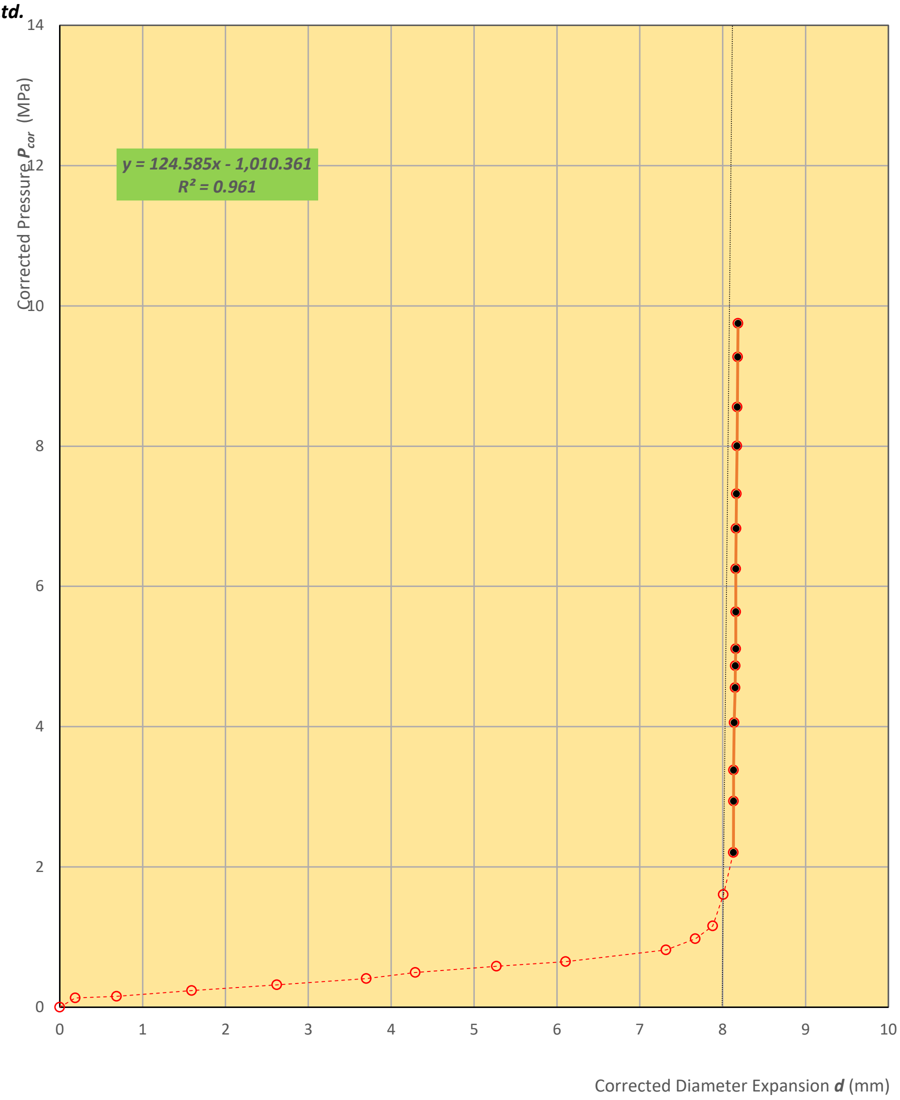
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*151.804*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *18398.7* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH302-DMP***
Test No.: ***17***
Test Depth (m): 45.89
Client: ***Golder Associates Ltd.***

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.132	0.187
0.155	0.685
0.237	1.592
0.319	2.620
0.409	3.700
0.495	4.290
0.584	5.270
0.650	6.106
0.816	7.316
0.977	7.671
1.160	7.880
1.605	8.009
2.207	8.129
2.938	8.131
3.382	8.131
4.058	8.140
4.556	8.151
4.868	8.153
5.111	8.159
5.636	8.159
6.250	8.159
6.826	8.163
7.320	8.166
8.002	8.173
8.556	8.177
9.271	8.182
9.749	8.186



$$E = (1+\nu) D_0 \, {}^{P}\!/_{d}$$

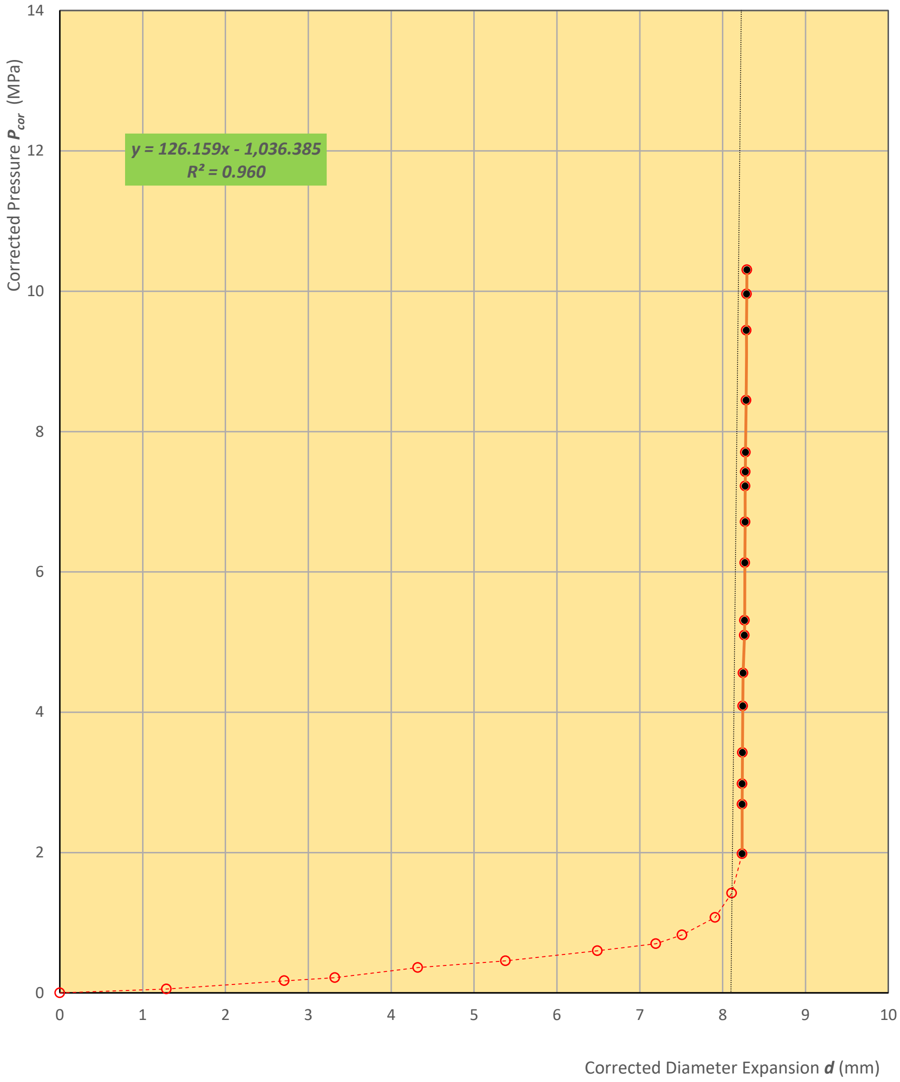
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*124.585*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *15099.7* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH302-DMP***
Test No.: ***18***
Test Depth (m): 44.36
Client: ***Golder Associates Ltd.***

Field Data	
Pressure	Diameter Expansion
P_{cor} MPa	d_{avg} mm
0.000	0.000
0.056	1.288
0.173	2.710
0.217	3.320
0.361	4.321
0.457	5.380
0.601	6.488
0.702	7.193
0.826	7.511
1.076	7.908
1.422	8.110
1.982	8.235
2.689	8.235
2.980	8.236
3.424	8.239
4.088	8.243
4.559	8.246
5.097	8.263
5.310	8.265
6.130	8.268
6.711	8.271
7.224	8.272
7.427	8.274
7.705	8.275
8.447	8.283
9.443	8.286
9.961	8.290
10.305	8.293



$$E = (1+\nu)D_0 \, {}^{P}/_{d}$$

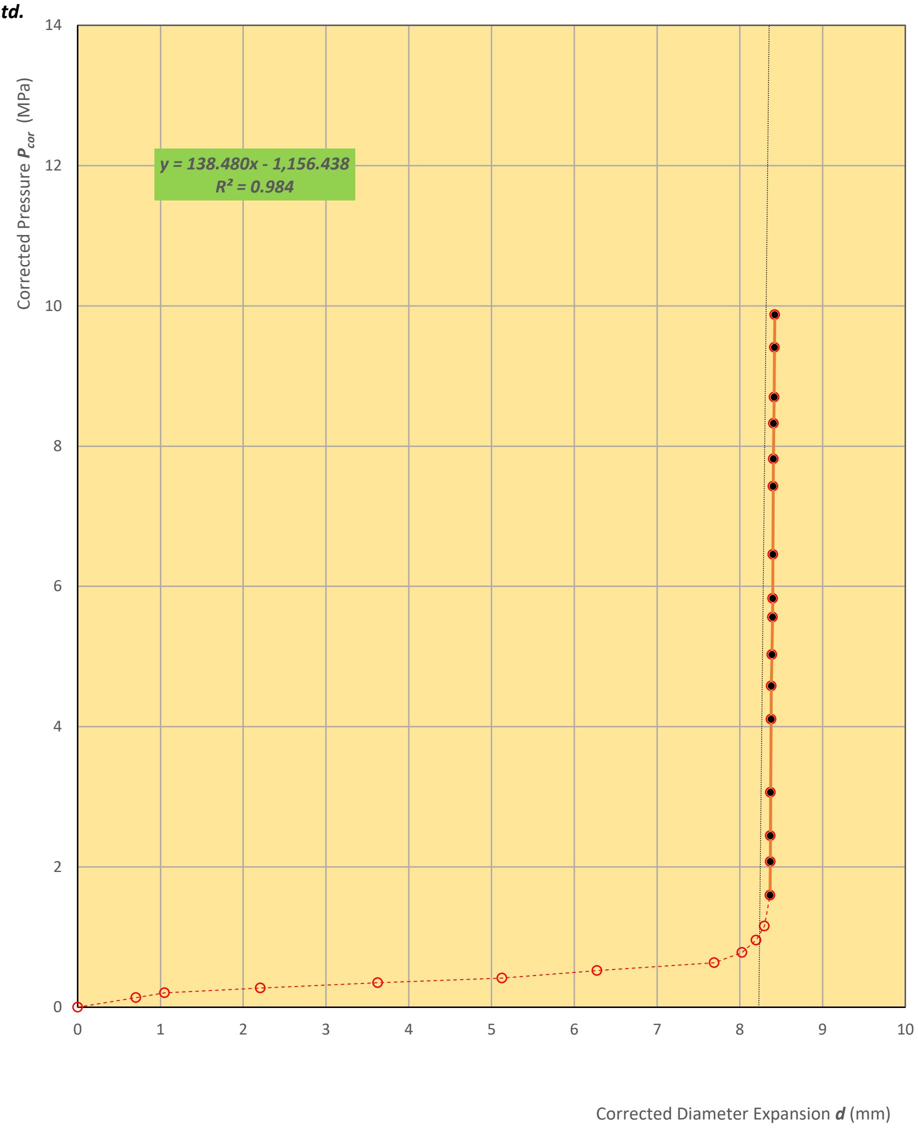
Elastic Modulus (Young's Mod)

μ	=	0.20		*Poisson's ratio*
D_0	=	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}			*MPa*	*Corrected Pressure for the elastic deformations*
P/d	=	*126.159*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *15290.4* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH302-DMP***
Test No.: ***19***
Test Depth (m): 42.84
Client: ***Golder Associates Ltd.***

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.137	0.704
0.205	1.050
0.273	2.208
0.349	3.626
0.416	5.127
0.522	6.274
0.634	7.690
0.780	8.026
0.956	8.196
1.156	8.297
1.596	8.364
2.076	8.368
2.445	8.369
3.063	8.371
4.107	8.378
4.580	8.380
5.027	8.388
5.562	8.395
5.829	8.397
6.455	8.399
7.427	8.402
7.817	8.406
8.324	8.408
8.698	8.415
9.409	8.418
9.874	8.423



$$E = (1+\nu)D_0 \,{}^{P}\!/_{d}$$

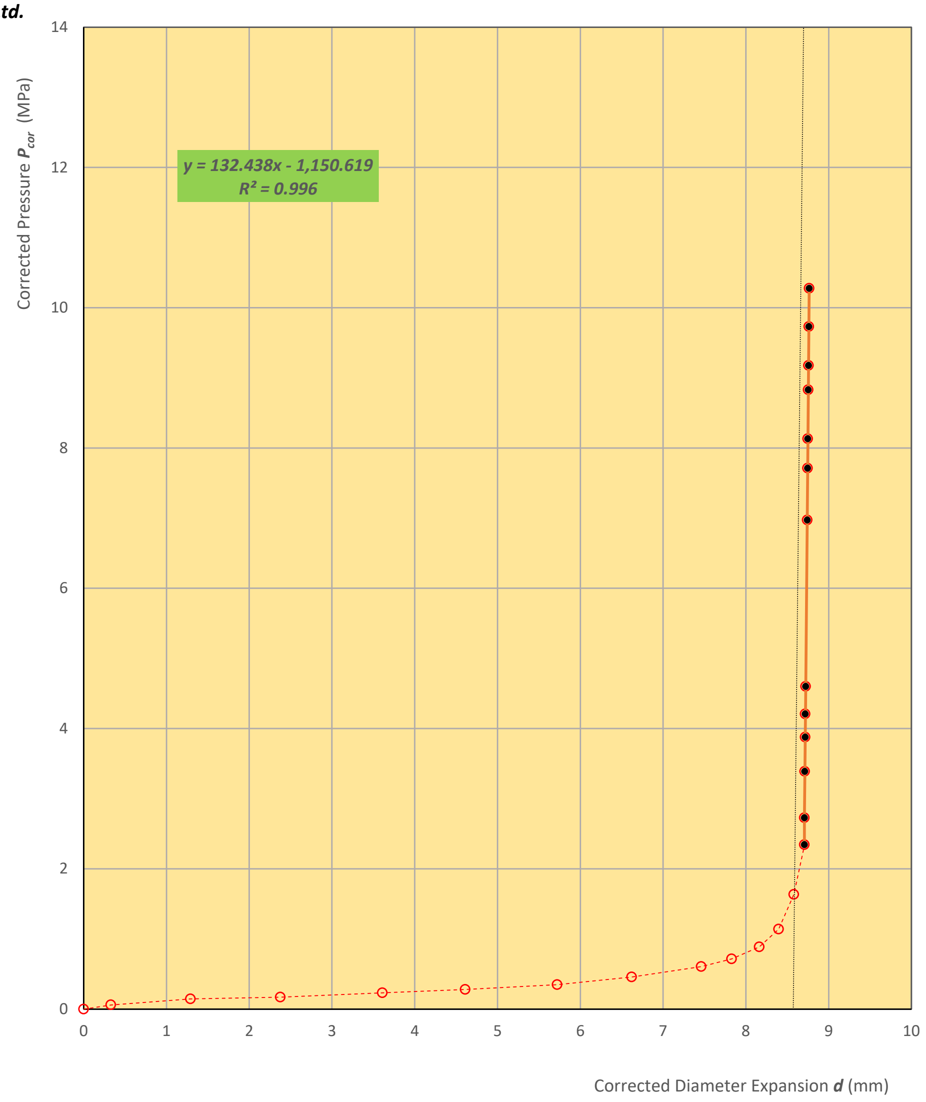
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*138.480*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *16783.8* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH302-DMP***
Test No.: ***20***
Test Depth (m): 41.31
Client: ***Golder Associates Ltd.***

Field Data	
Pressure	Diameter Expansion
P_{cor}	d_{avg}
MPa	mm
0.000	0.000
0.060	0.329
0.146	1.290
0.170	2.377
0.232	3.609
0.281	4.610
0.348	5.721
0.457	6.622
0.606	7.462
0.716	7.829
0.886	8.163
1.141	8.396
1.636	8.580
2.345	8.708
2.727	8.708
3.390	8.712
3.878	8.717
4.209	8.718
4.601	8.724
6.973	8.743
7.713	8.746
8.131	8.749
8.829	8.754
9.177	8.757
9.731	8.762
10.277	8.765



$$E = (1+\nu)D_0\,{}^{P}\!/_{d}$$

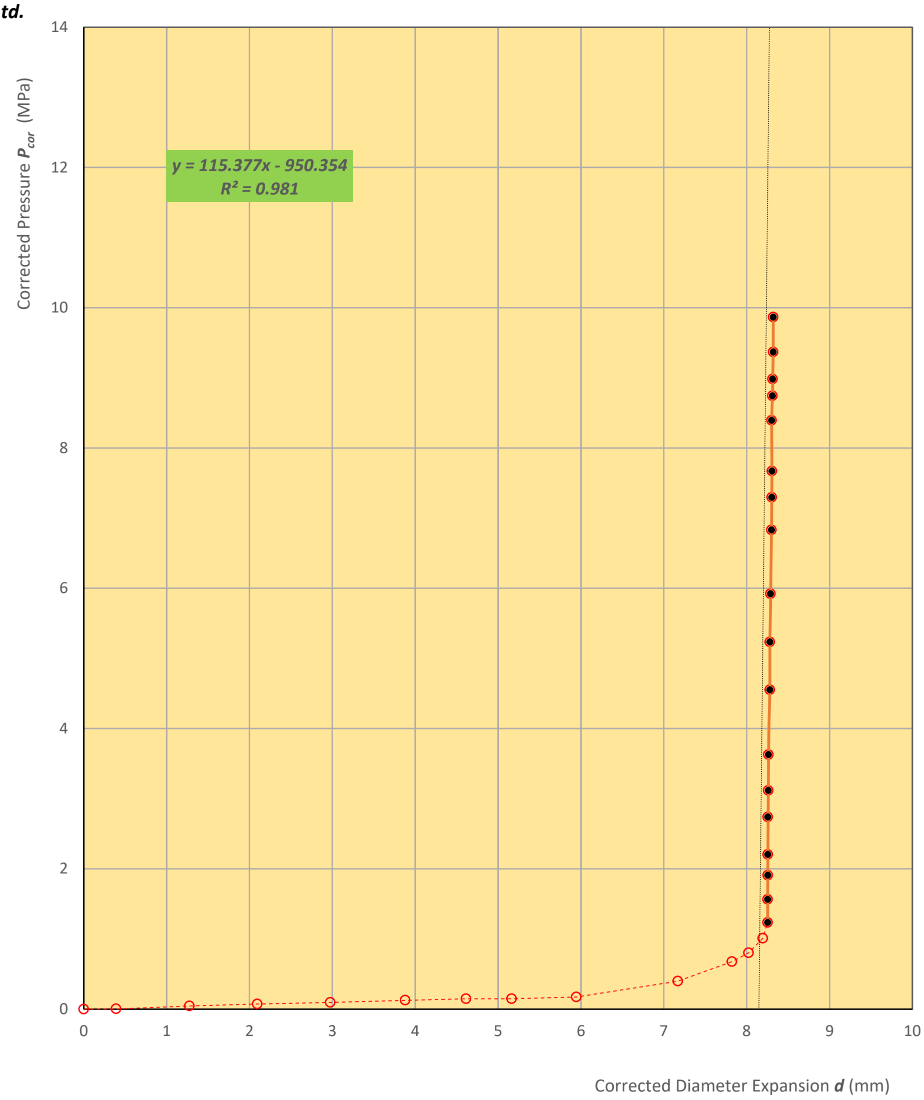
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*132.438*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *16051.5* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH302-DMP***
Test No.: ***21***
Test Depth (m): 39.79
Client: ***Golder Associates Ltd.***

Field Data	
Pressure	Diameter Expansion
P_{cor}	d_{avg}
MPa	mm
0.000	0.000
0.003	0.391
0.045	1.276
0.073	2.095
0.096	2.975
0.126	3.880
0.147	4.613
0.148	5.165
0.173	5.944
0.398	7.169
0.677	7.822
0.802	8.023
1.010	8.195
1.236	8.253
1.565	8.254
1.908	8.255
2.205	8.256
2.739	8.256
3.117	8.262
3.629	8.263
4.552	8.280
5.235	8.280
5.922	8.289
6.832	8.300
7.297	8.303
7.671	8.305
8.394	8.302
8.744	8.311
8.982	8.314
9.369	8.321
9.865	8.322



$$E = (1+\nu)D_0 \, {}^{P}\!/_{d}$$

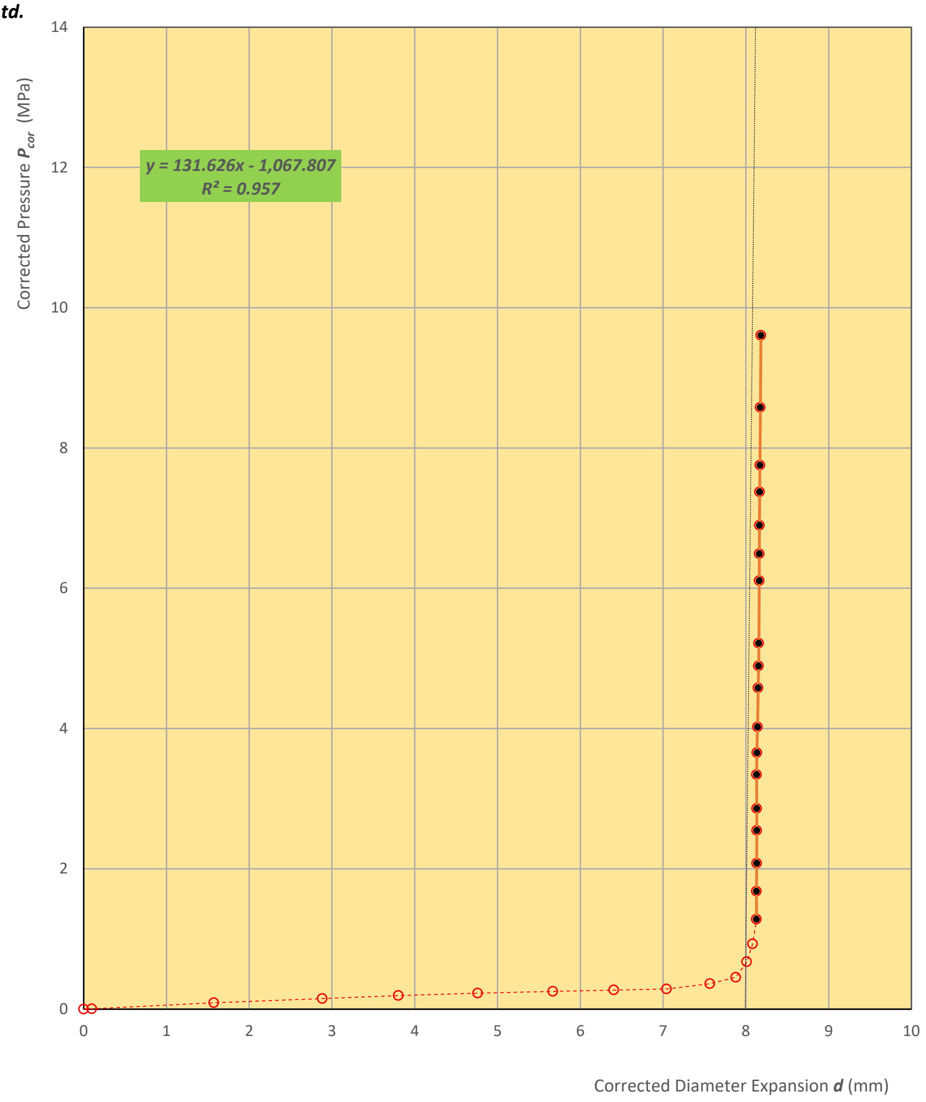
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*115.377*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *13983.6* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH302-DMP***
Test No.: ***22***
Test Depth (m): 38.27
Client: ***Golder Associates Ltd.***

Field Data	
Pressure	Diameter Expansion
P_{cor}	d_{avg}
MPa	mm
0.000	0.000
0.004	0.099
0.091	1.572
0.150	2.882
0.194	3.803
0.228	4.760
0.253	5.668
0.272	6.405
0.286	7.042
0.362	7.565
0.453	7.879
0.674	8.011
0.929	8.081
1.282	8.129
1.681	8.128
2.080	8.132
2.548	8.132
2.859	8.131
3.343	8.130
3.655	8.133
4.024	8.141
4.579	8.148
4.892	8.154
5.217	8.156
6.108	8.162
6.491	8.163
6.898	8.165
7.374	8.167
7.756	8.171
8.579	8.175
9.605	8.183



$$E = (1+\nu)D_0 \, {}^{P}\!/_{d}$$

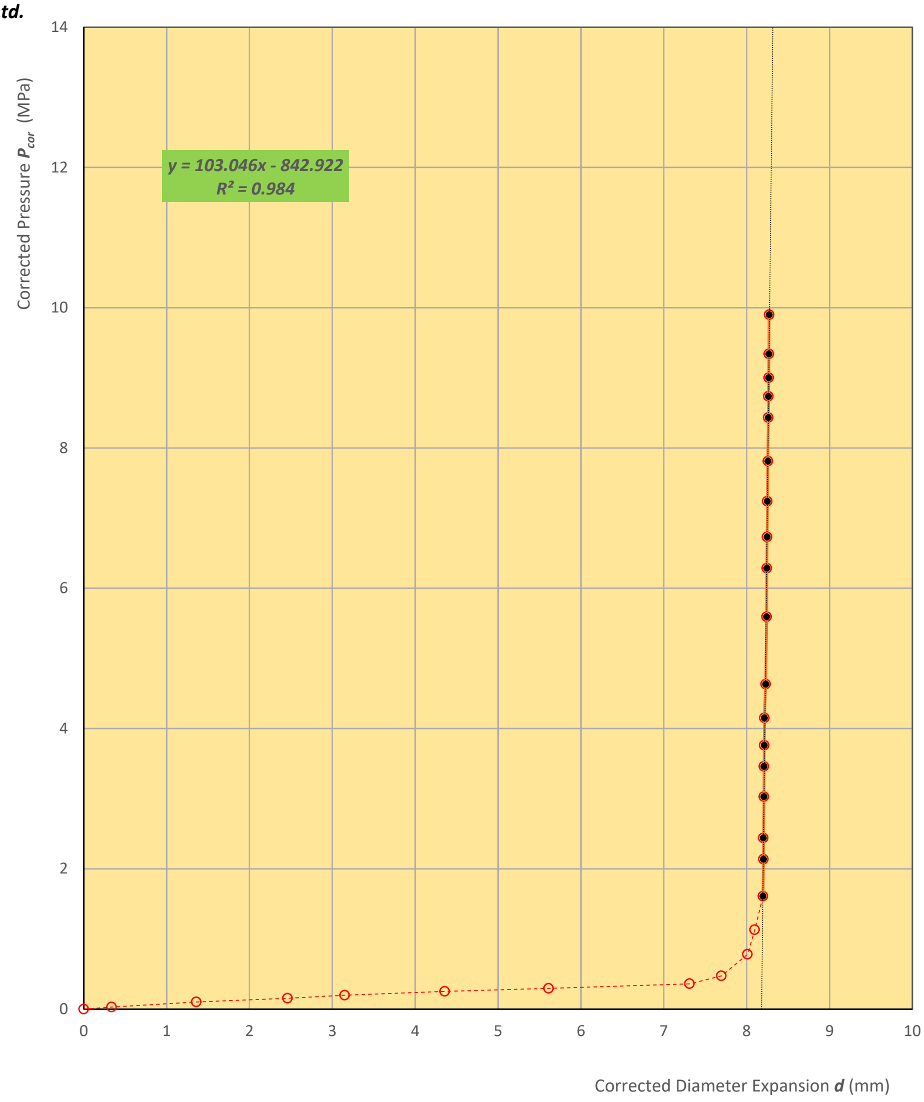
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*131.626*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *15953.0* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH302-DMP***
Test No.: ***23***
Test Depth (m): 36.74
Client: ***Golder Associates Ltd.***

Field Data	
Pressure	Diameter Expansion
P_{cor}	d_{avg}
MPa	mm
0.000	0.000
0.029	0.336
0.103	1.359
0.155	2.460
0.198	3.149
0.252	4.357
0.295	5.610
0.361	7.311
0.474	7.696
0.781	8.011
1.131	8.098
1.610	8.198
2.137	8.203
2.440	8.202
3.028	8.209
3.459	8.210
3.760	8.213
4.152	8.215
4.632	8.230
5.593	8.242
6.286	8.244
6.731	8.248
7.240	8.250
7.812	8.257
8.432	8.261
8.736	8.263
9.000	8.267
9.340	8.269
9.900	8.272



$$E = (1+\nu)D_0\,{}^{P}/_{d}$$

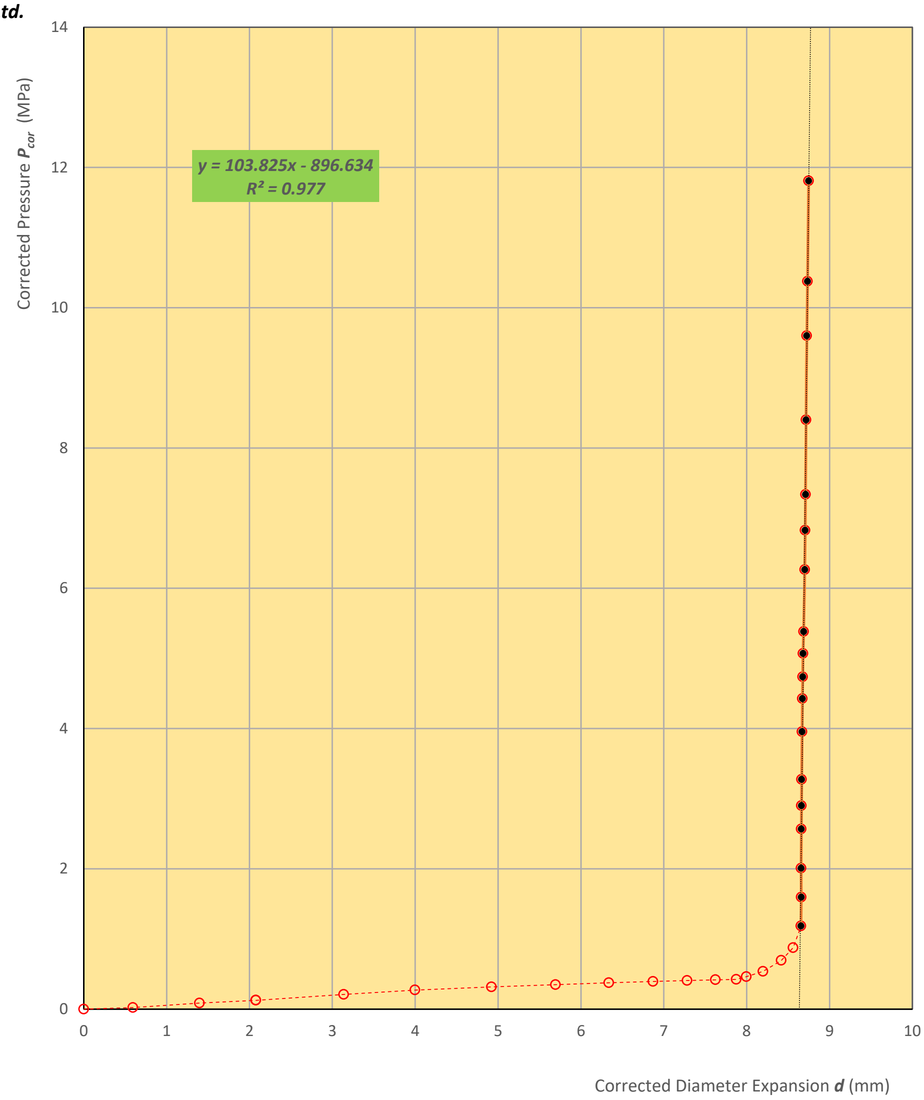
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	mm	*Initial corehole diameter (before expansion)*
P_{cor}		MPa	*Corrected Pressure for the elastic deformations*
P/d =	103.046	MPa / mm	*Test gradient from Linear elastic portion*

E_Y = *12489.2* MPa

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH302-DMP***
Test No.: ***24***
Test Depth (m): 35.22
Client: ***Golder Associates Ltd.***

Field Data	
Pressure	Diameter Expansion
P_{cor} MPa	d_{avg} mm
0.000	0.000
0.023	0.593
0.086	1.397
0.126	2.076
0.126	2.076
0.210	3.138
0.272	3.997
0.316	4.921
0.348	5.694
0.376	6.338
0.394	6.871
0.408	7.281
0.418	7.624
0.424	7.875
0.463	7.996
0.538	8.198
0.694	8.417
0.875	8.561
1.186	8.656
1.596	8.659
2.010	8.657
2.568	8.660
2.902	8.661
3.274	8.664
3.956	8.669
4.428	8.673
4.738	8.676
5.070	8.680
5.382	8.688
6.266	8.702
6.828	8.706
7.338	8.711
8.400	8.717
9.602	8.726
10.376	8.735
11.810	8.749



$$E = (1+\nu)D_0\,{}^{P}\!/_{d}$$

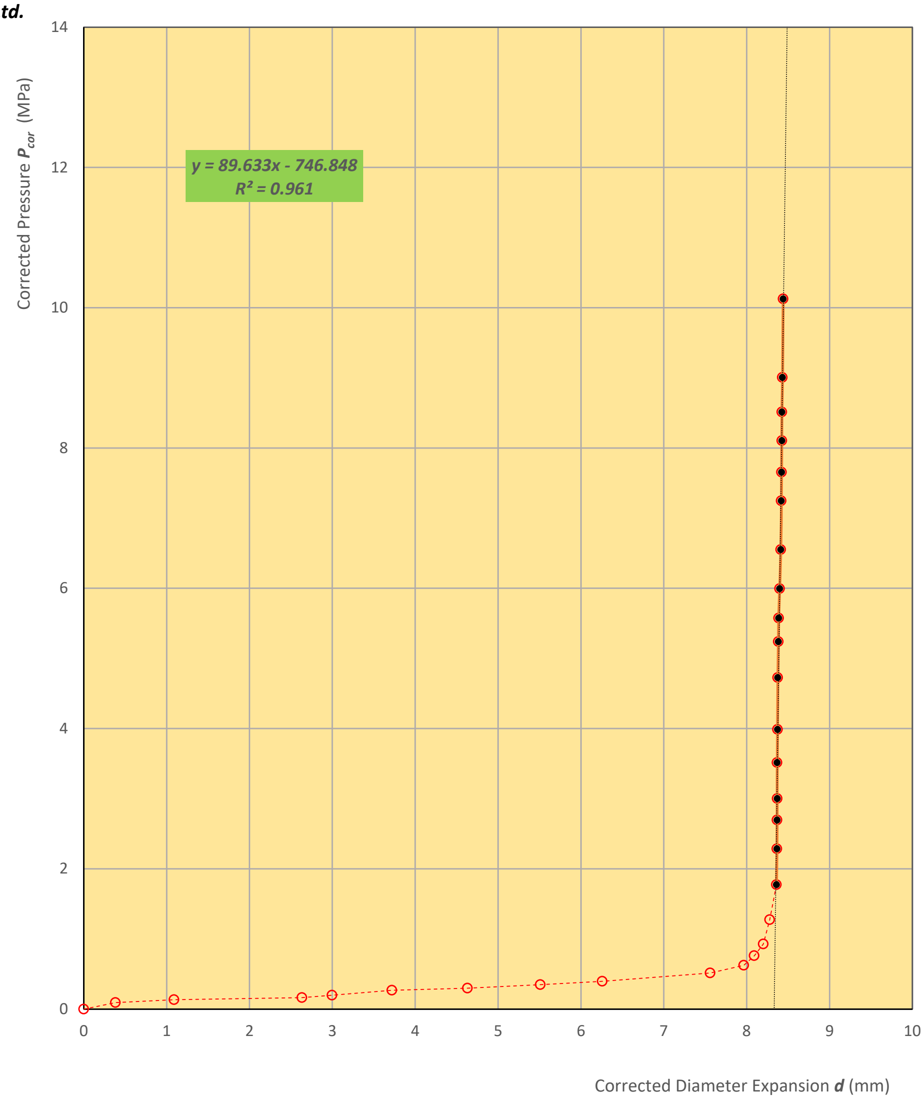
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*103.825*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *12583.6* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH302-DMP***
Test No.: ***25***
Test Depth (m): 33.69
Client: ***Golder Associates Ltd.***

Field Data	
Pressure	Diameter Expansion
P_{cor}	d_{avg}
MPa	mm
0.000	0.000
0.092	0.383
0.134	1.090
0.163	2.634
0.198	2.996
0.268	3.720
0.299	4.631
0.349	5.510
0.396	6.258
0.514	7.561
0.625	7.966
0.761	8.092
0.927	8.201
1.274	8.278
1.774	8.359
2.286	8.365
2.696	8.368
3.002	8.369
3.515	8.367
3.988	8.373
4.726	8.376
5.239	8.383
5.574	8.386
5.994	8.398
6.552	8.413
7.246	8.418
7.655	8.421
8.105	8.425
8.512	8.425
9.005	8.432
10.126	8.442



$$E = (1+\nu)D_0 \,{}^{P}\!/_{d}$$

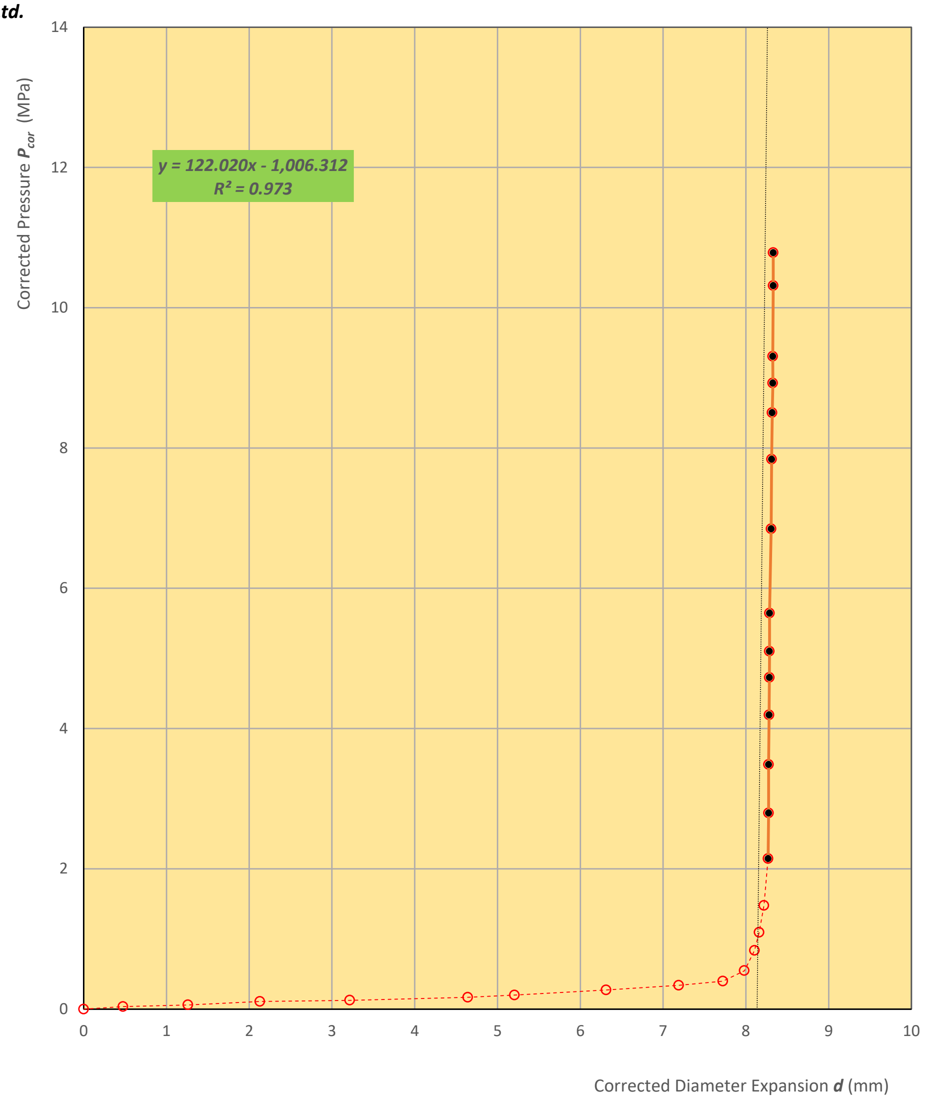
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*89.633*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *10863.5* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH302-DMP***
Test No.: ***26***
Test Depth (m): 32.17
Client: ***Golder Associates Ltd.***

Field Data	
Pressure	Diameter Expansion
P_{cor}	d_{avg}
MPa	mm
0.000	0.000
0.035	0.475
0.060	1.259
0.109	2.129
0.126	3.214
0.169	4.640
0.201	5.205
0.274	6.312
0.339	7.190
0.398	7.722
0.548	7.982
0.837	8.104
1.095	8.161
1.477	8.218
2.147	8.269
2.796	8.275
3.488	8.275
4.194	8.281
4.728	8.284
5.102	8.285
5.646	8.286
6.848	8.306
7.840	8.311
8.504	8.318
8.926	8.326
9.306	8.325
10.314	8.331
10.786	8.330



$$E = (1+\nu)D_0 \, {}^{P}/_{d}$$

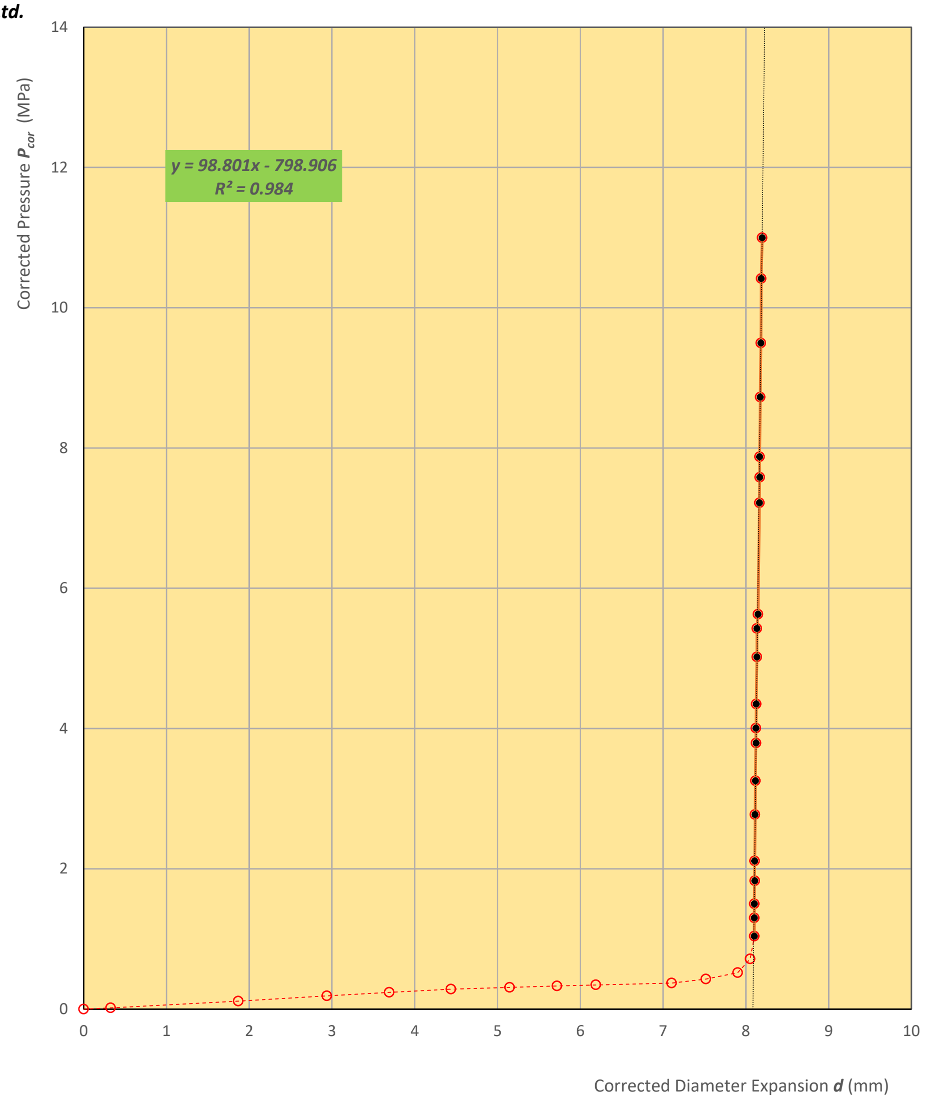
Elastic Modulus (Young's Mod)

μ	=	0.20		*Poisson's ratio*
D_0	=	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}			*MPa*	*Corrected Pressure for the elastic deformations*
P/d	=	*122.020*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *14788.9* *MPa*

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.: **BH302-DMP**
Test No.: **27**
Test Depth (m): 30.65
Client: **Golder Associates Ltd.**

Field Data	
Pressure	Diameter Expansion
P_{cor}	d_{avg}
MPa	mm
0.000	0.000
0.017	0.327
0.113	1.868
0.188	2.939
0.239	3.693
0.284	4.437
0.309	5.147
0.331	5.719
0.345	6.189
0.372	7.105
0.428	7.518
0.519	7.902
0.716	8.053
1.040	8.102
1.299	8.103
1.501	8.103
1.828	8.109
2.111	8.107
2.773	8.110
3.254	8.116
3.794	8.124
4.004	8.122
4.350	8.126
5.021	8.133
5.426	8.134
5.630	8.147
7.216	8.164
7.583	8.169
7.873	8.167
8.726	8.174
9.496	8.182
10.416	8.186
10.996	8.198



$$E = (1 + \nu) D_0 \, {}^{P}\!/_{d}$$

Elastic Modulus (Young's Mod)

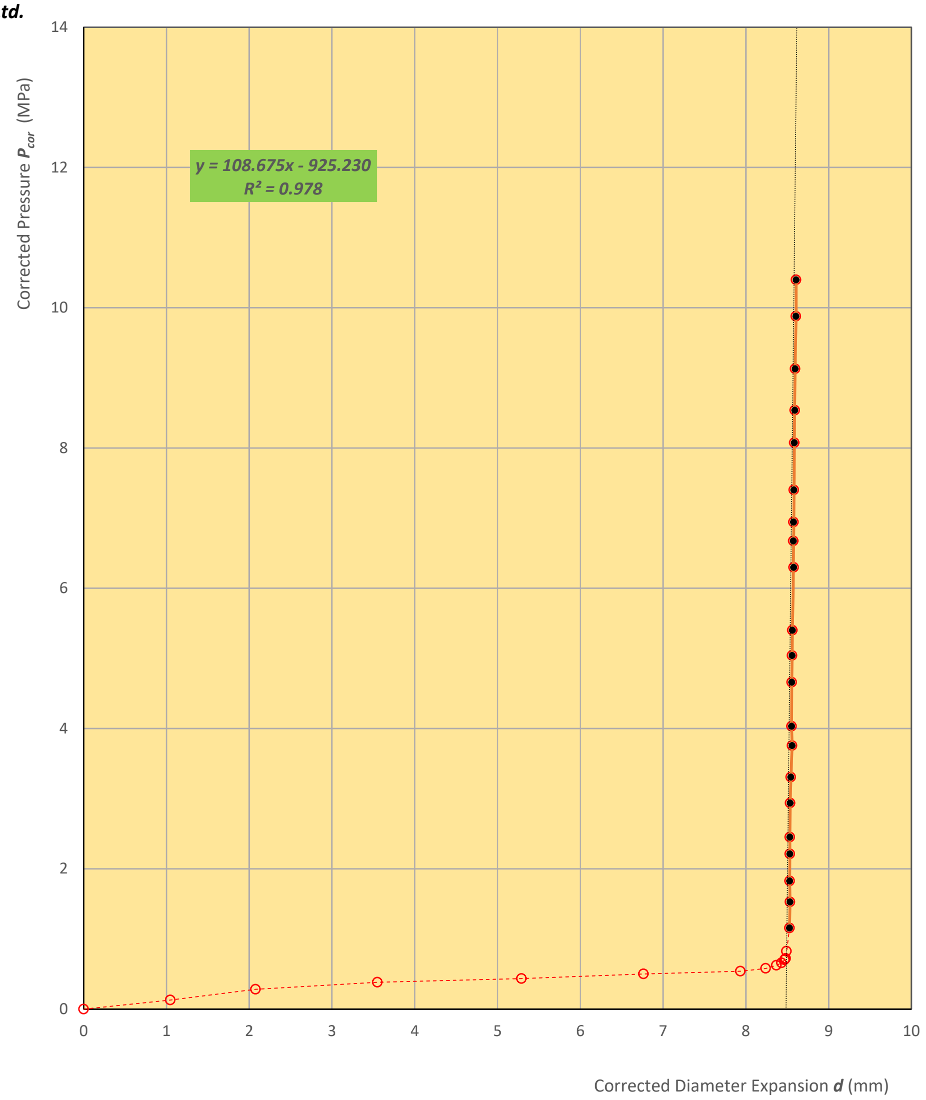
μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*98.801*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *11974.7* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH302-DMP***
Test No.: ***28***
Test Depth (m): 29.12
Client: ***Golder Associates Ltd.***

Field Data

Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.129	1.048
0.283	2.076
0.382	3.550
0.435	5.289
0.502	6.765
0.540	7.934
0.580	8.240
0.625	8.369
0.658	8.431
0.703	8.469
0.715	8.478
0.723	8.481
0.825	8.492
1.155	8.528
1.528	8.533
1.827	8.530
2.211	8.531
2.452	8.531
2.937	8.535
3.306	8.544
3.757	8.559
4.033	8.553
4.659	8.555
5.041	8.558
5.401	8.563
6.298	8.578
6.675	8.575
6.943	8.577
7.402	8.581
8.074	8.585
8.538	8.591
9.129	8.595
9.877	8.606
10.398	8.608



$$E = (1+\nu) D_0 \, {}^{P}\!/_{d}$$

Elastic Modulus (Young's Mod)

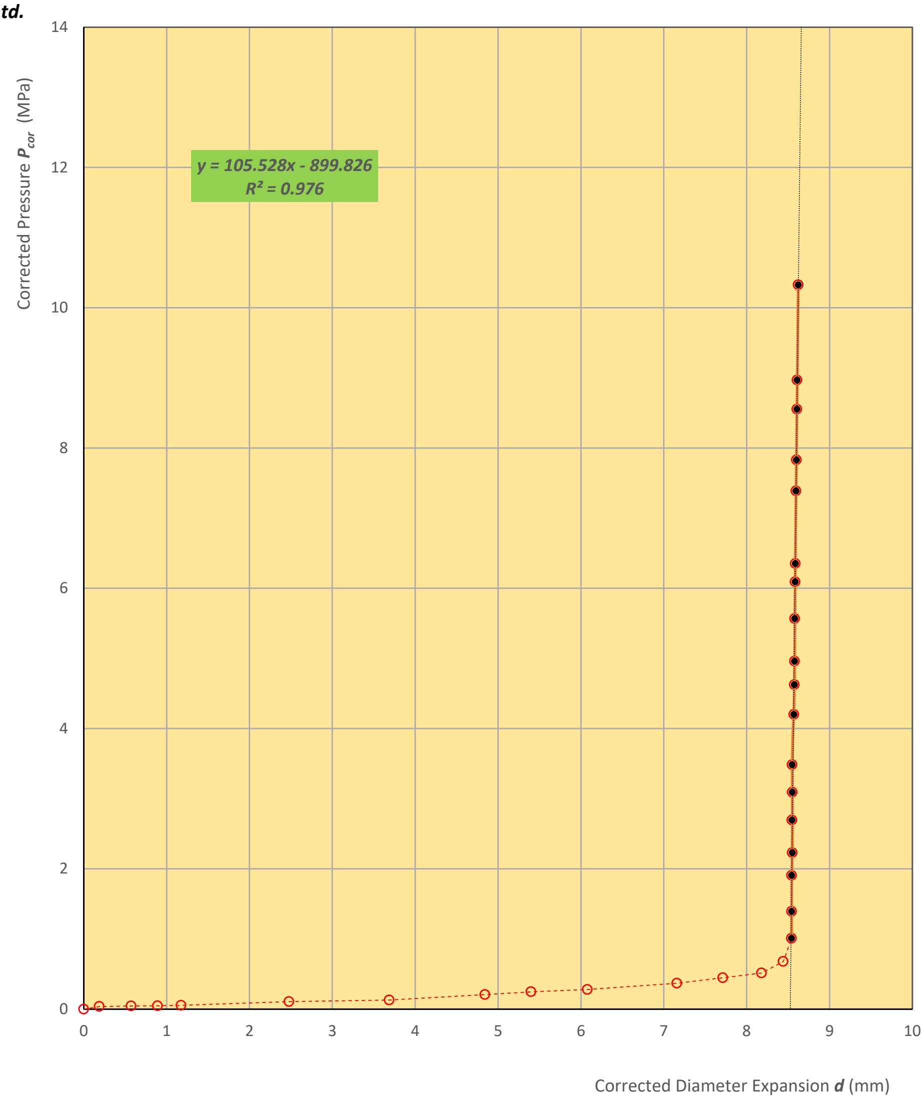
μ =	0.20		Poisson's ratio
D_0 =	101	mm	Initial corehole diameter (before expansion)
P_{cor}		MPa	Corrected Pressure for the elastic deformations
P/d =	108.675	MPa / mm	Test gradient from Linear elastic portion

E_Y = *13171.4* MPa

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH302-DMP***
Test No.: ***29***
Test Depth (m): 27.60
Client: ***Golder Associates Ltd.***

Field Data

Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.037	0.187
0.046	0.571
0.048	0.890
0.054	1.175
0.106	2.477
0.130	3.687
0.207	4.842
0.247	5.398
0.281	6.078
0.368	7.158
0.446	7.713
0.514	8.181
0.678	8.441
1.009	8.542
1.394	8.543
1.907	8.543
2.230	8.552
2.695	8.548
3.092	8.551
3.486	8.550
4.201	8.570
4.626	8.576
4.962	8.579
5.568	8.581
6.092	8.585
6.353	8.588
7.388	8.595
7.830	8.601
8.553	8.607
8.970	8.610
10.327	8.623



$$E = (1+\nu) D_0 \, {}^{P}\!/_{d}$$

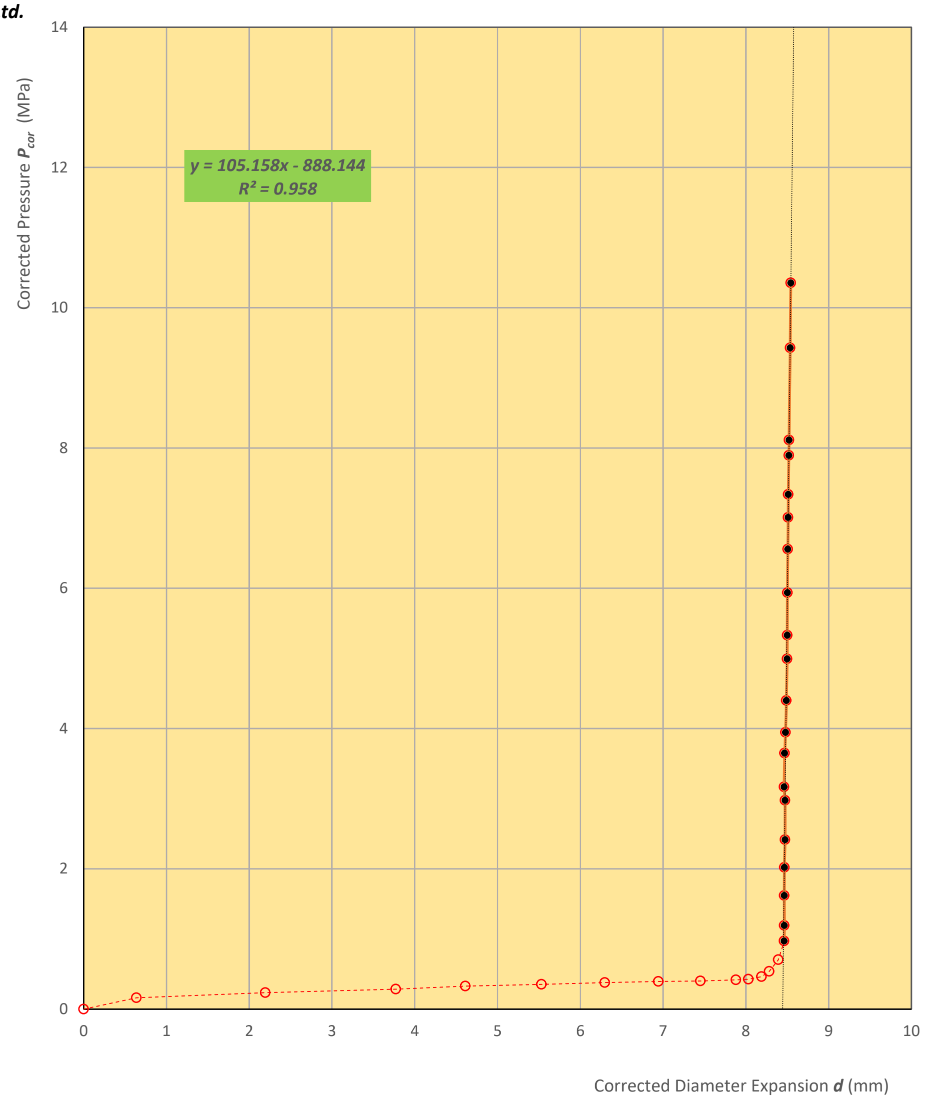
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*105.528*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *12789.9* *MPa*

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.: **BH302-DMP**
Test No.: **30**
Test Depth (m): 26.07
Client: **Golder Associates Ltd.**

Field Data	
Pressure	Diameter Expansion
P_{cor}	d_{avg}
MPa	mm
0.000	0.000
0.161	0.637
0.235	2.194
0.284	3.772
0.327	4.612
0.354	5.531
0.378	6.296
0.395	6.944
0.401	7.451
0.417	7.881
0.425	8.031
0.463	8.189
0.538	8.283
0.705	8.392
0.972	8.463
1.192	8.465
1.618	8.464
2.021	8.466
2.415	8.474
2.977	8.473
3.168	8.463
3.649	8.469
3.946	8.479
4.400	8.490
4.994	8.499
5.330	8.501
5.937	8.503
6.557	8.507
7.010	8.510
7.339	8.513
7.894	8.520
8.113	8.522
9.428	8.536
10.354	8.544



$$E = (1+\nu) D_0 \, {}^{P}\!/_{d}$$

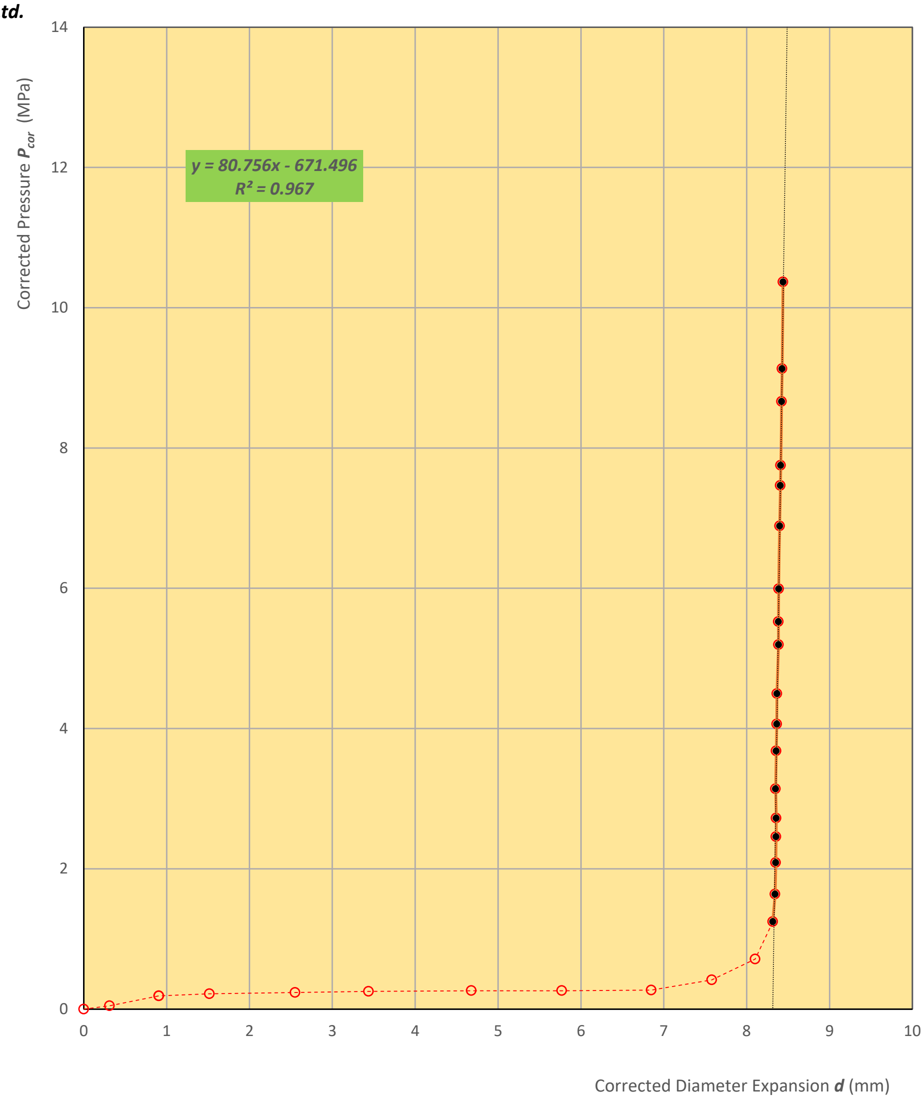
Elastic Modulus (Young's Mod)

μ =	0.20		Poisson's ratio
D_0 =	101	mm	Initial corehole diameter (before expansion)
P_{cor}		MPa	Corrected Pressure for the elastic deformations
P/d =	105.158	MPa / mm	Test gradient from Linear elastic portion

E_Y = 12745.1 MPa

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH302-DMP***
Test No.: ***31***
Test Depth (m): 24.55
Client: ***Golder Associates Ltd.***

Field Data	
Pressure	Diameter Expansion
P_{cor}	d_{avg}
MPa	mm
0.000	0.000
0.048	0.311
0.189	0.906
0.189	0.906
0.218	1.517
0.236	2.550
0.252	3.438
0.263	4.677
0.263	5.770
0.270	6.849
0.416	7.579
0.714	8.102
1.247	8.316
1.640	8.343
2.090	8.351
2.459	8.355
2.724	8.357
3.140	8.349
3.682	8.357
4.064	8.363
4.498	8.366
5.195	8.385
5.525	8.383
5.992	8.387
6.889	8.398
7.466	8.407
7.753	8.411
8.664	8.422
9.130	8.428
10.367	8.440



$$E = (1+\nu) D_0 \, {}^{P}/_{d}$$

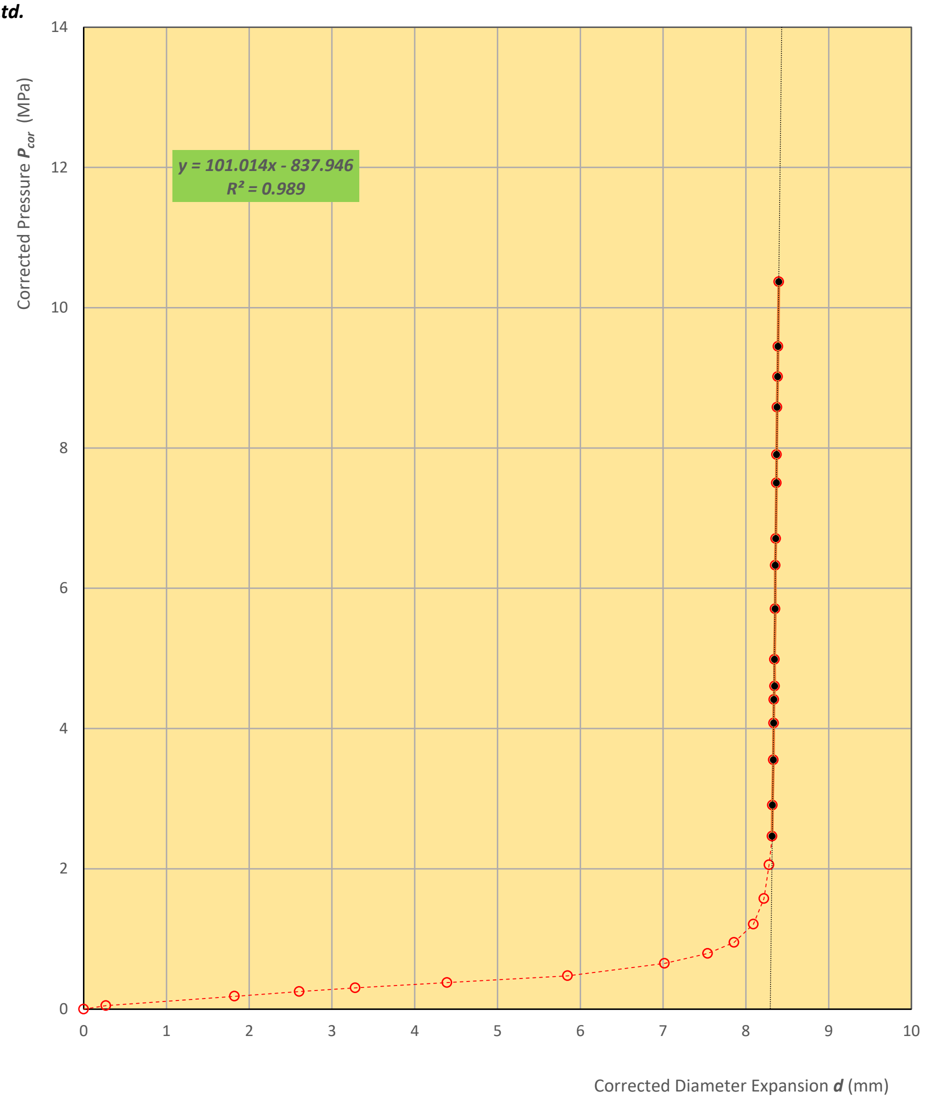
Elastic Modulus (Young's Mod)

μ	=	0.20		*Poisson's ratio*
D_0	=	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}			*MPa*	*Corrected Pressure for the elastic deformations*
P/d	=	*80.756*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *9787.6* *MPa*

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.: **BH302-DMP**
Test No.: **32**
Test Depth (m): 23.03
Client: **Golder Associates Ltd.**

Field Data	
Pressure	Diameter Expansion
P_{cor}	d_{avg}
MPa	mm
0.000	0.000
0.049	0.269
0.183	1.822
0.250	2.604
0.303	3.280
0.379	4.390
0.475	5.846
0.652	7.018
0.793	7.538
0.950	7.857
1.210	8.091
1.576	8.218
2.058	8.281
2.465	8.318
2.908	8.321
3.553	8.332
4.077	8.336
4.413	8.338
4.606	8.348
4.986	8.346
5.707	8.355
6.328	8.356
6.709	8.361
7.503	8.369
7.905	8.372
8.582	8.377
9.018	8.385
9.447	8.388
10.370	8.399



$$E = (1+\nu)D_0 \, {}^{P}\!/_{d}$$

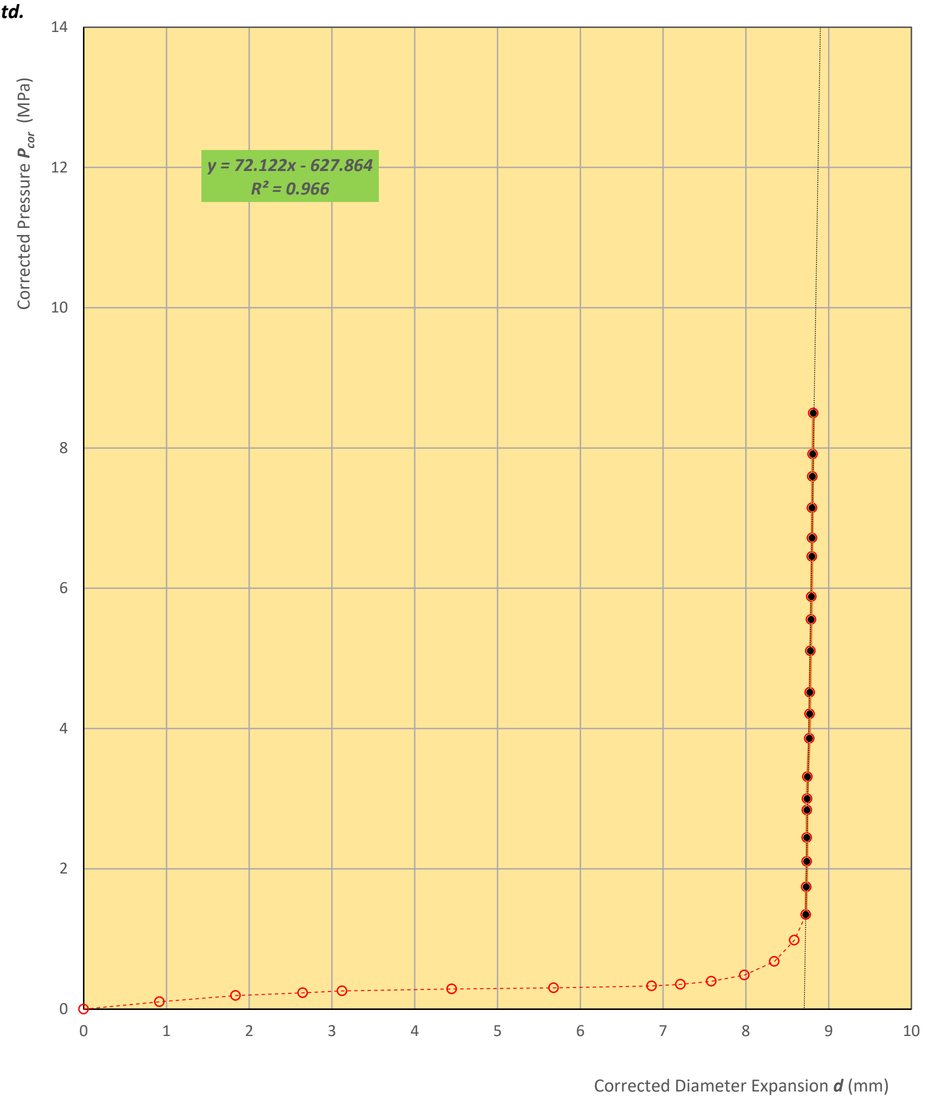
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	mm	*Initial corehole diameter (before expansion)*
P_{cor}		MPa	*Corrected Pressure for the elastic deformations*
P/d =	101.014	MPa / mm	*Test gradient from Linear elastic portion*

E_Y = *12242.9* MPa

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.: **BH302-DMP**
Test No.: **33**
Test Depth (m): 21.50
Client: **Golder Associates Ltd.**

Field Data	
Pressure	Diameter Expansion
P_{cor}	d_{avg}
MPa	mm
0.000	0.000
0.104	0.916
0.193	1.836
0.232	2.647
0.259	3.122
0.287	4.447
0.302	5.679
0.330	6.862
0.353	7.211
0.397	7.583
0.485	7.984
0.679	8.345
0.982	8.586
1.348	8.726
1.742	8.731
2.104	8.737
2.445	8.737
2.838	8.738
3.000	8.740
3.312	8.745
3.858	8.767
4.209	8.771
4.516	8.774
5.107	8.782
5.554	8.789
5.880	8.792
6.454	8.799
6.717	8.801
7.147	8.800
7.594	8.805
7.912	8.809
8.497	8.815



$$E = (1+\nu)D_0\, {}^{P}\!/_{d}$$

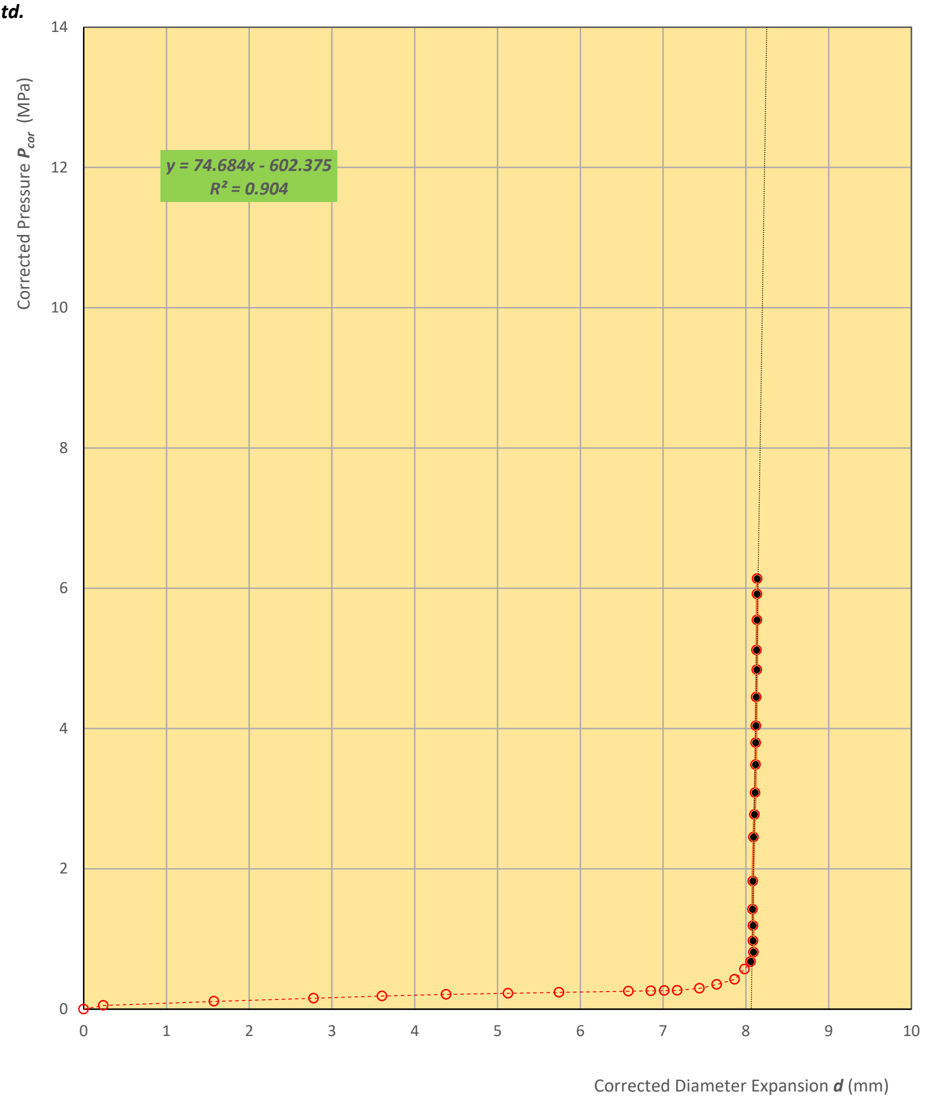
Elastic Modulus (Young's Mod)

μ =	0.20		Poisson's ratio
D_0 =	101	mm	Initial corehole diameter (before expansion)
P_{cor}		MPa	Corrected Pressure for the elastic deformations
P/d =	72.122	MPa / mm	Test gradient from Linear elastic portion

E_Y = 8741.1 MPa

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH302-DMP***
Test No.: ***34***
Test Depth (m): 19.98
Client: ***Golder Associates Ltd.***

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.052	0.237
0.110	1.574
0.154	2.779
0.186	3.605
0.209	4.379
0.226	5.127
0.239	5.744
0.255	6.583
0.260	6.853
0.264	7.016
0.267	7.171
0.296	7.441
0.351	7.648
0.424	7.865
0.569	7.985
0.676	8.059
0.811	8.093
0.974	8.088
1.191	8.087
1.423	8.081
1.824	8.086
2.452	8.094
2.774	8.104
3.086	8.112
3.484	8.118
3.797	8.121
4.040	8.122
4.448	8.126
4.838	8.134
5.119	8.130
5.547	8.136



$$E = (1+\nu)D_0 \, {}^{P}\!/_{d}$$

Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*74.684*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = 9051.7 MPa

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***

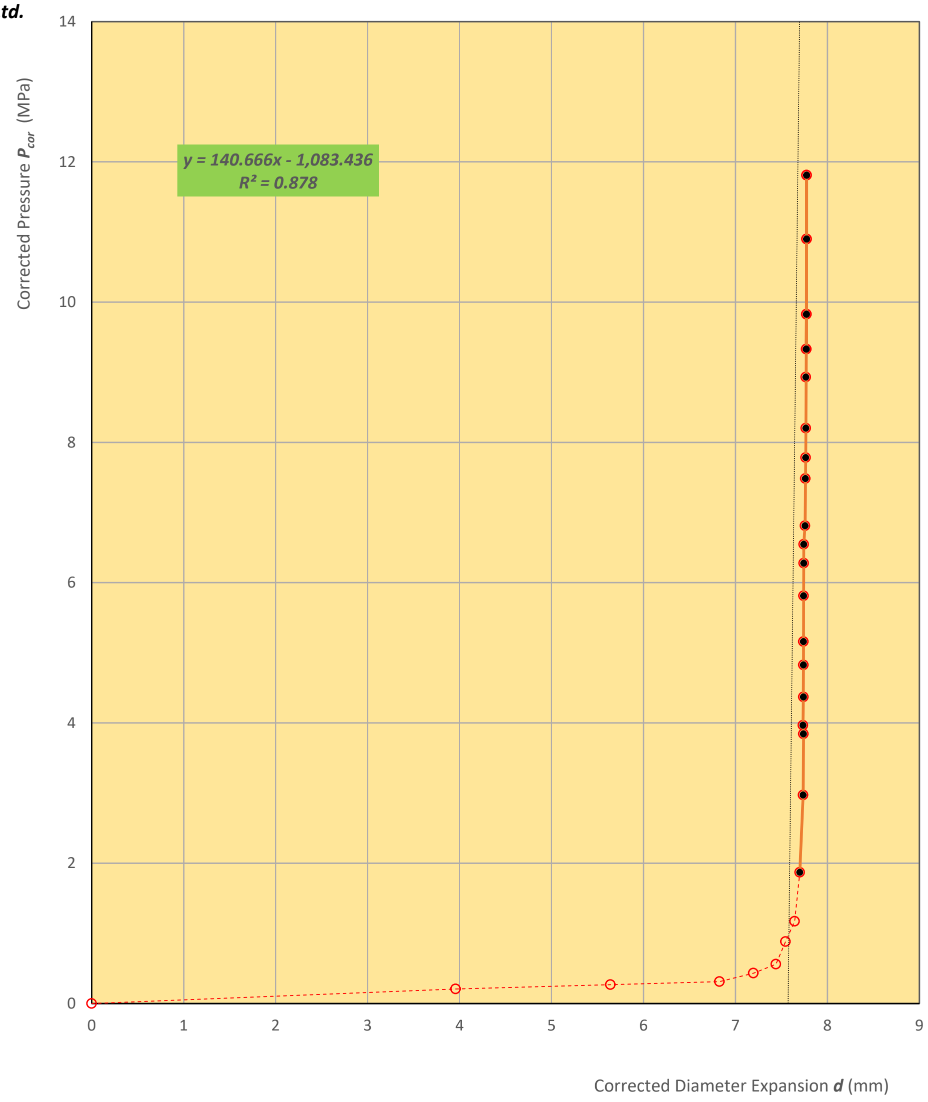
Corehole No.: ***BH307-DMP***

Test No.: ***1***

Test Depth (m): 60.37

Client: ***Golder Associates Ltd.***

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.208	3.958
0.268	5.641
0.312	6.826
0.434	7.196
0.560	7.440
0.882	7.544
1.173	7.644
1.871	7.699
2.971	7.736
3.844	7.740
3.966	7.734
4.371	7.739
4.827	7.739
5.159	7.739
5.811	7.742
6.277	7.743
6.546	7.743
6.812	7.757
7.484	7.761
7.782	7.764
8.203	7.766
8.931	7.766
9.330	7.770
9.826	7.772
10.899	7.774
11.809	7.774
9.330	7.770
9.826	7.773
10.899	7.775
11.809	7.774



$$E = (1+\nu) D_0 \, {}^{P}/_{d}$$

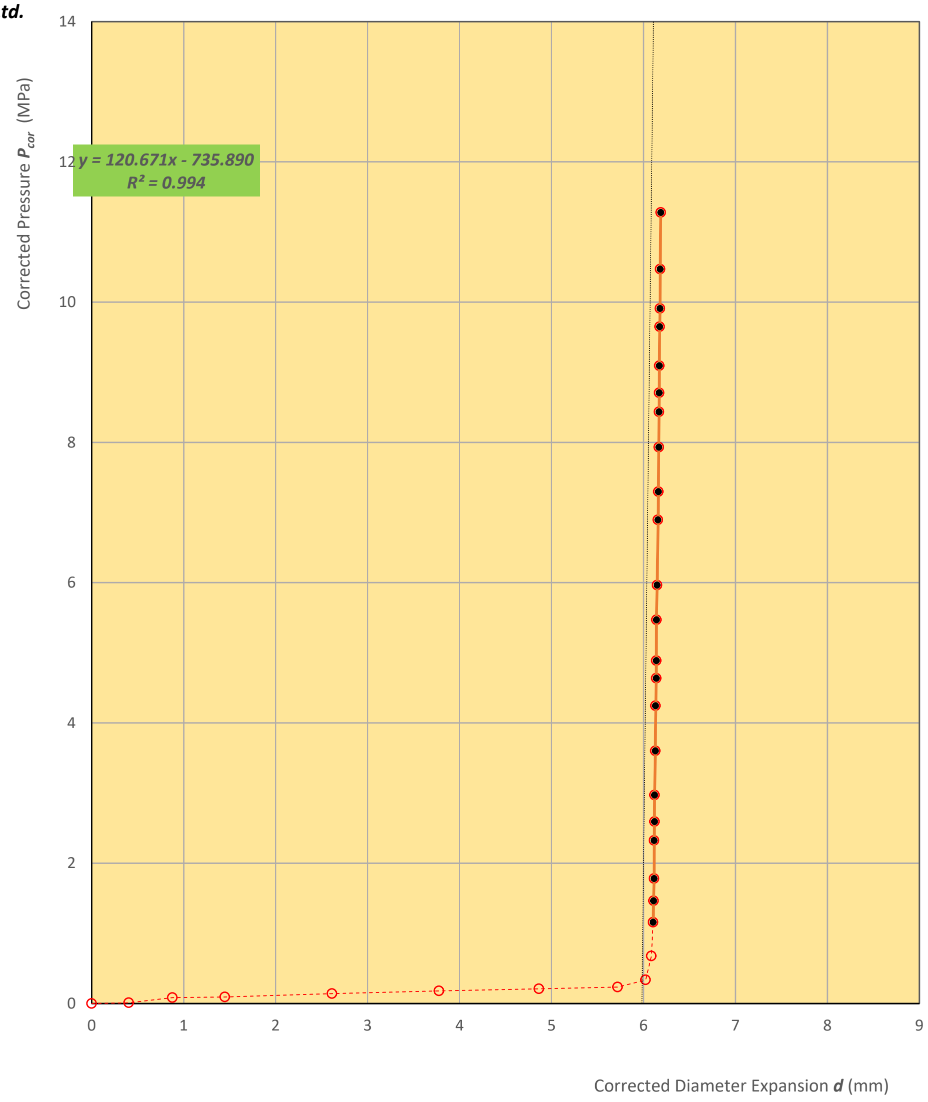
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*140.666*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *17048.7* *MPa*

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.: **BH307-DMP**
Test No.: **2**
Test Depth (m): 58.84
Client: **Golder Associates Ltd.**

Field Data	
Pressure	Diameter Expansion
P_{cor}	d_{avg}
MPa	mm
0.000	0.000
0.011	0.404
0.083	0.878
0.094	1.449
0.141	2.614
0.180	3.777
0.209	4.863
0.234	5.719
0.336	6.023
0.678	6.086
1.158	6.105
1.463	6.110
1.782	6.115
2.324	6.116
2.594	6.120
2.971	6.121
3.601	6.130
4.245	6.132
4.637	6.139
4.889	6.140
5.469	6.142
5.964	6.148
6.896	6.158
7.298	6.163
7.932	6.167
8.435	6.170
8.706	6.171
9.092	6.173
9.649	6.176
9.908	6.179
10.471	6.182
11.277	6.189



$$E = (1+\nu)D_0\, {}^{P}\!/_{d}$$

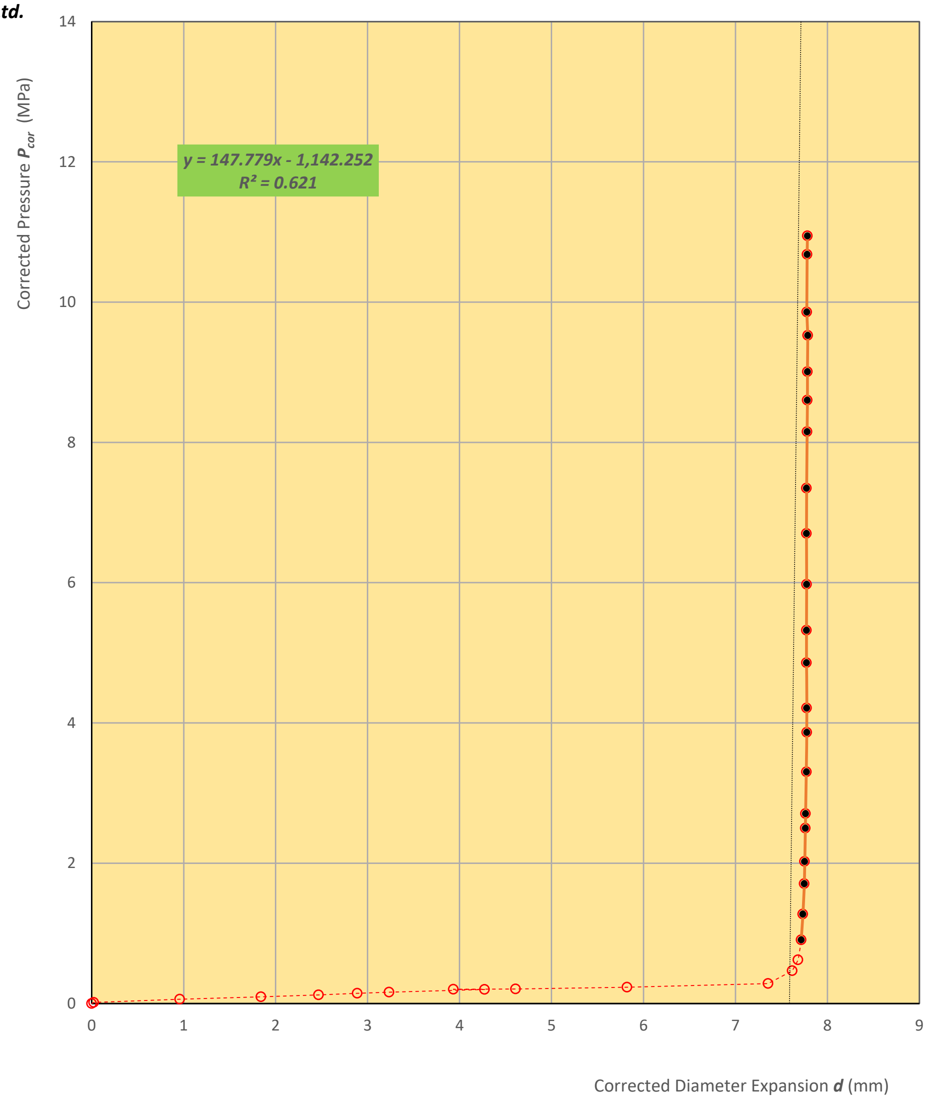
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*120.671*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *14625.4* *MPa*

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.: **BH307-DMP**
Test No.: **3**
Test Depth (m): 57.32
Client: **Golder Associates Ltd.**

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.016	0.022
0.062	0.958
0.095	1.842
0.123	2.468
0.145	2.889
0.161	3.234
0.201	4.273
0.202	3.934
0.208	4.610
0.233	5.822
0.285	7.355
0.468	7.617
0.622	7.681
0.907	7.716
1.275	7.733
1.707	7.749
2.026	7.752
2.500	7.761
2.708	7.762
3.303	7.772
3.867	7.776
4.212	7.774
4.858	7.772
5.322	7.772
5.977	7.774
6.702	7.772
7.348	7.773
8.153	7.779
8.603	7.782
9.007	7.783
9.527	7.787
9.860	7.776
10.681	7.779
10.945	7.783



$$E = (1+\nu) D_0 \, {}^{P}\!/_{d}$$

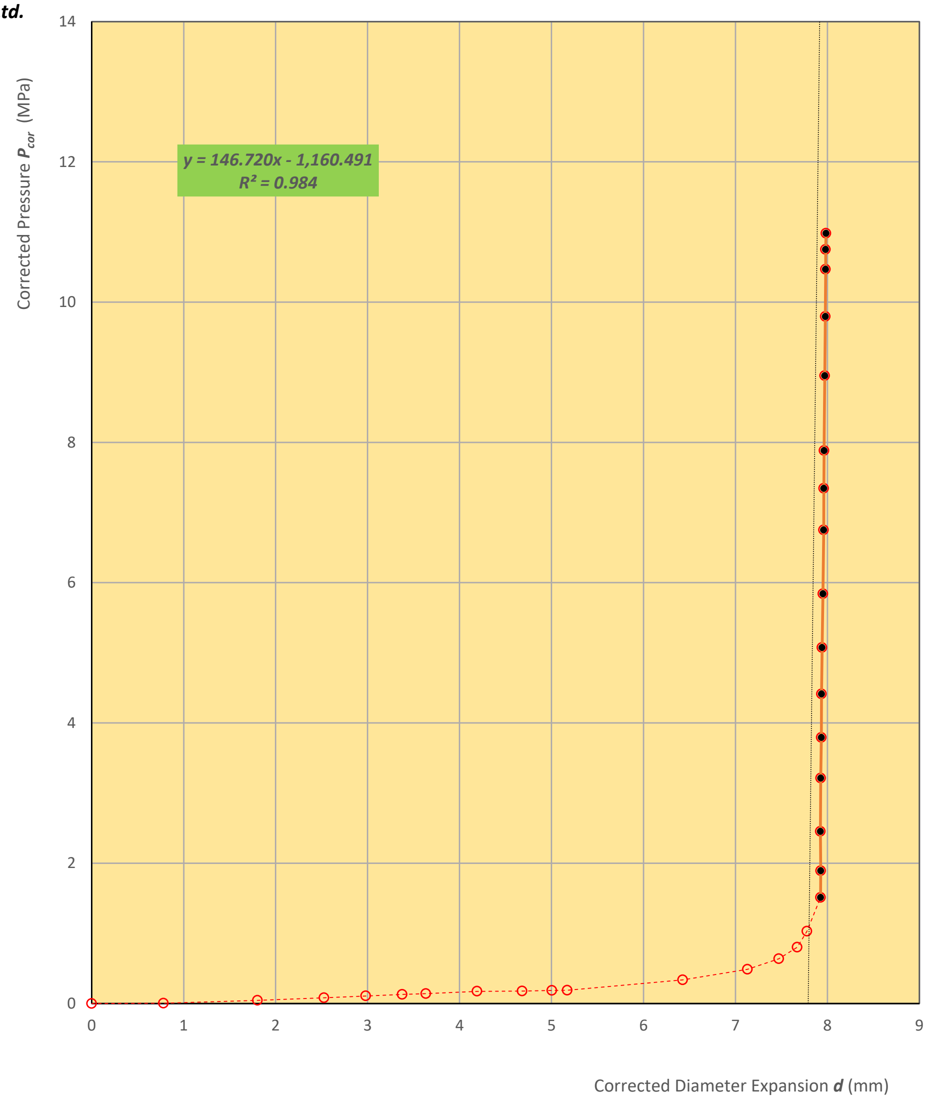
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*147.779*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = 17910.8 MPa

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.: **BH307-DMP**
Test No.: **4**
Test Depth (m): 55.80
Client: **Golder Associates Ltd.**

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.005	0.781
0.045	1.803
0.082	2.527
0.108	2.981
0.129	3.376
0.142	3.635
0.174	4.190
0.178	4.681
0.187	5.004
0.188	5.172
0.337	6.426
0.487	7.131
0.639	7.471
0.803	7.671
1.031	7.778
1.511	7.925
1.892	7.927
2.453	7.924
3.214	7.927
3.792	7.934
4.413	7.936
5.076	7.942
5.841	7.951
6.753	7.959
7.344	7.961
7.884	7.963
8.952	7.971
9.794	7.977
10.467	7.980
10.750	7.980
10.982	7.985



$$E = (1+\nu)D_0 \, {}^{P}\!/_{d}$$

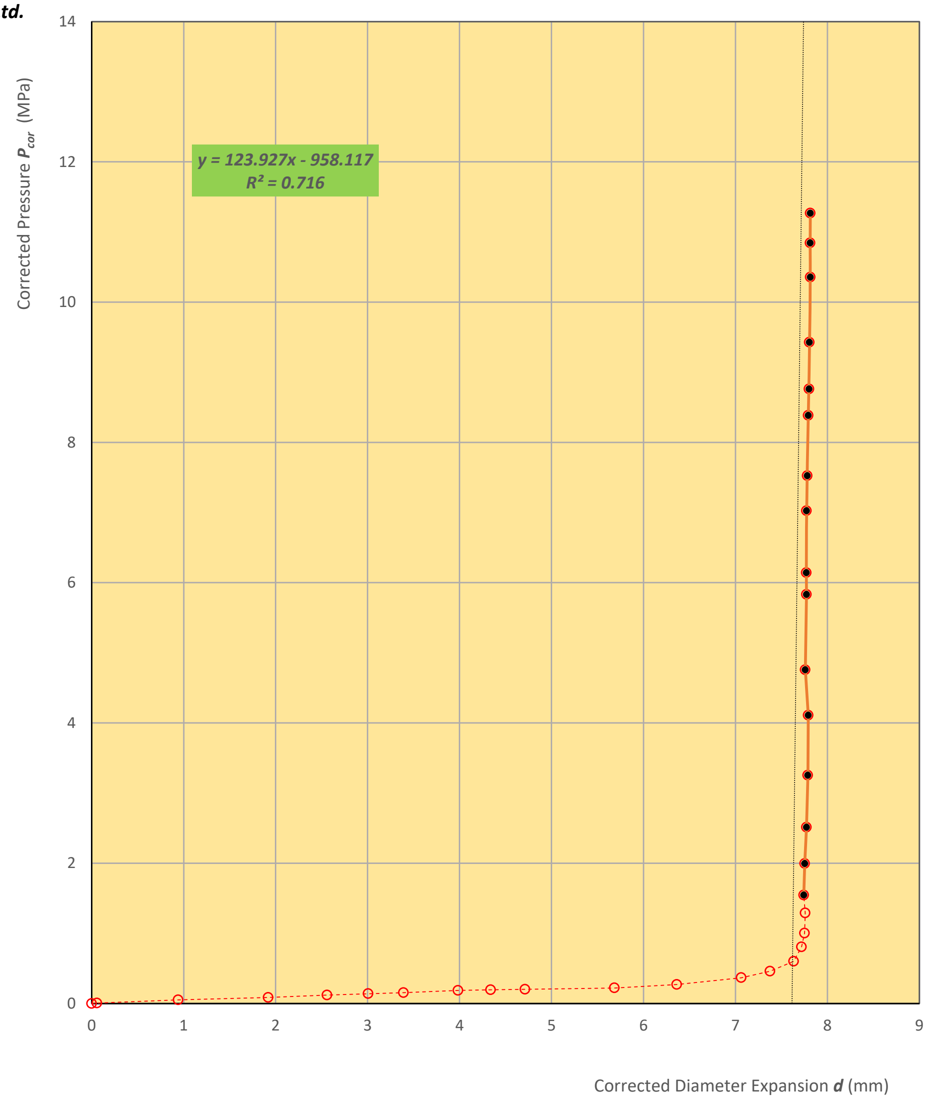
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*146.720*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = 17782.5 MPa

Project:	***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.:	***BH307-DMP***
Test No.:	***5***
Test Depth (m):	54.27
Client:	***Golder Associates Ltd.***

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.006	0.058
0.052	0.940
0.087	1.920
0.121	2.560
0.140	3.007
0.155	3.391
0.186	3.983
0.195	4.339
0.203	4.712
0.222	5.685
0.271	6.362
0.368	7.063
0.461	7.376
0.602	7.633
0.806	7.718
1.003	7.752
1.290	7.758
1.546	7.743
1.996	7.753
2.513	7.772
3.255	7.787
4.110	7.792
4.758	7.759
5.832	7.772
6.142	7.771
7.026	7.772
7.525	7.781
8.385	7.792
8.762	7.800
9.427	7.804
10.356	7.814
10.845	7.812
11.269	7.814



$$E = (1+\nu) D_0 \, {}^{P}\!/_{d}$$

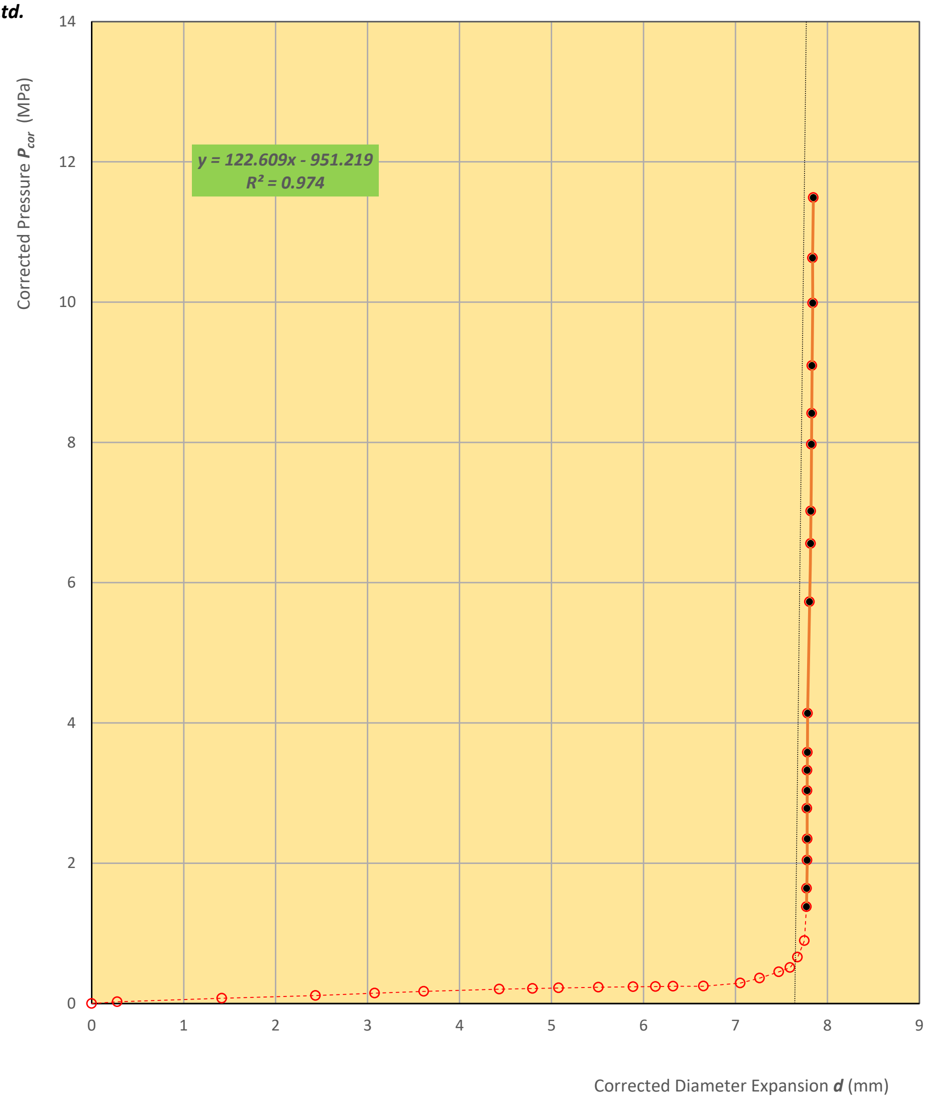
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*123.927*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = 15019.9 MPa

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH307-DMP***
Test No.: ***6***
Test Depth (m): 52.75
Client: ***Golder Associates Ltd.***

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.025	0.278
0.075	1.415
0.113	2.435
0.147	3.078
0.173	3.612
0.205	4.432
0.215	4.794
0.222	5.077
0.232	5.510
0.240	5.887
0.242	6.131
0.246	6.323
0.247	6.653
0.291	7.052
0.363	7.263
0.451	7.471
0.512	7.594
0.662	7.676
0.895	7.750
1.380	7.772
1.643	7.775
2.043	7.780
2.347	7.781
2.783	7.778
3.036	7.780
3.326	7.780
3.582	7.783
4.137	7.785
5.727	7.806
6.557	7.818
7.021	7.820
7.973	7.827
8.416	7.830
9.095	7.832
9.986	7.840
10.631	7.838
11.489	7.847



$$E = (1+\nu) D_0 \, {}^{P}/_{d}$$

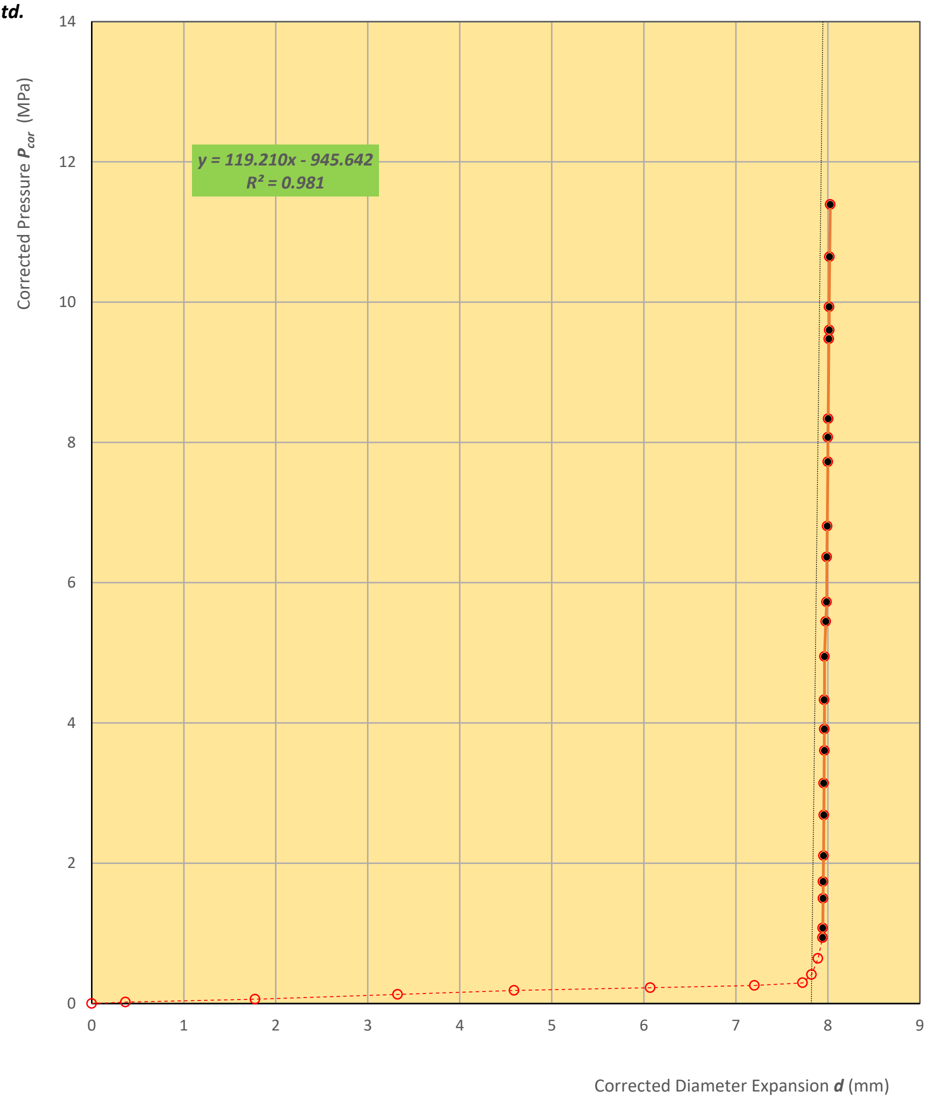
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*122.609*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *14860.2* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH307-DMP***
Test No.: ***7***
Test Depth (m): 51.22
Client: ***Golder Associates Ltd.***

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.020	0.367
0.061	1.775
0.130	3.324
0.187	4.591
0.226	6.071
0.258	7.202
0.295	7.725
0.413	7.823
0.642	7.893
0.940	7.943
1.077	7.944
1.498	7.948
1.738	7.949
2.107	7.953
2.686	7.957
3.140	7.956
3.606	7.963
3.911	7.962
4.330	7.961
4.947	7.964
5.446	7.977
5.726	7.987
6.367	7.989
6.806	7.993
7.723	8.000
8.072	8.000
8.337	8.004
9.475	8.011
9.602	8.016
9.932	8.014
10.645	8.018
11.393	8.027



$$E = (1+\nu)D_0\, {}^{P}\!/_{d}$$

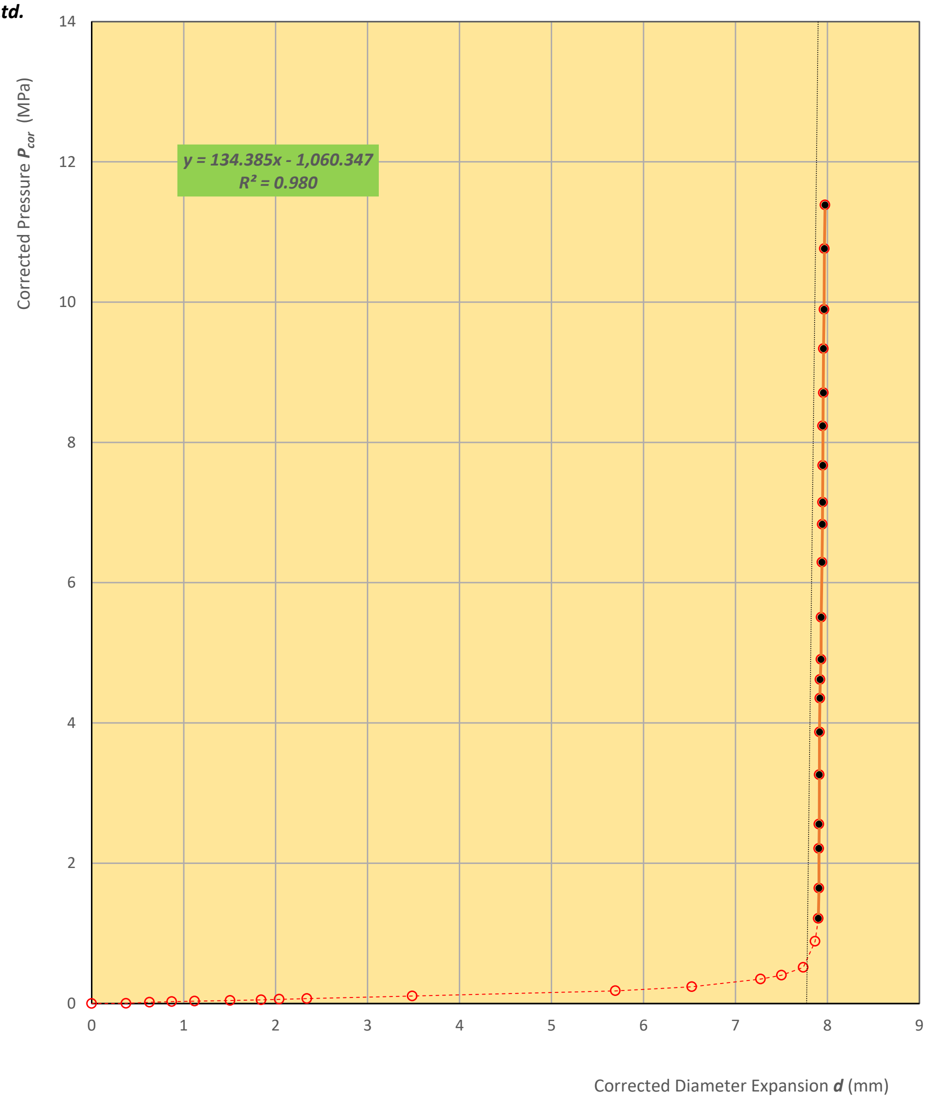
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*119.210*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *14448.2* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH307-DMP***
Test No.: ***8***
Test Depth (m): 49.70
Client: ***Golder Associates Ltd.***

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.001	0.374
0.017	0.629
0.026	0.872
0.034	1.120
0.043	1.506
0.052	1.844
0.060	2.040
0.070	2.341
0.106	3.486
0.181	5.695
0.240	6.526
0.348	7.273
0.404	7.501
0.515	7.737
0.886	7.866
1.214	7.901
1.645	7.908
2.209	7.907
2.557	7.909
3.262	7.912
3.870	7.915
4.351	7.918
4.619	7.920
4.907	7.930
5.507	7.932
6.290	7.941
6.832	7.945
7.147	7.948
7.672	7.950
8.234	7.949
8.708	7.957
9.336	7.957
9.896	7.963
10.762	7.967
11.385	7.974



$$E = (1+\nu)D_0\,{}^{P}\!/_{d}$$

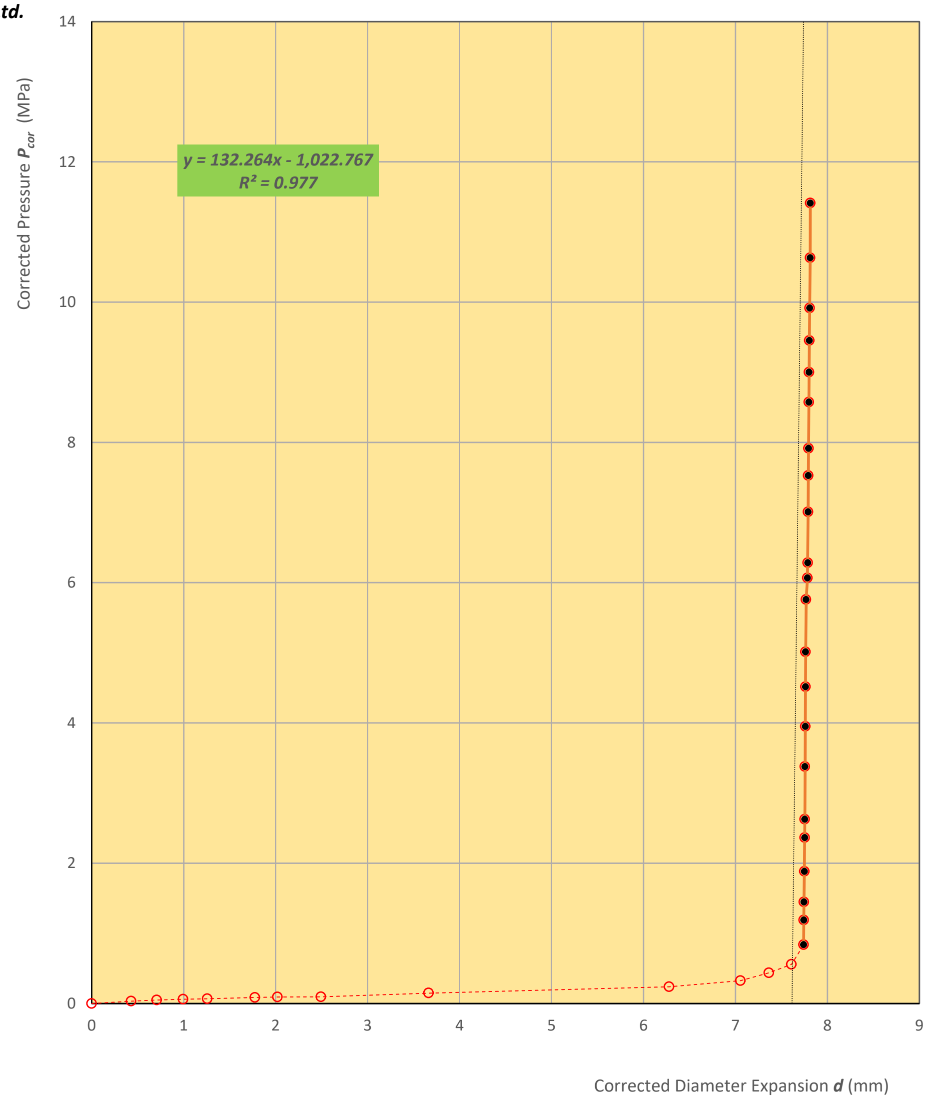
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*134.385*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *16287.5* *MPa*

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.: **BH307-DMP**
Test No.: **9**
Test Depth (m): 48.18
Client: **Golder Associates Ltd.**

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.034	0.429
0.049	0.708
0.061	0.995
0.069	1.257
0.086	1.775
0.093	2.021
0.095	2.494
0.149	3.664
0.240	6.279
0.326	7.054
0.438	7.364
0.559	7.609
0.838	7.742
1.191	7.743
1.448	7.745
1.883	7.750
2.364	7.753
2.627	7.754
3.377	7.755
3.950	7.761
4.516	7.762
5.013	7.763
5.759	7.768
6.067	7.783
6.285	7.786
7.009	7.790
7.528	7.792
7.915	7.795
8.575	7.799
9.002	7.800
9.453	7.804
9.917	7.807
10.632	7.812
11.413	7.815



$$E = (1+\nu)D_0 \, {}^{P}/_{d}$$

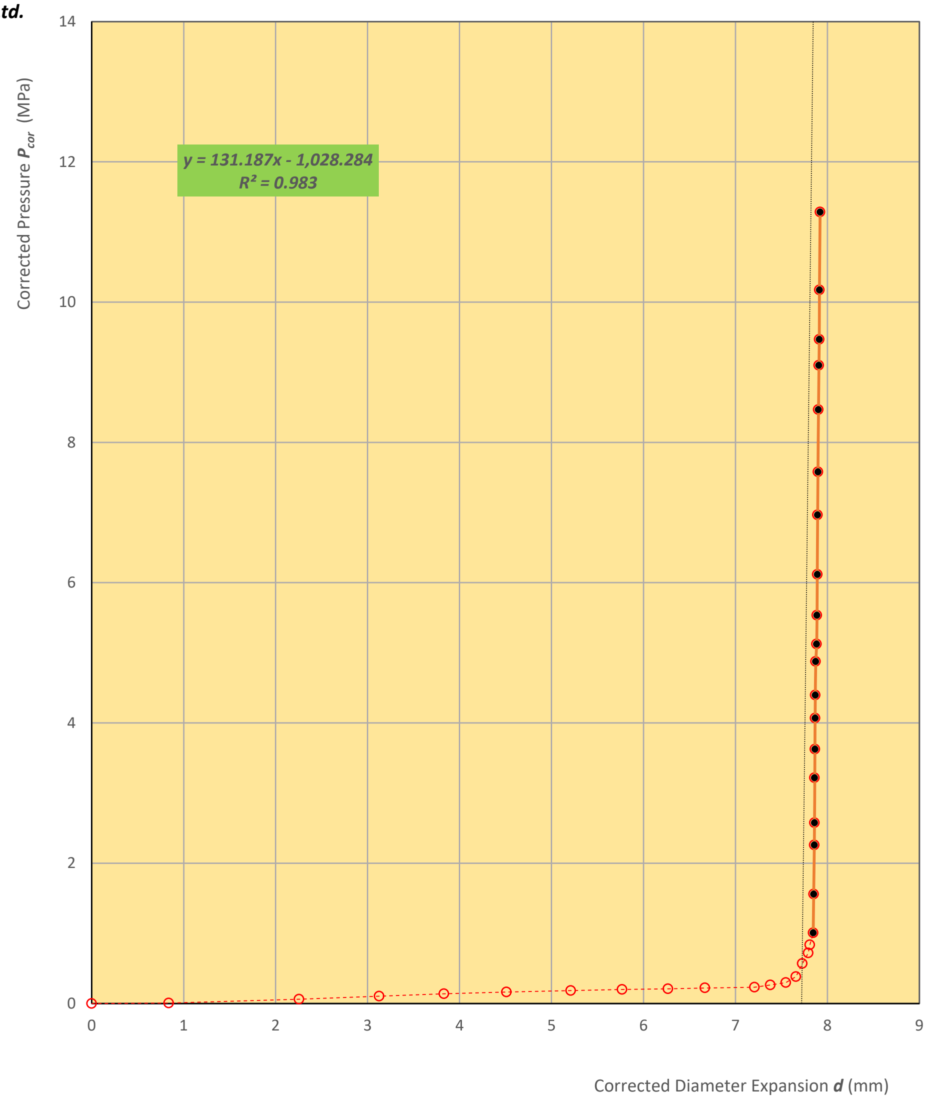
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*132.264*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *16030.4* *MPa*

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.: **BH307-DMP**
Test No.: **10**
Test Depth (m): 46.65
Client: **Golder Associates Ltd.**

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.006	0.838
0.061	2.255
0.104	3.127
0.139	3.831
0.164	4.510
0.184	5.209
0.201	5.767
0.210	6.266
0.222	6.668
0.232	7.208
0.264	7.379
0.298	7.548
0.383	7.657
0.569	7.728
0.721	7.791
0.837	7.809
1.008	7.846
1.559	7.851
2.260	7.857
2.578	7.860
3.218	7.860
3.626	7.864
4.070	7.866
4.398	7.868
4.876	7.872
5.125	7.883
5.535	7.886
6.117	7.890
6.966	7.892
7.579	7.898
8.467	7.902
9.100	7.907
9.468	7.911
10.174	7.913
11.285	7.921



$$E = (1+\nu) D_0 \, {}^{P}\!/_{d}$$

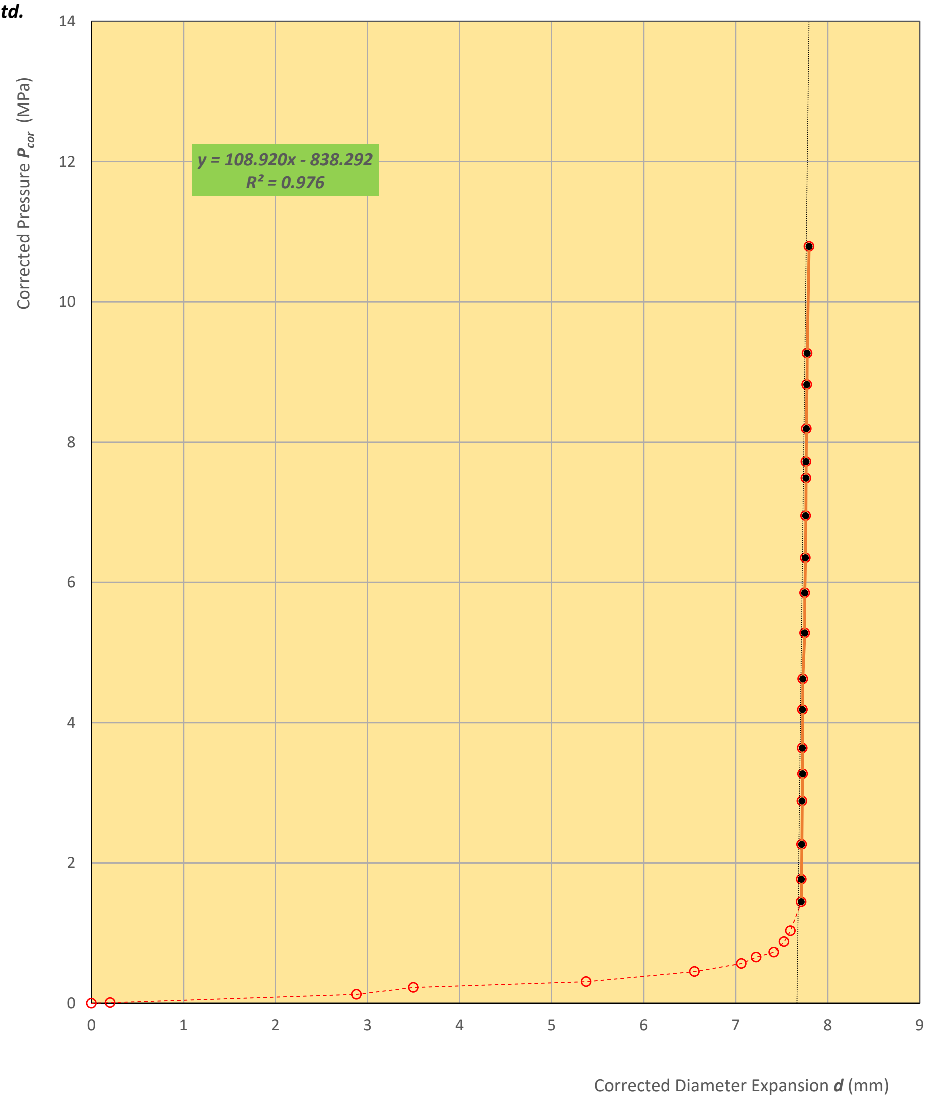
Elastic Modulus (Young's Mod)

μ = 0.20 *Poisson's ratio*
D_0 = 101 *mm* *Initial corehole diameter (before expansion)*
P_{cor} *MPa* *Corrected Pressure for the elastic deformations*
P/d = *131.187* *MPa / mm* *Test gradient from Linear elastic portion*

E_Y = *15899.8* *MPa*

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.: **BH307-DMP**
Test No.: **11**
Test Depth (m): 45.13
Client: **Golder Associates Ltd.**

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.008	0.203
0.127	2.882
0.226	3.499
0.307	5.376
0.451	6.554
0.565	7.063
0.656	7.225
0.728	7.416
0.878	7.528
1.033	7.597
1.445	7.714
1.767	7.716
2.265	7.719
2.882	7.722
3.271	7.729
3.637	7.726
4.185	7.728
4.623	7.731
5.278	7.751
5.850	7.752
6.351	7.758
6.951	7.763
7.487	7.766
7.722	7.765
8.192	7.769
8.820	7.775
9.265	7.778
10.790	7.798



$$E = (1+\nu) D_0 \, {}^{P}\!/_{d}$$

Elastic Modulus (Young's Mod)

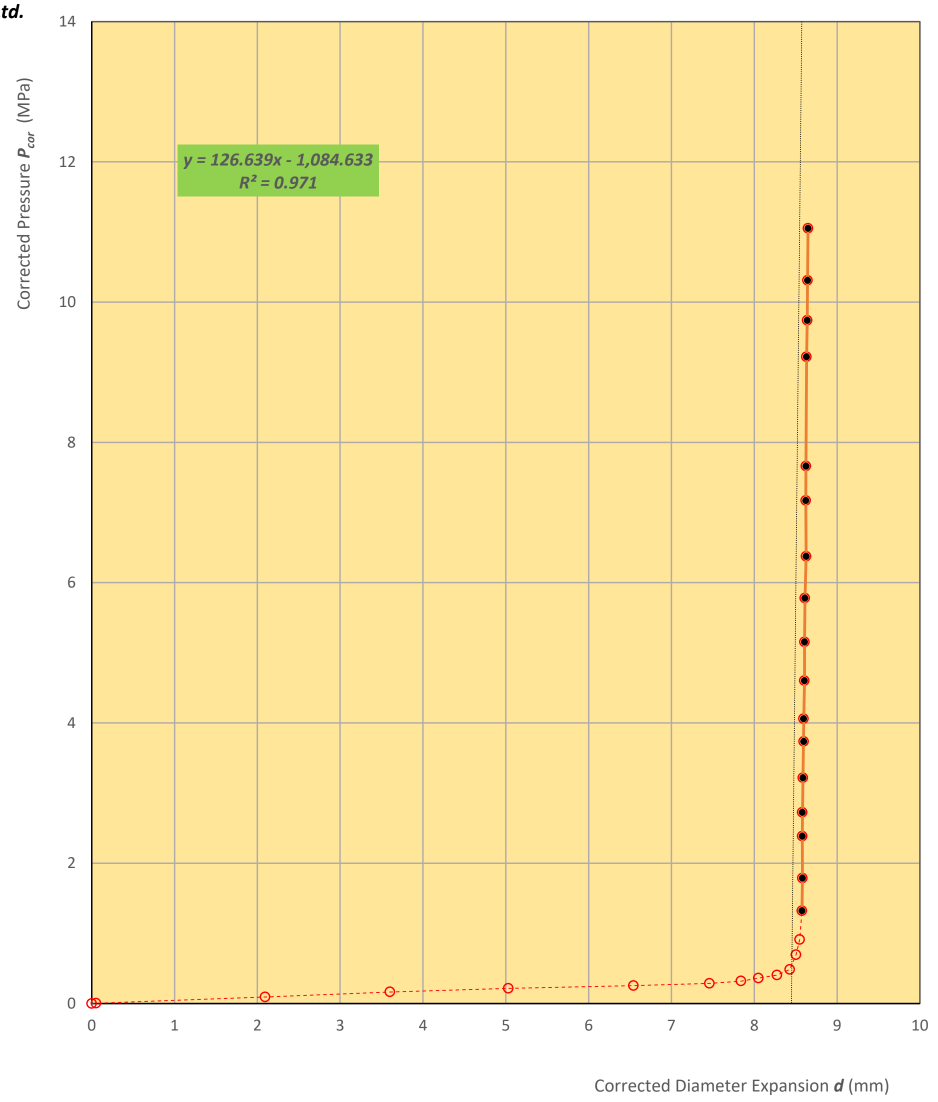
μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*108.920*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *13201.1* *MPa*

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.: **BH307-DMP**
Test No.: **12**
Test Depth (m): 43.60
Client: **Golder Associates Ltd.**

Field Data

Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.005	0.052
0.093	2.094
0.165	3.602
0.217	5.031
0.256	6.541
0.288	7.460
0.320	7.841
0.363	8.050
0.405	8.275
0.485	8.429
0.696	8.504
0.913	8.549
1.323	8.576
1.787	8.582
2.385	8.580
2.725	8.581
3.218	8.588
3.737	8.597
4.061	8.595
4.603	8.606
5.156	8.607
5.780	8.612
6.375	8.626
7.171	8.623
7.661	8.624
9.220	8.631
9.741	8.640
10.310	8.644
11.051	8.650



$$E = (1+\nu)D_0 \, {}^{P}\!/_{d}$$

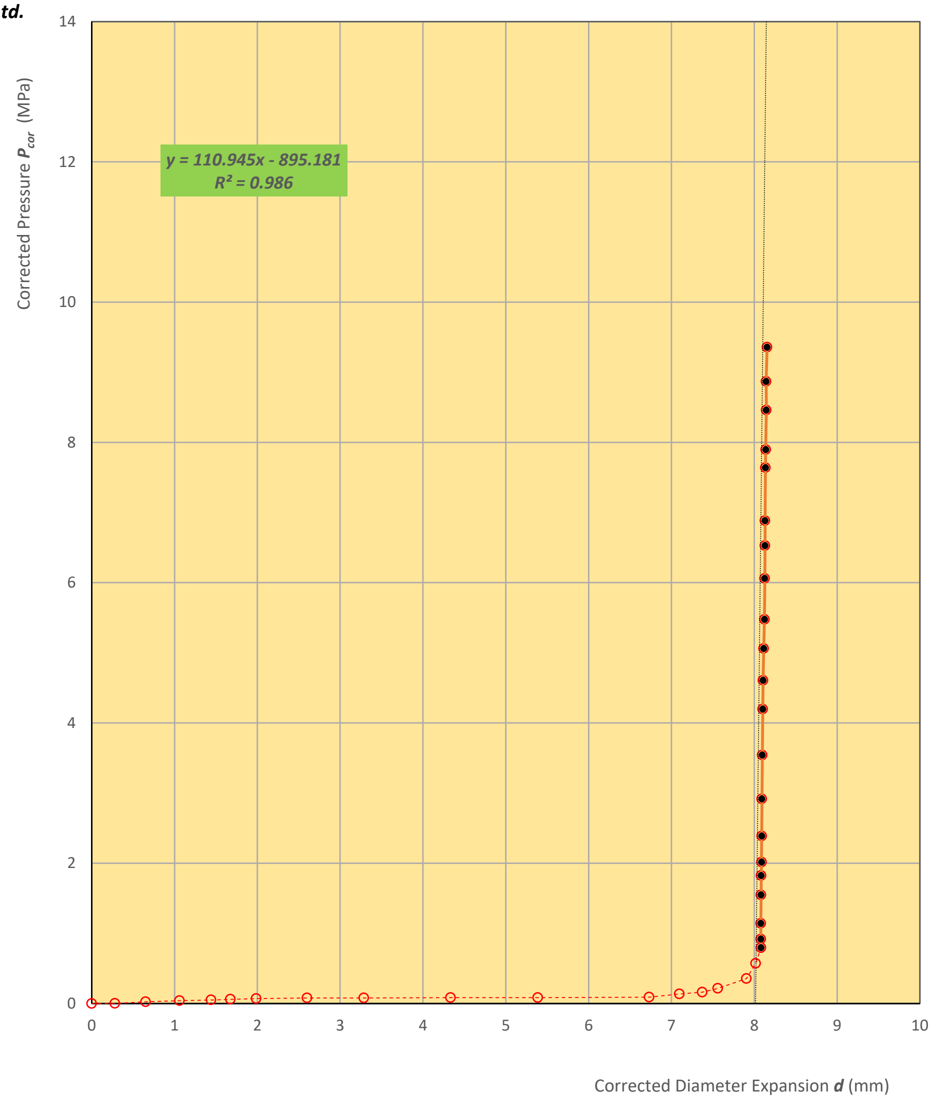
Elastic Modulus (Young's Mod)

μ =	0.20		Poisson's ratio
D_0 =	101	mm	Initial corehole diameter (before expansion)
P_{cor}		MPa	Corrected Pressure for the elastic deformations
P/d =	126.639	MPa / mm	Test gradient from Linear elastic portion

E_Y = 15348.6 MPa

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH307-DMP***
Test No.: ***13***
Test Depth (m): 42.08
Client: ***Golder Associates Ltd.***

Field Data	
Pressure	Diameter Expansion
P_{cor} MPa	d_{avg} mm
0.000	0.000
0.002	0.280
0.024	0.651
0.041	1.061
0.051	1.442
0.060	1.675
0.070	1.987
0.079	2.600
0.080	3.287
0.083	4.333
0.084	5.386
0.091	6.731
0.137	7.097
0.162	7.372
0.216	7.561
0.356	7.906
0.573	8.017
0.796	8.081
0.919	8.079
1.143	8.080
1.549	8.081
1.825	8.083
2.016	8.089
2.389	8.091
2.917	8.091
3.543	8.098
4.198	8.103
4.607	8.107
5.061	8.114
5.476	8.124
6.060	8.127
6.528	8.130
6.884	8.130
7.640	8.136
7.898	8.139
8.461	8.146
8.868	8.143
9.357	8.155



$$E = (1+\nu)D_0 \, {}^{P}/_{d}$$

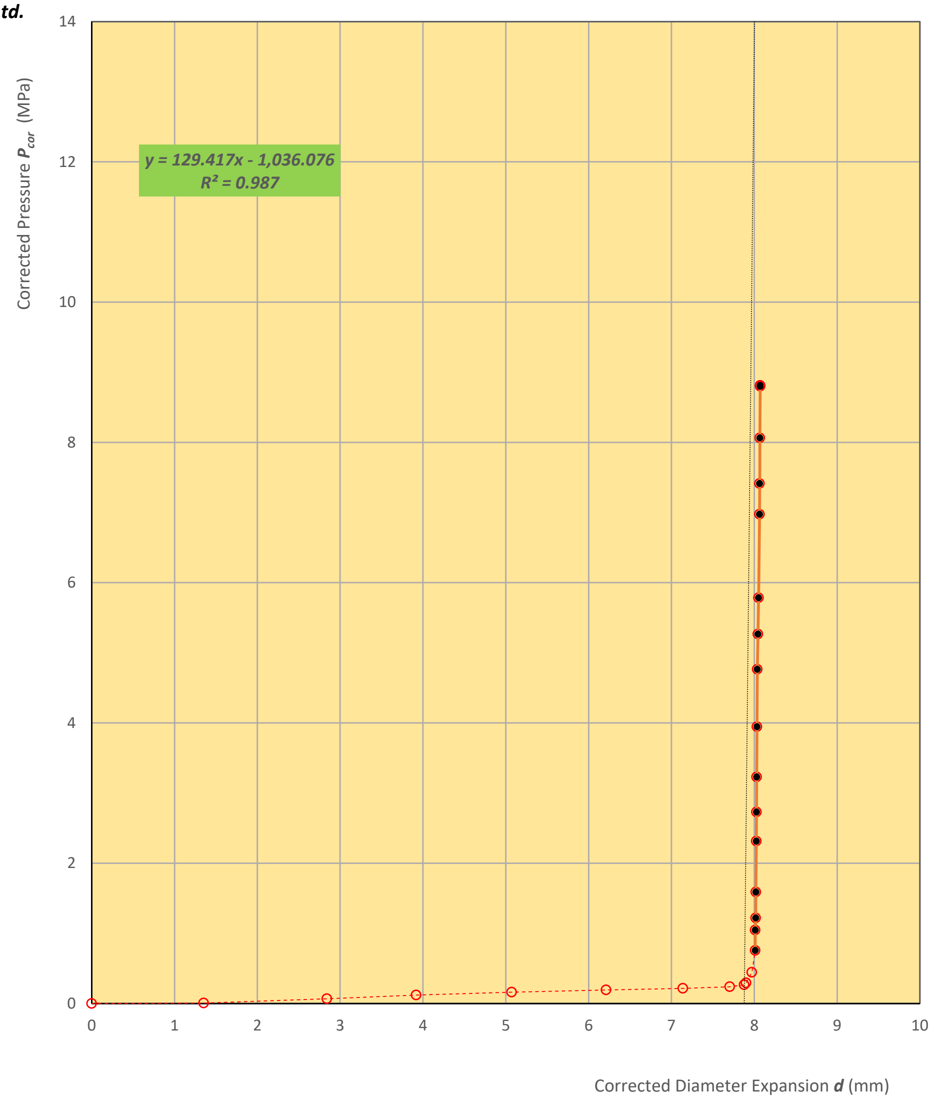
Elastic Modulus (Young's Mod)

μ	=	0.20		*Poisson's ratio*
D_0	=	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}			*MPa*	*Corrected Pressure for the elastic deformations*
P/d	=	*110.945*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = 13446.5 MPa

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH307-DMP***
Test No.: ***14***
Test Depth (m): 40.56
Client: ***Golder Associates Ltd.***

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.007	1.352
0.069	2.841
0.121	3.919
0.162	5.071
0.193	6.212
0.217	7.138
0.240	7.705
0.266	7.878
0.293	7.902
0.444	7.971
0.756	8.012
1.046	8.012
1.221	8.018
1.590	8.020
2.316	8.025
2.729	8.028
3.230	8.030
3.946	8.033
4.764	8.037
5.267	8.045
5.785	8.052
6.976	8.064
7.413	8.065
8.064	8.068
8.800	8.072
8.812	8.072



$$E = (1+\nu)D_0 \, {}^{P}/_{d}$$

Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*129.417*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *15685.4* *MPa*

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**

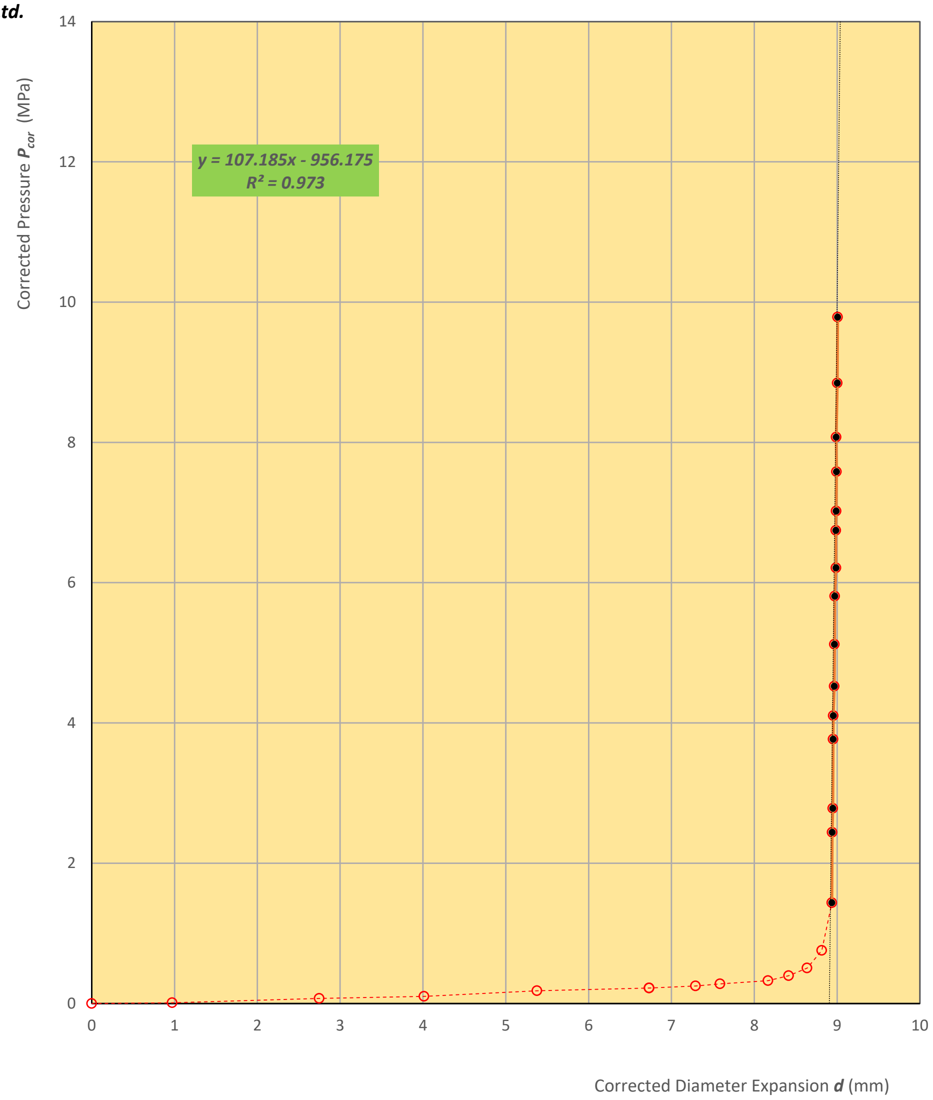
Corehole No.: **BH307-DMP**

Test No.: **15**

Test Depth (m): 39.03

Client: **Golder Associates Ltd.**

Field Data	
Pressure	Diameter Expansion
P_{cor} MPa	d_{avg} mm
0.000	0.000
0.010	0.971
0.072	2.747
0.103	4.013
0.183	5.376
0.221	6.732
0.221	6.732
0.250	7.291
0.280	7.588
0.326	8.167
0.396	8.415
0.507	8.639
0.756	8.816
1.437	8.937
2.440	8.941
2.783	8.949
3.767	8.953
4.104	8.955
4.523	8.966
5.120	8.969
5.807	8.972
6.212	8.987
6.745	8.986
7.020	8.989
7.582	8.993
8.075	8.990
8.846	9.003
9.787	9.008



$$E = (1+\nu)D_0 \, {}^{P}\!/_{d}$$

Elastic Modulus (Young's Mod)

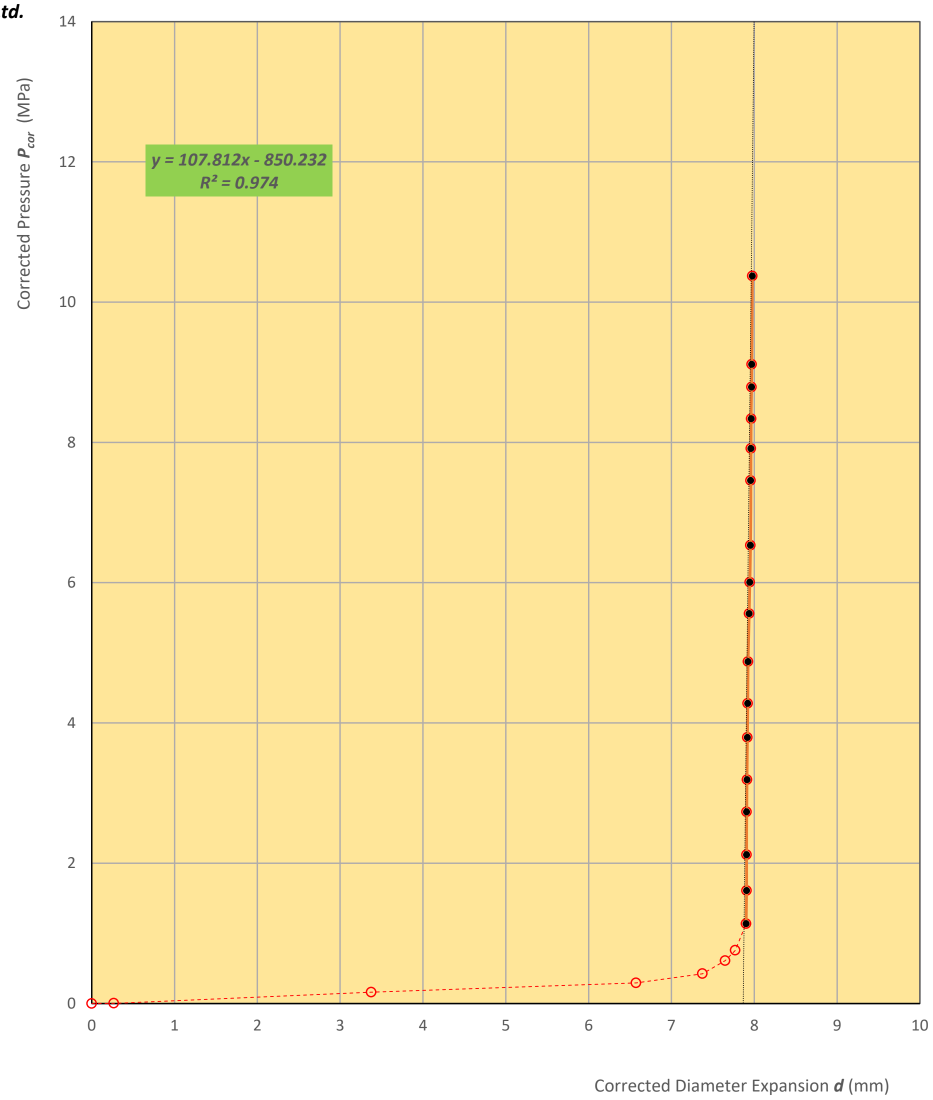
μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*107.185*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *12990.8* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH307-DMP***
Test No.: ***16***
Test Depth (m): 37.51
Client: ***Golder Associates Ltd.***

Field Data

Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.003	0.267
0.161	3.376
0.293	6.573
0.425	7.374
0.611	7.648
0.758	7.771
1.137	7.902
1.610	7.907
2.120	7.908
2.733	7.908
3.192	7.913
3.792	7.917
4.279	7.921
4.875	7.925
5.559	7.939
6.007	7.946
6.532	7.955
7.457	7.957
7.913	7.960
8.337	7.964
8.790	7.968
9.113	7.970
10.373	7.977



$$E = (1+\nu)D_0\, {}^{P}\!/_{d}$$

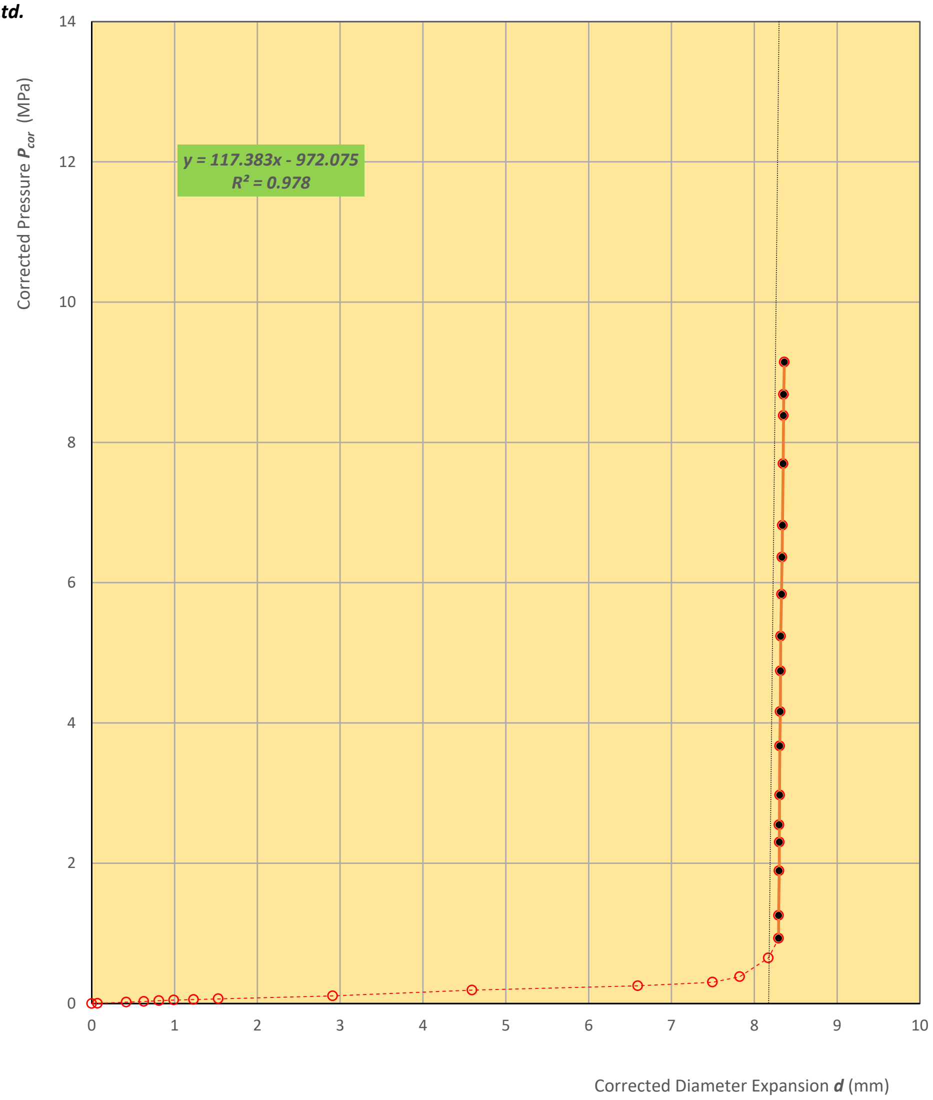
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*107.812*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *13066.8* *MPa*

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.: **BH307-DMP**
Test No.: **17**
Test Depth (m): 35.98
Client: **Golder Associates Ltd.**

Field Data	
Pressure	Diameter Expansion
P_{cor} MPa	d_{avg} mm
0.000	0.000
0.001	0.069
0.021	0.417
0.029	0.630
0.040	0.812
0.049	0.991
0.057	1.231
0.067	1.528
0.110	2.910
0.192	4.592
0.253	6.594
0.304	7.497
0.383	7.825
0.650	8.170
0.931	8.295
1.257	8.295
1.893	8.301
2.301	8.303
2.548	8.301
2.972	8.308
3.673	8.308
4.163	8.314
4.742	8.317
5.237	8.319
5.835	8.330
6.364	8.334
6.818	8.340
7.696	8.349
8.383	8.353
8.684	8.355
9.146	8.363



$$E = (1+\nu)D_0 \, {}^{P}/_{d}$$

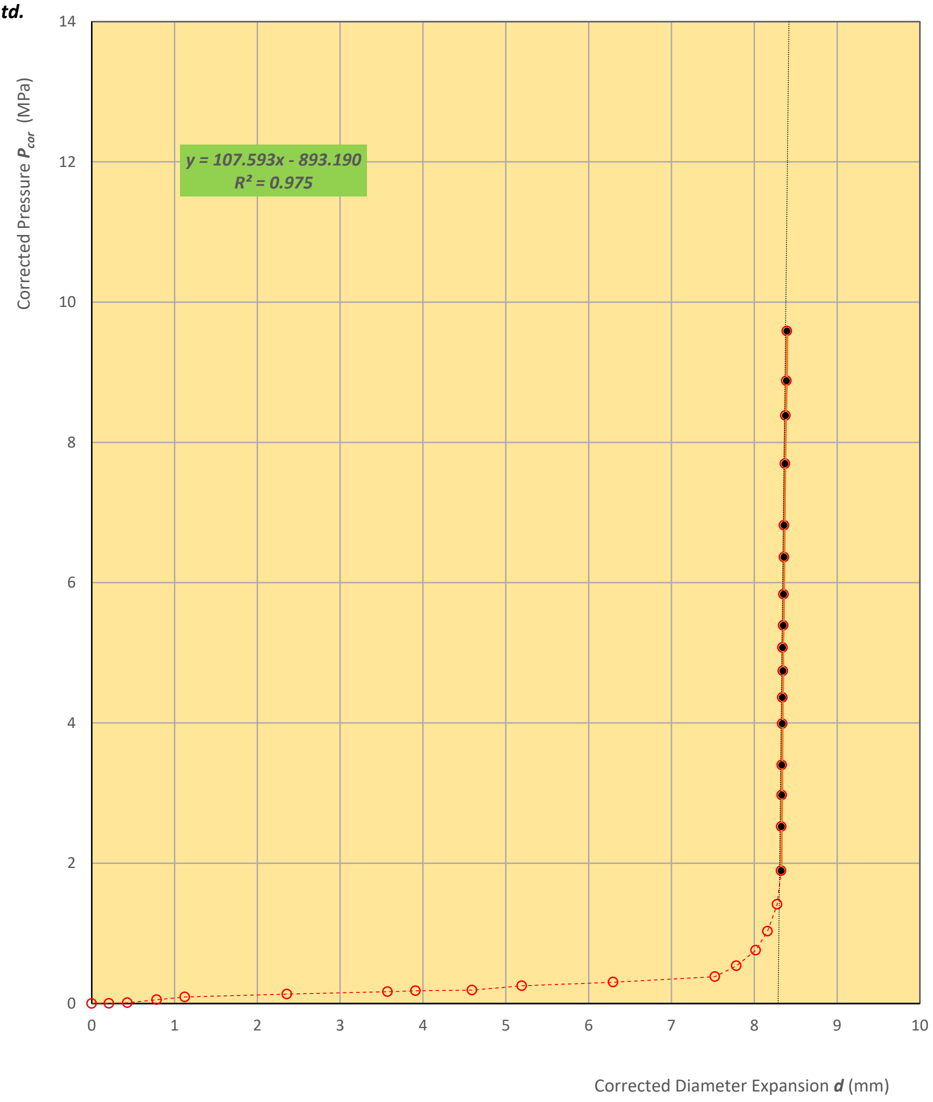
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*117.383*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *14226.8* *MPa*

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.: **BH307-DMP**
Test No.: **18**
Test Depth (m): 34.46
Client: **Golder Associates Ltd.**

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.002	0.209
0.011	0.431
0.055	0.785
0.094	1.125
0.134	2.357
0.169	3.572
0.182	3.910
0.192	4.592
0.253	5.194
0.304	6.297
0.383	7.525
0.538	7.785
0.760	8.017
1.031	8.160
1.413	8.276
1.893	8.325
2.523	8.327
2.972	8.333
3.400	8.333
3.990	8.339
4.363	8.340
4.742	8.346
5.076	8.342
5.391	8.351
5.835	8.355
6.364	8.359
6.818	8.360
7.696	8.371
8.383	8.378
8.877	8.389
9.588	8.394



$$E = (1+\nu)D_0 \, {}^{P}/_{d}$$

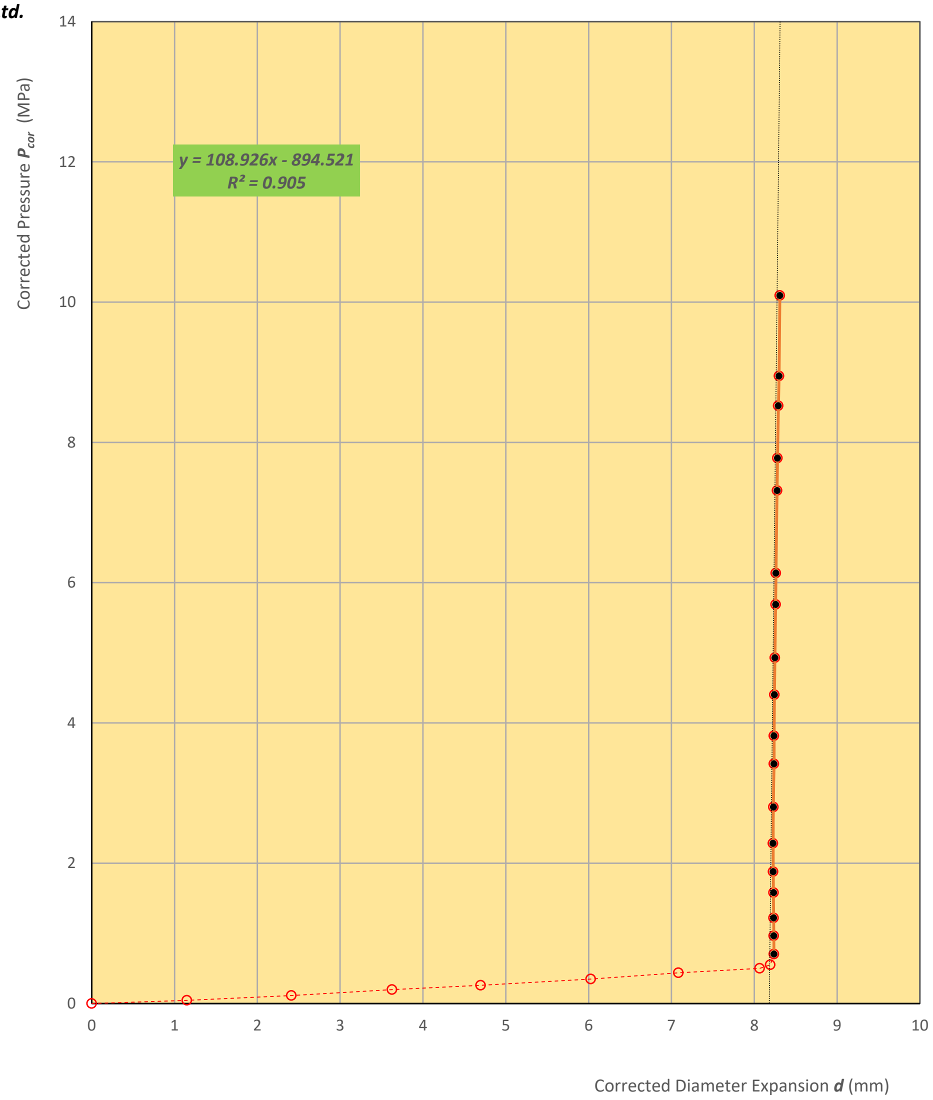
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*107.593*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *13040.3* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH307-DMP***
Test No.: ***19***
Test Depth (m): 32.94
Client: ***Golder Associates Ltd.***

Field Data	
Pressure	Diameter Expansion
P_{cor} MPa	d_{avg} mm
0.000	0.000
0.046	1.149
0.113	2.412
0.198	3.627
0.259	4.696
0.349	6.026
0.438	7.084
0.501	8.066
0.552	8.193
0.704	8.238
0.964	8.236
1.220	8.234
1.581	8.234
1.879	8.228
2.282	8.227
2.801	8.232
3.417	8.239
3.817	8.239
4.403	8.244
4.930	8.249
5.688	8.259
6.135	8.261
7.313	8.277
7.776	8.280
8.522	8.291
8.947	8.300
10.094	8.309



$$E = (1+\nu)D_0\,{}^{P}/_{d}$$

Elastic Modulus (Young's Mod)

μ	=	0.20		*Poisson's ratio*
D_0	=	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}			*MPa*	*Corrected Pressure for the elastic deformations*
P/d	=	*108.926*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *13201.8* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***

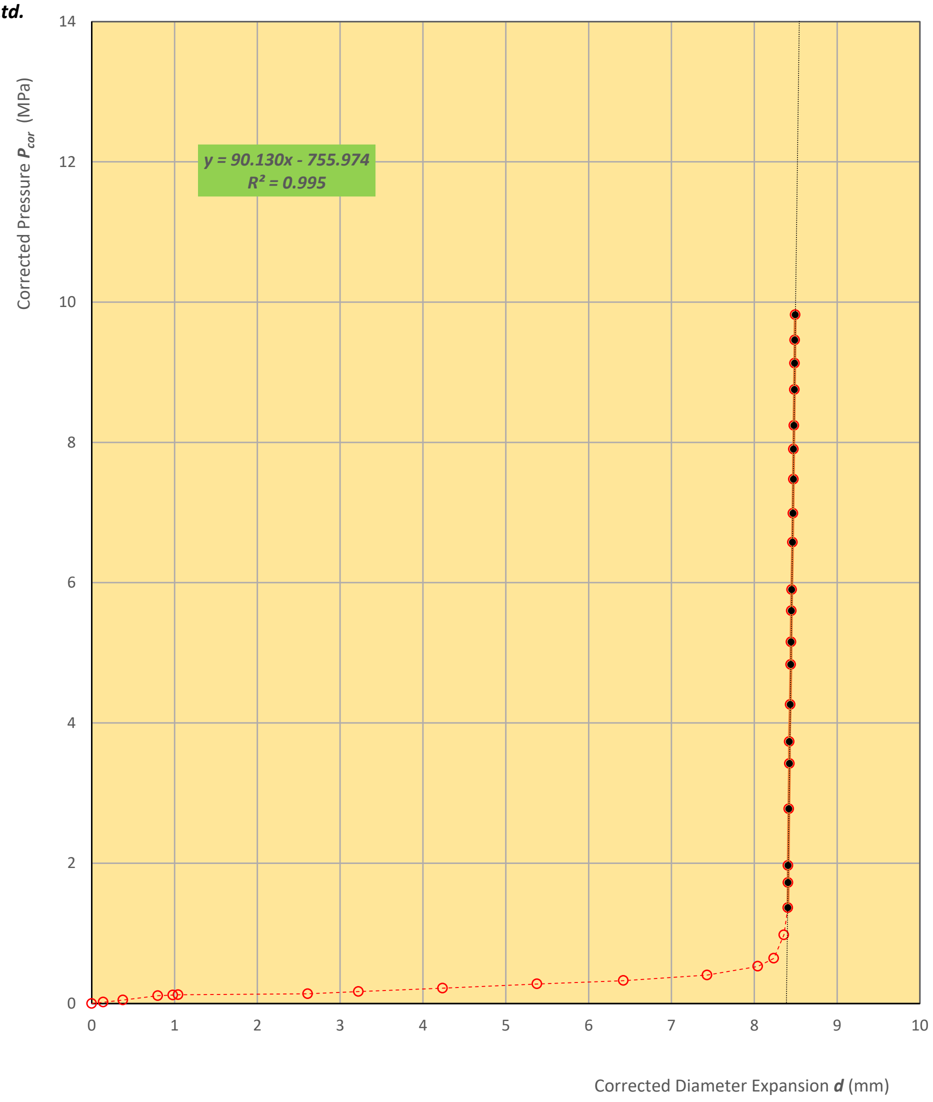
Corehole No.: ***BH307-DMP***

Test No.: ***20***

Test Depth (m): 31.41

Client: ***Golder Associates Ltd.***

Field Data	
Pressure	Diameter Expansion
P_{cor} MPa	d_{avg} mm
0.000	0.000
0.019	0.139
0.049	0.377
0.112	0.797
0.120	0.980
0.125	1.043
0.139	2.609
0.171	3.220
0.219	4.236
0.279	5.376
0.327	6.421
0.406	7.430
0.530	8.043
0.644	8.236
0.979	8.358
1.365	8.406
1.724	8.409
1.969	8.409
2.776	8.417
3.422	8.425
3.734	8.423
4.264	8.435
4.834	8.442
5.154	8.445
5.599	8.449
5.902	8.452
6.577	8.462
6.989	8.468
7.474	8.474
7.904	8.474
8.242	8.479
8.752	8.486
9.129	8.488
9.459	8.490
9.820	8.496



$$E = (1+\nu)D_0 \, {}^{P}/_{d}$$

Elastic Modulus (Young's Mod)

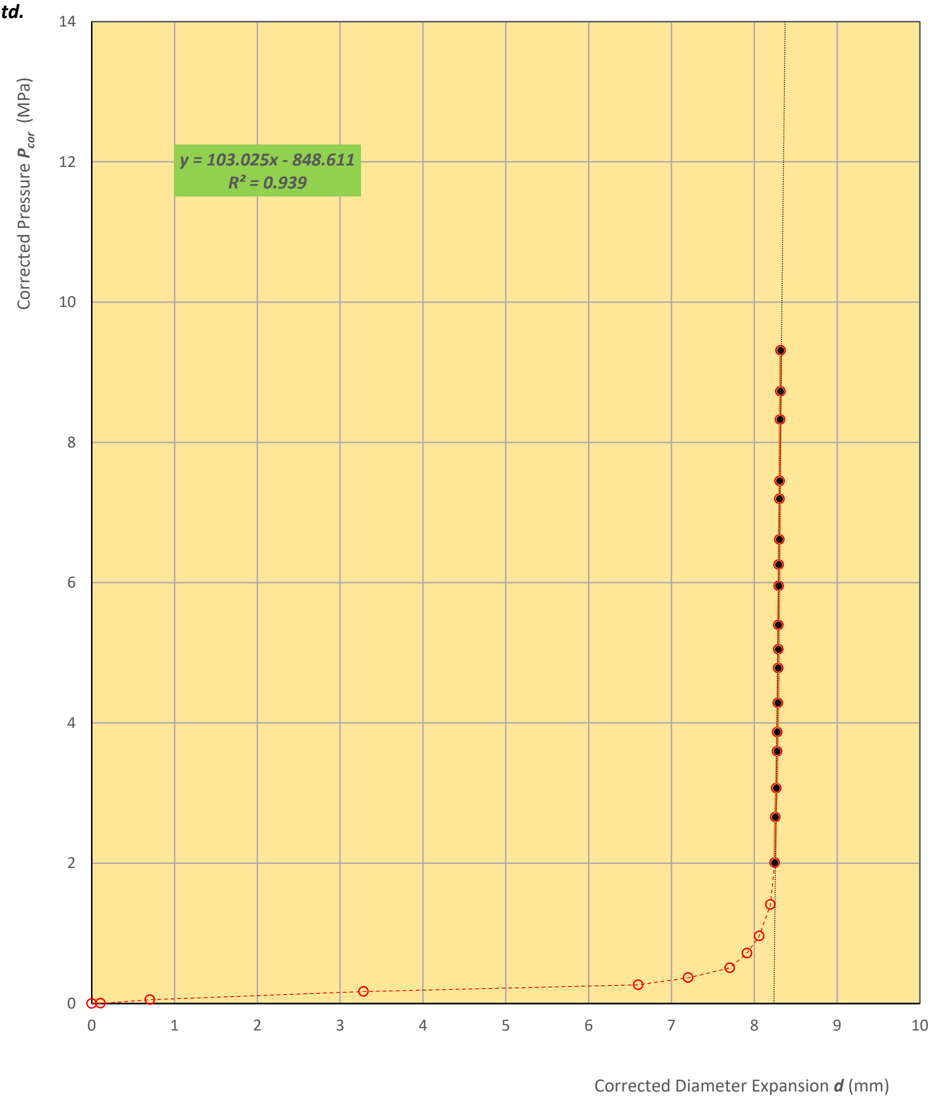
μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*90.130*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = 10923.7 MPa

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH307-DMP***
Test No.: ***21***
Test Depth (m): 29.89
Client: ***Golder Associates Ltd.***

Field Data

Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.003	0.107
0.054	0.704
0.171	3.282
0.267	6.600
0.368	7.203
0.508	7.705
0.719	7.913
0.963	8.060
1.411	8.195
2.007	8.248
2.658	8.255
3.070	8.268
3.595	8.276
3.868	8.279
4.286	8.286
4.784	8.290
5.051	8.292
5.396	8.292
5.954	8.297
6.257	8.297
6.615	8.303
7.195	8.306
7.451	8.308
8.327	8.313
8.727	8.317
9.311	8.319



$$E = (1+\nu)D_0 \,{}^{P}/_{d}$$

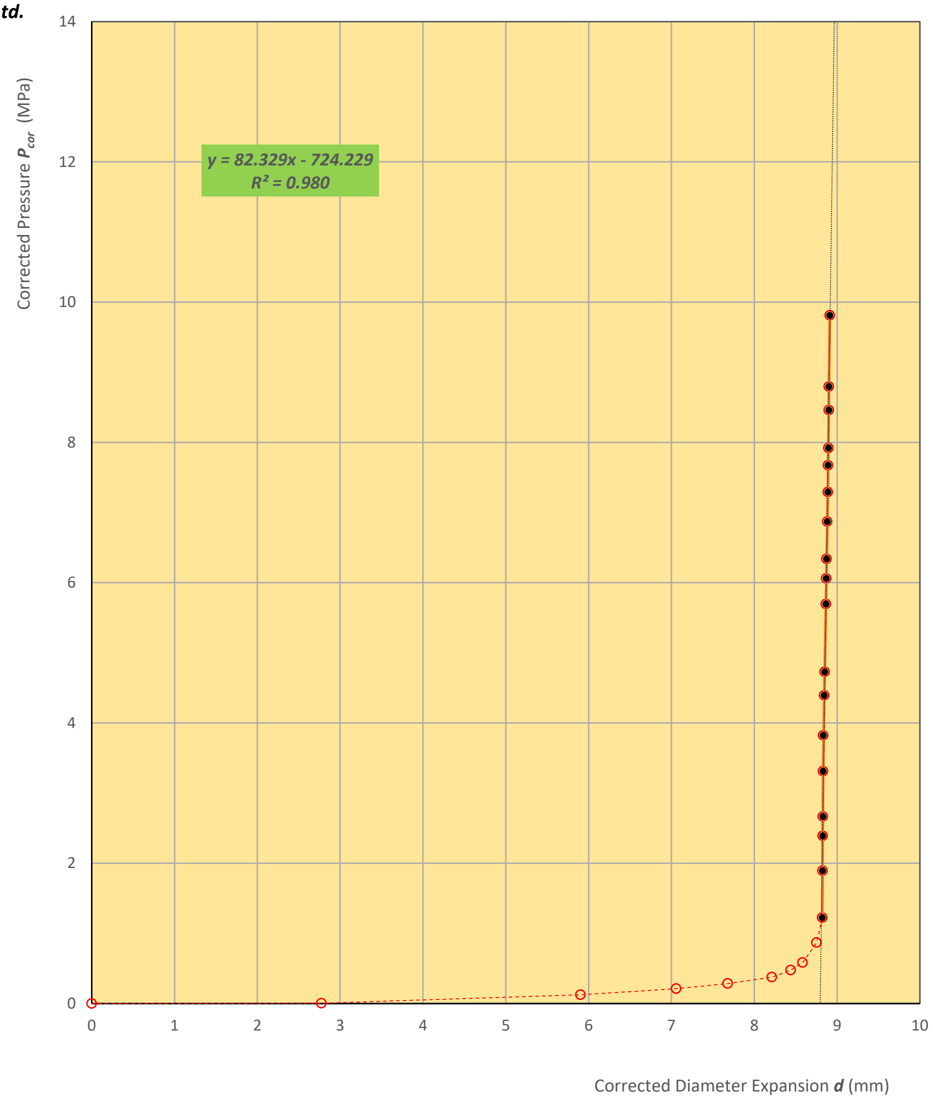
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*103.025*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *12486.6* *MPa*

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.: **BH307-DMP**
Test No.: **22**
Test Depth (m): 28.36
Client: **Golder Associates Ltd.**

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.005	2.775
0.126	5.902
0.213	7.057
0.285	7.679
0.377	8.213
0.477	8.441
0.584	8.584
0.868	8.753
1.225	8.822
1.894	8.826
2.390	8.827
2.667	8.829
3.312	8.832
3.823	8.834
4.392	8.845
4.729	8.850
5.695	8.866
6.060	8.870
6.338	8.875
6.870	8.882
7.292	8.888
7.673	8.891
7.919	8.897
8.461	8.901
8.797	8.901
9.812	8.913



$$E = (1+\nu)D_0 \, {}^{P}/_{d}$$

Elastic Modulus (Young's Mod)

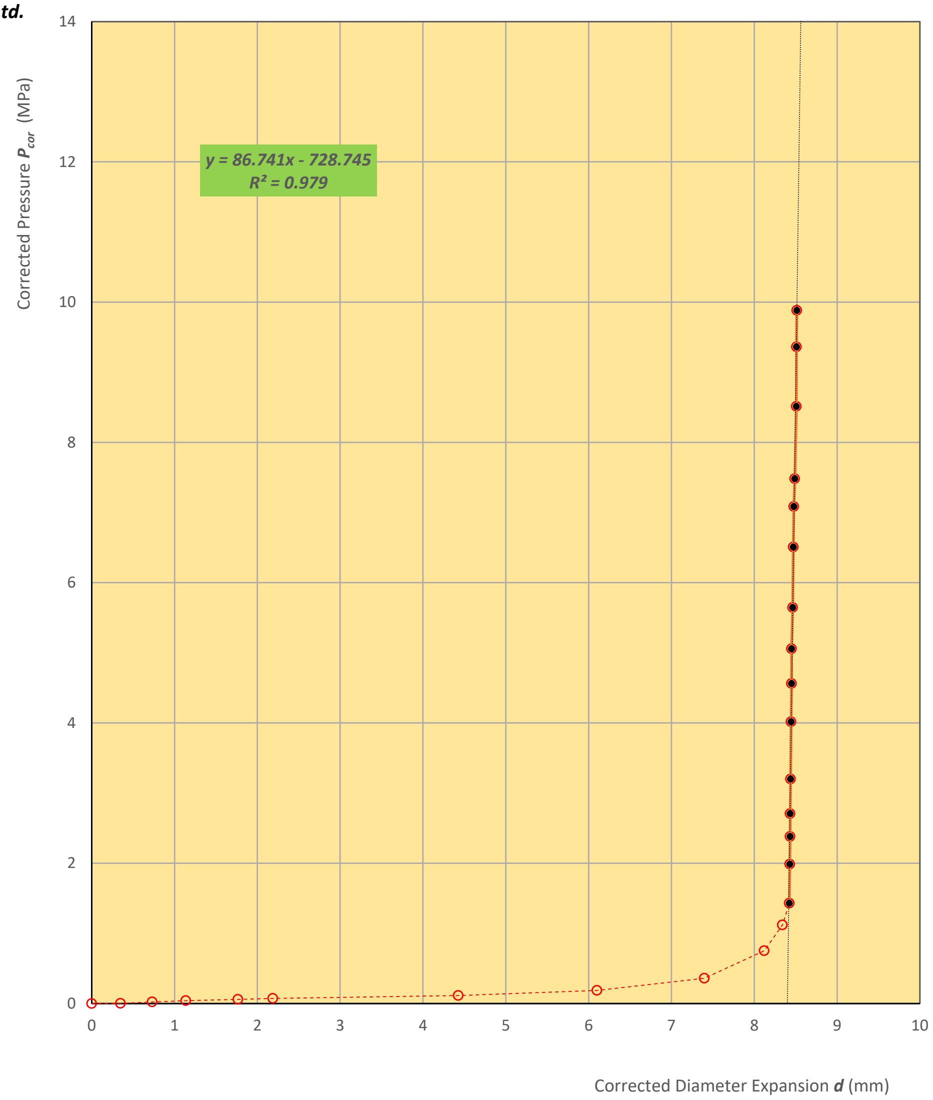
μ =	0.20		Poisson's ratio
D_0 =	101	mm	Initial corehole diameter (before expansion)
P_{cor}		MPa	Corrected Pressure for the elastic deformations
P/d =	82.329	MPa / mm	Test gradient from Linear elastic portion

E_Y = *9978.3* MPa

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH307-DMP***
Test No.: ***23***
Test Depth (m): 26.84
Client: ***Golder Associates Ltd.***

Field Data

Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.001	0.347
0.022	0.730
0.040	1.137
0.059	1.766
0.073	2.187
0.113	4.426
0.187	6.102
0.360	7.398
0.753	8.120
1.120	8.340
1.429	8.423
1.987	8.429
2.382	8.433
2.707	8.434
3.201	8.439
4.016	8.445
4.561	8.450
5.056	8.451
5.645	8.464
6.507	8.472
7.084	8.478
7.482	8.490
8.513	8.508
9.361	8.510
9.881	8.515



$$E = (1+\nu)D_0 \, {}^{P}\!/_{d}$$

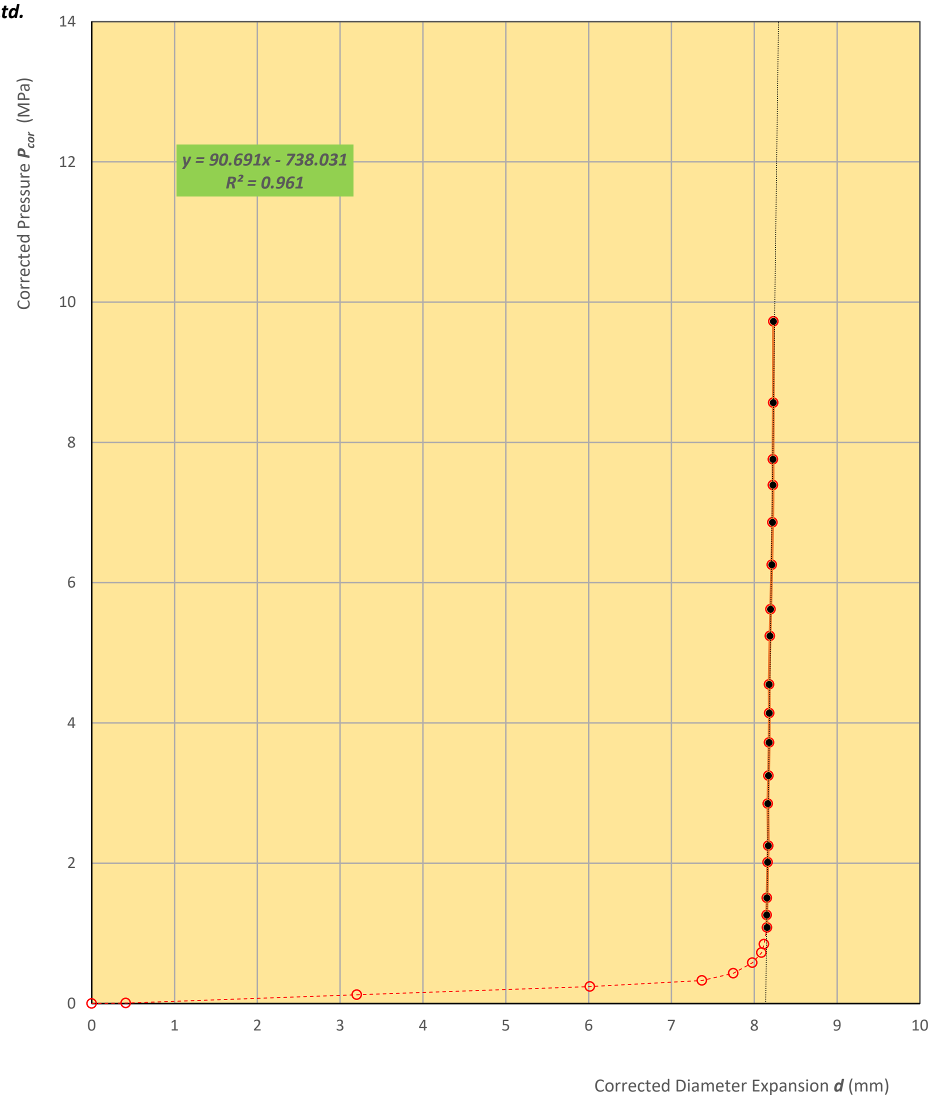
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*86.741*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *10513.0* *MPa*

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH307-DMP***
Test No.: ***24***
Test Depth (m): 25.32
Client: ***Golder Associates Ltd.***

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.007	0.411
0.125	3.201
0.241	6.016
0.329	7.369
0.430	7.747
0.581	7.977
0.724	8.088
0.846	8.118
1.084	8.155
1.260	8.151
1.504	8.154
2.013	8.162
2.249	8.170
2.849	8.165
3.247	8.172
3.721	8.180
4.141	8.182
4.549	8.180
5.239	8.190
5.620	8.197
6.254	8.214
6.860	8.221
7.391	8.227
7.759	8.226
8.565	8.230



$$E = (1+\nu)D_0 \, {}^{P}\!/_{d}$$

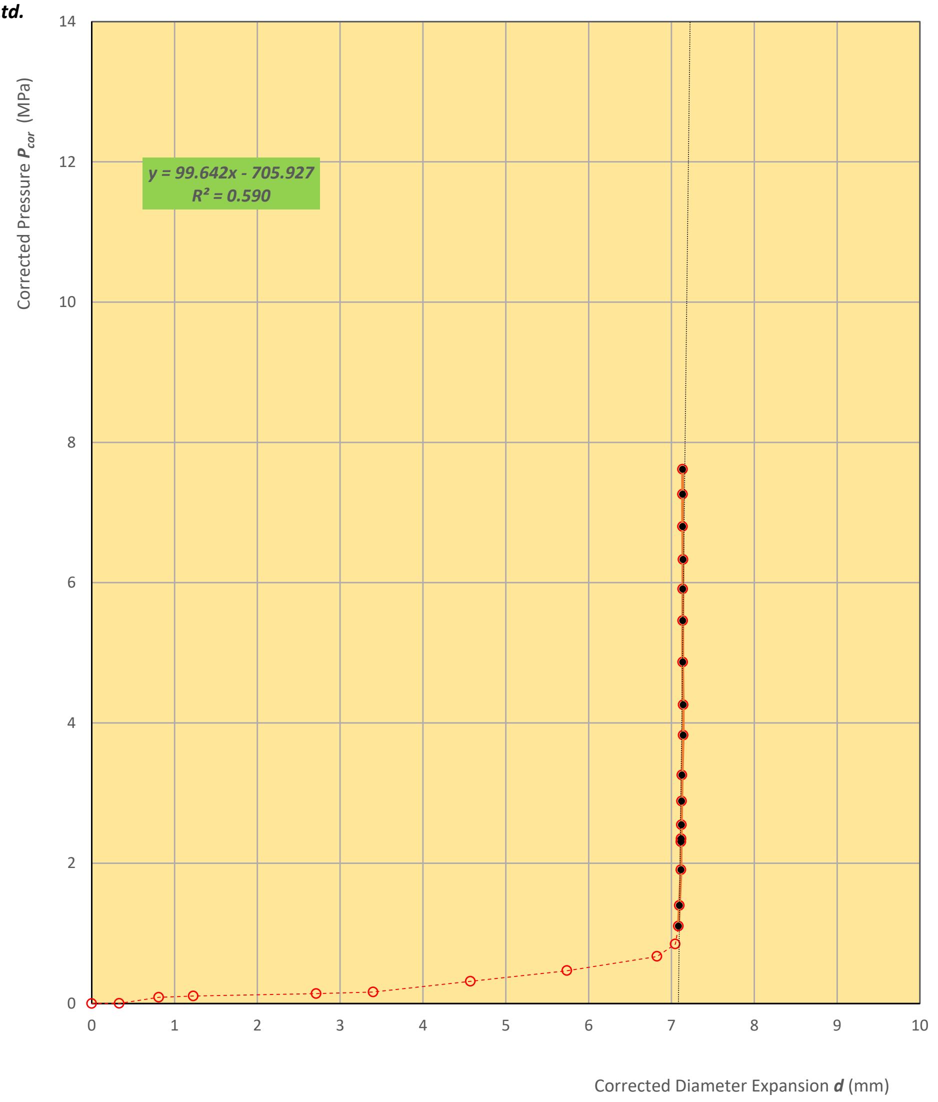
Elastic Modulus (Young's Mod)

μ	=	0.20		*Poisson's ratio*
D_0	=	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}			*MPa*	*Corrected Pressure for the elastic deformations*
P/d	=	*90.691*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = 10991.8 MPa

Project: ***DNNP - Darlington New Nuclear Plant - Bowmanville***
Corehole No.: ***BH307-DMP***
Test No.: ***25***
Test Depth (m): 23.79
Client: ***Golder Associates Ltd.***

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.001	0.333
0.088	0.809
0.107	1.226
0.141	2.710
0.163	3.398
0.316	4.574
0.468	5.738
0.671	6.825
0.848	7.047
1.104	7.084
1.398	7.096
1.908	7.116
2.307	7.116
2.350	7.117
2.547	7.121
2.885	7.124
3.257	7.128
3.824	7.142
4.258	7.142
4.869	7.137
5.459	7.137
5.910	7.136
6.329	7.141
6.799	7.135
7.261	7.135
7.617	7.135



$$E = (1+\nu)D_0 \, {}^{P}\!/_{d}$$

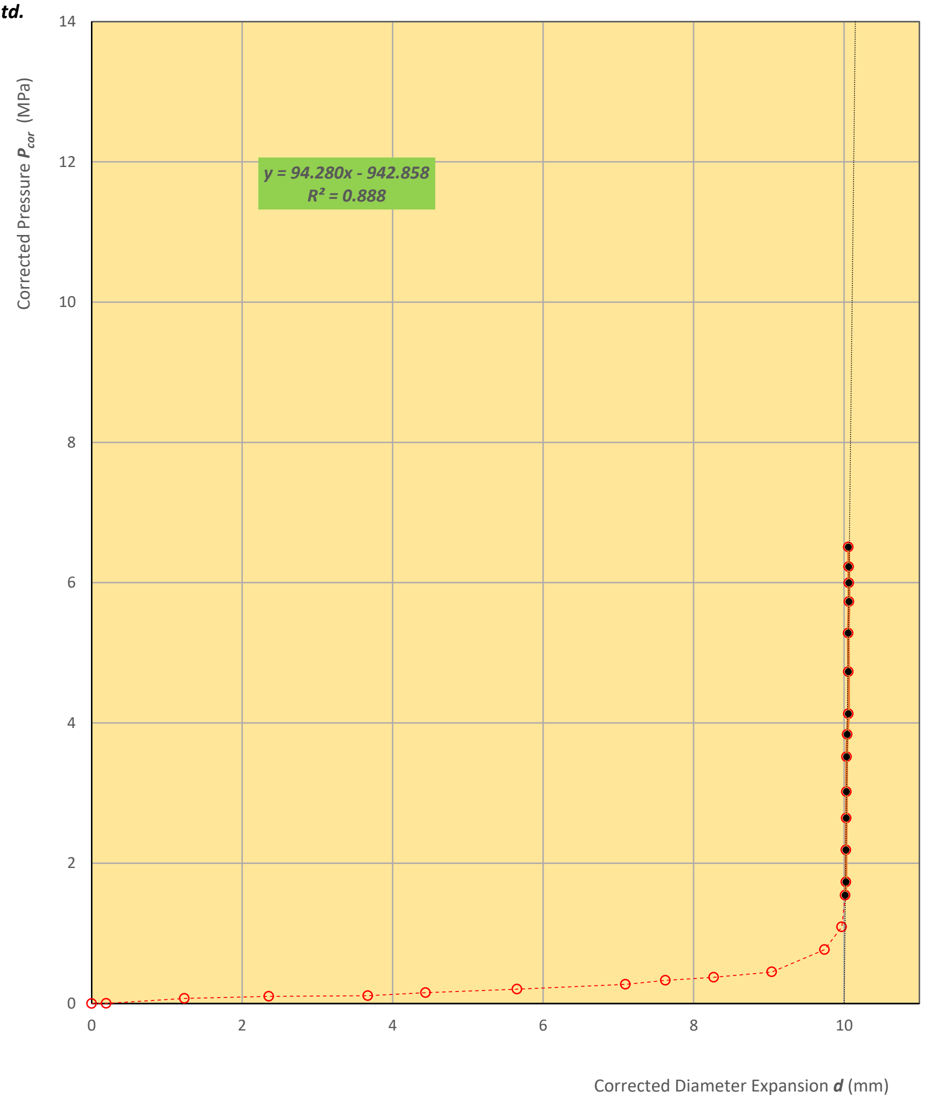
Elastic Modulus (Young's Mod)

μ =	0.20		*Poisson's ratio*
D_0 =	101	*mm*	*Initial corehole diameter (before expansion)*
P_{cor}		*MPa*	*Corrected Pressure for the elastic deformations*
P/d =	*99.642*	*MPa / mm*	*Test gradient from Linear elastic portion*

E_Y = *12076.6* *MPa*

Project: **DNNP - Darlington New Nuclear Plant - Bowmanville**
Corehole No.: **BH307-DMP**
Test No.: **26**
Test Depth (m): 22.27
Client: **Golder Associates Ltd.**

Field Data	
Pressure P_{cor} MPa	Diameter Expansion d_{avg} mm
0.000	0.000
0.002	0.194
0.072	1.233
0.102	2.354
0.112	3.671
0.155	4.437
0.205	5.654
0.274	7.094
0.331	7.625
0.373	8.267
0.450	9.039
0.768	9.740
1.092	9.968
1.543	10.015
1.734	10.025
2.189	10.025
2.643	10.029
3.020	10.031
3.516	10.033
3.836	10.042
4.130	10.057
4.730	10.057
5.281	10.054
5.731	10.065
5.997	10.063
6.227	10.061
6.507	10.057



$$E = (1+\nu)D_0 \, {}^{P}/_{d}$$

Elastic Modulus (Young's Mod)

μ =	0.20		Poisson's ratio
D_0 =	101	mm	Initial corehole diameter (before expansion)
P_{cor}		MPa	Corrected Pressure for the elastic deformations
P/d =	94.280	MPa / mm	Test gradient from Linear elastic portion

E_Y = 11426.7 MPa

Appendix Two

Rock Dilatometer Interpretation

Interpretation of Rock Dilatometer Test Results

Rock Dilatometer test results are expressed in terms of applied pressure versus diameter expansion of the corehole.

The DMP test uses a pressure-controlled loading procedure, which is operated with a pressure regulator attached to a tank of pressurized nitrogen, with a maximum pressure of 14 MPa. Typical pressure-controlled systems are sluggish in nature, and it takes some time to stabilize pressure levels between the source (nitrogen tank) and the probe, which they are connected with a 100 m long high-pressure tubing.

A pressure transducer is located inside the probe in order to eliminate errors associated with pressure loses or leaks along the tubing and probe. *Pressure* and *diameter expansion* readings are taken applying a 15-second time-delay between pressure set and reading. This is to allow for pressure stabilization within the tubing–probe system.

Diameter displacements are measured at three orientations, 120^0 apart from each other, using displacement transducers, as illustrated in the picture below.

These three sensors, D1, D2, and D3 are placed at three different levels, top, center and bottom, 75 mm apart, respectively. Sensor D2, at the center length of the rubber membrane, is located 0.65 m above the lower tip of the DMP probe. The overall length of the rubber membrane (test section) is 1.00 m. See attached Manufacturer’s Manual.

Corrections of pressure and displacement readings

Pressure readings must be corrected for membrane inertia, as it takes some small amount of pressure to mobilize the rubber membrane expansion. This is completed using the membrane inertia calibration curves. For example,

$P_{applied} = P_{reading} - P_{inertia}$

The membrane inertia calibration curve is non-linear. This response is fitted with a suitable 5th order polynomial expression. This polynomial expression, or pressure calibration, is determined for each new membrane and for each new project. Under current test procedures, each one of the displacement sensor (radial expansion) has its own calibration curve.

Displacement or diameter expansion measurements must be corrected for zero-reading of the sensors (frequency-based transducers). The zero-reading correction consists of shifting the entire set of displacement readings by the transducer's reading at the point of full contact between the membrane and the corehole wall. Once again, this shift is applied to each individual sensor. The displacement corrections are completed during the data processing stage.

Test responses and related topics

Based on the current loading procedure, increasing pressure steps are applied in a monotonic pattern. Once sufficient data points along the quasi-elastic portion of the response are acquired, the probe is deflated without further pressure/displacement readings.

Typical *pressure* versus *diameter expansion* curves feature two main distinctive portions which characterize the rock dilatometer response, namely:

a) The pressure-displacement reading at the first full contact between membrane and corehole wall, P_0 and D_0 ; and
b) The quasi-linear elastic conditions.

Based on a linear regression analysis of the data from quasi-linear conditions, the Young's modulus of the rock is inferred using the corrected values of applied pressure and diameter expansion. Unload/reload cycles were not attempted in this test series.

This rock dilatometer equipment does not apply sufficiently high pressures to induce yield or failure of any rock masses, not even for low-strength rock masses.

Young's Modulus E_Y:

The Young's modulus of the rock is represented by the slope of the corrected pressure versus diameter expansion curve along each sensor alignment.

Using the average displacement or expansion of the three sensors, the Young's elastic modulus can be calculated with the following expression:

$$E_Y = (1+\nu)\, D_0 \frac{P}{d}$$ where

ν is the Poisson's ratio, typically $\nu = 0.30$

D_0 is the initial corehole diameter,

P Corrected *pressure increment* during quasi-elastic deformations

d *average* diameter expansion of the corehole, corresponding to the *pressure increment* D_0

as indicated in the Manufacturer's Manual (see attached Roctest DMP 95 Manual)

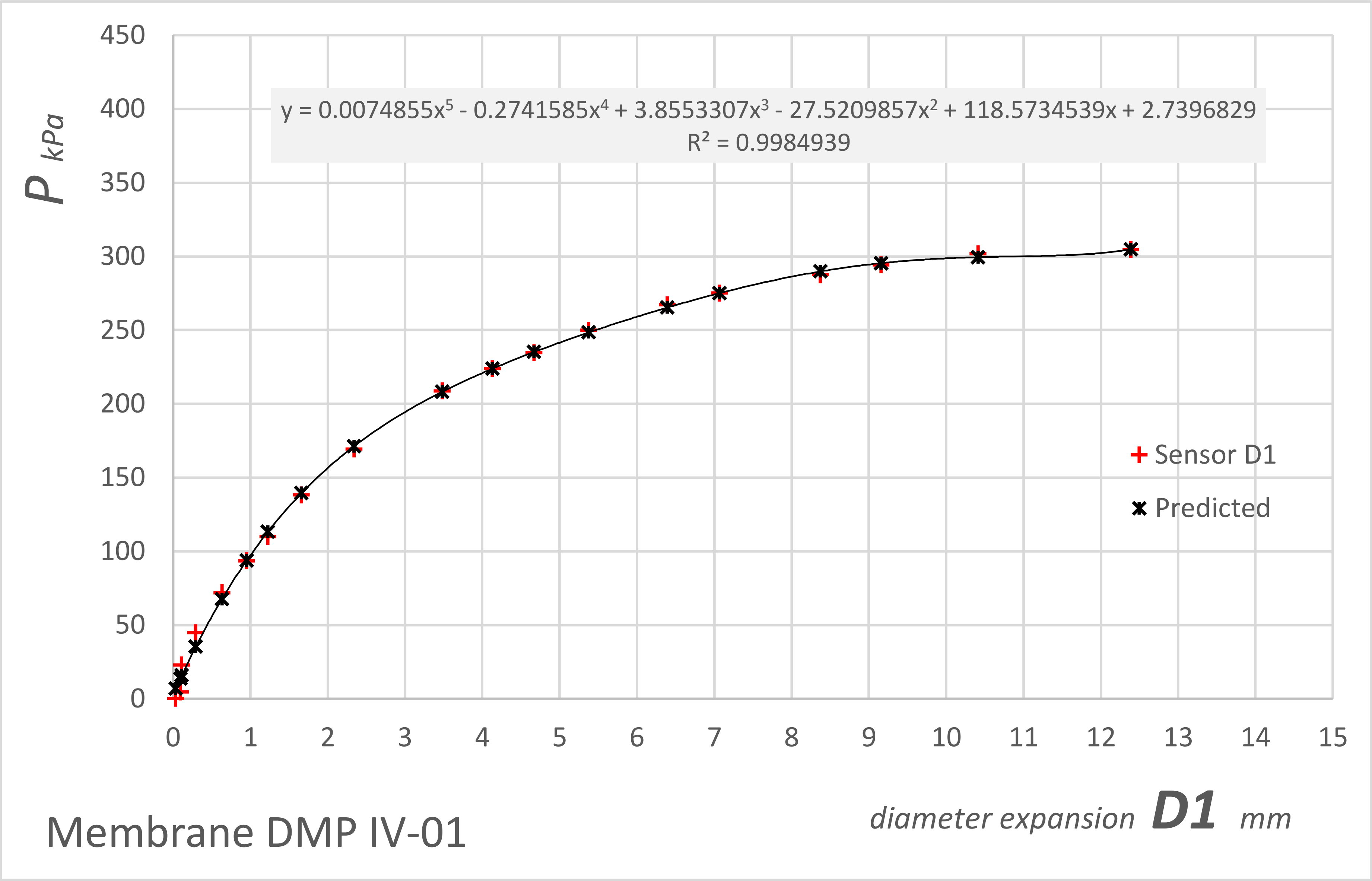
Test interpretation

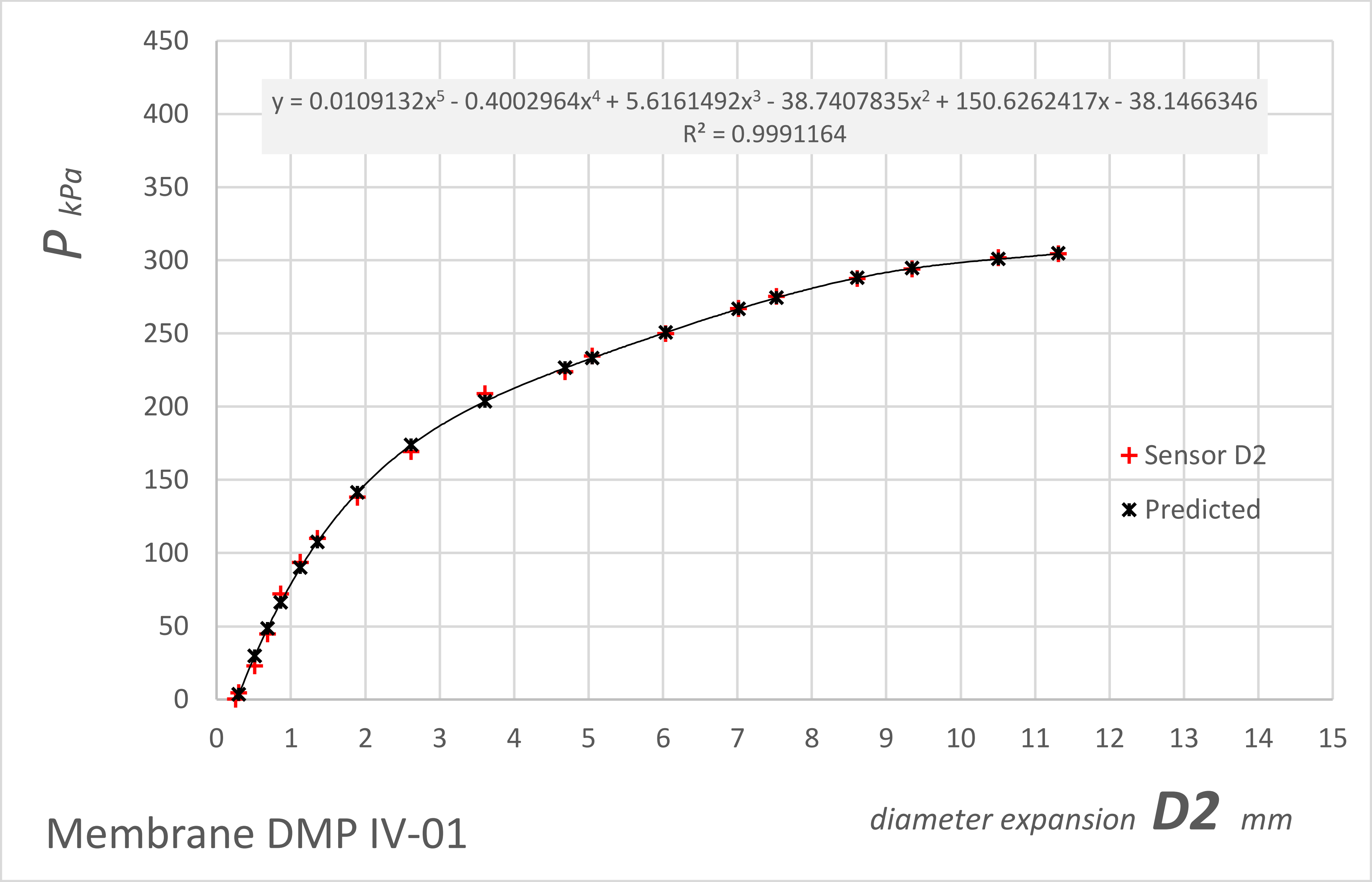
The inferred values of E_Y are highly susceptible to localized rock mass conditions. Care should be use when interpreting the results from this Rock Dilatometer test results.

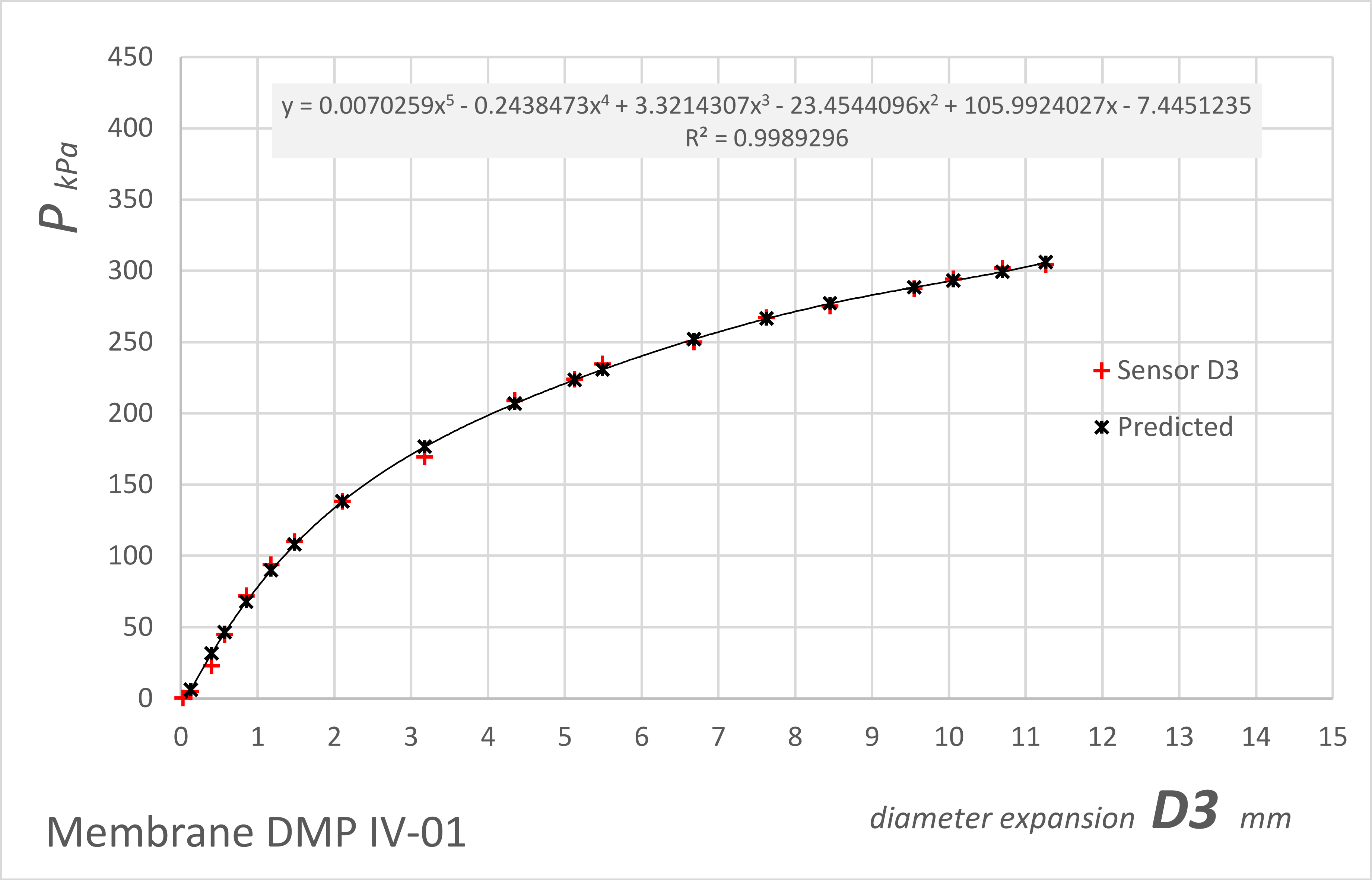
Although the length of the test section of the DMP probe is 1.00 m, the diameter expansion is measured at a very small, specific elevation and orientation corresponding to each sensor. Strictly speaking, each sensor responds to rock conditions on an approximately 25 mm thick layer only. For the three sensors, this is equivalent to a 75 mm tested zone over a 1000 mm length of the tested corehole, corresponding to only 7.5 % of the test zone.

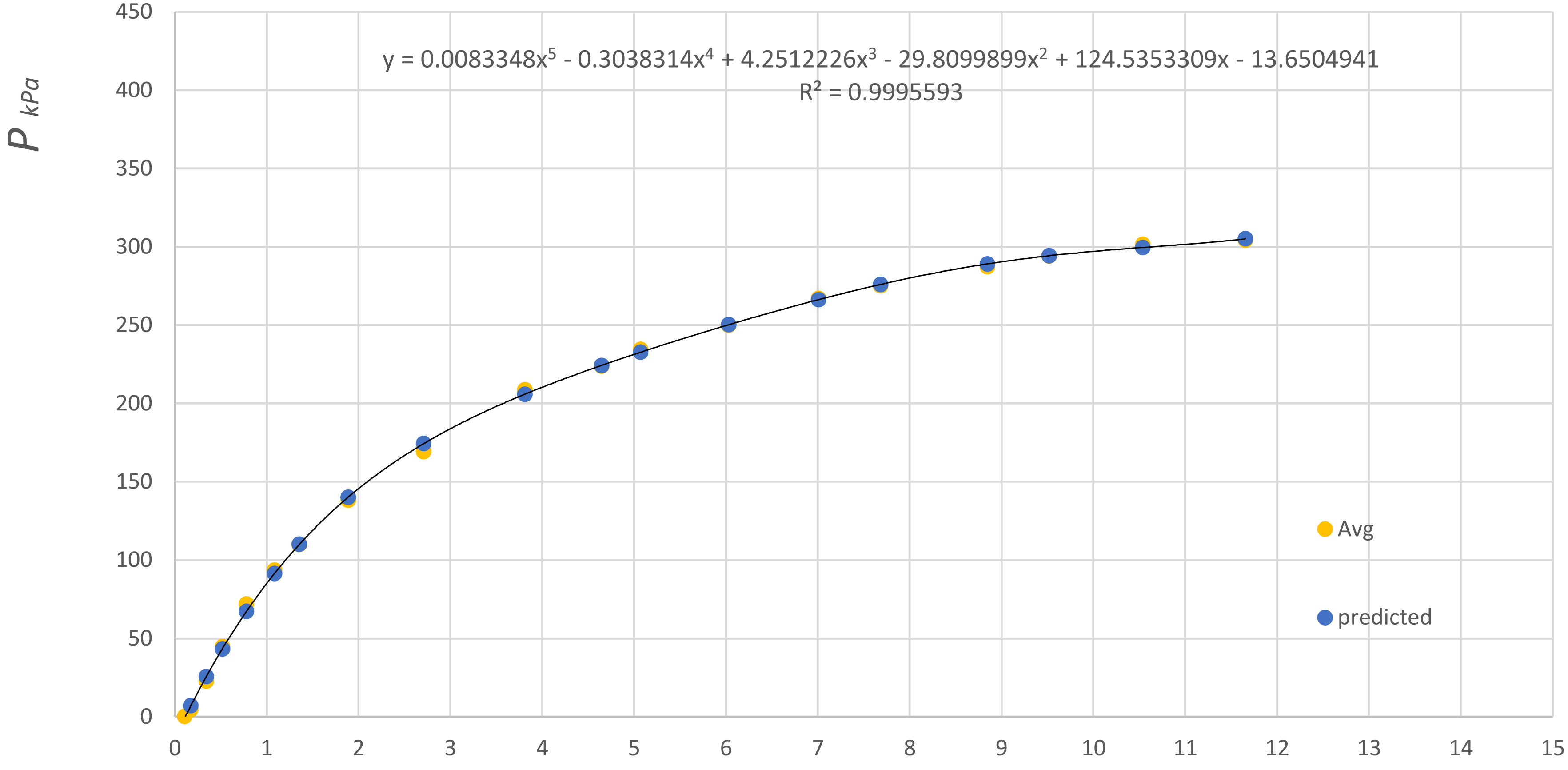
Appendix Three

Rock Dilatometer – Membrane Inertia Calibration


450
400
350
300
250
200
150
100
50
0
P kPa
y = 0.0074855x5 - 0.2741585x4 + 3.8553307x3 - 27.5209857x2 + 118.5734539x + 2.7396829
R² = 0.9984939
Sensor D1
Predicted
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
diameter expansion D1 mm
Membrane DMP IV-01


y = 0.0109132x⁵ - 0.4002964x⁴ + 5.6161492x³ - 38.7407835x² + 150.6262417x - 38.1466346
R² = 0.9991164
P kPa
450
400
350
300
250
200
150
100
50
0
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
+ Sensor D2
✖ Predicted
diameter expansion D2 mm
Membrane DMP IV-01

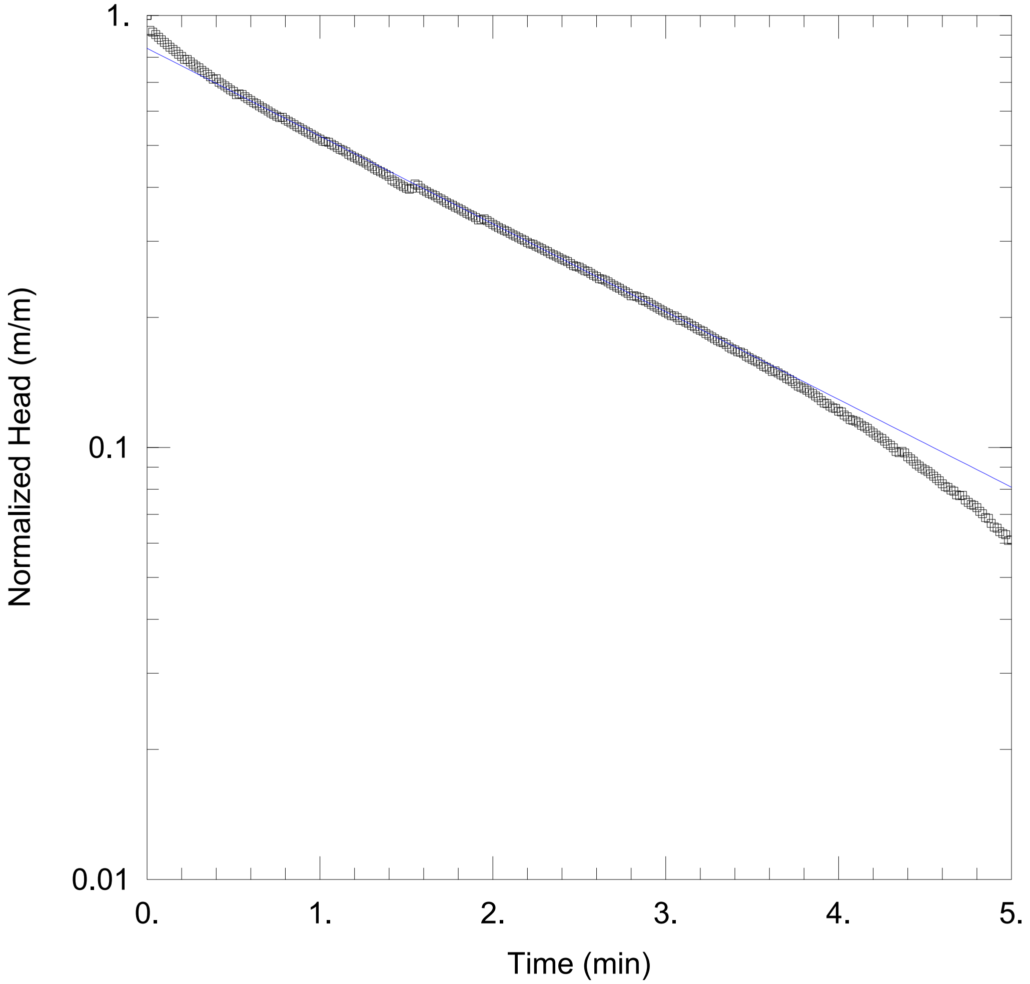

y = 0.0070259x⁵ - 0.2438473x⁴ + 3.3214307x³ - 23.4544096x² + 105.9924027x - 7.4451235
R² = 0.9989296
P kPa
450
400
350
300
250
200
150
100
50
0
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Sensor D3
Predicted
Membrane DMP IV-01
diameter expansion D3 mm



Membrane DMP IV-01

APPENDIX F

Groundwater Levels and Hydraulic Conductivity Testing



TEST 2 (LOGGER DATA)

Data Set: C:\...\21451329 2022'09'29 BH23 Test 2 RHT Logger Analysis.aqt
Date: 11/02/22 Time: 09:26:29

PROJECT INFORMATION

Company: WSP Golder
Client: E.S. Fox
Project: 21451329
Location: Darlington
Test Well: BH23
Test Date: 2022-Sep-29

AQUIFER DATA

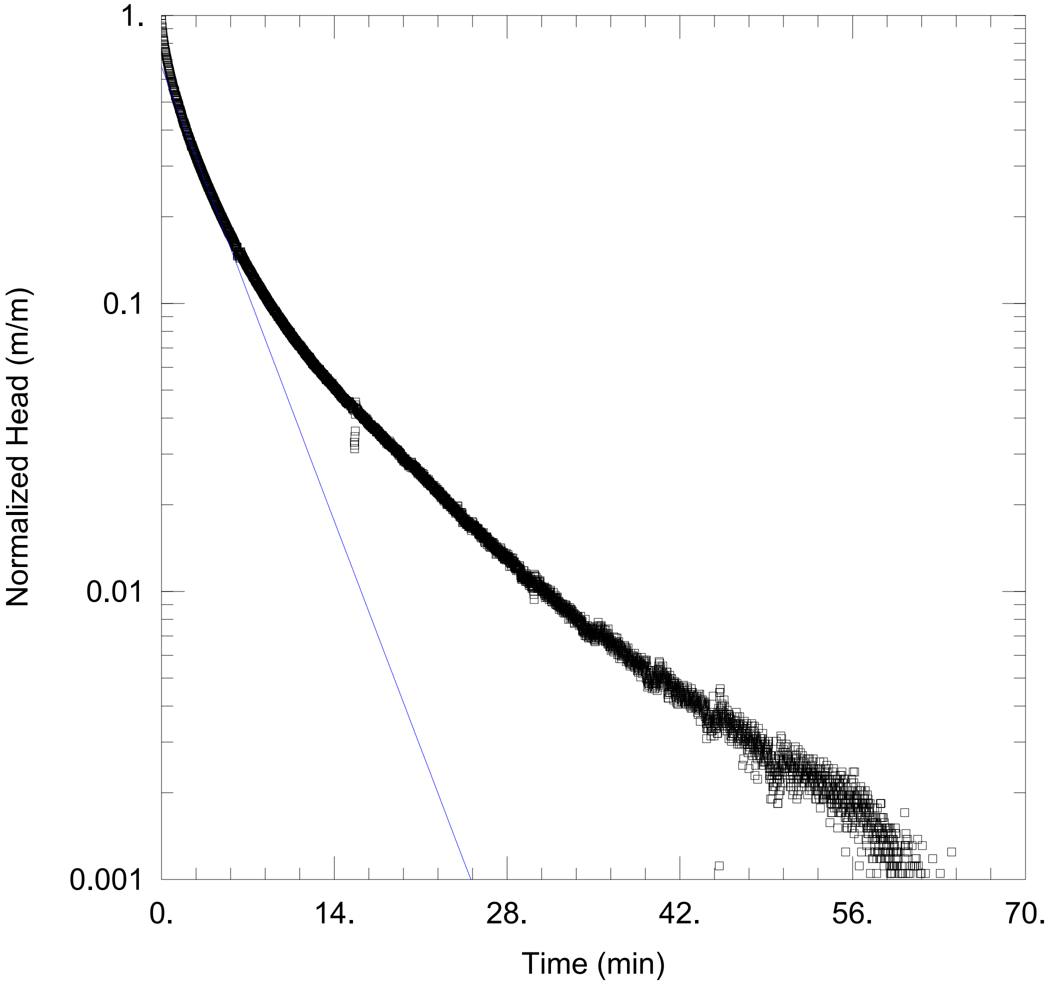
Saturated Thickness: 2.38 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH23)

Initial Displacement: 1.064 m
Static Water Column Height: 12.65 m
Total Well Penetration Depth: 2.07 m
Screen Length: 2.07 m
Casing Radius: 0.026 m
Well Radius: 0.062 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.0003105 cm/sec
y0 = 0.8928 m



TEST 3 (LOGGER DATA)

Data Set: C:\...\21451329 2022'09'29 BH23 Test 3 RHT Logger Analysis.aqt
Date: 11/02/22
Time: 09:28:14

PROJECT INFORMATION

Company: WSP Golder
Client: E.S. Fox
Project: 21451329
Location: Darlington
Test Well: BH23
Test Date: 2022-Sep-30

AQUIFER DATA

Saturated Thickness: 2.38 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH23)

Initial Displacement: 1.525 m
Static Water Column Height: 12.88 m
Total Well Penetration Depth: 2.07 m
Screen Length: 2.07 m
Casing Radius: 0.026 m
Well Radius: 0.062 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

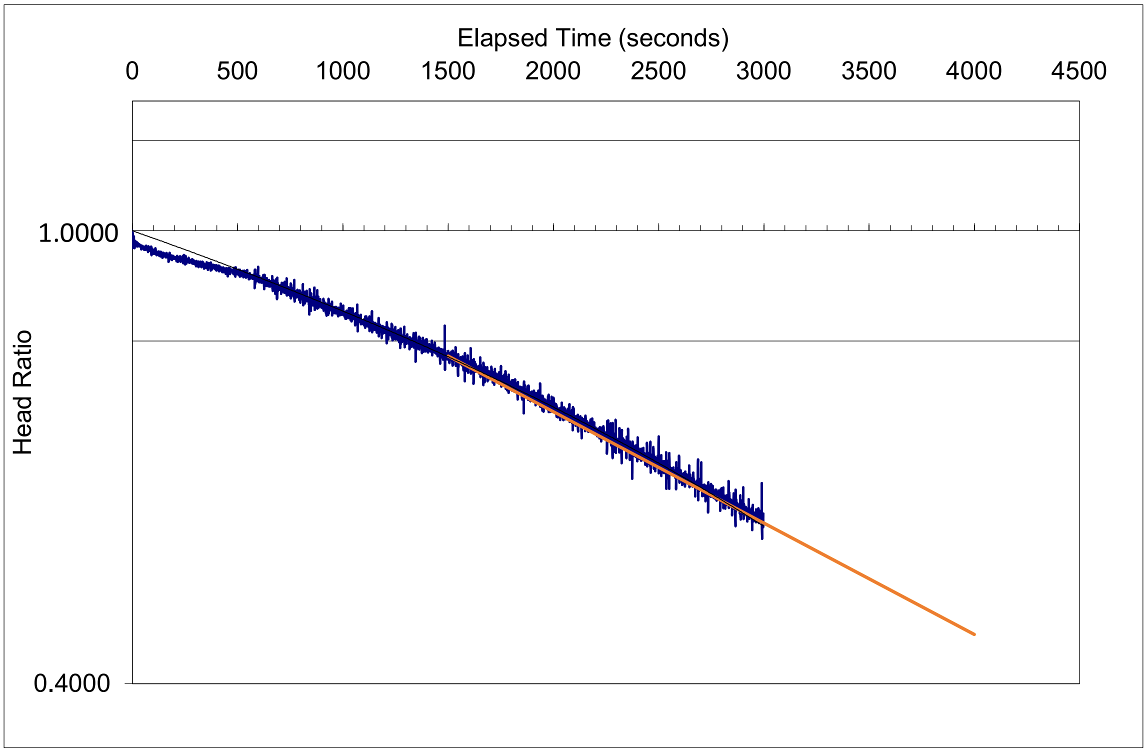
K = 0.000172 cm/sec
y0 = 1.01 m

BH23 Test 1 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$ **(Hvorslev, 1951)**

	Test Information	Input Values
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	17.38
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[4000 - 1500]
	[h_1 / h_2] = Head Ratio	[0.776 - 0.442]

Test Result	Hydraulic Conductivity (m/s)
K =	**5.8E-08**



Falling Head Test

Darlington New Nuclear Project

Darlington, On

BH23 Test 1

Project No. 21451329
Date: 10/25/2022
Calcs By: KL
Review: MT

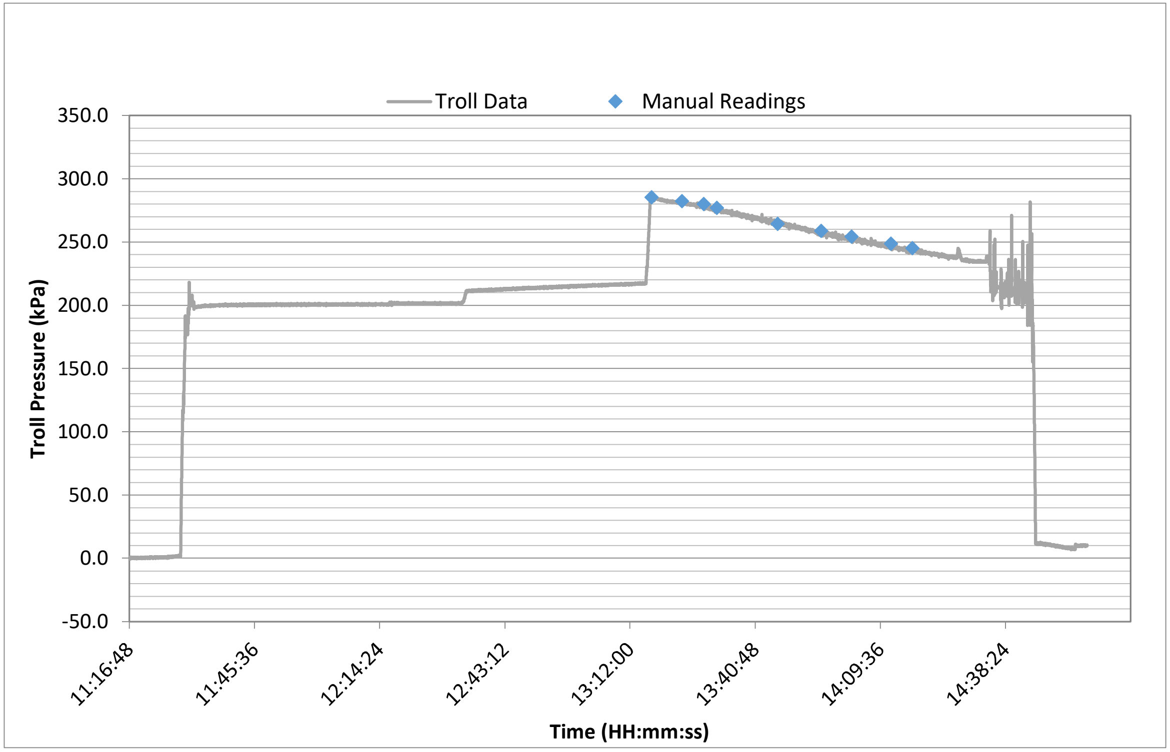
BH23 Test 1 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$

(Hvorslev, 1951)

	Test Information	**Input Values**
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	17.38
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[4000 - 1500]
	[h_1 / h_2] = Head Ratio	[0.776 - 0.442]

Test Results	**Hydraulic Conductivity (m/s)**
K =	**5.8E-08**



Falling Head Test **Darlington New Nuclear Project** **Darlington, On**	**BH23 Test 1**
	Project No. 21451329
	Date: 10/25/2022
	Calcs By KL
	Review: MT

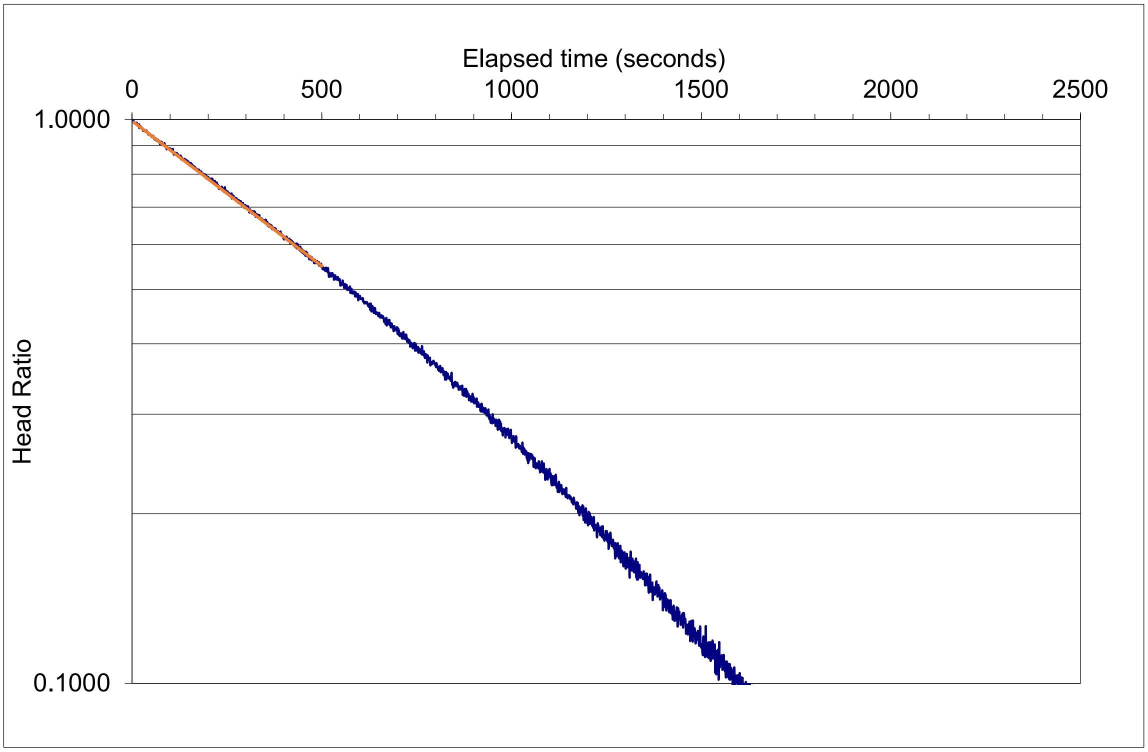
BH23 Test 2 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$

(Hvorslev, 1951)

	Test Information	Input Values
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	21.92
	[R] = Borehole Radius (m)	0.048
	$[t_2 - t_1]$ = Δtime (seconds)	[500 - 5]
	$[h_1 / h_2]$ = Head Ratio	[1.000 - 0.500]

Test Result	Hydraulic Conductivity (m/s)
K =	**2.5E-07**



	Falling Head Test **Darlington New Nuclear Project** **Darlington, On**	**BH23 Test 2**
		Project No. 21451329
		Date: 10/25/2022
		Calcs By: KL
		Review: MT

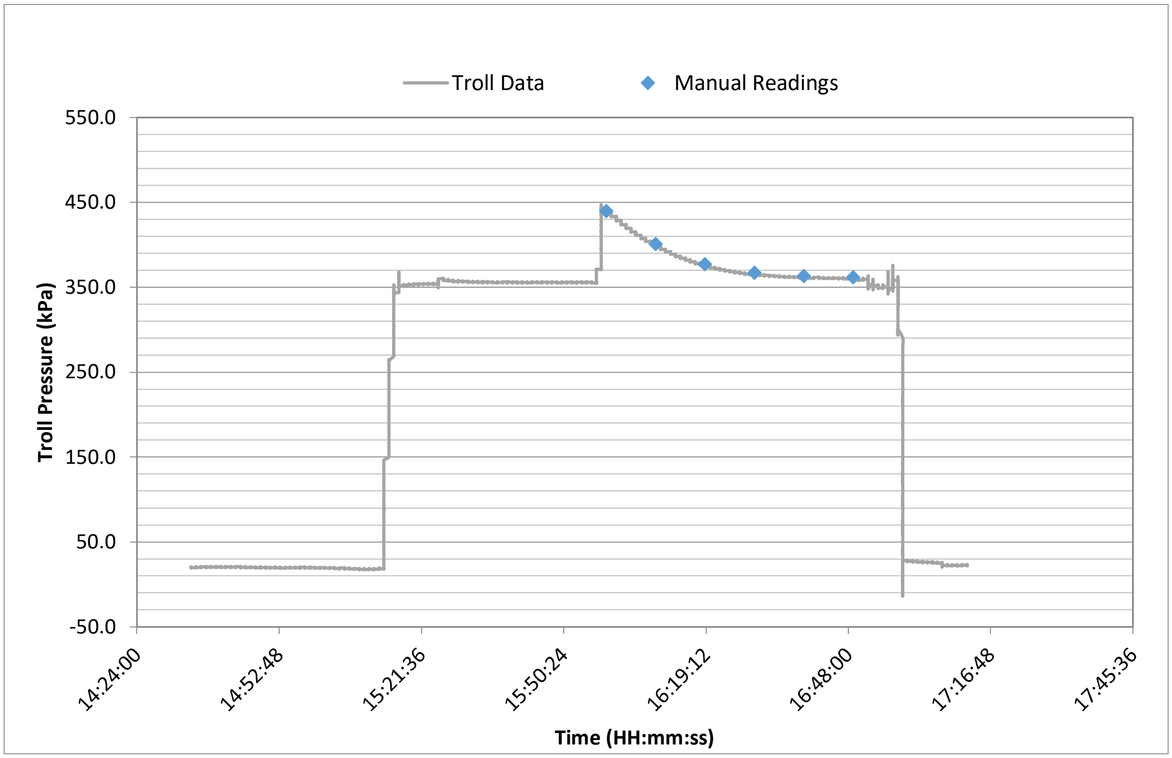
BH23 Test 2 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$

(Hvorslev, 1951)

	Test Information	**Input Values**
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	21.92
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[500 - 5]
	[h_1 / h_2] = Head Ratio	[1.000 - 0.500]

Test Results	**Hydraulic Conductivity (m/s)**
K =	**2.5E-07**



Falling Head Test

Darlington New Nuclear Project

Darlington, On

BH23 Test 2

Project No. 21451329
Date: 10/25/2022
Calcs By KL
Review: MT

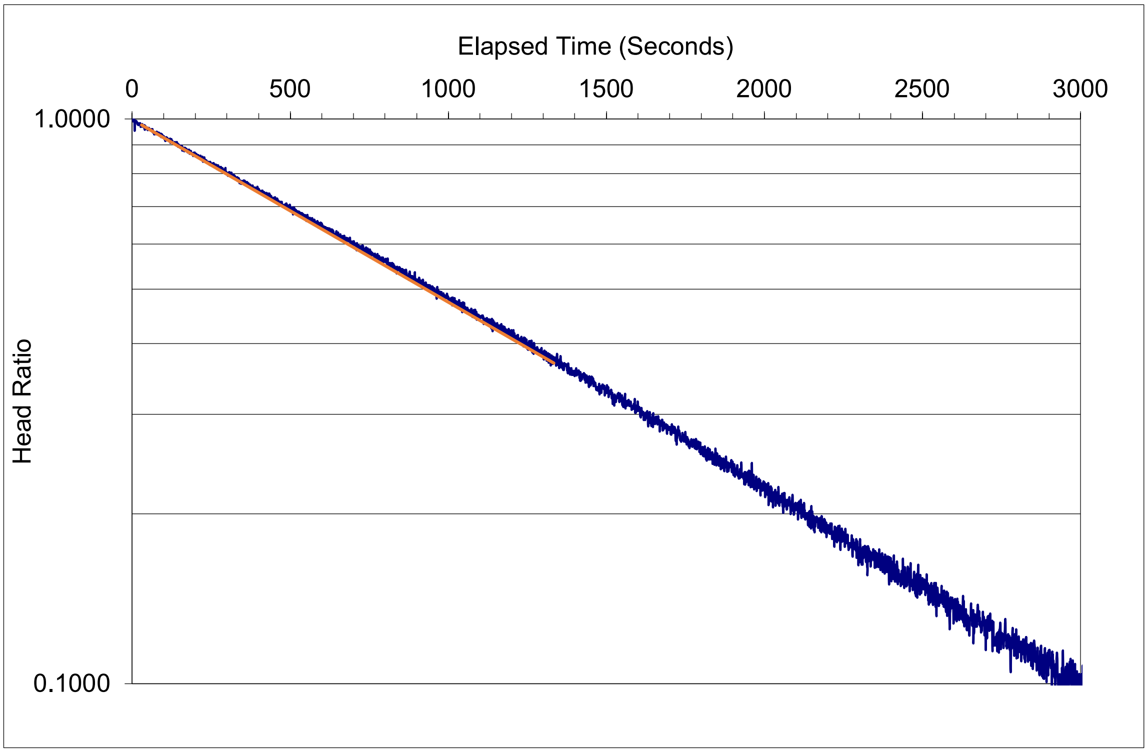
BH23 Test 3 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_2 - t_1)}$$

(Hvorslev, 1951)

	Test Information	Input Values
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	13.82
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[1250 - 0]
	[h_1 / h_2] = Head Ratio	[1.000 - 0.335]

Test Result	**Hydraulic Conductivity (m/s)**
K =	**2.3E-07**



Falling Head Test

Darlington New Nuclear Project

Darlington, On

BH23 Test 3

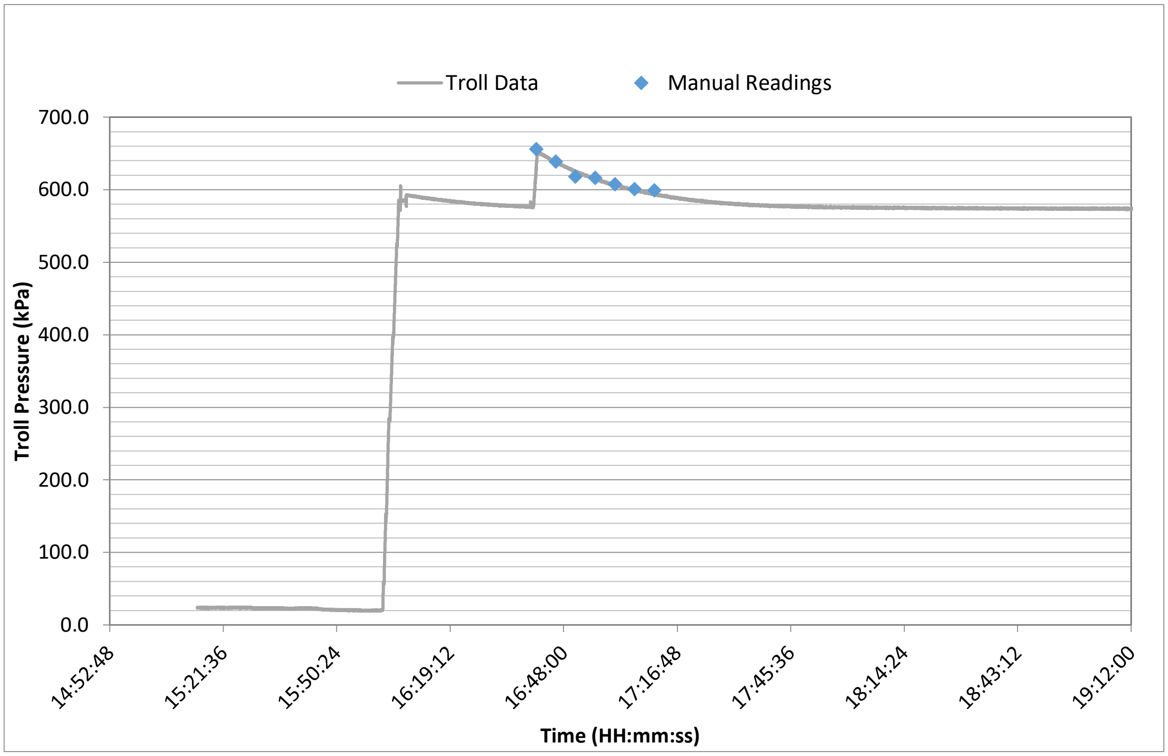
Project No. 21451329	
Date: 10/26/2022	
Calcs By:	KL
Review:	MT

BH23 Test 3 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$ **(Hvorslev, 1951)**

	Test Information	Input Values
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	13.82
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[1250 - 0]
	[h_1 / h_2] = Head Ratio	[1.000 - 0.335]

Test Results	**Hydraulic Conductivity (m/s)**
K =	**2.3E-07**



Falling Head Test

Darlington New Nuclear Project

Darlington, On

BH23 Test 3

Project No. 21451329
Date: 10/26/2022
Calcs By KL
Review: MT

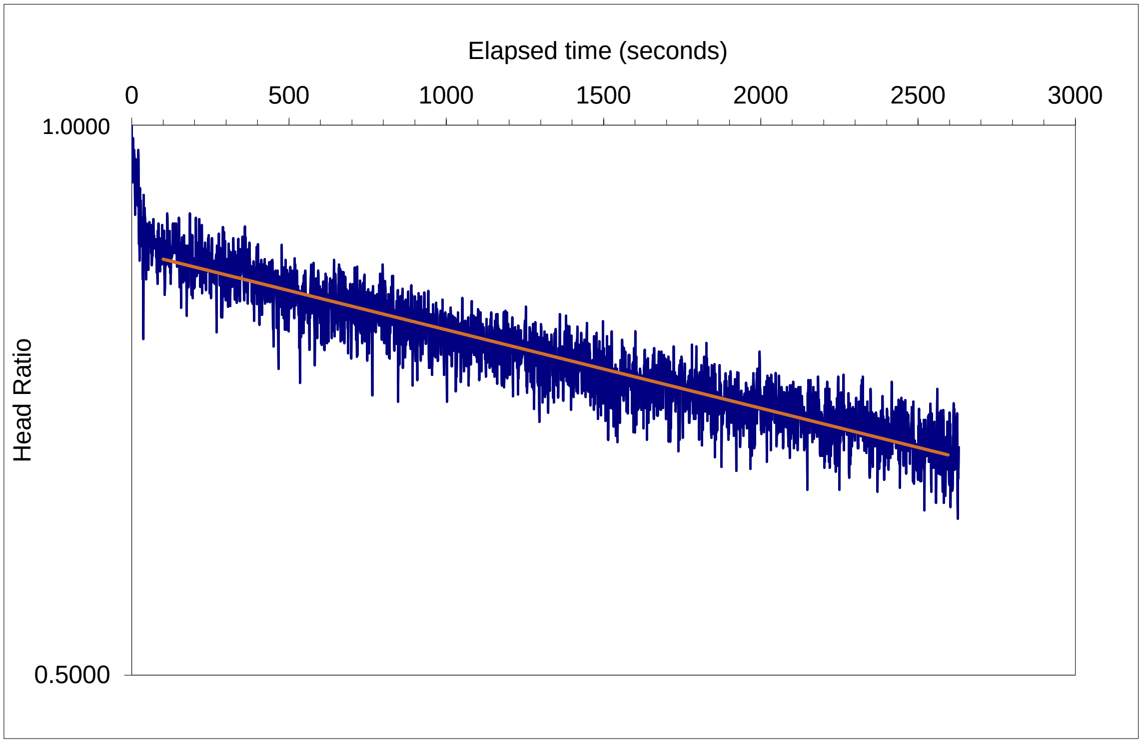
BH203 Test 1 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_2 - t_1)}$$

(Hvorslev, 1951)

	Test Information	Input Values
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	7.77
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[2595 - 100]
	[h_1 / h_2] = Head Ratio	[0.845 - 0.660]

Test Result	Hydraulic Conductivity (m/s)
K =	**4.9E-08**



Falling Head Test

Darlington New Nuclear Project

Darlington, On

BH203 Test 1

Project No. 21451329
Date: 09/02/2022
Calcs By: KL
Review: MT

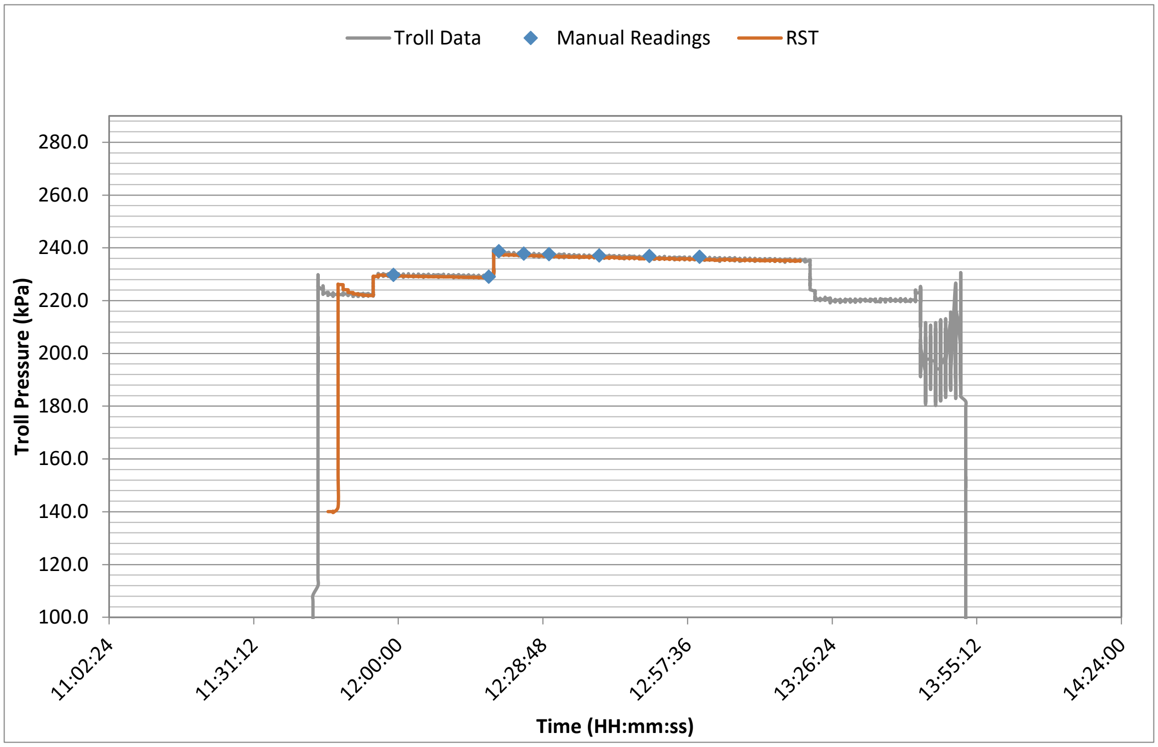
BH203 test 1 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$

(Hvorslev, 1951)

	Test Information	Input Values
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	7.77
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[2595 - 100]
	[h_1 / h_2] = Head Ratio	[0.845 - 0.660]

Test Results	Hydraulic Conductivity (m/s)
K =	4.9E-08



Falling Head Test

Darlington New Nuclear Project

Darlington, On

BH203 Test 1

Project No. 21451329
Date: 09/02/2022
Calcs By: KL
Review: MT

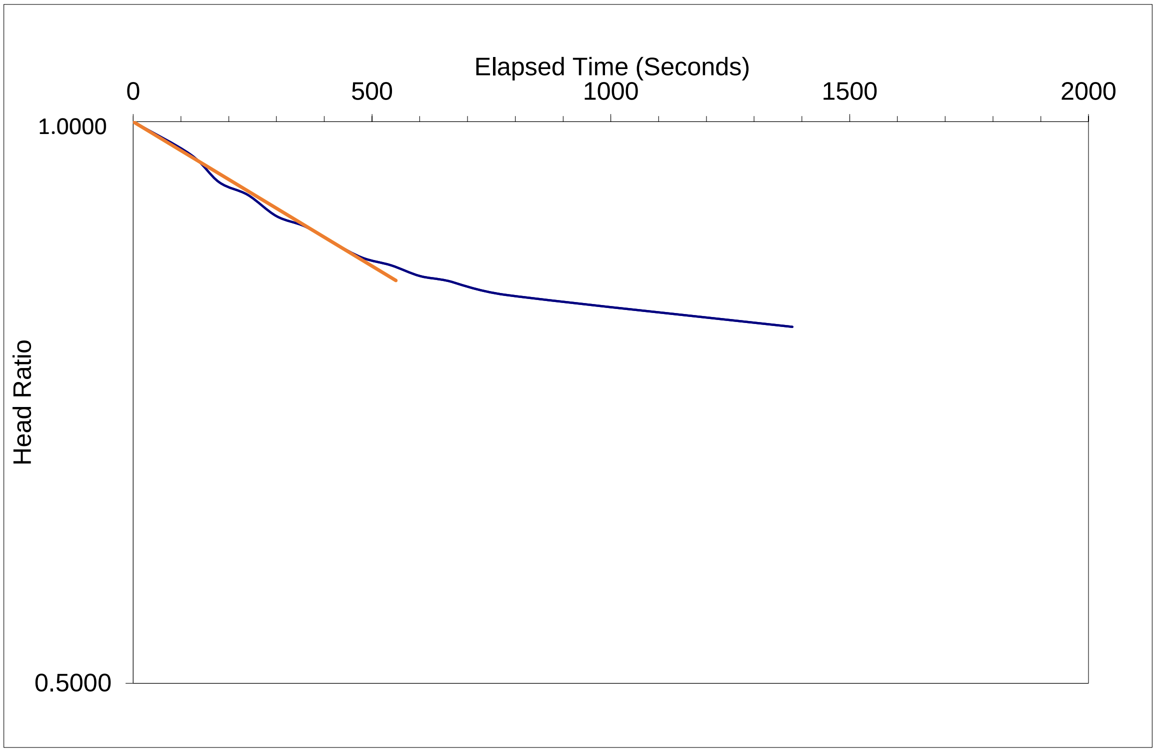
BH203 Test 2 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$

(Hvorslev, 1951)

	Test Information	Input Values
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	22.91
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[550 - 0]
	[h_1 / h_2] = Head Ratio	[1.000 - 0.822]

Test Result	Hydraulic Conductivity (m/s)
K =	**7.3E-08**



wsp	**Falling Head Test** **Darlington New Nuclear Project** **Darlington, On**	**BH203 Test 2** Project No. 21451329 Date: 10/27/2022 Calcs By: KL Review: MT

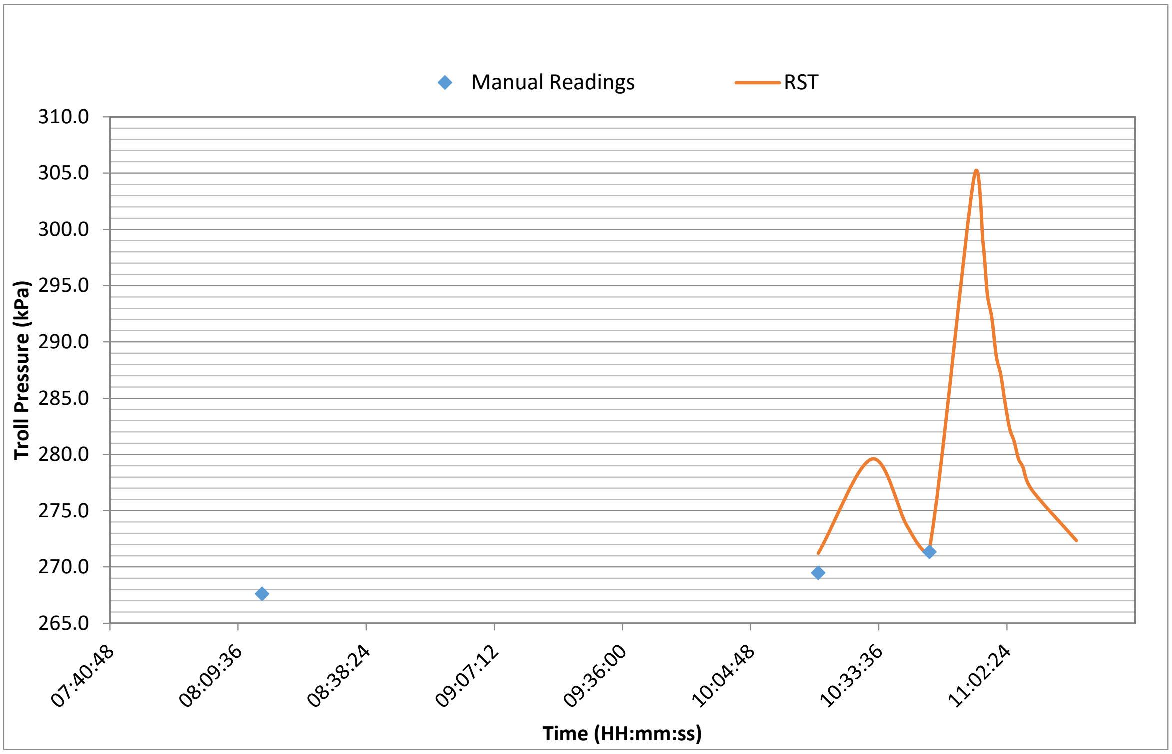
BH203 Test 2 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$

(Hvorslev, 1951)

	Test Information	Input Values
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	22.91
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[550 - 0]
	[h_1 / h_2] = Head Ratio	[1.000 - 0.822]

Test Results	Hydraulic Conductivity (m/s)
K =	**7.3E-08**



	Falling Head Test **Darlington New Nuclear Project** **Darlington, On**	**BH203 Test 2**
		Project No. 21451329 Date: 10/27/2022 Calcs By: KL Review: MT

Interval Information

Borehole Radius [R] (m)	Interval Information		
	Top (m)	Bottom (m)	Length [L] (m)
0.048	27.01	49.92	22.91

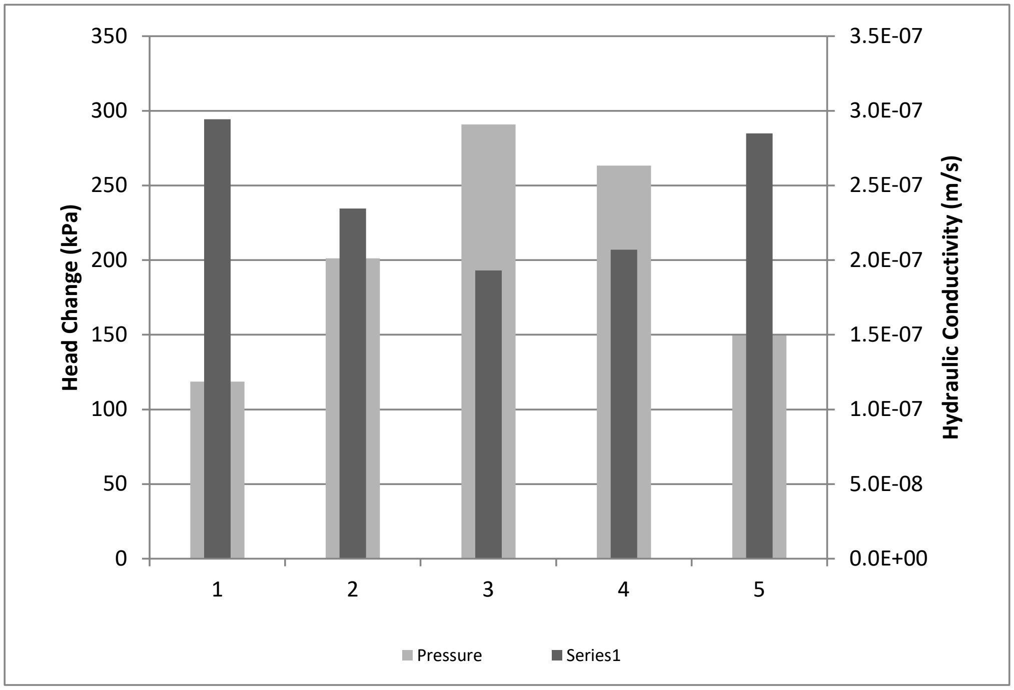
Test Information

	Test Data
1	Flow Rate (Q) = 5.0 L/min Pressure (P) = 118.5 kPa
2	Flow Rate (Q) = 6.7 L/min Pressure (P) = 201.3 kPa
3	Flow Rate (Q) = 8.0 L/min Pressure (P) = 290.9 kPa
4	Flow Rate (Q) = 7.8 L/min Pressure (P) = 263.3 kPa
5	Flow Rate (Q) = 6.1 L/min Pressure (P) = 149.6 kPa

Steady State Equation:
K=[Q*ln(L/R)]/[2πLP] (Thiem 1906)

Steps	Hydraulic Conductivity m/s
1	2.9E-07
2	2.3E-07
3	1.9E-07
4	2.1E-07
5	2.8E-07
Selected	**1.9E-07**

Pressure and Hydraulic Conductivity



wsp	**Multi-Rate Step Test** **BH203 - Test 3** **27.01 m to 49.92 m**	**BH203 Test 3**

Project No.	21451329
Date:	10/27/2022
Calcs By:	KL
Review:	MT

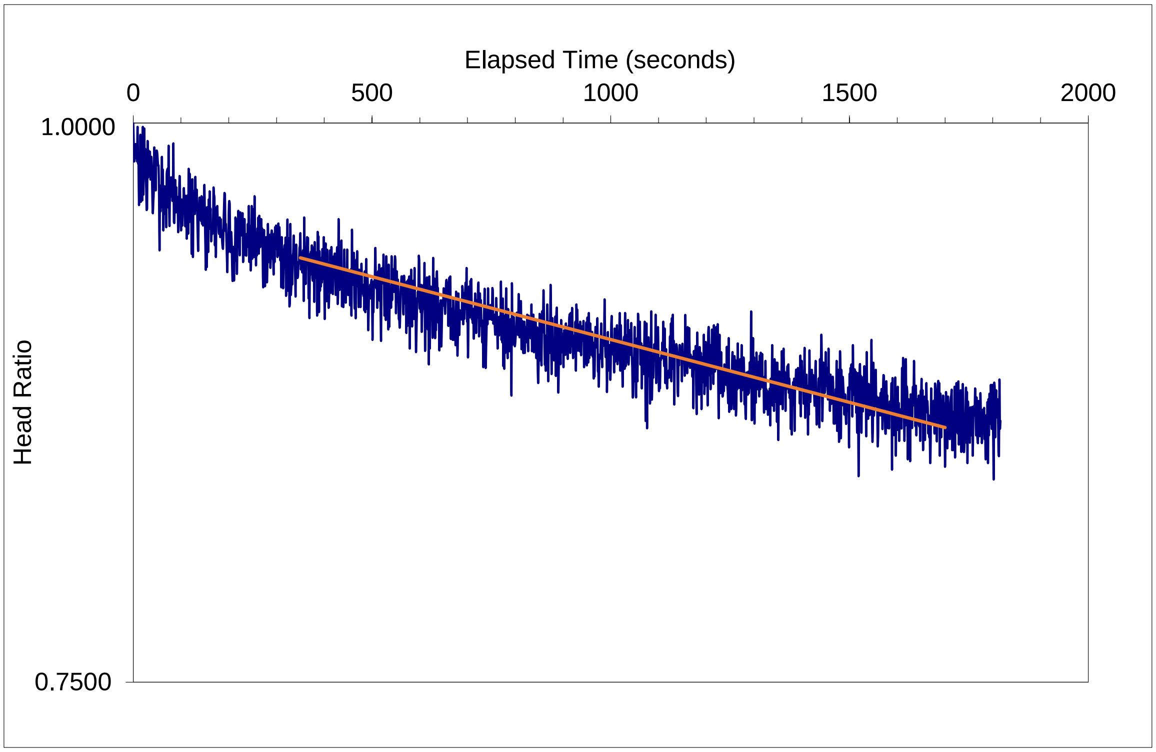
BH203 Test 4 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$

(Hvorslev, 1951)

	Test Information	**Input Values**
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	20.02
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[1700 - 350]
	[h_1 / h_2] = Head Ratio	[0.933 - 0.855]

Test Result	**Hydraulic Conductivity (m/s)**
K =	**1.5E-08**



Falling Head Test

Darlington New Nuclear Project

Darlington, On

BH203 Test 4

Project No. 21451329
Date: 09/02/2022
Calcs By: KL
Review: MT

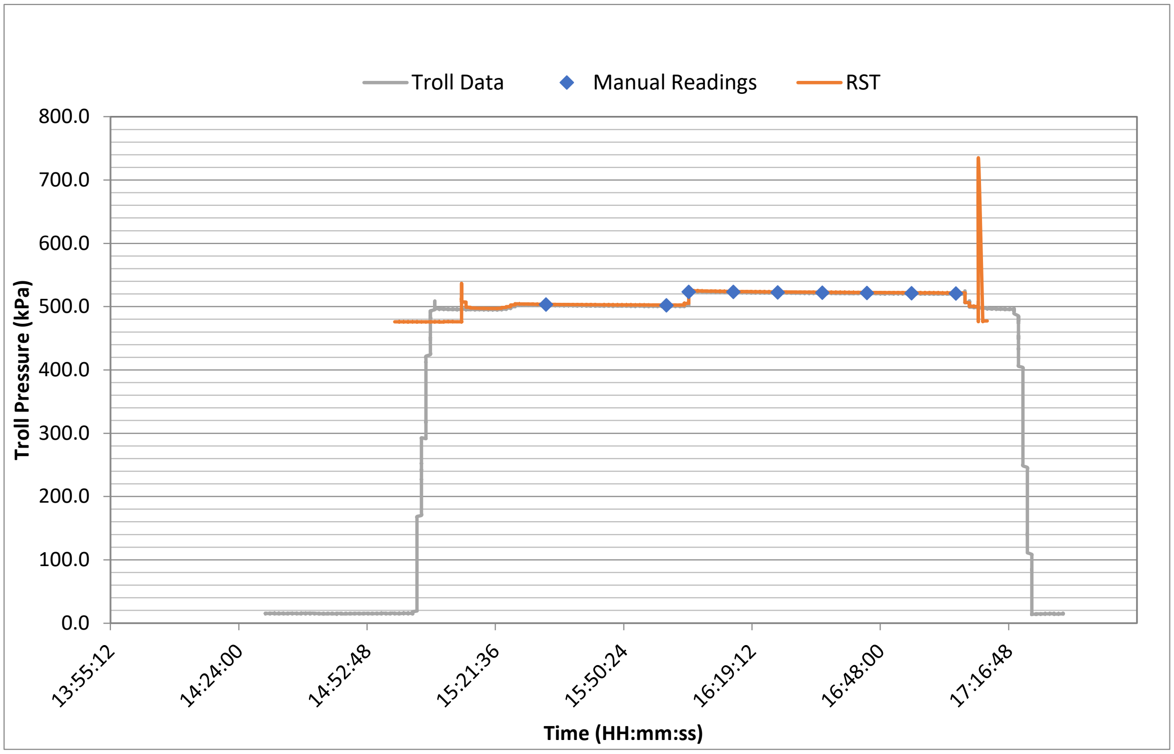
BH203 Test 4 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$

(Hvorslev, 1951)

	Test Information	**Input Values**
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	20.02
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[1700 - 350]
	[h_1 / h_2] = Head Ratio	[0.933 - 0.855]

Test Results	**Hydraulic Conductivity (m/s)**
K =	**1.5E-08**



Falling Head Test

Darlington New Nuclear Project

Darlington, On

BH203 Test 4

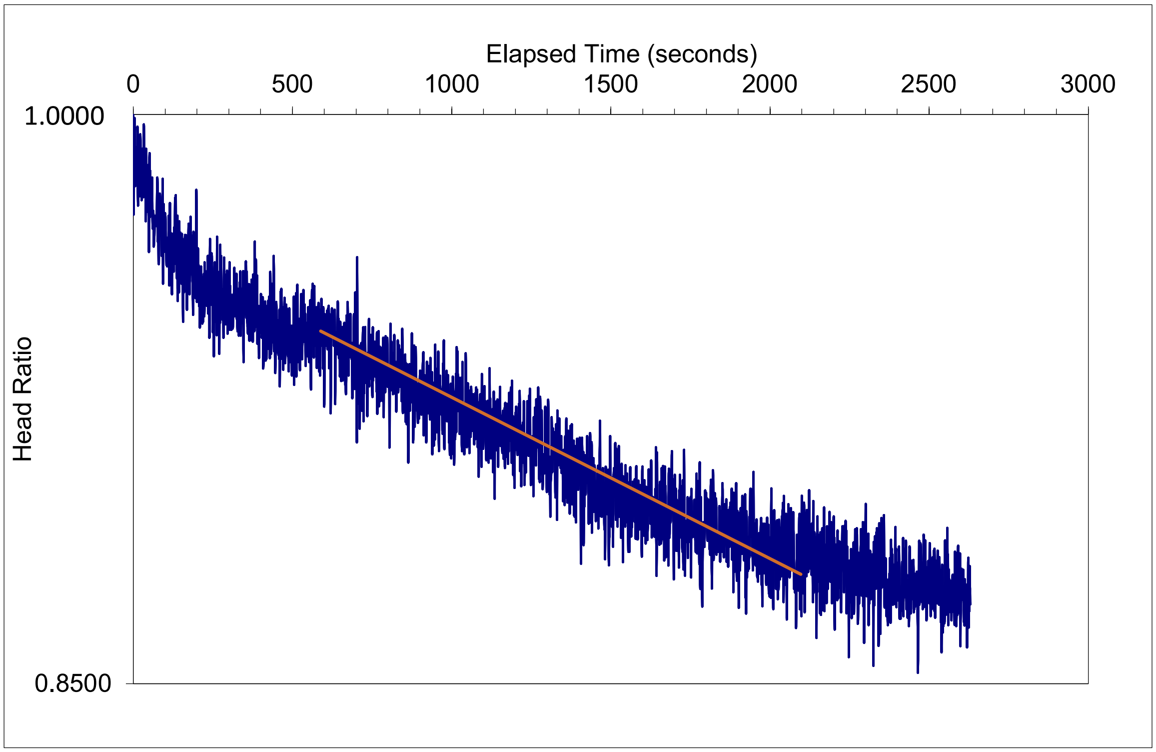
Project No. 21451329
Date: 09/02/2022
Calcs By: KL
Review: MT

BH207 Test 1 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$ **(Hvorslev, 1951)**

	Test Information	Input Values
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	18.38
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[2097 - 589]
	[h_1 / h_2] = Head Ratio	[0.940 - 0.877]

Test Result	Hydraulic Conductivity (m/s)
K =	**1.1E-08**



	Falling Head Test Darlington New Nuclear Project Darlington, On	BH207 Test 1
		Project No. 21451329
		Date: 07/14/2022
		Calcs By: LT
		Review: MT

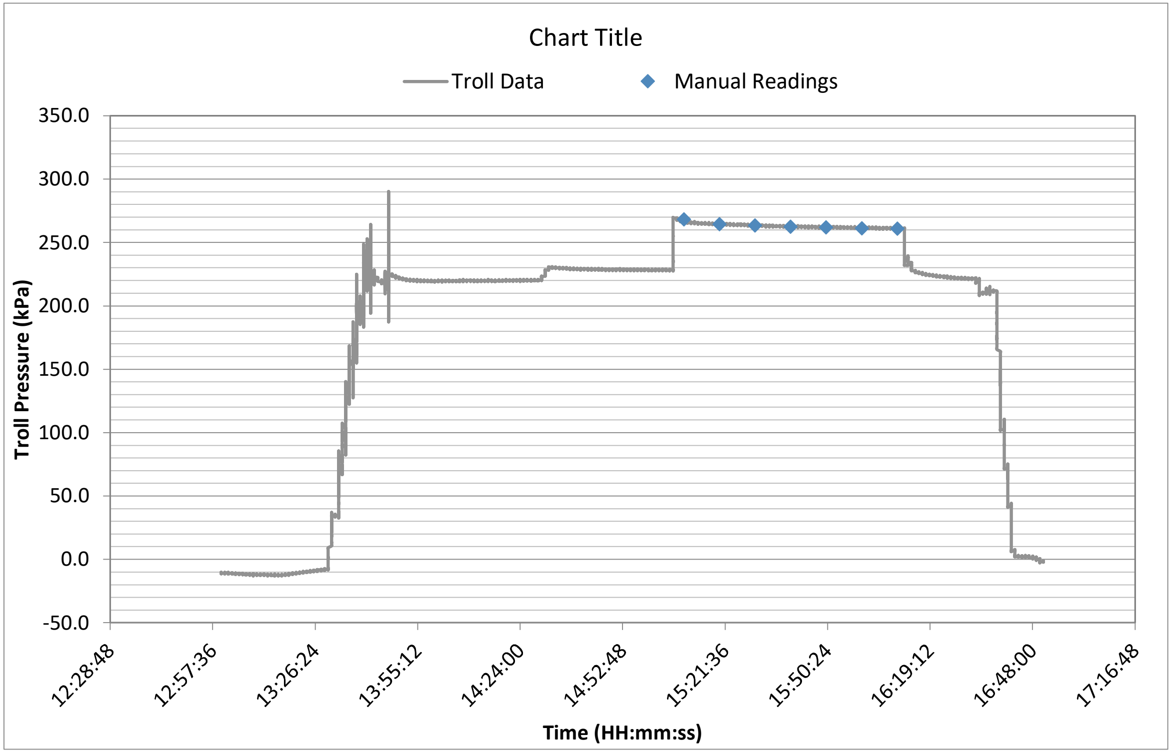
BH207 Test 1 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$

(Hvorslev, 1951)

	Test Information	Input Values
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	18.38
	[R] = Borehole Radius (m)	0.05
	[t_2 - t_1] = Δtime (seconds)	[2097 - 589]
	[h_1 / h_2] = Head Ratio	[0.940 - 0.877]

Test Results	Hydraulic Conductivity (m/s)
K =	**1.1E-08**



Falling Head Test

Darlington New Nuclear Project

Darlington, On

BH207 Test 1

Project No. 21451329
Date: 07/14/2022
Calcs By: LT
Review: MT

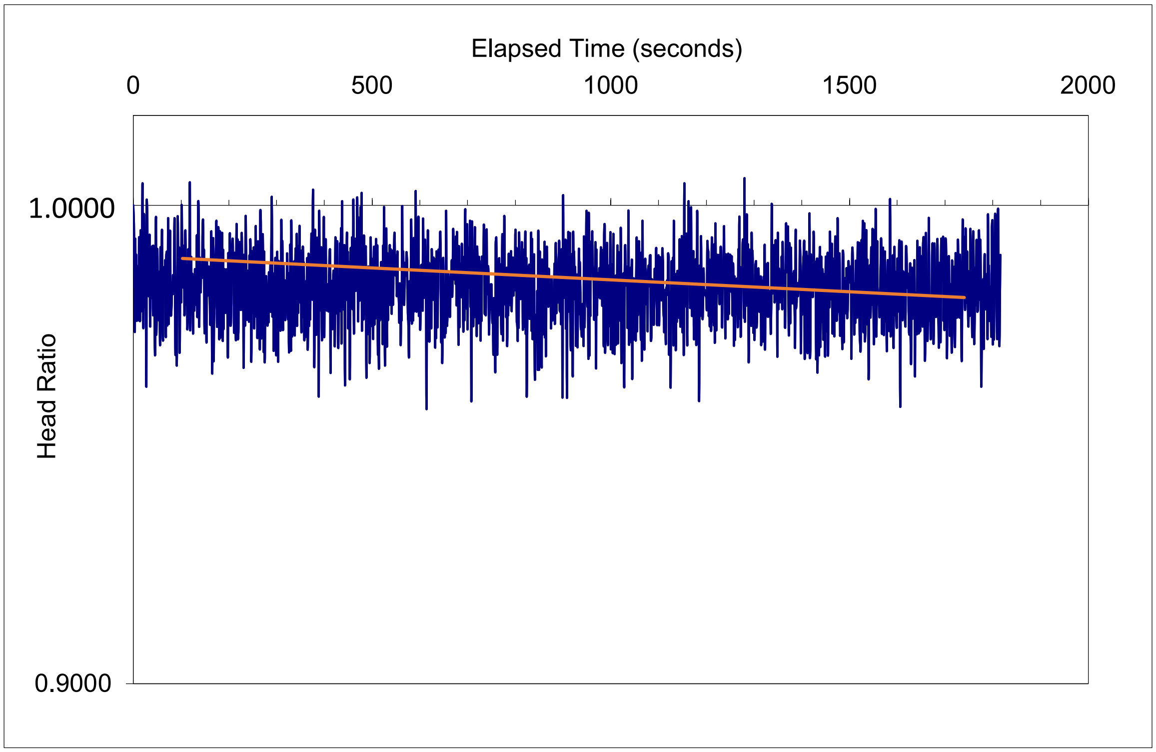
BH207 Test 2 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$

(Hvorslev, 1951)

	Test Information	Input Values
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	19.86
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[1740 - 103]
	[h_1 / h_2] = Head Ratio	[0.980 - 0.976]

Test Result	**Hydraulic Conductivity (m/s)**
K =	**1.2E-09**



Falling Head Test

Darlington New Nuclear Project

Darlington, On

BH207 Test 2

Project No. 21451329
Date: 07/14/2022
Calcs By: LT
Review: MT

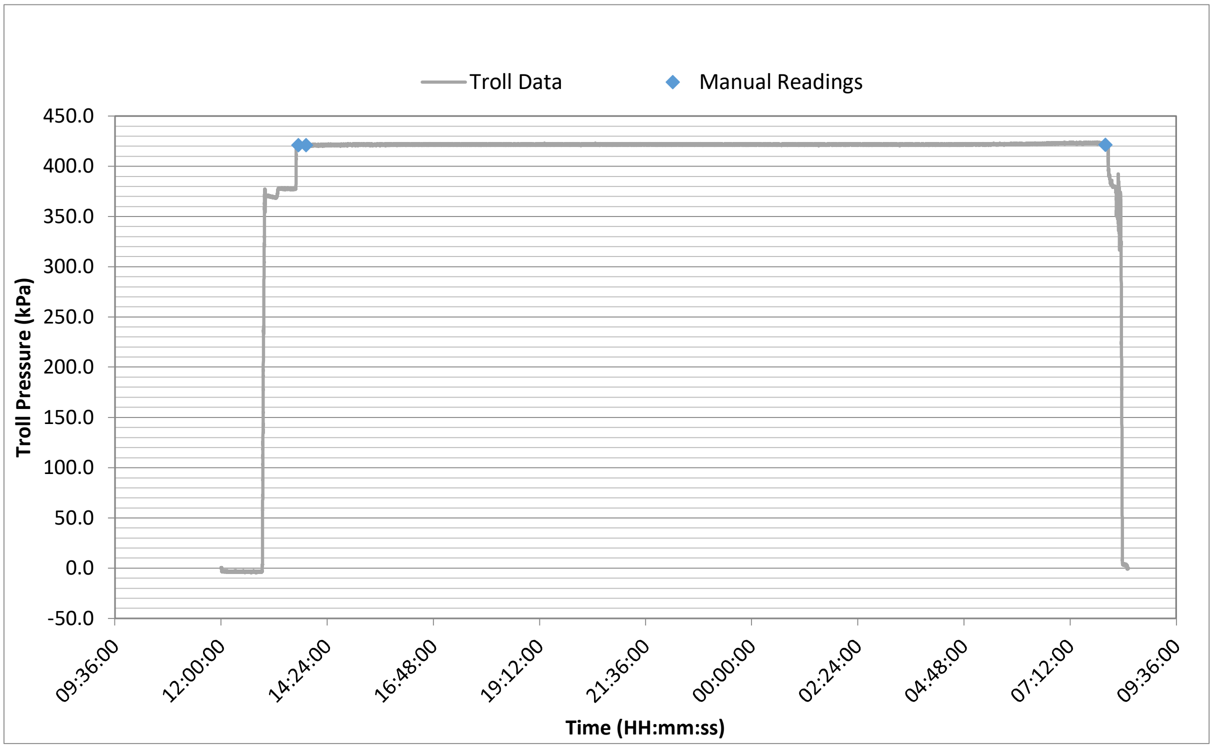
BH207 Test 2 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$

(Hvorslev, 1951)

	Test Information	**Input Values**
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	19.86
	[R] = Borehole Radius (m)	0.048
	$[t_2 - t_1]$ = Δtime (seconds)	[1740 - 103]
	$[h_1 / h_2]$ = Head Ratio	[0.980 - 0.976]

Test Results	**Hydraulic Conductivity (m/s)**
K =	**1.2E-09**



Falling Head Test

Darlington New Nuclear Project

Darlington, On

BH207 Test 2

Project No. 21451329
Date: 07/14/2022
Calcs By: LT
Review: MT

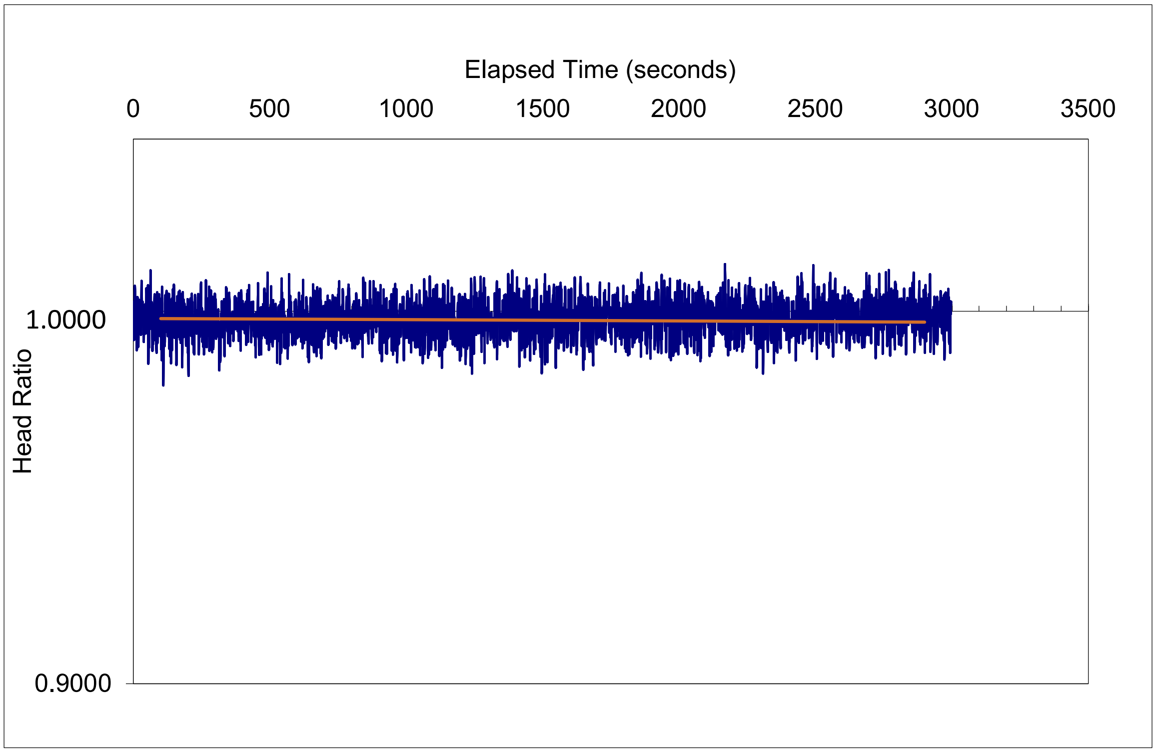
BH207 Test 3 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$

(Hvorslev, 1951)

	Test Information	**Input Values**
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	15.33
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[2900 - 100]
	[h_1 / h_2] = Head Ratio	[0.998 - 0.997]

Test Result	**Hydraulic Conductivity (m/s)**
K =	**1.0E-10**



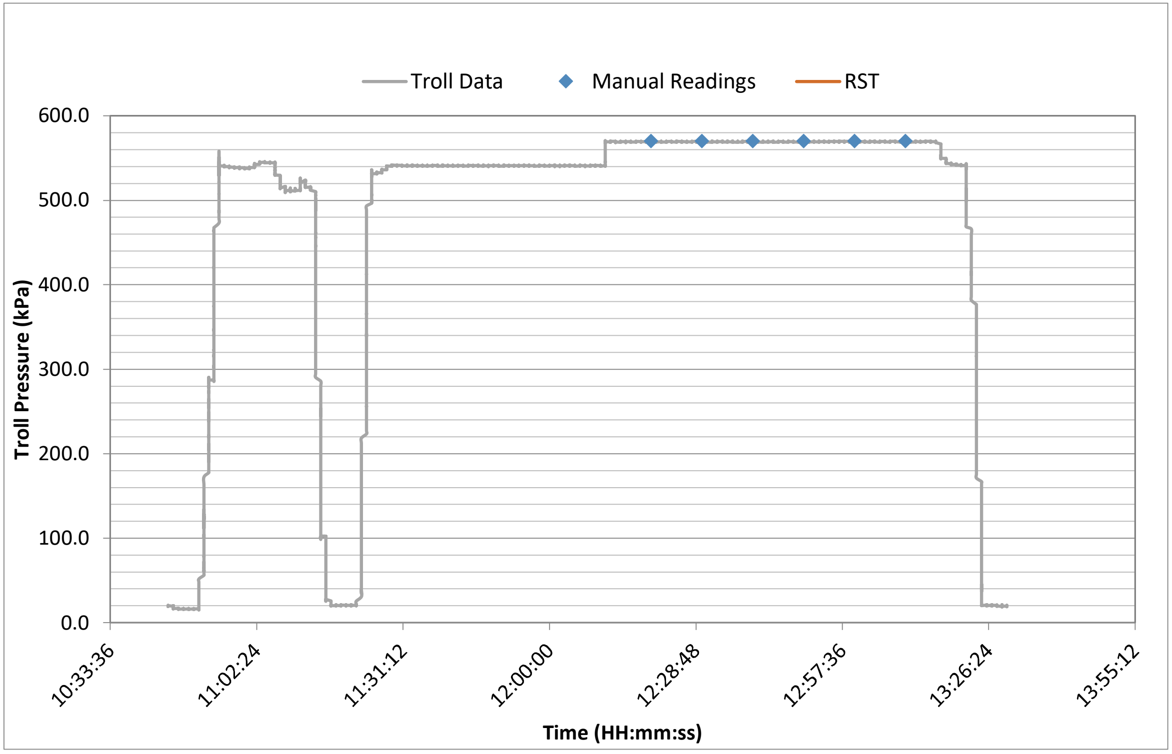
	Falling Head Test **Darlington New Nuclear Project** **Darlington, On**	**BH207 Test 3**
		Project No. 21451329
		Date: 07/14/2022
		Calcs By: LT
		Review: MT

BH207 Test 3 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$ **(Hvorslev, 1951)**

	Test Information	Input Values
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	15.33
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[2900 - 100]
	[h_1 / h_2] = Head Ratio	[0.998 - 0.997]

Test Results	Hydraulic Conductivity (m/s)
K =	**1.0E-10**



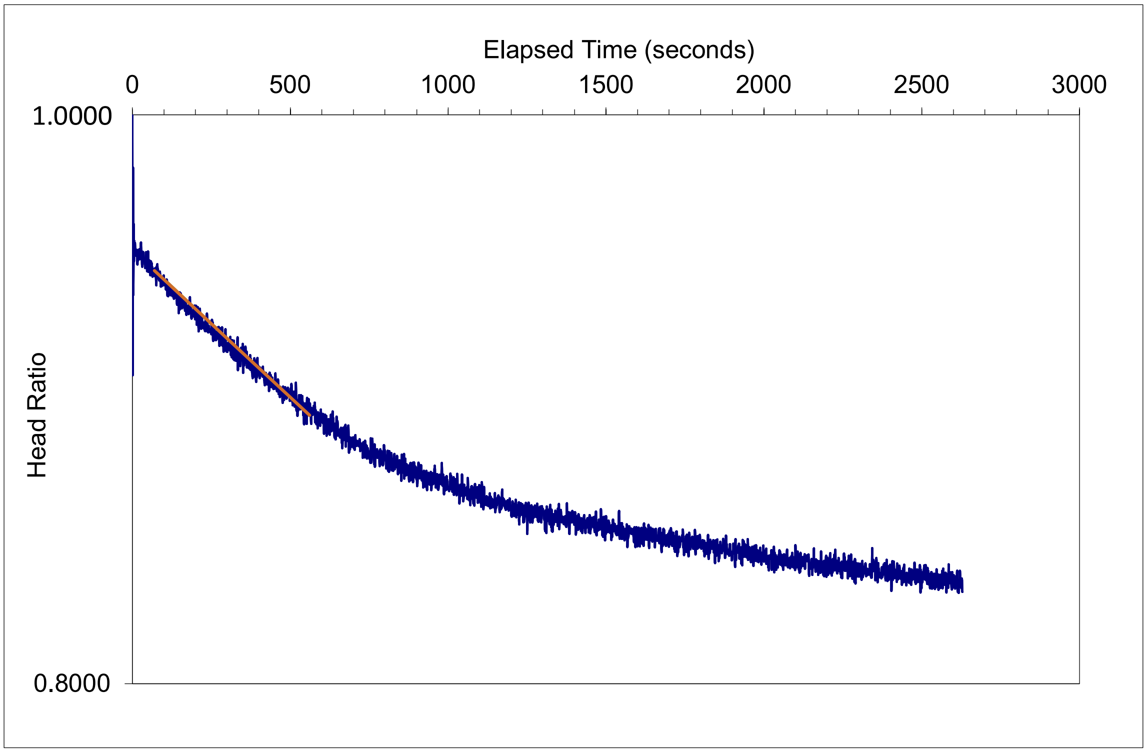
	Falling Head Test Darlington New Nuclear Project Darlington, On	**BH207 Test 3**
		Project No. 21451329
		Date: 07/14/2022
		Calcs By: LT
		Review: MT

BH303 Test 1 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$ **(Hvorslev, 1951)**

	Test Information	Input Values
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	16.90
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[561 - 70]
	[h_1 / h_2] = Head Ratio	[0.941 - 0.889]

Test Result	Hydraulic Conductivity (m/s)
K =	**3.0E-08**



Falling Head Test

Darlington New Nuclear Project

Darlington, On

BH303 Test 1

Project No. 21451329
Date: 07/13/2022
Calcs By: LT
Review: MT

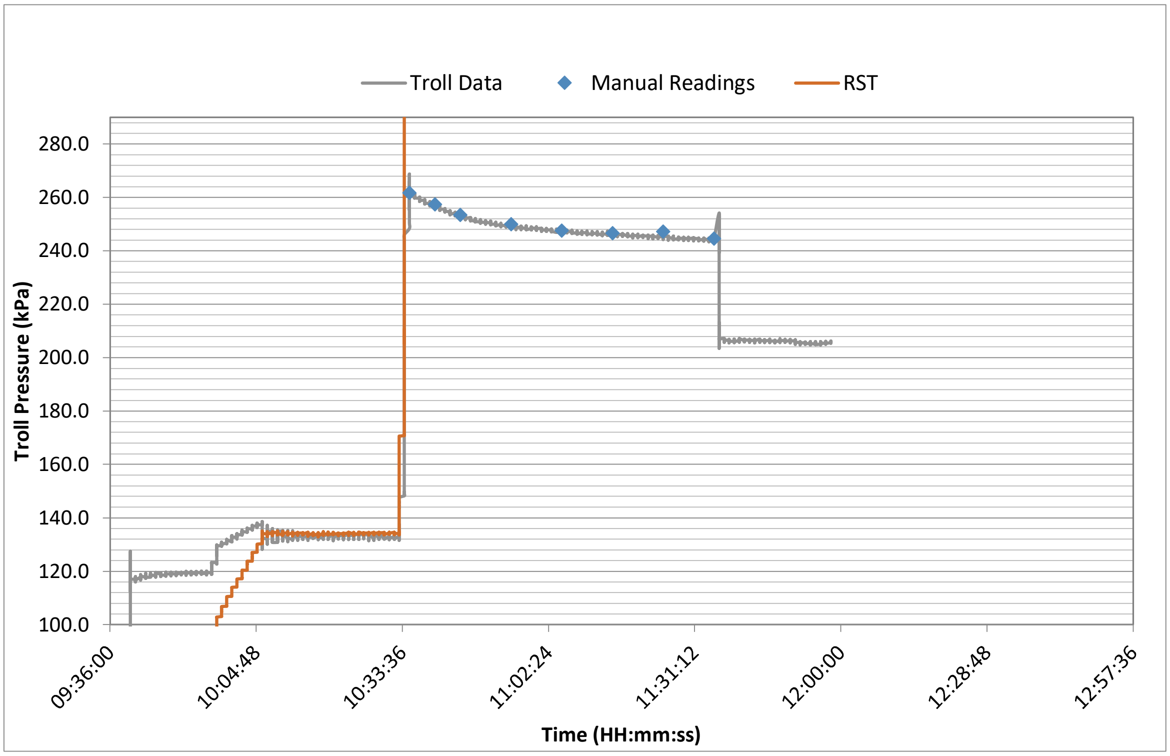
BH303 Test 1 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$

(Hvorslev, 1951)

	Test Information	**Input Values**
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	16.90
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[561 - 70]
	[h_1 / h_2] = Head Ratio	[0.941 - 0.889]

Test Results	**Hydraulic Conductivity (m/s)**
K =	**3.0E-08**



Falling Head Test

Darlington New Nuclear Project

Darlington, On

BH303 Test 1

Project No. 21451329
Date: 07/13/2022
Calcs By: LT
Review: MT

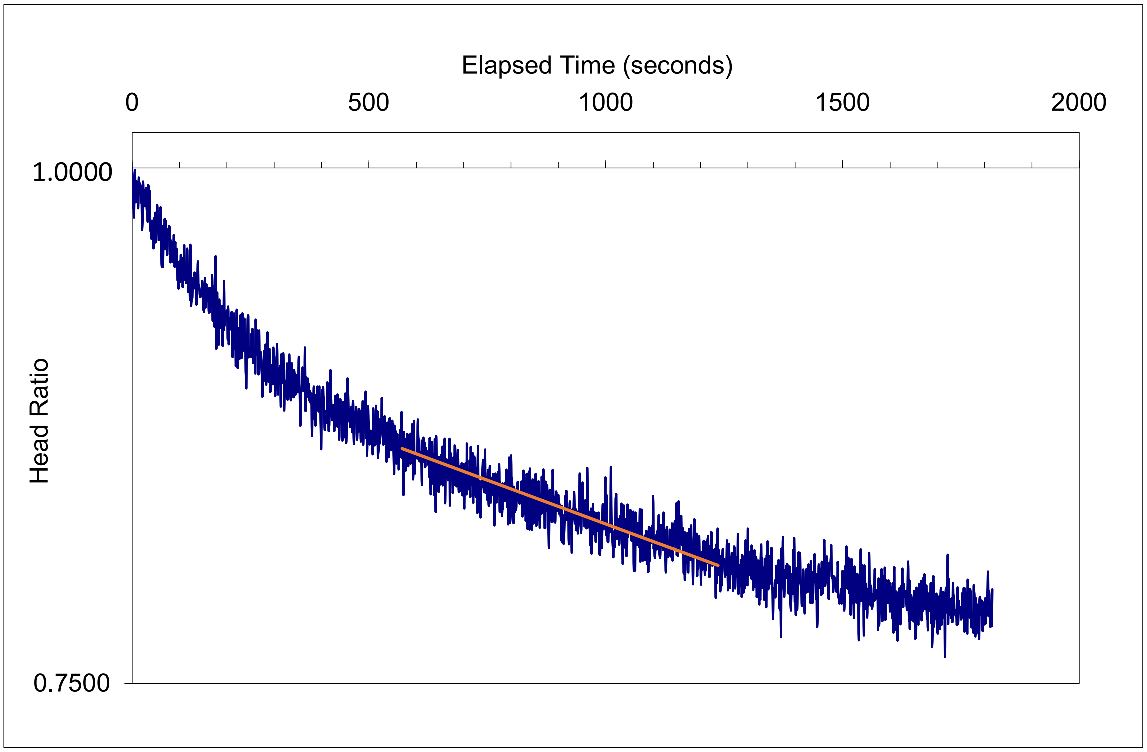
BH303 Test 2 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$

(Hvorslev, 1951)

	Test Information	Input Values
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	20.83
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[1237 - 570]
	[h_1 / h_2] = Head Ratio	[0.855 - 0.801]

Test Result	Hydraulic Conductivity (m/s)
K =	**2.2E-08**



	Falling Head Test **Darlington New Nuclear Project** **Darlington, On**	**BH303 Test 2**
		Project No. 21451329
		Date: 07/14/2022
		Calcs By: KL
		Review: MT

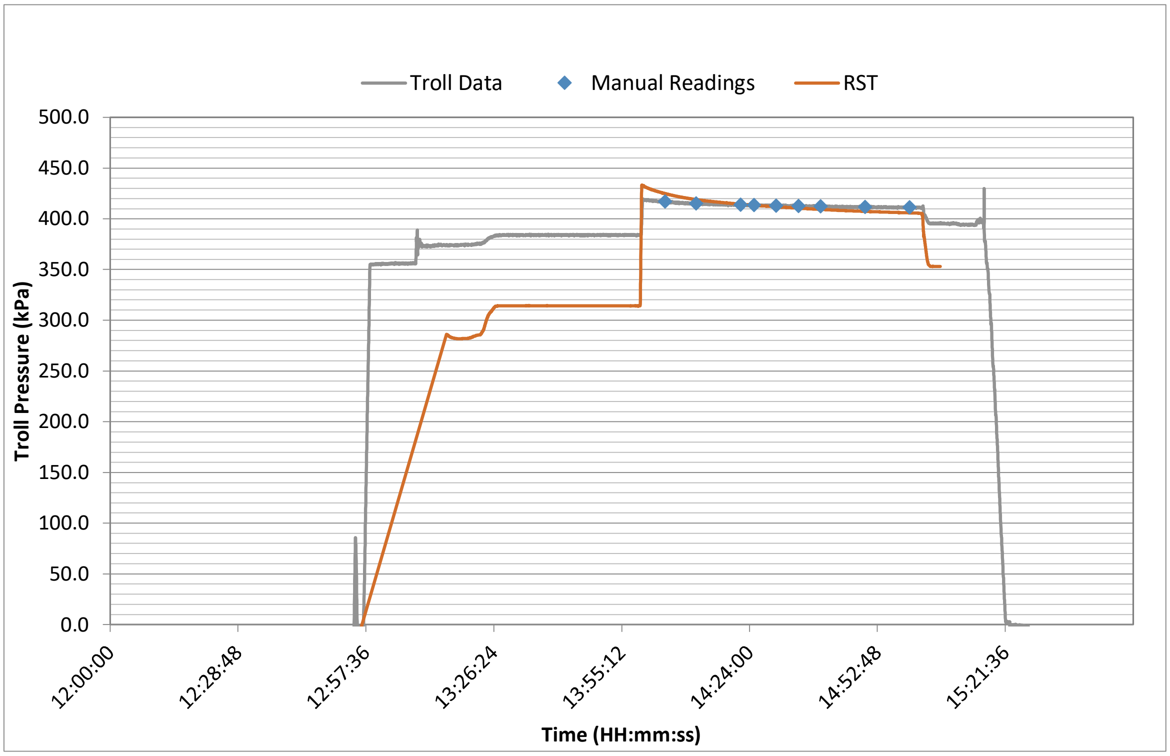
BH303 Test 2 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$

(Hvorslev, 1951)

	Test Information	Input Values
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	20.83
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[1237 - 570]
	[h_1 / h_2] = Head Ratio	[0.855 - 0.801]

Test Results	**Hydraulic Conductivity (m/s)**
K =	**2.2E-08**



Falling Head Test

Darlington New Nuclear Project

Darlington, On

BH303 Test 2

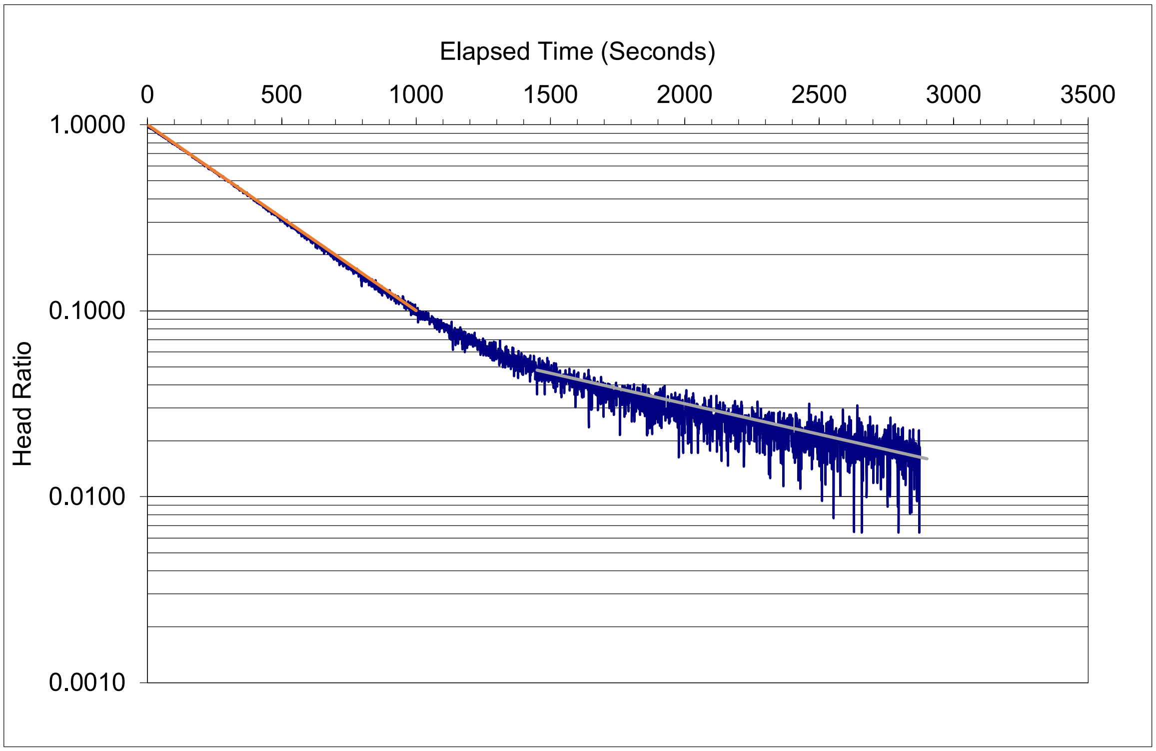
Project No. 21451329
Date: 07/14/2022
Calcs By: KL
Review: MT

BH305 Test 1 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$ **(Hvorslev, 1951)**

	Test Information	Input Values
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	16.88
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[1000 - 0]
	[h_1 / h_2] = Head Ratio	[1.000 - 0.100]

Test Result	**Hydraulic Conductivity (m/s)**
K =	**6.1E-07**



Falling Head Test

Darlington New Nuclear Project

Darlington, On

BH303 Test 1

Project No. 21451329
Date: 09/29/2022
Calcs By: KL
Review: MT

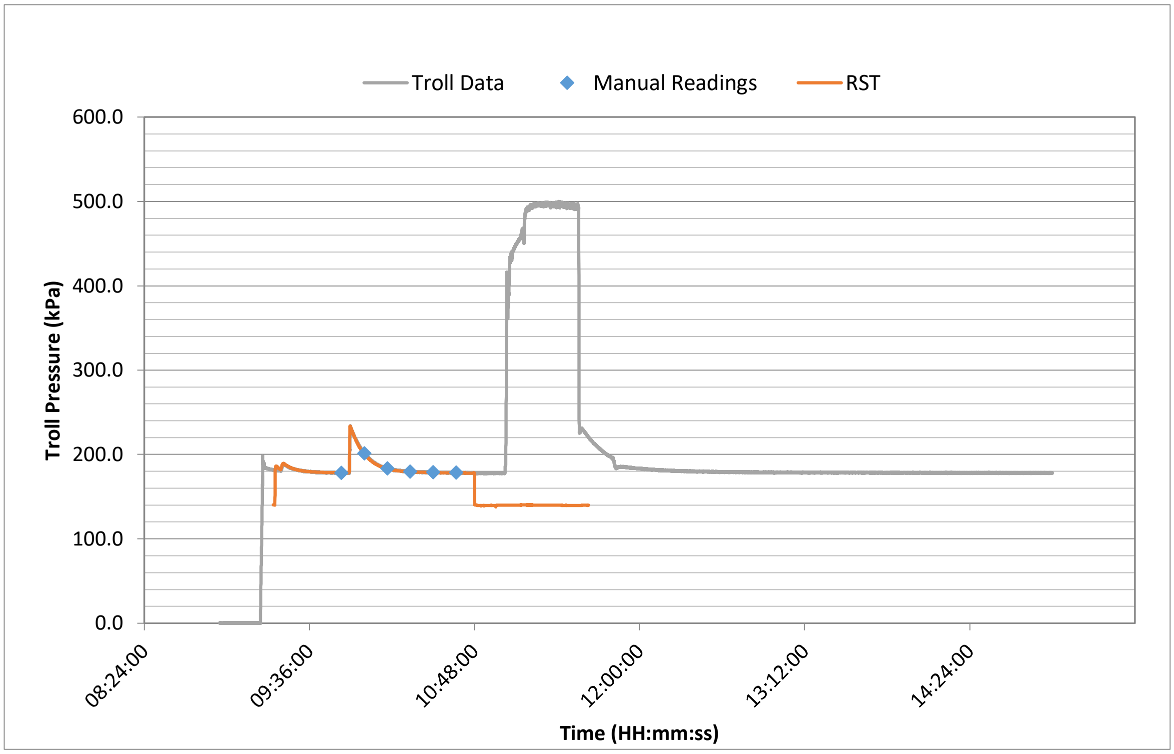
BH305 Test 1 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$

(Hvorslev, 1951)

	Test Information	**Input Values**
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	16.88
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[1000 - 0]
	[h_1 / h_2] = Head Ratio	[1.000 - 0.100]

Test Results	**Hydraulic Conductivity (m/s)**
K =	**6.1E-07**



Falling Head Test

Darlington New Nuclear Project

Darlington, On

BH303 Test 1

Project No. 21451329
Date: 09/29/2022
Calcs By: KL
Review: MT

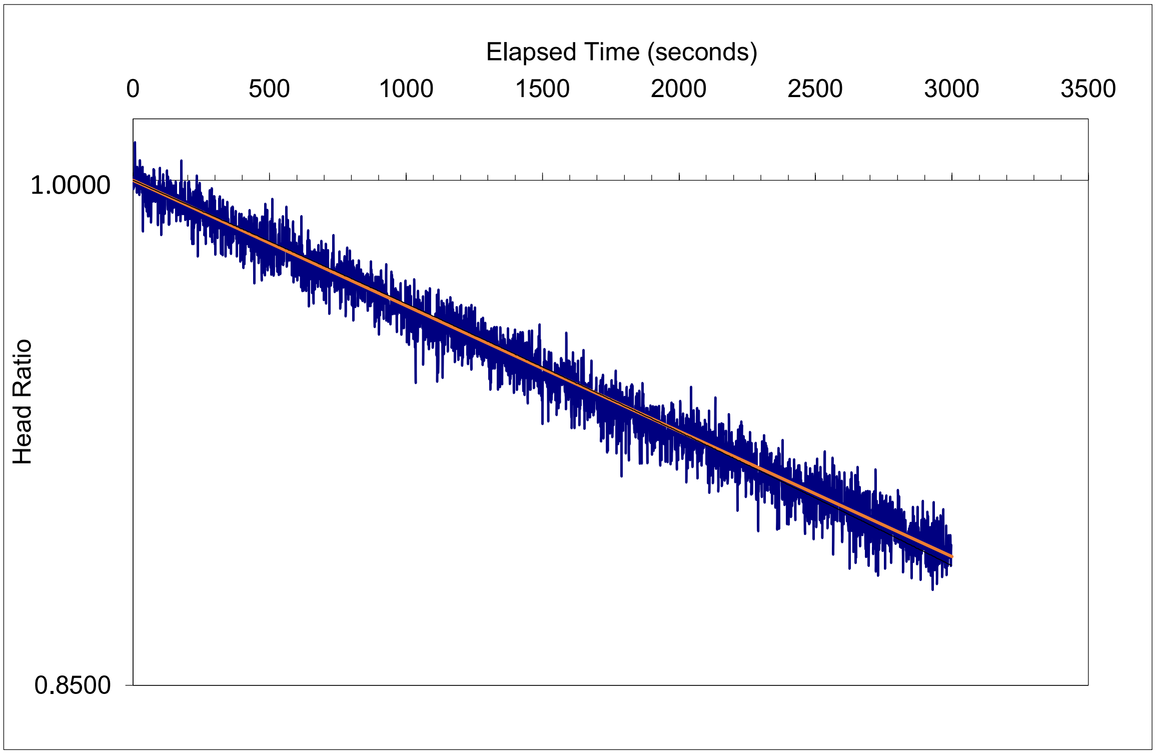
BH305 Test 2 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$

(Hvorslev, 1951)

	Test Information	Input Values
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	22.93
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[3000 - 0]
	[h_1 / h_2] = Head Ratio	[1.000 - 0.886]

Test Result	**Hydraulic Conductivity (m/s)**
K =	**8.2E-09**



Falling Head Test

Darlington New Nuclear Project

Darlington, On

BH303 Test 2

Project No. 21451329
Date: 09/29/2022
Calcs By: KL
Review: MT

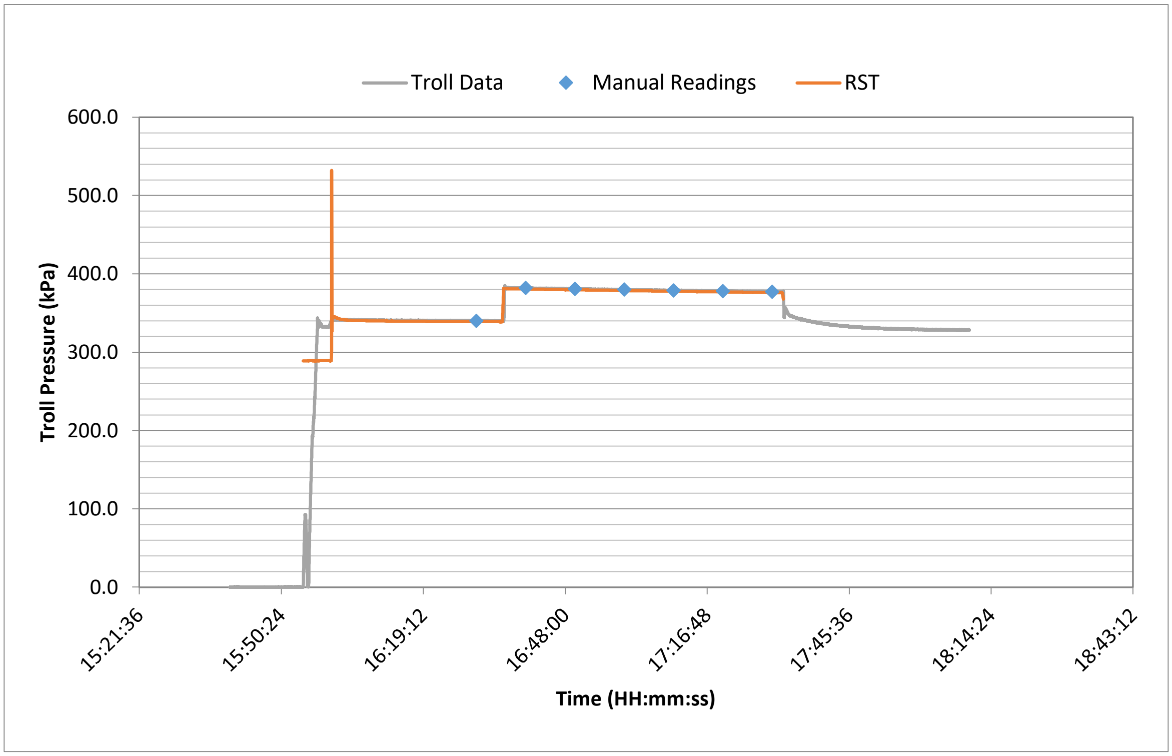
BH305 Test 2 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$

(Hvorslev, 1951)

	Test Information	Input Values
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	22.93
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[3000 - 0]
	[h_1 / h_2] = Head Ratio	[1.000 - 0.886]

Test Results	**Hydraulic Conductivity (m/s)**
K =	**8.2E-09**



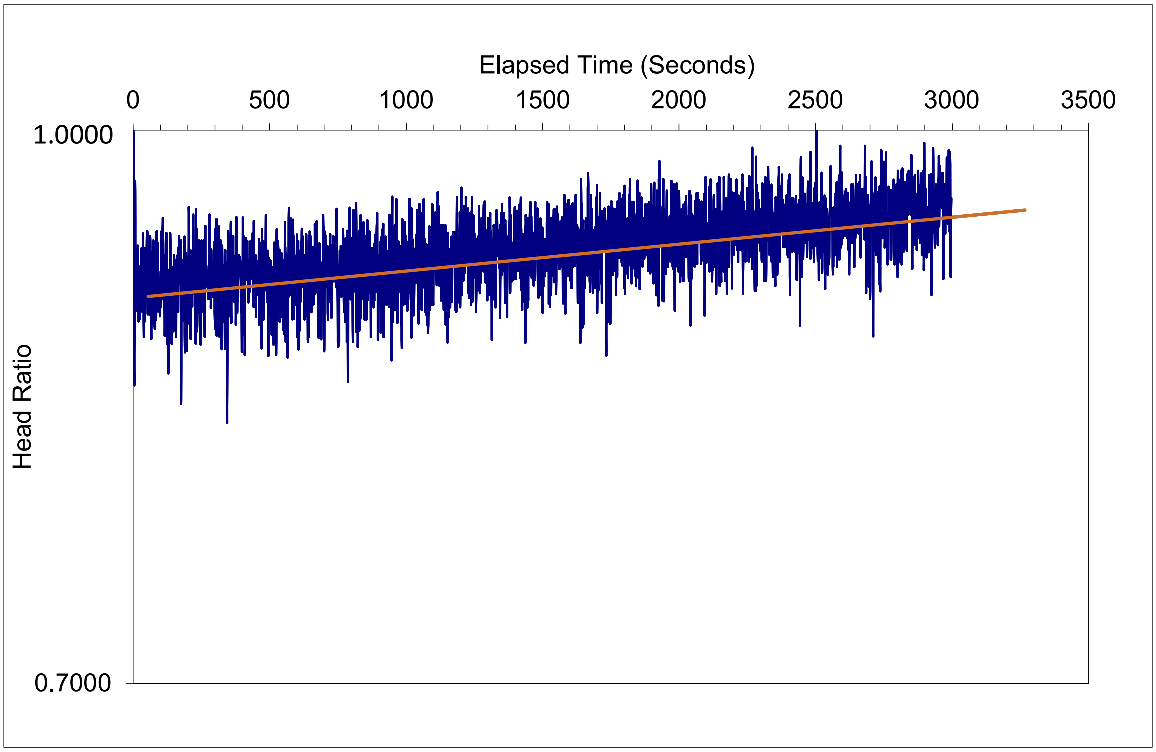
	Falling Head Test **Darlington New Nuclear Project** **Darlington, On**	**BH303 Test 2** Project No. 21451329 Date: 09/29/2022 Calcs By: KL Review: MT

BH308 Test 1 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$ **(Hvorslev, 1951)**

	Test Information	Input Values
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	18.48
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[3267 - 55]
	[h_1 / h_2] = Head Ratio	[0.898 - 0.950]

Test Result	Hydraulic Conductivity (m/s)	Comment
K =	**Not measureable**	**low K, gas pressure interference**



Falling Head Test

Darlington New Nuclear Project

Darlington, On

BH308 Test 1

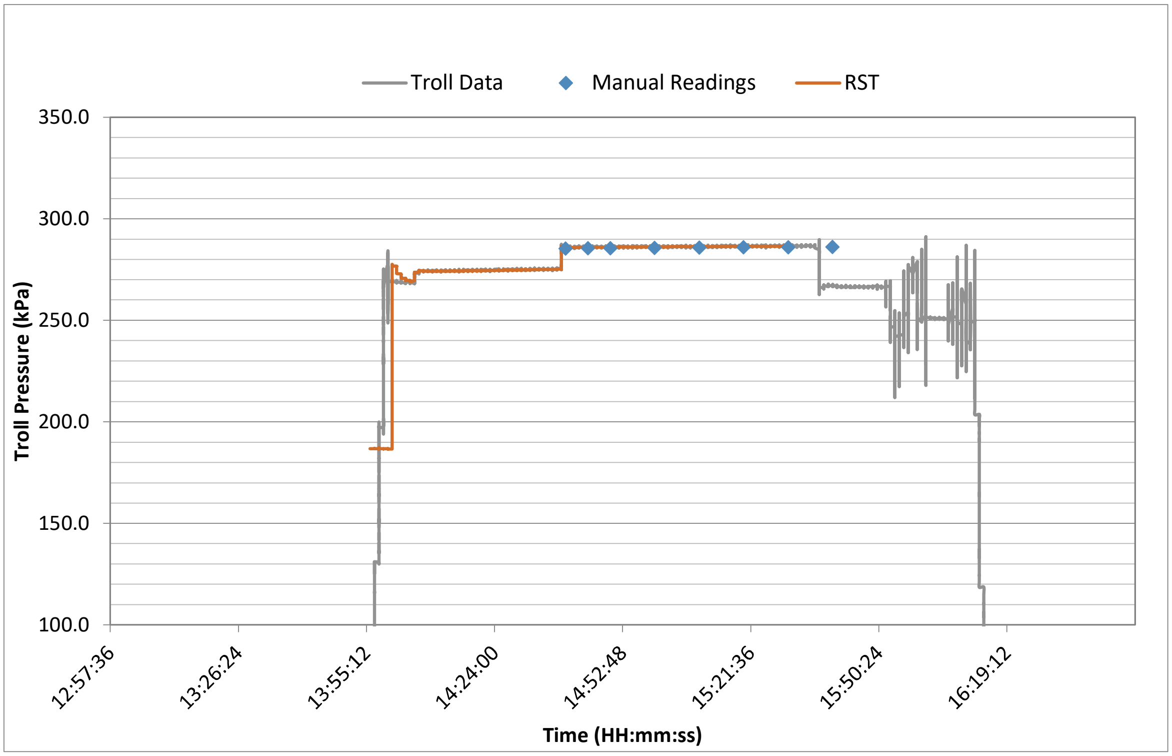
Project No. 21451329
Date: 09/06/2022
Calcs By: KL
Review: MT

BH308 Test 1 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$ **(Hvorslev, 1951)**

	Test Information	Input Values
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	18.48
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[3267 - 55]
	[h_1 / h_2] = Head Ratio	[0.898 - 0.950]

Test Results	**Hydraulic Conductivity (m/s)**	**Comment**
K =	**Not measureable**	**low K, gas pressure interference**



	Falling Head Test **Darlington New Nuclear Project** **Darlington, On**	**BH308 Test 1**
		Project No. 21451329
		Date: 09/06/2022
		Calcs By: KL
		Review: MT

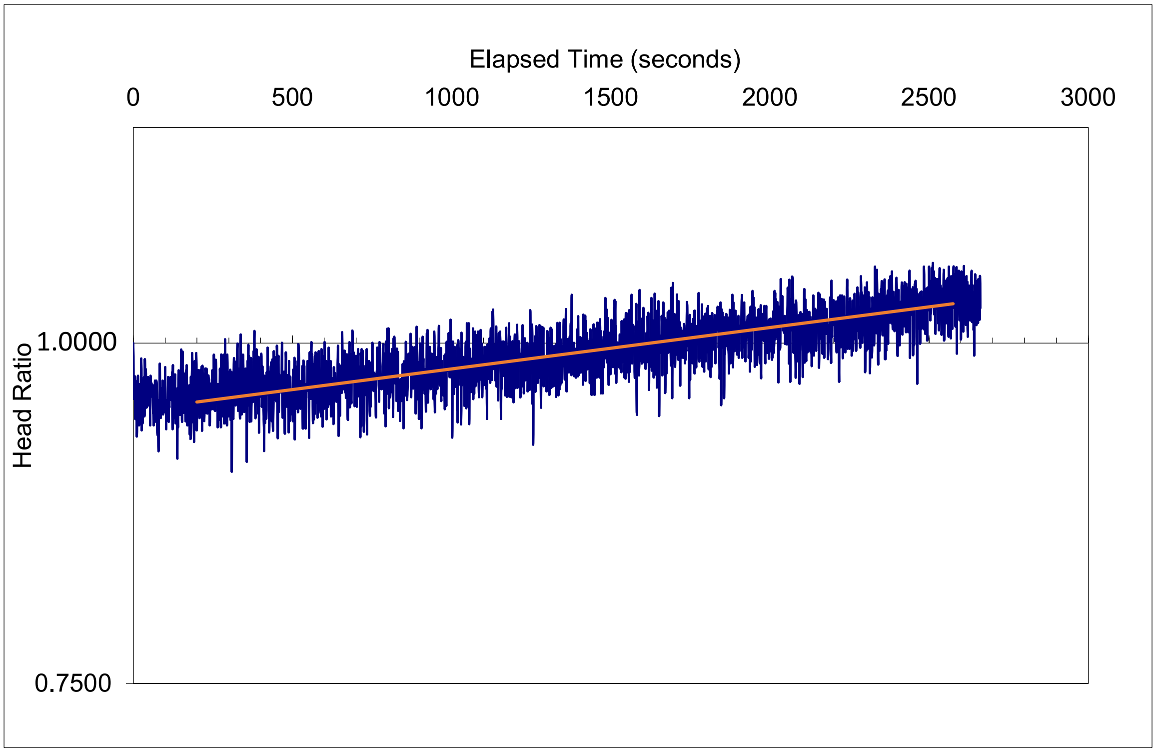
BH308 Test 2 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$

(Hvorslev, 1951)

	Test Information	Input Values
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	24.67
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[2575 - 200]
	[h_1 / h_2] = Head Ratio	[0.952 - 1.034]

Test Result	Hydraulic Conductivity (m/s)	Comment
K =	**Not measureable**	**low K, gas pressure interference**



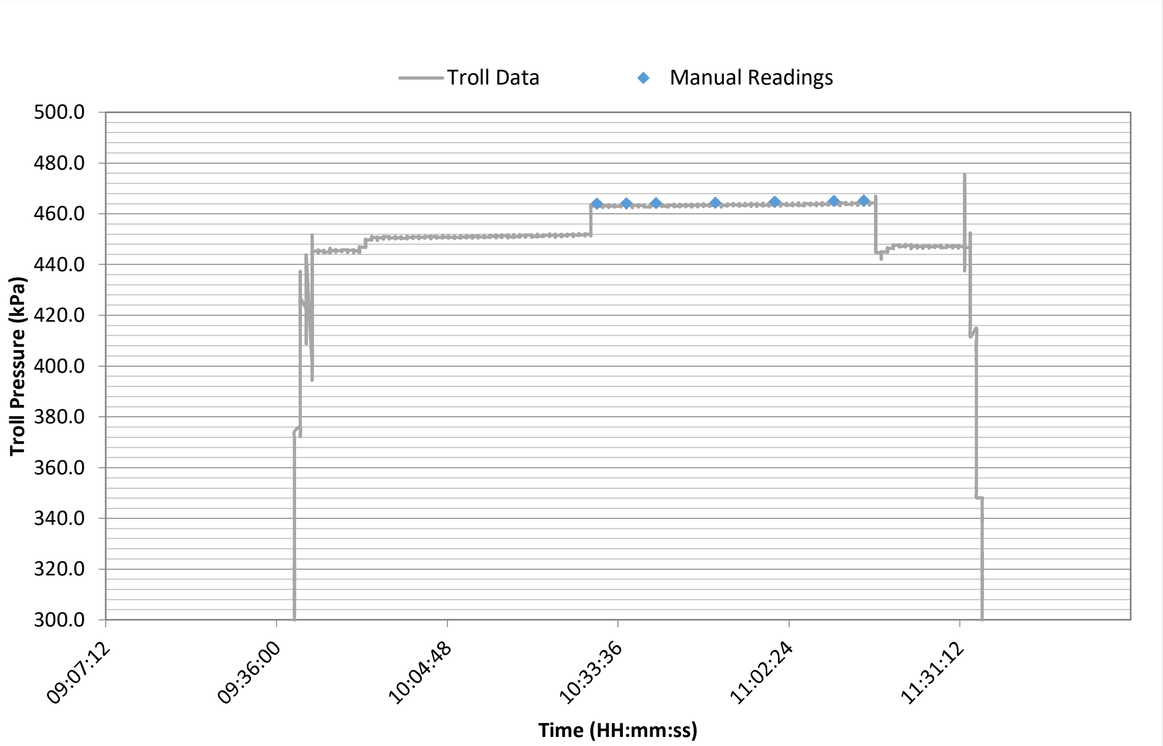
	Falling Head Test **Darlington New Nuclear Project** **Darlington, On**	**BH303 Test 2** Project No. 21451329 Date: 09/06/2022 Calcs By: KL Review: MT

BH308 Test 2 - Falling Head Test

$$K = \frac{r^2 * ln\left(\frac{L}{R}\right) * ln\left(\frac{h_1}{h_2}\right)}{2L(t_{2-}t_1)}$$ **(Hvorslev, 1951)**

	Test Information	Input Values
Where:	[r] = Well Radius (m)	0.039
	[L] = Length of Screened Interval (m)	24.67
	[R] = Borehole Radius (m)	0.048
	[t_2 - t_1] = Δtime (seconds)	[2575 - 200]
	[h_1 / h_2] = Head Ratio	[0.952 - 1.034]

Test Results	Hydraulic Conductivity (m/s)	Comment
K =	**Not measureable**	**low K, gas pressure interference**



wsp	**Falling Head Test** **Darlington New Nuclear Project** **Darlington, On**	**BH303 Test 2** Project No. 21451329 Date: 09/06/2022 Calcs By: KL Review: MT

APPENDIX G

In Situ Stress Measurement Results

IN SITU STRESS MEASUREMENTS

1.0 INTRODUCTION

The following document provides a summary of the in-situ stress measurement data collected at boreholes BH23, BH202, BH205, BH304, and BH307 as part of the second stage geotechnical investigation for the Darlington New Nuclear Project at Darlington, Ontario. With the exception of BH23 which is located onshore (in the vicinity of the proposed intake structure), the rest of the boreholes are located offshore. Boreholes BH202 and BH205 are located in the vicinity of the proposed Intake Tunnel alignment, whereas boreholes BH304 and BH307 are located in the vicinity of the proposed Discharge Tunnel alignment.

2.0 IN-SITU STRESS TESTING METHOD AND RESULTS

The in-situ stress testing program for the second stage geotechnical investigation was carried out in five (5) boreholes from June 9 to September 8, 2022. All the boreholes were drilled into the Lindsay Formation where the in situ overcoring tests were undertaken. The Lindsay Formation is a fresh, thinly to medium bedded, grey, medium strong to very strong, fine to medium grained fossiliferous limestone with very thin to thin wavy shaly interbeds throughout. The boreholes were core-drilled vertically by Walker Drilling Limited, using a Dietrich D-10 diamond drill equipped with HQ triple-tube (HQ3) drill string for both the onshore and offshore work. Detailed borehole information and the testing depths/elevations in each borehole are listed below in Table G-1. The dates of testing in the boreholes, and the number of interpretable tests achieved with the test attempts are also summarized in Table G-1.

Table G-1: Test Borehole Details

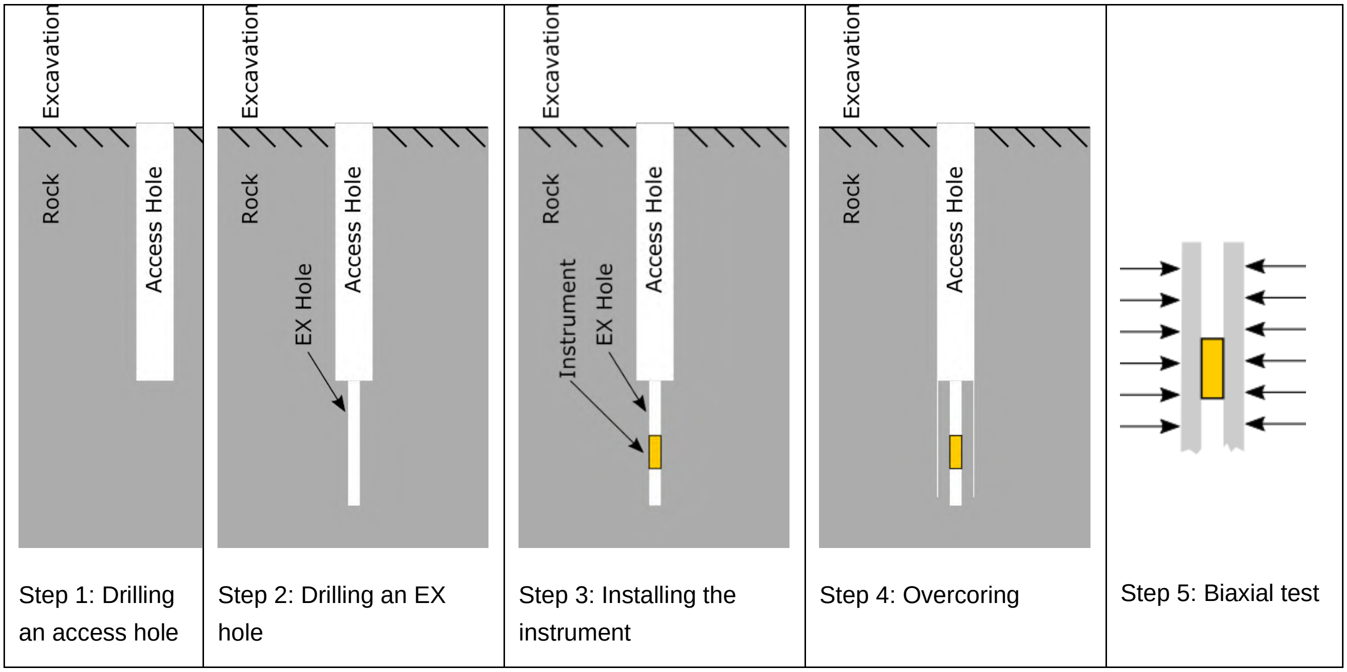
Borehole ID	Northing (m)	Easting (m)	Ground/ Barge deck* Elevation (m.a.s.l)	Top of Bedrock Depth (Elevation) (m.a.s.l)	Test Depths (m.a.h.) (Elevations)	Testing Dates (No. of Interpretable Tests/Test Attempts)
BH23 (onshore)	683833.1	4859899	85.31	62.53	45.88 – 53.50 (39.43 – 31.81)	July 11 – July 19 (4/7)
BH202 (offshore)	684020.2	4859652	78.30*	61.92	29.98 – 46.80 (48.32 – 31.5)	Aug. 13 – Aug. 16 (3/3)
BH205 (offshore)	684125.3	4859272	78.16*	61.88	30.70 – 44.86 (47.46 – 33.30)	Sept. 1 – Sept. 8 (3/6)
BH304 (offshore)	684429.9	4859536	79.40*	63.91	28.70 – 44.60 (50.70 – 34.80)	June 9 – June 12 (3/4)
BH307 (offshore)	684836.9	4859387	78.90*	59.80	28.99 – 44.30 (49.91 – 34.60)	July 1 – July 4 (3/4)

Notes: m = metres; m.a.s.l. = metres above sea level; m.a.h. = metres along hole, relative to ground surface; * barge deck elevation
Elevations are geodetic and are referred to GSC Benchmark No. 0011910U178, having an elevation of 90.025m (CGVD-1928:1978).
Coordinates (based on plan from OPG) are referred to UTM Zone 17, NAD83 (CSRS)(2010.0).

2.1 Testing Method

In situ stress tests were undertaken to investigate horizontal stresses in the rock mass. The testing was conducted using the United States Bureau of Mines (USBM) borehole deformation gauge overcoring method. This method is slightly modified from the procedure described in ASTM D4623 to make use of standard HQ drilling equipment (96 mm diameter).

Overcoring is a common method of in situ stress measurement, whereby the USBM borehole deformation gauge is installed in an EX hole (38 mm diameter) within a volume of rock that is subject to in situ stresses. The gauge is then monitored as the EX hole is overcored and isolated from the in situ stresses. The diametral deformations of the EX hole across three axes (spaced 120 degrees apart) are recorded during the overcoring process. The steps involved in overcoring stress measurements in a vertical drillhole are described below and illustrated graphically in Figure G-1.



Step 1: Drilling an access hole

Step 2: Drilling an EX hole

Step 3: Installing the instrument

Step 4: Overcoring

Step 5: Biaxial test

Figure G-1: Generic overcoring stress measurement steps

Step 1: An access hole (96 mm diameter) is advanced to the target testing depth with standard HQ triple tube drill string and bit, with core recovery. If necessary, the bottom of the borehole is ground flat.

Step 2: A 38 mm diameter (EX size) pilot hole (approximately 600 mm in length) concentric with the 96 mm diameter hole is drilled through the desired test interval, and the core is examined for natural discontinuities.

Step 3: If a suitably long interval of the EX hole is found to be free of natural discontinuities the deformation gauge may be installed. The USBM deformation gauge (photograph shown in Figure G-2 below) is then installed in the pilot hole, normally about 200 mm to 300 mm into the pilot hole (i.e. from the end of the 96 mm diameter hole). The USBM deformation gauge is designed to measure the changes in the deformation of the bedrock across three axes (spaced 120 degrees apart). The gauge has three pairs of buttons which provide contact between the surface of the 38 mm diameter pilot hole and the sensing element of the gauge.

Figure G-2: Photograph of a USBM borehole deformation gauge.

Step 4: The pilot hole (with USBM gauge in position) is then overcored using a 96 mm diameter thin wall coring bit to relieve the in-situ stresses around the pilot hole. The corresponding changes in diametral deformation of the pilot hole are monitored during overcoring using the USBM deformation gauge connected by a cable through the drill string to a digital strain indicator / recorder, allowing continuous observation of the borehole deformation changes during overcoring. The overcore, or sample of bedrock that was in place between the pilot hole and the thin wall coring bit during the overcore test is recovered, intact if possible.

Step 5: The elastic deformation modulus (Young's Modulus) of the bedrock overcore sample is determined by testing the recovered overcored rock sample in a biaxial chamber (cell). The cell consists of a cylindrical steel jacket, membrane and seals. The overcored rock sample, recovered from the test position is placed in the biaxial chamber with the USBM gauge installed in the same configuration as it was during the overcore test, where possible. Hydraulic oil is pumped into the space between the steel jacket and the sealed membrane which is in contact with the overcore. The outer surface of the overcore is therefore subjected to a uniformly distributed radial (biaxial) pressure. During modulus testing, the deformation of the inner pilot hole of the overcore sample is monitored using the USBM gauge as described above at various pressure increments and decrements. A photograph of a typical biaxial test setup in the field is shown in Figure G-3.

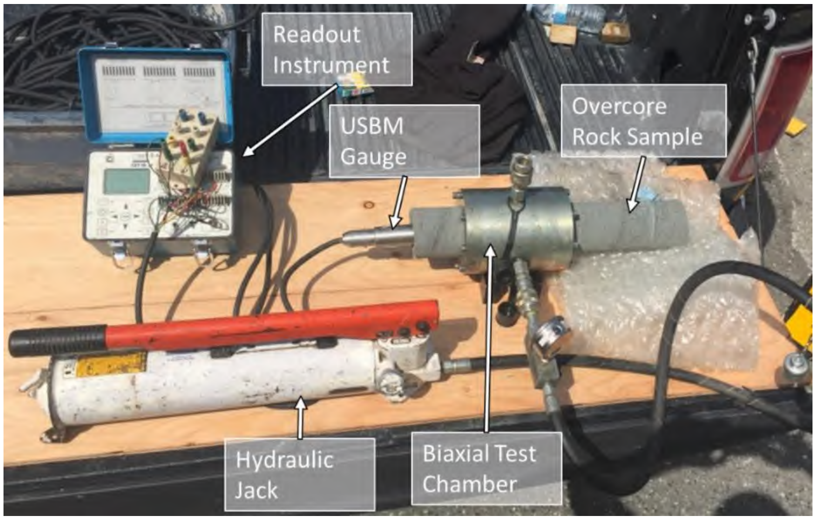


Figure G-3: Typical biaxial test setup in the field

2.2 Evaluation of Stresses from Overcoring Stress Data

Based on the deformations measured across the three pairs of buttons of the USBM borehole deformation gauge described in Steps 3 to 4 above, the stresses on the plane perpendicular to the axis of the borehole are given by the following expressions (Obert and Duval, 1967).

$$P = \frac{E}{6d(1-\upsilon^2)}\left(U_1 + U_2 + U_3 + \frac{1}{\sqrt{2}}\left[(U_1 - U_2)^2 + (U_2 - U_3)^2 + (U_3 - U_1)^2\right]^{1/2}\right)$$

$$Q = \frac{E}{6d(1-\upsilon^2)}\left(U_1 + U_2 + U_3 - \frac{1}{\sqrt{2}}\left[(U_1 - U_2)^2 + (U_2 - U_3)^2 + (U_3 - U_1)^2\right]^{1/2}\right)$$

where,

E	is the average deformation modulus
ν	is the Poisson's ratio
d	is the diameter of the pilot hole
U_1, U_2, U_3	are the measured changes in borehole diameter across three diameters at 60° rotation (i.e. the 3 sets of buttons on the USBM deformation gauge).
U	is positive for an increasing diameter
P	is the maximum stress perpendicular to borehole axis
Q	is the minimum stress perpendicular to borehole axis

The direction of P is given by:

$$\theta = \frac{1}{2}\tan^{-1}\left[\frac{\sqrt{3}(U_2 - U_3)}{2U_1 - U_2 - U_3}\right]$$

where,

θ is the angle to P measured counter clockwise from the direction of the U_1 diameter.

The quadrant of θ may be determined as follows:

If $U_2 > U_3$ and $U_2 + U_3 < 2U_1$ then θ is between 0° and 45°
$U_2 > U_3$ and $U_2 + U_3 > 2U_1$ then θ is between 45° and 90°
$U_2 < U_3$ and $U_2 + U_3 > 2U_1$ then θ is between 90° and 135°
$U_2 < U_3$ and $U_2 + U_3 < 2U_1$ then θ is between 135° and 180°

The above equations are derived for plane strain conditions with zero axial strain ($\varepsilon_2 = 0$) along the borehole. If the effect of axial strain is to be taken into account, an estimate of the axial stress along the borehole is required.

The deformation modulus of the rock is evaluated from the results of the biaxial tests using the following expression and assuming isotropic elasticity:

$$E = \frac{4ab^2P_0}{(b^2 - a^2)U}$$

where,

E is the deformation modulus
a is the inner radius of the overcore
b is the outer radius of the overcore
P_o is the radial pressure on the outer surface of the overcore
U is the average diametral deformation of pilot hole in the overcore

2.3 Results of Measurements

All the in-situ stress measurements were carried out within the Lindsay Formation which is a fresh and medium strong to very strong limestone with thin wavy shaly interbeds throughout. In general, due to the relatively competent nature of the limestone in this formation, a high average success rate of around 75% was achieved in the overcoring tests in the offshore boreholes. Lower success rates in the onshore borehole BH23 and offshore borehole BH205 were due to some equipment related issues during testing. Unsuccessful tests generally resulted from occasional breakages of the rock along the shaly interbeds during overcoring. The depths of the overcoring tests range from 28.7 m to 53.5 m from ground surface or the barge deck level (elevation from 50.7 m to 31.81 m). The deepest test (at 53.5 m depth or 31.81 m elevation) was achieved in the onshore borehole BH23. All the tests were conducted at elevations within a zone which is 1.5 times the tunnel diameter above and below the springline locations of the proposed discharge and intake tunnels. In the onshore borehole BH23, some equipment related issue occurred during testing resulting in only four (4) interpretable tests which are less than the required six (6) interpretable tests for onshore boreholes. However, results of the completed tests in this borehole showed that the stresses and orientations measured are very consistent with only minor variations. It is therefore considered that the results obtained in this borehole have fulfilled the testing requirements from a statistical perspective. For the offshore boreholes, three (3) interpretable tests were achieved in each test hole, thus fulfilling the test requirements for the offshore boreholes.

Table G-2 summarizes results of the interpretable tests achieved in each of the boreholes. It includes the borehole and test numbers, deformations measured in the EX pilot holes during overcoring as interpreted from the overcoring stress relief plots, the measured horizontal elastic modulus (E) values, and the maximum (P) and the minimum (Q) horizontal stresses interpreted from the test data. The horizontal elastic modulus (E) used for the interpretations were measured from biaxial tests on the overcore samples recovered from the boreholes after overcoring. Where overcoring tests were not successful but overcore samples were recovered for biaxial tests, the E values measured from the biaxial tests were also listed with the overcoring test number indicated.

The results obtained in each borehole are presented and discussed below:

BH23 – Onshore borehole in the vicinity of proposed intake structure (Tests between 39.43 m and 31.81 m elevation; springline elevation – 39.50 m)

The maximum horizontal stresses (P) in this hole range from 11.92 MPa to 13.24 MPa and the minimum horizontal stresses (Q) range from 8.21 MPa and 9.48 MPa, showing a fairly uniform stress distribution with depth. Figure G-4 shows a plot of the in situ horizontal stresses (P and Q) with elevation in this borehole.

The biaxial modulus (E) values of the rock range from 40.95 GPa to 54.79 GPa. All the overcore samples recovered from the test locations were intact. The range of the E values is consistent with the natural variations of the rock. Figure G-5 shows a plot of the biaxial modulus values with elevation in this borehole.

The orientations of the maximum horizontal stresses (P) are all within the first quadrant and the ratio of the maximum to minimum horizontal stresses (P/Q) ranges from 1.28 to 1.45.

BH202 – Offshore borehole in the vicinity of proposed intake tunnel (Tests between 48.32 m and 31.5 m elevation; springline elevation – 39.84 m)

The maximum horizontal stresses (P) in this hole range from 9.20 MPa to 11.87 MPa and the minimum horizontal stresses (Q) range from 6.31 MPa to 7.91 MPa, showing a fairly uniform stress distribution with depth. Figure G-6 shows a plot of the in situ horizontal stresses (P and Q) with elevation in this borehole.

The biaxial modulus (E) values of the rock range from 32.36 GPa to 54.86 GPa. All the overcore samples recovered from this hole for biaxial tests were intact. The range of the E values at lower elevations shows fairly uniform modulus values whereas the test at a higher elevation is higher due probably to a stiffer layer where the test was carried out. Nevertheless, the range of E values is consistent with the natural variations of the rock. Figure G-7 shows a plot of the biaxial modulus values with elevation in this borehole.

The orientations of the maximum horizontal stresses (P) are all within the second quadrant and the ratio of the maximum to minimum horizontal stresses (P/Q) ranges from 1.40 to 1.81.

BH205 – Offshore borehole in the vicinity of proposed intake tunnel (Tests between 47.46 m and 33.30 m elevation; springline elevation – 40.19 m)

The maximum horizontal stresses (P) in this hole range from 10.10 MPa to 22.41 MPa and the minimum horizontal stresses (Q) range from 4.42 MPa and 14.31 MPa, showing quite a large variation but there is no apparent trend of stress increase with depth. The location (elevation 37.76 m) where the higher stresses were measured is likely a stiffer layer where a high biaxial modulus was also measured. Figure G-8 shows a plot of the in situ horizontal stresses (P and Q) with elevation in this borehole.

The biaxial modulus (E) values of the rock range from 39.88 GPa to 57.27 GPa. All the overcore samples recovered from the test locations were intact. The higher modulus (E=57.27 GPa) occurred at the location where the higher stresses were measured as discussed above. Figure G-9 shows a plot of the biaxial modulus values with elevation in this borehole.

The orientations of the maximum horizontal stresses (P) generally vary between due north and due east and the ratio of the maximum to minimum horizontal stresses (P/Q) ranges from 1.23 to 2.28.

BH304 – Offshore borehole in the vicinity of proposed discharge tunnel (Tests between 50.7 m and 34.80 m elevation; springline elevation – 40.19 m)

The maximum horizontal stresses (P) in this hole range from 14.04 MPa to 19.07 MPa and the minimum horizontal stresses (Q) range from 5.29 MPa and 11.78 MPa, showing a fairly uniform stress distribution with depth. Figure G-10 shows a plot of the in situ horizontal stresses (P and Q) with elevation in this borehole.

The biaxial modulus (E) values of the rock range from 42.39 GPa to 47.05 GPa. All the overcore samples recovered from the test locations were intact. The range of the E values shows a fairly uniform modulus values with depth. Figure G-11 shows a plot of the biaxial modulus values with elevation in this borehole.

The orientations of the maximum horizontal stresses (P) are generally within the second quadrant and the ratio of the maximum to minimum horizontal stresses (P/Q) ranges from 1.62 to 2.65.

BH307 – offshore borehole in the vicinity of discharge tunnel (Tests between 49.91 m and 34.6 m elevation; springline elevaton – 40.62 m)

The maximum horizontal stresses (P) in this hole range from 10.06 MPa to 11.79 MPa and the minimum horizontal stresses (Q) range from 5.91 MPa and 6.54 MPa, showing a fairly uniform stress distribution with depth. Figure G-12 shows a plot of the in situ horizontal stresses (P and Q) with elevation in this borehole.

The biaxial modulus (E) values of the rock range from 40.74 GPa to 50.32 GPa. All the overcore samples recovered from the test locations were intact. The range of the E values shows a fairly uniform distribution of modulus values with depth. Figure G-13 shows a plot of the biaxial modulus values with elevation in this borehole.

The orientations of the maximum horizontal stresses (P) are within the first quadrant and the ratio of the maximum to minimum horizontal stresses (P/Q) ranges from 1.70 to 1.63.

3.0 OVERALL SUMMARY

The in situ horizontal stresses were measured in five (5) boreholes located within two zones: the proposed intake tunnel and proposed discharge tunnel sites. The results are summarized as follows:

Test area in the vicinity of proposed intake structure and tunnel (boreholes BH23, BH202 and BH205)

- With the exception of the tests at the relatively stiffer zone in borehole BH205 (elevation 37.76 m), the maximum horizontal stresses (P) and minimum horizontal stresses (Q) are fairly uniform with depth with P values ranging from 9.20 to 14.21 MPa and Q values ranging from 4.42 to 11.47 MPa.
- The biaxial modulus (E) values range from 39.88 to 57.27 GPa which are within the natural variations of the rock. The relatively higher modulus value at elevation 37.76 m as discussed above, results in localized higher P and Q values (P = 22.40 MPa and Q = 14.31 MPa)
- The orientations of the maximum stresses (P) vary between the first and second quadrant and the ratio of the maximum and minimum stresses (P/Q) ranges from 1.23 to 2.28 with an average value of 1.53.
- Figure G-14 shows a combined plot of all the measured maximum horizontal stresses (P) and minimum horizontal stresses (Q) with elevation for the test area in the vicinity of the proposed intake tunnel.
- Figure G-15 shows a combined plot of all the measured biaxial modulus with elevation for the test area in the vicinity of the proposed intake tunnel

Test area in the vicinity of proposed discharge tunnel (boreholes BH304 and BH307)

- The maximum horizontal stresses (P) and the minimum horizontal stresses (Q) are fairly uniform with depth with P values ranging from 10.66 to 19.07 MPa and Q values ranging from 5.29 to 11.78 MPa.
- The biaxial modulus (E) values range from 40.74 to 50.32 GPa which are within the natural variations of the rock.
- The orientations of the maximum stresses (P) are generally within the first quadrant and the ratio of the maximum and minimum stresses (P/Q) ranges from 1.62 to 2.65 with and average value of 1.87.
- Figure G-16 shows a combined plot of all the measured maximum horizontal stresses (P) and minimum horizontal stresses (Q) with elevation for the test area in the vicinity of the proposed discharge tunnel.
- Figure G-17 shows a combined plot of all the measured biaxial modulus with elevation for the test area in the vicinity of the proposed discharge tunnel.

Comparison of Test results with historic data and Stage1 overcoring test data at the Darlington Power Station site

For the sake of comparison, the in situ horizontal stresses (P and Q) and biaxial modulus (E) values measured at the site of the intake tunnel located in the existing Darlington Nuclear Power Station (Lo and Lukajic,1984) are summarized below:

- Between 80 m and 40 m elevation in the Lindsay Formation, the maximum horizontal stresses (P) range from 10 MPa to 14 MPa whereas the minimum horizontal stresses (Q) range from 5 MPa to 8 MPa.
- Below 40 m elevation (from 40 m to -100 m), the in situ stresses are fairly uniform with an average P value of 14 MPa and an average Q value of 8 MPa.
- Between 85 to 20 m elevation, the biaxial modulus (E) values range from 32 GPa to 63 GPa.

It may be noted that the in situ horizontal stresses and biaxial modulus values obtained from the current overcoring test program carried out at the sites of the proposed intake and discharge tunnel of the New Darlington Station are consistent with the set of historic stress data obtained in the same rock formation at comparable depths at the site of the existing Darlington Power Station.

A comparison of the test data from the first and second stage stress measurement programs at the Darlington New Nuclear project site are as follows:

1st stage stress measurements (test elevations: 57.98 m to 25.78 m)

Maximum horizontal stress (P): 8.03 MPa to 23.36 MPa

Minimum horizontal stress (Q): 5.02 MPa to 12.30 MPa

Biaxial modulus (E): 34.95 GPa to 58.75 GPa

2nd stage stress measurements (test elevations: 49.91 m to 31.5 m)

Maximum horizontal stress (P): 9.20 MPa to 22.41 MPa

Minimum horizontal stress (Q): 4.42 MPa to 11.78 MPa

Biaxial modulus (E): 39.88 GPa to 57.27 GPa

It may be noted that the test data from the first and second stages of stress measurements are consistent in terms of the horizontal stresses (P and Q) and the biaxial modulus (E) values.

APPENDIX A presents the overcoring and biaxial test data from the interpretable tests. Photos of the overcore samples recovered for the biaxial tests are also presented.

Table G-2: Summary of In Situ Stress Measurement Test Results

Borehole	Test No.	Depth (mbgs)	U_1		U_2		U_3		P	Q	E	Azimuth of P	Remarks
		Elev.(m)	(min)	(mm)	(min)	(mm)	(min)	(mm)	(MPa)	(MPa)	(GPa)	(°)	
BH23 (onshore, proposed intake structure)	1	45.88 (39.43)	737	18.71	448	11.38	861	21.87	12.82	8.92	47.69	55.5	
	2	47.40 (37.91)	-	-	-	-	-	-	-	-	40.95	-	Biaxial test only
	3	48.90 (36.41)	860	21.84	444	11.28	659	16.74	11.92	8.21	45.95	78.42	
	5	52.00 (33.31)	608	15.44	805	20.45	441	11.20	13.24	9.39	54.79	61.3	
	6	53.50 (31.81)	597	15.16	581	14.75	838	21.28	12.15	9.48	48.15	35.6	
BH202 (offshore, proposed intake tunnel)	1	29.98 (48.32)	703	18.32	583	14.81	221	5.61	11.87	6.55	54.86	165.1	
	2	40.65 (37.65)	1123	28.52	615	15.62	898	22.81	11.09	7.91	32.36	125.2	
	3	46.80 (31.50)	798	20.27	733	18.62	409	10.39	9.20	6.31	35.92	167.5	

Borehole	Test No.	Depth (mbgs)	U_1		U_2		U_3		P	Q	E	Azimuth of P	Remarks
		Elev.(m)	(min)	(mm)	(min)	(mm)	(min)	(mm)	(MPa)	(MPa)	(GPa)	(°)	
BH205 (offshore, proposed intake tunnel)	1	30.7 (47.46)	113	2.87	730	18.54	590	15.00	10.10	4.42	45.51	103.78	
	2	36.73 (41.43)	-	-	-	-	-	-	-	-	44.13	-	Biaxial test only
	3	38.20 (39.96)	-	-	-	-	-	-	-	-	41.55	-	Biaxial test only
	5	40.40 (37.76)	597	15.16	1330	33.78	952	24.19	22.41	14.31	57.27	94.46	
	6	44.86 (33.30)	1168	29.67	863	21.92	858	21.79	14.21	11.47	39.88	20.45	
BH304 (offshore, proposed discharge tunnel)	1	28.7 (50.70)	1140	28.96	1163	29.54	350	9.64	16.32	8.74	42.39	162.7	
	2	39.4 (40.00)	1052	26.97	616	15.65	1474	37.44	19.07	11.78	44.06	87.29	
	3	44.00 35.40)	-	-	-	-	-	-	-	-	45.61	-	Biaxial Test Only
	4	44.60 (34.80)	1156	30.31	230	5.84	458	11.63	14.04	5.29	47.05	125.0	
BH307 (offshore,proposed discharge tunnel)	1	28.99 (49.91)	-	-	-	-	-	-	-	-	-	-	Biaxial test not successful
	2	30.60 (48.30)	305	7.75	791	20.09	525	13.33	10.06	5.91	44.18	20.4	
	3	39.70 (39.20)	388	10.19	857	21.79	389	9.88	11.79	6.54	50.32	7.1	
	4	44.30 (34.60)	334	8.48	835	21.21	724	18.39	10.66	6.52	40.74	31.0	

Notes:

Only results of interpretable tests shown. Gas pockets encountered during overcoring of Tests 3 and 4 in BH-7.

U_1, U_2, and U_3 are measured diametral deformations (in microinches-min, and in micrometer-mm) of the EX pilot hole during overcoring. These values are interpreted from the recorded USBM gauge readings.

P = Maximum Horizontal Stress (Major Principal Horizontal Stress).

Q = Minimum Horizontal Stress (Minor Principal Horizontal Stress).

E = Horizontal Deformation Modulus determined from biaxial tests on overcore samples unless otherwise state.

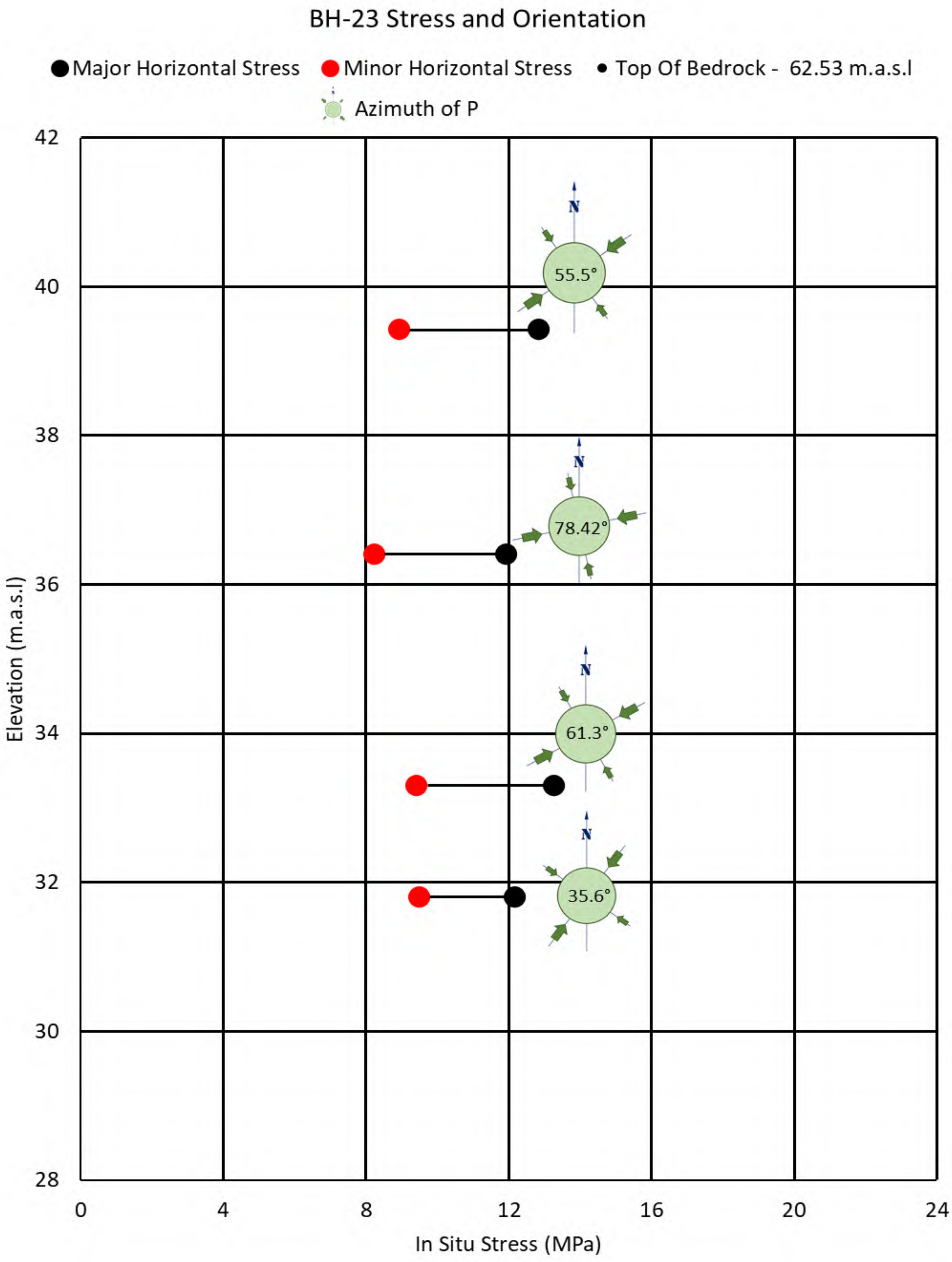


Figure G-4: Maximum (P) and minimum horizontal stresses (Q) for the interpretable tests

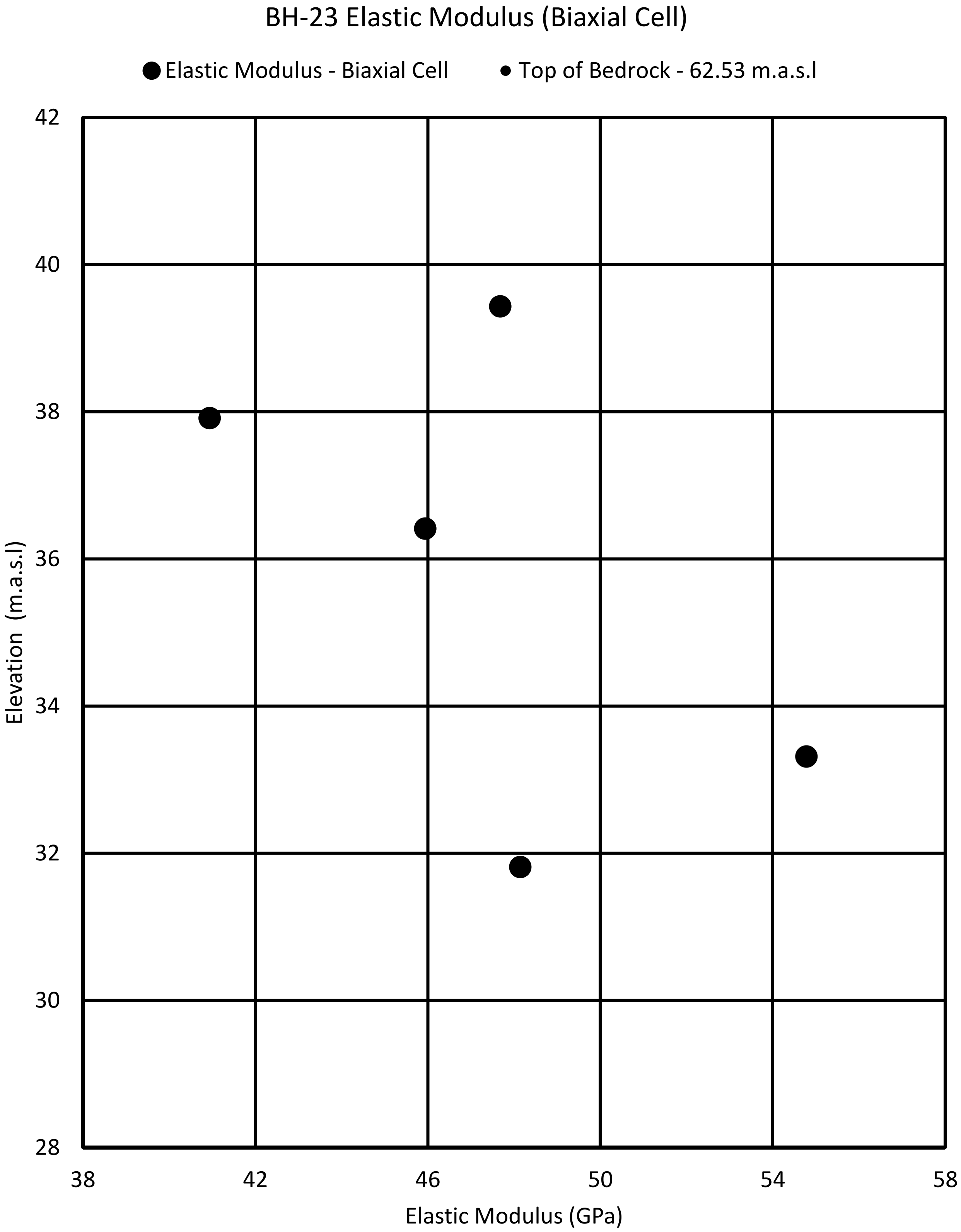


Figure G-5: Horizontal elastic modulus (*E*) of the rock measured from the biaxial tests

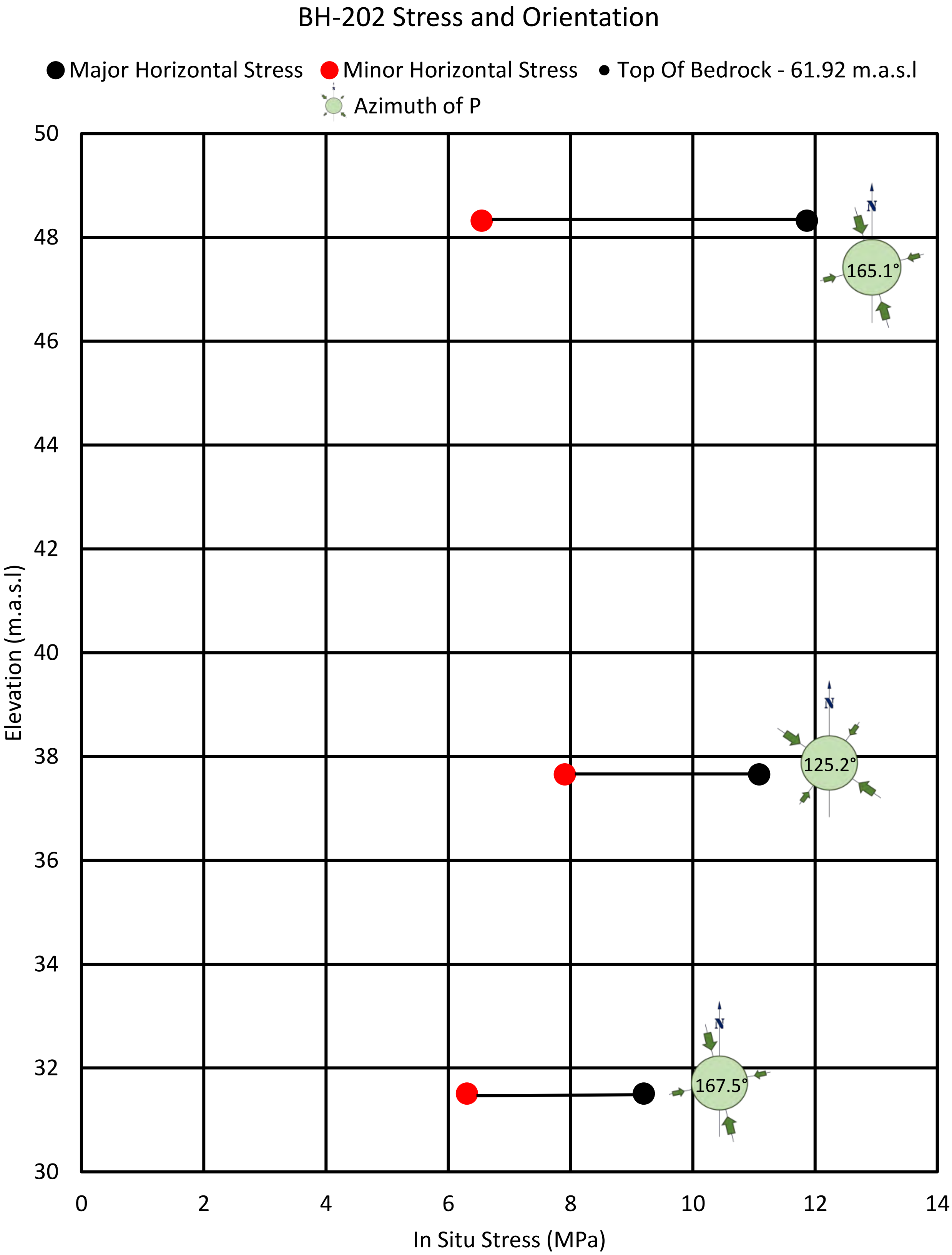


Figure G-6: Maximum (P) and minimum horizontal stresses (Q) for the interpretable tests

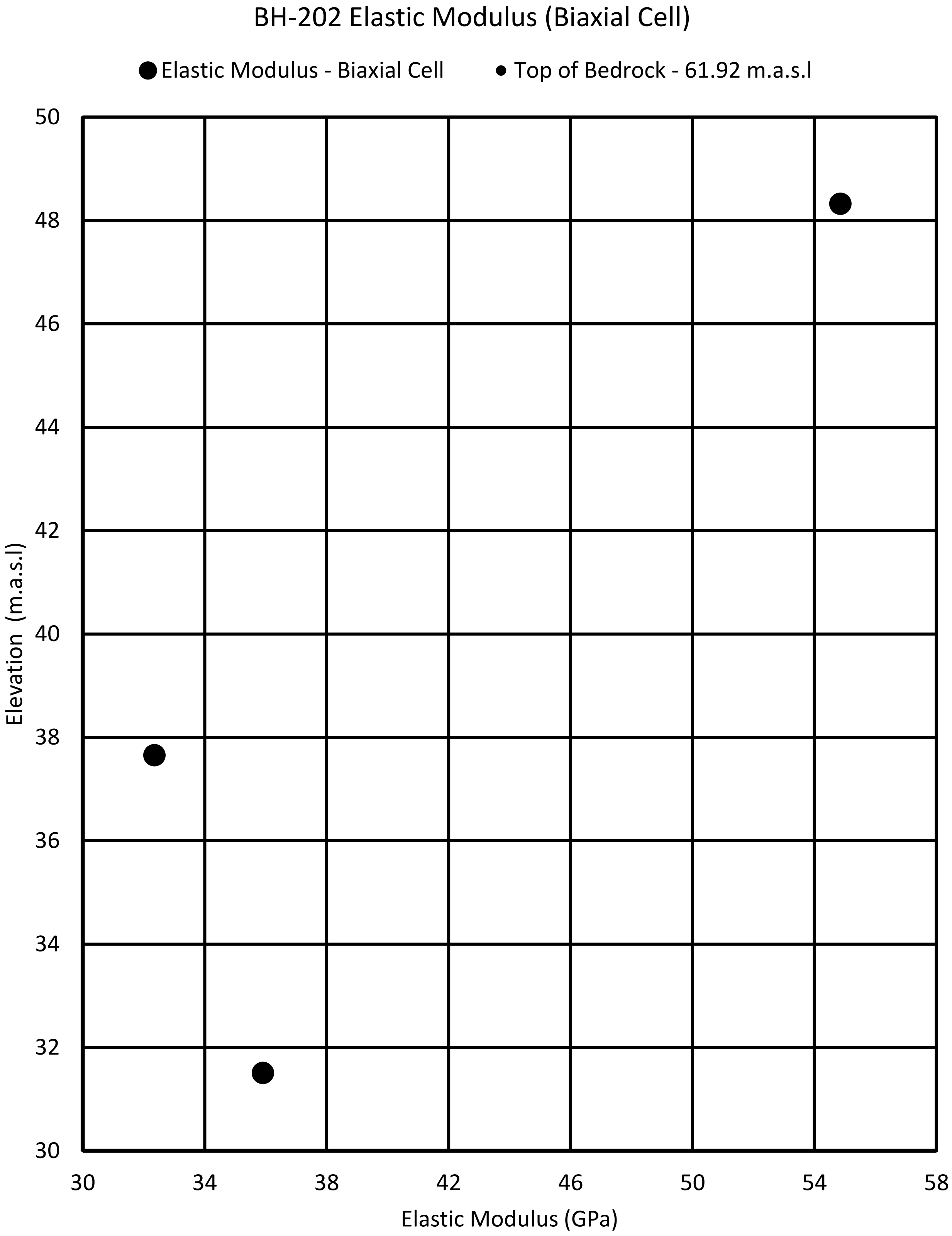


Figure G-7: Horizontal elastic modulus (*E*) of the rock measured from the biaxial tests

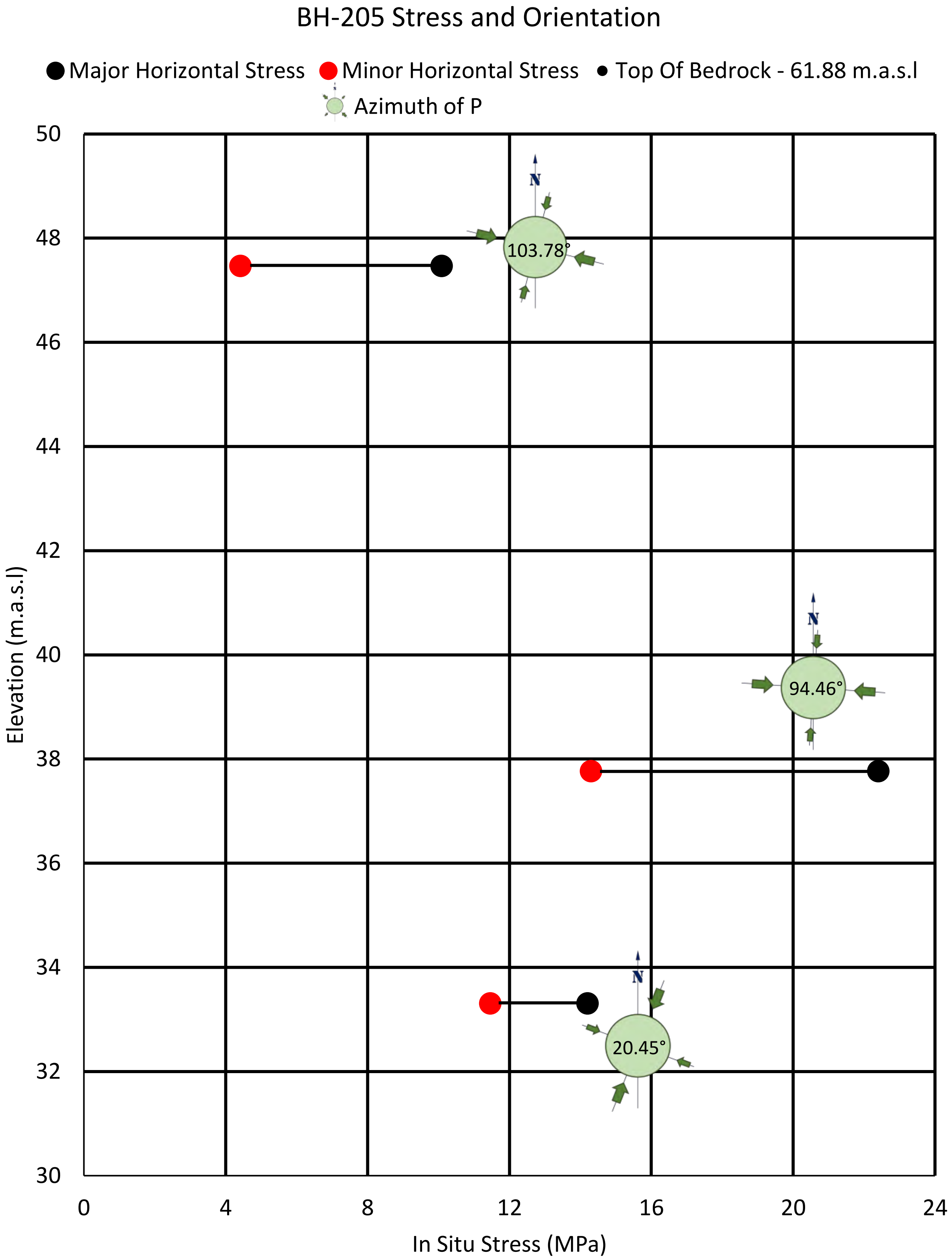


Figure G8: Maximum (P) and minimum horizontal stresses (Q) for the interpretable tests

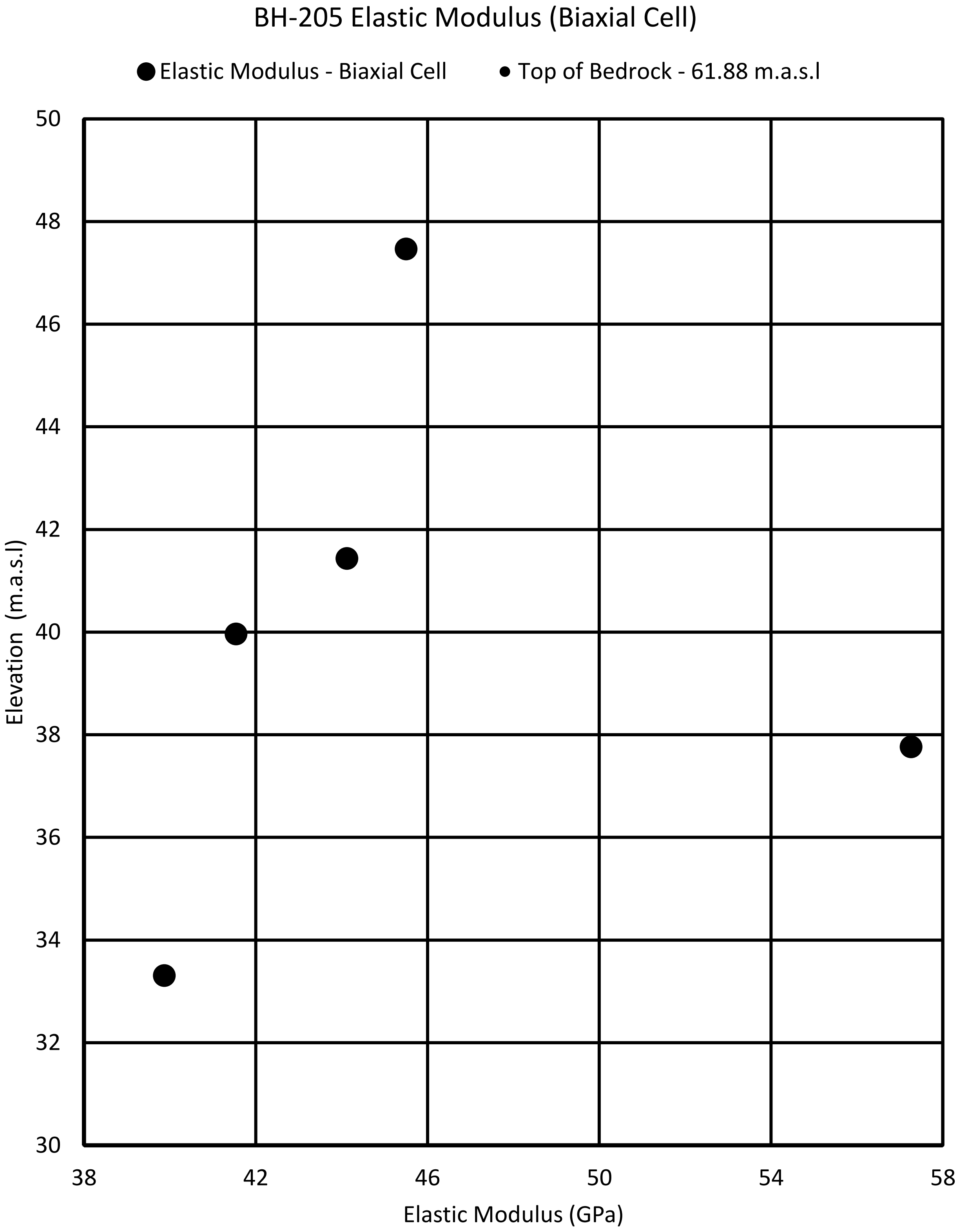


Figure G-9: Horizontal elastic modulus (*E*) of the rock measured from the biaxial tests

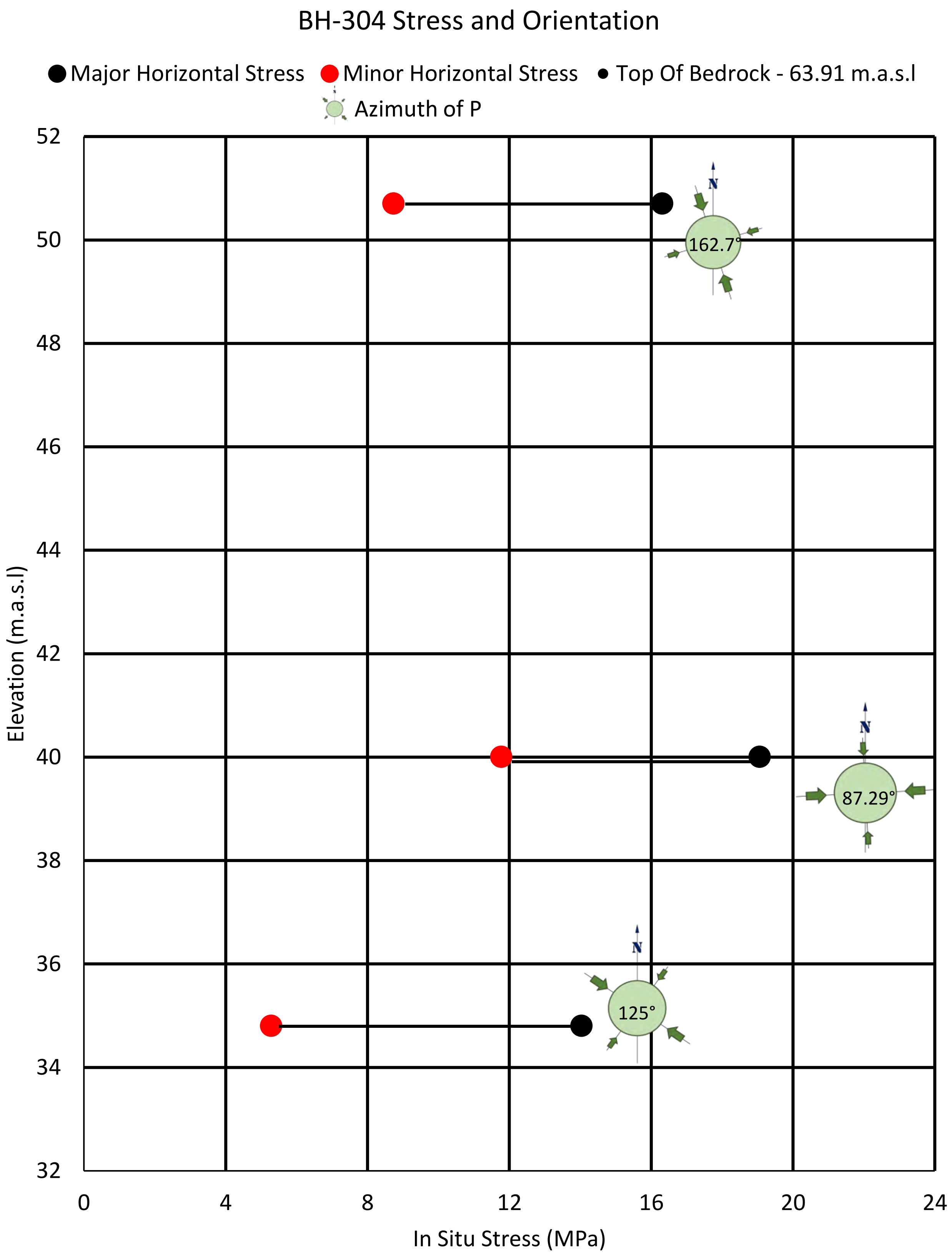


Figure G-10: Maximum (P) and minimum horizontal stresses (Q) for the interpretable tests

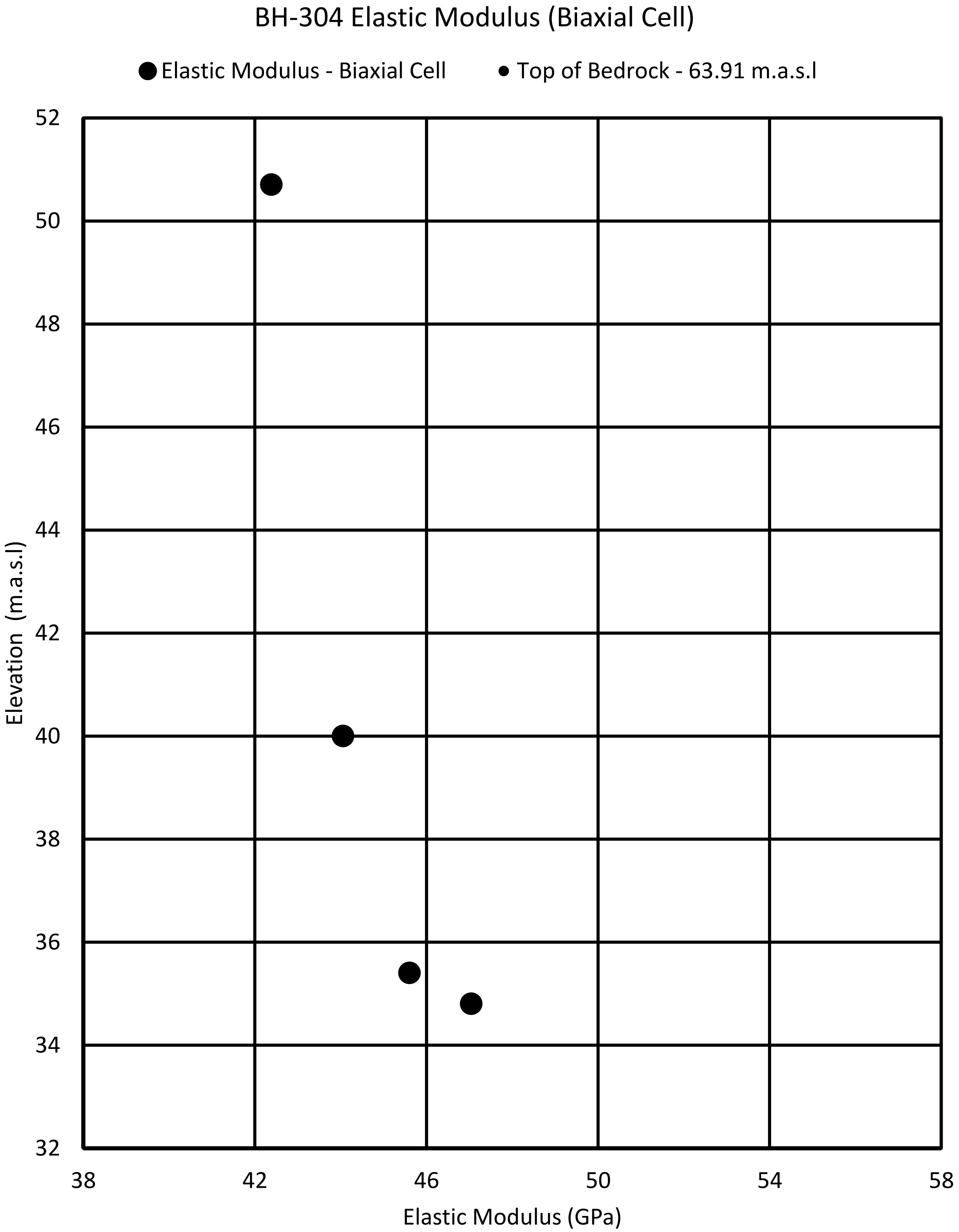


Figure G-11: Horizontal elastic modulus (*E*) of the rock measured from the biaxial tests

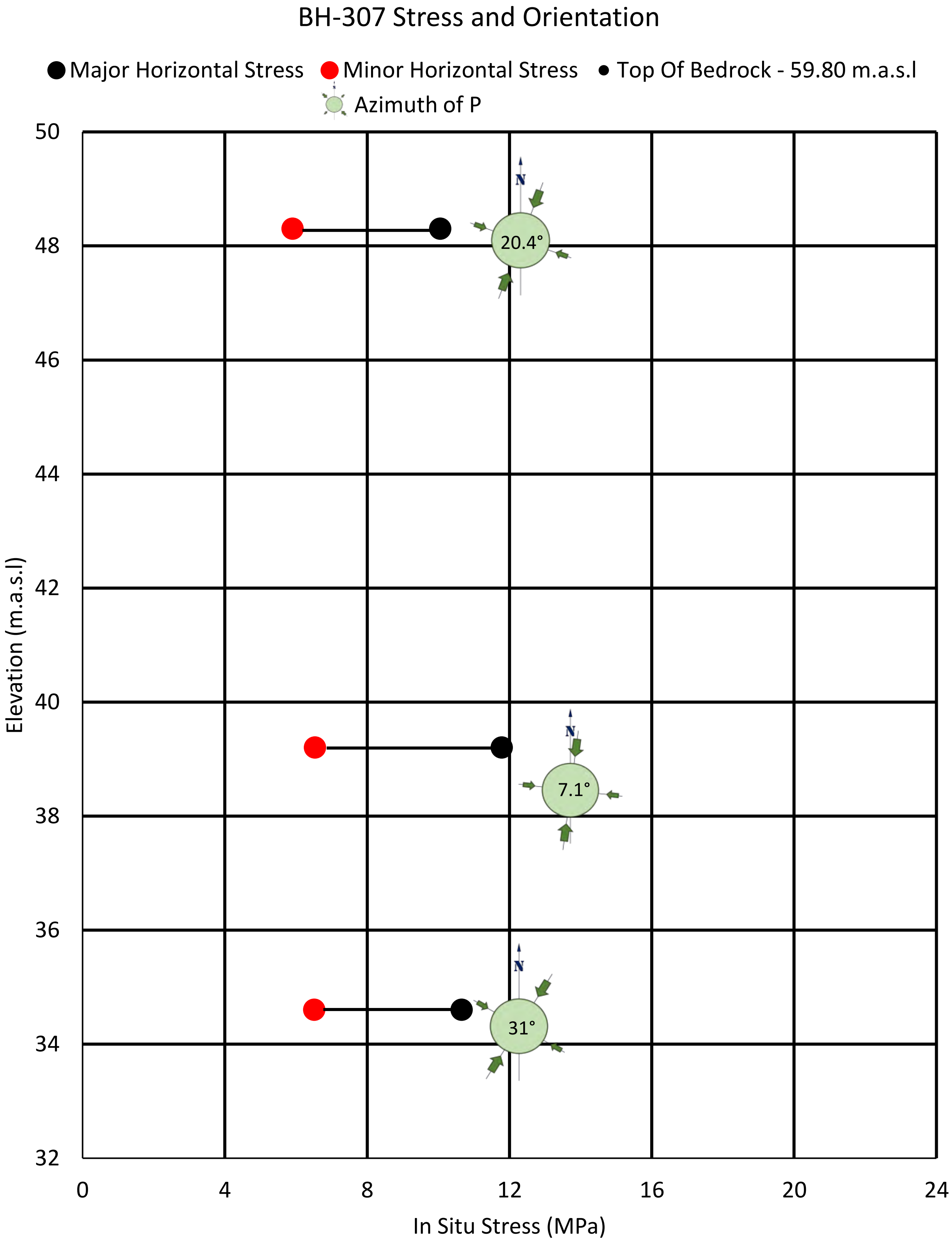


Figure G-12: Maximum (P) and minimum horizontal stresses (Q) for the interpretable tests

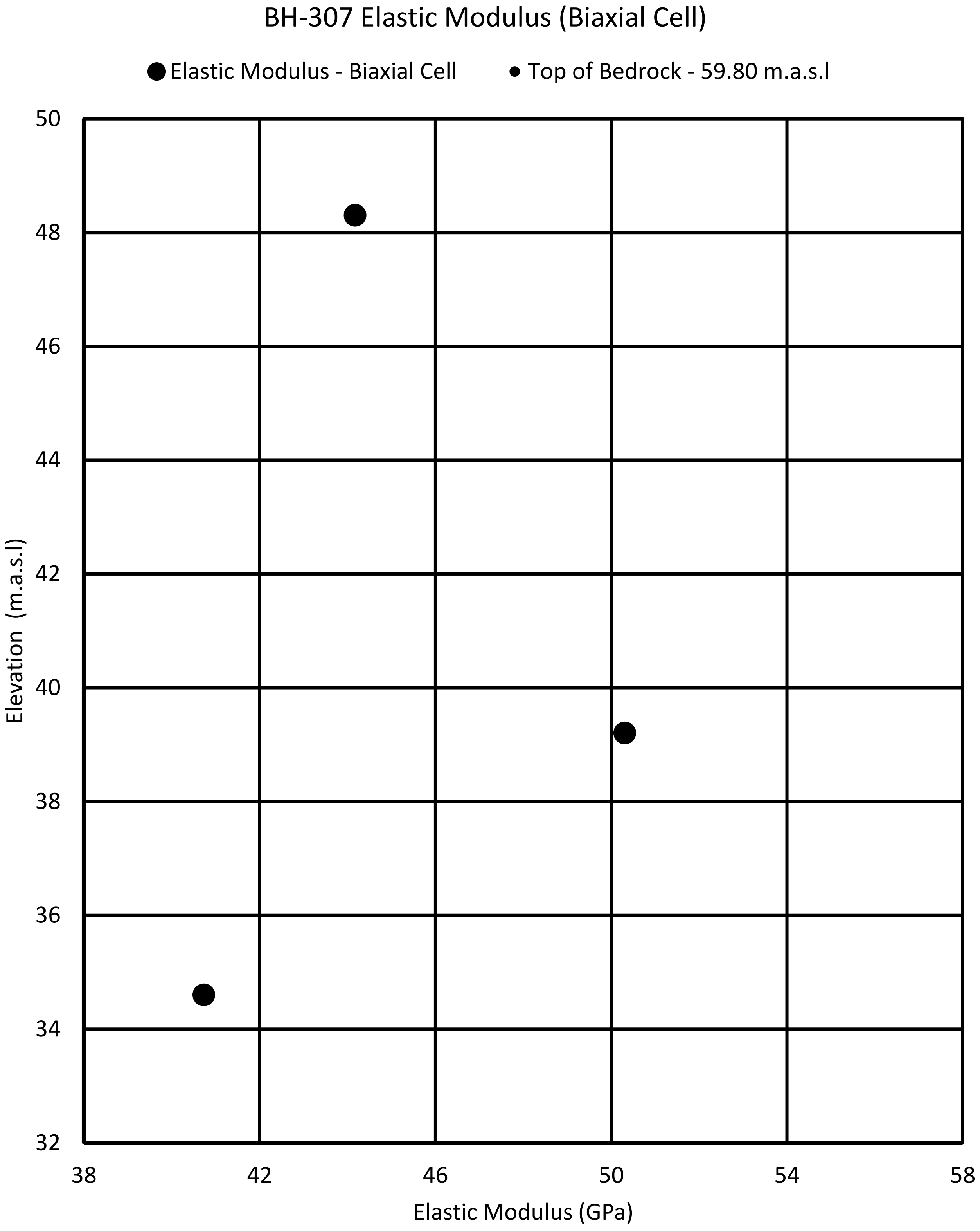


Figure G-13: Horizontal elastic modulus (*E*) of the rock measured from the biaxial tests

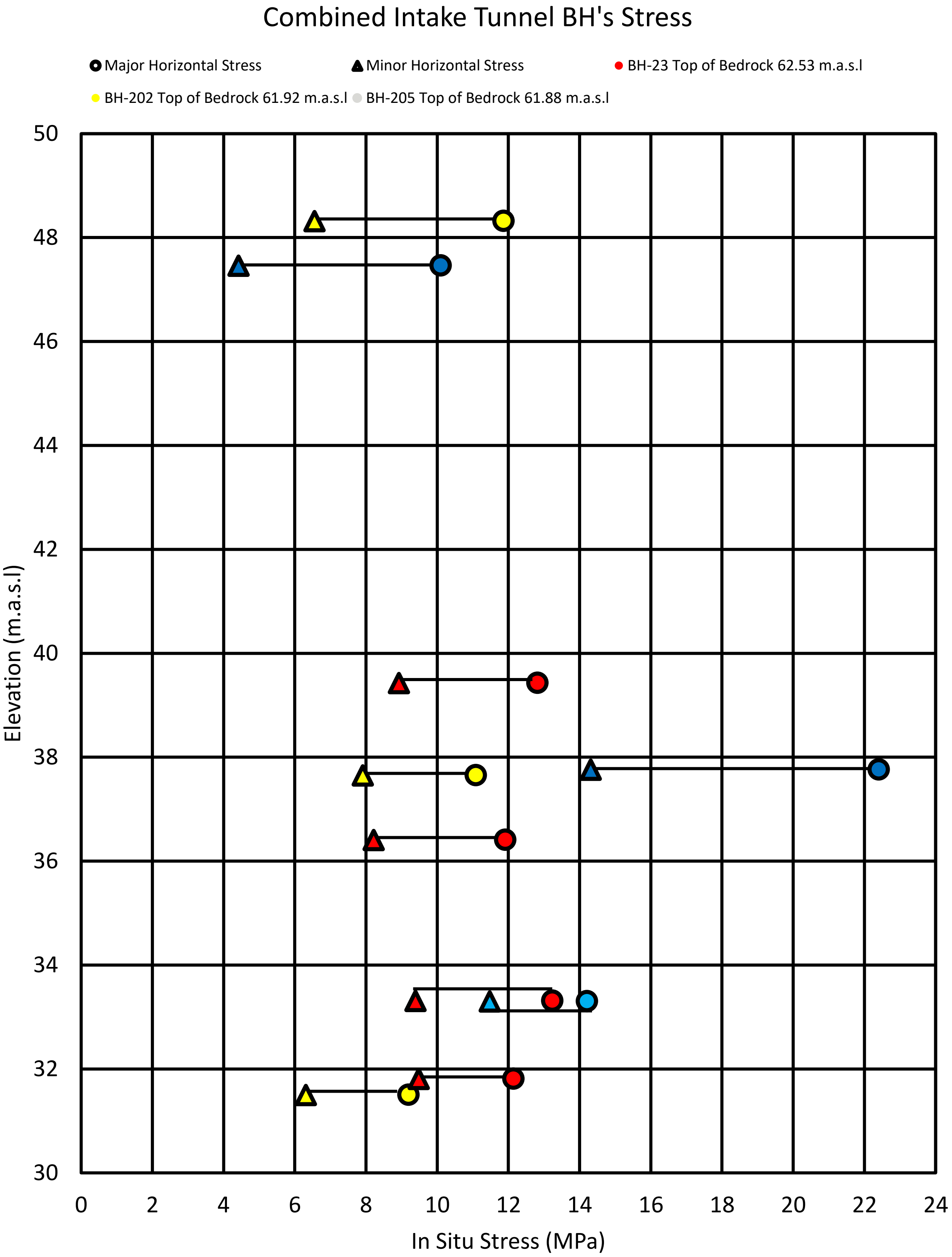


Figure G-14: Combined Maximum (P) and minimum horizontal stresses (Q) for the interpretable tests

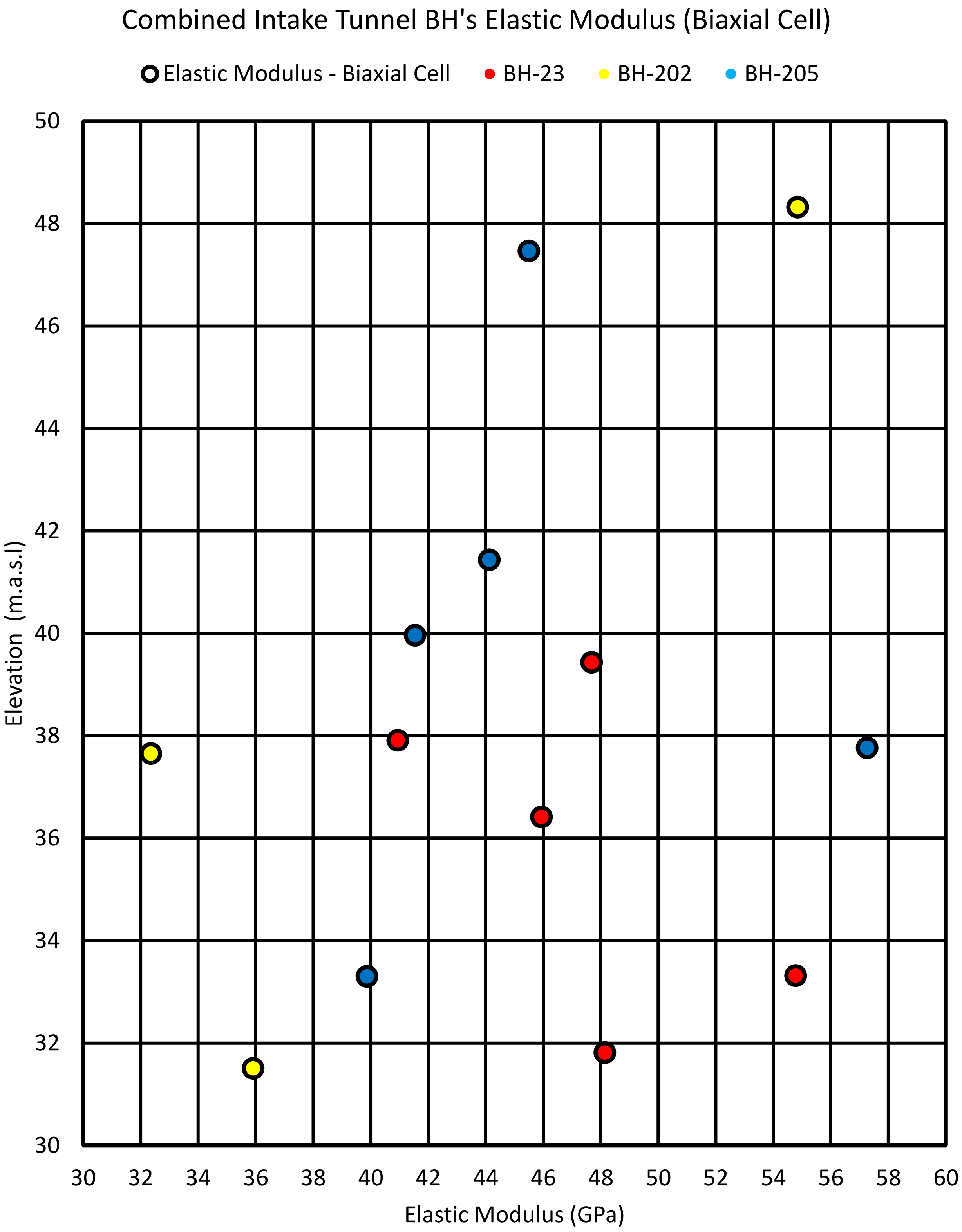


Figure G-15: Combined Horizontal elastic modulus (*E*) of the rock measured from the biaxial tests

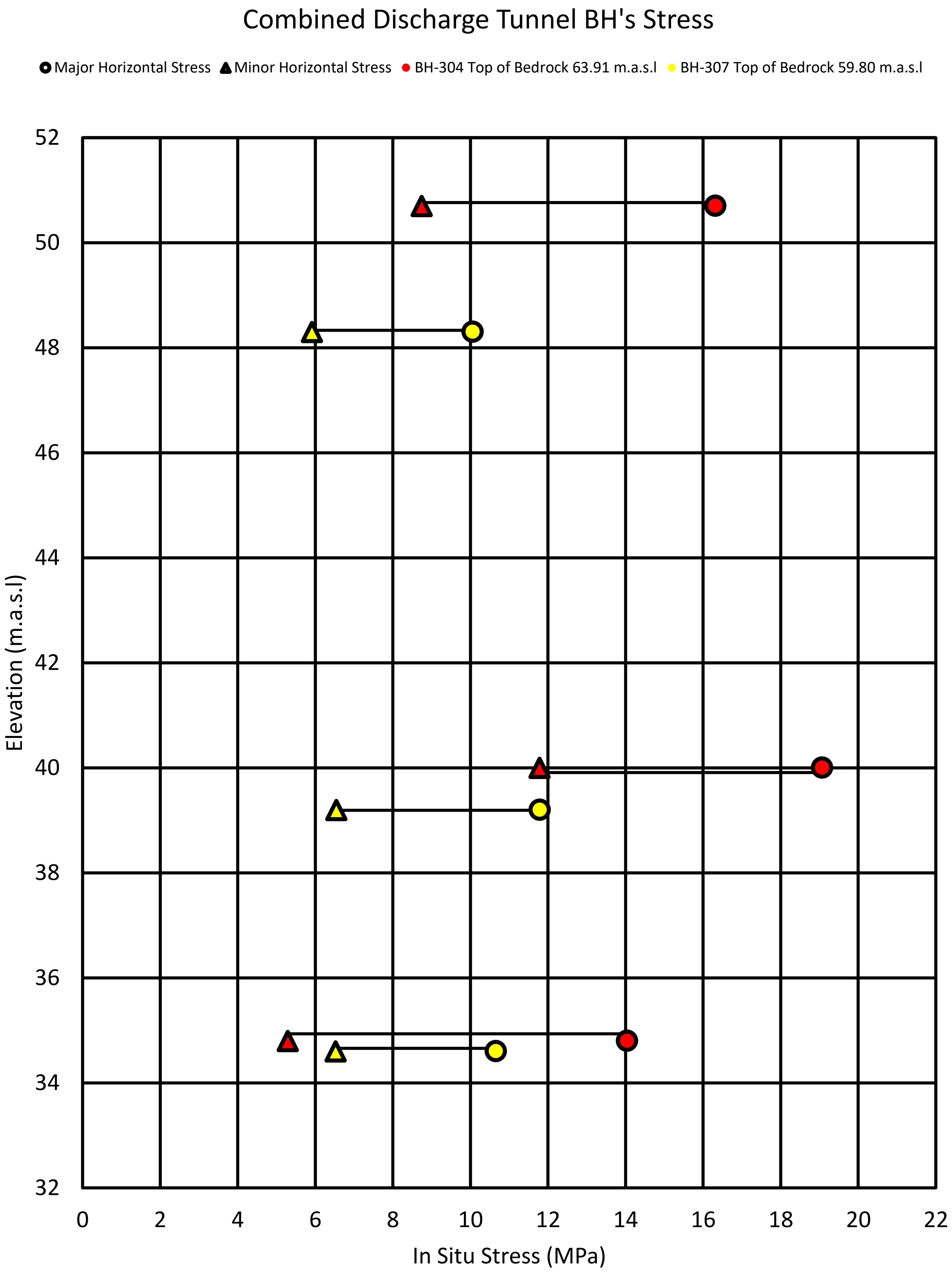


Figure G-16: Combined Maximum (P) and minimum horizontal stresses (Q) for the interpretable tests

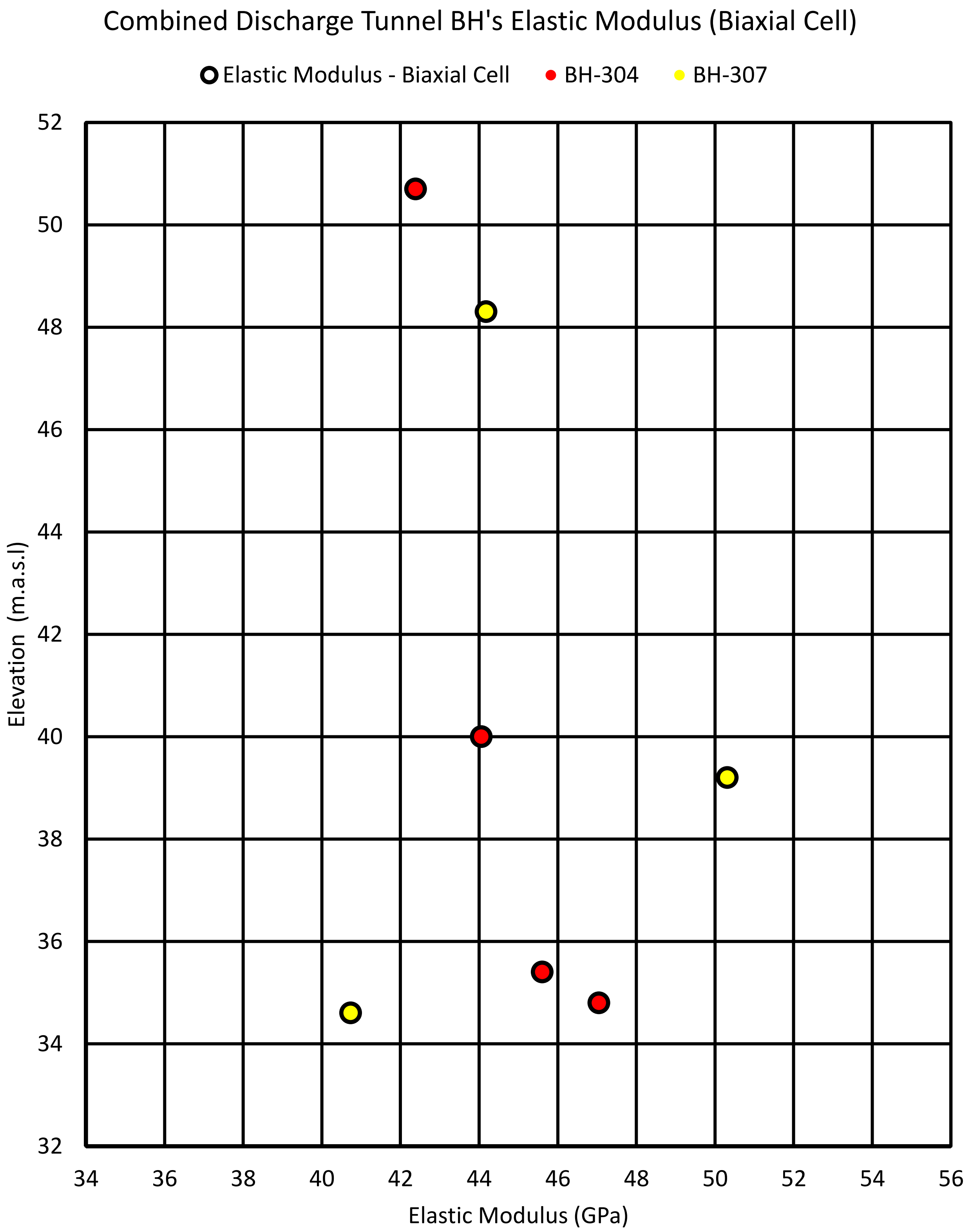


Figure G-17: Combined Horizontal elastic modulus (*E*) of the rock measured from the biaxial tests

REFERENCES

ASTM. 2008. D4623-08 Standard Test Method for Determination of In Situ Stress in Rock Mass by Overcoring Method - USBM Borehole Deformation Gauge. ASTM International.

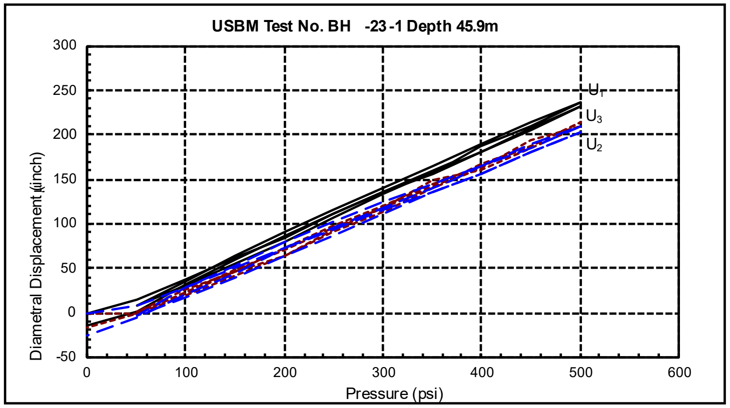
Brown, E.T. (ed.) 1981. Suggested Methods for Rock Characterization Testing and Monitoring, International Society for Rock Mechanics. Oxford : Pergamon.

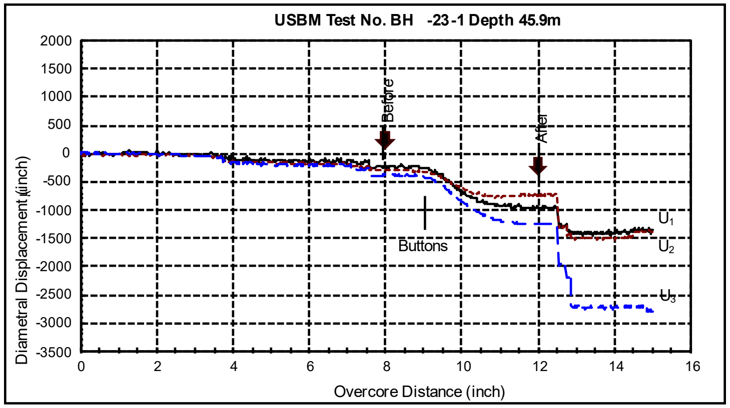
Obert, L., and Duvall, W.I. 1967. Rock Mechanics and the Design of Structures in Rocks. New York, NY: Wiley.

Lo, K.Y., Lukajic, B., 1984. Predicted and Measured Stresses and Displacements Around the Darlington Intake Tunnel. Can. Geotech. J. 21, 147-165.

APPENDIX A

Appendix A: Overcoring and Biaxial Test Data Intrepretation and Core Photographs





Biaxial Test No.	BH-23-1		Upper P	501
Hole:			Lower P	51
Biaxial Reduction			Radius	Measured
			(inches)	Diam (in)
E Hole Diameter (mm)	38.00		0.748	1.496
HQ Hole Diameter (mm)	87.30		1.719	3.437
	Pressure	Displacement	Modulus	Modulus
	(psi)	(minch)	(psi)	(GPa)
U_1	450	235.52	6.42E+06	44.26
U_2	450	213.532	7.08E+06	48.81
U_3	450	208.464	7.25E+06	50.00
Average Modulus			6.92E+06	47.69

Darlington New Nuclear Project				
Hole:	BH-23			
USBM Reduction	Test:	BH-23-1		
				inches
Modulus (GPa)	47.69	Before USBM Gauge		7.89
Poissons ratio	0.30	After USBM Gauge		12
Borehole diameter (mm)	38.00	1.496063		
Displacement 1 (minch)	737			
Displacement 2 (minch)	448			
Displacement 3 (minch)	861			
P (MPa)	12.82			
Q (MPa)	8.92			
θ (deg)	141.53			
Angle U_1 from 0 (clockwise = +ve)	94.00			
Corrected θ (deg)	55.53			

Figure A1: USBM Results for Test #1 BH-23-1 (45.88m)

Figure A2: Photograph of retrieved core for Test #1 BH-23-1 (45.88m)

Biaxial Test No.	BH-23-2		Upper P	501
Hole:			Lower P	51
Biaxial Reduction			Radius	Measured
			(inches)	Diam (in)
E Hole Diameter (mm)	38.00		0.748	1.496
HQ Hole Diameter (mm)	87.30		1.719	3.437
	Pressure	Displacement	Modulus	Modulus
	(psi)	(minch)	(psi)	(GPa)
U_1	450	249.856	6.05E+06	41.72
U_2	450	259.072	5.84E+06	40.23
U_3	450	254.904	5.93E+06	40.89
Average Modulus			5.94E+06	40.95

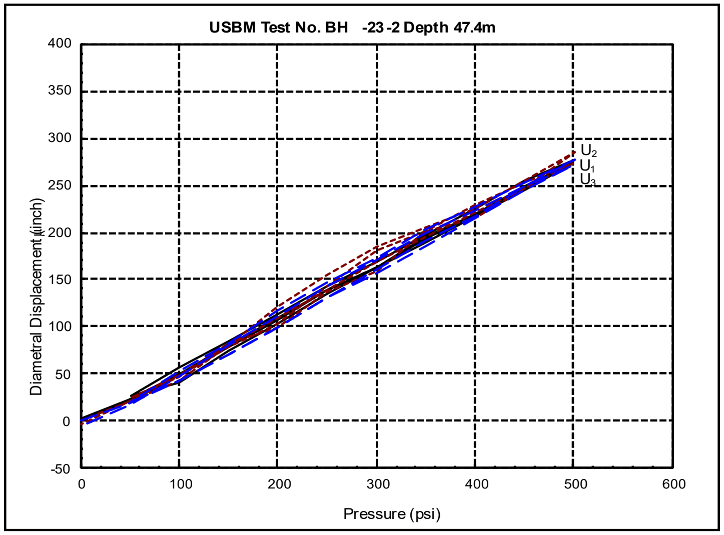
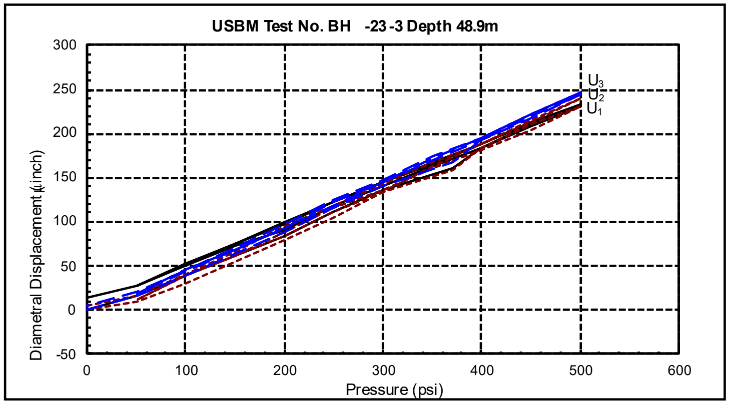
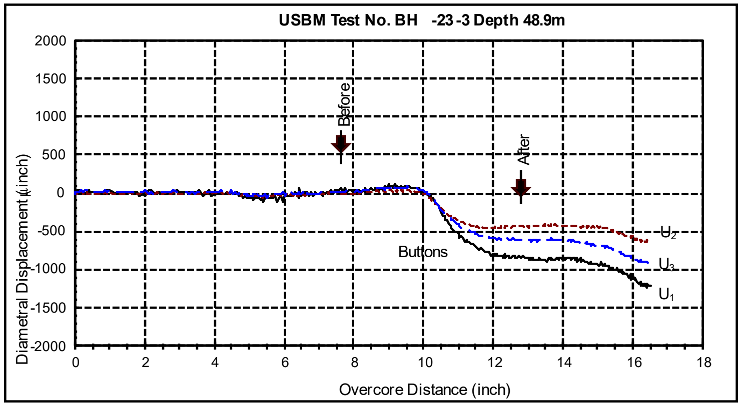


Figure A3: Biaxial Results for Test #2 BH-23-2 (47.40m)

Figure A4: Photograph of retrieved core for Test #2 BH-23-2 (47.40m)



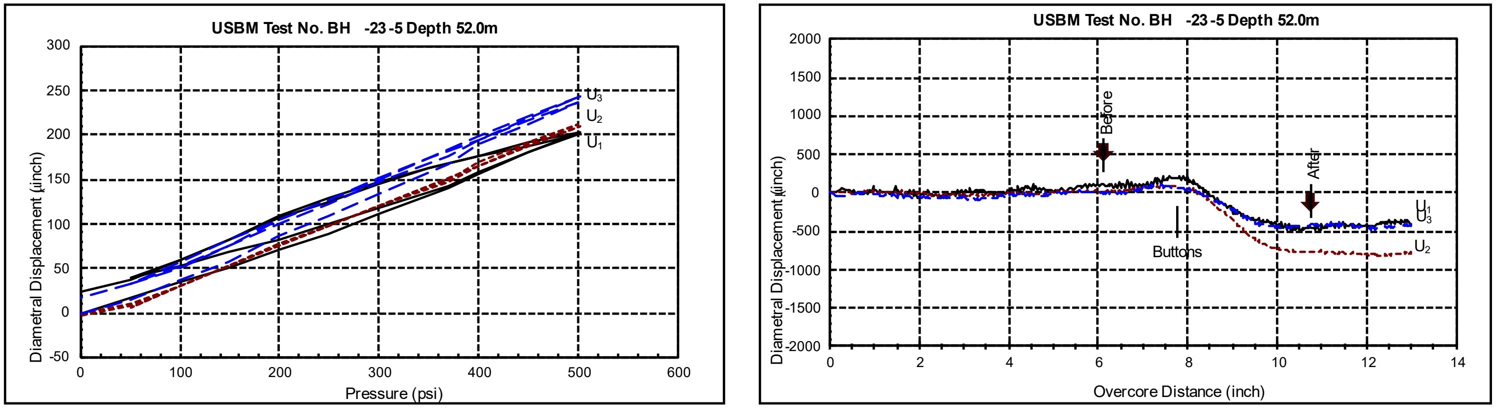


Biaxial Test No.	BH-23-3		Upper P	501
Hole:			Lower P	51
Biaxial Reduction			Radius	Measured
			(inches)	Diam (in)
E Hole Diameter (mm)	38.00		0.748	1.496
HQ Hole Diameter (mm)	87.30		1.719	3.437
	Pressure	Displacement	Modulus	Modulus
	(psi)	(minch)	(psi)	(GPa)
U_1	450	218.112	6.93E+06	47.79
U_2	450	230.736	6.55E+06	45.17
U_3	450	232.2	6.51E+06	44.89
Average Modulus			6.66E+06	45.95

Darlington New Nuclear Project				
Hole:	BH-23			
USBM Reduction	Test:	BH-23-3		
				inches
Modulus (GPa)	45.95	Before USBM Gauge		7.8
Poissons ratio	0.30	After USBM Gauge		12.9
Borehole diameter (mm)	38.00	1.496063		
Displacement 1 (minch)	860			
Displacement 2 (minch)	444			
Displacement 3 (minch)	659			
P (MPa)	11.90			
Q (MPa)	8.21			
θ (deg)	164.42			
Angle U_1 from 0 (clockwise = +ve)	94.00			
Corrected θ (deg)	78.42			

Figure A5: USBM Results for Test #3 BH-23-3 (48.90m)

Figure A6: Photograph of retrieved core for Test #3 BH-23-3 (48.90m)

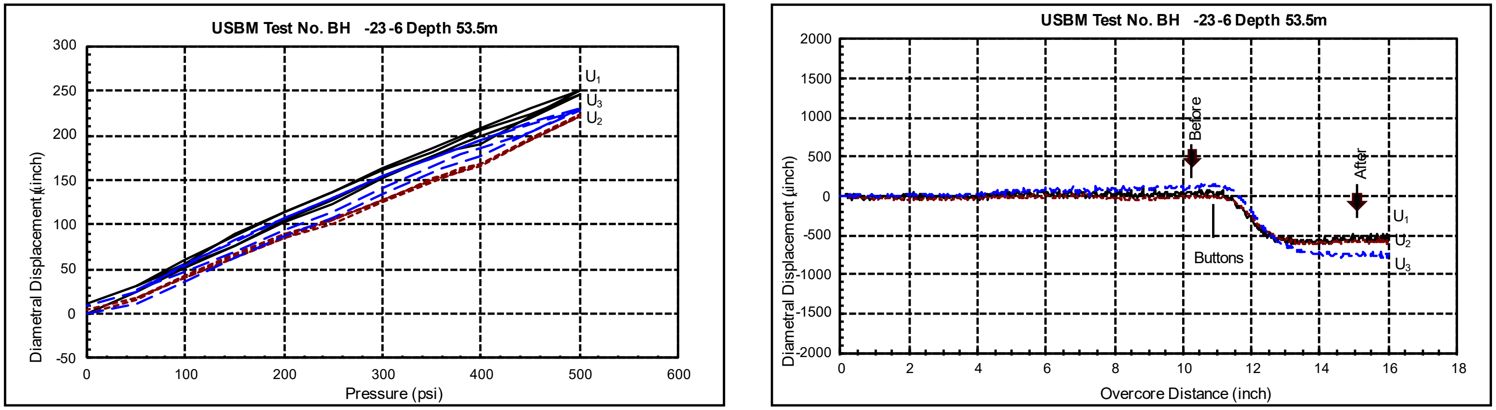


Biaxial Test No.	BH-23-5		Upper P	501
Hole:			Lower P	51
Biaxial Reduction			Radius	Measured
			(inches)	Diam (in)
E Hole Diameter (mm)	38.00		0.748	1.496
HQ Hole Diameter (mm)	87.30		1.719	3.437
	Pressure	Displacement	Modulus	Modulus
	(psi)	(minch)	(psi)	(GPa)
U_1	450	163.84	9.23E+06	63.62
U_2	450	204.424	7.39E+06	50.99
U_3	450	209.496	7.22E+06	49.75
Average Modulus			7.95E+06	54.79

Darlington New Nuclear Project				
Hole:	BH-23			
USBM Reduction	Test:	BH-23-5		
				inches
Modulus (GPa)	54.79	Before USBM Gauge		6.3
Poissons ratio	0.30	After USBM Gauge		10.63
Borehole diameter (mm)	38.00	1.496063		
Displacement 1 (minch)	608			
Displacement 2 (minch)	805			
Displacement 3 (minch)	441			
P (MPa)	13.24			
Q (MPa)	9.39			
θ (deg)	46.30			
Angle U_1 from 0 (clockwise = +ve)	15.00			
Corrected θ (deg)	61.30			

Figure A7: USBM Results for Test #5 BH-23-5 (52.00m)

Figure A8: Photograph of retrieved core for Test #5 BH-23-5 (52.00m)

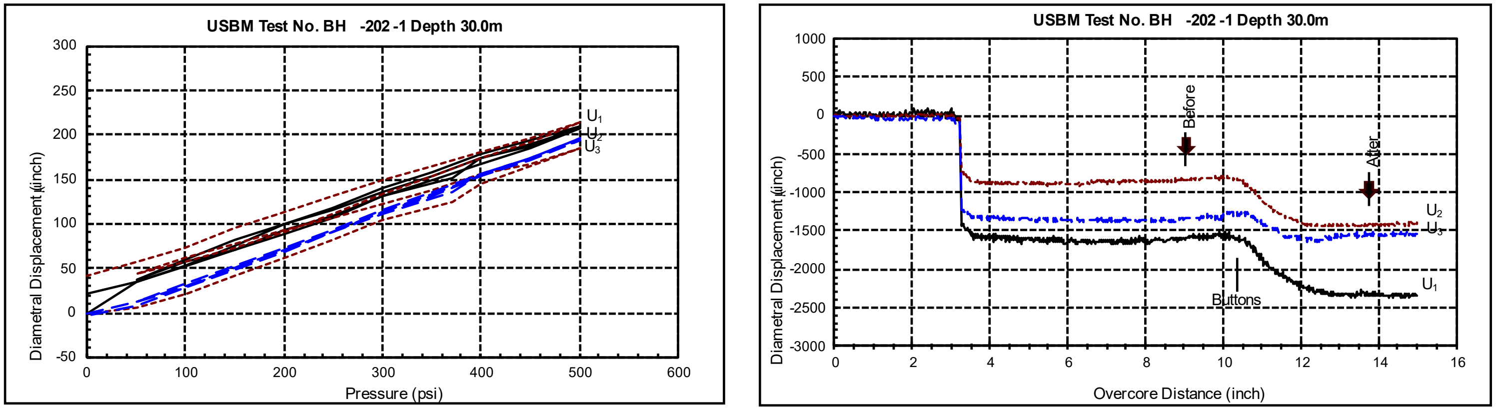


Biaxial Test No.	BH-23-6		Upper P	501
Hole:			Lower P	51
Biaxial Reduction			Radius (inches)	Measured Diam (in)
E Hole Diameter (mm)	38.00		0.748	1.496
HQ Hole Diameter (mm)	87.30		1.719	3.437
	Pressure (psi)	Displacement (minch)	Modulus (psi)	Modulus (GPa)
U_1	450	225.28	6.71E+06	46.27
U_2	450	204.424	7.39E+06	50.99
U_3	450	220.848	6.84E+06	47.20
Average Modulus			6.98E+06	48.15

Darlington New Nuclear Project				
Hole:	BH-23			
USBM Reduction	Test:	BH-23-6		
				inches
Modulus (GPa)	48.15	Before USBM Gauge		10.16
Poissons ratio	0.30	After USBM Gauge		14.63
Borehole diameter (mm)	38.00	1.496063		
Displacement 1 (minch)	597			
Displacement 2 (minch)	581			
Displacement 3 (minch)	838			
P (MPa)	12.15			
Q (MPa)	9.48			
θ (deg)	121.60			
Angle U_1 from 0 (clockwise = +ve)	94.00			
Corrected θ (deg)	35.60			

Figure A9: USBM Results for Test #6 BH-23-6 (53.50m)

Figure A10: Photograph of retrieved core for Test #6 BH-23-6 (53.50m)

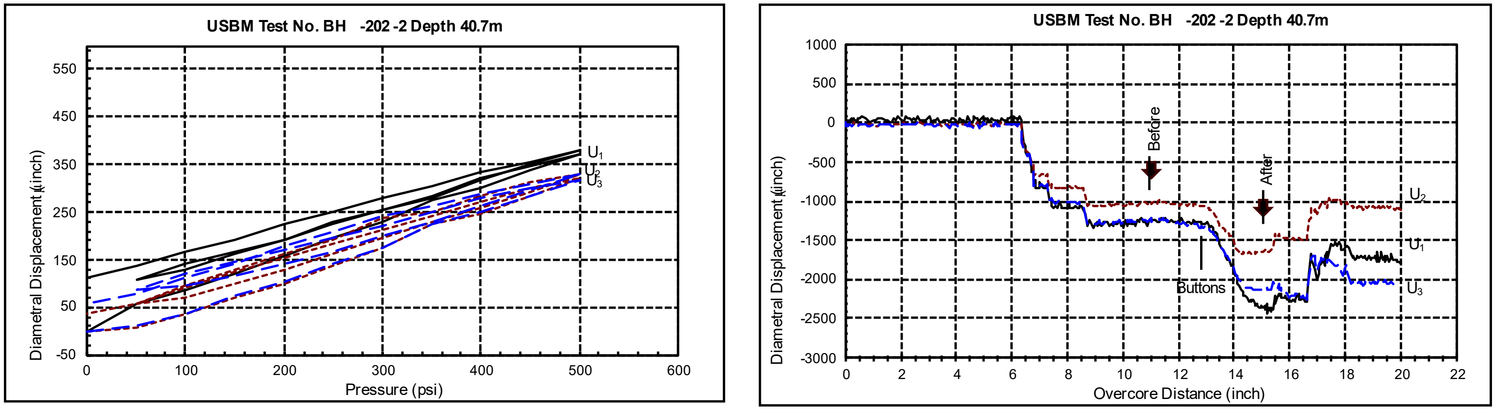


Biaxial Test No.	BH-202-1		Upper P	501
Hole:			Lower P	101
Biaxial Reduction			Radius	Measured
			(inches)	Diam (in)
E Hole Diameter (mm)	38.00		0.748	1.496
HQ Hole Diameter (mm)	87.30		1.719	3.437
	Pressure	Displacement	Modulus	Modulus
	(psi)	(minch)	(psi)	(GPa)
U_1	400	154.624	8.69E+06	59.92
U_2	400	192.28	6.99E+06	48.19
U_3	400	164.088	8.19E+06	56.46
Average Modulus			7.96E+06	54.86

Darlington New Nuclear Project				
Hole:	BH-202			
USBM Reduction	Test:	BH-202-1		
				inches
Modulus (GPa)	54.86	Before USBM Gauge		9.025
Poissons ratio	0.30	After USBM Gauge		13.72
Borehole diameter (mm)	38.00	1.496063		
Displacement 1 (minch)	703			
Displacement 2 (minch)	583			
Displacement 3 (minch)	221			
P (MPa)	11.87			
Q (MPa)	6.55			
θ (deg)	23.06			
Angle U_1 from 0 (clockwise = +ve)	322.00			
Corrected θ (deg)	165.06			

Figure A11: USBM Results for Test #1 BH-202-1 (29.98m)

Figure A12: Photograph of retrieved core for Test #1 BH-202-1 (29.98m)

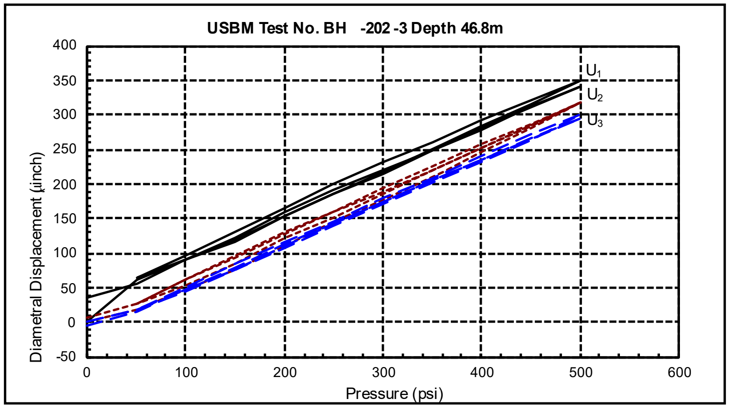


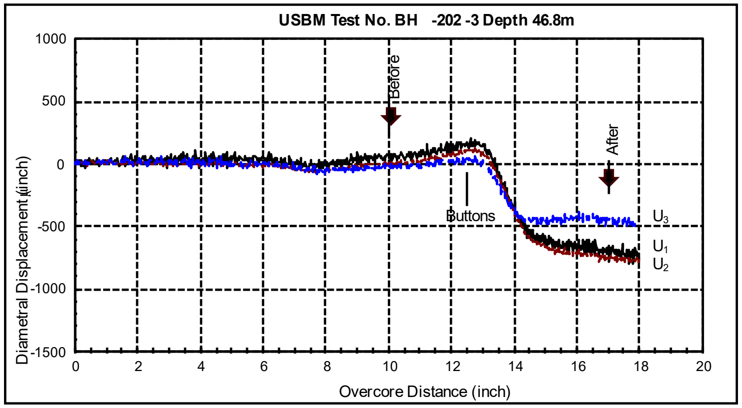
Biaxial Test No.	BH -202 -2		Upper P	501
Hole:			Lower P	51
Biaxial Reduction			Radius	Measured
			(inches)	Diam (in)
E Hole Diameter (mm)	38.00		0.748	1.496
HQ Hole Diameter (mm)	87.30		1.719	3.437
	Pressure	Displacement	Modulus	Modulus
	(psi)	(minch)	(psi)	(GPa)
U1	450	321.536	4.70E+06	32.42
U2	450	323.84	4.67E+06	32.19
U3	450	320.952	4.71E+06	32.48
Average Modulus			4.69E+06	32.36

Darlington New Nuclear Project				
Hole:	BH -202			
USBM Reduction	Test:	BH -202 -2		
				inches
Modulus (GPa)	32.36	Before USBM Gauge		11.04
Poissons ratio	0.30	After USBM Gauge		15.13
Borehole diameter (mm)	38.00	1.496063		
Displacement 1 (minch)	1123			
Displacement 2 (minch)	615			
Displacement 3 (minch)	898			
P (MPa)	11.09			
Q (MPa)	7.91			
θ (deg)	163.15			
Angle U_1 from 0 (clockwise = +ve)	322.00			
Corrected θ (deg)	125.15			

Figure A13: USBM Results for Test #2 BH-202-2 (40.65m)

Figure A14: Photograph of retrieved core for Test #2 BH-202-2 (40.65m)



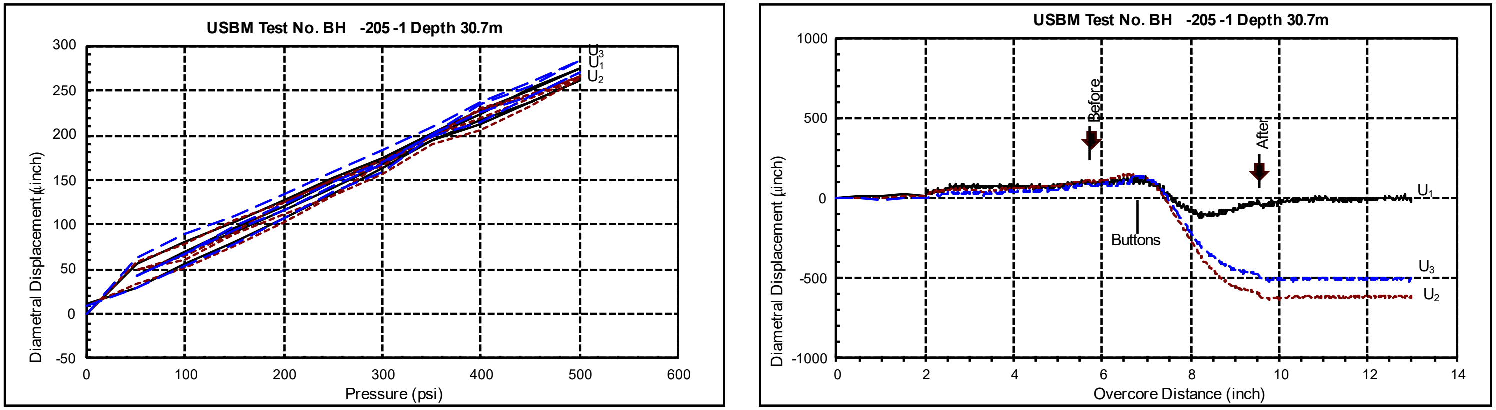


Biaxial Test No.	BH-202-3		Upper P	501
Hole:			Lower P	51
Biaxial Reduction			Radius (inches)	Measured Diam (in)
E Hole Diameter (mm)	38.00		0.748	1.496
HQ Hole Diameter (mm)	87.30		1.719	3.437
	Pressure (psi)	Displacement (minch)	Modulus (psi)	Modulus (GPa)
U_1	450	289.792	5.22E+06	35.97
U_2	450	299.552	5.05E+06	34.80
U_3	450	281.736	5.37E+06	37.00
Average Modulus			5.21E+06	35.92

Darlington New Nuclear Project				
Hole:	BH-202			
USBM Reduction	Test:	BH-202-3		
				inches
Modulus (GPa)	35.92	Before USBM Gauge		10
Poissons ratio	0.30	After USBM Gauge		17
Borehole diameter (mm)	38.00	1.496063		
Displacement 1 (minch)	798			
Displacement 2 (minch)	733			
Displacement 3 (minch)	409			
P (MPa)	9.20			
Q (MPa)	6.31			
θ (deg)	25.51			
Angle U_1 from 0 (clockwise = +ve)	322.00			
Corrected θ (deg)	167.51			

Figure A15: USBM Results for Test #3 BH-202-3 (46.80m)

Figure A16: Photograph of retrieved core for Test #3 BH-202-3 (46.80m)



Biaxial Test No.	BH-205-1		Upper P	501
Hole:			Lower P	51
Biaxial Reduction			Radius (inches)	Measured Diam (in)
E Hole Diameter (mm)	38.00		0.748	1.496
HQ Hole Diameter (mm)	87.30		1.719	3.437
	Pressure (psi)	Displacement (minch)	Modulus (psi)	Modulus (GPa)
U_1	450	231.424	6.53E+06	45.04
U_2	450	216.568	6.98E+06	48.13
U_3	450	240.456	6.29E+06	43.35
Average Modulus			6.60E+06	45.51

Darlington New Nuclear Project				
Hole:	BH-205			
USBM Reduction	Test:	BH-205-1		
				inches
Modulus (GPa)	45.51	Before USBM Gauge		5.85
Poissons ratio	0.30	After USBM Gauge		9.75
Borehole diameter (mm)	38.00	1.496063		
Displacement 1 (minch)	113			
Displacement 2 (minch)	730			
Displacement 3 (minch)	590			
P (MPa)	10.10			
Q (MPa)	4.42			
θ (deg)	83.78			
Angle U_1 from 0 (clockwise = +ve)	20.00			
Corrected θ (deg)	103.78			

Figure A17: USBM Results for Test #1 BH-205-1 (30.70m)

Figure A18: Photograph of retrieved core for Test #1 BH-205-1 (30.70m)

Biaxial Test No.	BH-205-2		Upper P	501
Hole:			Lower P	51
Biaxial Reduction			Radius (inches)	Measured Diam (in)
E Hole Diameter (mm)	38.00		0.748	1.496
HQ Hole Diameter (mm)	87.30		1.719	3.437
	Pressure (psi)	Displacement (minch)	Modulus (psi)	Modulus (GPa)
U_1	450	238.592	6.34E+06	43.69
U_2	450	237.82	6.36E+06	43.83
U_3	450	232.2	6.51E+06	44.89
Average Modulus			6.40E+06	44.13

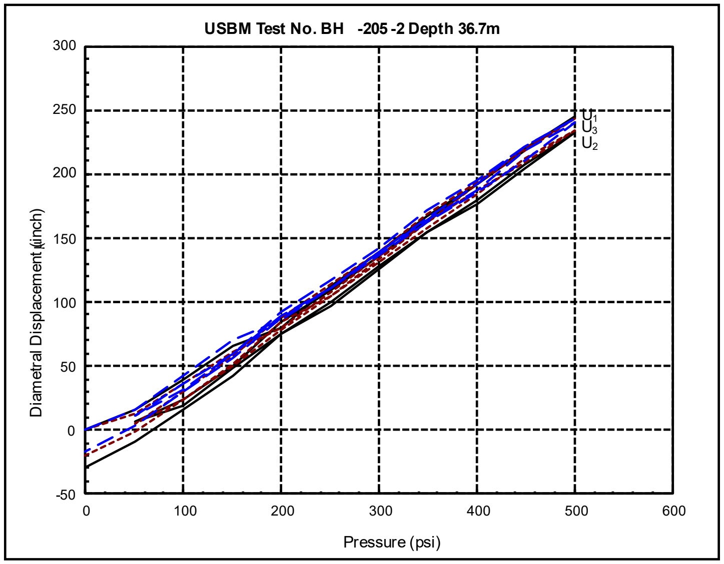


Figure A19: Biaxial Results for Test #2 BH-205-2 (36.73m)

Figure A20: Photograph of retrieved core for Test #2 BH-205-2 (36.73m)

Biaxial Test No.	BH-205-3		Upper P	501
Hole:			Lower P	51
Biaxial Reduction			Radius	Measured
			(inches)	Diam (in)
E Hole Diameter (mm)	38.00		0.748	1.496
HQ Hole Diameter (mm)	87.30		1.719	3.437
	Pressure	Displacement	Modulus	Modulus
	(psi)	(minch)	(psi)	(GPa)
U_1	450	246.784	6.13E+06	42.24
U_2	450	254.012	5.95E+06	41.03
U_3	450	251.808	6.00E+06	41.39
Average Modulus			6.03E+06	41.55

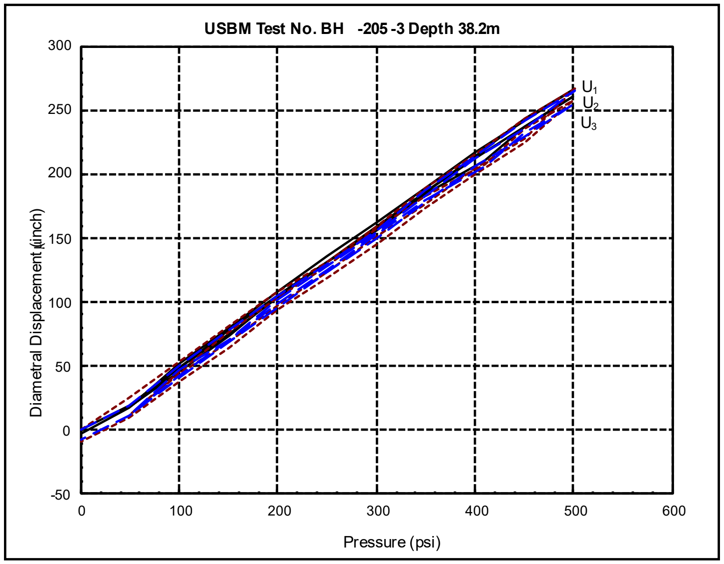
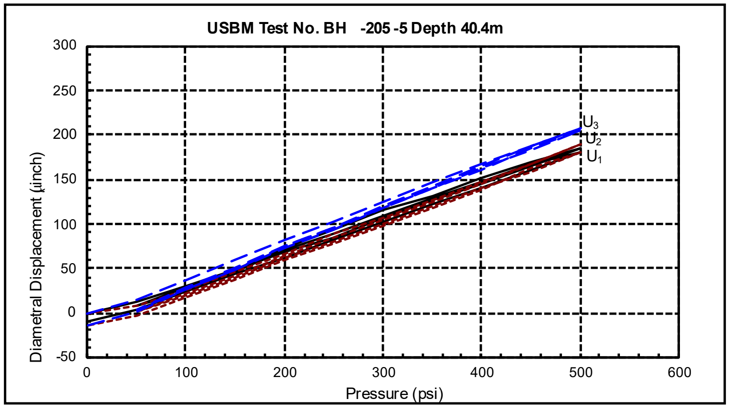
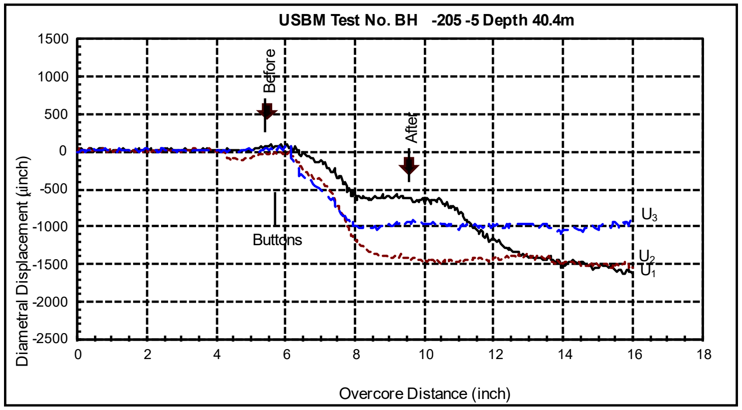


Figure A21: Biaxial Results for Test #3 BH-205-3 (38.20m)

Figure A22: Photograph of retrieved core for Test #3 BH-205-3 (38.20m)



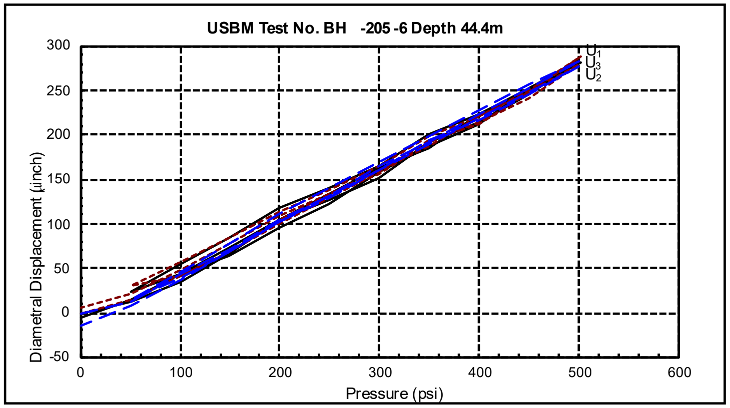


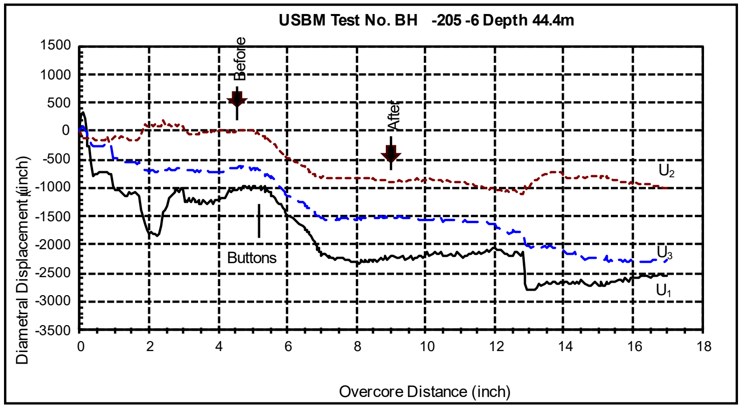
Biaxial Test No.	BH-205-5		Upper P	501
Hole:			Lower P	51
Biaxial Reduction			Radius (inches)	Measured Diam (in)
E Hole Diameter (mm)	38.00		0.748	1.496
HQ Hole Diameter (mm)	87.30		1.719	3.437
	Pressure (psi)	Displacement (minch)	Modulus (psi)	Modulus (GPa)
U_1	450	172.032	8.79E+06	60.59
U_2	450	182.16	8.30E+06	57.22
U_3	450	192.984	7.83E+06	54.01
Average Modulus			8.31E+06	57.27

Darlington New Nuclear Project				
Hole:	BH-205			
USBM Reduction	Test:	BH-205-5		
				inches
Modulus (GPa)	57.27	Before USBM Gauge		4.64
Poissons ratio	0.30	After USBM Gauge		9.4
Borehole diameter (mm)	38.00	1.496063		
Displacement 1 (minch)	597			
Displacement 2 (minch)	1330			
Displacement 3 (minch)	952			
P (MPa)	22.41			
Q (MPa)	14.31			
θ (deg)	74.46			
Angle U_1 from 0 (clockwise = +ve)	20.00			
Corrected θ (deg)	94.46			

Figure A23: USBM Results for Test #5 BH-205-5 (40.40m)

Figure A24: Photograph of retrieved core for Test #5 BH-205-5 (40.40m)



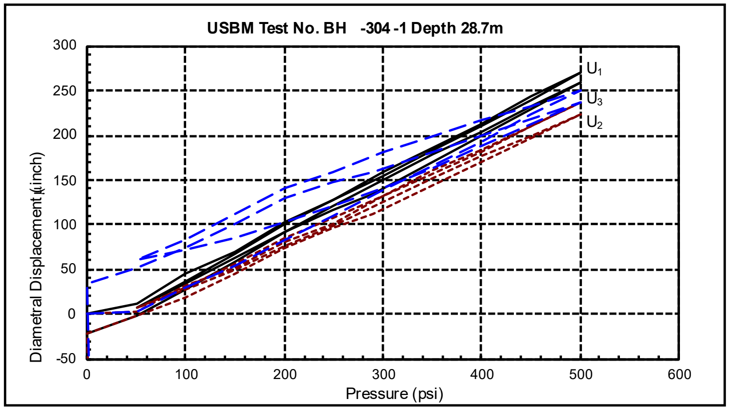


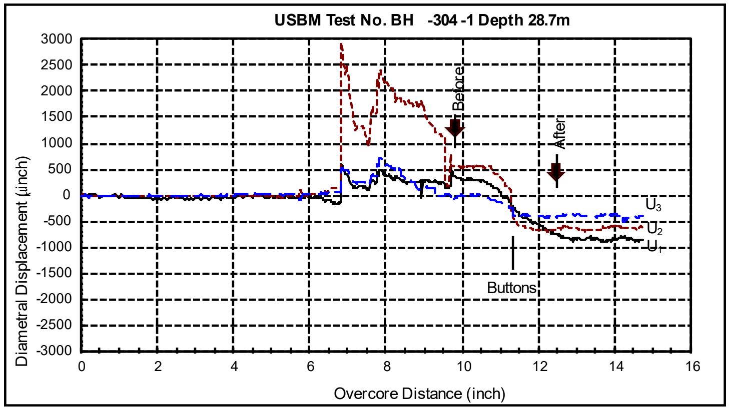
Biaxial Test No.	BH-205-6		Upper P	501
Hole:			Lower P	51
Biaxial Reduction			Radius	Measured
			(inches)	Diam (in)
E Hole Diameter (mm)	38.00		0.748	1.496
HQ Hole Diameter (mm)	87.30		1.719	3.437
	Pressure	Displacement	Modulus	Modulus
	(psi)	(minch)	(psi)	(GPa)
U_1	450	256	5.91E+06	40.72
U_2	450	259.072	5.84E+06	40.23
U_3	450	269.352	5.61E+06	38.70
Average Modulus			5.78E+06	39.88

Darlington New Nuclear Project				
Hole:	BH-205			
USBM Reduction	Test:	BH-205-6		
				inches
Modulus (GPa)	39.88	Before USBM Gauge		4.27
Poissons ratio	0.30	After USBM Gauge		8.55
Borehole diameter (mm)	38.00	1.496063		
Displacement 1 (minch)	1168			
Displacement 2 (minch)	863			
Displacement 3 (minch)	858			
P (MPa)	14.21			
Q (MPa)	11.47			
θ (deg)	0.45			
Angle U_1 from 0 (clockwise = +ve)	20.00			
Corrected θ (deg)	20.45			

Figure A25: USBM Results for Test #6 BH-205-6 (44.86m)

Figure A26: Photograph of retrieved core for Test #6 BH-205-6 (44.86m)





Biaxial Test No.	BH-304-1		Upper P	501
Hole:			Lower P	51
Biaxial Reduction			Radius (inches)	Measured Diam (in)
E Hole Diameter (mm)	38.00		0.748	1.496
HQ Hole Diameter (mm)	87.30		1.719	3.437
	Pressure (psi)	Displacement (minch)	Modulus (psi)	Modulus (GPa)
U_1	450	258.912	5.84E+06	40.26
U_2	450	233.168	6.48E+06	44.70
U_3	450	247	6.12E+06	42.20
Average Modulus			6.15E+06	42.39

Darlington New Nuclear Project				
Hole:	BH-304			
USBM Reduction	Test:	BH-304-1		
				inches
Modulus (GPa)	42.39	Before USBM Gauge		9.93
Poissons ratio	0.30	After USBM Gauge		12.8
Borehole diameter (mm)	38.00	1.496063		
Displacement 1 (minch)	1140			
Displacement 2 (minch)	1163			
Displacement 3 (minch)	350			
P (MPa)	16.32			
Q (MPa)	8.74			
θ (deg)	30.72			
Angle U_1 from 0 (clockwise = +ve)	132.00			
Corrected θ (deg)	162.72			

Figure A27: USBM Results for Test #1 BH-304-1 (28.70m)

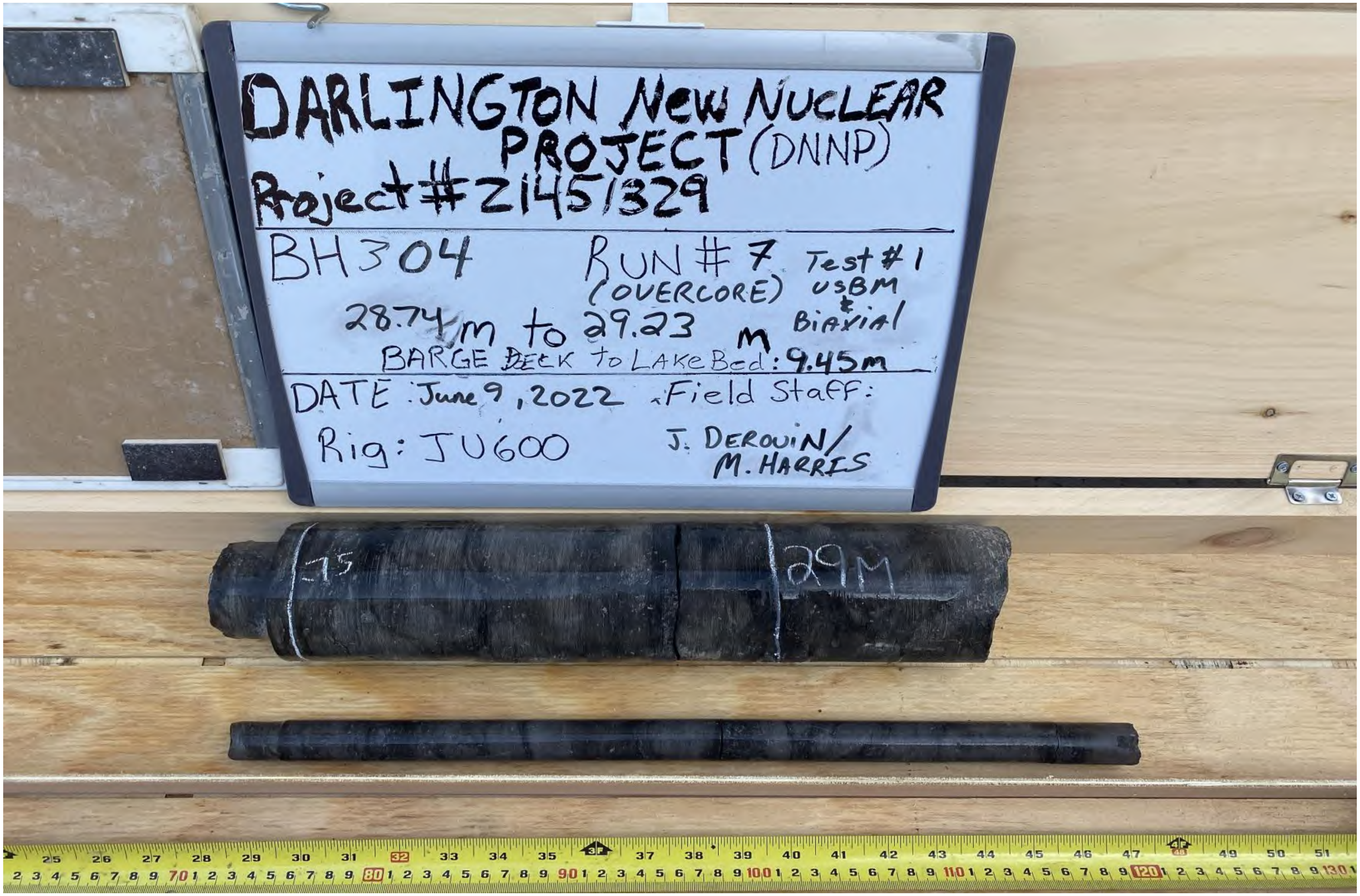
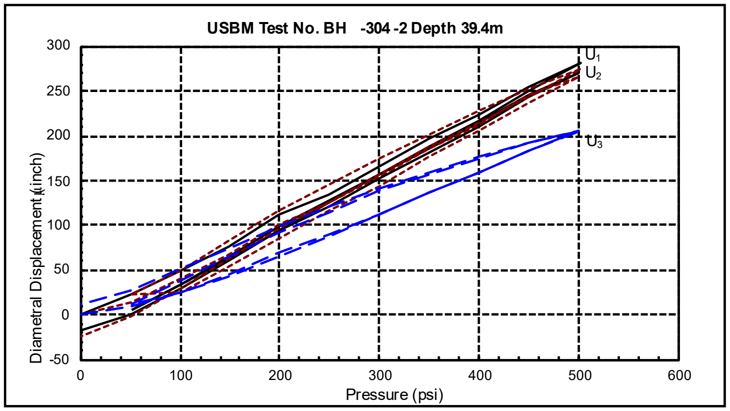
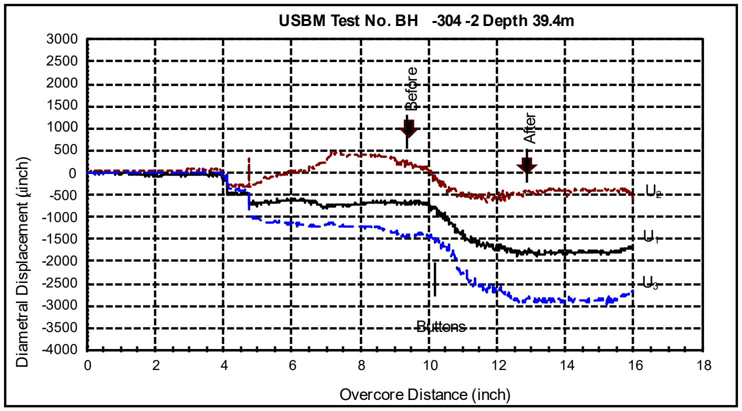


Figure A28: Photograph of retrieved core for Test #1 BH-304-1 (28.70m)





Biaxial Test No.	BH -304 -2		Upper P	501
Hole:			Lower P	51
Biaxial Reduction			Radius	Measured
			(inches)	Diam (in)
E Hole Diameter (mm)	38.00		0.748	1.496
HQ Hole Diameter (mm)	87.30		1.719	3.437
	Pressure	Displacement	Modulus	Modulus
	(psi)	(minch)	(psi)	(GPa)
U_1	450	277.76	5.44E+06	37.53
U_2	450	252.928	5.98E+06	41.21
U_3	450	195	7.75E+06	53.45
Average Modulus			6.39E+06	44.06

Darlington New Nuclear Project				
Hole:	BH -304			
USBM Reduction	Test:	BH -304 -2		
				inches
Modulus (GPa)	44.06	Before USBM Gauge		9.41
Poissons ratio	0.30	After USBM Gauge		12.81
Borehole diameter (mm)	38.00	1.496063		
Displacement 1 (minch)	1052			
Displacement 2 (minch)	616			
Displacement 3 (minch)	1474			
P (MPa)	19.07			
Q (MPa)	11.78			
θ (deg)	135.29			
Angle U_1 from 0 (clockwise = +ve)	132.00			
Corrected θ (deg)	87.29			

Figure A29: USBM Results for Test #2 BH-304-2 (39.40m)

Figure A30: Photograph of retrieved core for Test #2 BH-304-2 (39.40m)

Biaxial Test No.	BH-304-3		Upper P	501
Hole:			Lower P	51
Biaxial Reduction			Radius (inches)	Measured Diam (in)
E Hole Diameter (mm)	38.00		0.748	1.496
HQ Hole Diameter (mm)	87.30		1.719	3.437
	Pressure (psi)	Displacement (minch)	Modulus (psi)	Modulus (GPa)
U_1	450	228.16	6.63E+06	45.68
U_2	450	203.528	7.43E+06	51.21
U_3	450	261	5.79E+06	39.94
Average Modulus			6.61E+06	45.61

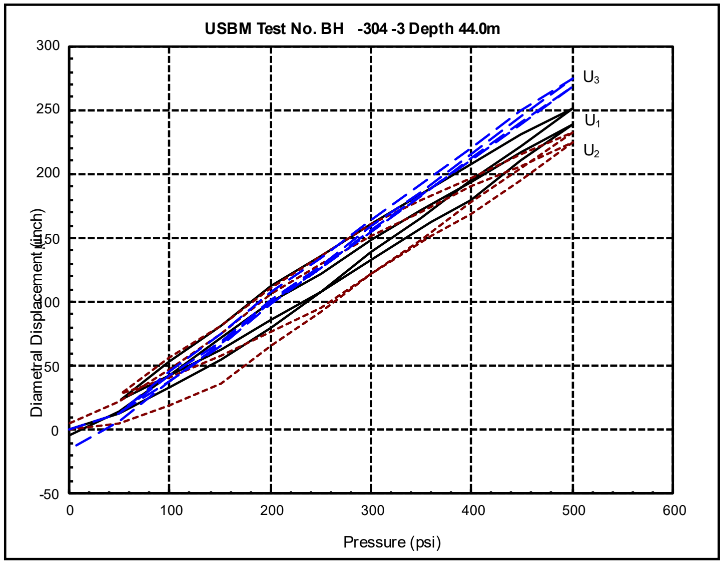
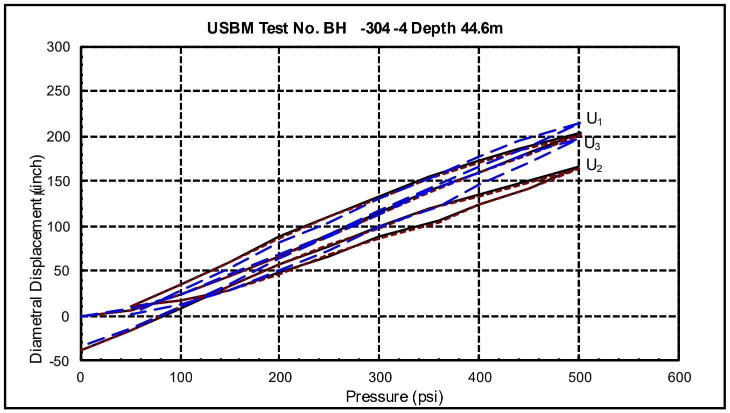
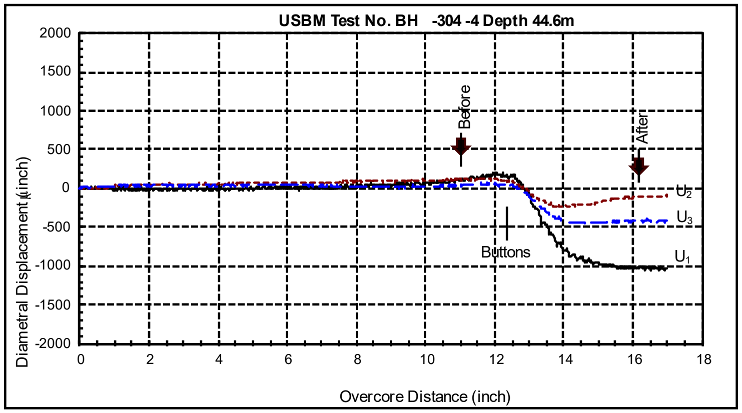


Figure A31: Biaxial Results for Test #3 BH-304-3 (44.00m)

Figure A32: Photograph of retrieved core for Test #3 BH-304-3 (44.00m)



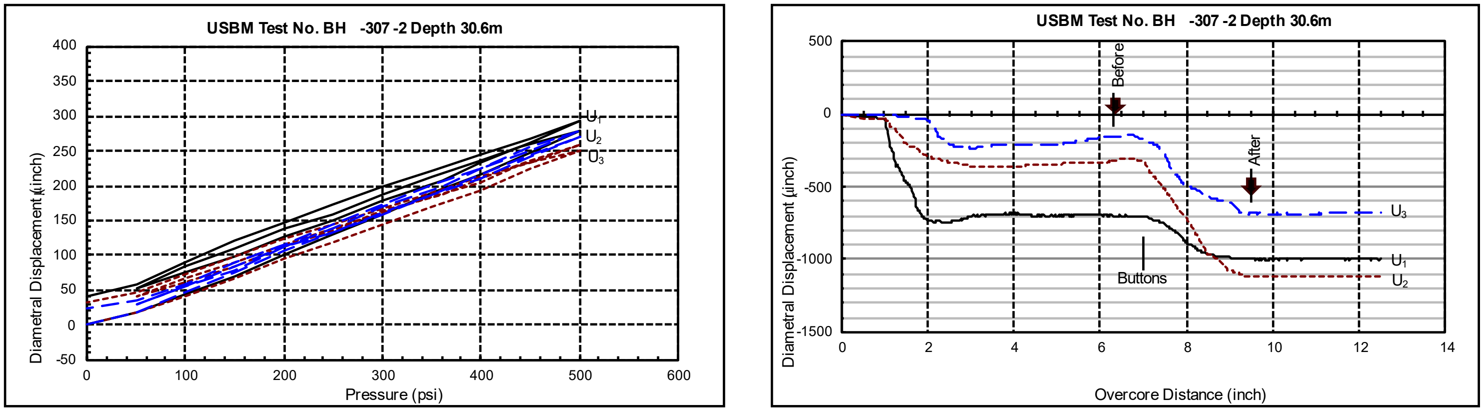


Biaxial Test No.	BH-304-4		Upper P	501
Hole:			Lower P	101
Biaxial Reduction			Radius	Measured
			(inches)	Diam (in)
E Hole Diameter (mm)	38.00		0.748	1.496
HQ Hole Diameter (mm)	87.30		1.719	3.437
	Pressure	Displacement	Modulus	Modulus
	(psi)	(minch)	(psi)	(GPa)
U_1	400	195.584	6.87E+06	47.37
U_2	400	191.268	7.03E+06	48.44
U_3	400	204.336	6.58E+06	45.34
Average Modulus			6.82E+06	47.05

Darlington New Nuclear Project					
Hole:	BH-304				
USBM Reduction	Test:	BH-304-4			
				inches	
Modulus (GPa)	47.05		Before USBM Gauge	10.91	
Poissons ratio	0.30		After USBM Gauge	16.05	
Borehole diameter (mm)	38.00	1.496063			
Displacement 1 (minch)	1156				
Displacement 2 (minch)	230				
Displacement 3 (minch)	458				
P (MPa)	14.04				
Q (MPa)	5.29				
θ (deg)	173.17				
Angle U_1 from 0 (clockwise = +ve)	132.00				
Corrected θ (deg)	125.17				

Figure A33: Biaxial Results for Test #4 BH-304-4 (44.60m)

Figure A34: Photograph of retrieved core for Test #4 BH-304-4 (44.60m)



Biaxial Test No.	BH -307 -2		Upper P	501
Hole:			Lower P	51
Biaxial Reduction			Radius	Measured
			(inches)	Diam (in)
E Hole Diameter (mm)	38.00		0.748	1.496
HQ Hole Diameter (mm)	87.30		1.719	3.437
	Pressure	Displacement	Modulus	Modulus
	(psi)	(minch)	(psi)	(GPa)
U_1	450	241.664	6.26E+06	43.13
U_2	450	218.592	6.92E+06	47.68
U_3	450	249.744	6.05E+06	41.74
Average Modulus			6.41E+06	44.18

Darlington New Nuclear Project				
Hole:	BH -307			
USBM Reduction	Test:	BH -307 -2		
				inches
Modulus (GPa)	44.18	Before USBM Gauge		6.13
Poissons ratio	0.30	After USBM Gauge		9.75
Borehole diameter (mm)	38.00	1.496063		
Displacement 1 (minch)	305			
Displacement 2 (minch)	791			
Displacement 3 (minch)	525			
P (MPa)	10.06			
Q (MPa)	5.91			
θ (deg)	73.44			
Angle U_1 from 0 (clockwise = +ve)	127.00			
Corrected θ (deg)	20.44			

Figure A35: USBM Results for Test #2 BH-307-2 (30.60m)

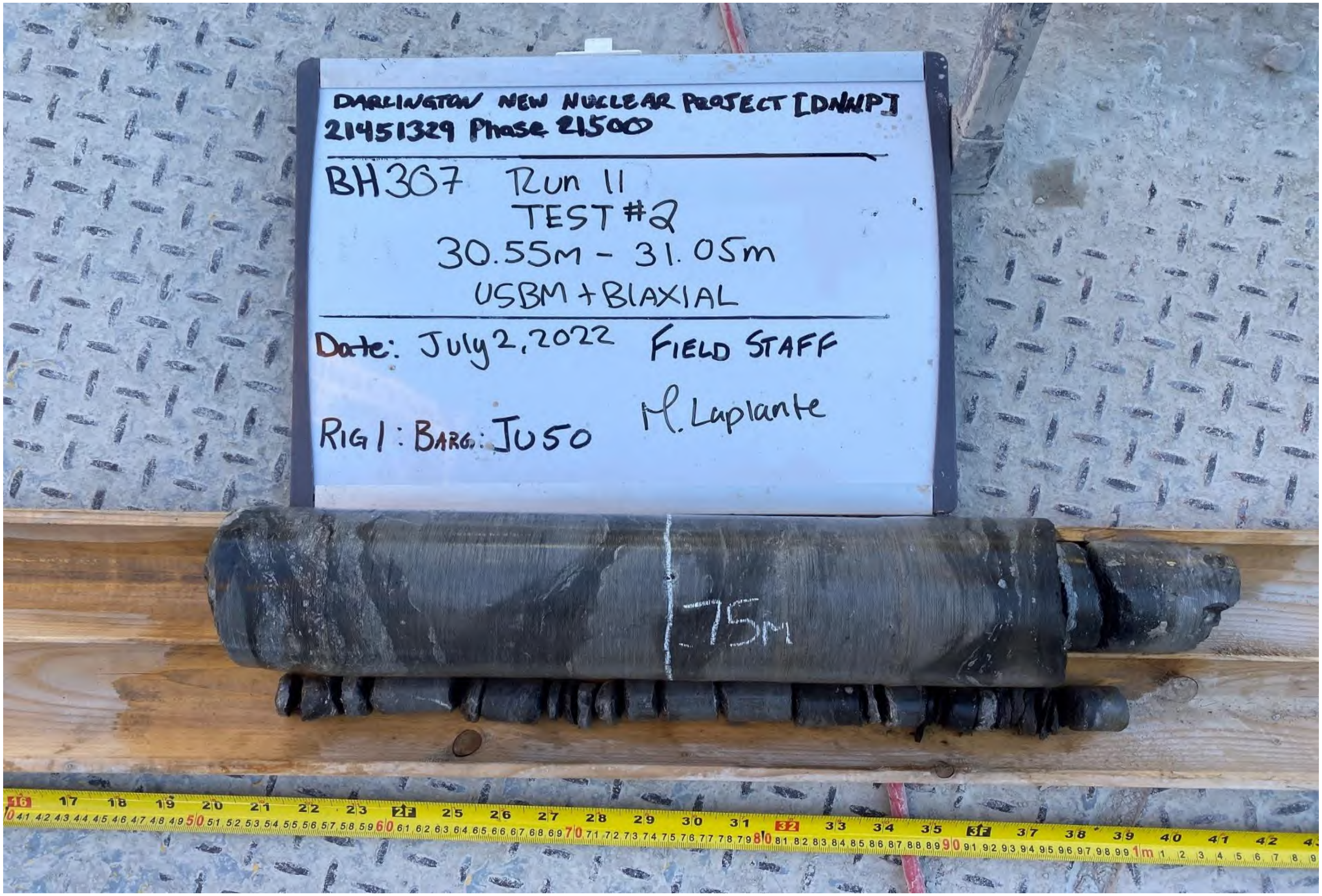
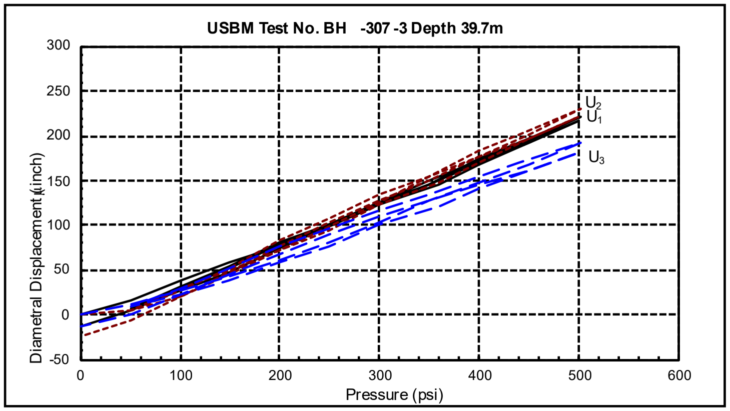
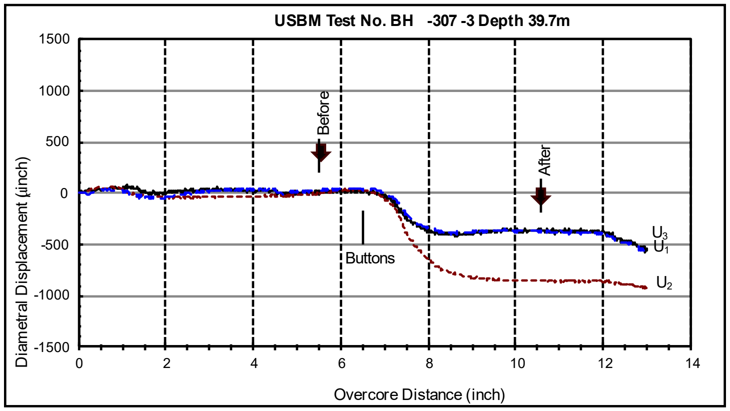


Figure A36: Photograph of retrieved core for Test #2 BH-307-2 (30.60m)



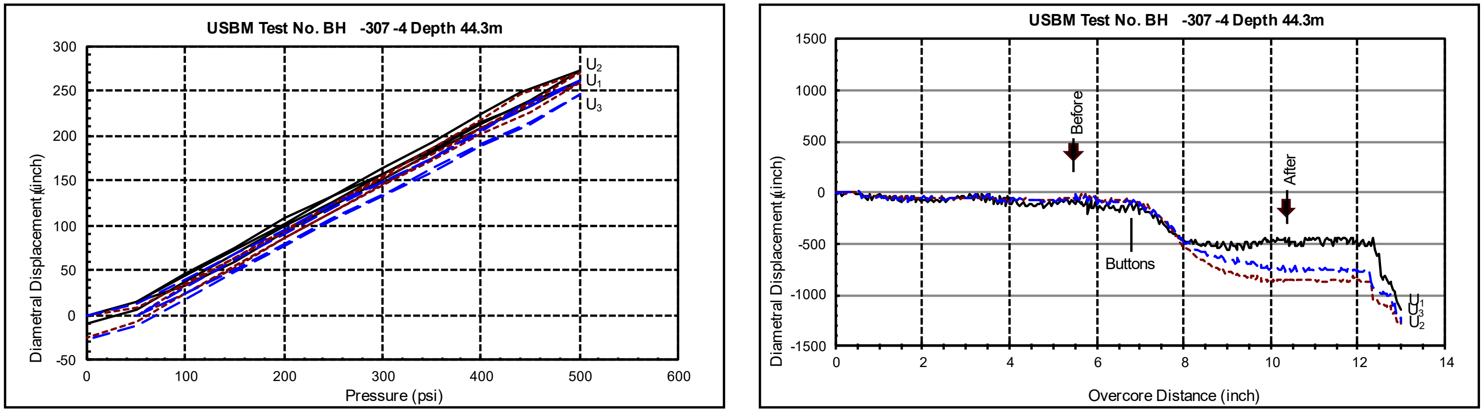


Biaxial Test No.	BH -307 -3		Upper P	501
Hole:			Lower P	51
Biaxial Reduction			Radius	Measured
			(inches)	Diam (in)
E Hole Diameter (mm)	38.00		0.748	1.496
HQ Hole Diameter (mm)	87.30		1.719	3.437
	Pressure	Displacement	Modulus	Modulus
	(psi)	(minch)	(psi)	(GPa)
U_1	450	216.064	7.00E+06	48.24
U_2	450	226.688	6.67E+06	45.98
U_3	450	183.696	8.23E+06	56.74
Average Modulus			7.30E+06	50.32

Darlington New Nuclear Project				
Hole:	BH -307			
USBM Reduction	Test:	BH -307 -3		
				inches
Modulus (GPa)	50.32	Before USBM Gauge		5.58
Poissons ratio	0.30	After USBM Gauge		10.37
Borehole diameter (mm)	38.00	1.496063		
Displacement 1 (minch)	388			
Displacement 2 (minch)	857			
Displacement 3 (minch)	389			
P (MPa)	11.79			
Q (MPa)	6.54			
θ (deg)	60.05			
Angle U_1 from 0 (clockwise = +ve)	127.00			
Corrected θ (deg)	7.05			

Figure A37: USBM Results for Test #3 BH-307-3 (39.70m)

Figure A38: Photograph of retrieved core for Test #3 BH-307-3 (39.70m)



Biaxial Test No.	BH-307-4		Upper P	501
Hole:			Lower P	51
Biaxial Reduction			Radius (inches)	Measured Diam (in)
E Hole Diameter (mm)	38.00		0.748	1.496
HQ Hole Diameter (mm)	87.30		1.719	3.437
	Pressure (psi)	Displacement (minch)	Modulus (psi)	Modulus (GPa)
U_1	450	257.024	5.88E+06	40.55
U_2	450	262.108	5.77E+06	39.77
U_3	450	248.712	6.08E+06	41.91
Average Modulus			5.91E+06	40.74

Darlington New Nuclear Project				
Hole:	BH-307			
USBM Reduction	Test:	BH-307-4		
				inches
Modulus (GPa)	40.74	Before USBM Gauge		5.56
Poissons ratio	0.30	After USBM Gauge		10.18
Borehole diameter (mm)	38.00	1.496063		
Displacement 1 (minch)	334			
Displacement 2 (minch)	835			
Displacement 3 (minch)	724			
P (MPa)	10.66			
Q (MPa)	6.52			
θ (deg)	83.95			
Angle U_1 from 0 (clockwise = +ve)	127.00			
Corrected θ (deg)	30.95			

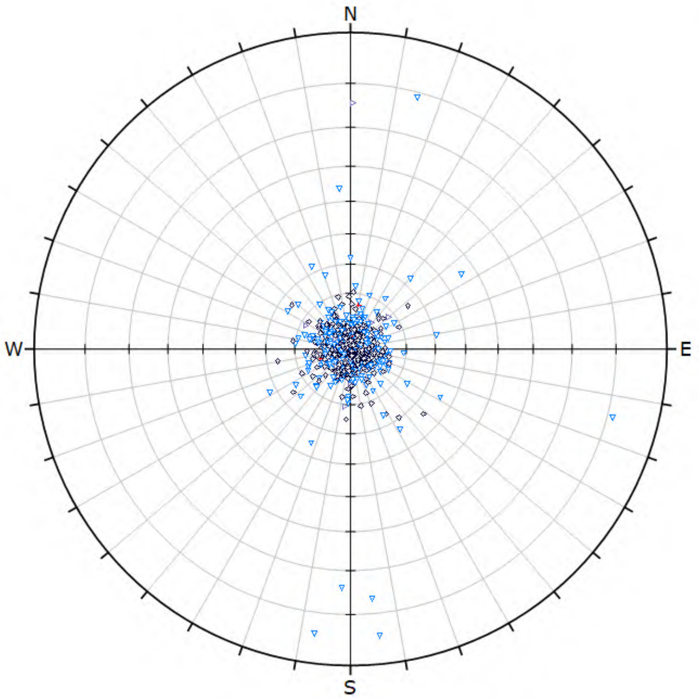
Figure A39: USBM Results for Test #4 BH-307-4 (44.30m)

Figure A40: Photograph of retrieved core for Test #4 BH-307-4 (44.30m)

APPENDIX H

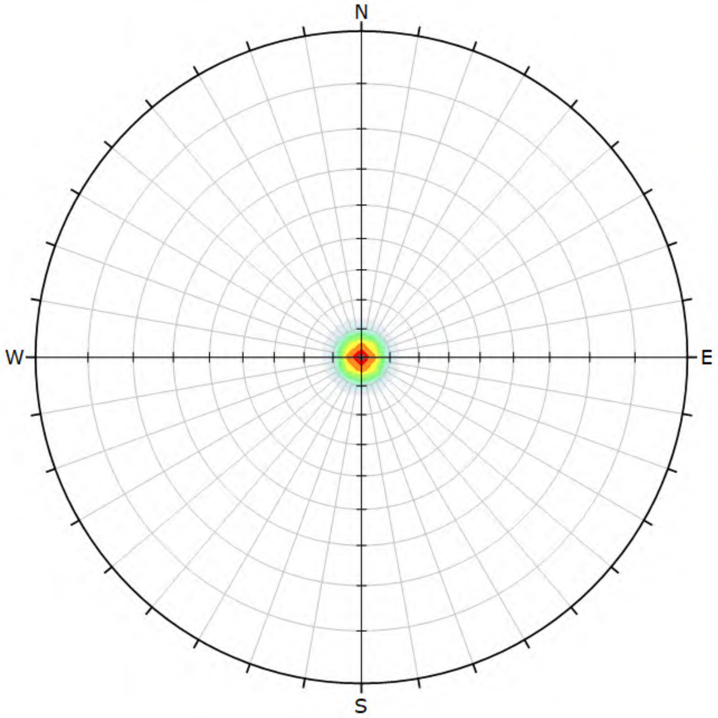
Stereoplots of Discontinuity Data

Stereographic Projection of all Televiewer Data Collected from Blue Mountain and Lindsay Formations



Symbol	FEATURE	Quantity
◇	Bedding	1663
+	Contact	7
▽	Filled Joint	628
◁	Major Open Joint"N/A	6
▷	Partially Open Joint	40

Plot Mode	Pole Vectors
Vector Count	2344 (2344 Entries)
Hemisphere	Lower
Projection	Equal Angle



Color	Density Concentrations
	0.00 - 8.70
⬜	8.70 - 17.40
🟦	17.40 - 26.10
🟦	26.10 - 34.80
🟩	34.80 - 43.50
🟩	43.50 - 52.20
🟨	52.20 - 60.90
🟧	60.90 - 69.60
🟥	69.60 - 78.30

Contour Data	Pole Vectors
Maximum Density	77.90%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Plot Mode	Pole Vectors
Vector Count	2344 (2344 Entries)
Hemisphere	Lower
Projection	Equal Angle

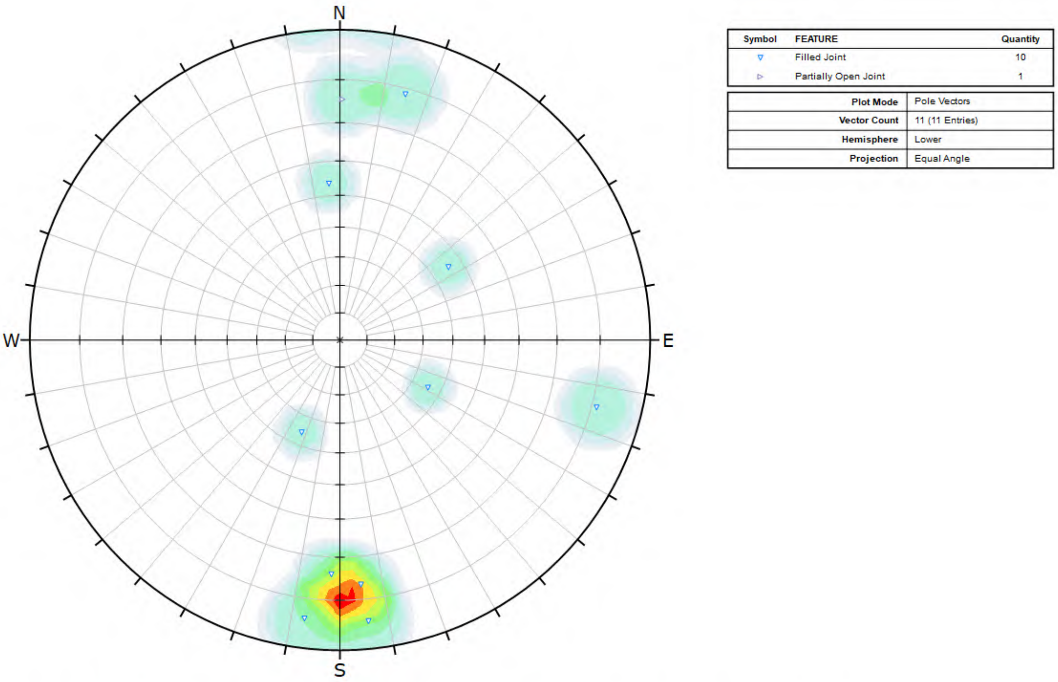
Date: February 15, 2023

Project: 21451329

Prepared By: PKS

Checked By: MJT

Stereographic Projection of all Joints Dipping more than 35⁰ Collected from Blue Mountain and Lindsay Formations



Viewing Filtered Data: subvertical joints (((Dip >= 35 && (FEATURE == Bedding || FEATURE == Contact || FEATURE == FilledJoint || FEATURE == MajorOpenJoint"N/A || FEATURE == PartiallyOpenJoint)))

Note: Joints dipping more than 35⁰ are not registered in Blue Mountain Formation

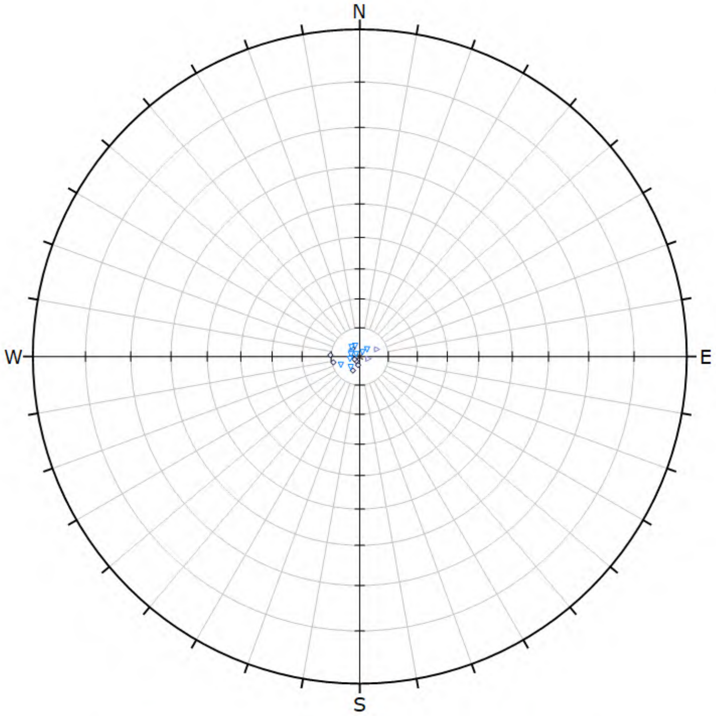
Date: February 15, 2023

Project: 21451329

Prepared By: PKS

Checked By: MJT

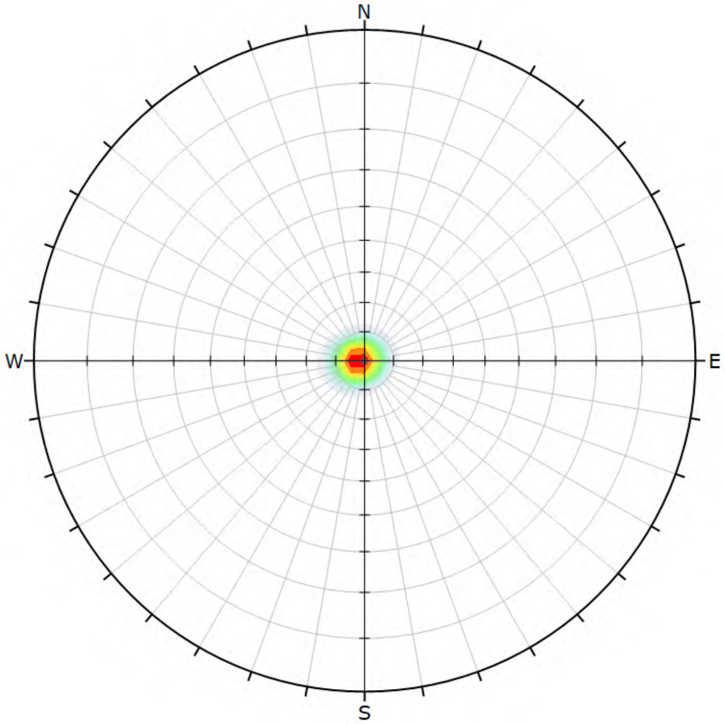
Stereographic Projection of all Televiewer Data Collected from Blue Mountain Formation



Symbol	FEATURE	Quantity
◇	Bedding	8
▽	Filled Joint	10
▷	Partially Open Joint	2

Plot Mode	Pole Vectors
Vector Count	20 (20 Entries)
Hemisphere	Lower
Projection	Equal Angle

Viewing Filtered Data: Blue Mountain ((FORMATION == BlueMountain))



Color	Density Concentrations
⬜	0.00 - 8.60
⬜	8.60 - 17.20
⬜	17.20 - 25.80
🟩	25.80 - 34.40
🟩	34.40 - 43.00
🟩	43.00 - 51.60
🟨	51.60 - 60.20
🟨	60.20 - 68.80
🟧	68.80 - 77.40
🟥	77.40 - 86.00
Contour Data	Pole Vectors
Maximum Density	85.20%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Plot Mode	Pole Vectors
Vector Count	20 (20 Entries)
Hemisphere	Lower
Projection	Equal Angle

Viewing Filtered Data: Blue Mountain ((FORMATION == BlueMountain))

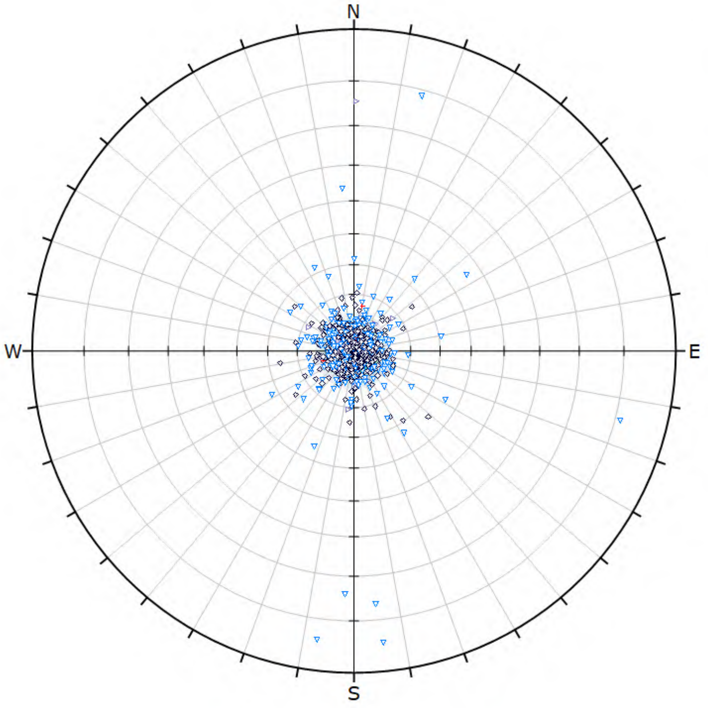
Date: February 15, 2023

Project: 21451329

Prepared By: PKS

Checked By: MJT

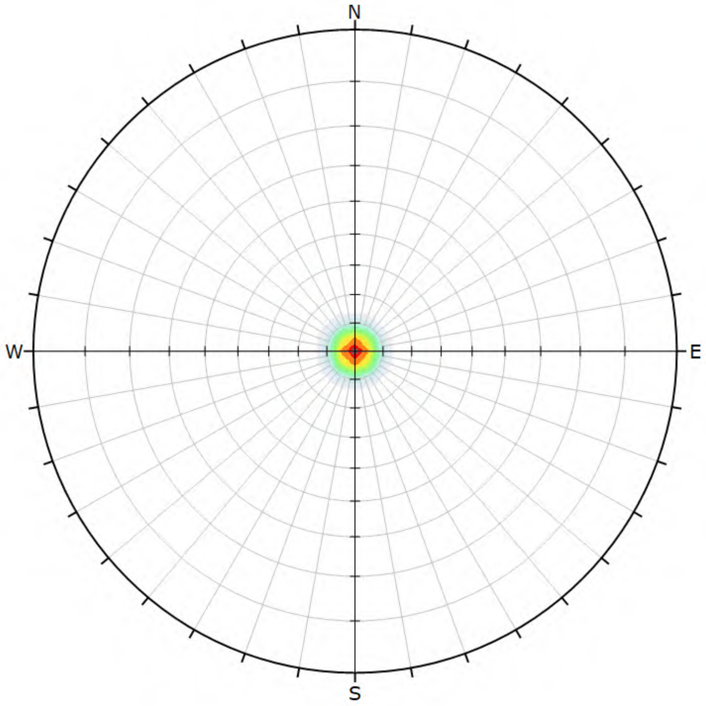
Stereographic Projection of all Televiewer Data Collected from Lindsay Formation



Symbol	FEATURE	Quantity
◇	Bedding	1655
+	Contact	7
▽	Filled Joint	618
◁	Major Open Joint"N/A	6
▷	Partially Open Joint	38

Plot Mode	Pole Vectors
Vector Count	2324 (2324 Entries)
Hemisphere	Lower
Projection	Equal Angle

Viewing Filtered Data: Lindsay ((FORMATION == Lindsay))



Color	Density Concentrations
⬜	0.00 - 7.80
⬜	7.80 - 15.60
🟦	15.60 - 23.40
🟦	23.40 - 31.20
🟩	31.20 - 39.00
🟩	39.00 - 46.80
🟩	46.80 - 54.60
🟨	54.60 - 62.40
🟧	62.40 - 70.20
🟥	70.20 - 78.00

Contour Data	Pole Vectors
Maximum Density	77.84%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Plot Mode	Pole Vectors
Vector Count	2324 (2324 Entries)
Hemisphere	Lower
Projection	Equal Angle

Viewing Filtered Data: Lindsay ((FORMATION == Lindsay))

Date: February 15, 2023

Project: 21451329

Prepared By: PKS

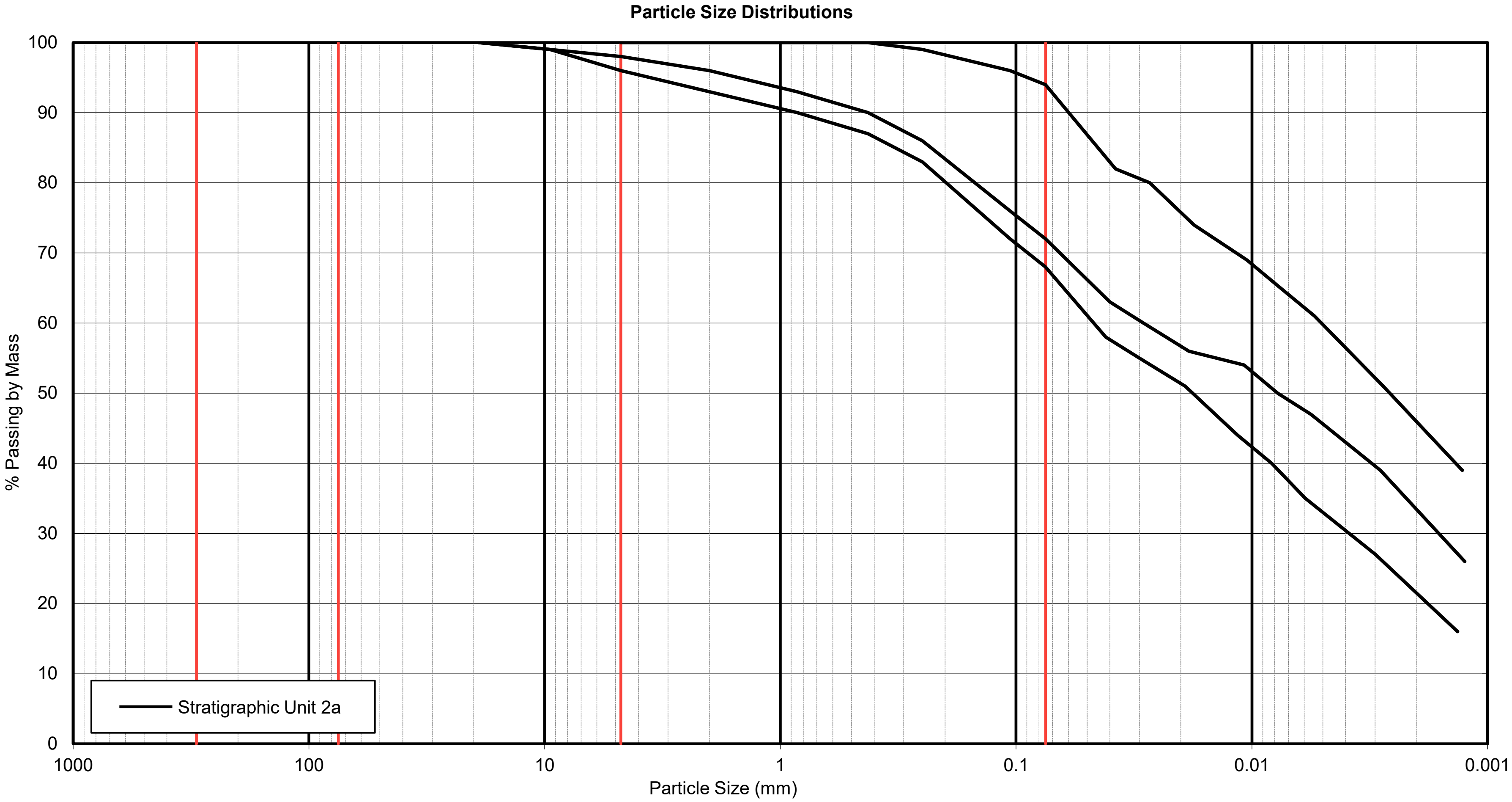
Checked By: MJT

APPENDIX I

Particle Size distributions and Atterberg Limits Charts, by Stratigraphic Unit

Particle Size Distributions
Stratigraphic Unit 2a
Surficial Glacio-Lacustrine Deposits - Sandy Lean Clay to Lean Clay

Project No.:	21451329	**Testing Method(s):**	ASTM D6913 and ASTM D422 (Method B)
Project:	Geotechnical Investigation - Condenser Cooling water System, Darlington DNNP	**Note(s):**	Particle size distributions for each tested sample are provided in Golder Report No. 21451329-001.
Client:	E.S. Fox Limited Nuclear Services		



BOULDERS	COBBLES	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	

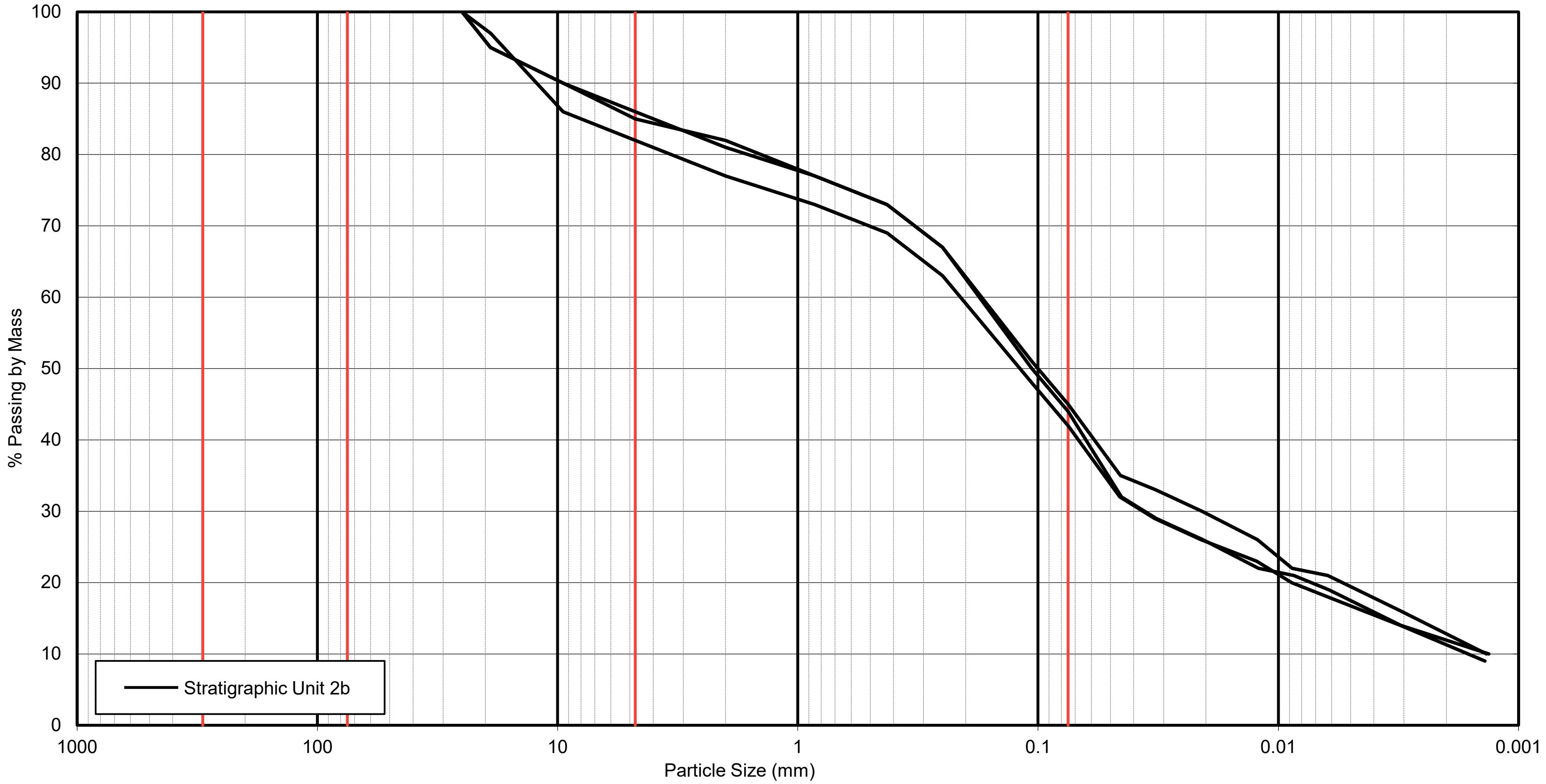
PREPARED BY: PAK DATE: 2023/02/07 CHECKED BY: KG DATE: 2023/02/13

Particle Size Distributions
Stratigraphic Unit 2b

Surficial Glacio-Lacustrine Deposits - Silty Clayey Sand to Silty Sand/Sandy Silt

Project No.:	21451329	**Testing Method(s):**	ASTM D6913 and ASTM D422 (Method B)
Project:	Geotechnical Investigation - Condenser Cooling water System, Darlington DNNP	**Note(s):**	Particle size distributions for each tested sample are provided in Golder Report No. 21451329-001.
Client:	E.S. Fox Limited Nuclear Services		

Particle Size Distributions

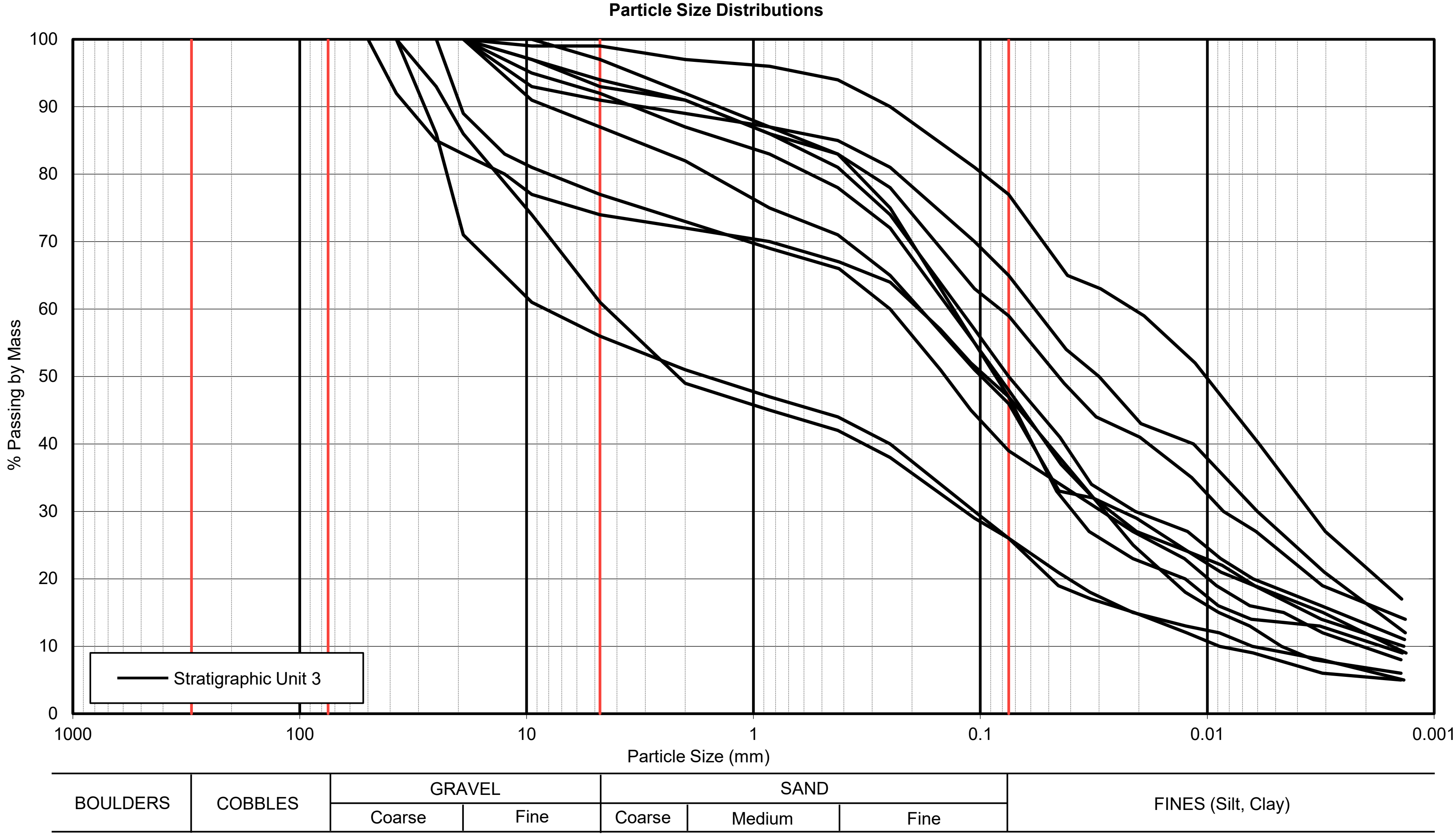


BOULDERS	COBBLES	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	

PREPARED BY: PAK DATE: 2023/02/07 CHECKED BY: KG DATE: 2023/02/13

Particle Size Distributions
Stratigraphic Unit 3
Upper Till

Project No.:	21451329	**Testing Method(s):**	ASTM D6913 and ASTM D422 (Method B)
Project:	Geotechnical Investigation - Condenser Cooling water System, Darlington DNNP	**Note(s):**	Particle size distributions for each tested sample are provided in Golder Report No. 21451329-001.
Client:	E.S. Fox Limited Nuclear Services		

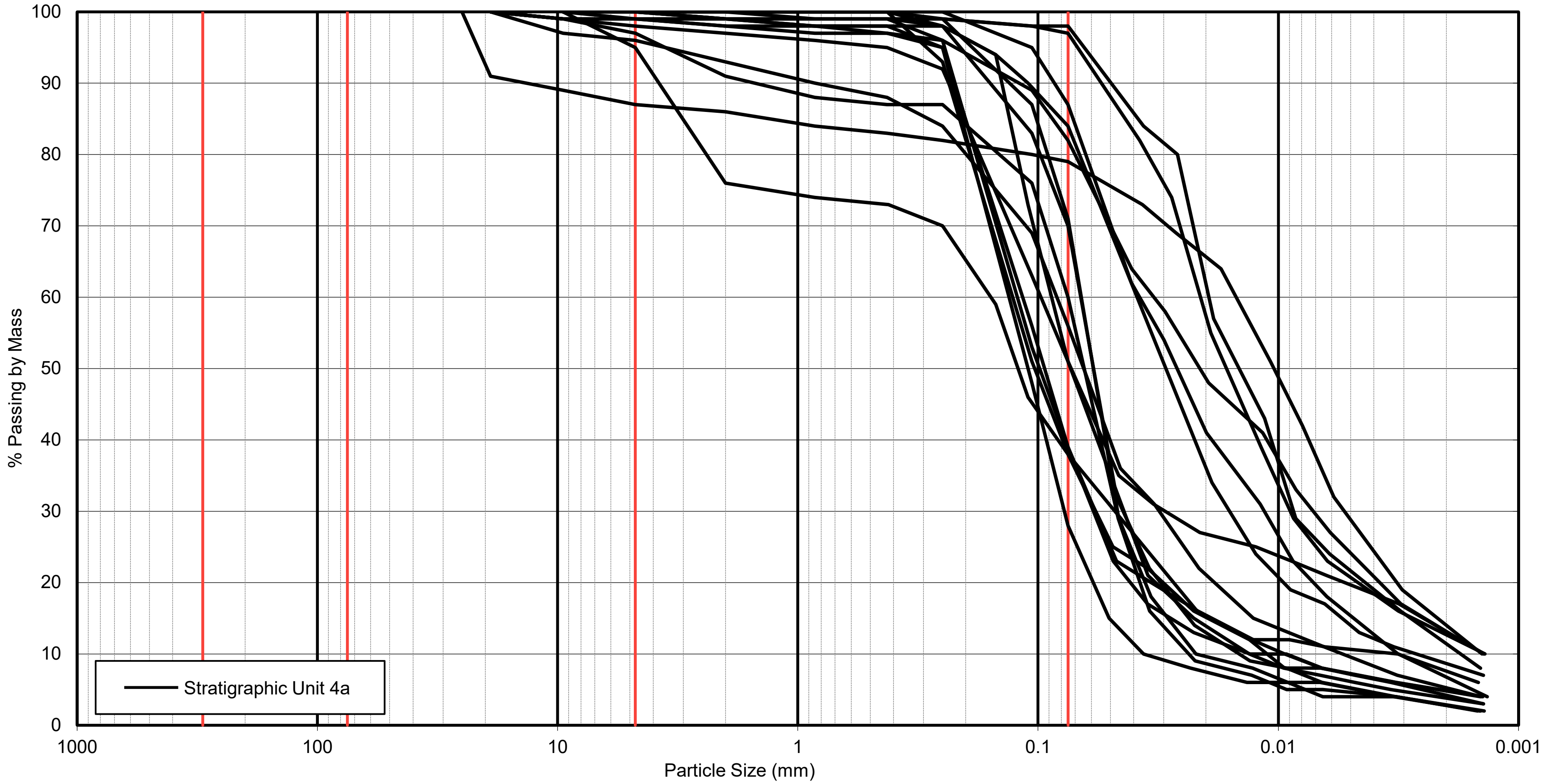


PREPARED BY: PAK	DATE: 2023/02/07	CHECKED BY: KG	DATE: 2023/02/13

Particle Size Distributions
Stratigraphic Unit 4a
Intermediate Glacio-Lacustrine Deposits - Silty Sand to Sandy Silt

Project No.:	21451329	**Testing Method(s):**	ASTM D6913 and ASTM D422 (Method B)
Project:	Geotechnical Investigation - Condenser Cooling water System, Darlington DNNP	**Note(s):**	Particle size distributions for each tested sample are provided in Golder Report No. 21451329-001.
Client:	E.S. Fox Limited Nuclear Services		

Particle Size Distributions



BOULDERS	COBBLES	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	

PREPARED BY: PAK DATE: 2023/02/07 CHECKED BY: KG DATE: 2023/02/13

Particle Size Distributions
Stratigraphic Unit 4b

Intermediate Glacio-Lacustrine Deposits - Sandy Lean Clay to Lean Clay

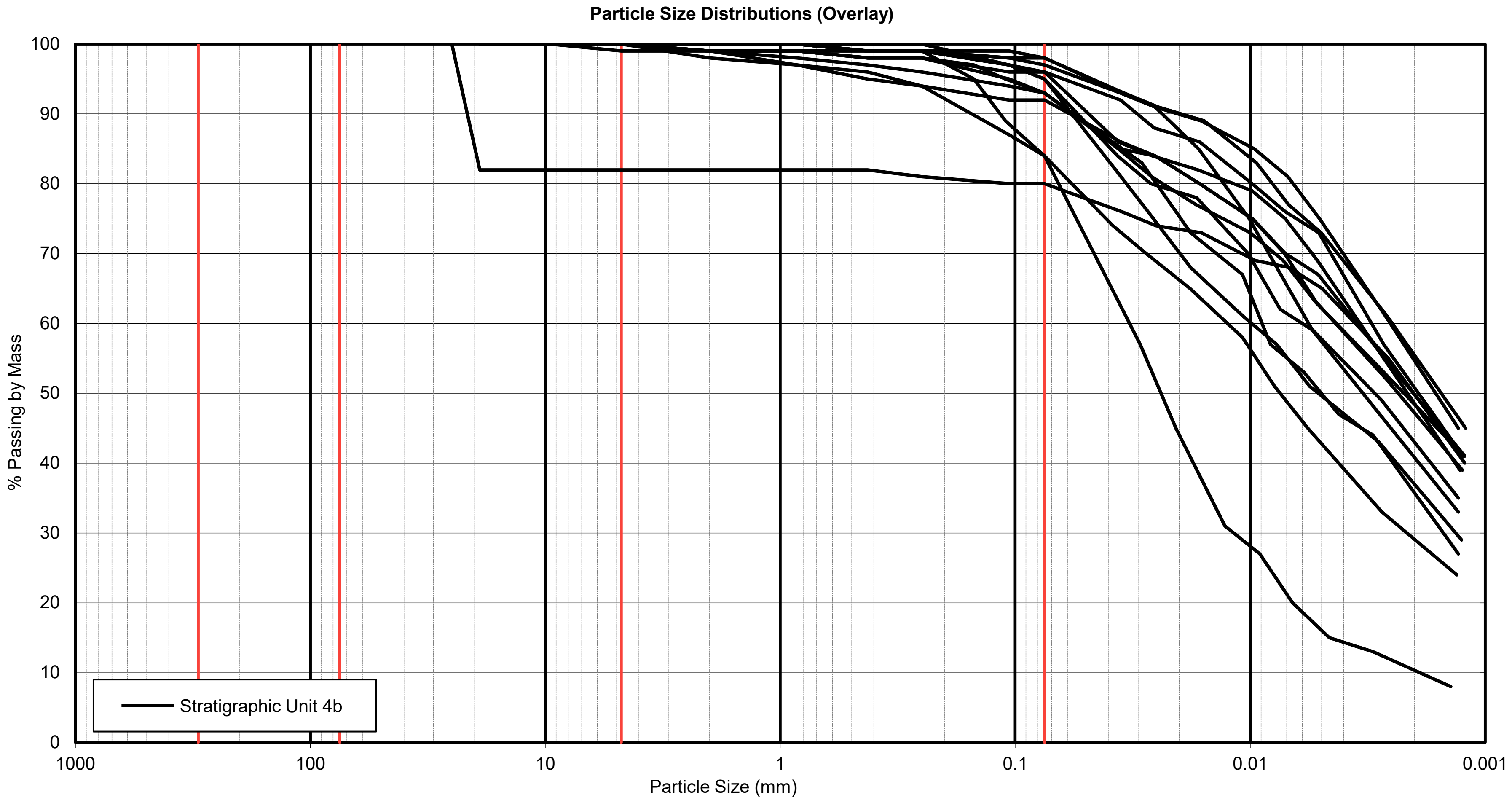
Project No.: 21451329

Project: Geotechnical Investigation - Condenser Cooling water System, Darlington DNNP

Client: E.S. Fox Limited Nuclear Services

Testing Method(s): ASTM D6913 and ASTM D422 (Method B)

Note(s): Particle size distributions for each tested sample are provided in Golder Report No. 21451329-001.



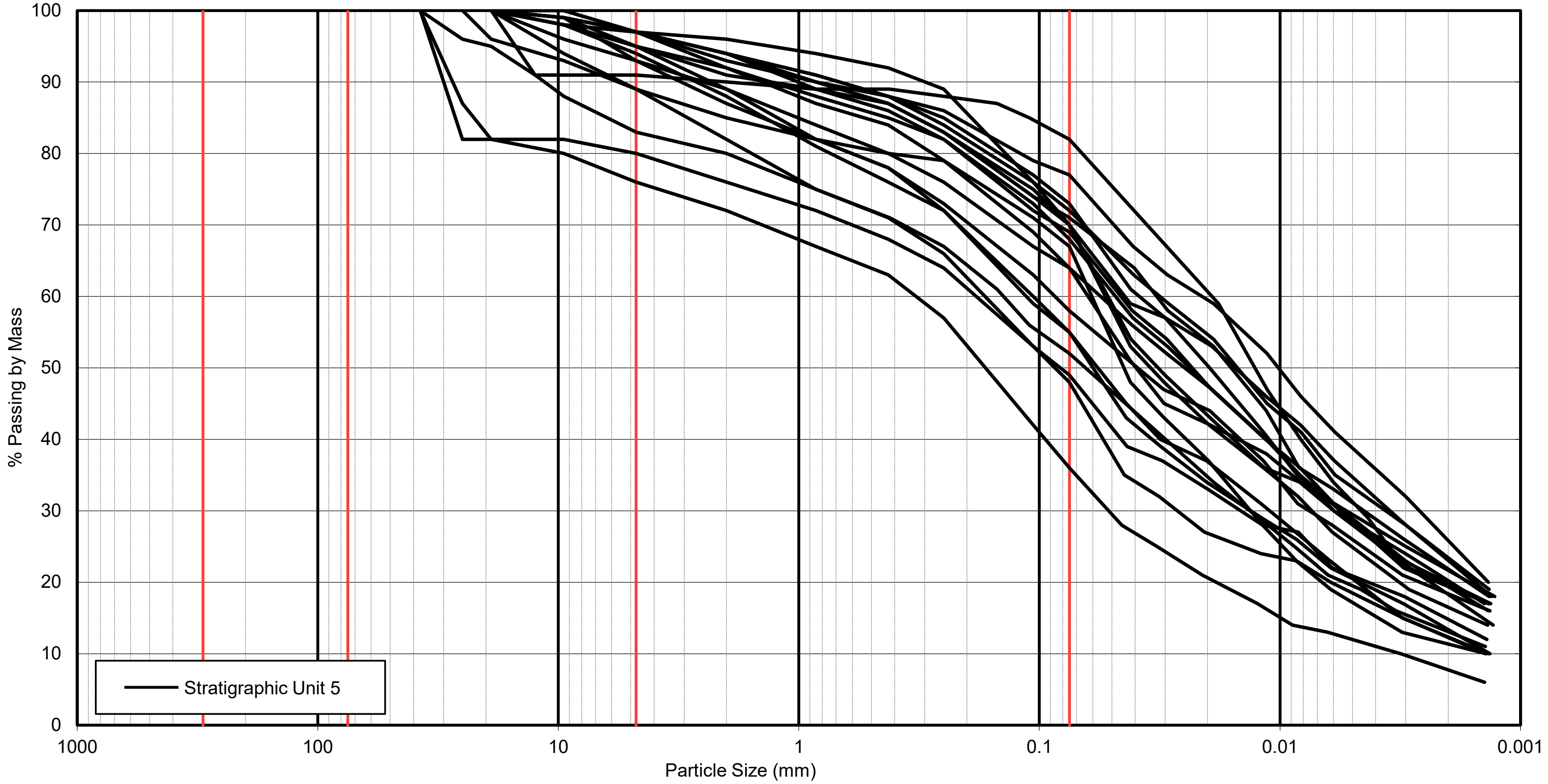
BOULDERS	COBBLES	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	

PREPARED BY: PAK DATE: 2023/02/07 CHECKED BY: KG DATE: 2023/02/13

Particle Size Distributions
Stratigraphic Unit 5
Lower Till

Project No.:	21451329	**Testing Method(s):**	ASTM D6913 and ASTM D422 (Method B)
Project:	Geotechnical Investigation - Condenser Cooling water System, Darlington DNNP	**Note(s):**	Particle size distributions for each tested sample are provided in Golder Report No. 21451329-001.
Client:	E.S. Fox Limited Nuclear Services		

Particle Size Distributions

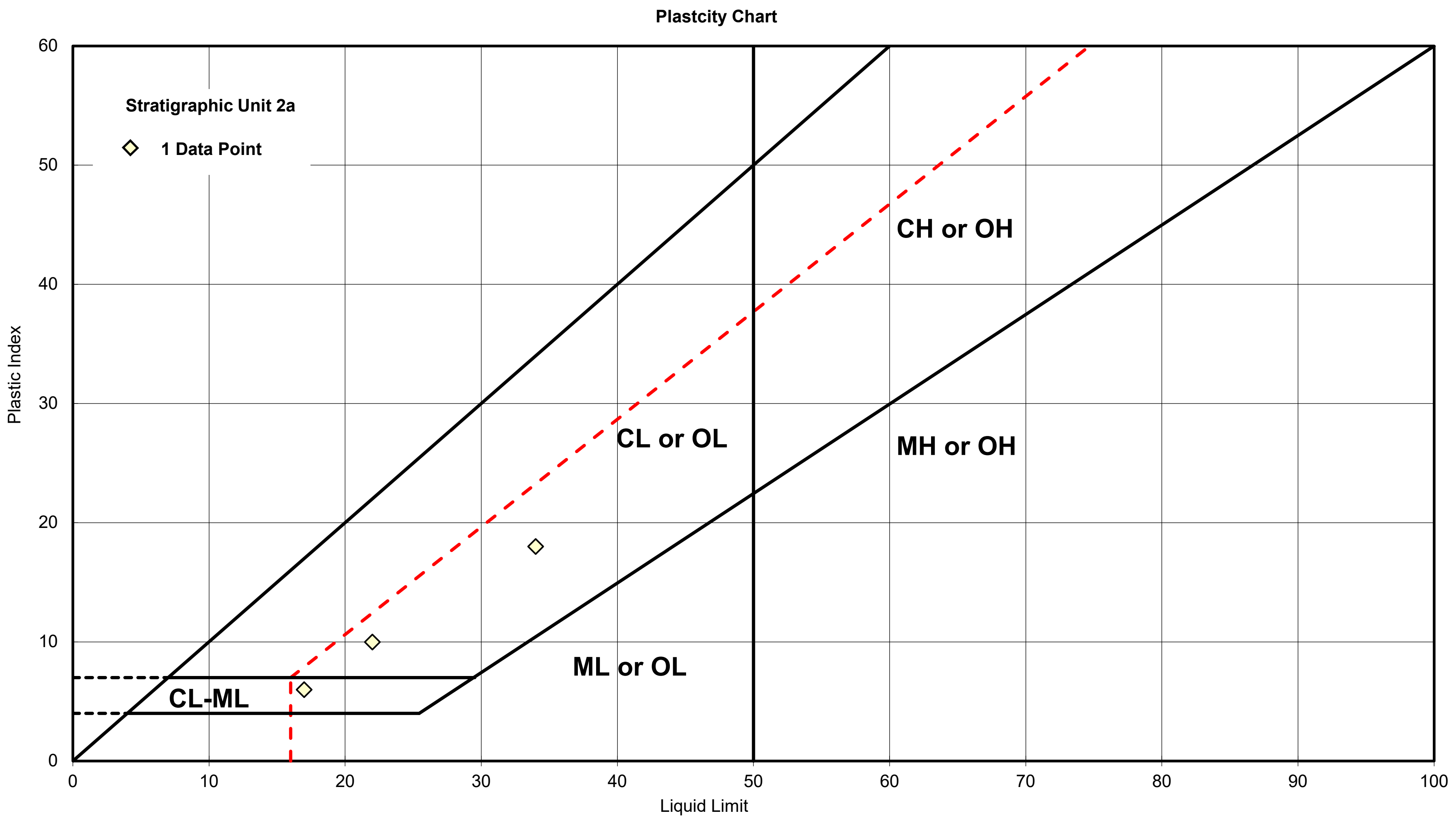


BOULDERS	COBBLES	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	

PREPARED BY: PAK DATE: 2023/02/07 CHECKED BY: KG DATE: 2023/02/13

Plasticity Chart
Stratigraphic Unit 2a
Surficial Glacio-Lacustrine Deposits - Sandy Lean Clay to Lean Clay

Project No.:	21451329	**Testing Method(s):**	ASTM D4318 (Method A)
Project:	Geotechnical Investigation- Condenser Cooling water System, Darlington DNNP	**Note(s):**	Atterberg limits for each tested sample are provided in Golder Report No. 21451329-001.
Client:	E.S. Fox Limited Nuclear Services		

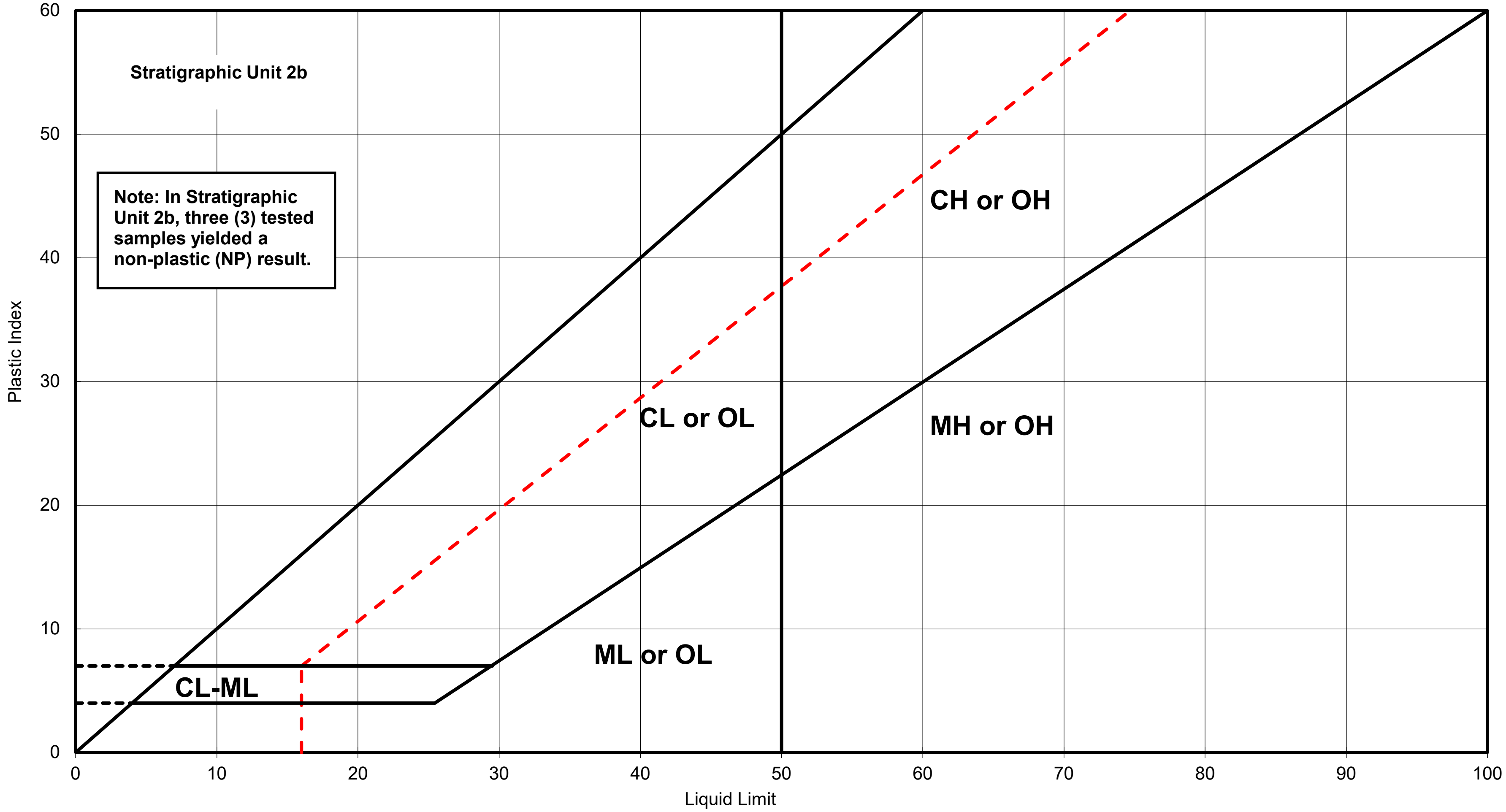


PREPARED BY: PAK DATE: 2023/02/07 CHECKED BY: KG DATE: 2023/02/07

Plasticity Chart
Stratigraphic Unit 2b
Surficial Glacio-Lacustrine Deposits - Silty Clayey Sand to Silty Sand/Sandy Silt

Project No.:	21451329	**Testing Method(s):**	ASTM D4318 (Method A)
Project:	Geotechnical Investigation- Condenser Cooling water System, Darlington DNNP	**Note(s):**	Atterberg limits for each tested sample are provided in Golder Report No. 21451329-001.
Client:	E.S. Fox Limited Nuclear Services		

Plastcity Chart

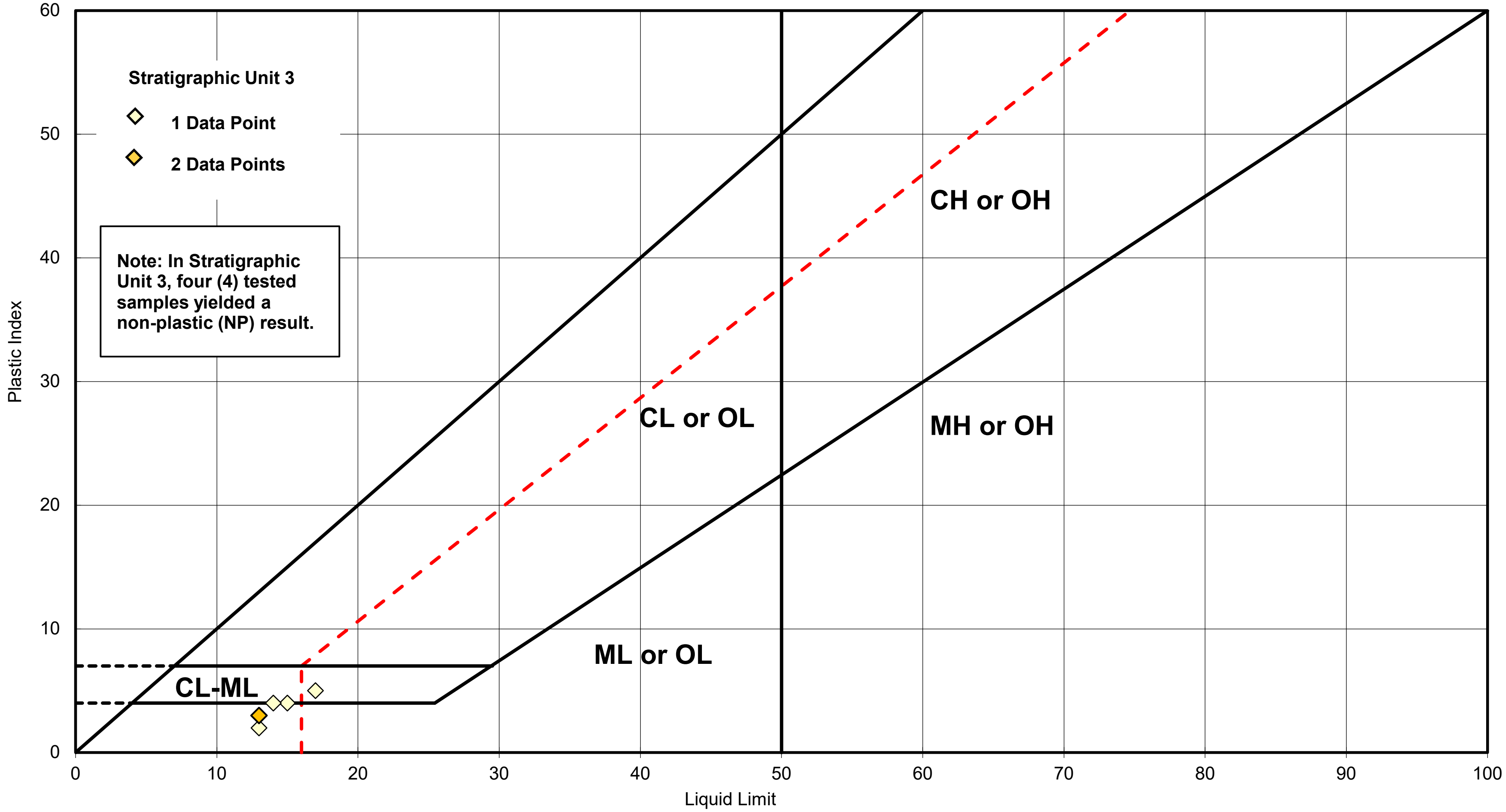


PREPARED BY: PAK DATE: 2023/02/07 CHECKED BY: KG DATE: 2023/02/07

Plasticity Chart
Stratigraphic Unit 3
Upper Till

Project No.:	21451329	**Testing Method(s):**	ASTM D4318 (Method A)
Project:	Geotechnical Investigation- Condenser Cooling water System, Darlington DNNP	**Note(s):**	Atterberg limits for each tested sample are provided in Golder Report No. 21451329-001.
Client:	E.S. Fox Limited Nuclear Services		

Plastcity Chart

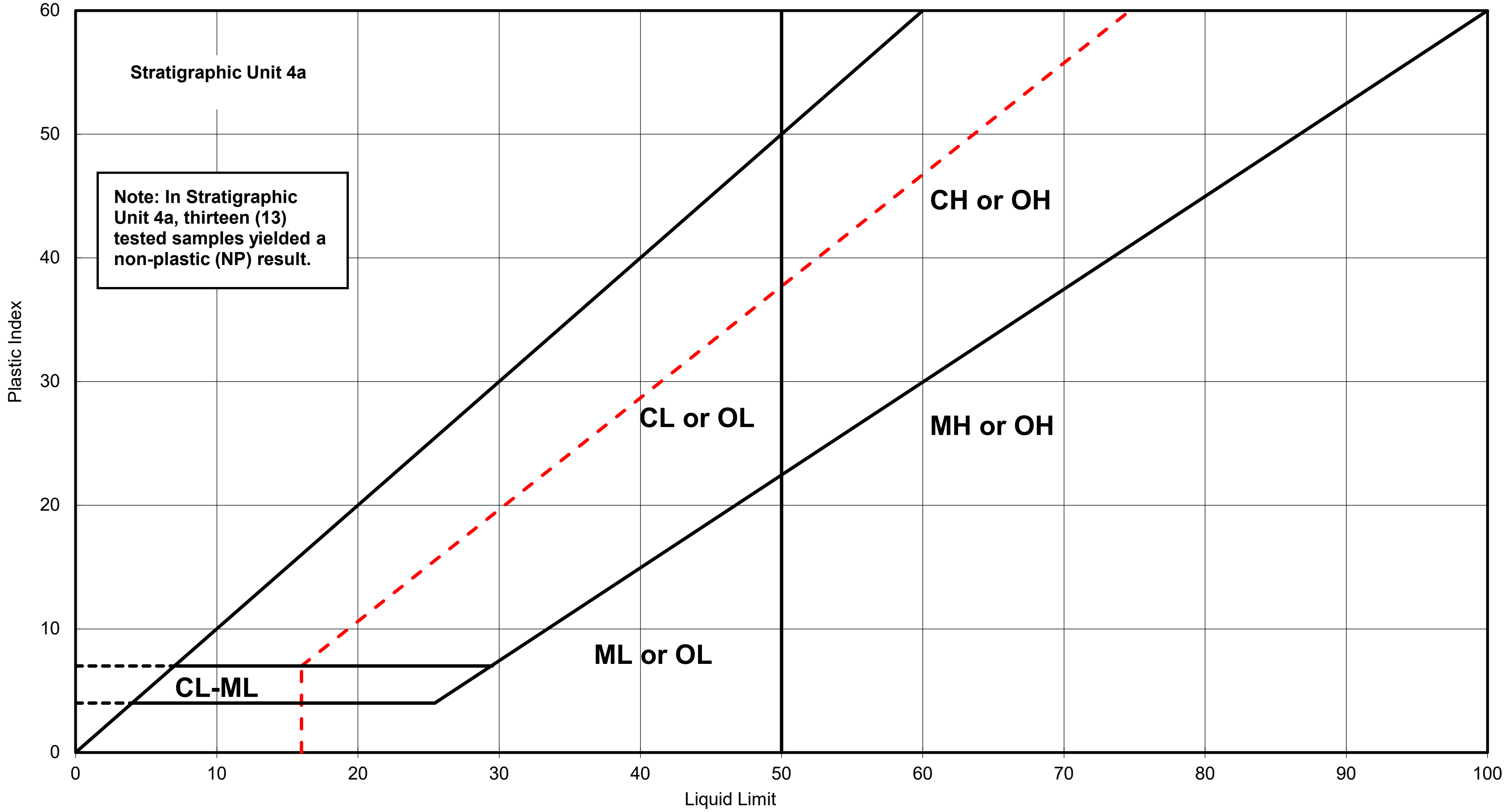


PREPARED BY: PAK DATE: 2023/02/07 CHECKED BY: KG DATE: 2023/02/07

Plasticity Chart
Stratigraphic Unit 4a
Intermediate Glacio-Lacustrine Deposits - Silty Sand to Sandy Silt

Project No.:	21451329	**Testing Method(s):**	ASTM D4318 (Method A)
Project:	Geotechnical Investigation- Condenser Cooling water System, Darlington DNNP	**Note(s):**	Atterberg limits for each tested sample are provided in Golder Report No. 21451329-001.
Client:	E.S. Fox Limited Nuclear Services		

Plastcity Chart



PREPARED BY: PAK DATE: 2023/02/07 CHECKED BY: KG DATE: 2023/02/07

Plasticity Chart
Stratigraphic Unit 4b
Intermediate Glacio-Lacustrine Deposits - Sandy Lean Clay to Lean Clay

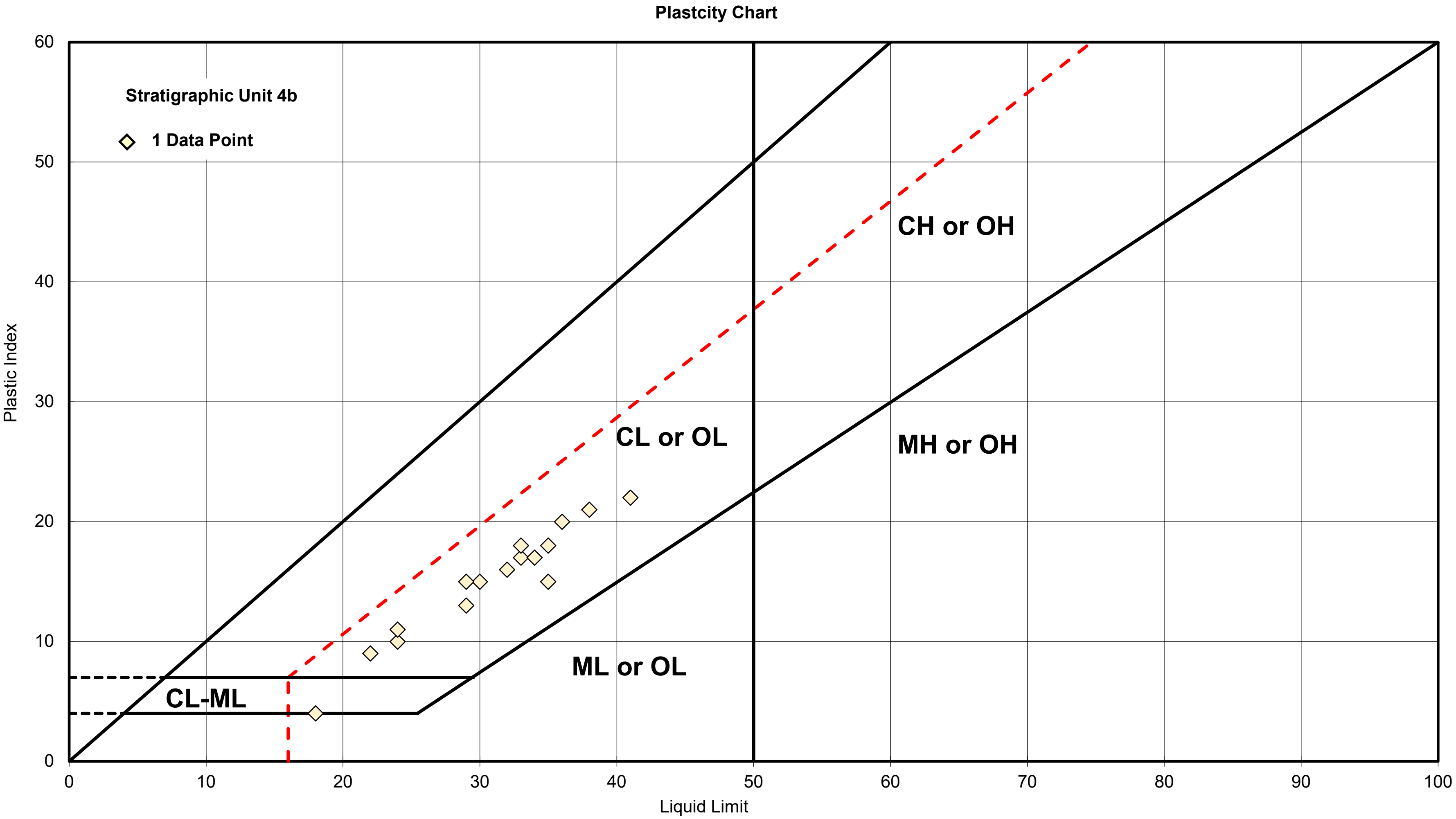
Project No.: 21451329

Project: Geotechnical Investigation- Condenser Cooling water System, Darlington DNNP

Client: E.S. Fox Limited Nuclear Services

Testing Method(s): ASTM D4318 (Method A)

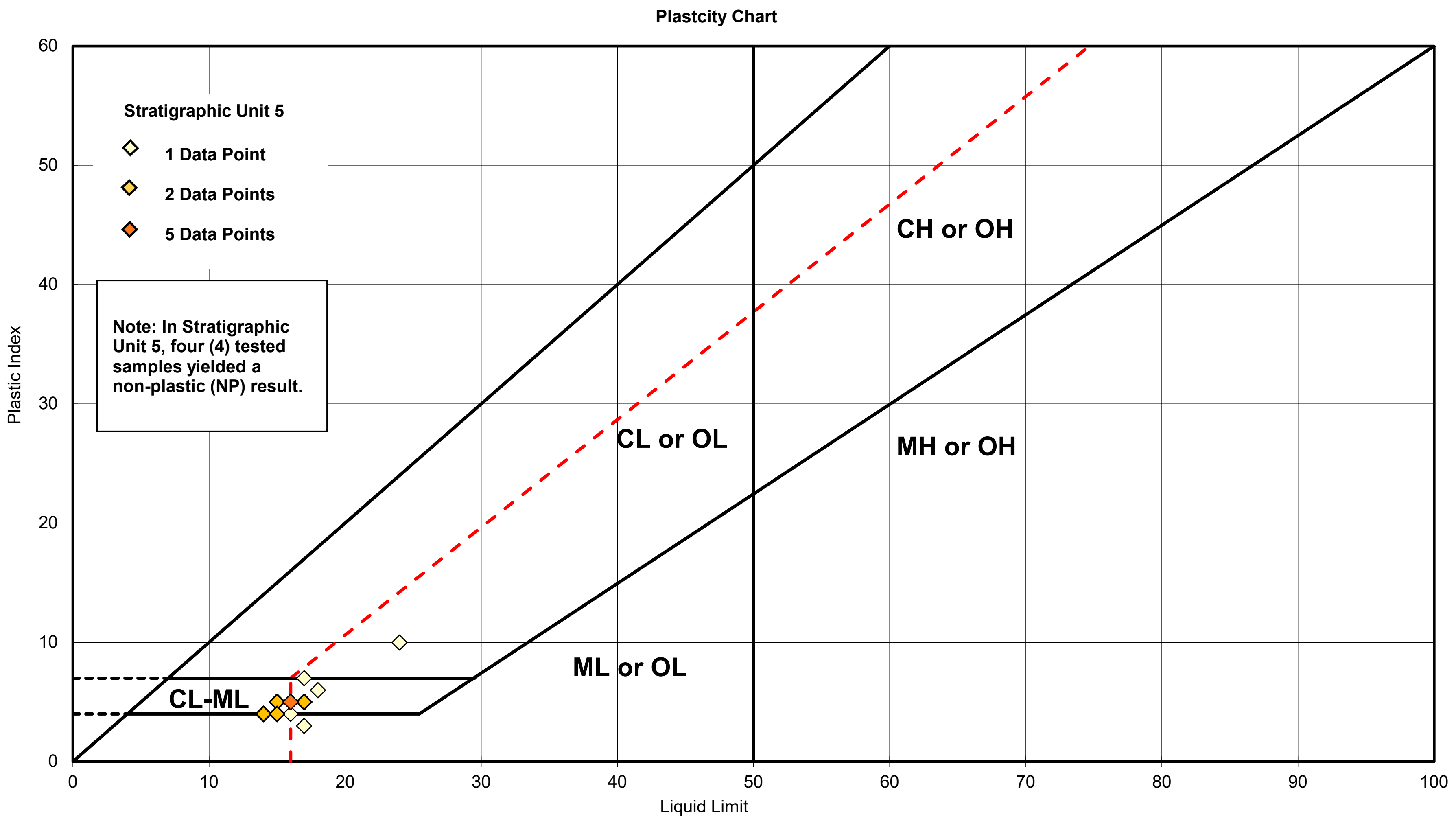
Note(s): Atterberg limits for each tested sample are provided in Golder Report No. 21451329-001.



PREPARED BY: PAK DATE: 2023/02/07 CHECKED BY: KG DATE: 2023/02/07

Plasticity Chart
Stratigraphic Unit 5
Lower Till

Project No.:	21451329	**Testing Method(s):**	ASTM D4318 (Method A)
Project:	Geotechnical Investigation- Condenser Cooling water System, Darlington DNNP	**Note(s):**	Atterberg limits for each tested sample are provided in Golder Report No. 21451329-001.
Client:	E.S. Fox Limited Nuclear Services		



PREPARED BY: PAK DATE: 2023/02/07 CHECKED BY: KG DATE: 2023/02/07

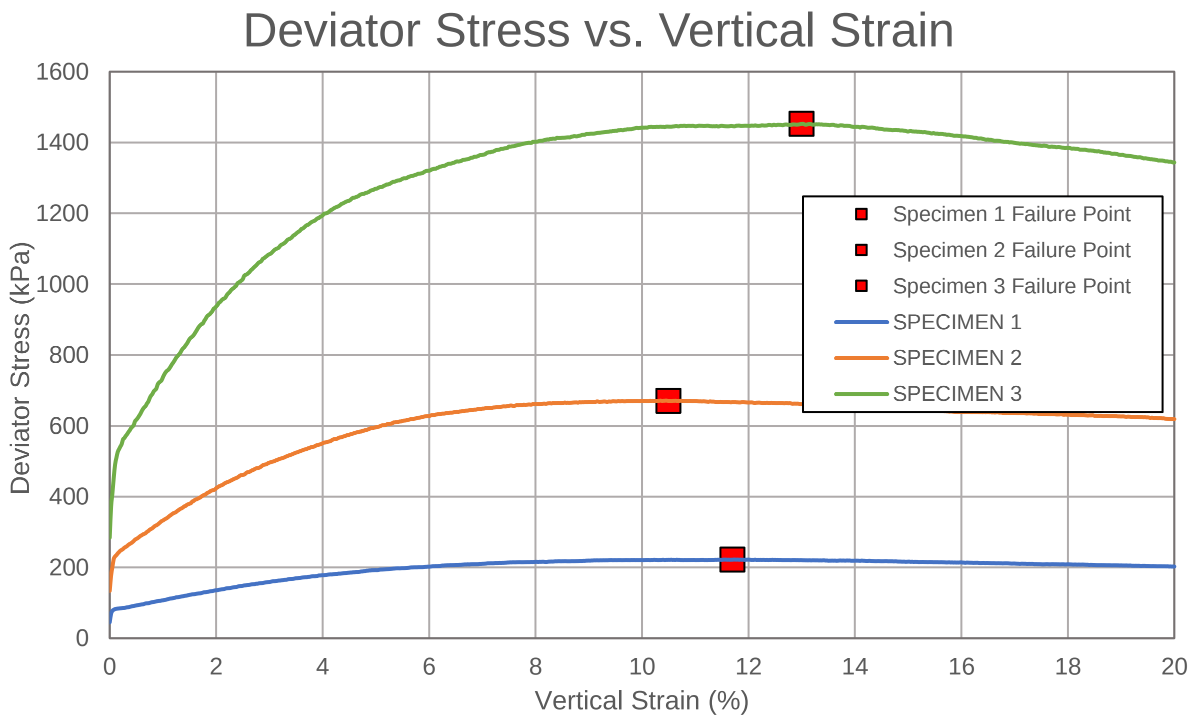
APPENDIX J

Consolidated Drained Triaxial Compression Testing Interpretations

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	3

	Specimen 1	Specimen 2	Specimen 3
Consolidation Stage:	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.67)
Sample ID:	SA12	SA14	SA17
Test ID:	CAD-1	CAD-2	CAD-3
Depth:	6.71m - 7.32 m	7.92 m - 8.53 m	9.75 m - 10.36 m



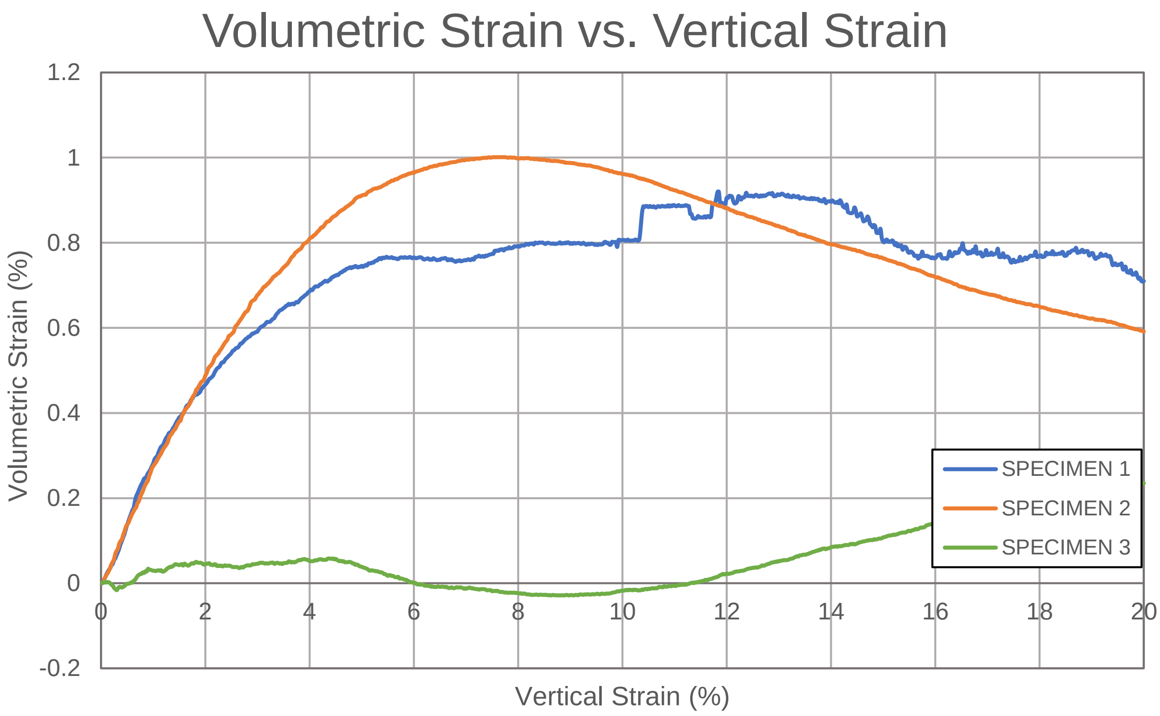
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 1.2

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	3

	Specimen 1	Specimen 2	Specimen 3
Consolidation Stage:	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.67)
Sample ID:	SA12	SA14	SA17
Test ID:	CAD-1	CAD-2	CAD-3
Depth:	6.71m - 7.32 m	7.92 m - 8.53 m	9.75 m - 10.36 m

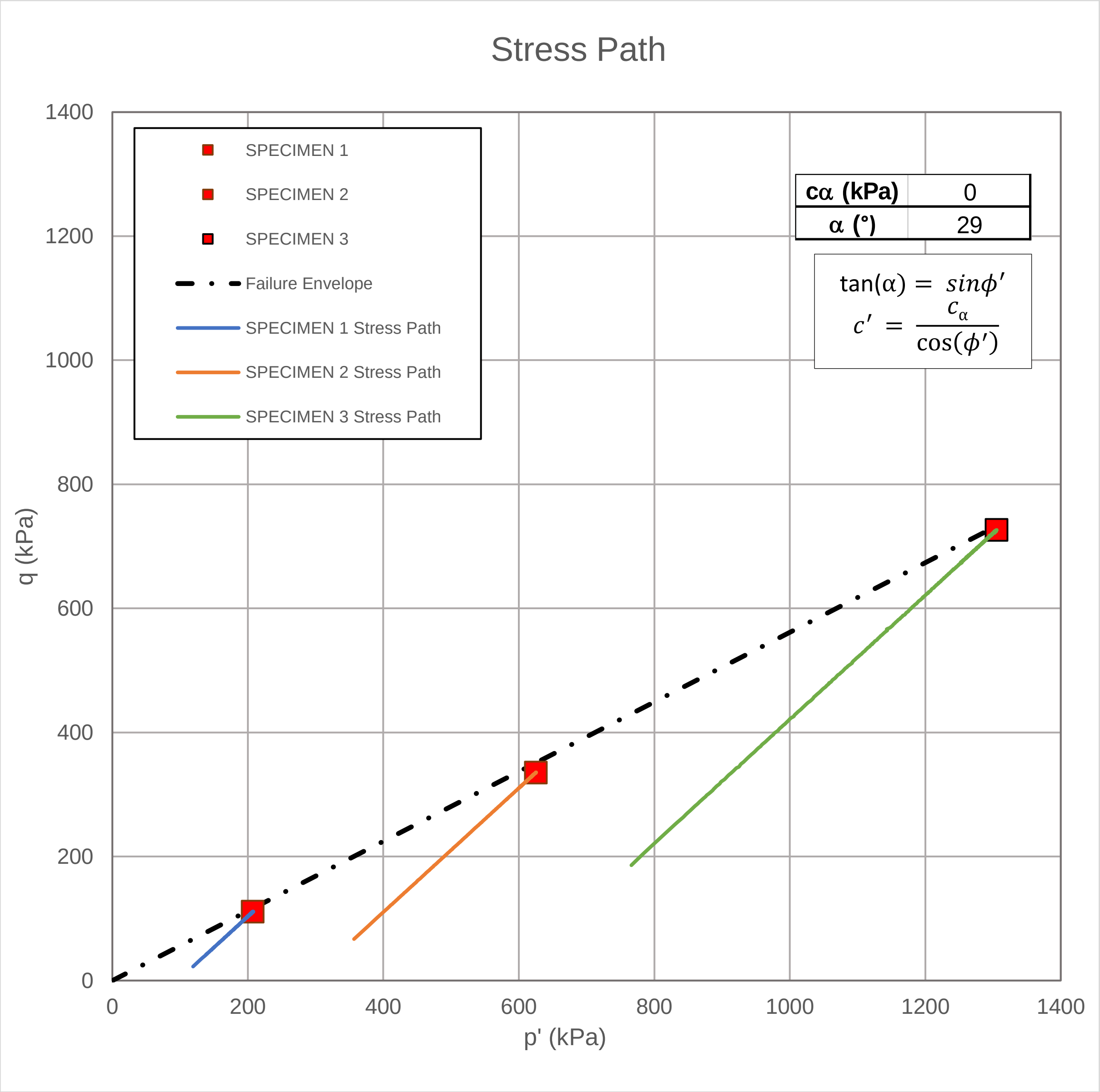


Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

	Specimen 1	Specimen 2	Specimen 3
Consolidation Stage:	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.67)
Sample ID:	SA12	SA14	SA17
Test ID:	CAD-1	CAD-2	CAD-3
Depth:	6.71m - 7.32 m	7.92 m - 8.53 m	9.75 m - 10.36 m

Project No.:	21451329
BH ID:	BH24
Soil Unit:	3



cα (kPa)	0
α (°)	29

$$\tan(\alpha) = \sin\phi'$$

$$c' = \frac{c_\alpha}{\cos(\phi')}$$

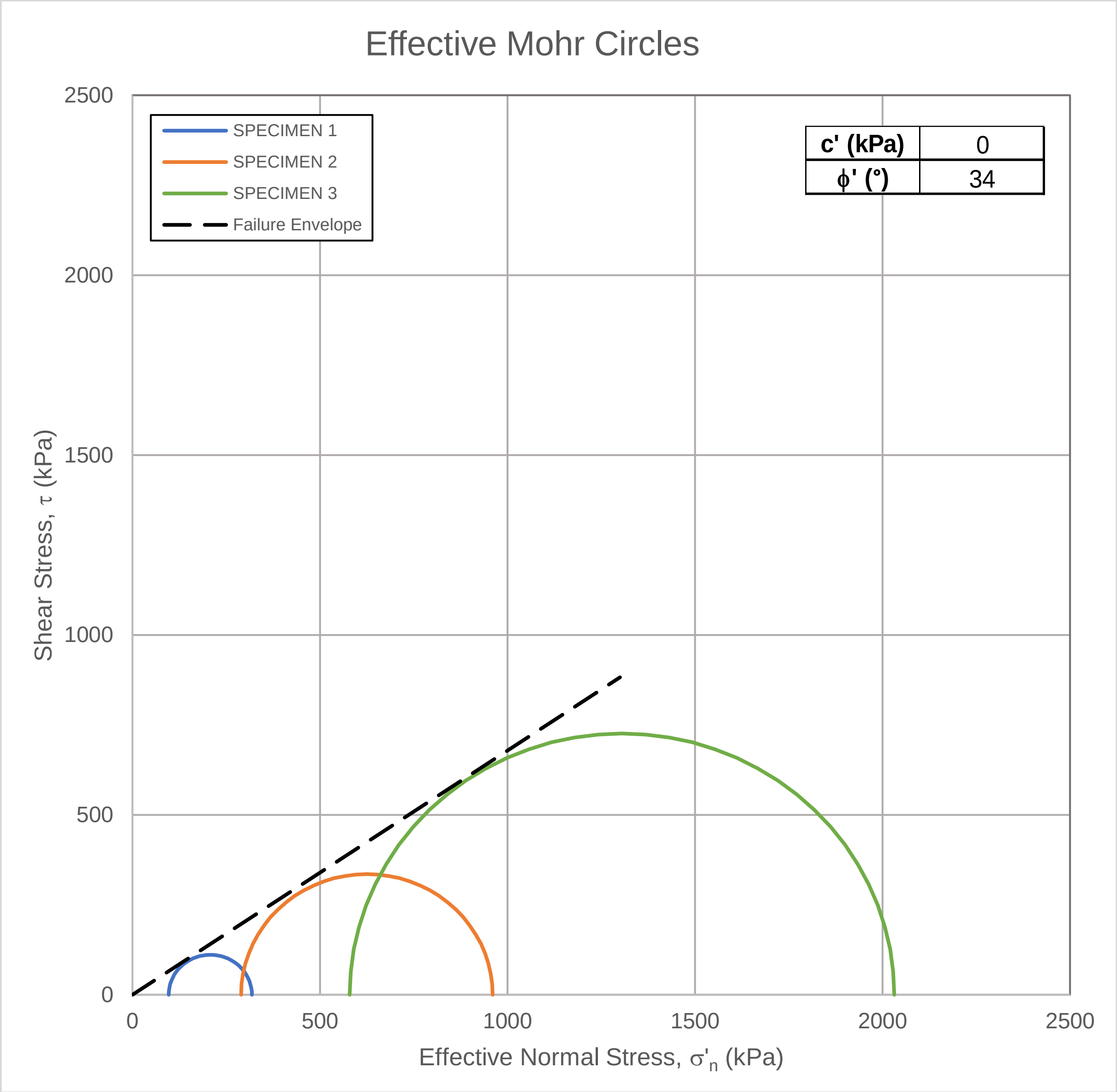
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 1.4

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	3

	Specimen 1	Specimen 2	Specimen 3
Consolidation Stage:	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.67)
Sample ID:	SA12	SA14	SA17
Test ID:	CAD-1	CAD-2	CAD-3
Depth:	6.71m - 7.32 m	7.92 m - 8.53 m	9.75 m - 10.36 m



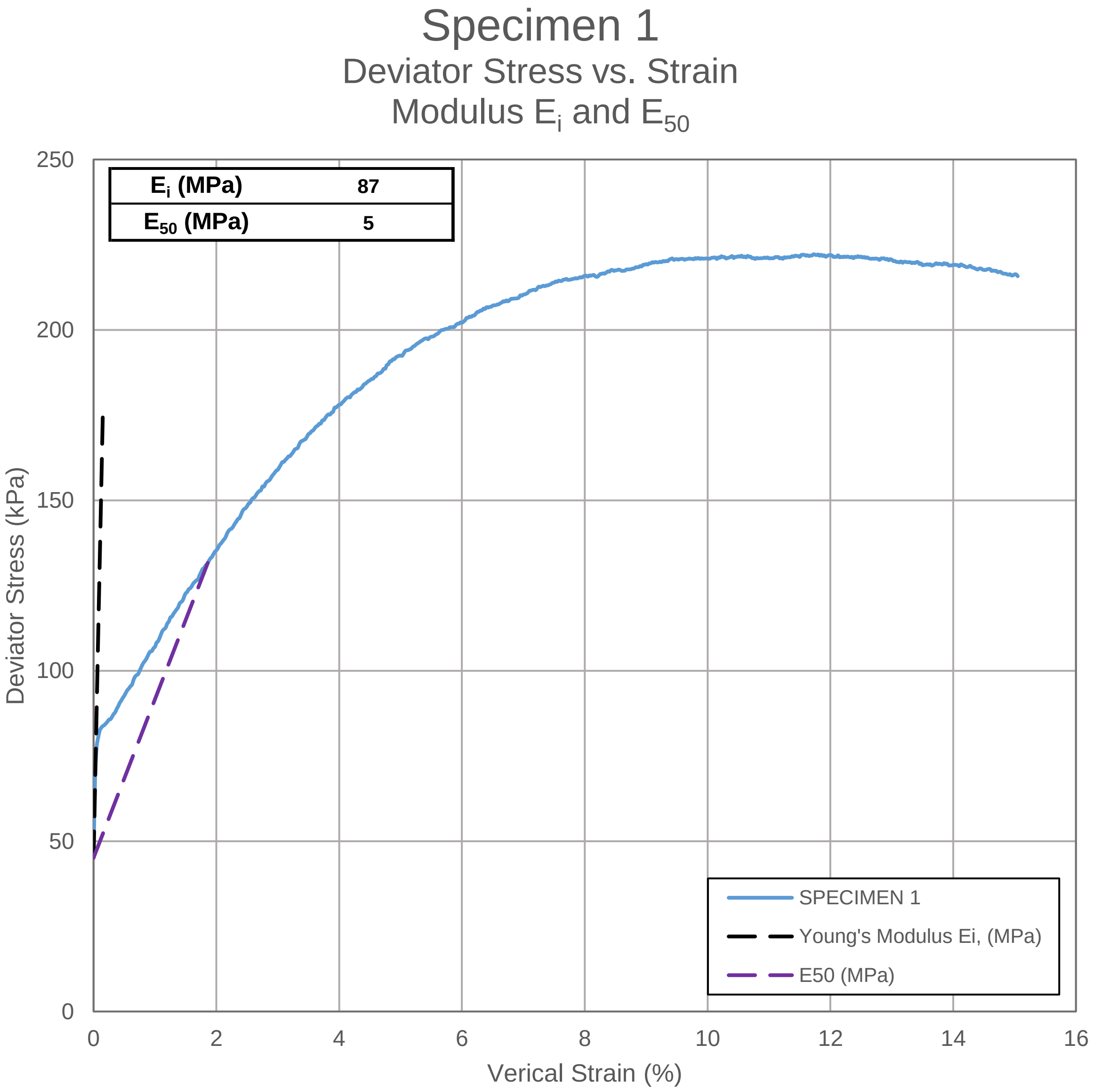
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 1.5

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	3

	Specimen 1	Specimen 2	Specimen 3
Consolidation Stage:	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.67)
Sample ID:	SA12	SA14	SA17
Test ID:	CAD-1	CAD-2	CAD-3
Depth:	6.71m - 7.32 m	7.92 m - 8.53 m	9.75 m - 10.36 m



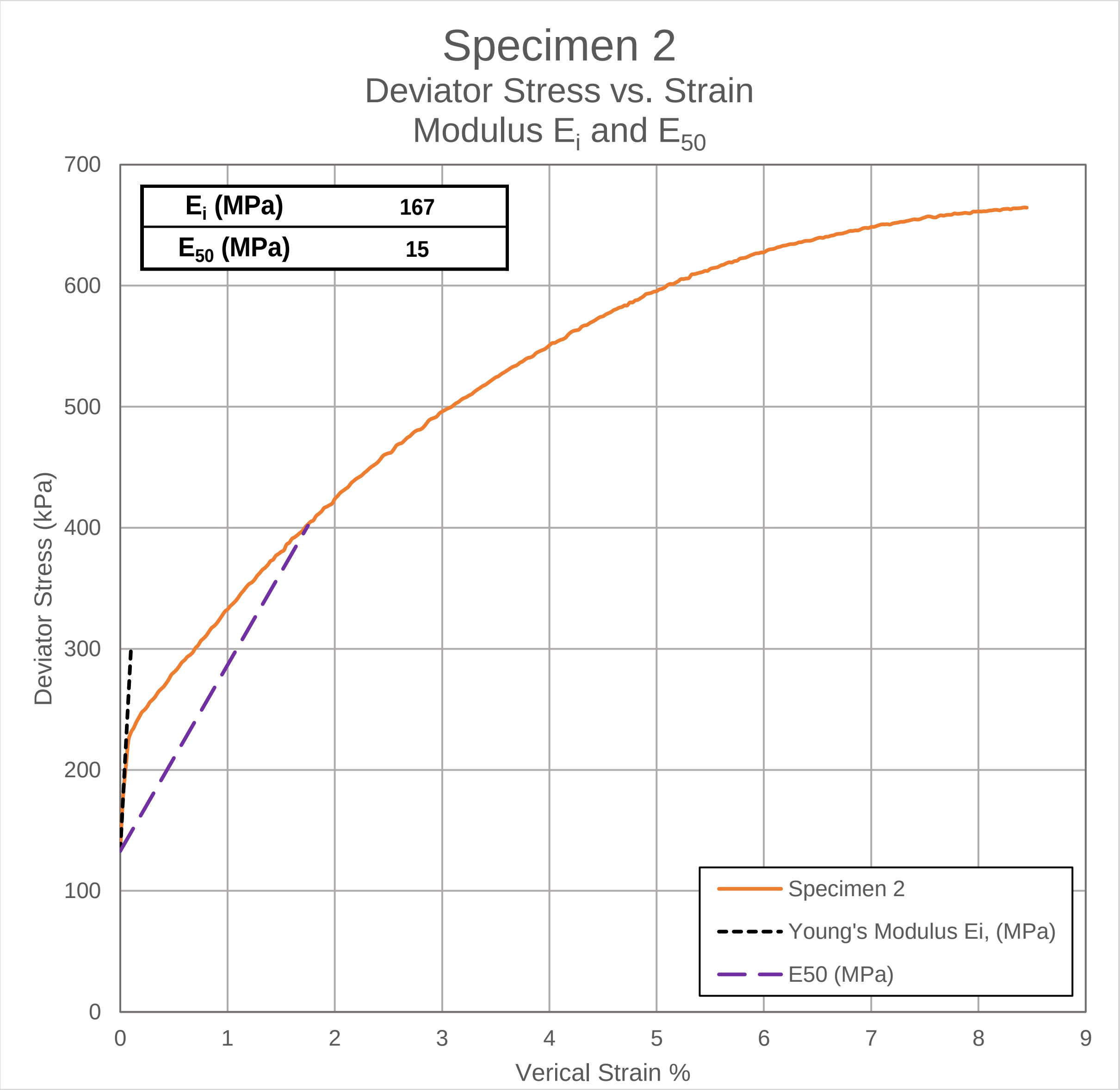
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 1.6

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	3

	Specimen 1	Specimen 2	Specimen 3
Consolidation Stage:	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.67)
Sample ID:	SA12	SA14	SA17
Test ID:	CAD-1	CAD-2	CAD-3
Depth:	6.71m - 7.32 m	7.92 m - 8.53 m	9.75 m - 10.36 m

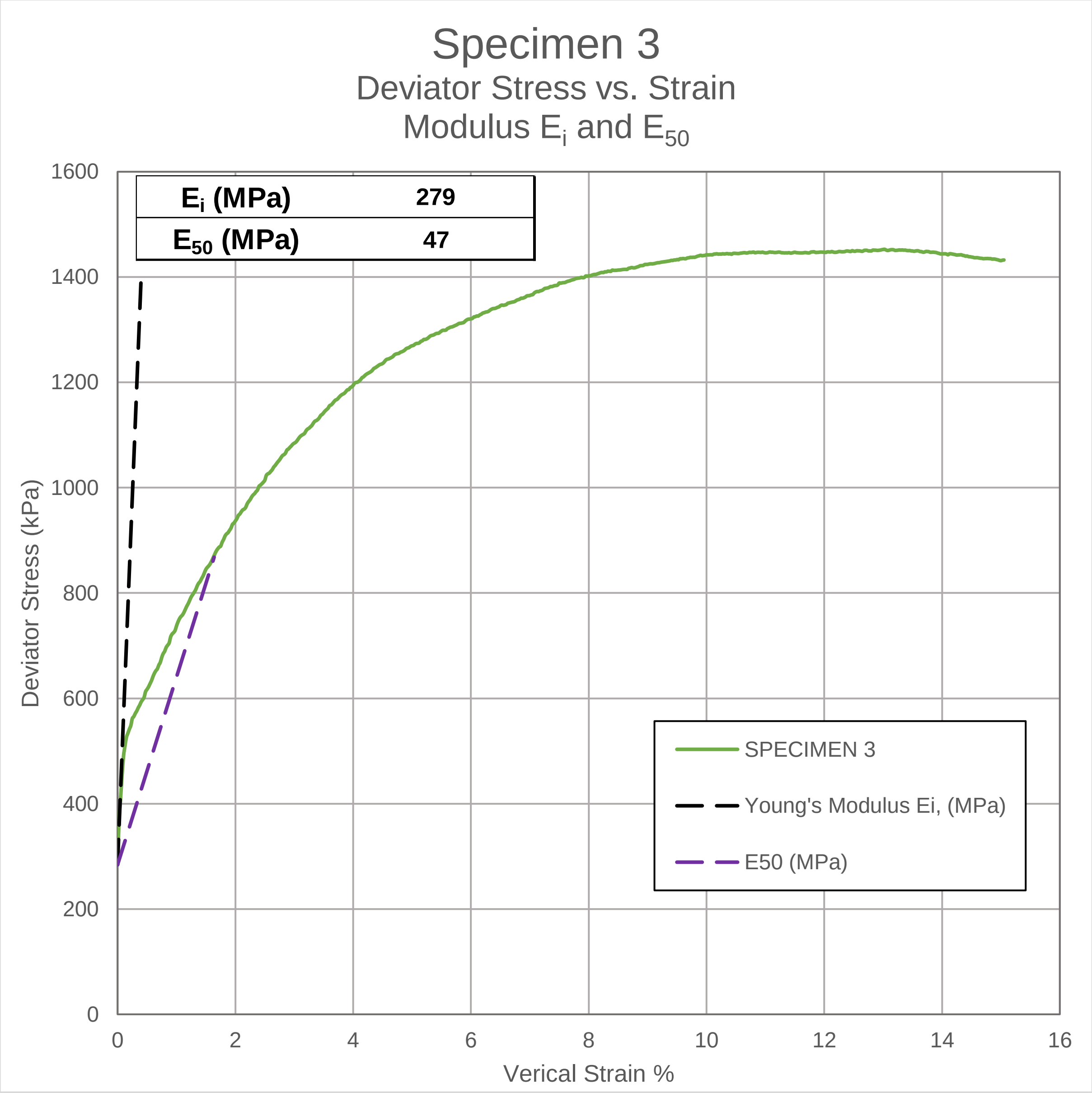


Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	3

	Specimen 1	Specimen 2	Specimen 3
Consolidation Stage:	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.67)
Sample ID:	SA12	SA14	SA17
Test ID:	CAD-1	CAD-2	CAD-3
Depth:	6.71m - 7.32 m	7.92 m - 8.53 m	9.75 m - 10.36 m

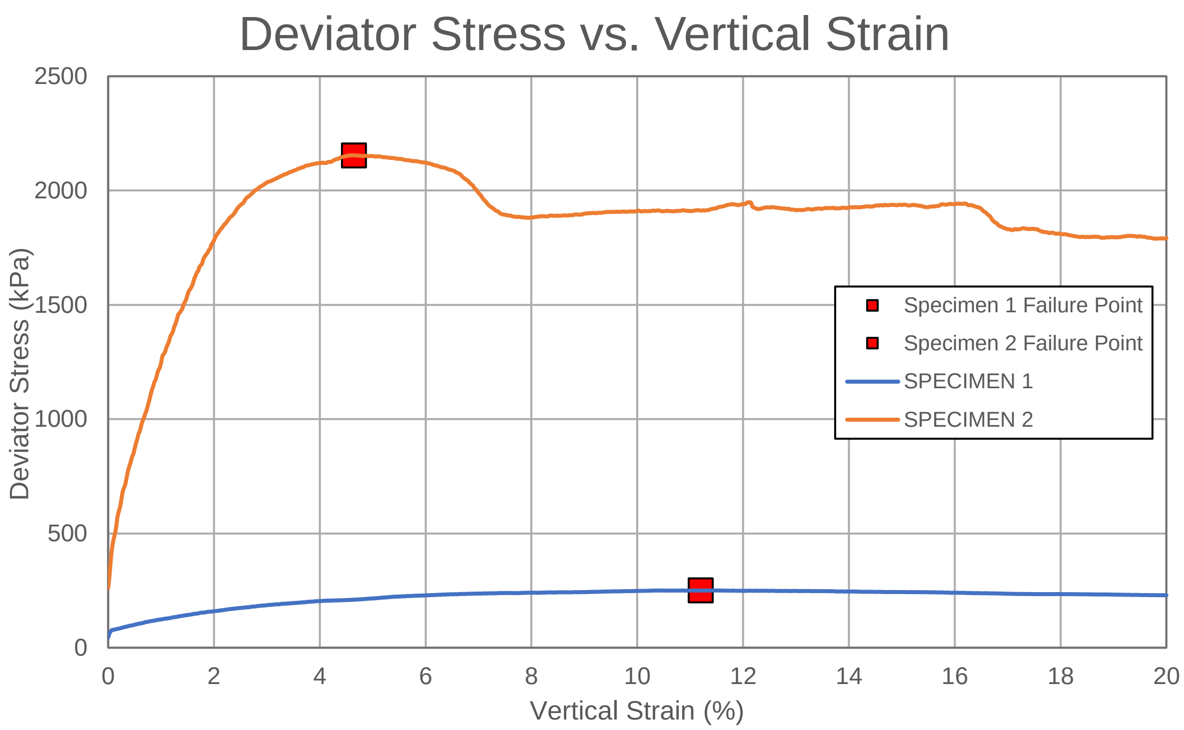


Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	3

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)
Sample ID:	SA20	SA23
Test ID:	CAD-4	CAD-5
Depth:	11.58 m - 12.19 m	13.41 m - 14.02 m

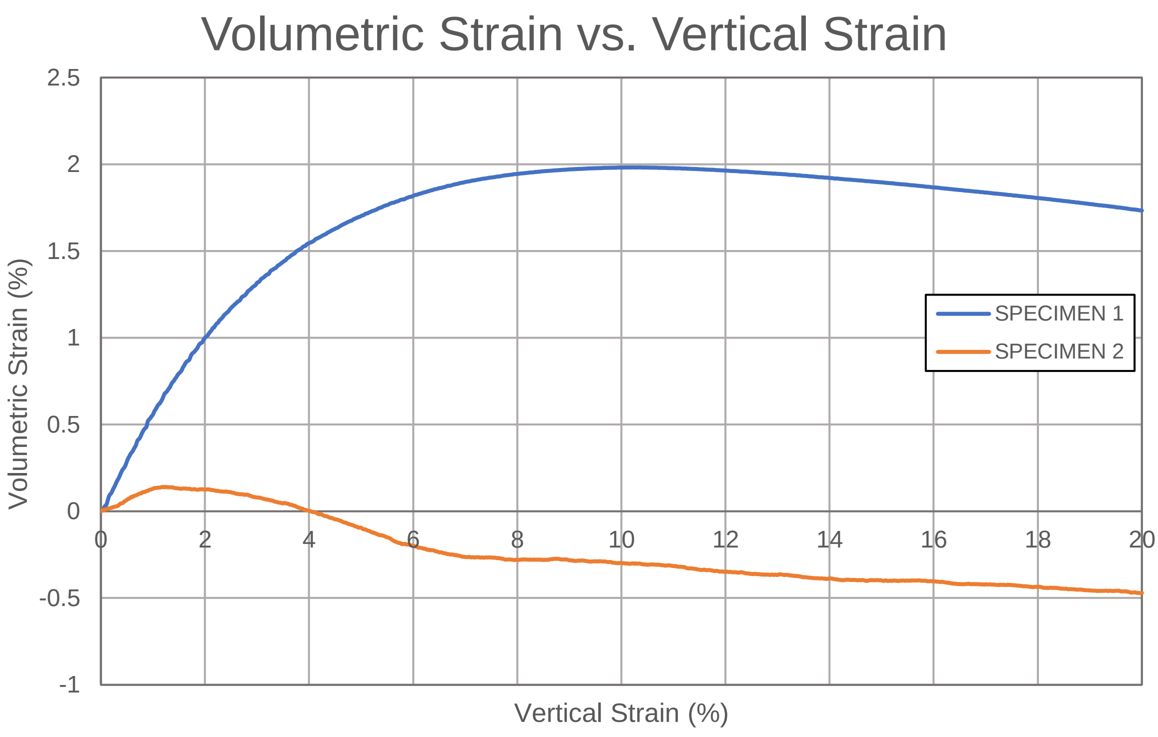


Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	3

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)
Sample ID:	SA20	SA23
Test ID:	CAD-4	CAD-5
Depth:	11.58 m - 12.19 m	13.41 m - 14.02 m



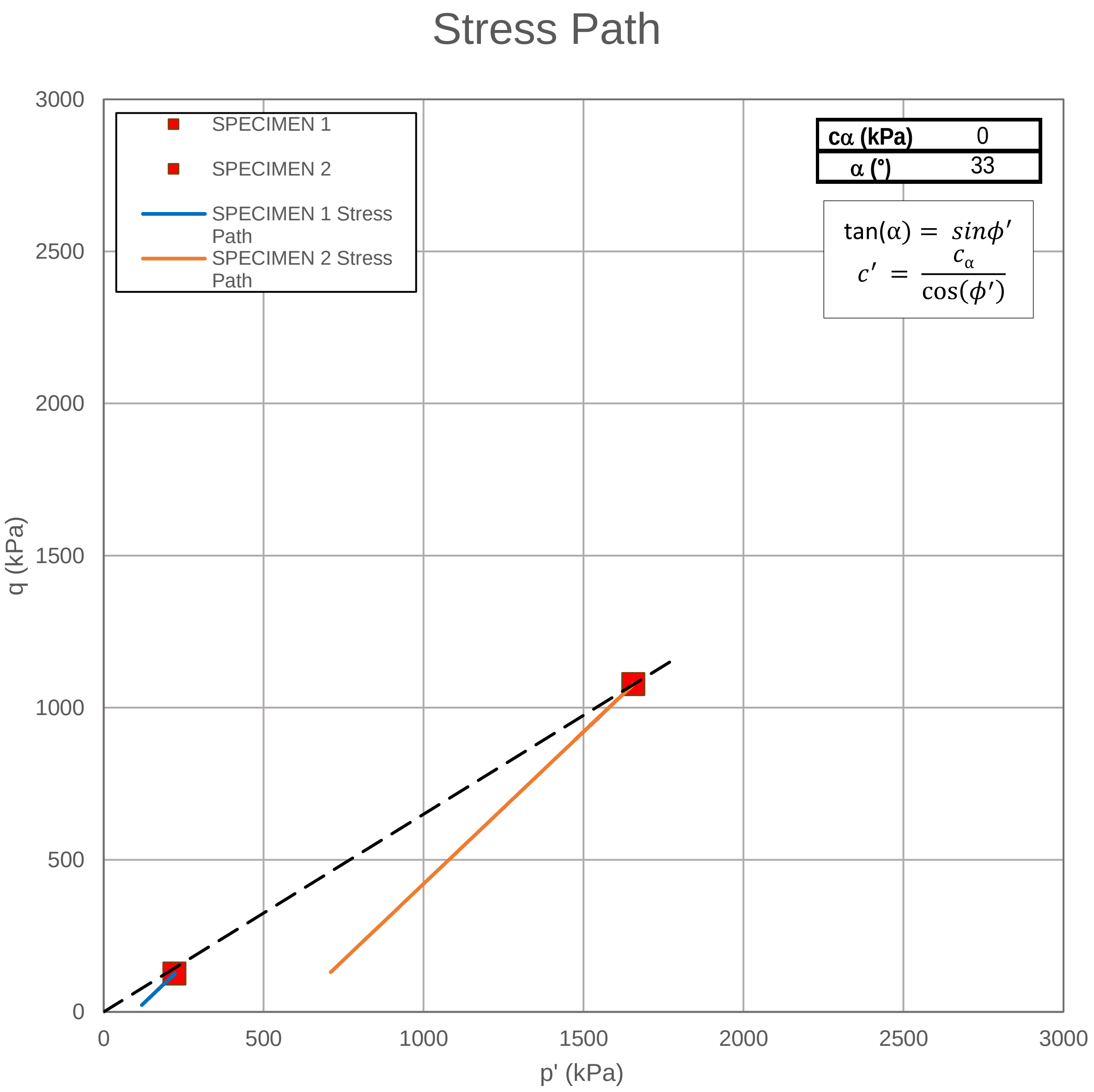
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 2.3

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	3

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)
Sample ID:	SA20	SA23
Test ID:	CAD-4	CAD-5
Depth:	11.58 m - 12.19 m	13.41 m - 14.02 m



cα (kPa)	0
α (°)	33

$$\tan(\alpha) = sin\phi'$$

$$c' = \frac{c_\alpha}{\cos(\phi')}$$

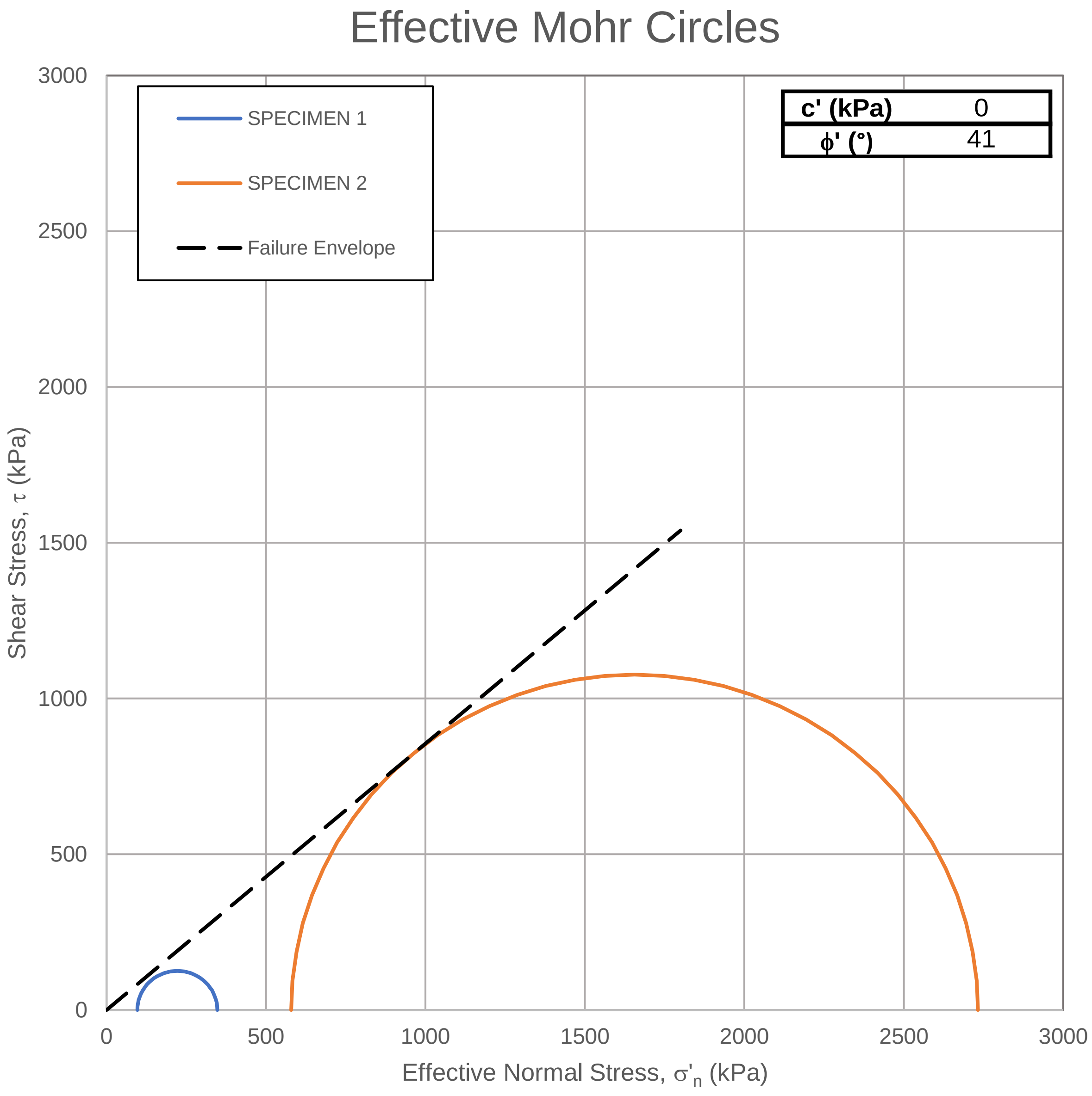
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 2.4

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	3

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)
Sample ID:	SA20	SA23
Test ID:	CAD-4	CAD-5
Depth:	11.58 m - 12.19 m	13.41 m - 14.02 m



Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 2.5

Consolidated Drained (CAD) Triaxial Test

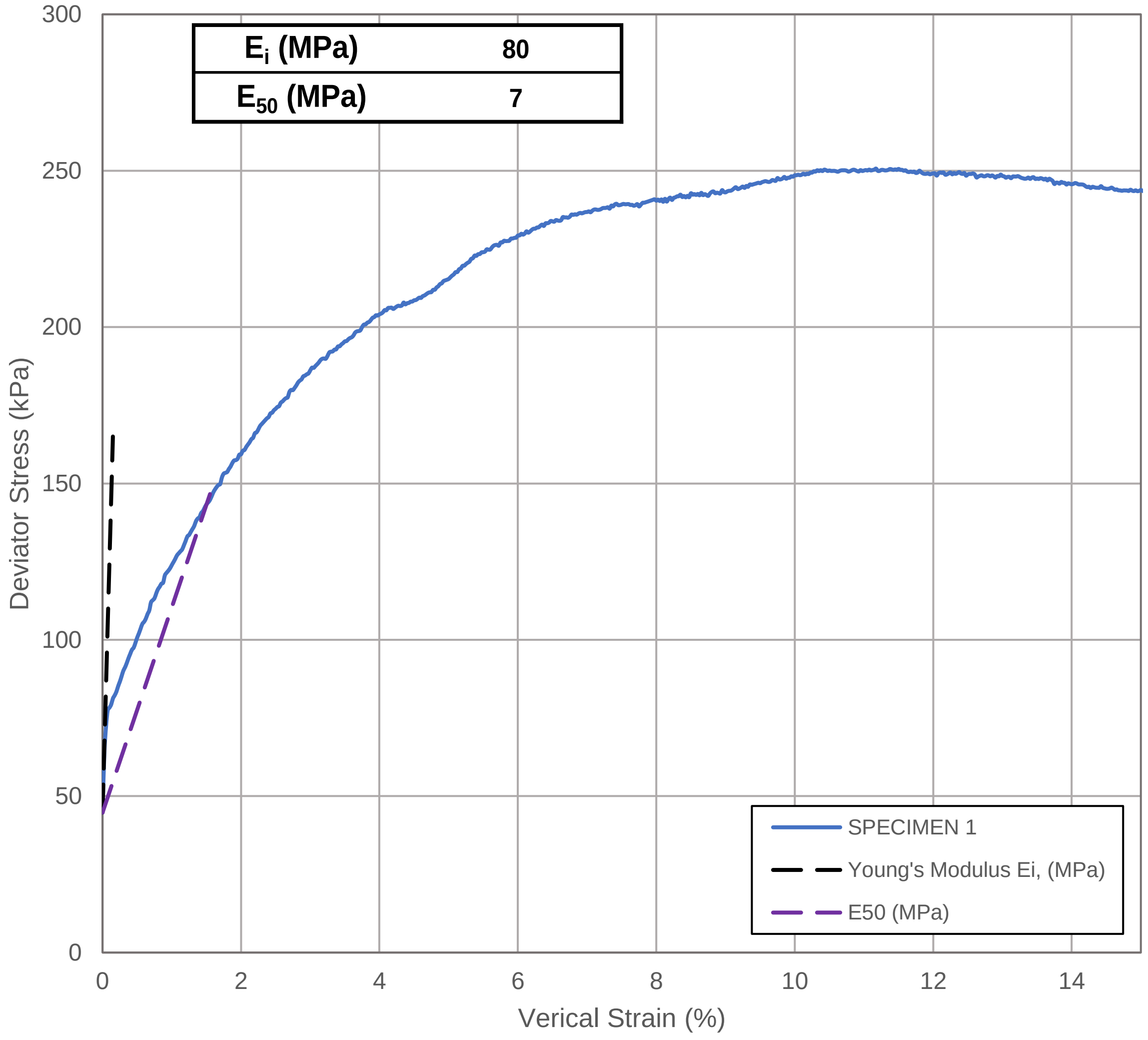
Project No.:	21451329
BH ID:	BH24
Soil Unit:	3

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)
Sample ID:	SA20	SA23
Test ID:	CAD-4	CAD-5
Depth:	11.58 m - 12.19 m	13.41 m - 14.02 m

Specimen 1

Deviator Stress vs. Strain

Modulus E_i and E_{50}

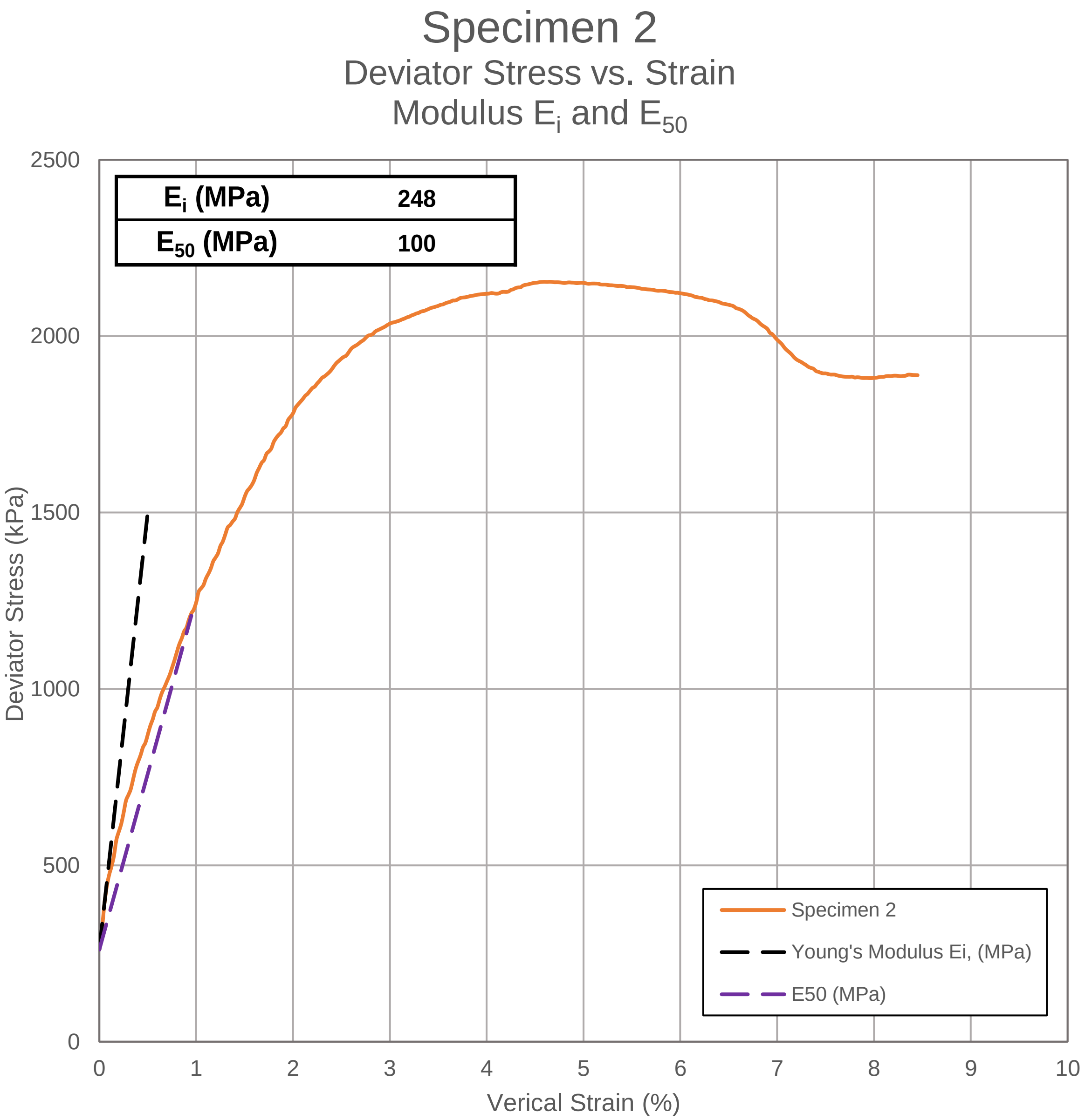


Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	3

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)
Sample ID:	SA20	SA23
Test ID:	CAD-4	CAD-5
Depth:	11.58 m - 12.19 m	13.41 m - 14.02 m



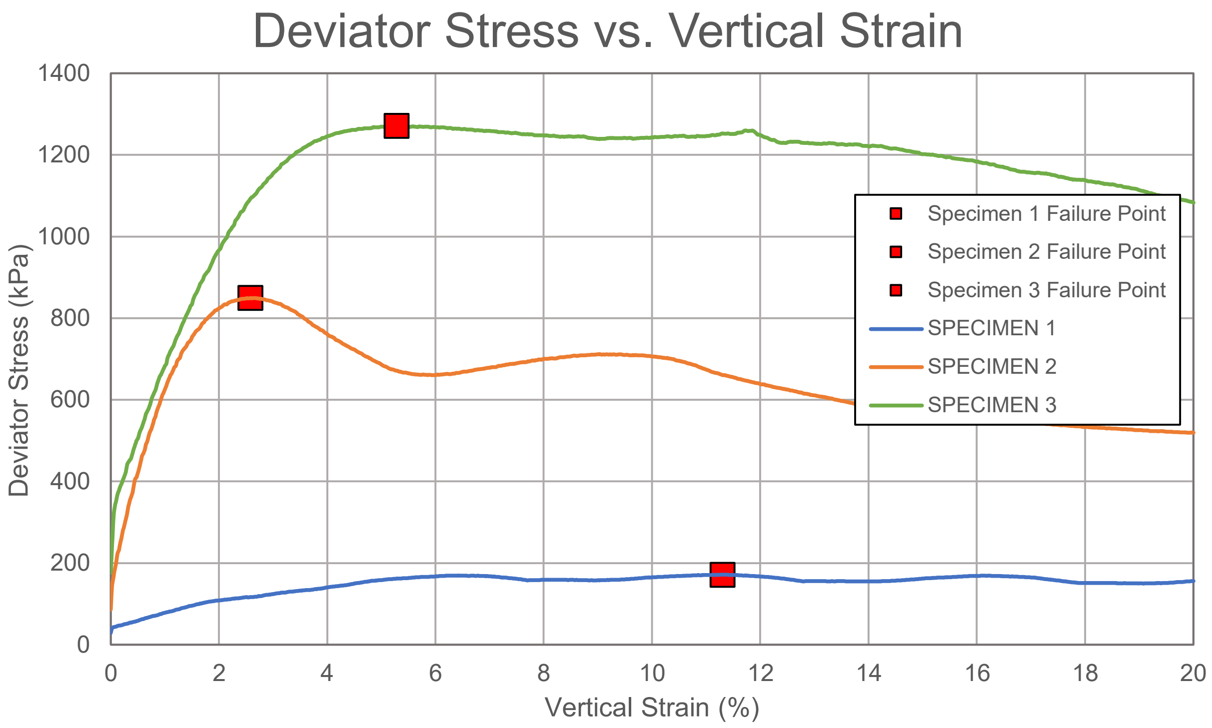
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 3.1

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	3

	Specimen 1	Specimen 2	Specimen 3
Consolidation Stage:	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)
Sample ID:	SA4	SA7	SA11
Test ID:	CAD-6	CAD-7R	CAD-8
Depth:	1.83 m - 2.44 m	3.66 m - 4.27 m	6.10 m - 6.71 m

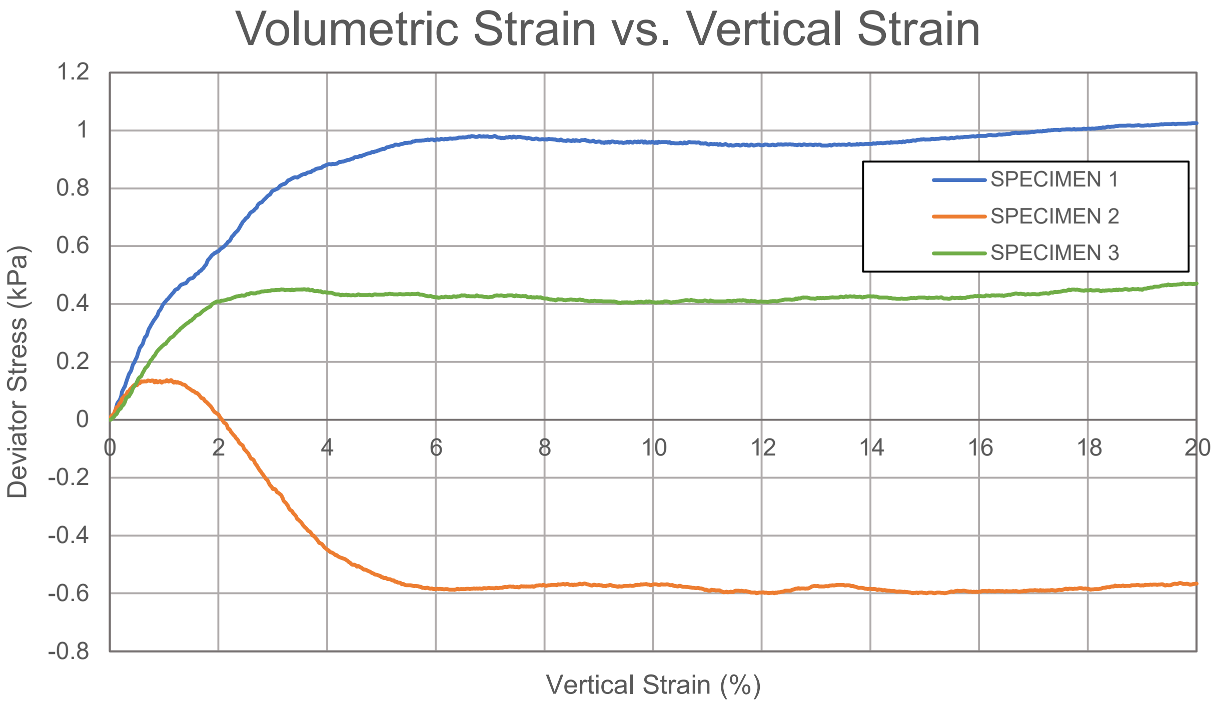


Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	3

	Specimen 1	Specimen 2	Specimen 3
Consolidation Stage:	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)
Sample ID:	SA4	SA7	SA11
Test ID:	CAD-6	CAD-7R	CAD-8
Depth:	1.83 m - 2.44 m	3.66 m - 4.27 m	6.10 m - 6.71 m



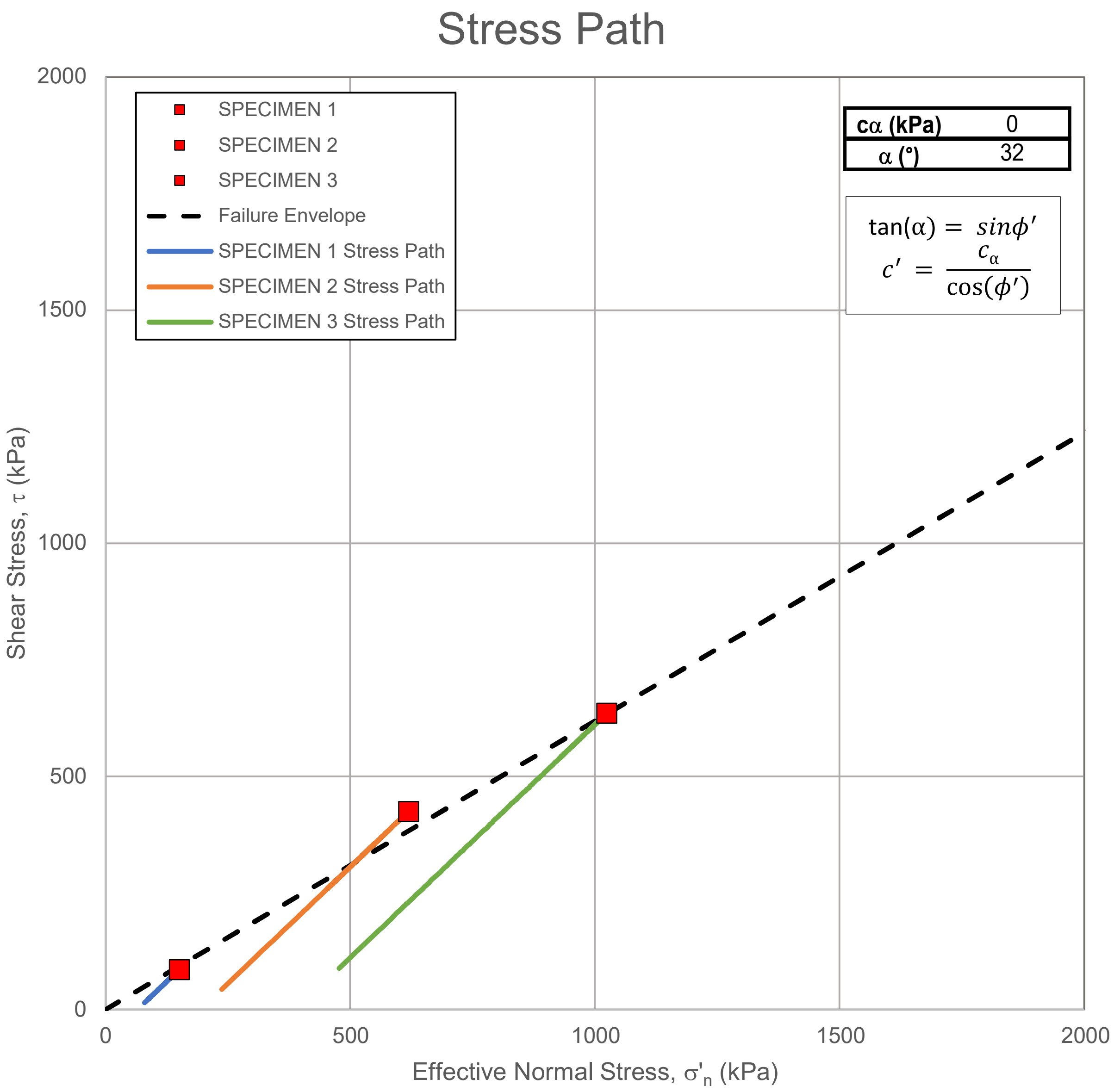
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 3.3

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	3

	Specimen 1	Specimen 2	Specimen 3
Consolidation Stage:	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)
Sample ID:	SA4	SA7	SA11
Test ID:	CAD-6	CAD-7R	CAD-8
Depth:	1.83 m - 2.44 m	3.66 m - 4.27 m	6.10 m - 6.71 m

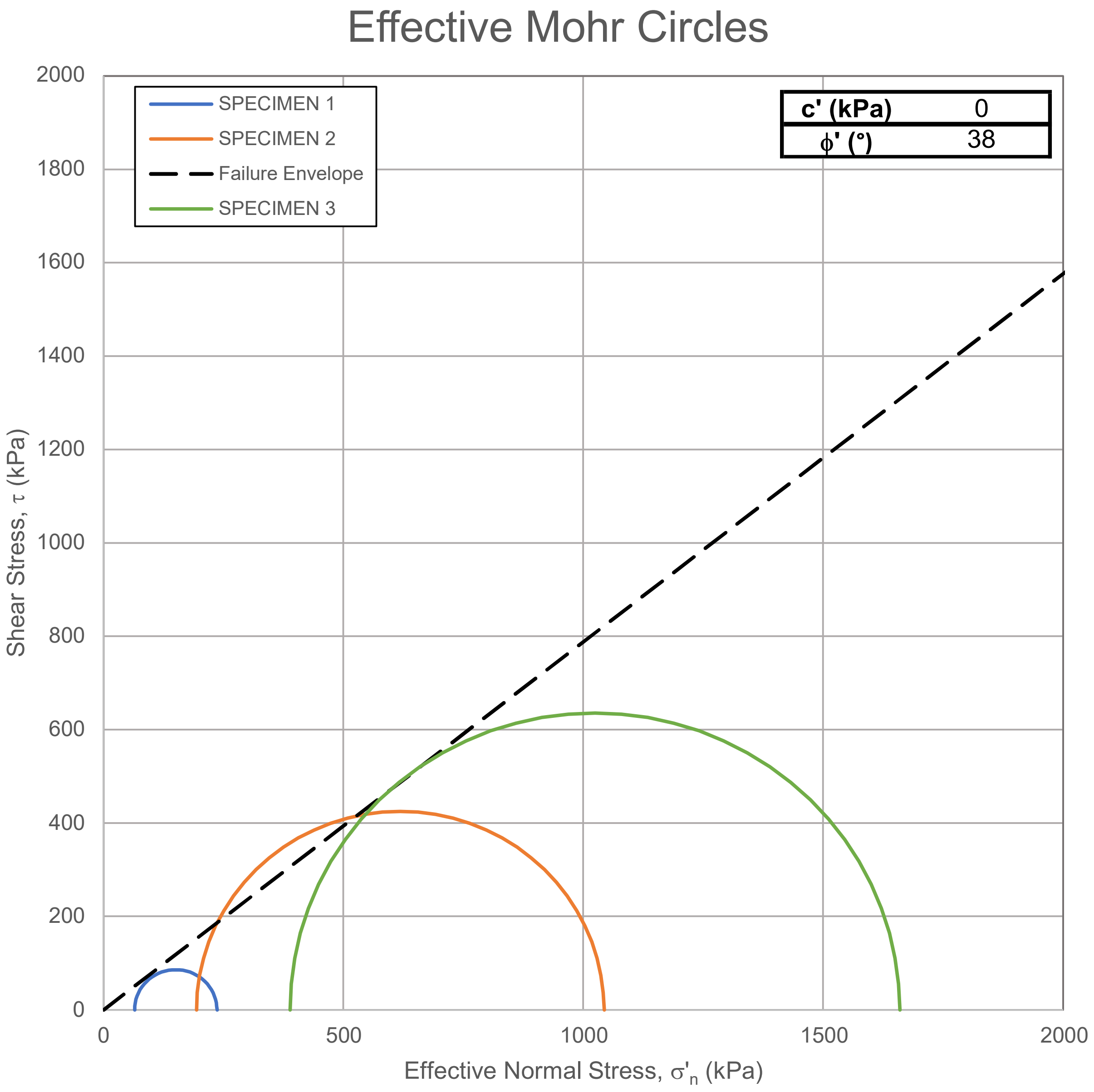

Stress Path

Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

	Specimen 1	Specimen 2	Specimen 3
Consolidation Stage:	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)
Sample ID:	SA4	SA7	SA11
Test ID:	CAD-6	CAD-7R	CAD-8
Depth:	1.83 m - 2.44 m	3.66 m - 4.27 m	6.10 m - 6.71 m

Project No.:	21451329
BH ID:	BH26
Soil Unit:	3

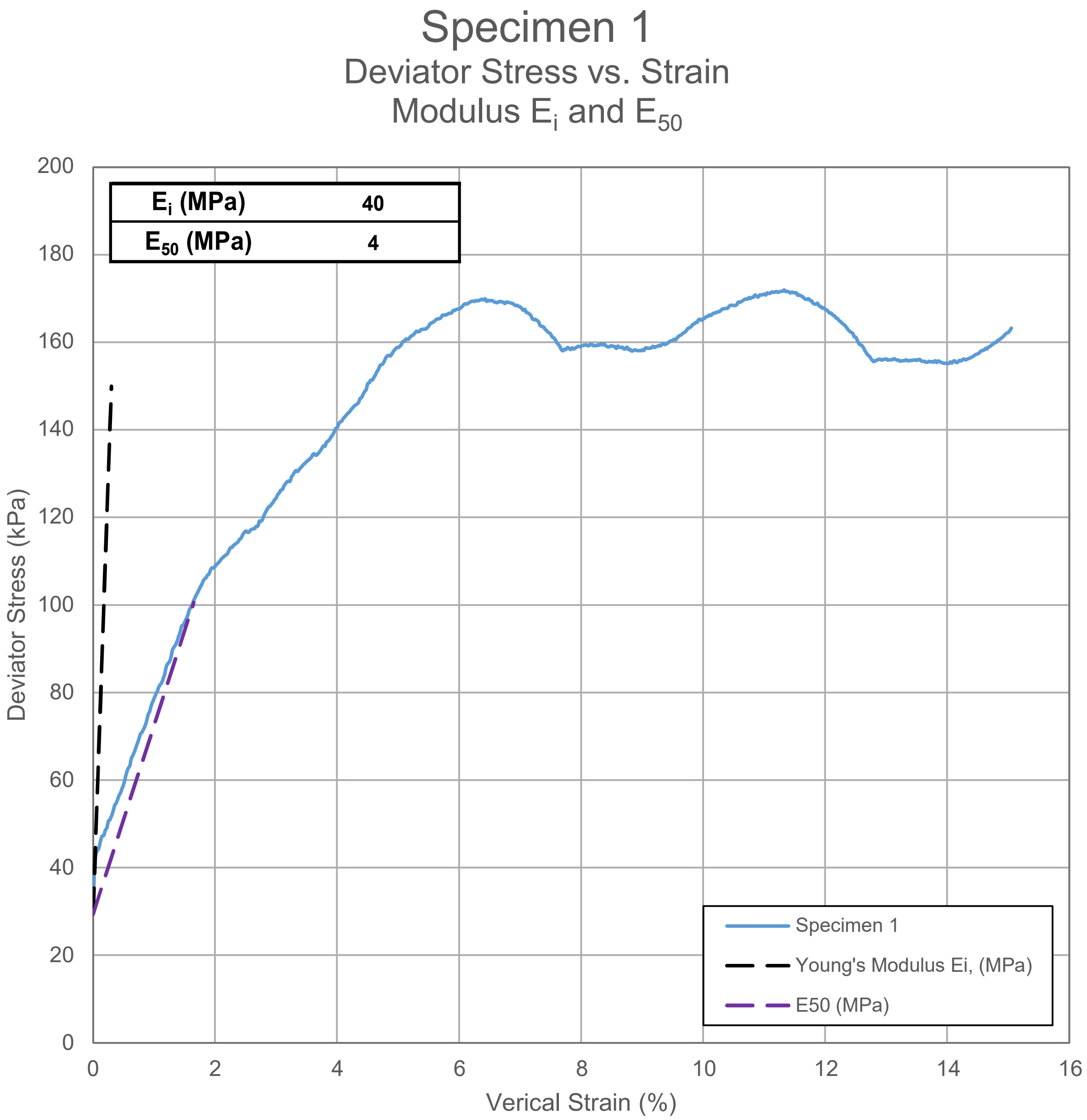


Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	3

	Specimen 1	Specimen 2	Specimen 3
Consolidation Stage:	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)
Sample ID:	SA4	SA7	SA11
Test ID:	CAD-6	CAD-7R	CAD-8
Depth:	1.83 m - 2.44 m	3.66 m - 4.27 m	6.10 m - 6.71 m

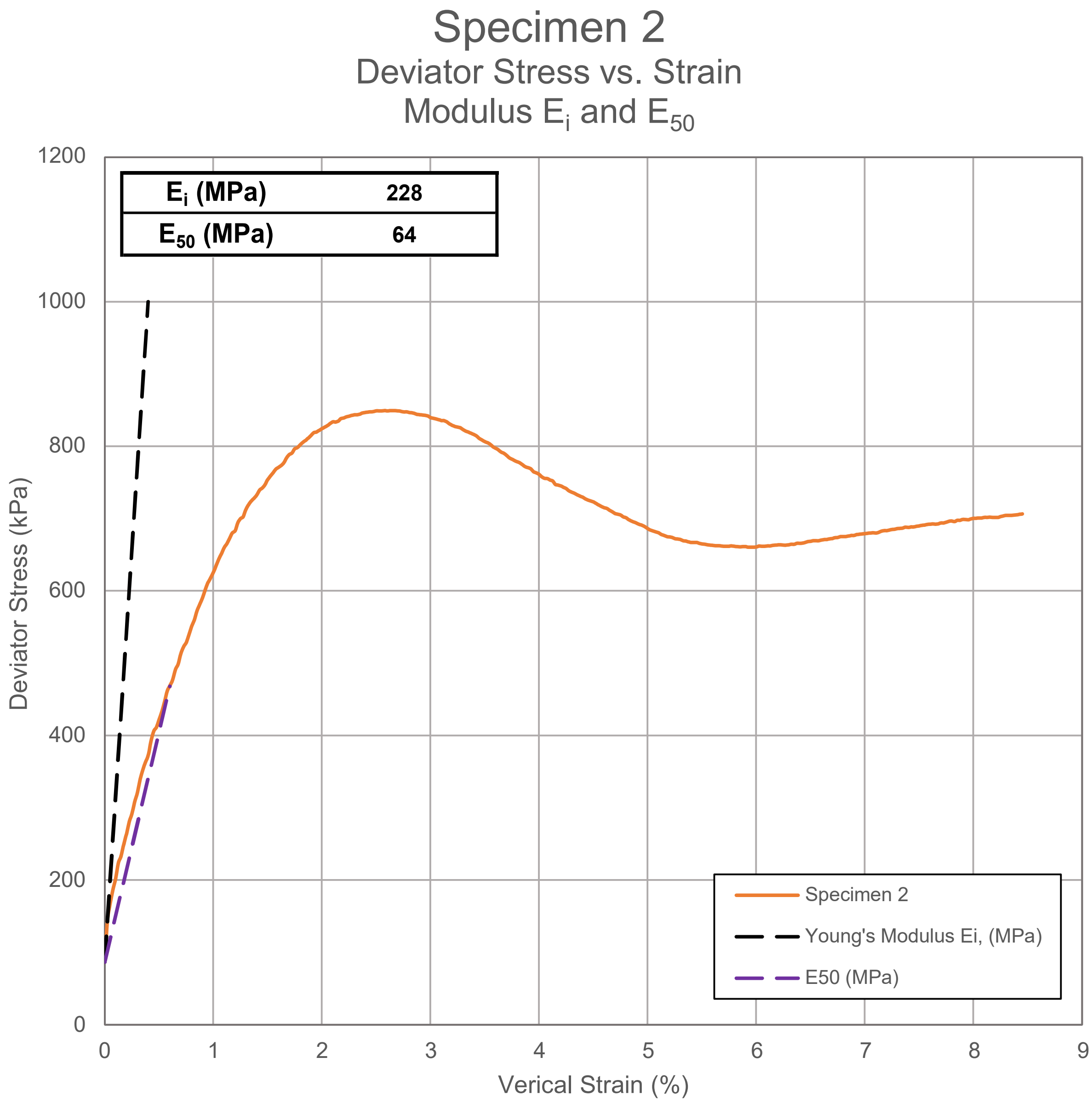


Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	3

	Specimen 1	Specimen 2	Specimen 3
Consolidation Stage:	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)
Sample ID:	SA4	SA7	SA11
Test ID:	CAD-6	CAD-7R	CAD-8
Depth:	1.83 m - 2.44 m	3.66 m - 4.27 m	6.10 m - 6.71 m

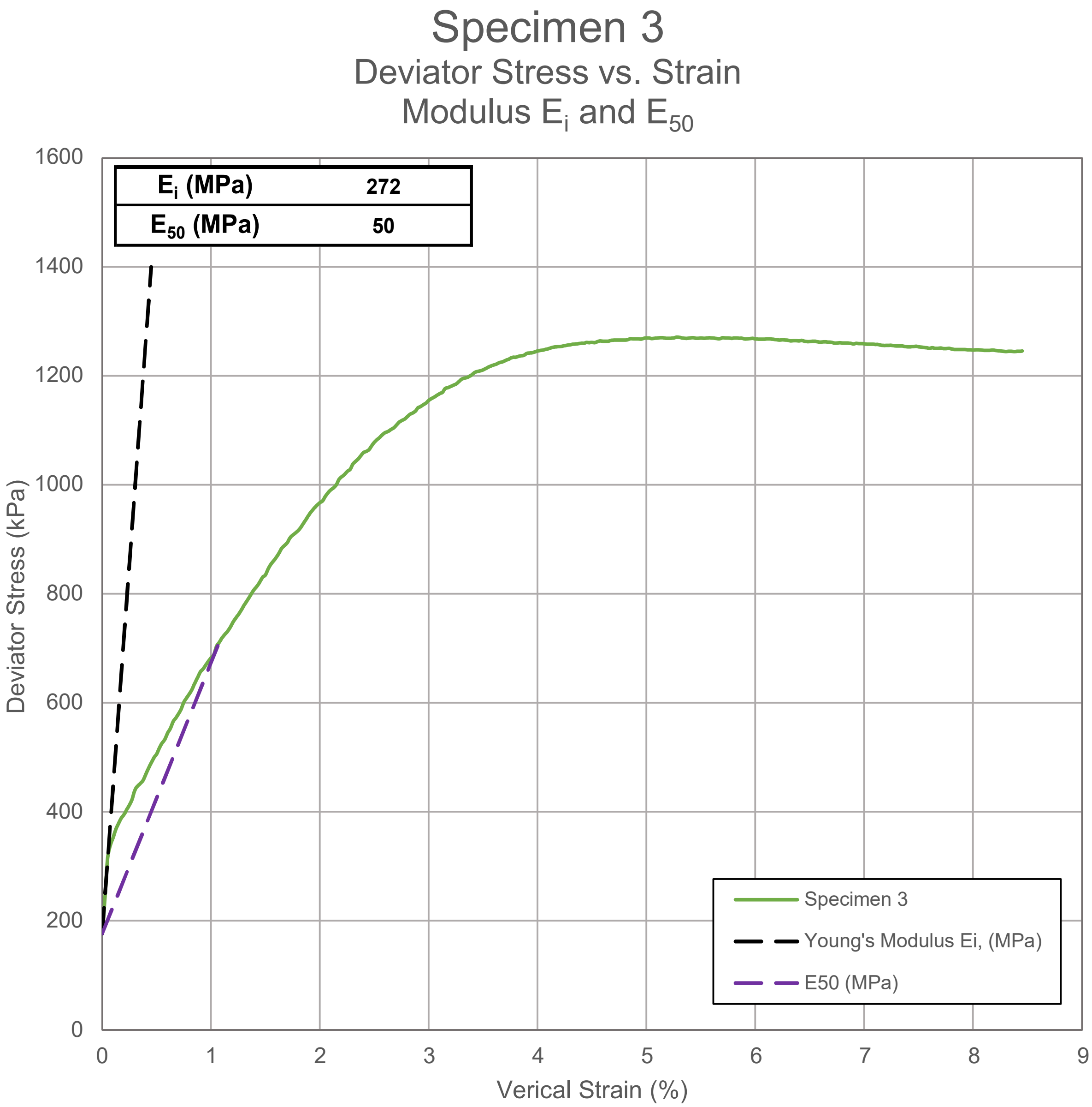


Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	3

	Specimen 1	Specimen 2	Specimen 3
Consolidation Stage:	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)
Sample ID:	SA4	SA7	SA11
Test ID:	CAD-6	CAD-7R	CAD-8
Depth:	1.83 m - 2.44 m	3.66 m - 4.27 m	6.10 m - 6.71 m

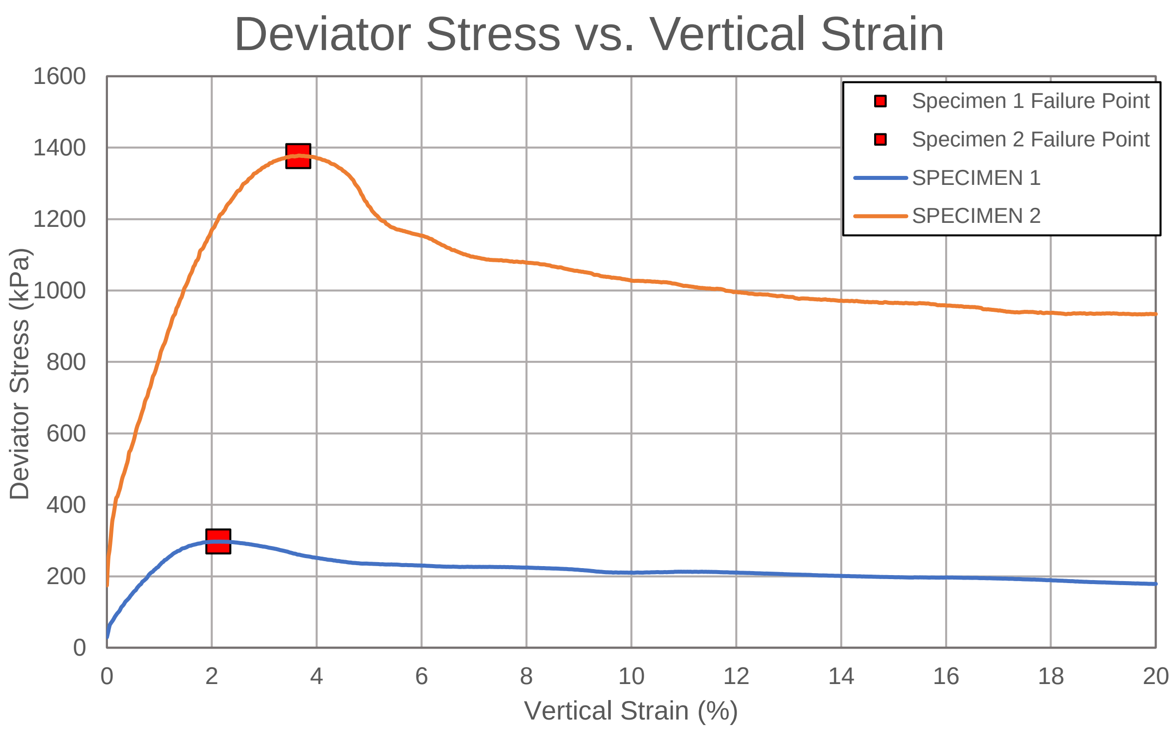


Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	3

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)
Sample ID:	SA15	SA17
Test ID:	CAD-9	CAD-10
Depth:	8.53 m - 9.14 m	9.75 m - 10.16 m



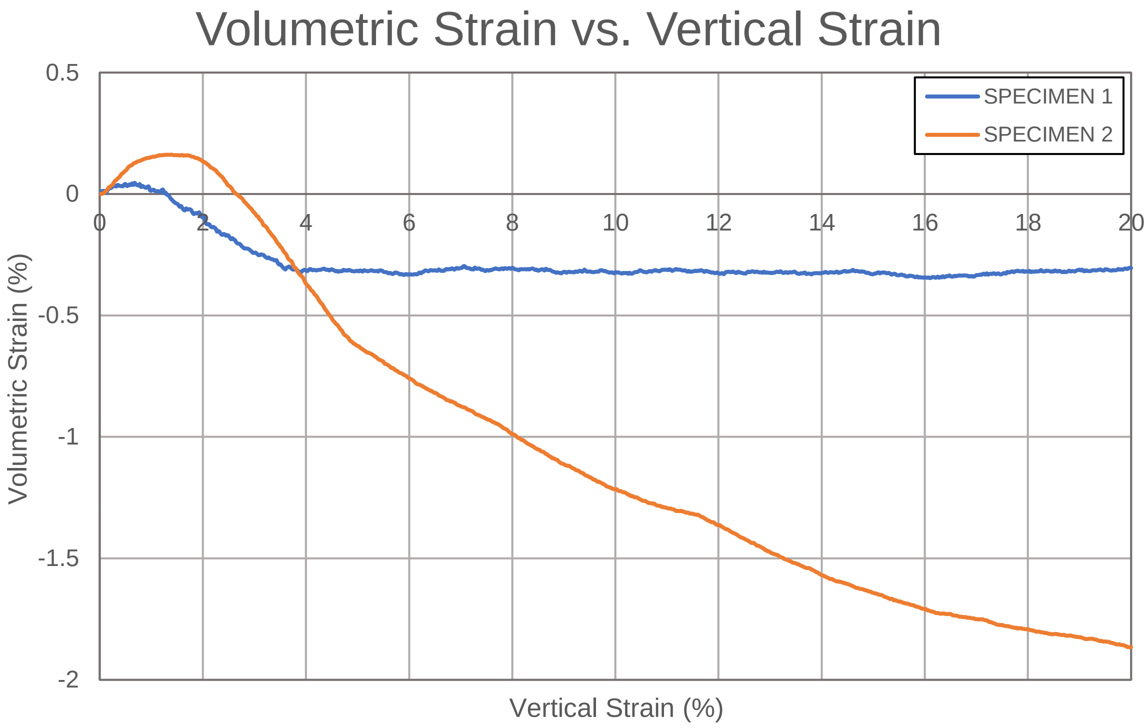
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 4.2

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	3

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)
Sample ID:	SA15	SA17
Test ID:	CAD-9	CAD-10
Depth:	8.53 m - 9.14 m	9.75 m - 10.16 m



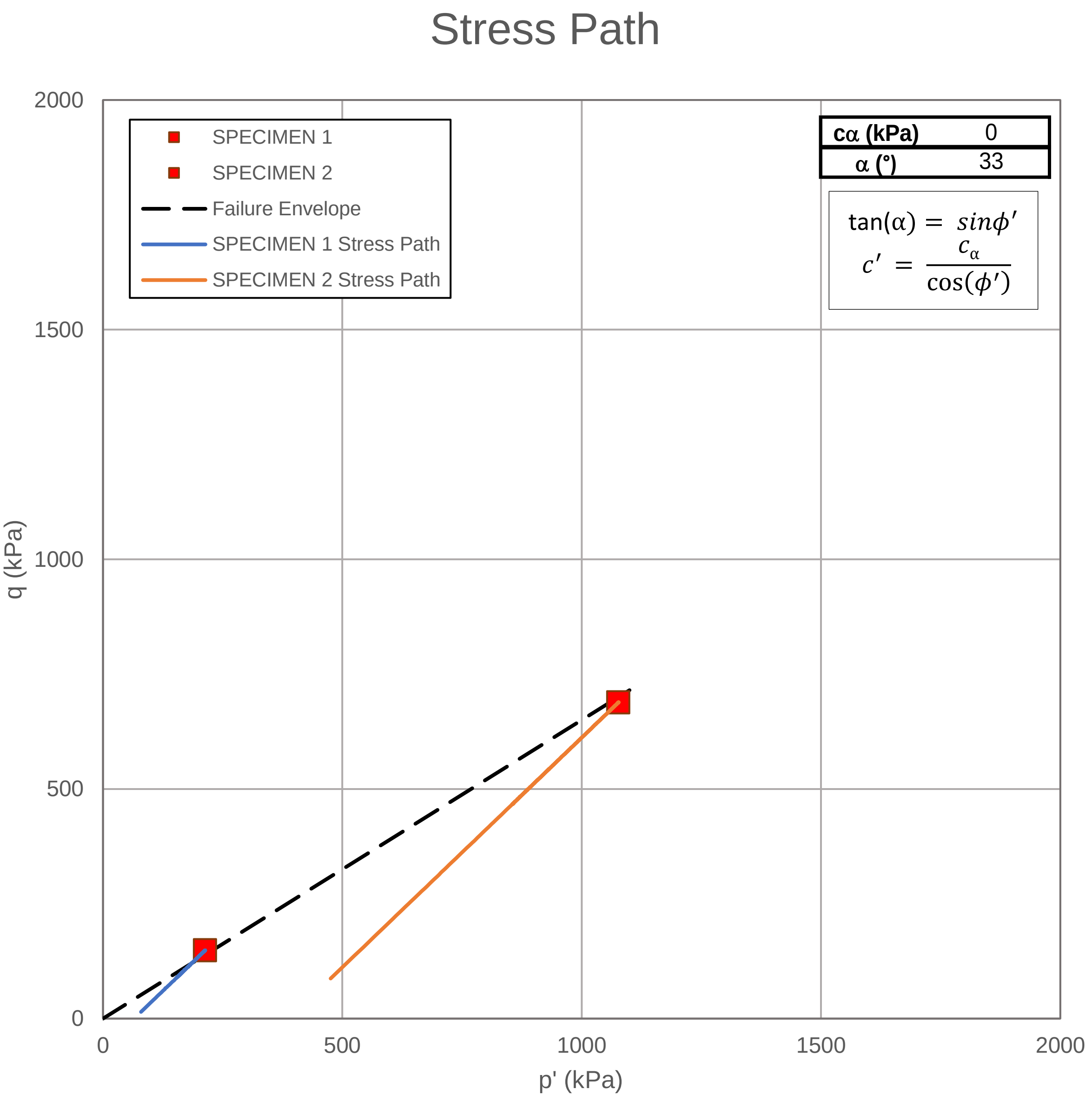
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 4.3

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	3

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)
Sample ID:	SA15	SA17
Test ID:	CAD-9	CAD-10
Depth:	8.53 m - 9.14 m	9.75 m - 10.16 m

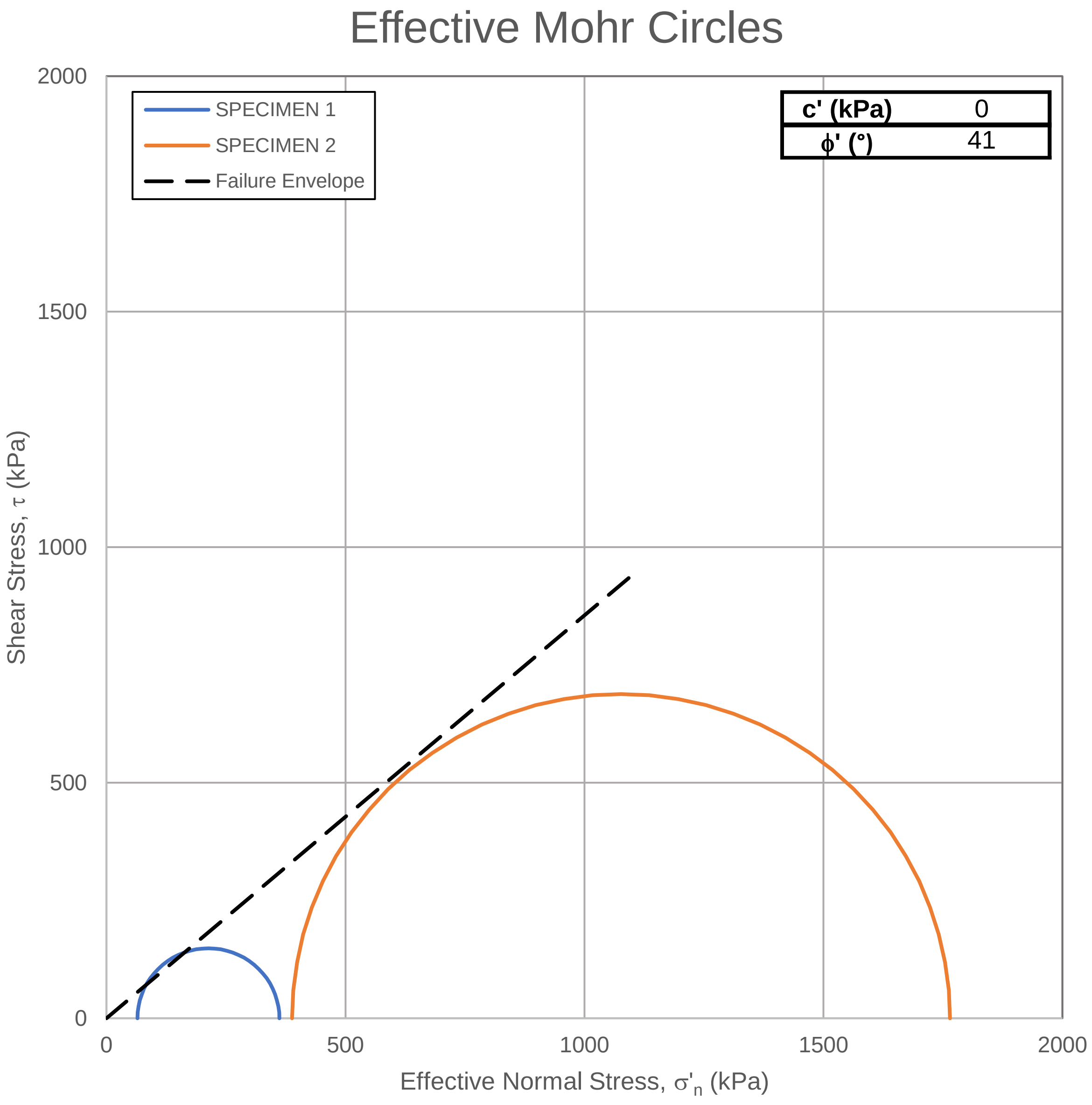


Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	3

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)
Sample ID:	SA15	SA17
Test ID:	CAD-9	CAD-10
Depth:	8.53 m - 9.14 m	9.75 m - 10.16 m

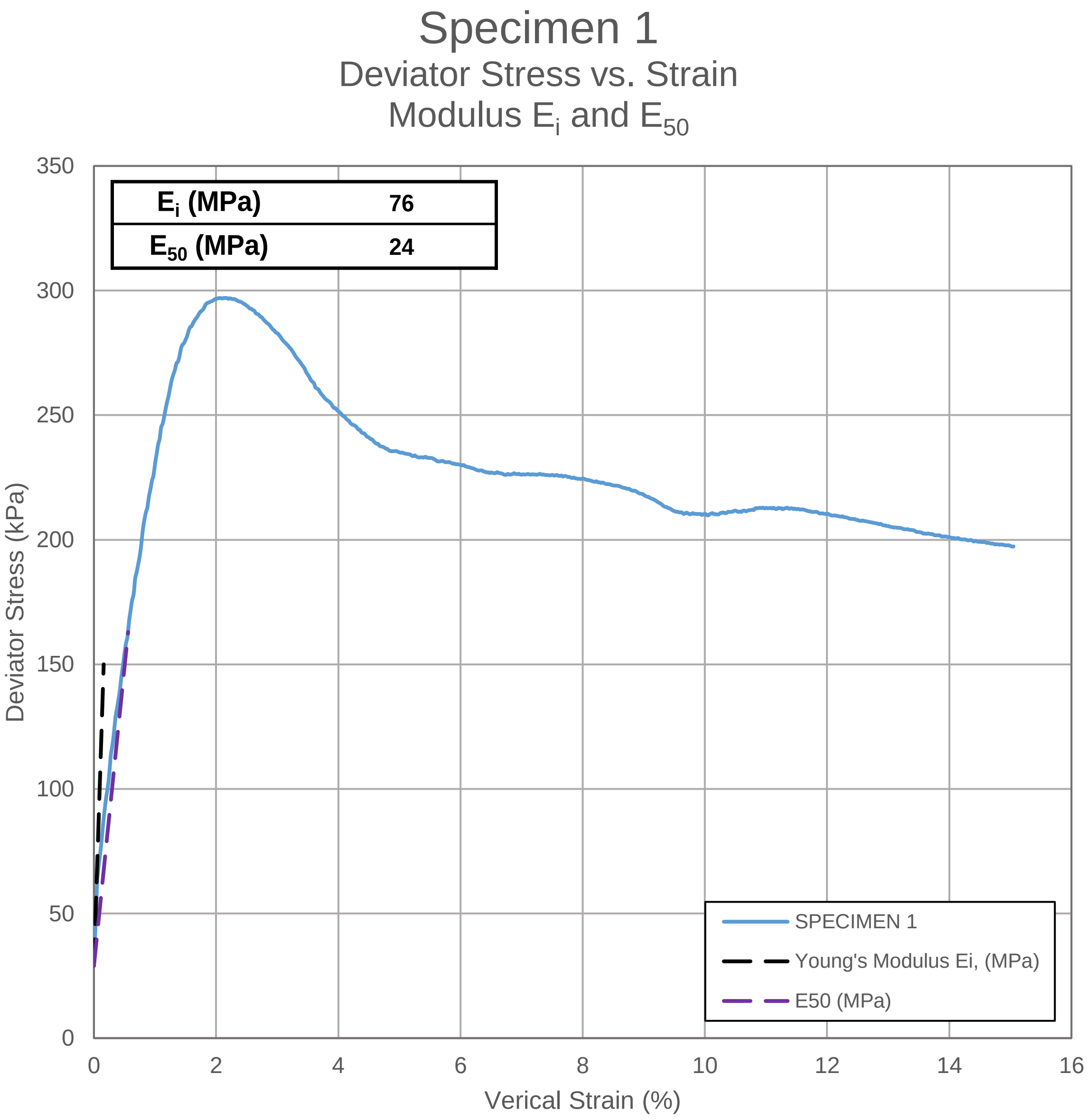


Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	3

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)
Sample ID:	SA15	SA17
Test ID:	CAD-9	CAD-10
Depth:	8.53 m - 9.14 m	9.75 m - 10.16 m



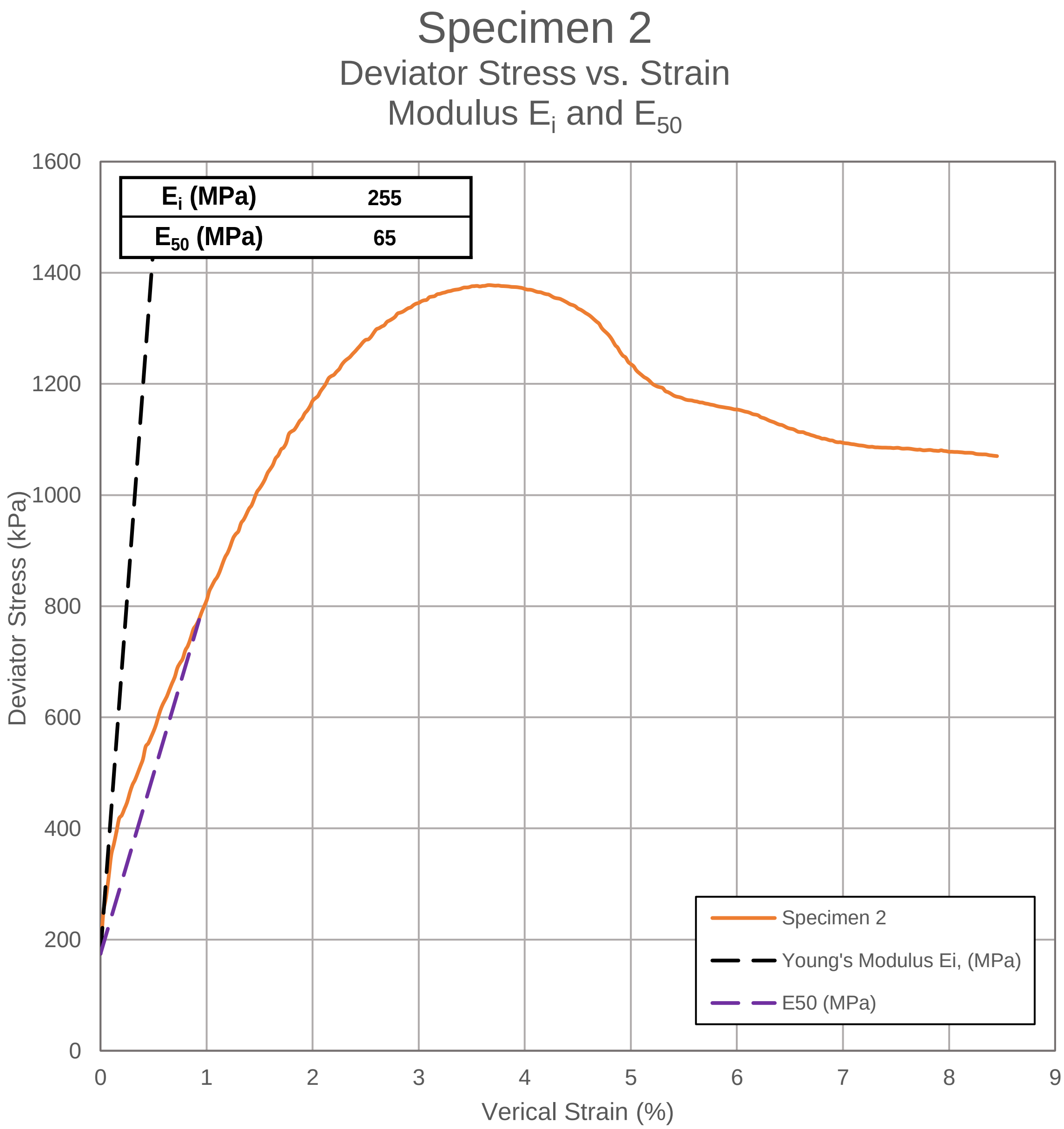
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 4.6

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	3

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.69)	Anisotropic (Consol. K= 0.69)
Sample ID:	SA15	SA17
Test ID:	CAD-9	CAD-10
Depth:	8.53 m - 9.14 m	9.75 m - 10.16 m

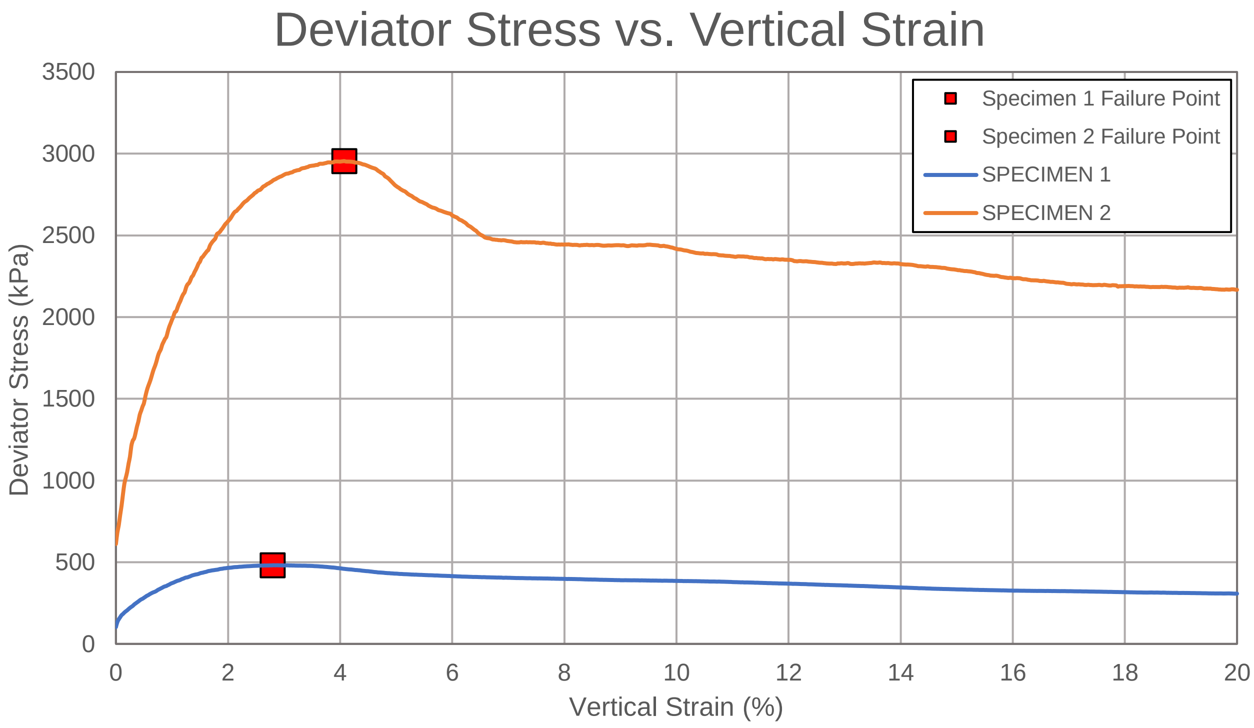


Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	4a

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.57)	Anisotropic (Consol. K= 0.57)
Sample ID:	SA25	SA27
Test ID:	CAD-11	CAD-12R
Depth:	14.63 m - 15.24 m	19.20 m - 19.81 m

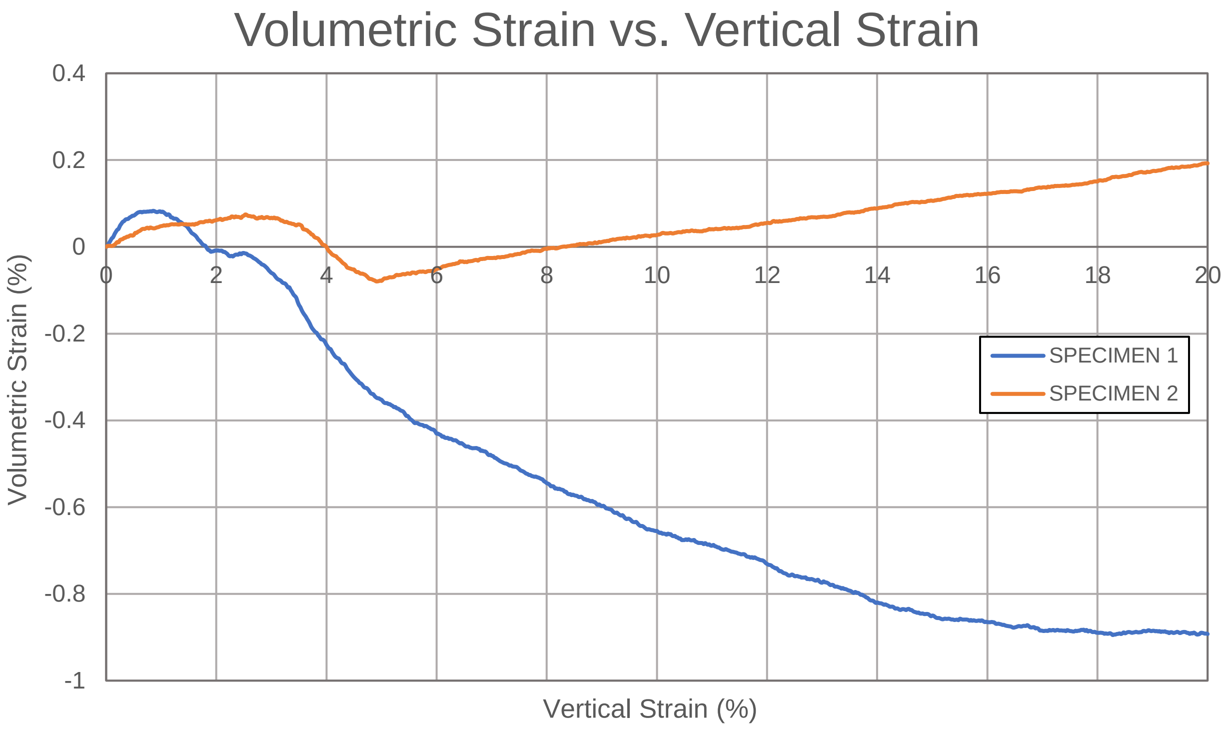


Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	4a

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.57)	Anisotropic (Consol. K= 0.57)
Sample ID:	SA25	SA27
Test ID:	CAD-11	CAD-12R
Depth:	14.63 m - 15.24 m	19.20 m - 19.81 m



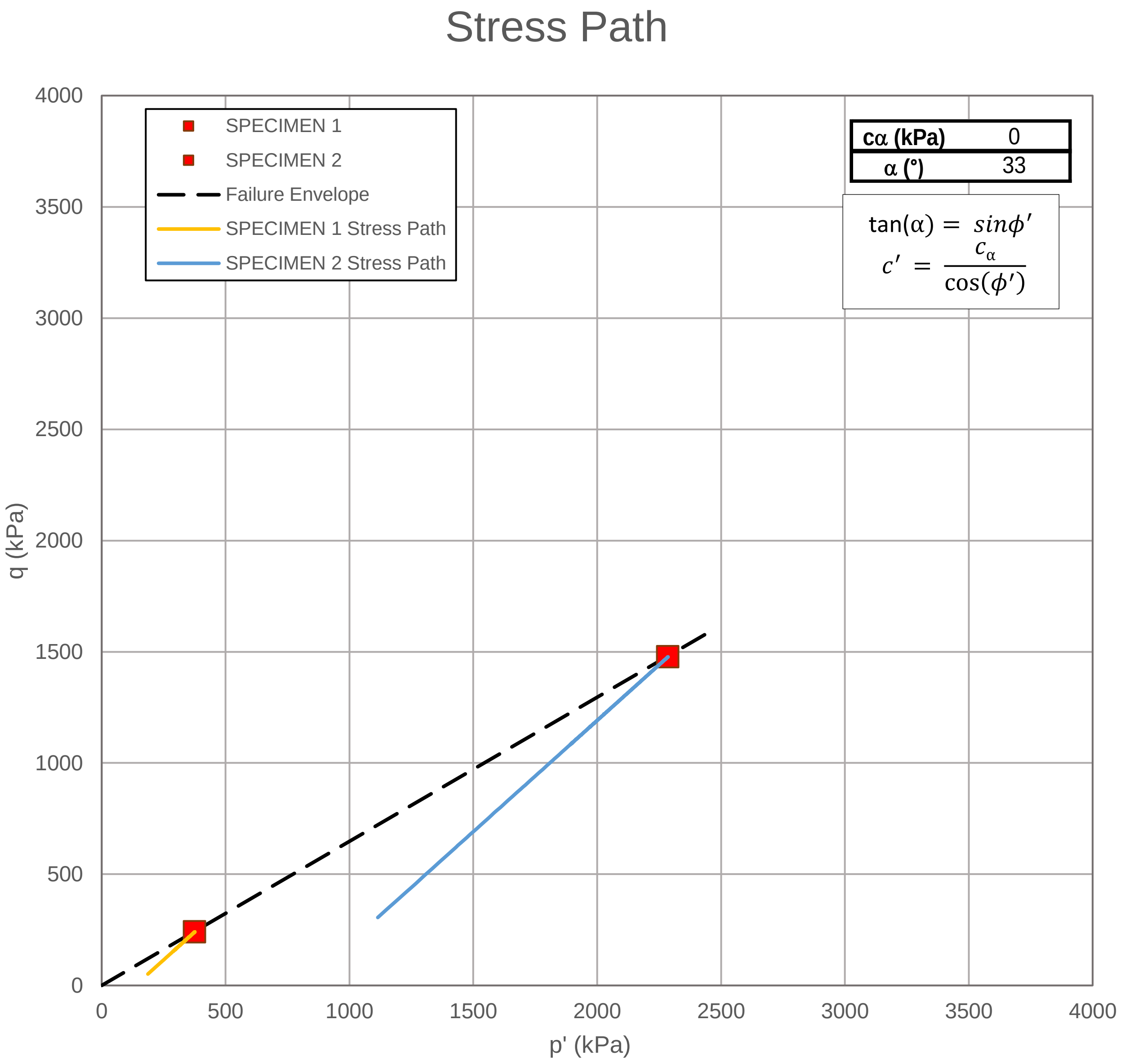
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 5.3

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	4a

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.57)	Anisotropic (Consol. K= 0.57)
Sample ID:	SA25	SA27
Test ID:	CAD-11	CAD-12R
Depth:	14.63 m - 15.24 m	19.20 m - 19.81 m



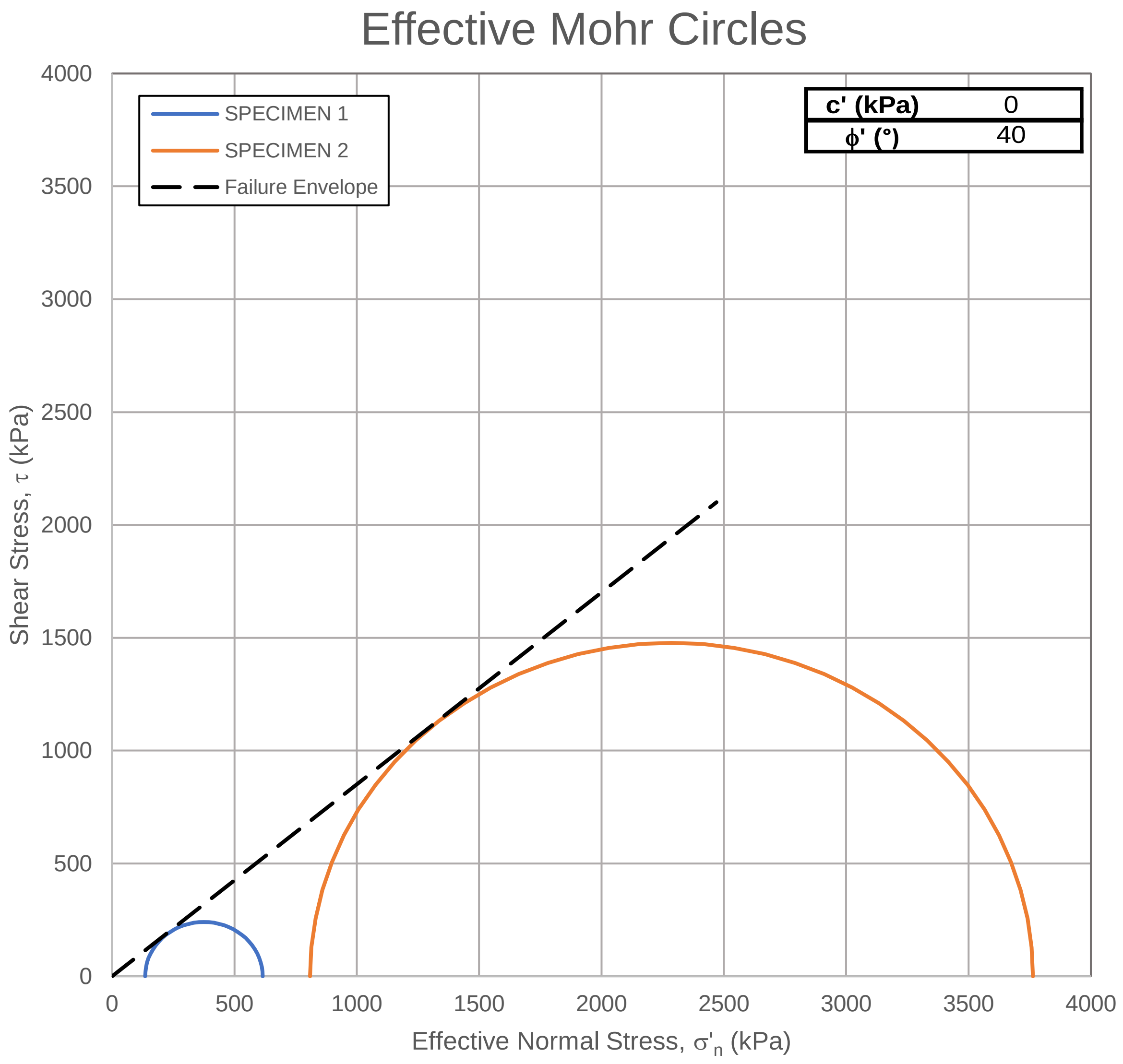
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

wsp GOLDER

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	4a

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.57)	Anisotropic (Consol. K= 0.57)
Sample ID:	SA25	SA27
Test ID:	CAD-11	CAD-12R
Depth:	14.63 m - 15.24 m	19.20 m - 19.81 m

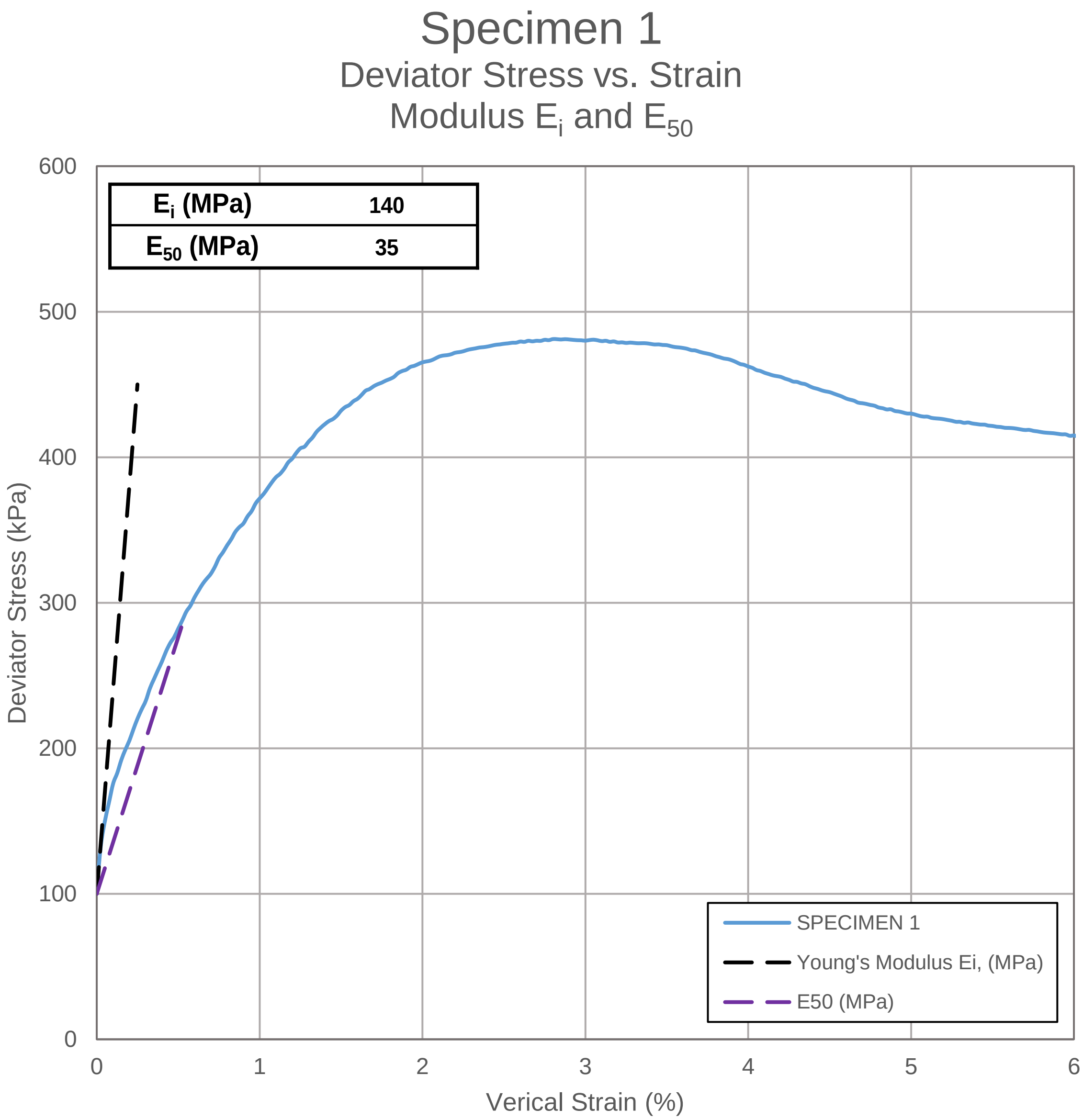


Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	4a

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.57)	Anisotropic (Consol. K= 0.57)
Sample ID:	SA25	SA27
Test ID:	CAD-11	CAD-12R
Depth:	14.63 m - 15.24 m	19.20 m - 19.81 m



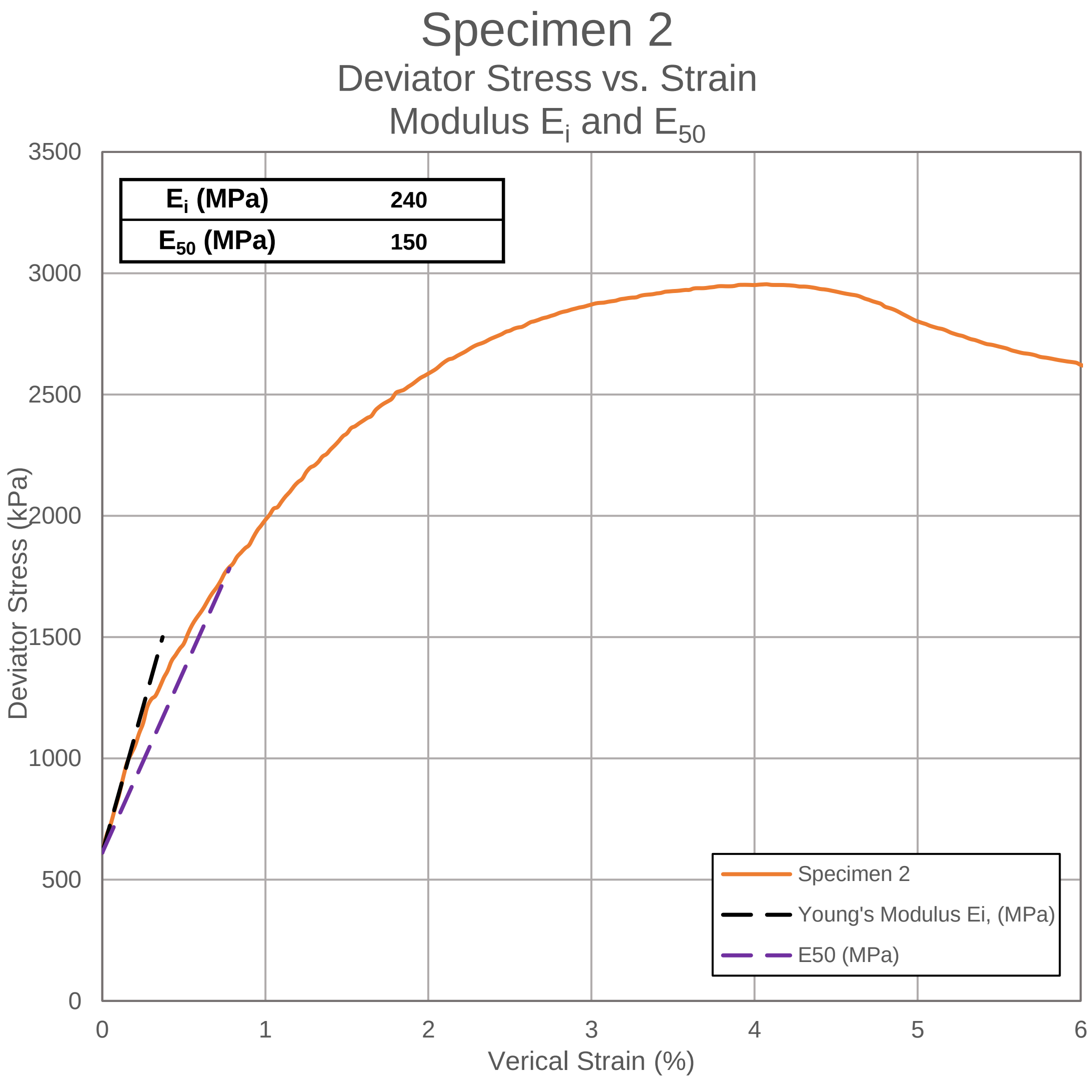
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 5.6

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	4a

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.57)	Anisotropic (Consol. K= 0.57)
Sample ID:	SA25	SA27
Test ID:	CAD-11	CAD-12R
Depth:	14.63 m - 15.24 m	19.20 m - 19.81 m



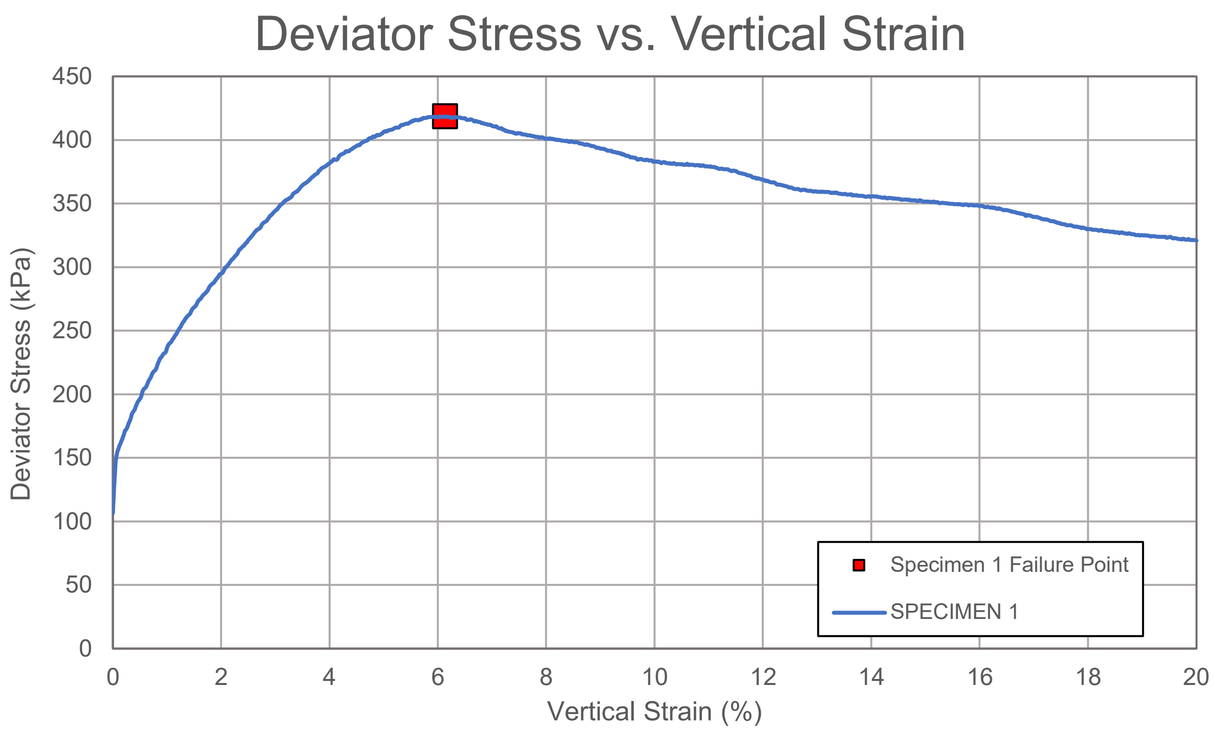
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 6.1

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	4a

	Specimen 1
Consolidation Stage:	Anisotropic (Consol. K=0.56)
Sample ID:	SA37
Test ID:	CAD-13R
Depth:	21.95 m - 22.56 m



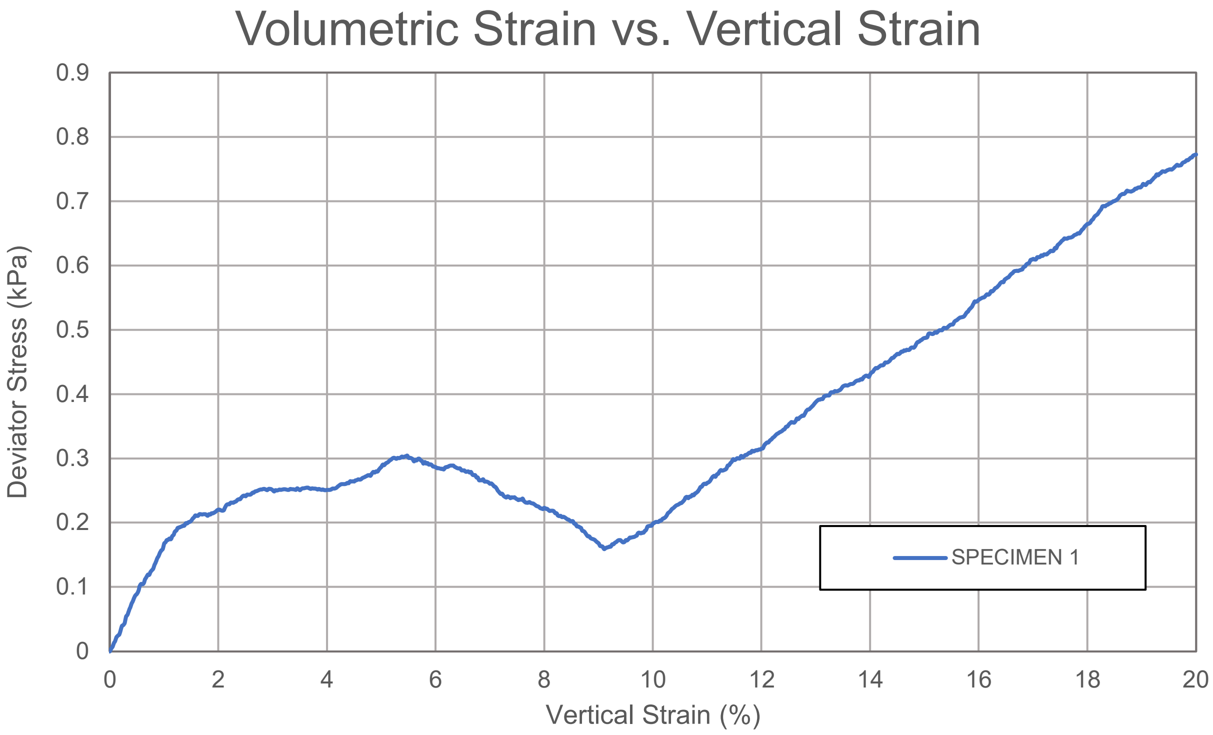
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 6.2

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	4a

	Specimen 1
Consolidation Stage:	Anisotropic (Consol. K=0.56)
Sample ID:	SA37
Test ID:	CAD-13R
Depth:	21.95 m - 22.56 m

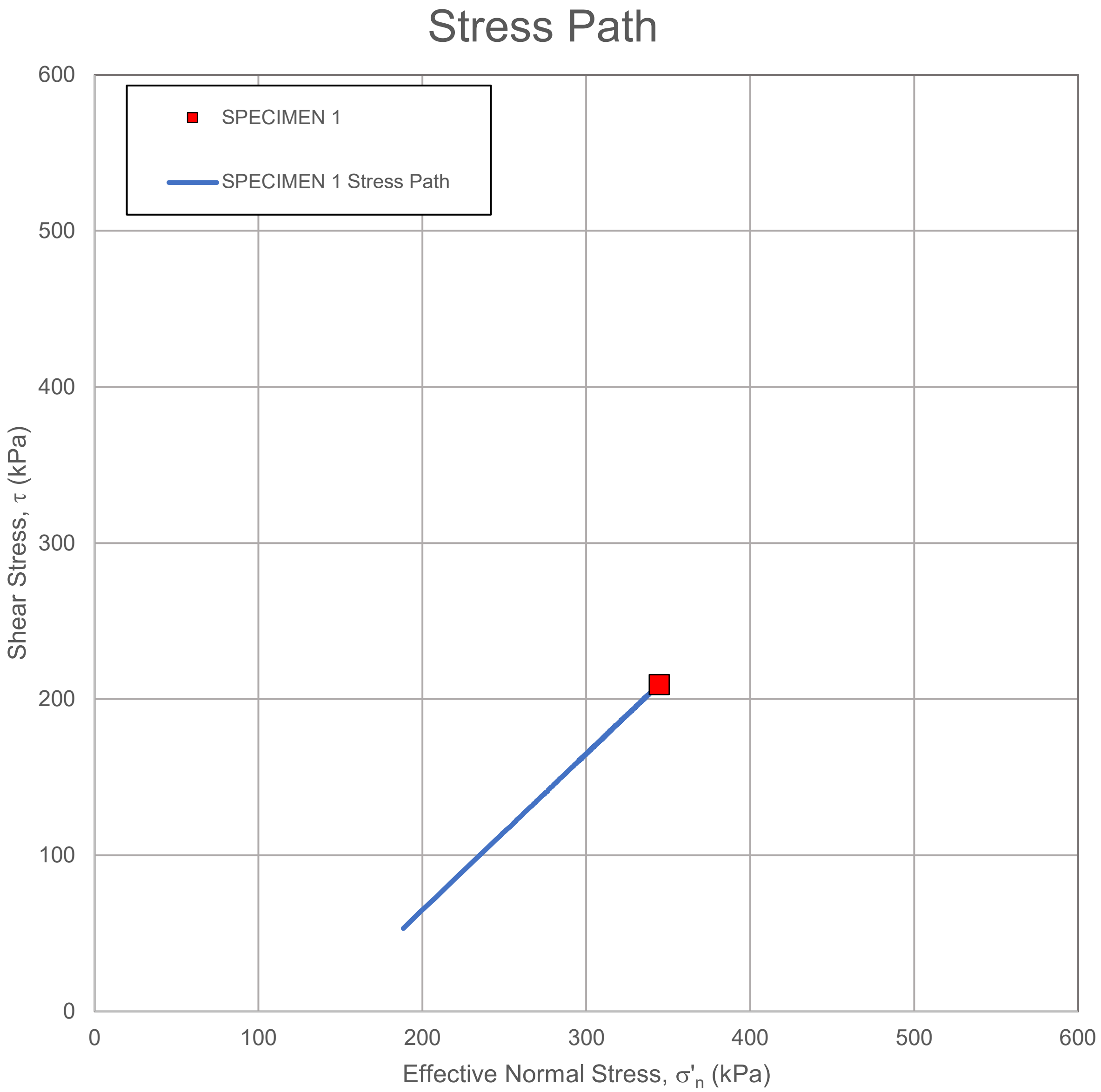


Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

	Specimen 1
Consolidation Stage:	Anisotropic (Consol. K=0.56)
Sample ID:	SA37
Test ID:	CAD-13R
Depth:	21.95 m - 22.56 m

Project No.:	21451329
BH ID:	BH24
Soil Unit:	4a



Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	4a

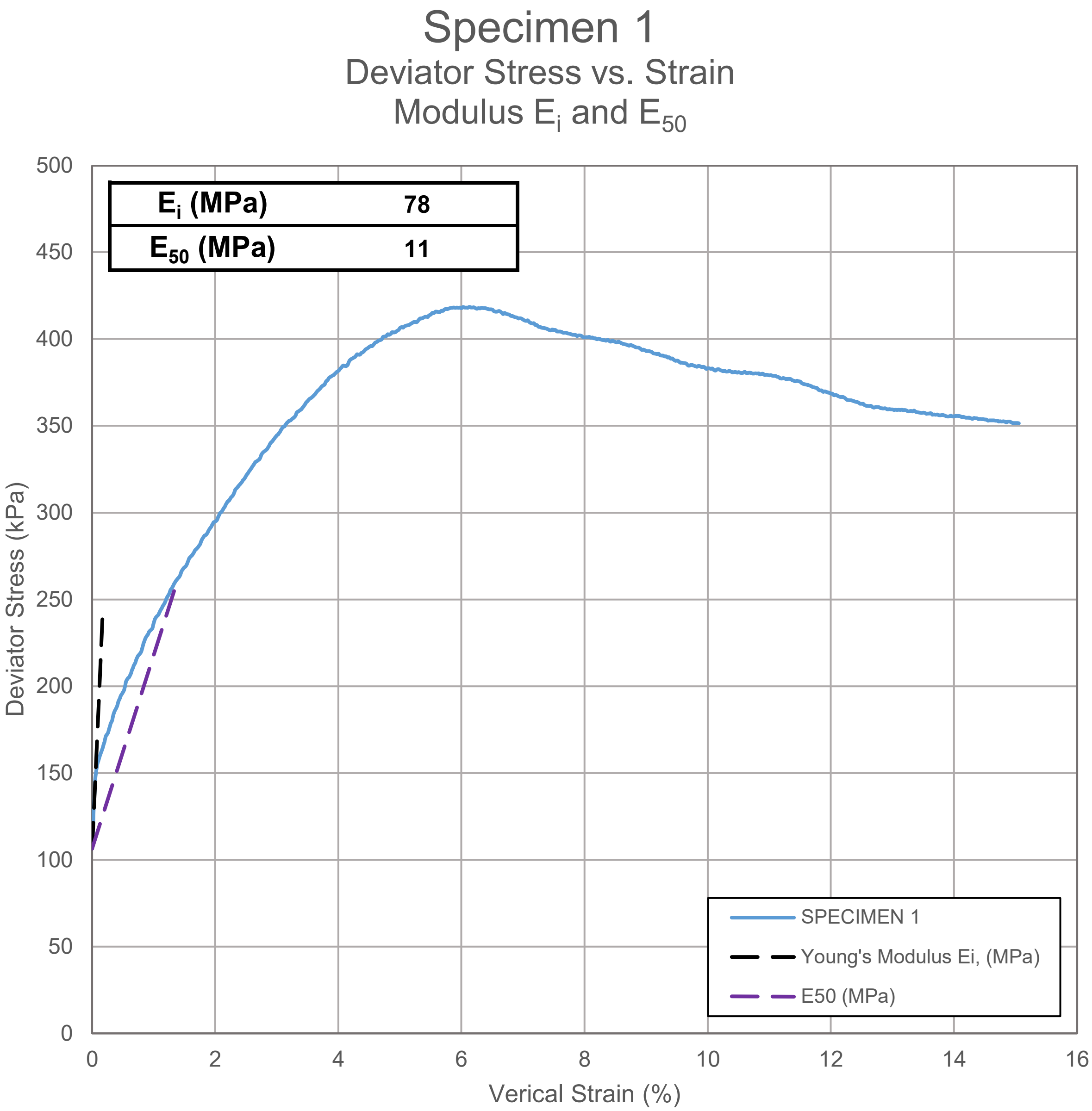
	Specimen 1
Consolidation Stage:	Anisotropic (Consol. K=0.56)
Sample ID:	SA37
Test ID:	CAD-13R
Depth:	21.95 m - 22.56 m

Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	4a

	Specimen 1
Consolidation Stage:	Anisotropic (Consol. K=0.56)
Sample ID:	SA37
Test ID:	CAD-13R
Depth:	21.95 m - 22.56 m

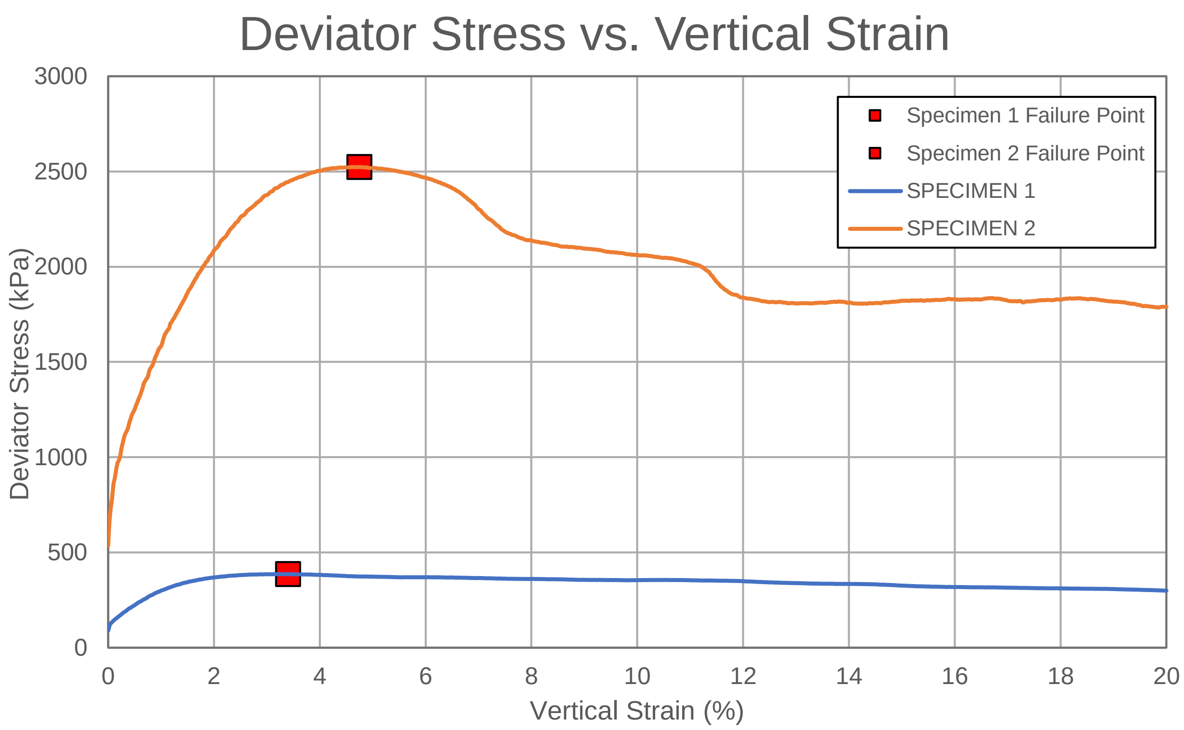


Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	4a

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.57)	Anisotropic (Consol. K= 0.57)
Sample ID:	SA20	SA21
Test ID:	CAD-15	CAD-16
Depth:	11.58 m - 12.14 m	12.19 m - 12.60 m



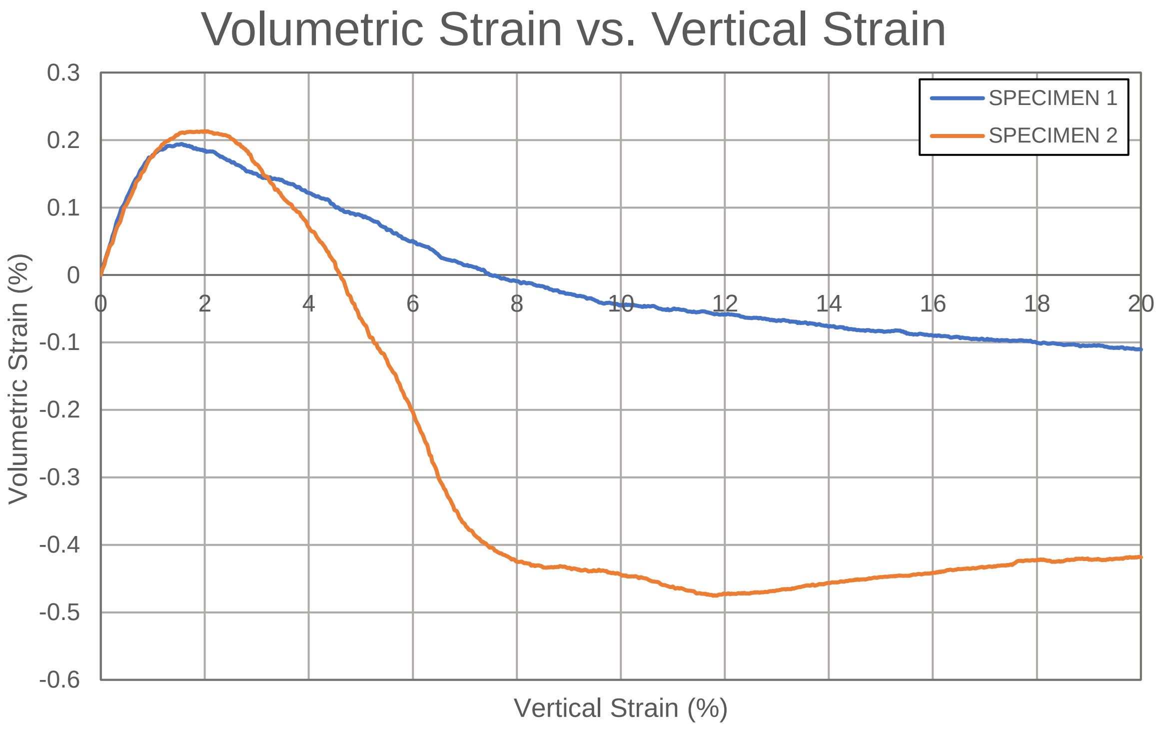
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 7.2

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	4a

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.57)	Anisotropic (Consol. K= 0.57)
Sample ID:	SA20	SA21
Test ID:	CAD-15	CAD-16
Depth:	11.58 m - 12.14 m	12.19 m - 12.60 m



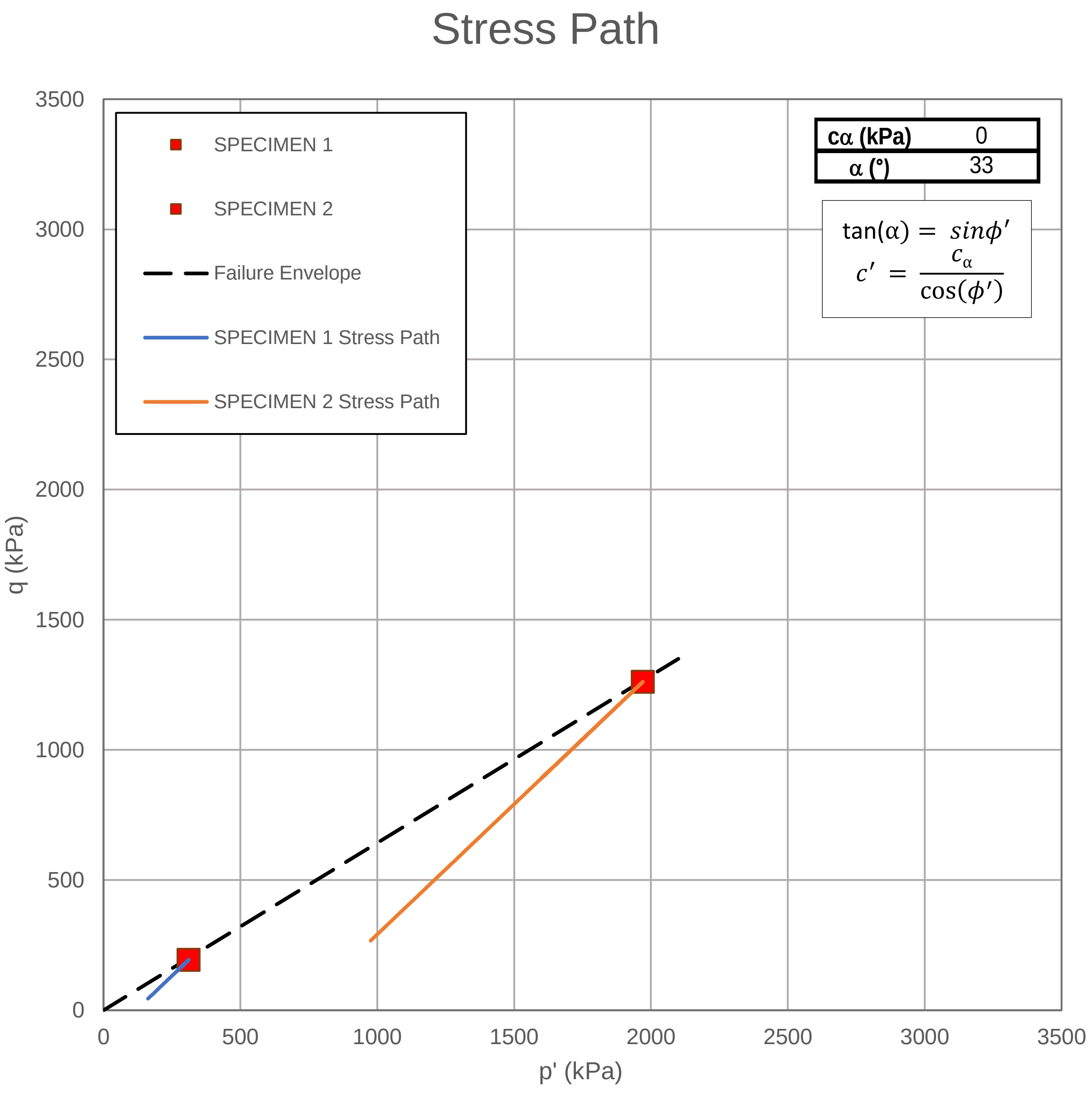
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 7.3

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	4a

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.57)	Anisotropic (Consol. K= 0.57)
Sample ID:	SA20	SA21
Test ID:	CAD-15	CAD-16
Depth:	11.58 m - 12.14 m	12.19 m - 12.60 m

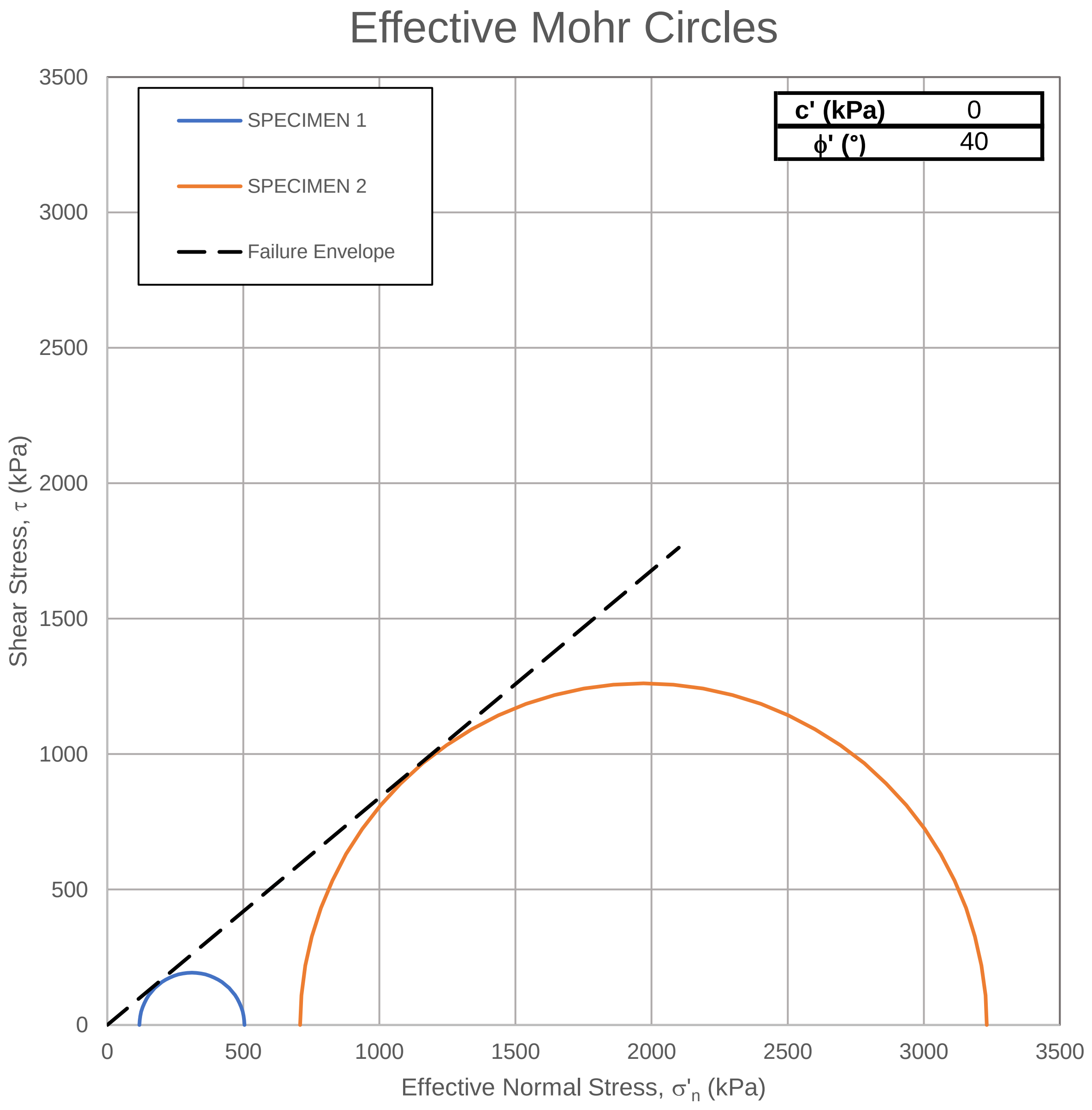


Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.57)	Anisotropic (Consol. K= 0.57)
Sample ID:	SA20	SA21
Test ID:	CAD-15	CAD-16
Depth:	11.58 m - 12.14 m	12.19 m - 12.60 m

Project No.:	21451329
BH ID:	BH26
Soil Unit:	4a



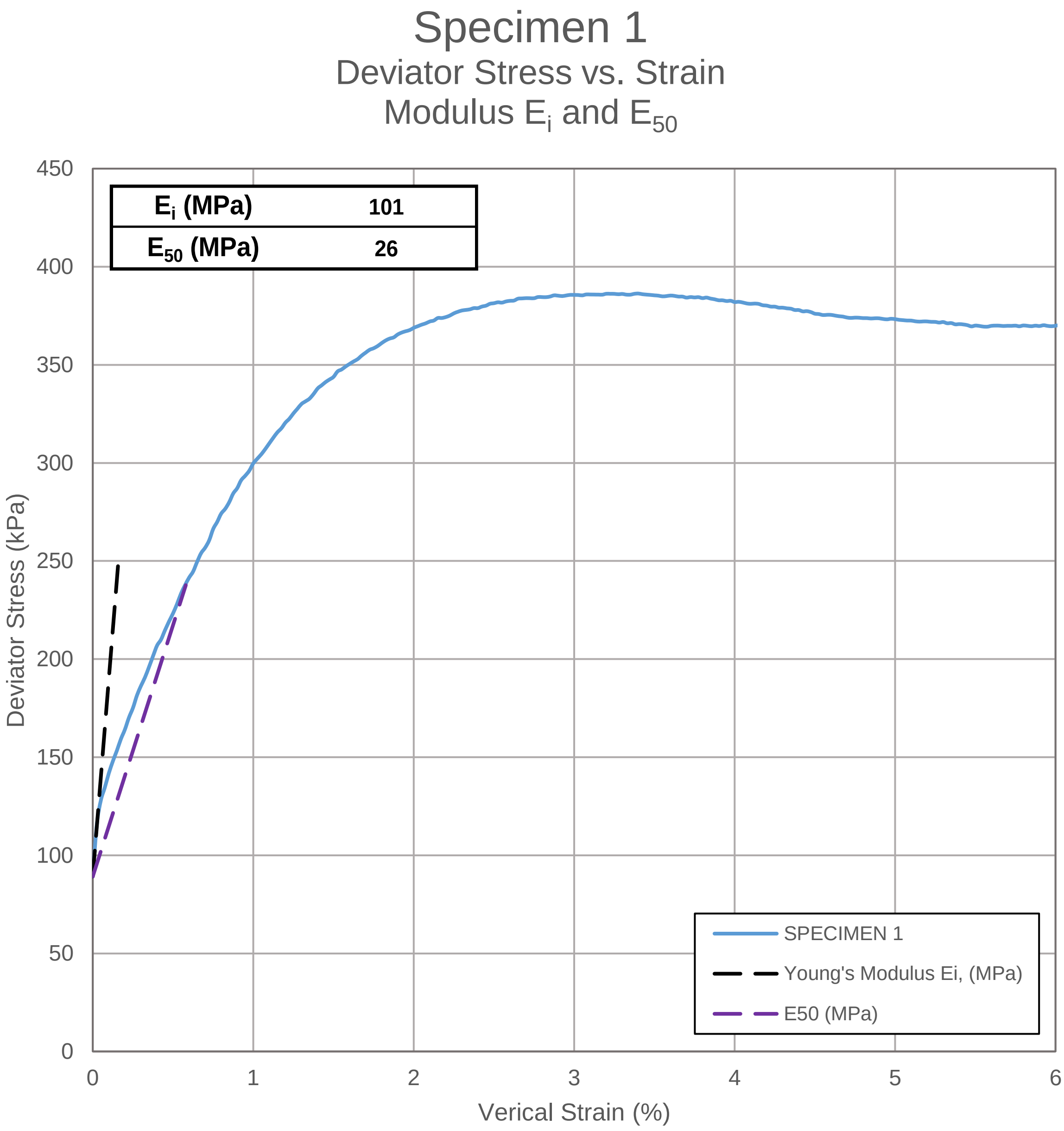
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 7.5

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	4a

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.57)	Anisotropic (Consol. K= 0.57)
Sample ID:	SA20	SA21
Test ID:	CAD-15	CAD-16
Depth:	11.58 m - 12.14 m	12.19 m - 12.60 m



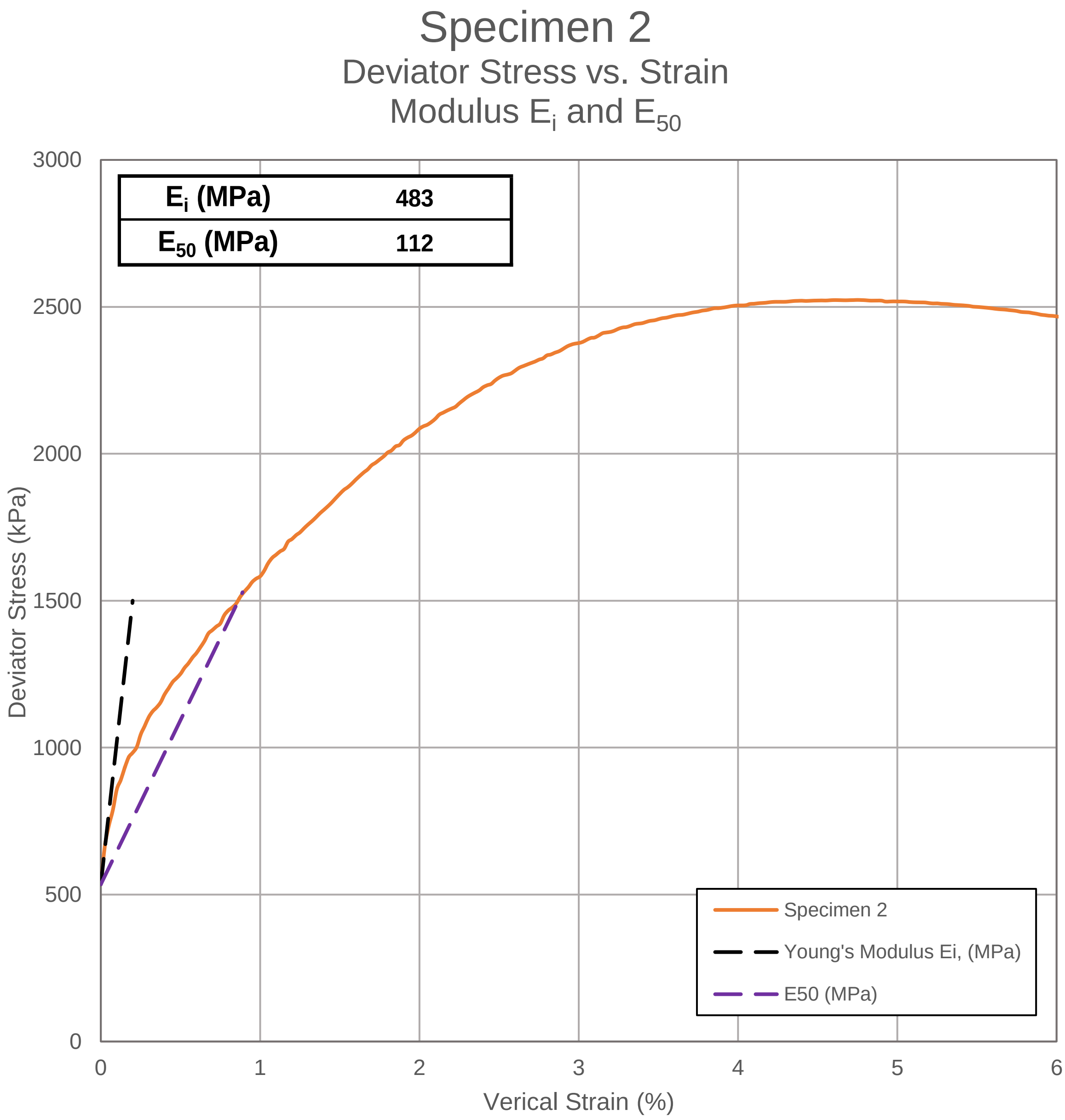
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 7.6

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	4a

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.57)	Anisotropic (Consol. K= 0.57)
Sample ID:	SA20	SA21
Test ID:	CAD-15	CAD-16
Depth:	11.58 m - 12.14 m	12.19 m - 12.60 m



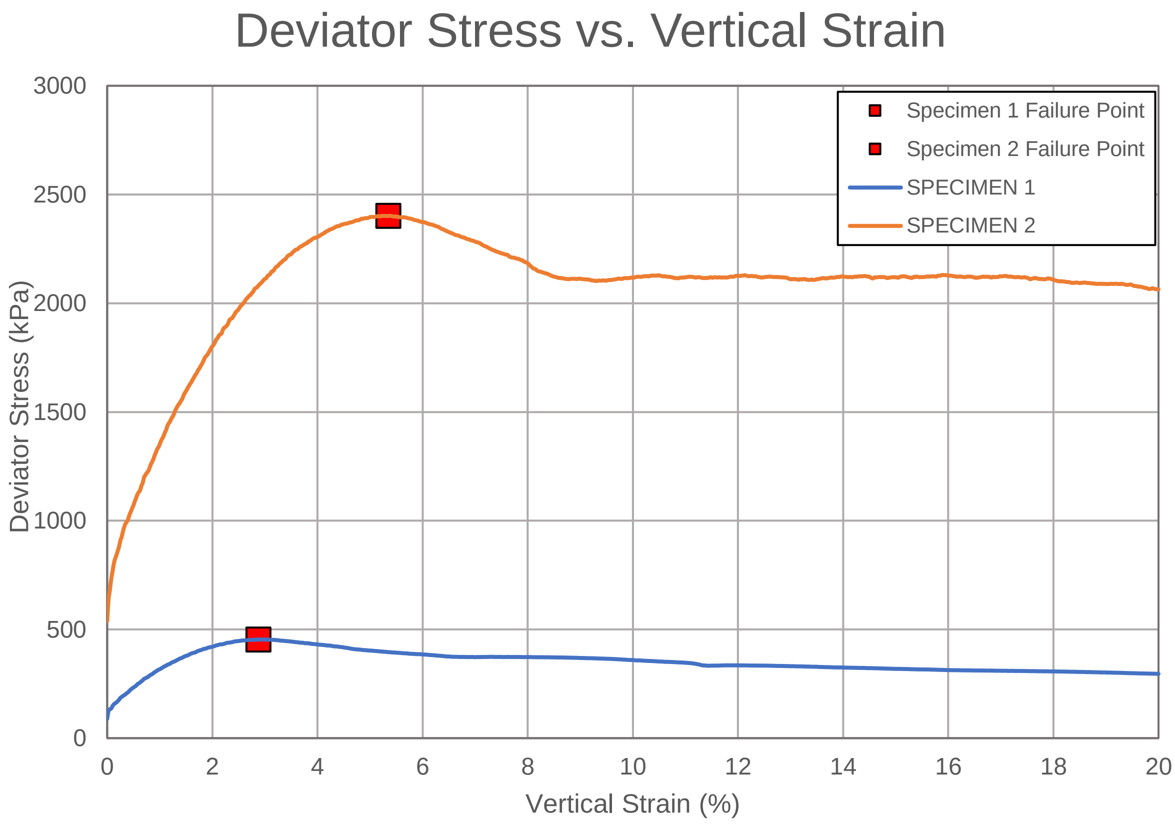
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 8.1

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	4a

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.57)	Anisotropic (Consol. K= 0.57)
Sample ID:	SA32	SA34A
Test ID:	CAD-17R	CAD-18
Depth:	18.90 - 19.93 m	20.12 - 20.35 m

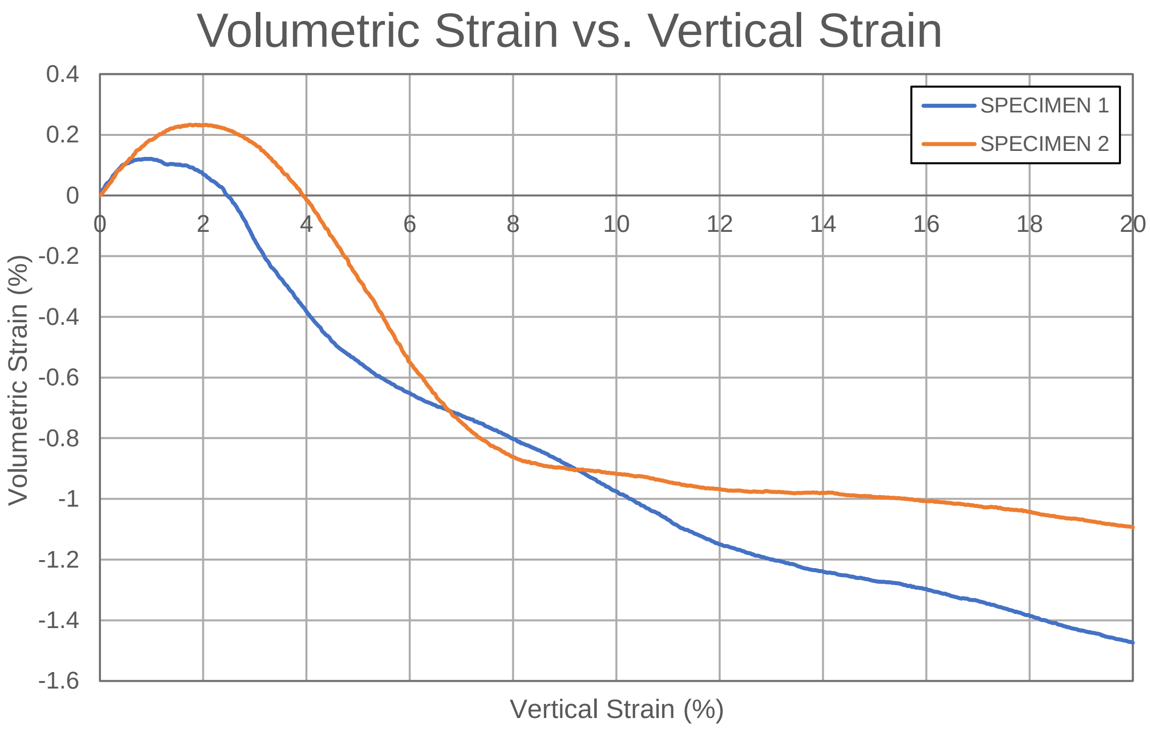


Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.57)	Anisotropic (Consol. K= 0.57)
Sample ID:	SA32	SA34A
Test ID:	CAD-17R	CAD-18
Depth:	18.90 - 19.93 m	20.12 - 20.35 m

Project No.:	21451329
BH ID:	BH26
Soil Unit:	4a



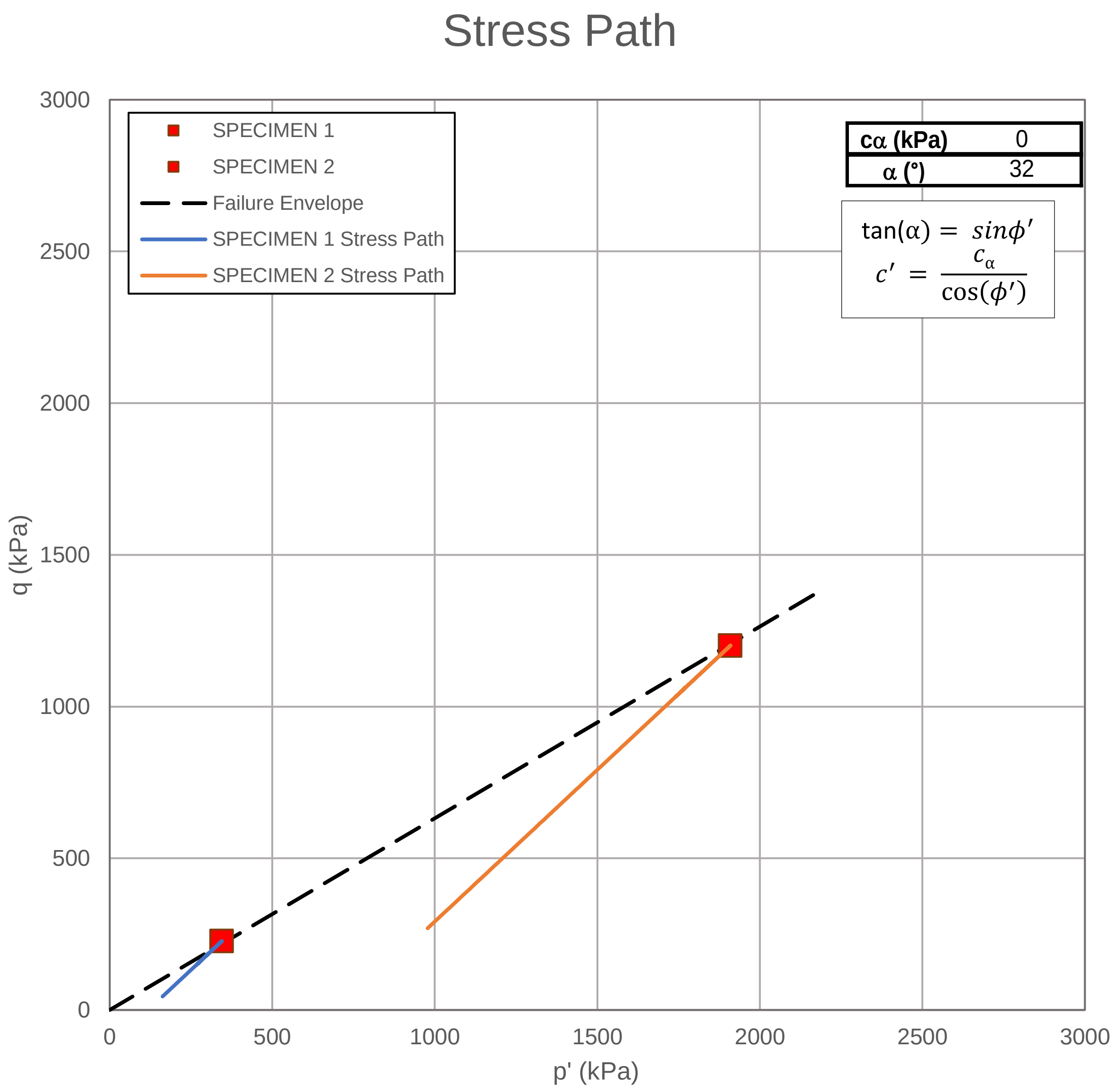
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 8.3

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	4a

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.57)	Anisotropic (Consol. K= 0.57)
Sample ID:	SA32	SA34A
Test ID:	CAD-17R	CAD-18
Depth:	18.90 - 19.93 m	20.12 - 20.35 m



cα (kPa)	0
α (°)	32

$$\tan(\alpha) = \sin\phi'$$

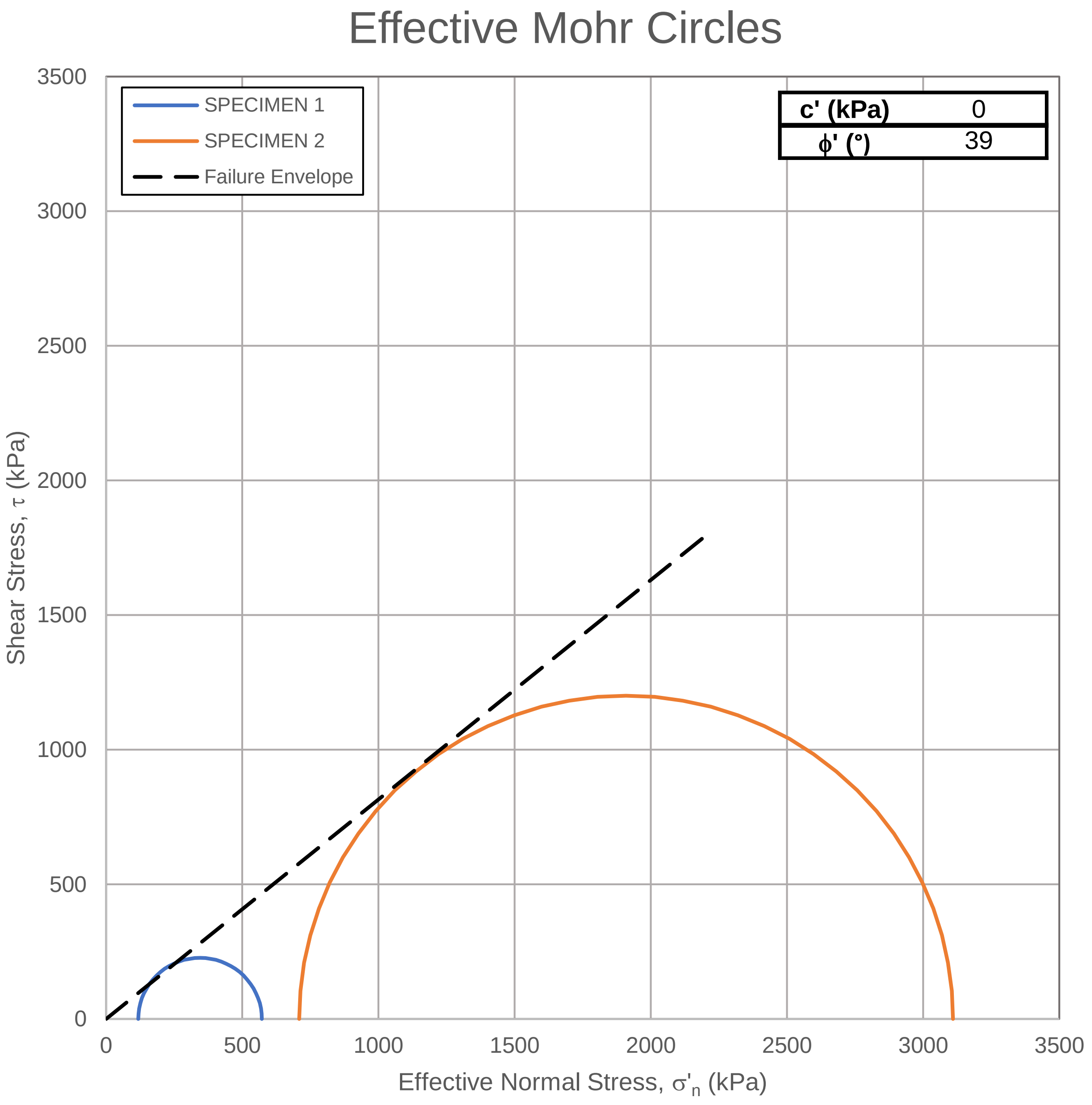
$$c' = \frac{c_{\alpha}}{\cos(\phi')}$$

Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	4a

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.57)	Anisotropic (Consol. K= 0.57)
Sample ID:	SA32	SA34A
Test ID:	CAD-17R	CAD-18
Depth:	18.90 - 19.93 m	20.12 - 20.35 m



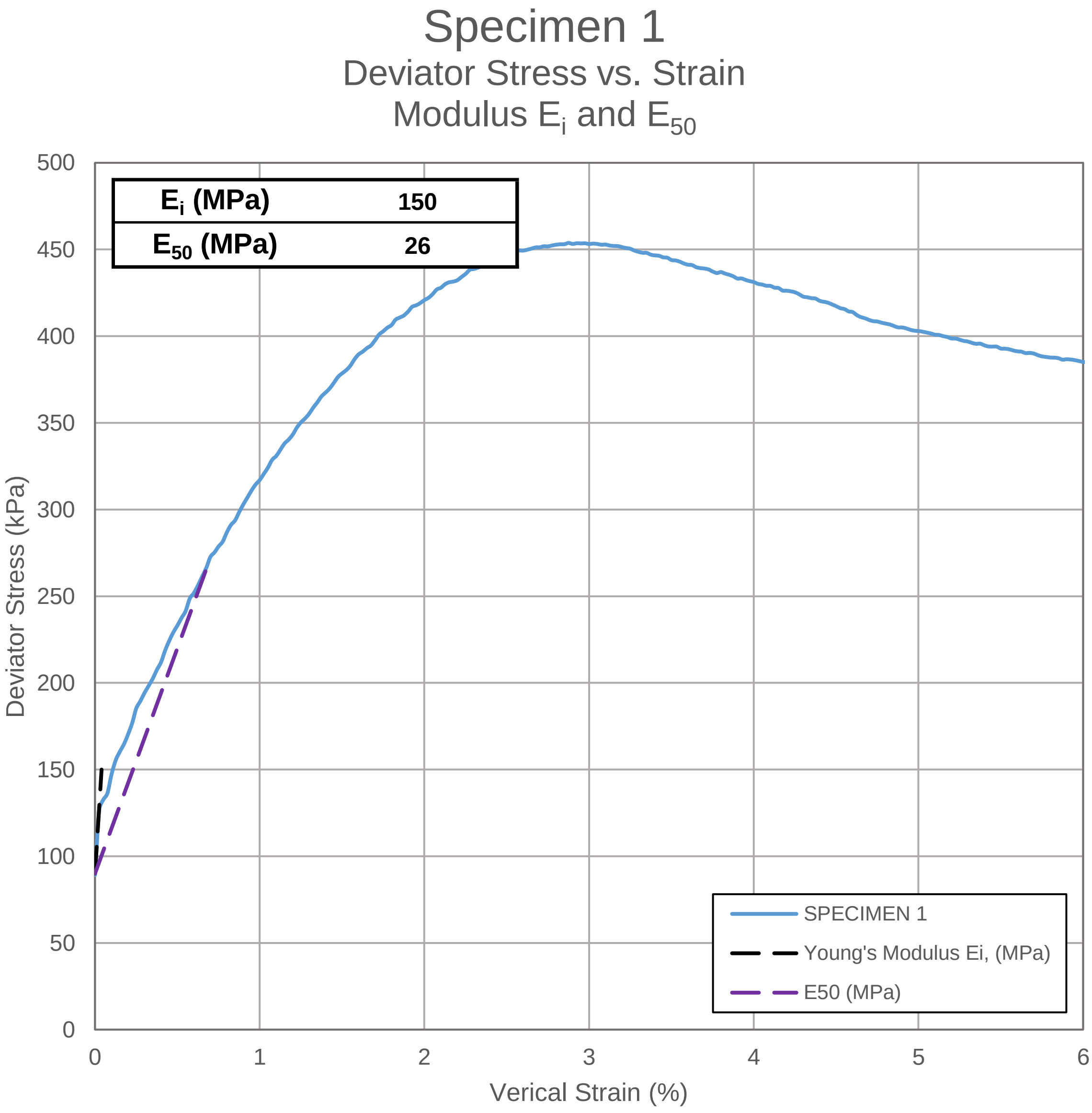
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 8.5

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	4a

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.57)	Anisotropic (Consol. K= 0.57)
Sample ID:	SA32	SA34A
Test ID:	CAD-17R	CAD-18
Depth:	18.90 - 19.93 m	20.12 - 20.35 m



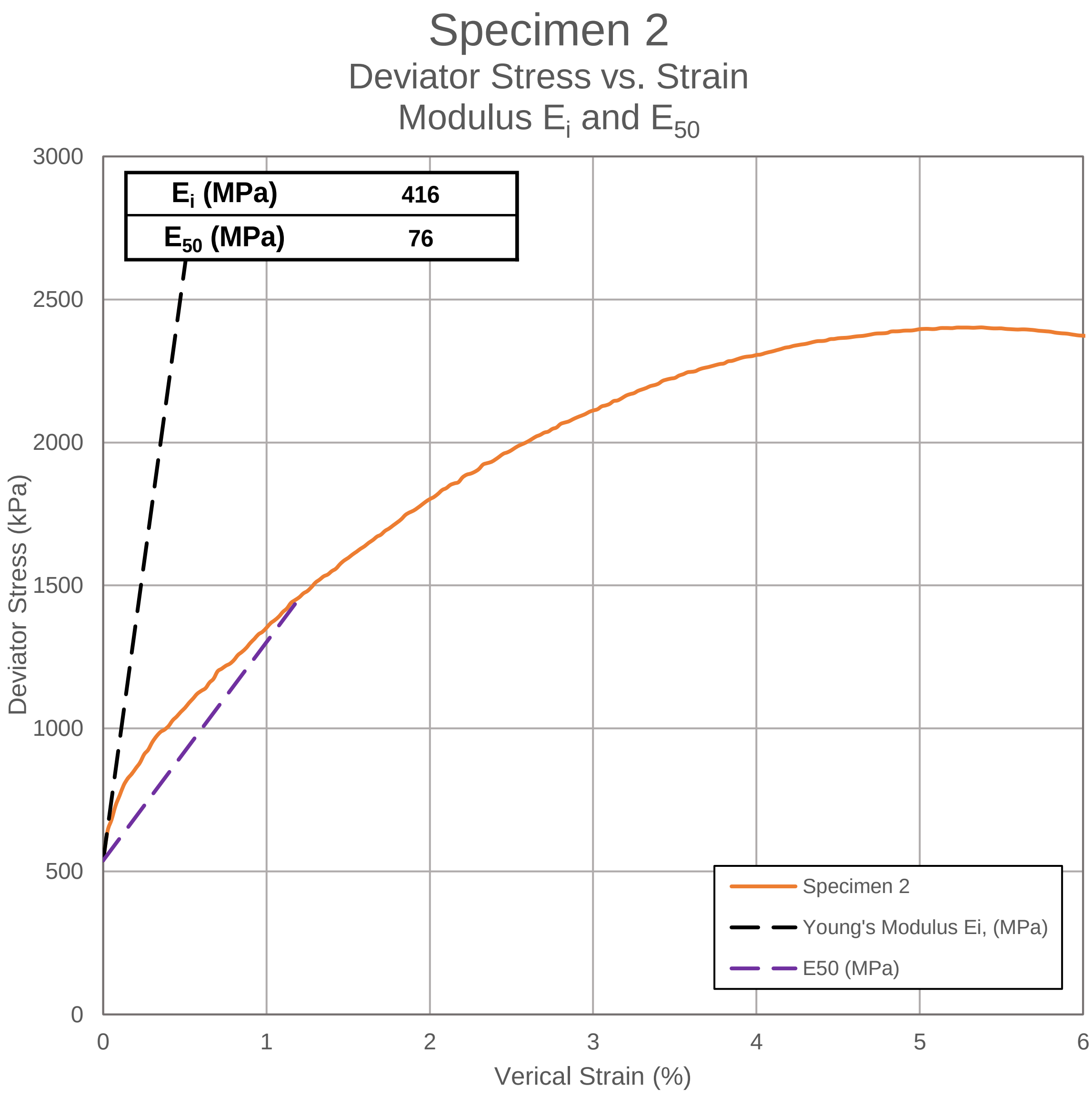
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 8.6

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	4a

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.57)	Anisotropic (Consol. K= 0.57)
Sample ID:	SA32	SA34A
Test ID:	CAD-17R	CAD-18
Depth:	18.90 - 19.93 m	20.12 - 20.35 m

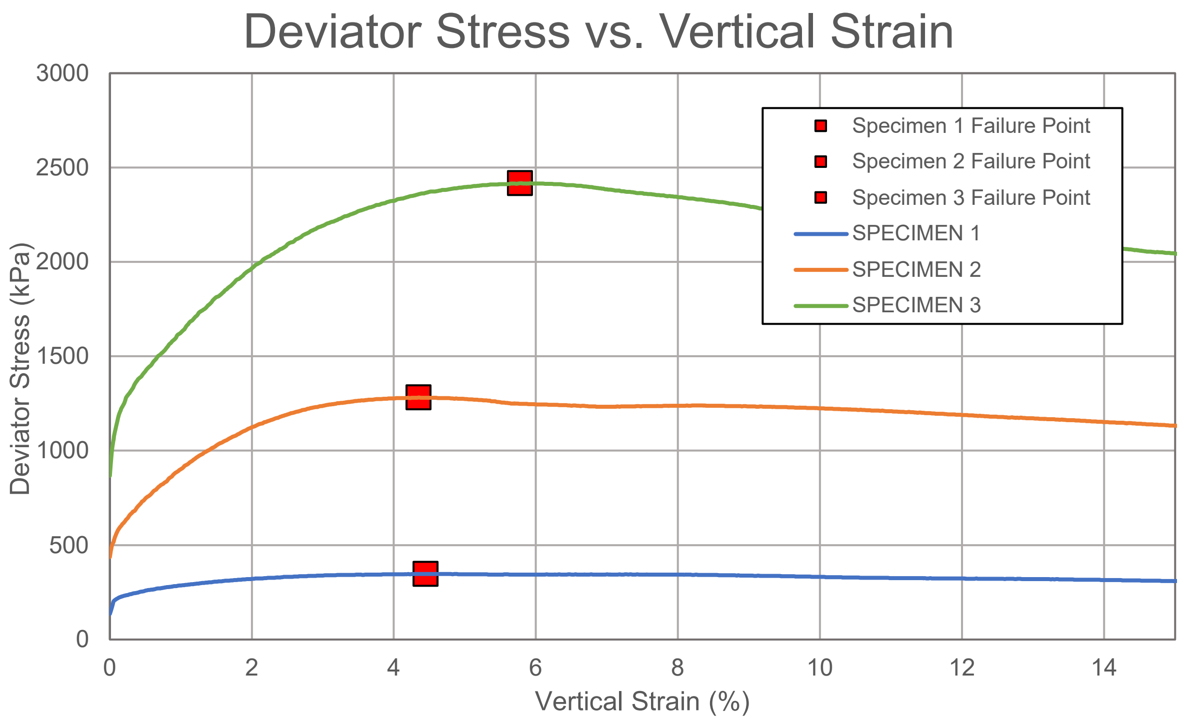


Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	5

	Specimen 1	Specimen 2	Specimen 3
Consolidation Stage:	Anisotropic (Consol. K= 0.52)	Anisotropic (Consol. K= 0.49)	Anisotropic (Consol. K= 0.49)
Sample ID:	SA34	SA35	SA36
Test ID:	CAD-19	CAD-20R	CAD-21
Depth:	20.12 m - 20.73 m	20.73 m - 21.34 m	21.34 m - 21.95 m



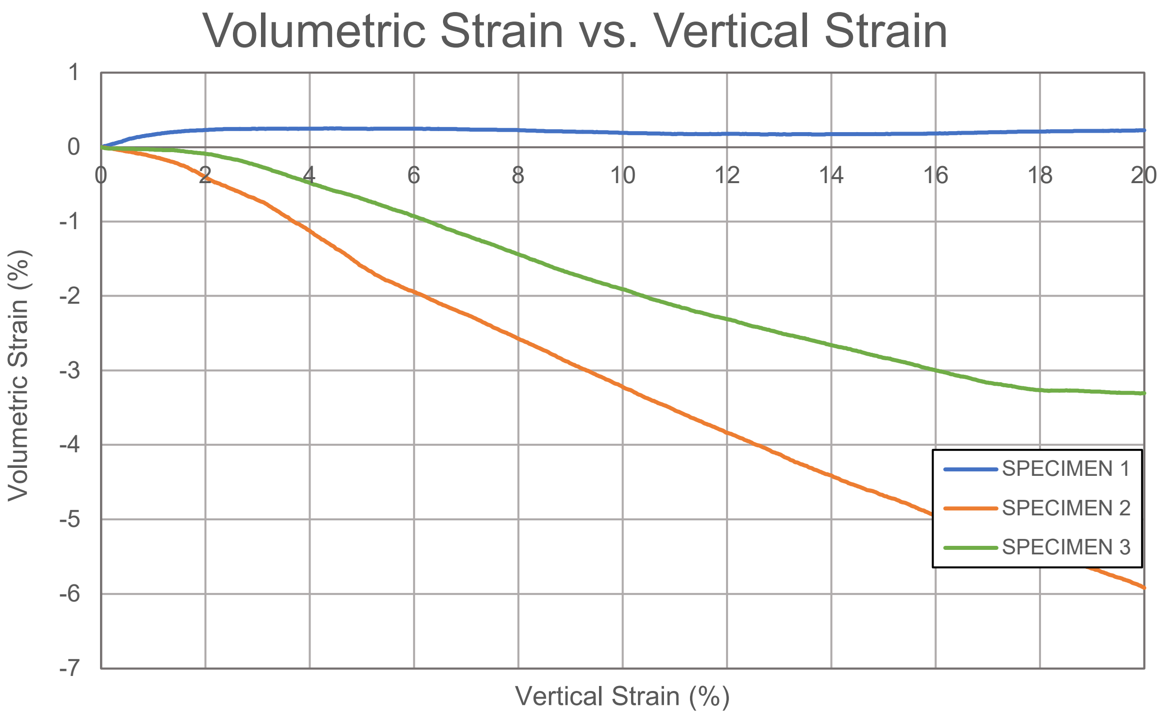
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 9.2

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	5

	Specimen 1	Specimen 2	Specimen 3
Consolidation Stage:	Anisotropic (Consol. K= 0.52)	Anisotropic (Consol. K= 0.49)	Anisotropic (Consol. K= 0.49)
Sample ID:	SA34	SA35	SA36
Test ID:	CAD-19	CAD-20R	CAD-21
Depth:	20.12 m - 20.73 m	20.73 m - 21.34 m	21.34 m - 21.95 m



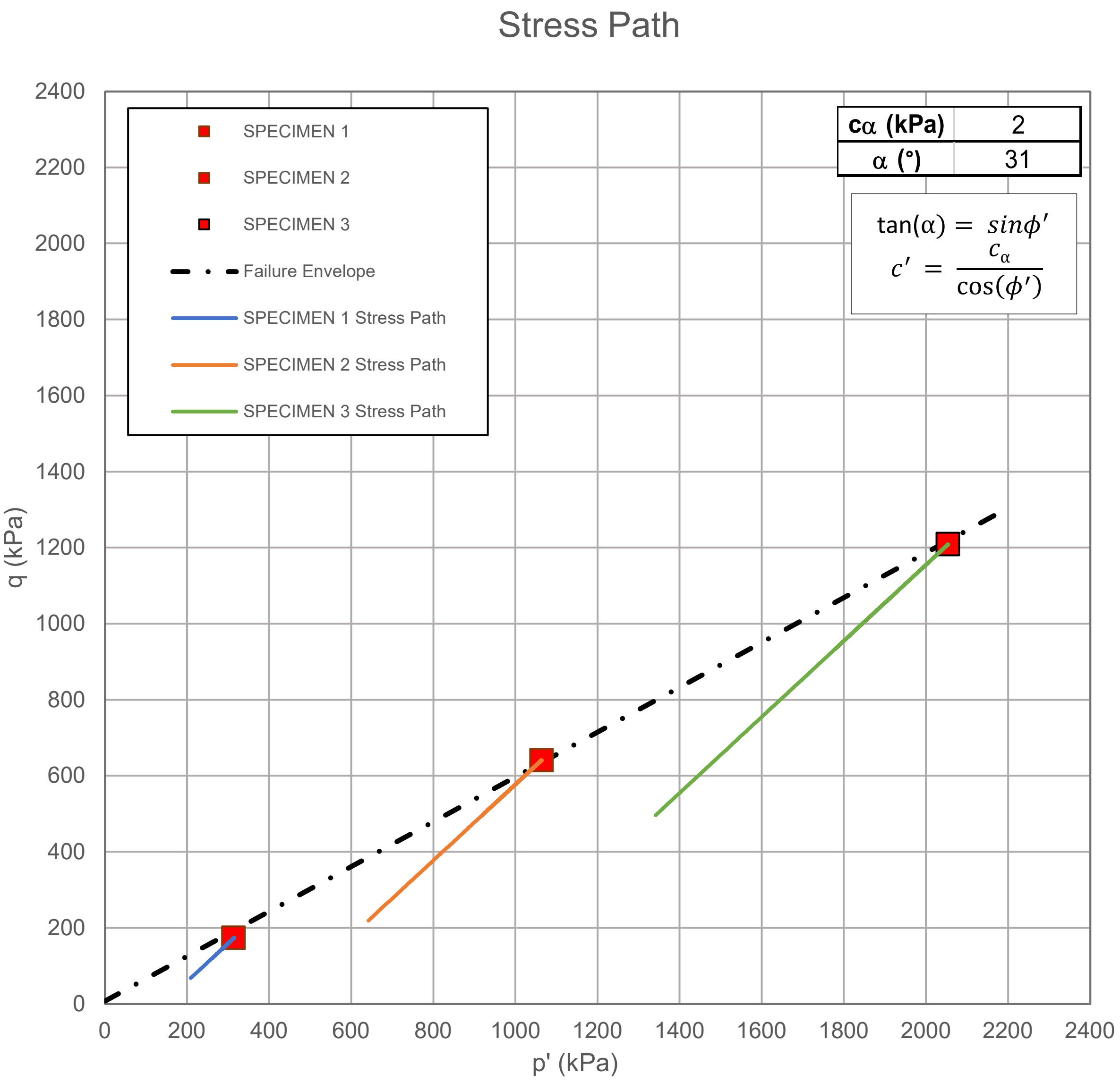
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 9.3

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	5

	Specimen 1	Specimen 2	Specimen 3
Consolidation Stage:	Anisotropic (Consol. K= 0.52)	Anisotropic (Consol. K= 0.49)	Anisotropic (Consol. K= 0.49)
Sample ID:	SA34	SA35	SA36
Test ID:	CAD-19	CAD-20R	CAD-21
Depth:	20.12 m - 20.73 m	20.73 m - 21.34 m	21.34 m - 21.95 m



cα (kPa)	2
α (°)	31

$$\tan(\alpha) = \sin\phi'$$

$$c' = \frac{c_\alpha}{\cos(\phi')}$$

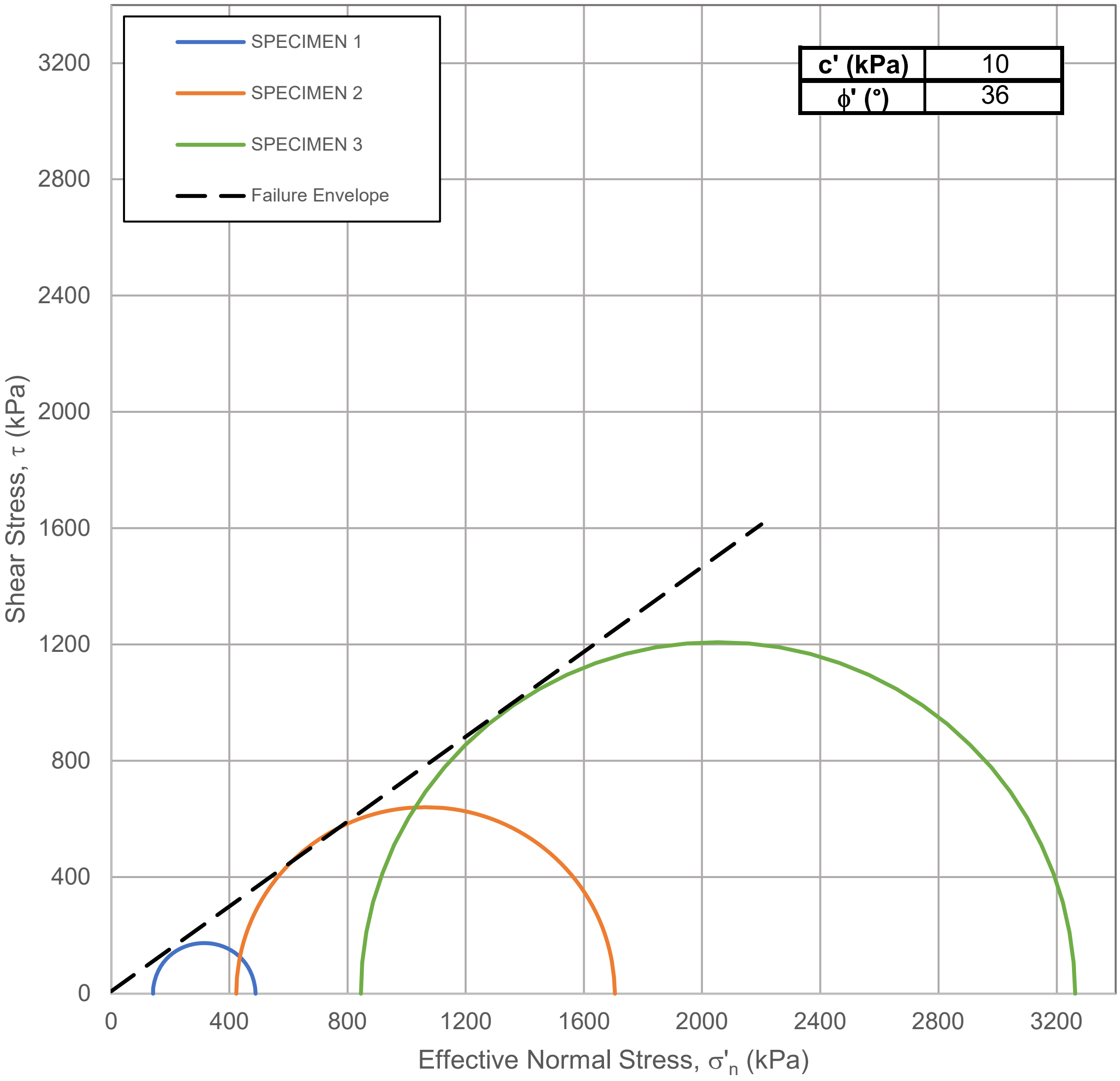
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	5

	Specimen 1	Specimen 2	Specimen 3
Consolidation Stage:	Anisotropic (Consol. K= 0.52)	Anisotropic (Consol. K= 0.49)	Anisotropic (Consol. K= 0.49)
Sample ID:	SA34	SA35	SA36
Test ID:	CAD-19	CAD-20R	CAD-21
Depth:	20.12 m - 20.73 m	20.73 m - 21.34 m	21.34 m - 21.95 m

Effective Mohr Circles



c' (kPa)	10
ϕ' (°)	36

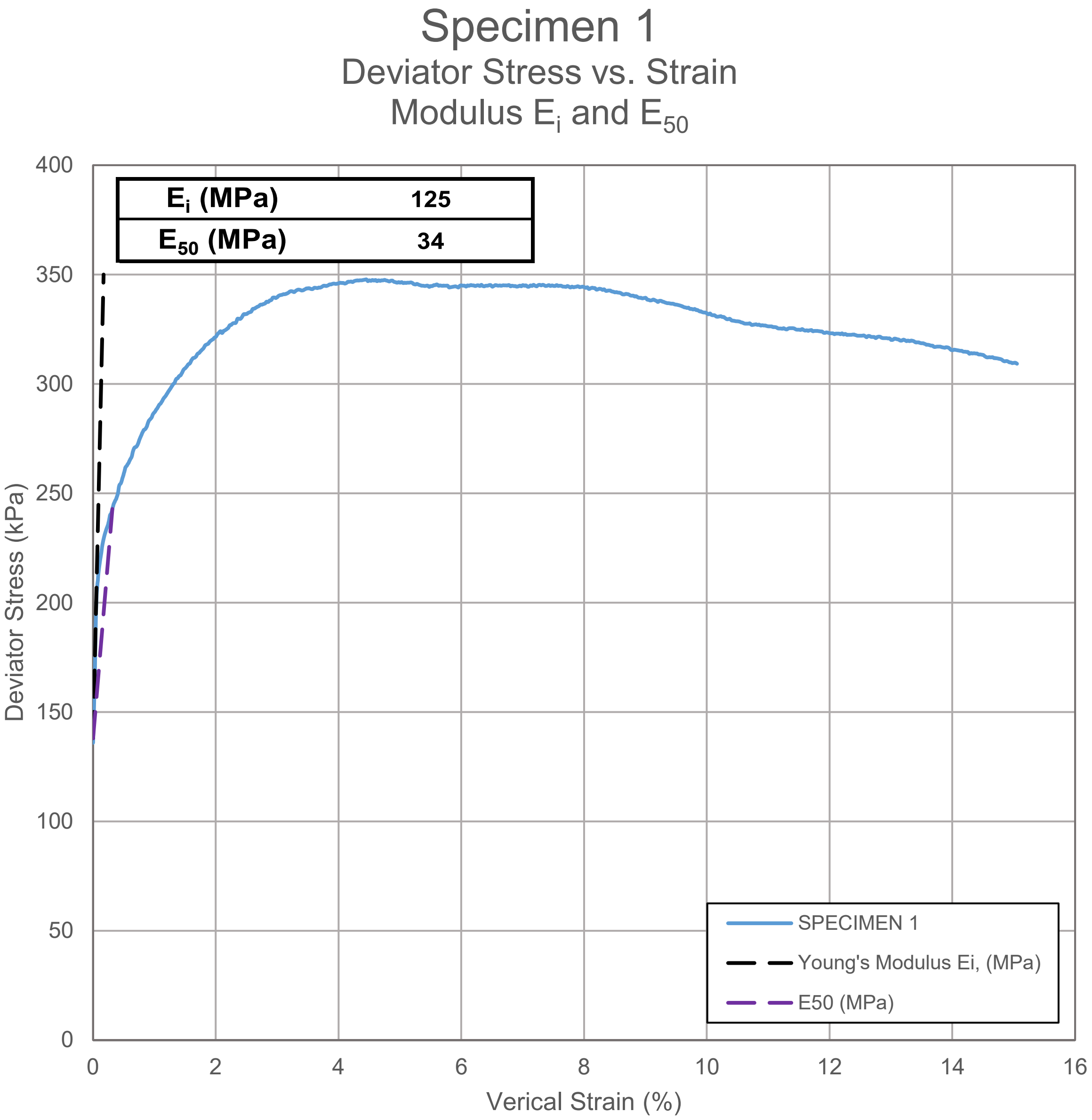
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 9.5

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	5

	Specimen 1	Specimen 2	Specimen 3
Consolidation Stage:	Anisotropic (Consol. K= 0.52)	Anisotropic (Consol. K= 0.49)	Anisotropic (Consol. K= 0.49)
Sample ID:	SA34	SA35	SA36
Test ID:	CAD-19	CAD-20R	CAD-21
Depth:	20.12 m - 20.73 m	20.73 m - 21.34 m	21.34 m - 21.95 m



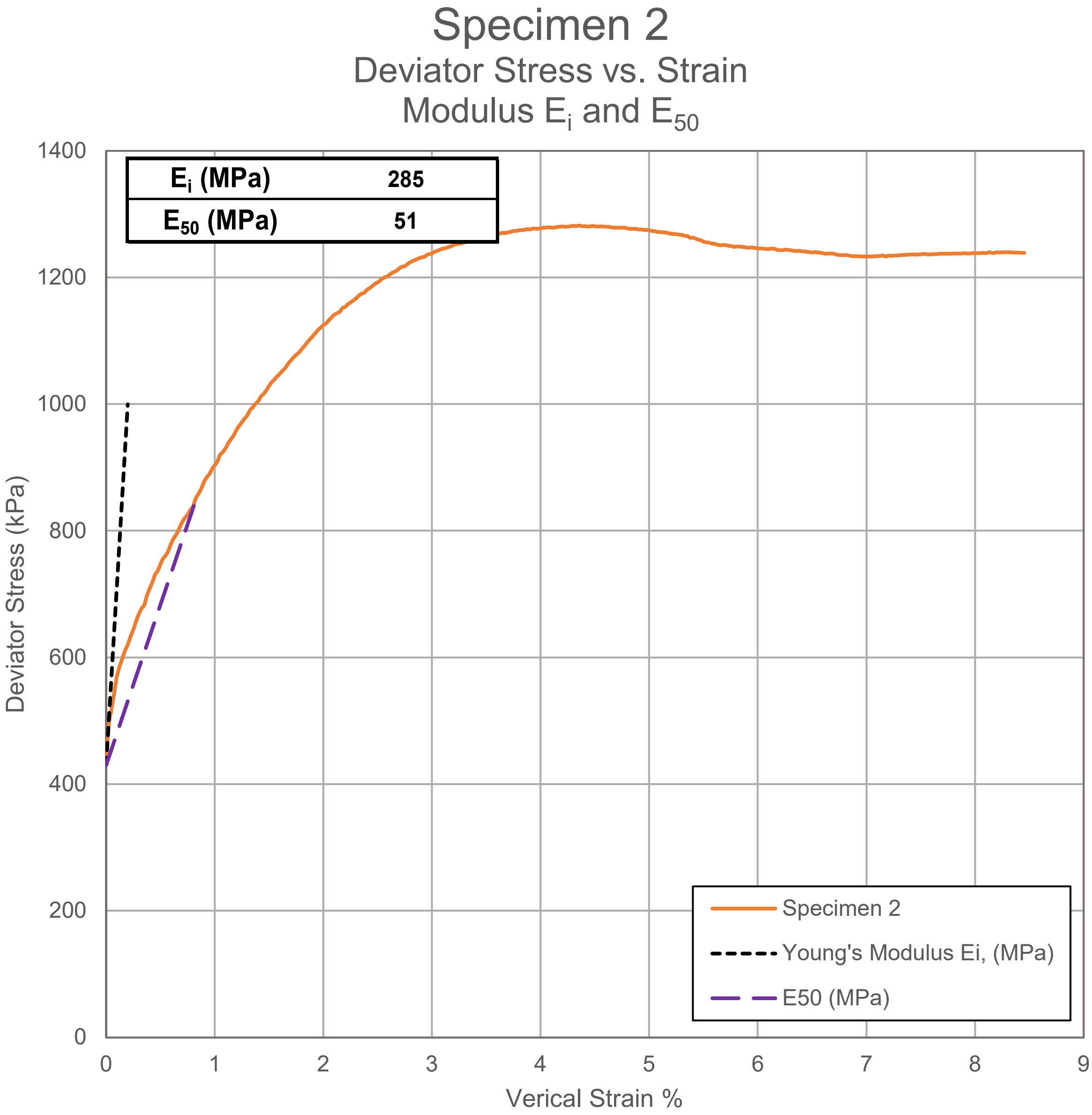
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 9.6

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	5

	Specimen 1	Specimen 2	Specimen 3
Consolidation Stage:	Anisotropic (Consol. K= 0.52)	Anisotropic (Consol. K= 0.49)	Anisotropic (Consol. K= 0.49)
Sample ID:	SA34	SA35	SA36
Test ID:	CAD-19	CAD-20R	CAD-21
Depth:	20.12 m - 20.73 m	20.73 m - 21.34 m	21.34 m - 21.95 m



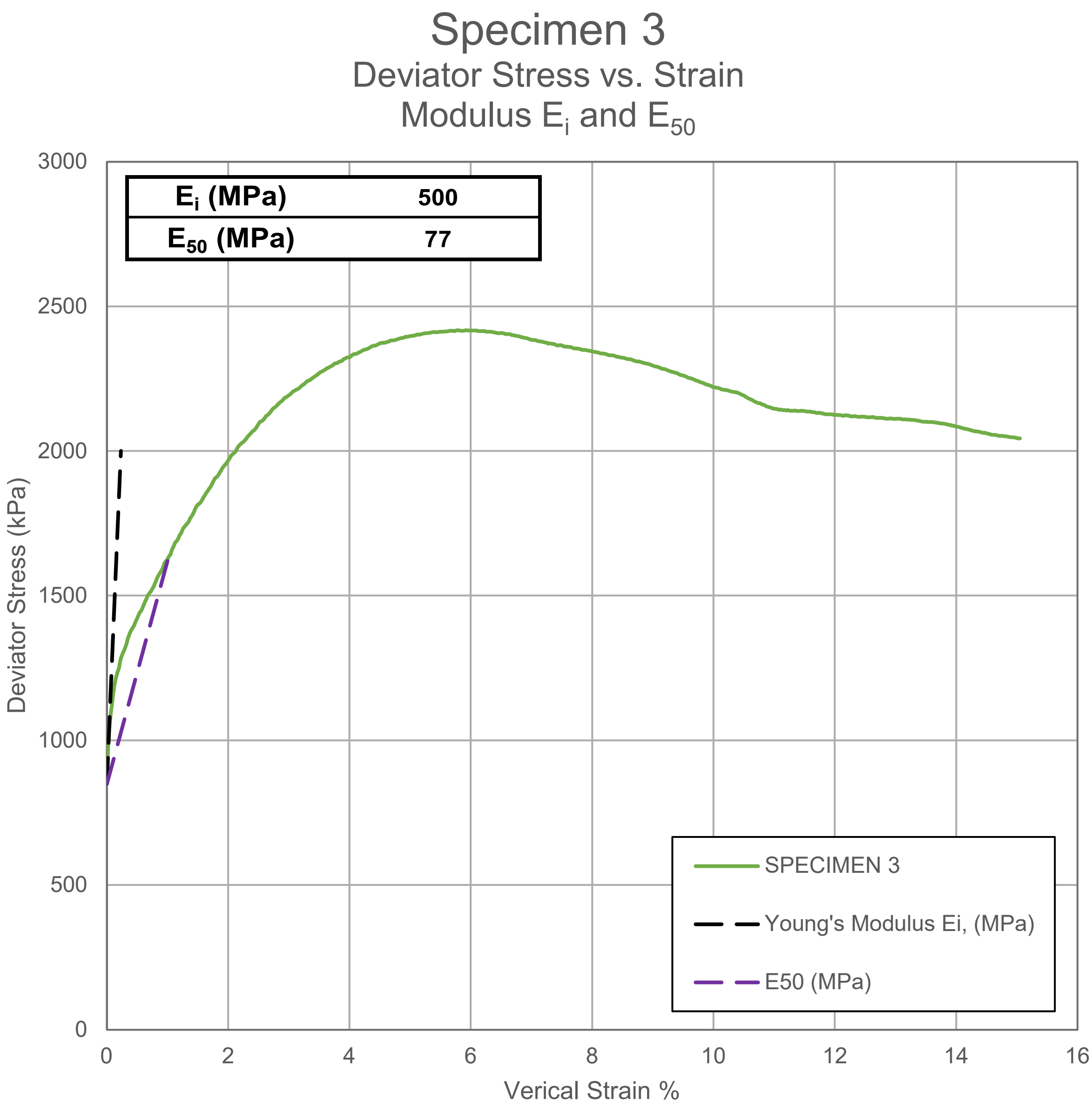
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 9.7

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	5

	Specimen 1	Specimen 2	Specimen 3
Consolidation Stage:	Anisotropic (Consol. K= 0.52)	Anisotropic (Consol. K= 0.49)	Anisotropic (Consol. K= 0.49)
Sample ID:	SA34	SA35	SA36
Test ID:	CAD-19	CAD-20R	CAD-21
Depth:	20.12 m - 20.73 m	20.73 m - 21.34 m	21.34 m - 21.95 m



Specimen 3

Deviator Stress vs. Strain

Modulus E_i and E_{50}

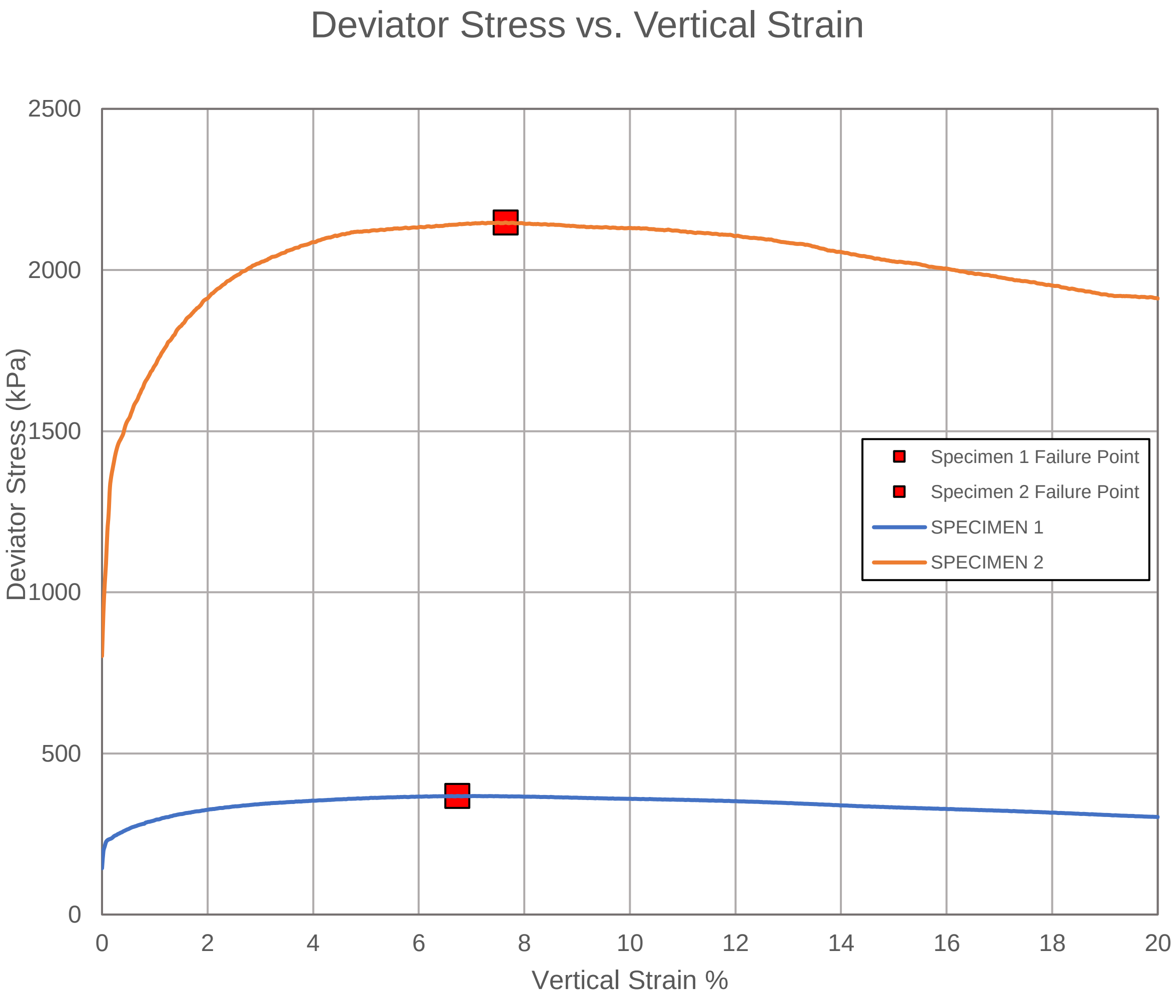
E_i (MPa)	500
E_{50} (MPa)	77

Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.50)	Anisotropic (Consol. K= 0.52)
Sample ID:	39A	40
Test ID:	CAD-22	CAD-23
Depth:	23.16m - 23.42 m	23.77m - 24.00 m

Project No.:	21451329
BH ID:	BH24
Soil Unit:	5

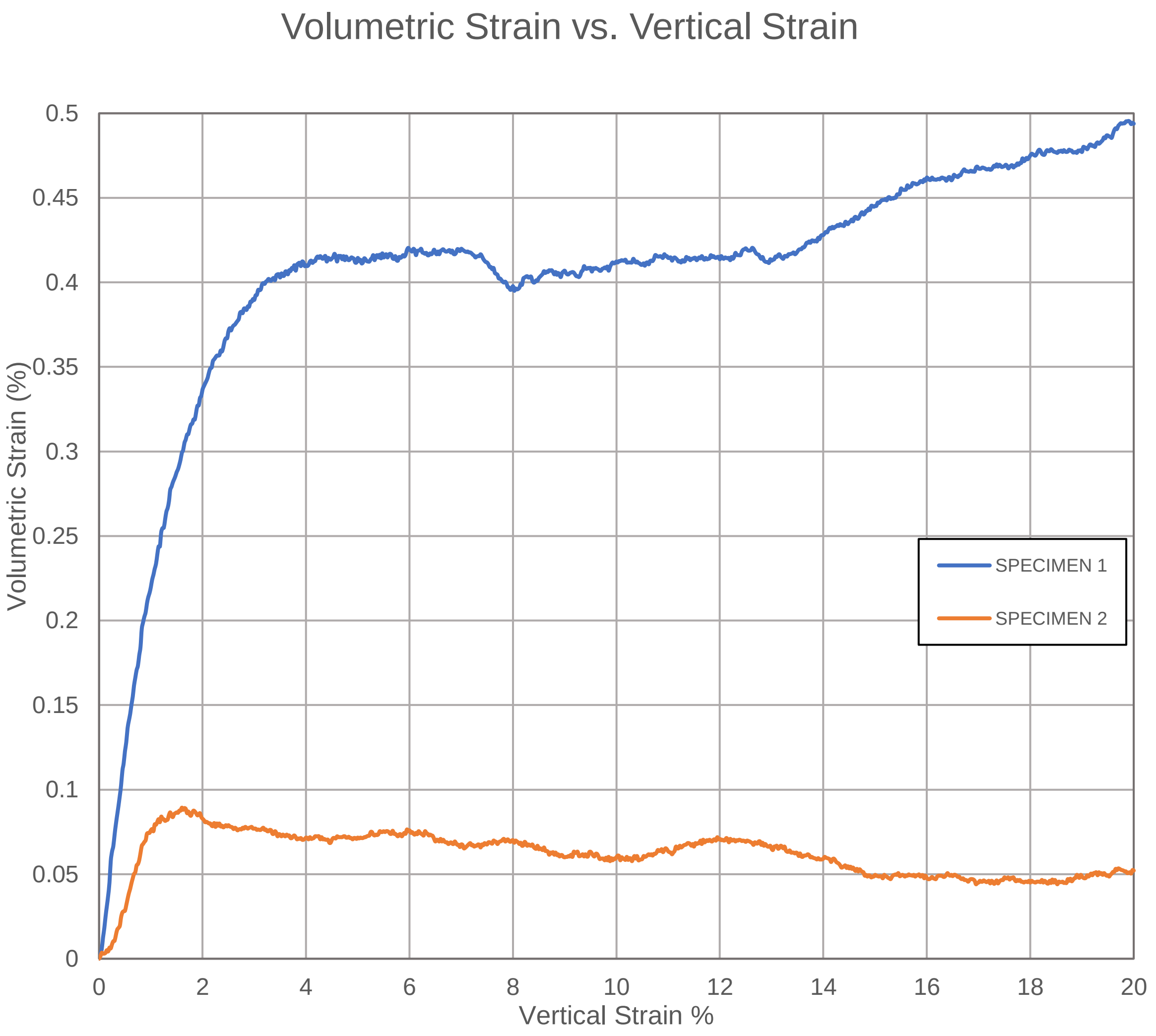


Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	5

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.50)	Anisotropic (Consol. K= 0.52)
Sample ID:	39A	40
Test ID:	CAD-22	CAD-23
Depth:	23.16m - 23.42 m	23.77m - 24.00 m



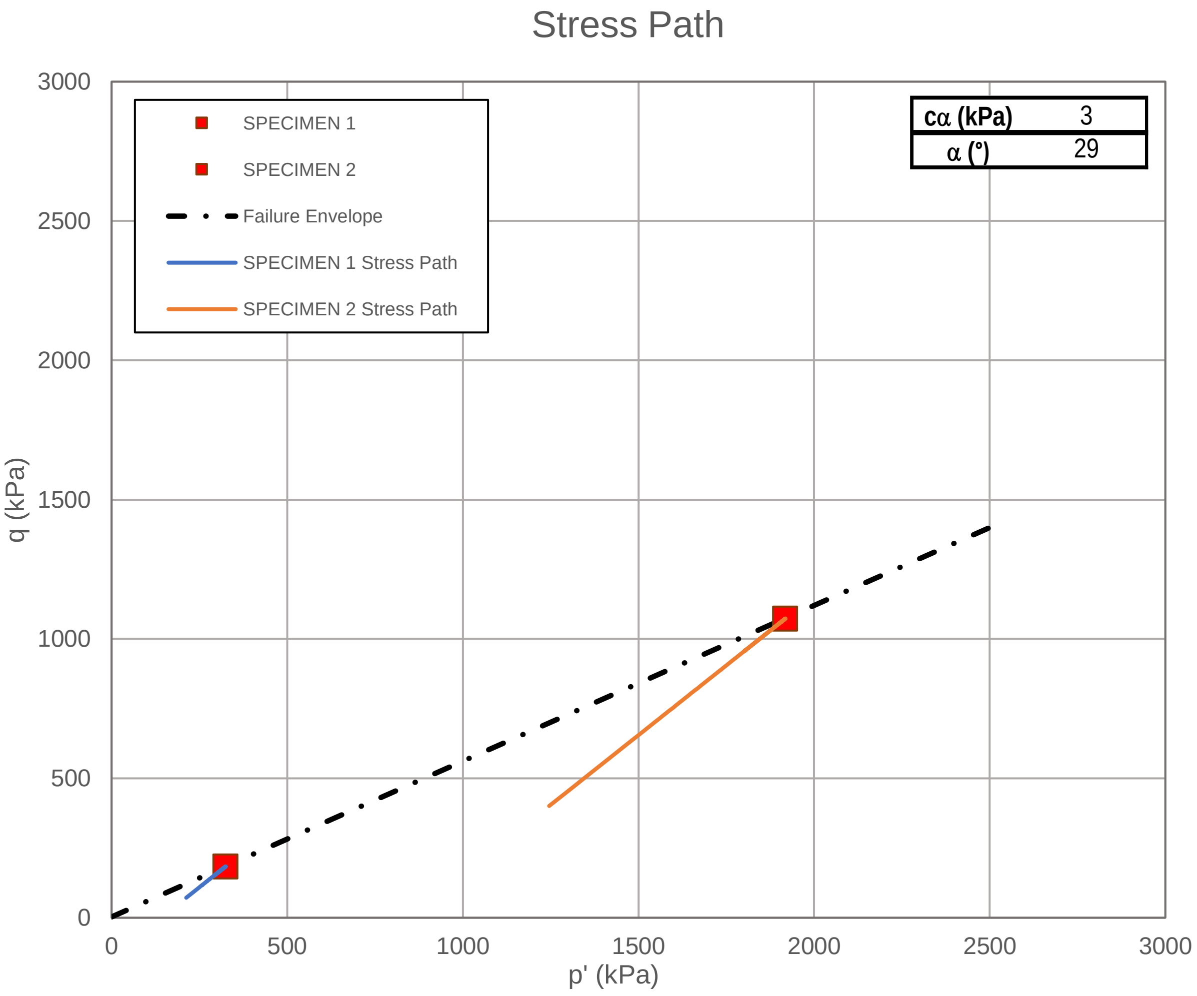
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 10.3

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	5

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.50)	Anisotropic (Consol. K= 0.52)
Sample ID:	39A	40
Test ID:	CAD-22	CAD-23
Depth:	23.16m - 23.42 m	23.77m - 24.00 m

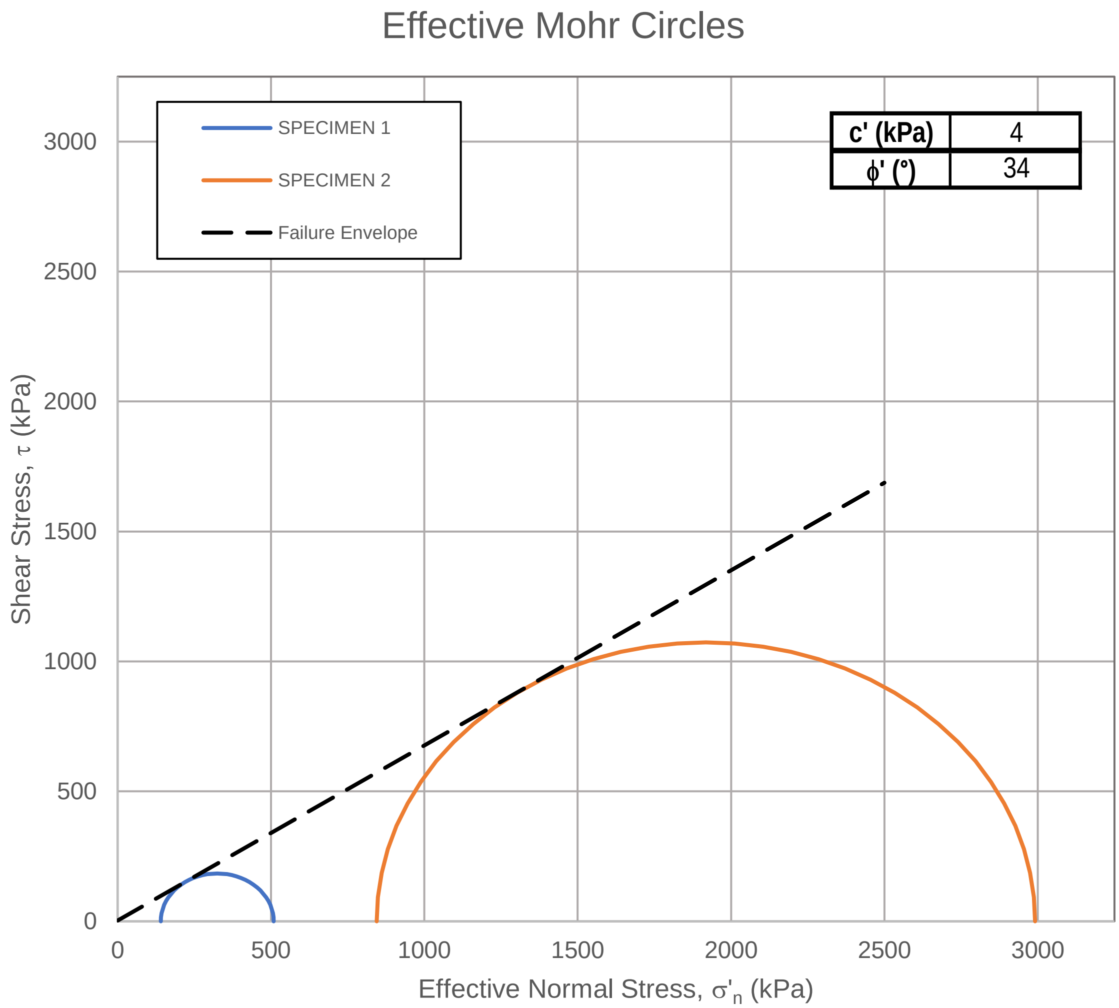


Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	5

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.50)	Anisotropic (Consol. K= 0.52)
Sample ID:	39A	40
Test ID:	CAD-22	CAD-23
Depth:	23.16m - 23.42 m	23.77m - 24.00 m



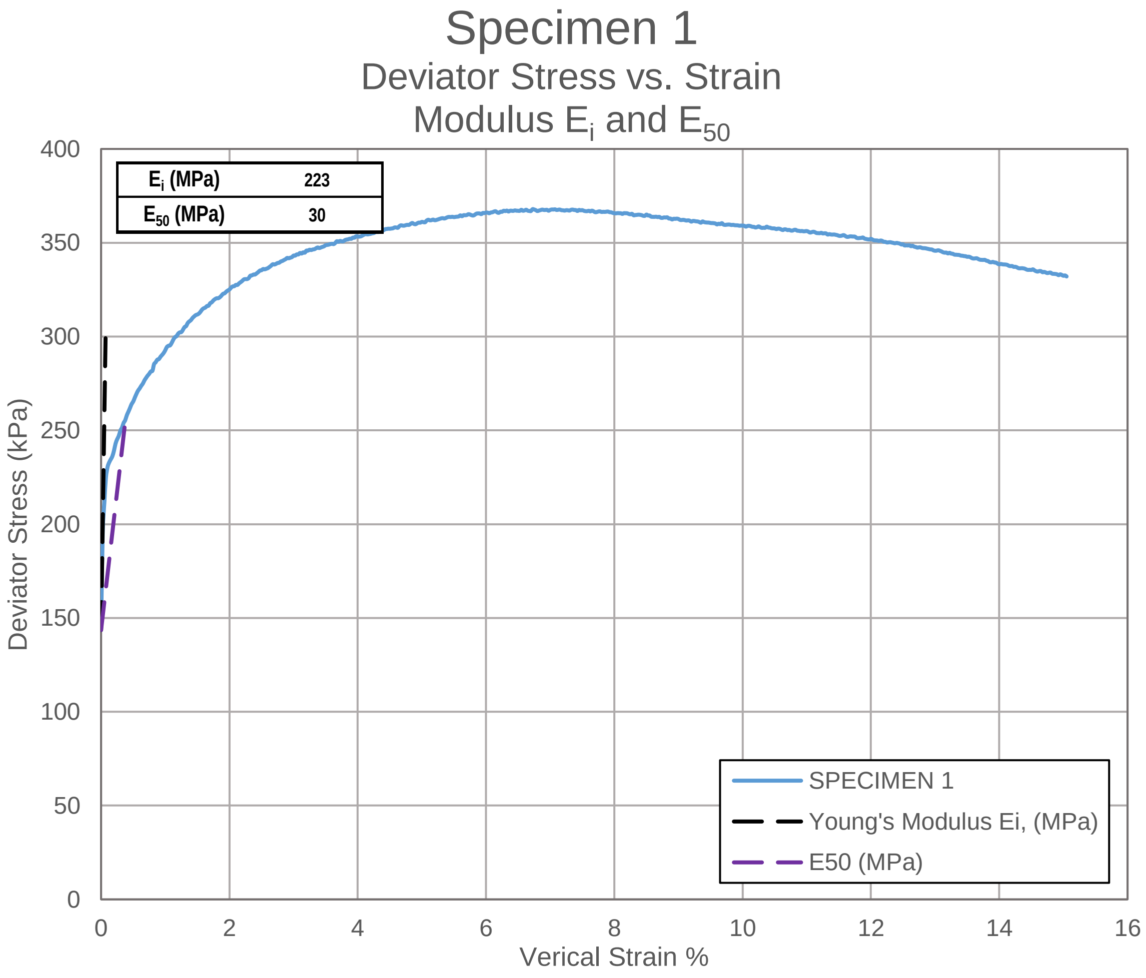
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 10.5

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	5

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.50)	Anisotropic (Consol. K= 0.52)
Sample ID:	39A	40
Test ID:	CAD-22	CAD-23
Depth:	23.16m - 23.42 m	23.77m - 24.00 m

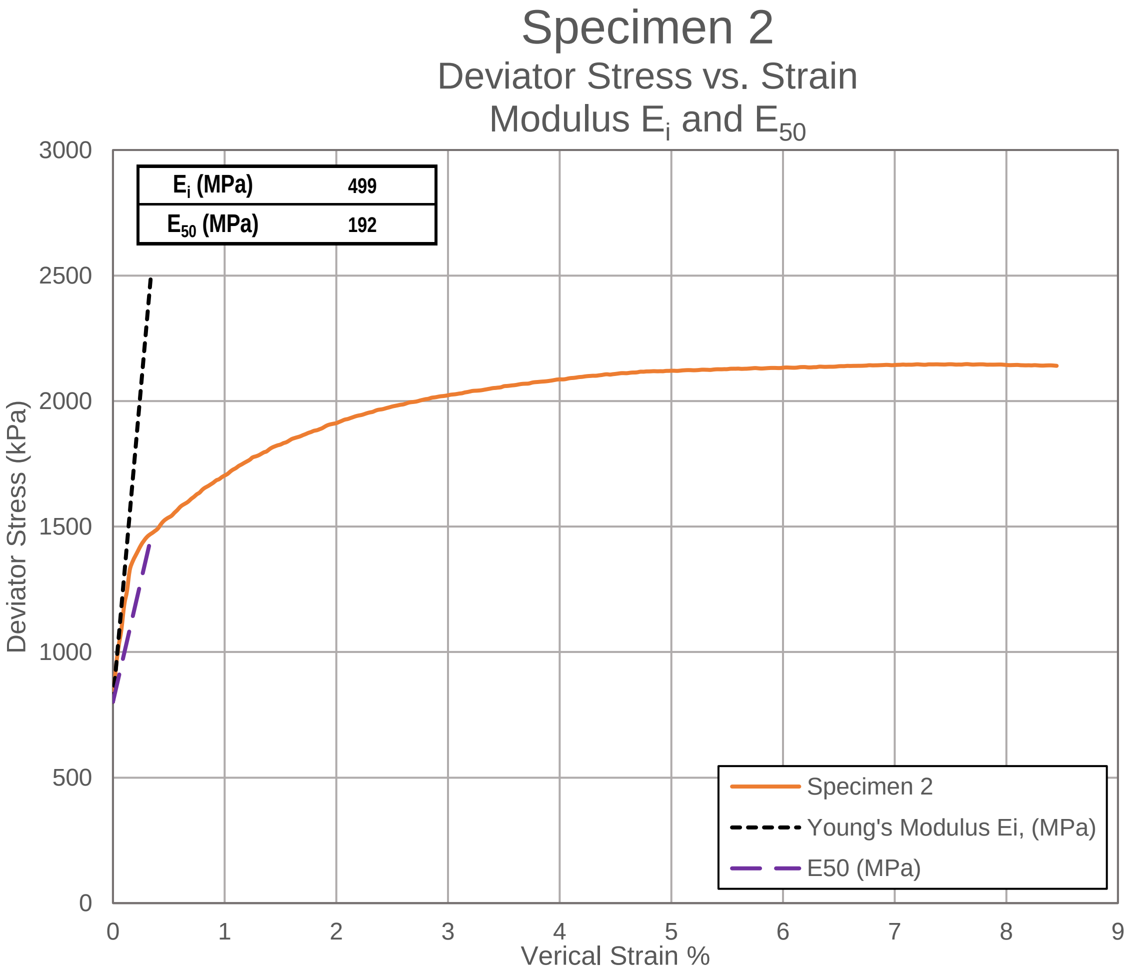


Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	5

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.50)	Anisotropic (Consol. K= 0.52)
Sample ID:	39A	40
Test ID:	CAD-22	CAD-23
Depth:	23.16m - 23.42 m	23.77m - 24.00 m



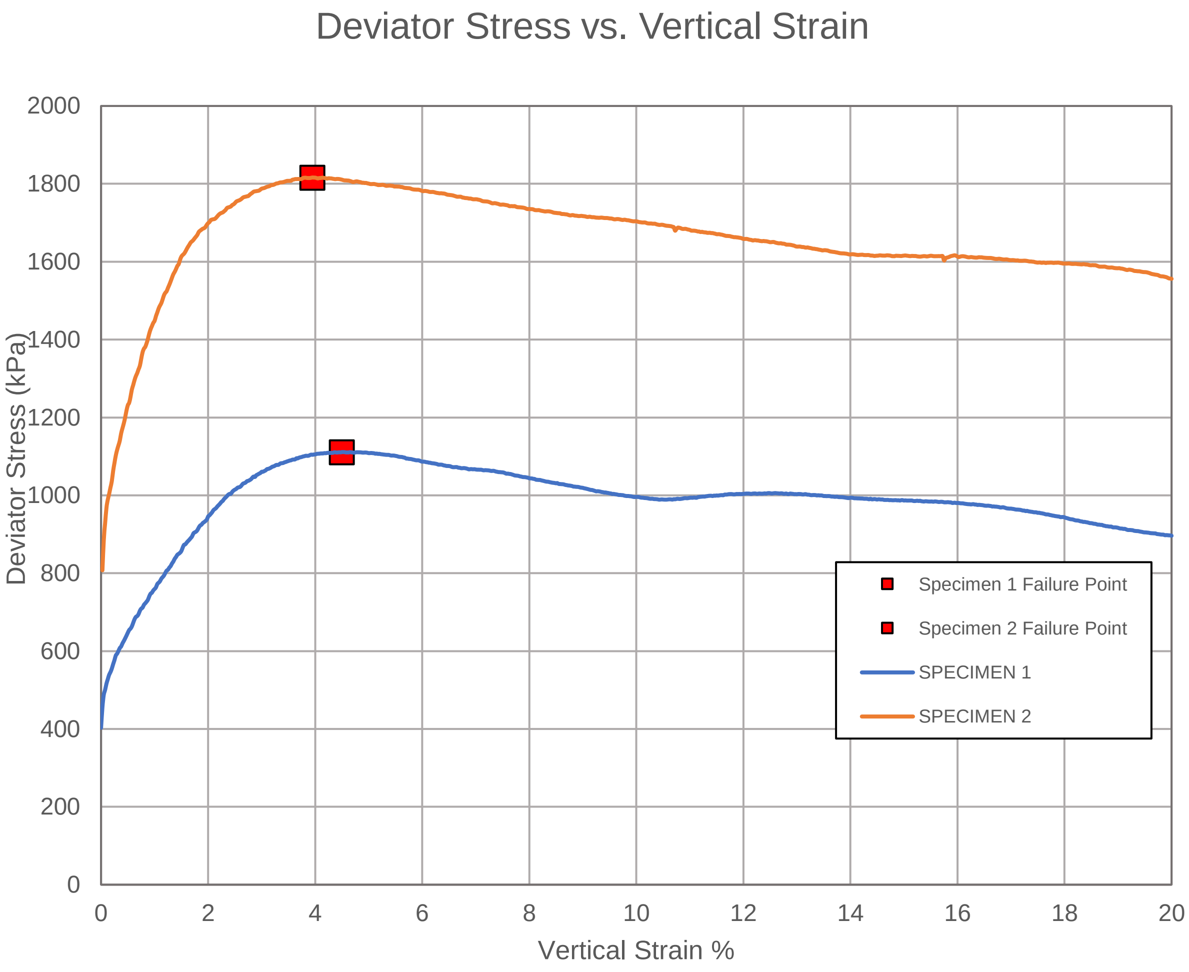
Consolidation of specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. J - 11.1

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	Unit 5

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.49)	Anisotropic (Consol. K= 0.52)
Sample ID:	35	36
Test ID:	CAD-25	CAD-26
Depth:	20.72m - 21.34 m	20.34m -21.95 m



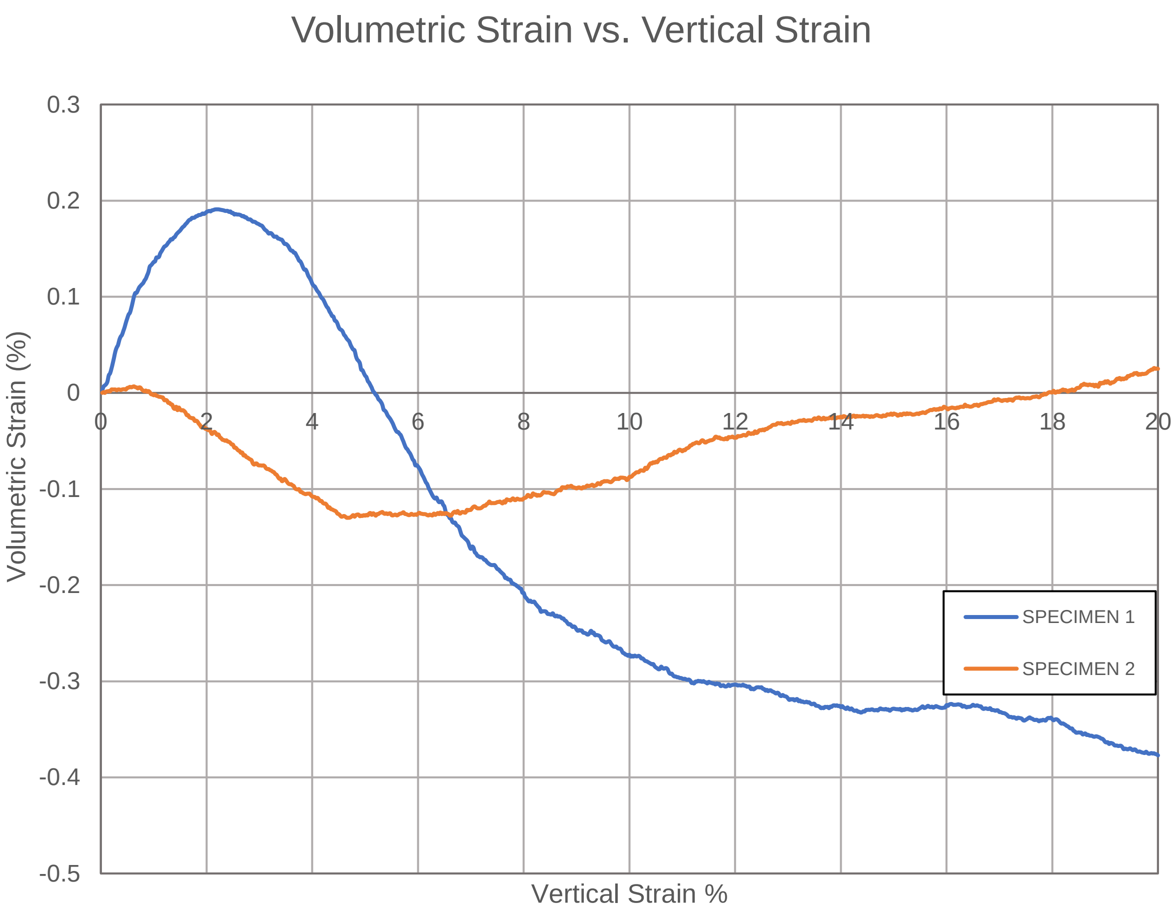
WSP GOLDER

Figure No. J - 11.2

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	Unit 5

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.49)	Anisotropic (Consol. K= 0.52)
Sample ID:	35	36
Test ID:	CAD-25	CAD-26
Depth:	20.72m - 21.34 m	20.34m -21.95 m

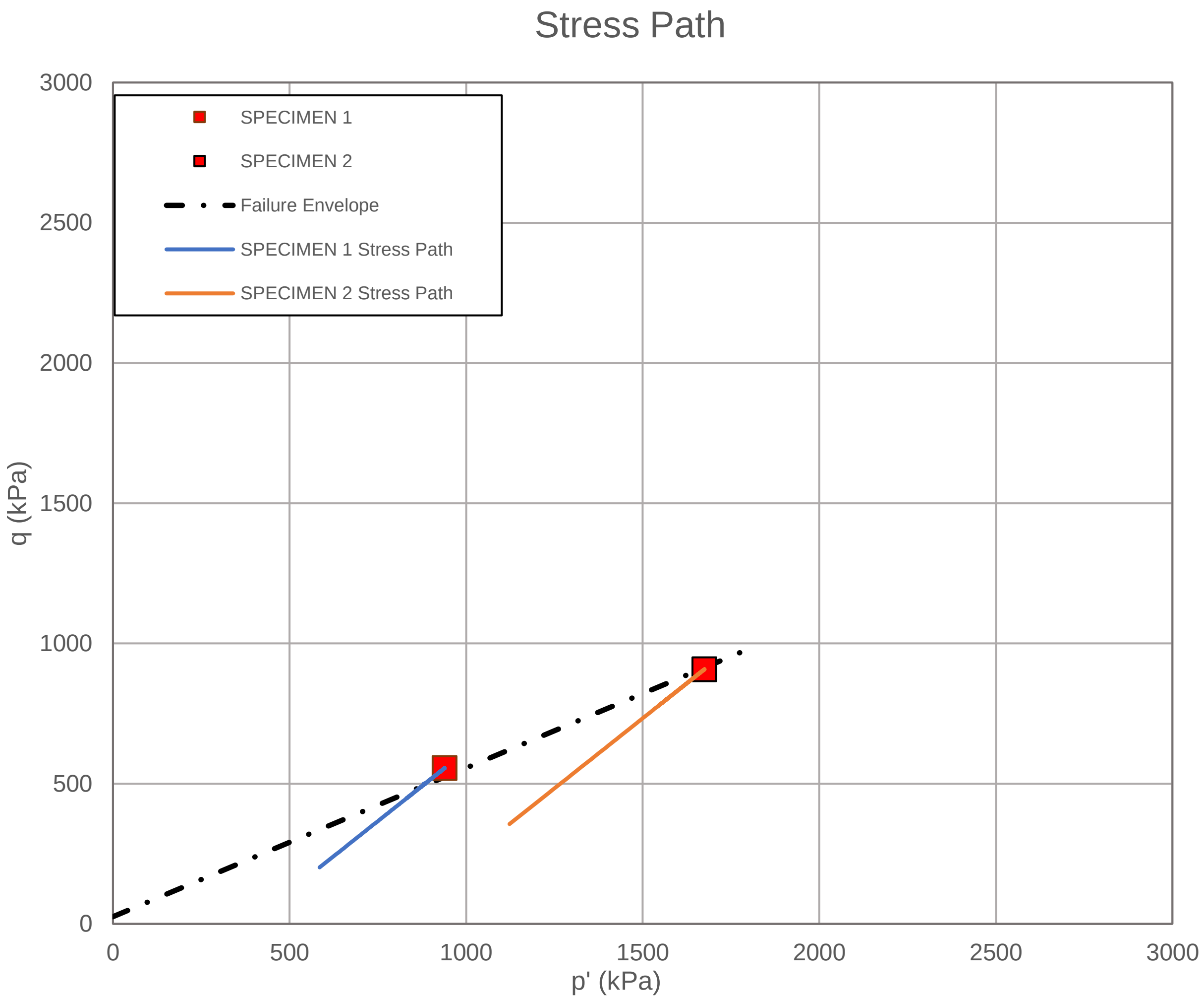


WSP GOLDER

Consolidated Drained (CAD) Triaxial Test

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.49)	Anisotropic (Consol. K= 0.52)
Sample ID:	35	36
Test ID:	CAD-25	CAD-26
Depth:	20.72m - 21.34 m	20.34m -21.95 m

Project No.:	21451329
BH ID:	BH26
Soil Unit:	Unit 5



Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	Unit 5

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.49)	Anisotropic (Consol. K= 0.52)
Sample ID:	35	36
Test ID:	CAD-25	CAD-26
Depth:	20.72m - 21.34 m	20.34m -21.95 m

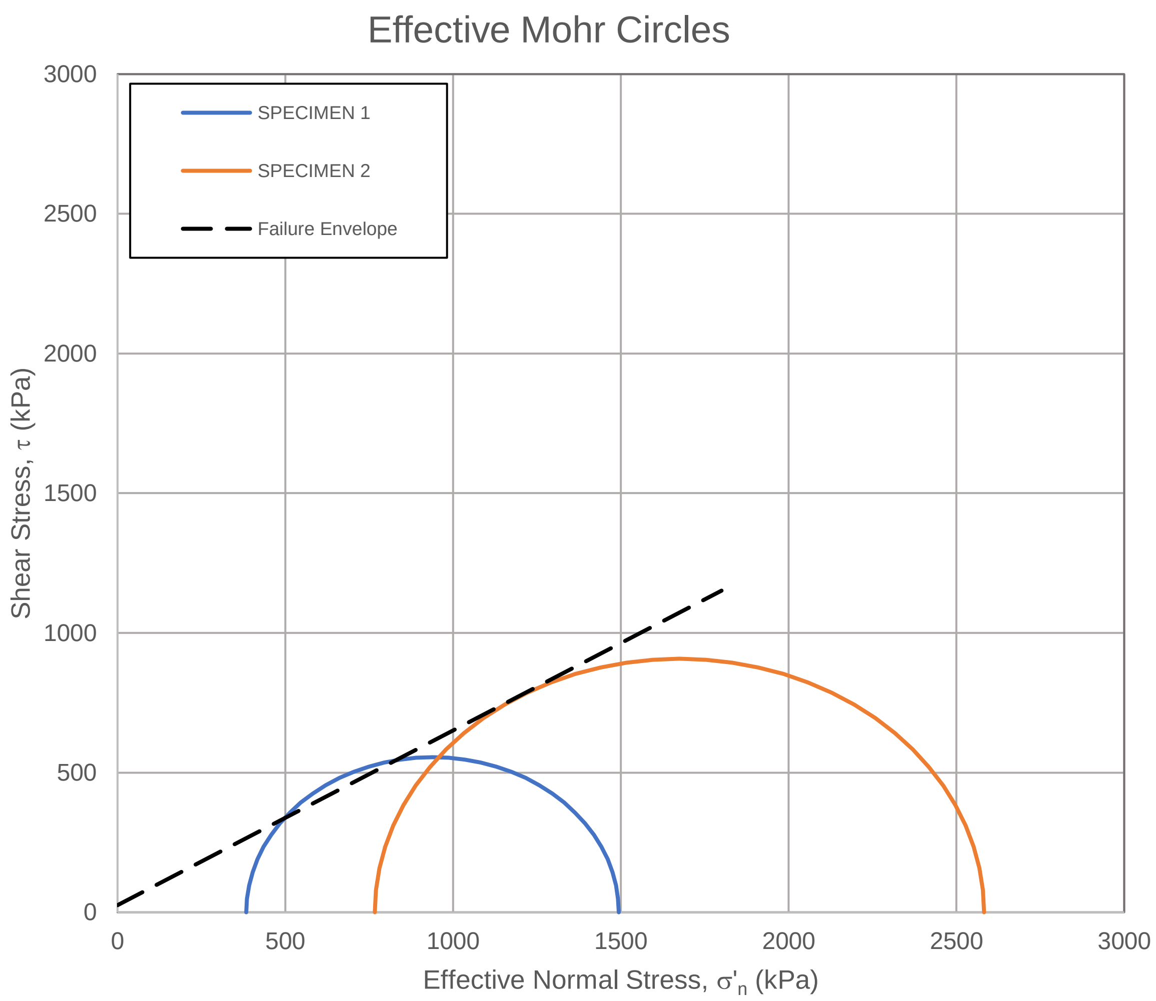


Figure No. J - 11.5

Consolidated Drained (CAD) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	Unit 5

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.49)	Anisotropic (Consol. K= 0.52)
Sample ID:	35	36
Test ID:	CAD-25	CAD-26
Depth:	20.72m - 21.34 m	20.34m -21.95 m

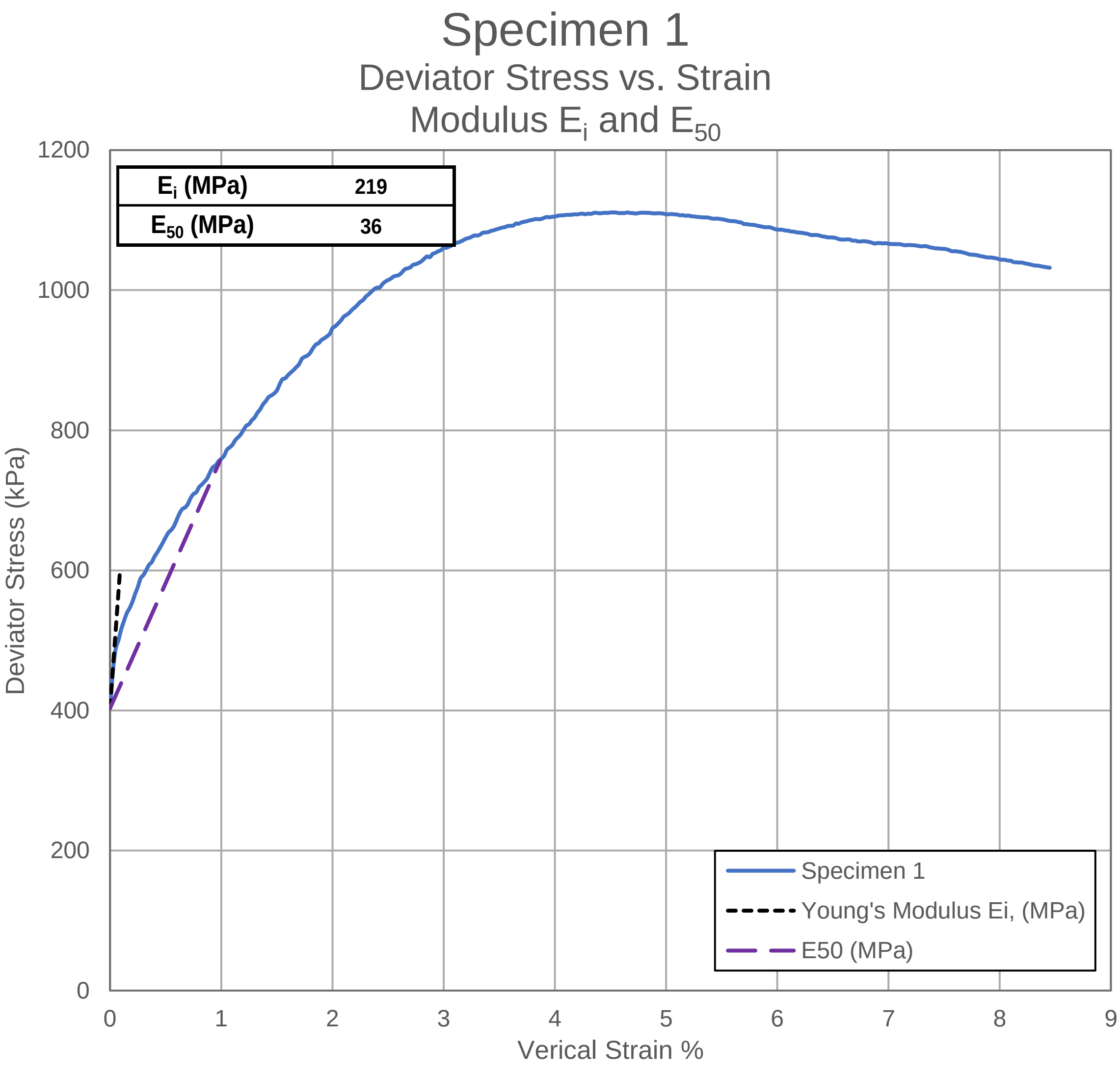


Figure No. J - 11.6

Consolidated Drained (CAD) Triaxial Test

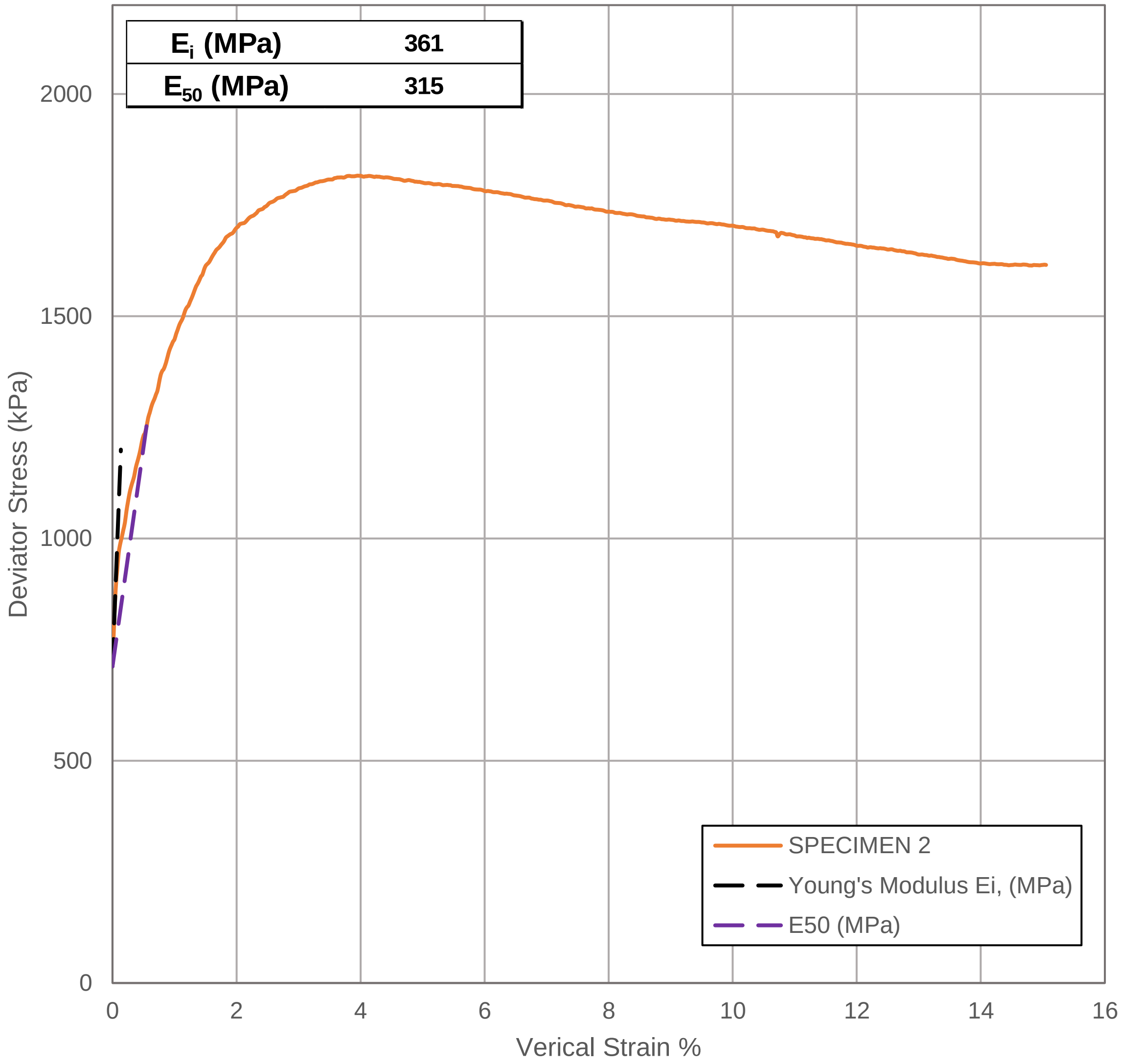
Project No.:	21451329
BH ID:	BH26
Soil Unit:	Unit 5

	Specimen 1	Specimen 2
Consolidation Stage:	Anisotropic (Consol. K= 0.49)	Anisotropic (Consol. K= 0.52)
Sample ID:	35	36
Test ID:	CAD-25	CAD-26
Depth:	20.72m - 21.34 m	20.34m -21.95 m

Specimen 3

Deviator Stress vs. Strain

Modulus E_i and E_{50}



E_i (MPa)	**361**
E_{50} (MPa)	**315**

APPENDIX K

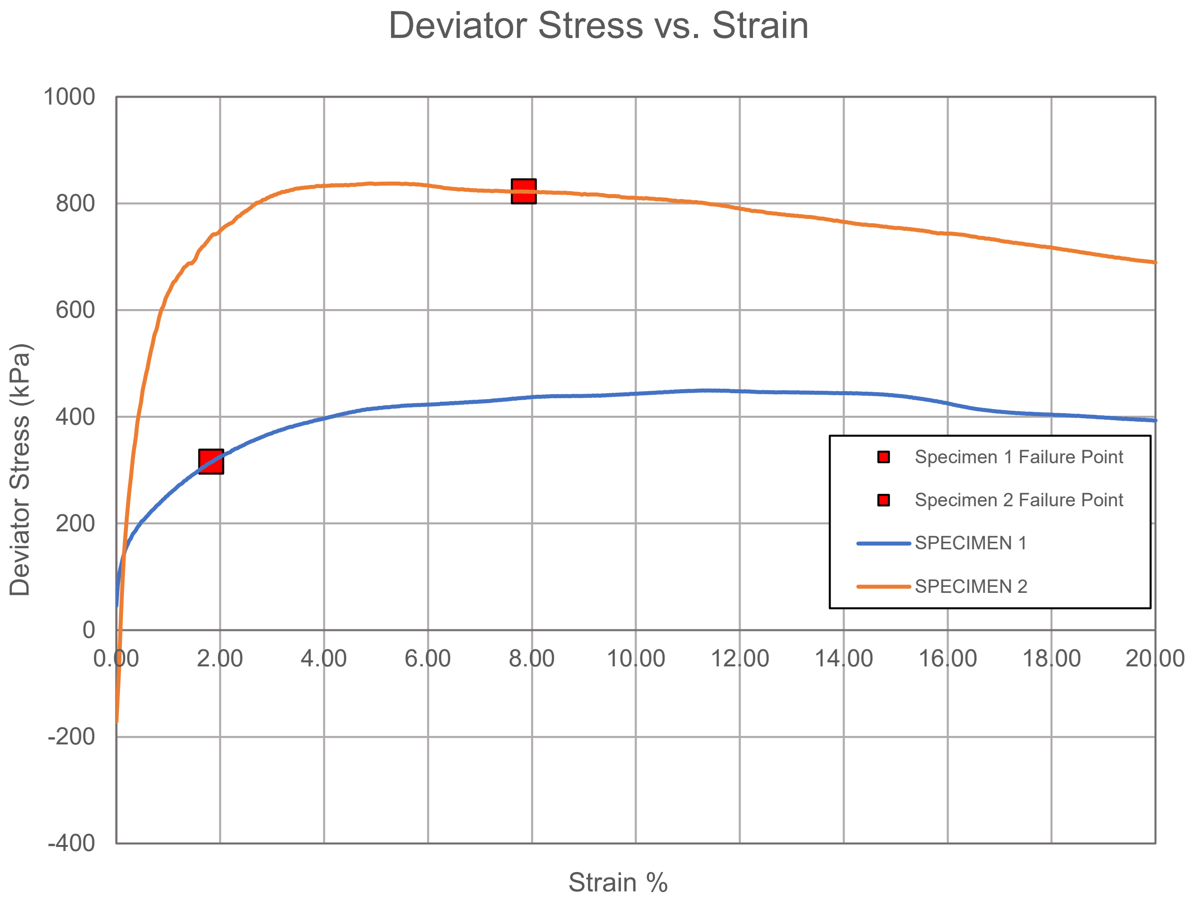
Consolidated Undrained Triaxal Compression Testing Interpretations

Figure No. K - 1.1

Consolidated Undrained (CK_0U) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	4b

	Specimen 1	Specimen 2
Consolidation Stage:	K_0-Conditions (Consol. K_0= 0.82)	K0-Conditions (Consol. K_0= 1.18)
Sample ID:	SA33-3	SA32-2
Test ID:	CK0Uc-1-1	CKoUc-1-2Alt
Depth:	19.56m - 19.71m	19.35m - 19.47m



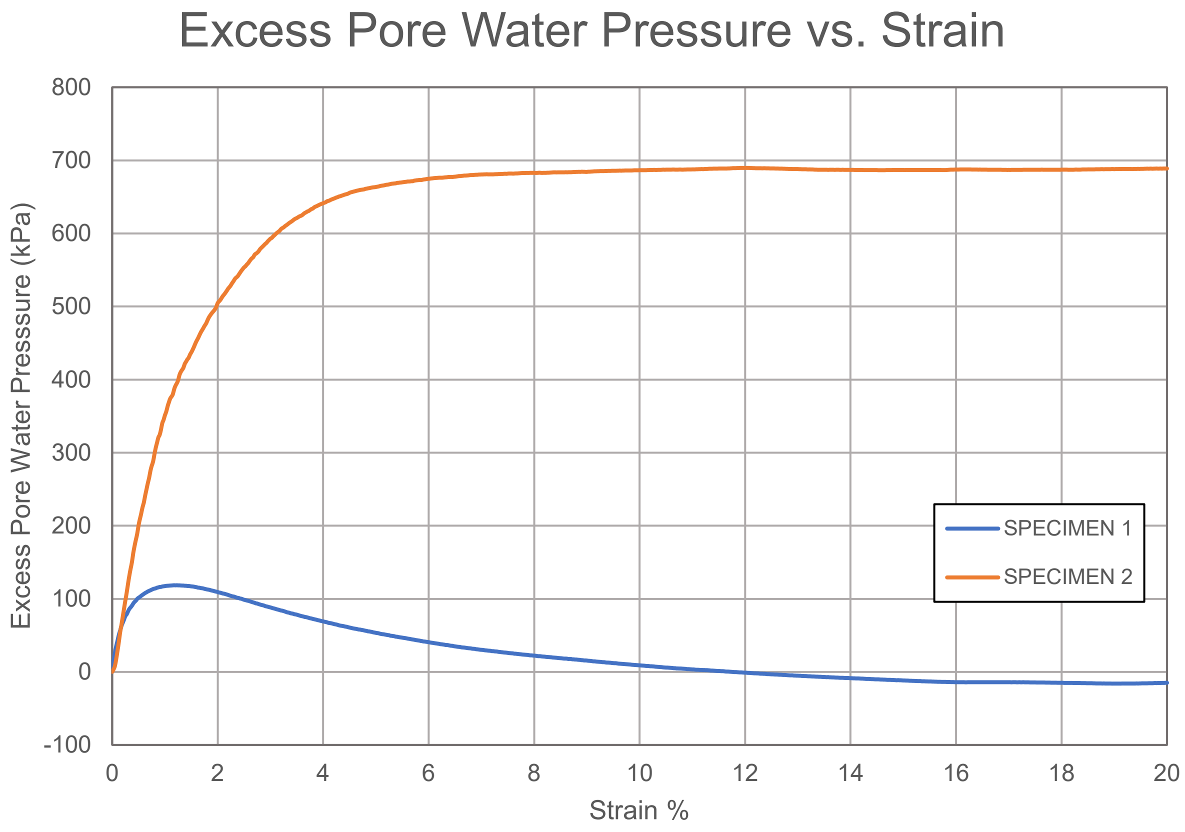
Note: Consolidation of Specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. K - 1.2

Consolidated Undrained (CK0U) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	4b

	Specimen 1	Specimen 2
Consolidation Stage:	K0-Conditions (Consol. K_0= 0.82)	K0-Conditions (Consol. K_0= 1.18)
Sample ID:	SA33-3	SA32-2
Test ID:	CK0Uc-1-1	CKoUc-1-2Alt
Depth:	19.56m - 19.71m	19.35m - 19.47m



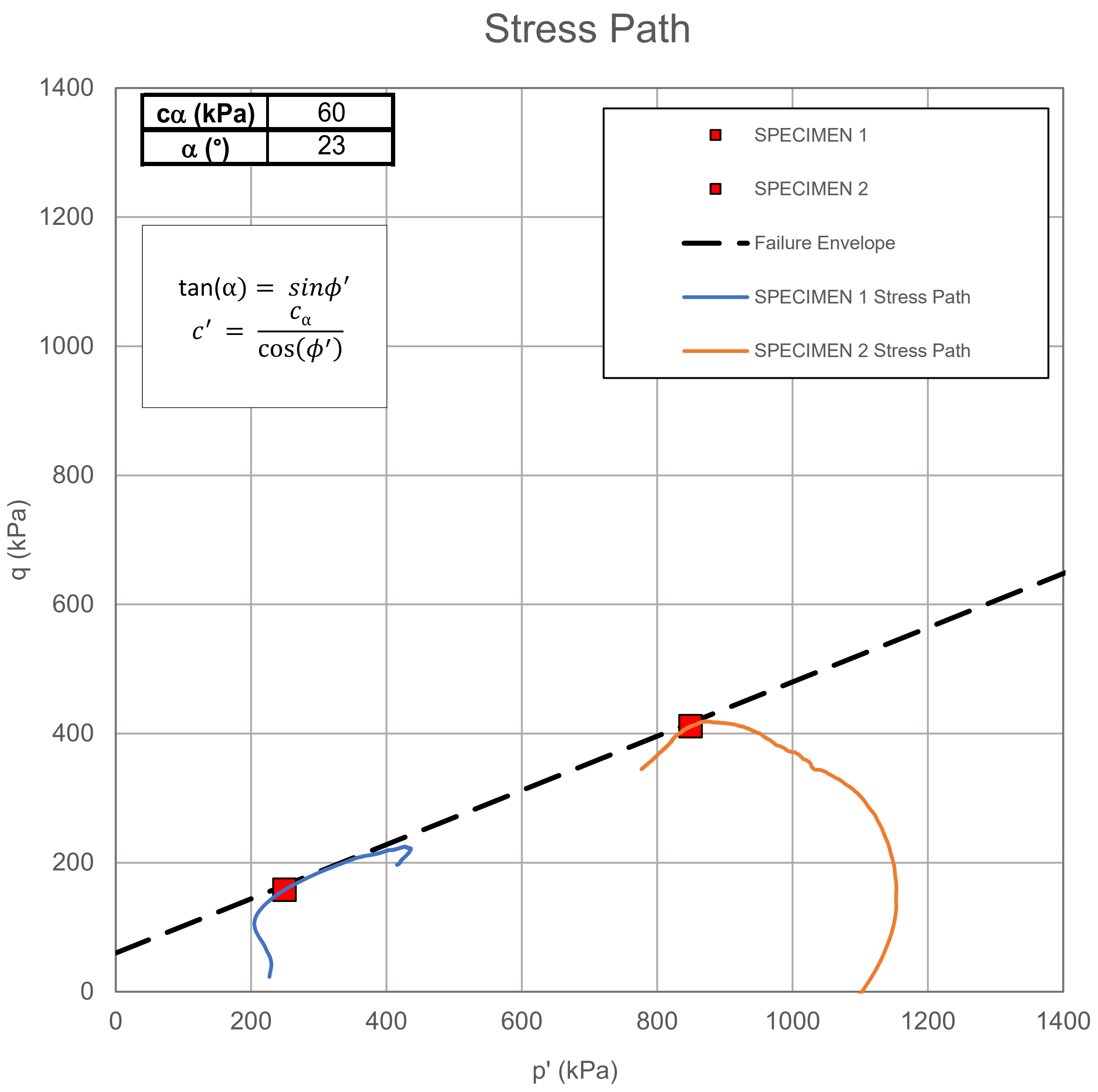
Note: Consolidation of Specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. K - 1.3

Consolidated Undrained (CK0U) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	4b

	Specimen 1	Specimen 2
Consolidation Stage:	K0-Conditions (Consol. K_0= 0.82)	K0-Conditions (Consol. K_0= 1.18)
Sample ID:	SA33-3	SA32-2
Test ID:	CK0Uc-1-1	CKoUc-1-2Alt
Depth:	19.56m - 19.71m	19.35m - 19.47m


Stress Path

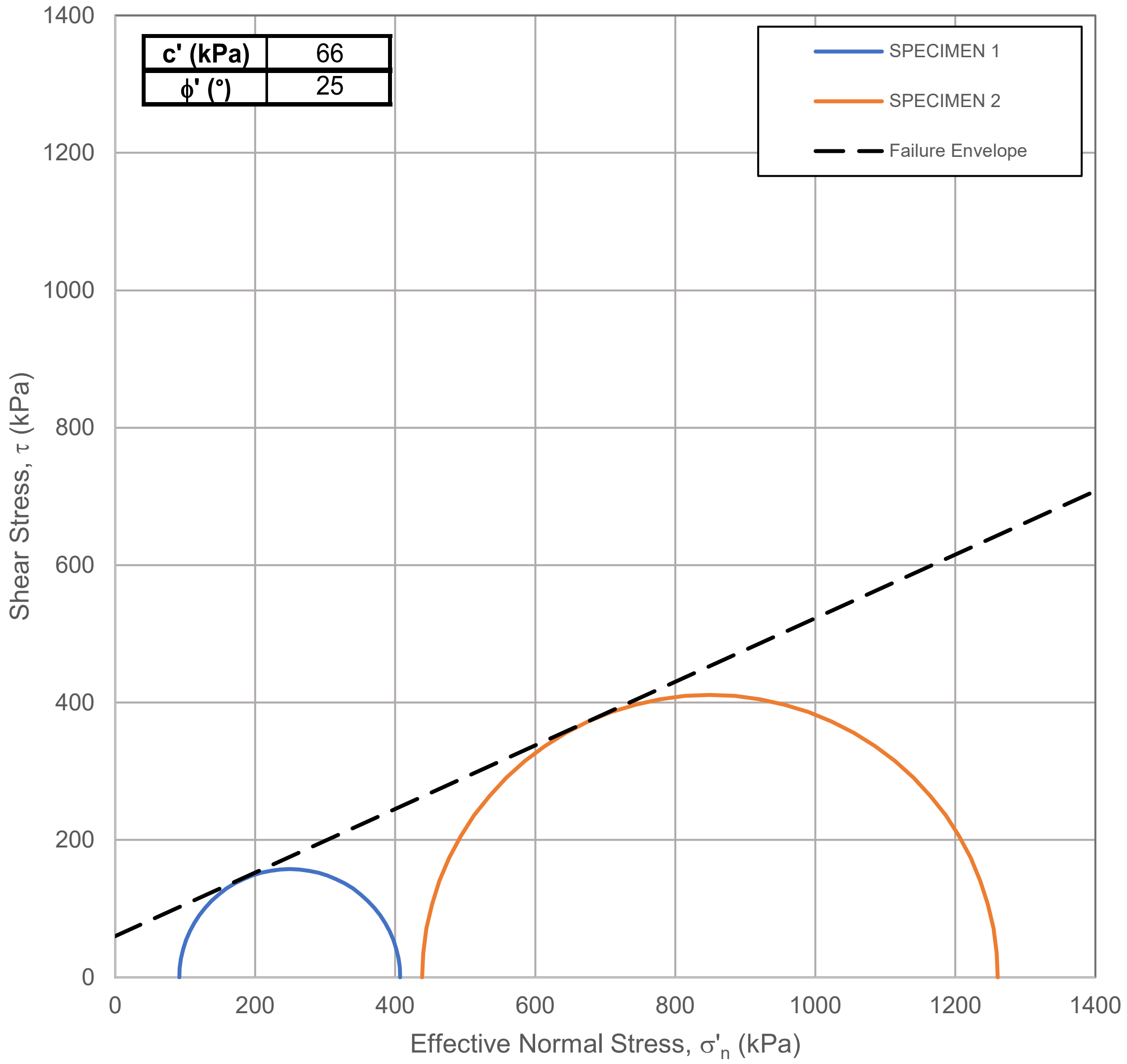
Note: Consolidation of Specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Undrained (CK0U) Triaxial Test

	Specimen 1	Specimen 2
Consolidation Stage:	K0-Conditions (Consol. K_0= 0.82)	K0-Conditions (Consol. K_0= 1.18)
Sample ID:	SA33-3	SA32-2
Test ID:	CK0Uc-1-1	CKoUc-1-2Alt
Depth:	19.56m - 19.71m	19.35m - 19.47m

Project No.:	21451329
BH ID:	BH24
Soil Unit:	4b

Effective Mohr Circles



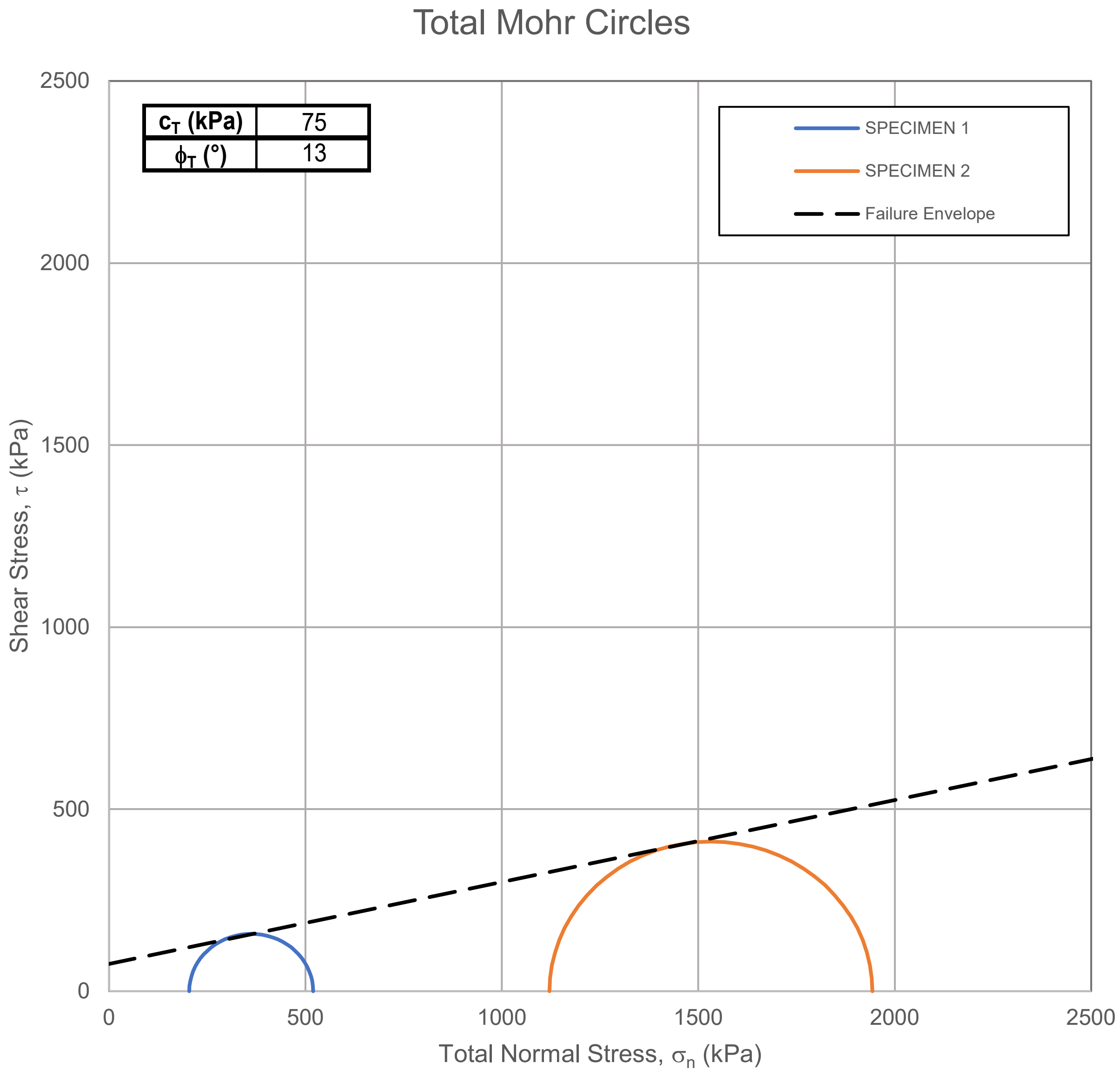
Note: Consolidation of Specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. K - 1.5

Consolidated Undrained (CK0U) Triaxial Test

Project No.:	21451329
BH ID:	BH24
Soil Unit:	4b

	Specimen 1	Specimen 2
Consolidation Stage:	K0-Conditions (Consol. K_0= 0.82)	K0-Conditions (Consol. K_0= 1.18)
Sample ID:	SA33-3	SA32-2
Test ID:	CK0Uc-1-1	CKoUc-1-2Alt
Depth:	19.56m - 19.71m	19.35m - 19.47m

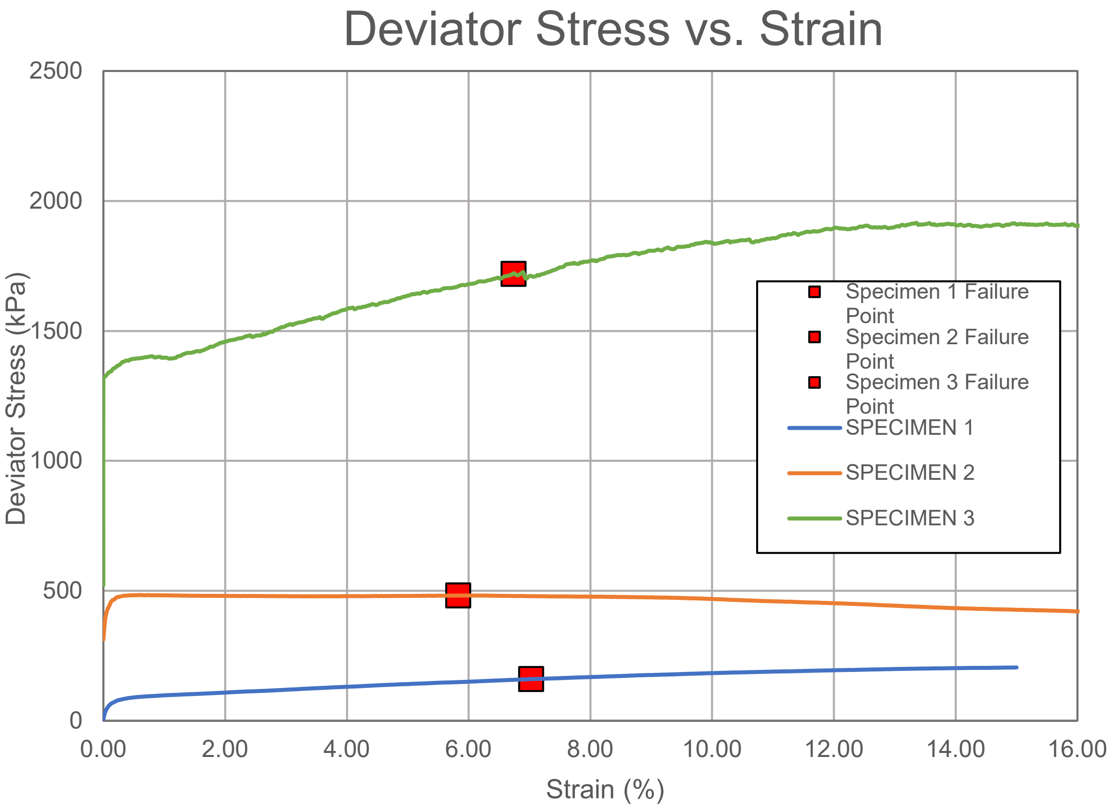


Note: Consolidation of Specimen(s) carried out under anisotropic conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Undrained (CK$_0$U) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	4b

	Specimen 1	Specimen 2	Specimen 3
Consolidation Stage:	K$_0$-Conditions (Consol. K= 0.97)	K$_0$-Conditions (Consol. K= 0.61)	K$_0$-Conditions (Consol. K= 0.60)
Sample ID:	SA24-3	SA28-3	SA24-4
Test ID:	CKoUc-2-1	CK0Uc-3-1	CKoUc-2-2R
Depth:	14.07m - 14.22m	16.54m - 16.69m	14.35m - 14.50m



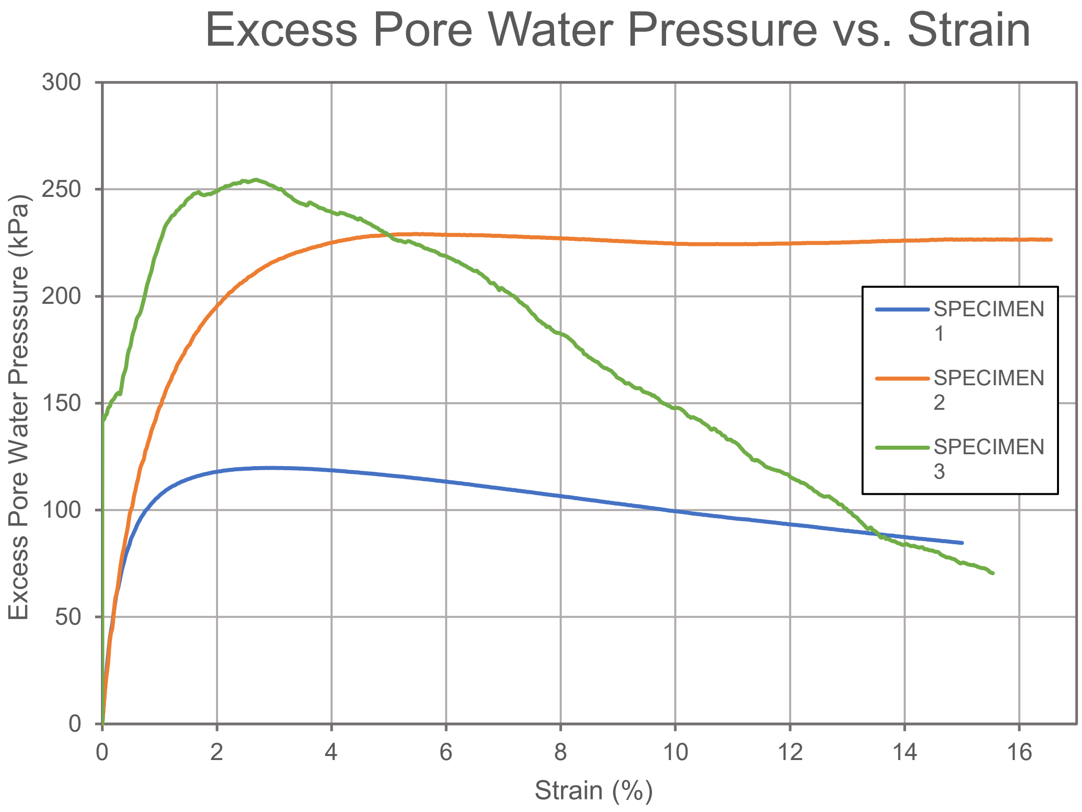
Note: Consolidation of Specimen(s) carried out under K$_0$ conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. K - 2.2

Consolidated Undrained (CK_0U) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	4b

	Specimen 1	Specimen 2	Specimen 3
Consolidation Stage:	K_0-Conditions (Consol. K= 0.97)	K_0-Conditions (Consol. K= 0.61)	K_0-Conditions (Consol. K= 0.60)
Sample ID:	SA24-3	SA28-3	SA24-4
Test ID:	CKoUc-2-1	CK0Uc-3-1	CKoUc-2-2R
Depth:	14.07m - 14.22m	16.54m - 16.69m	14.35m - 14.50m



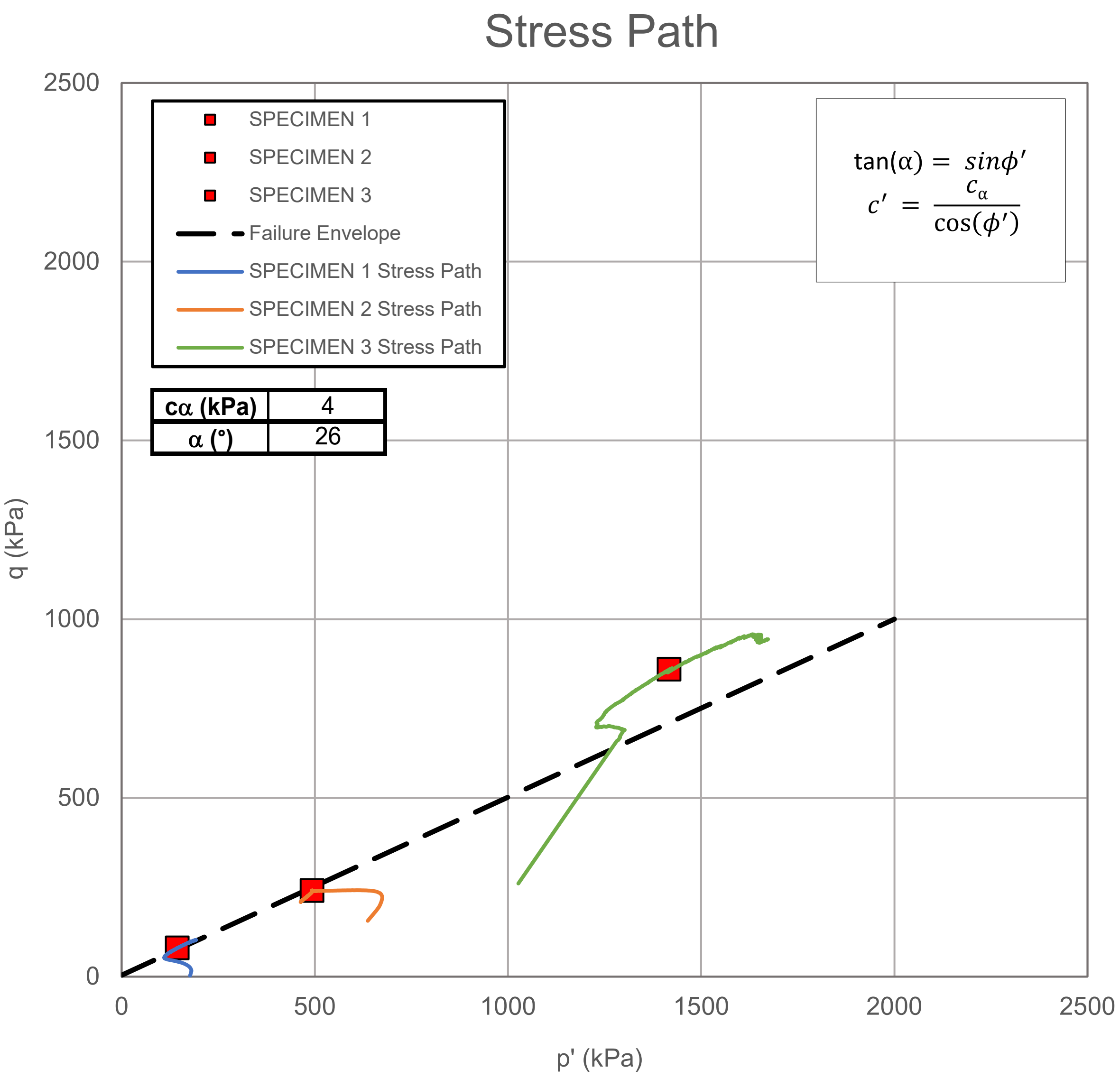
Note: Consolidation of Specimen(s) carried out under K_0 conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. K - 2.3

Consolidated Undrained (CK$_0$U) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	4b

	Specimen 1	Specimen 2	Specimen 3
Consolidation Stage:	K$_0$-Conditions (Consol. K= 0.97)	K$_0$-Conditions (Consol. K= 0.61)	K$_0$-Conditions (Consol. K= 0.60)
Sample ID:	SA24-3	SA28-3	SA24-4
Test ID:	CKoUc-2-1	CK0Uc-3-1	CKoUc-2-2R
Depth:	14.07m - 14.22m	16.54m - 16.69m	14.35m - 14.50m



Note: Consolidation of Specimen(s) carried out under K$_0$ conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Figure No. K - 2.4

Consolidated Undrained (CK$_0$U) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	4b

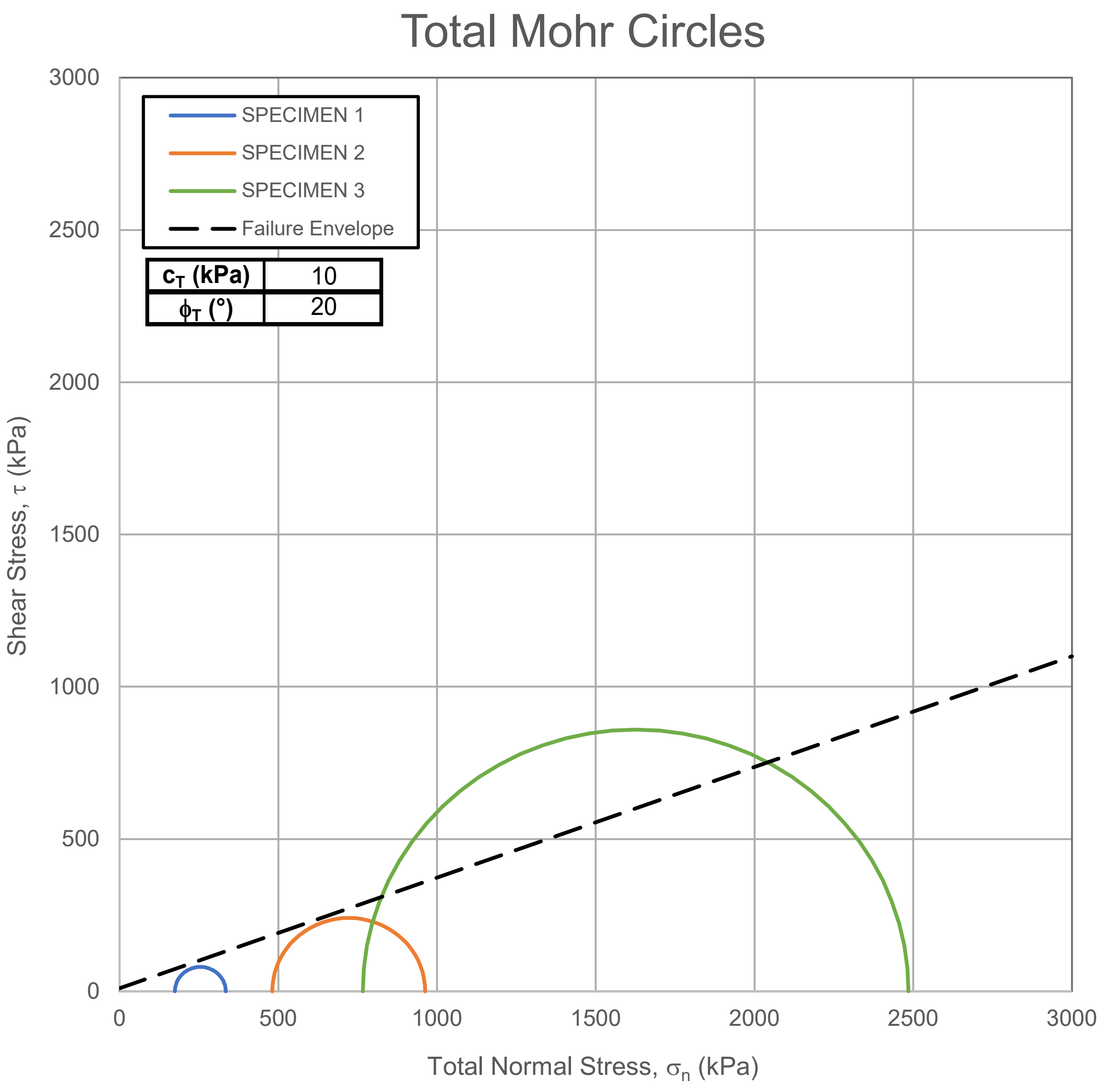
	Specimen 1	Specimen 2	Specimen 3
Consolidation Stage:	K$_0$-Conditions (Consol. K= 0.97)	K$_0$-Conditions (Consol. K= 0.61)	K$_0$-Conditions (Consol. K= 0.60)
Sample ID:	SA24-3	SA28-3	SA24-4
Test ID:	CKoUc-2-1	CK0Uc-3-1	CKoUc-2-2R
Depth:	14.07m - 14.22m	16.54m - 16.69m	14.35m - 14.50m

Note: Consolidation of Specimen(s) carried out under K$_0$ conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

Consolidated Undrained (CK_0U) Triaxial Test

Project No.:	21451329
BH ID:	BH26
Soil Unit:	4b

	Specimen 1	Specimen 2	Specimen 3
Consolidation Stage:	K_0-Conditions (Consol. K= 0.97)	K_0-Conditions (Consol. K= 0.61)	K_0-Conditions (Consol. K= 0.60)
Sample ID:	SA24-3	SA28-3	SA24-4
Test ID:	CKoUc-2-1	CK0Uc-3-1	CKoUc-2-2R
Depth:	14.07m - 14.22m	16.54m - 16.69m	14.35m - 14.50m

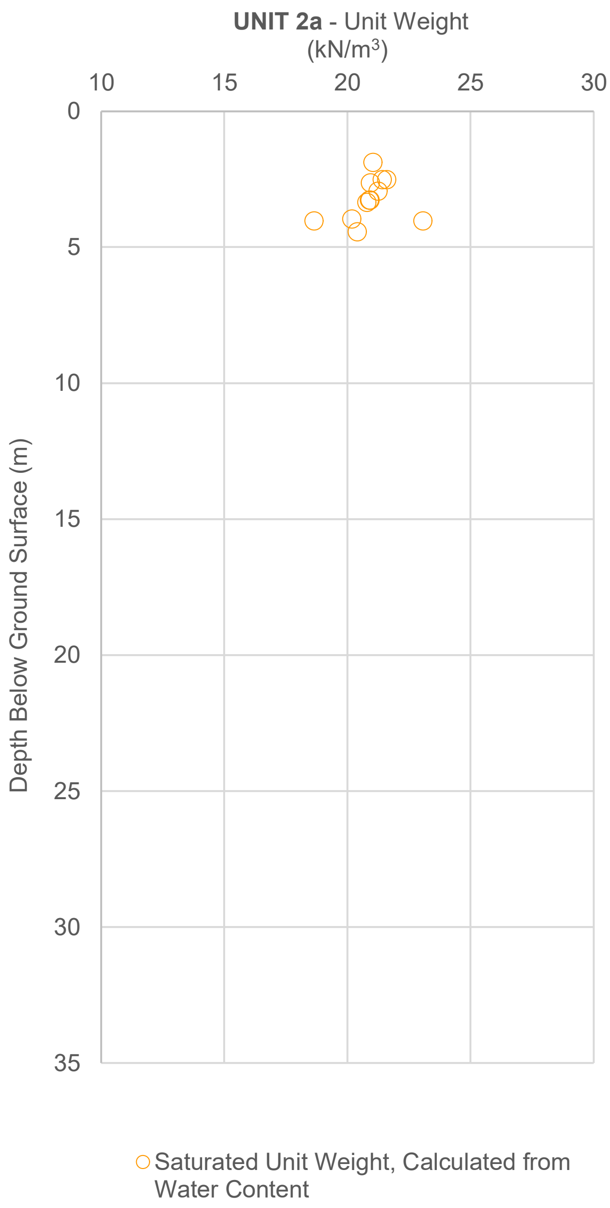


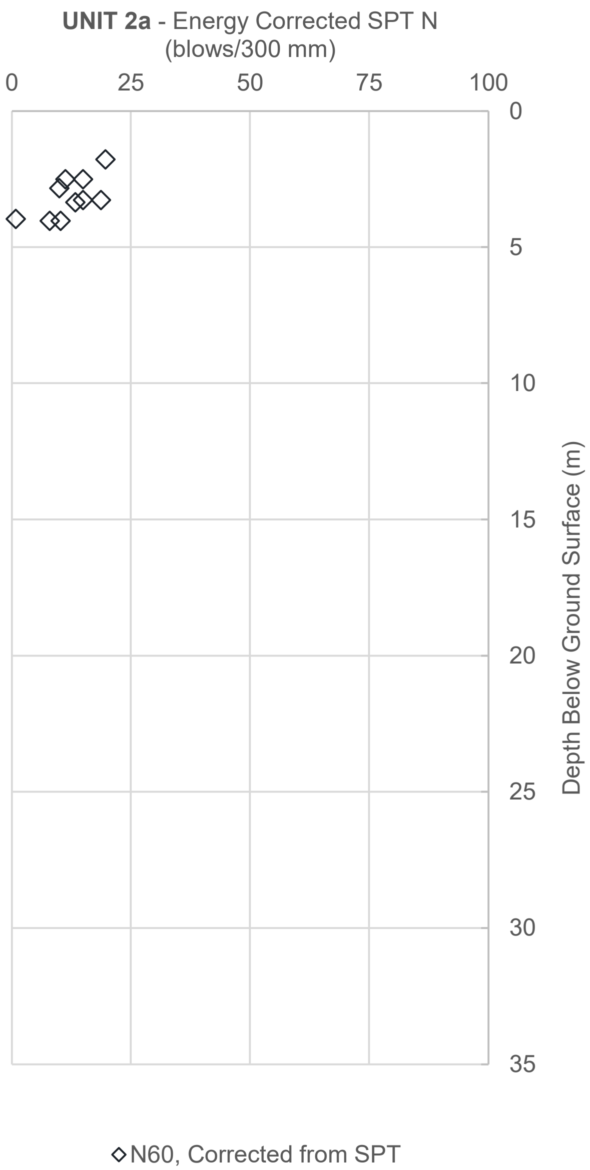
c_T (kPa)	10
ϕ_T (°)	20

Note: Consolidation of Specimen(s) carried out under K_0 conditions. Ratio of horizontal to vertical effective stress at end of consolidation stage (Consol. K) indicated above for each specimen.

APPENDIX L

Interpreted Soil Parameter Profiles





NOTE(S)

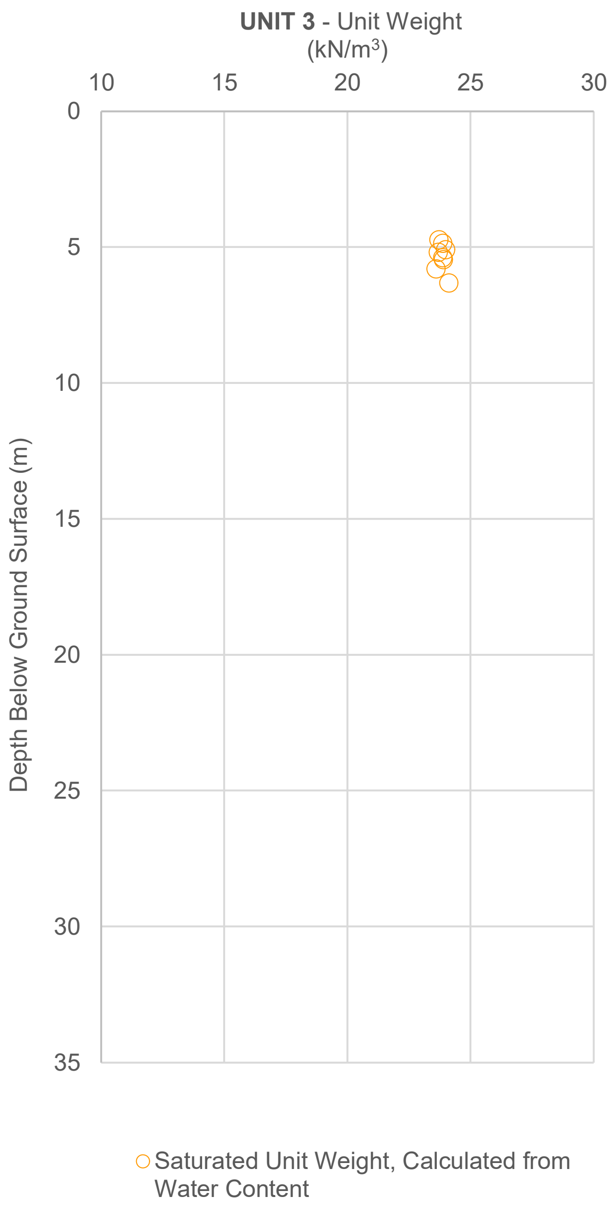
1. This figure is to be read in conjunction with the accompanying WSP Report No. 21451329-P2.
2. Saturated unit weight calculated from specific gravity and water content measured in laboratory (assumes 100% saturation).
3. SPT N_{60} represents the SPT N value corrected to 60% of the theortetical free-fall hammer energy.
4. SPT N_{60} value of 100 indicates practical refusal of split spoon sampler.

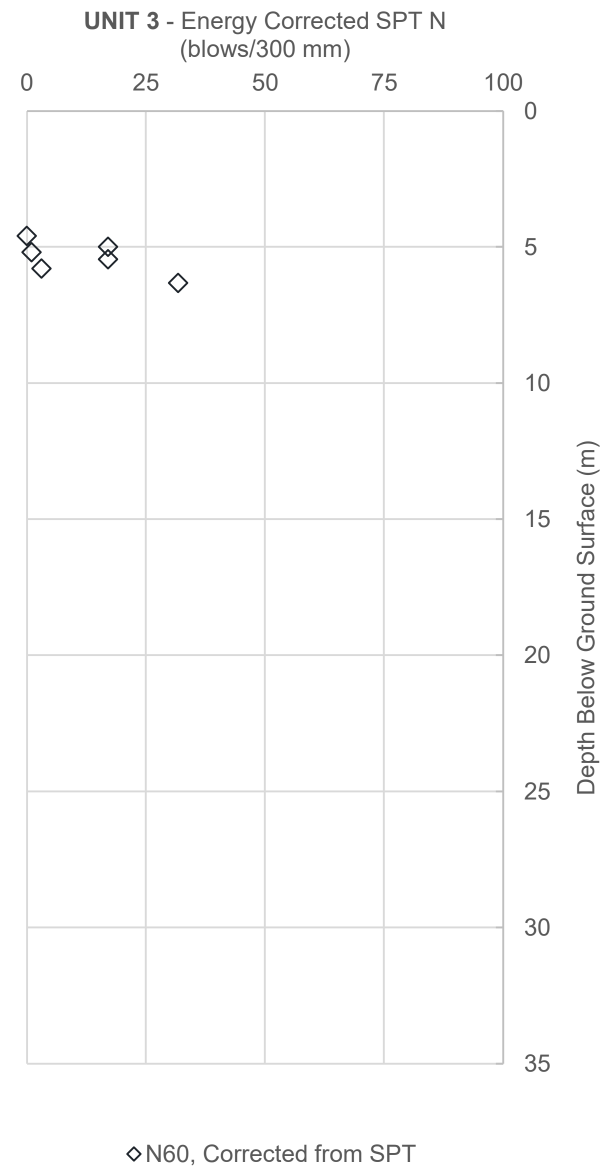
PROJECT: **PHASE II GEOTECHNICAL INVESTIGATION (CONDENSER COOLING WATER SYSTEM), DNNP**

PROJECT NO.: **21451329**

TITLE: **INTERPRETED SOIL PARAMETER PROFILES,**
BASIC MATERIAL CHARACTERISTICS – UNIT 2A

PREPARED BY: YW DATE: March 2023 CHECKED BY: SP DATE: March 2023





NOTE(S)

1. This figure is to be read in conjunction with the accompanying WSP Report No. 21451329-P2.
2. Saturated unit weight calculated from specific gravity and water content measured in laboratory (assumes 100% saturation).
3. SPT N_{60} represents the SPT N value corrected to 60% of the theortetical free-fall hammer energy.
4. SPT N_{60} value of 100 indicates practical refusal of split spoon sampler.

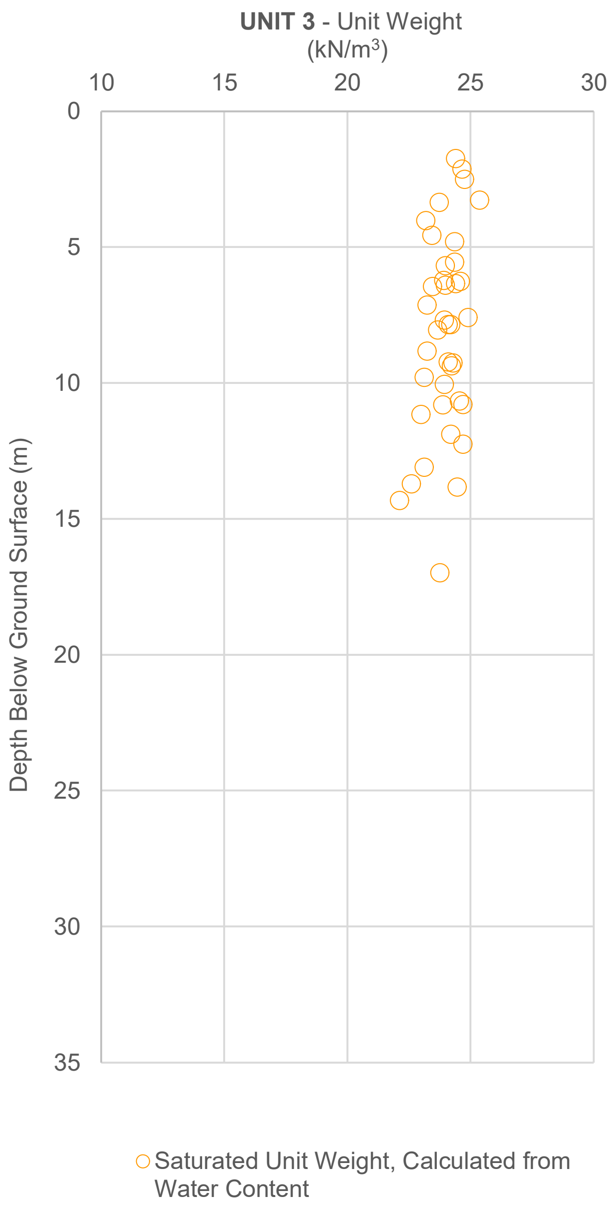
PROJECT: **PHASE II GEOTECHNICAL INVESTIGATION (CONDENSER COOLING WATER SYSTEM), DNNP**

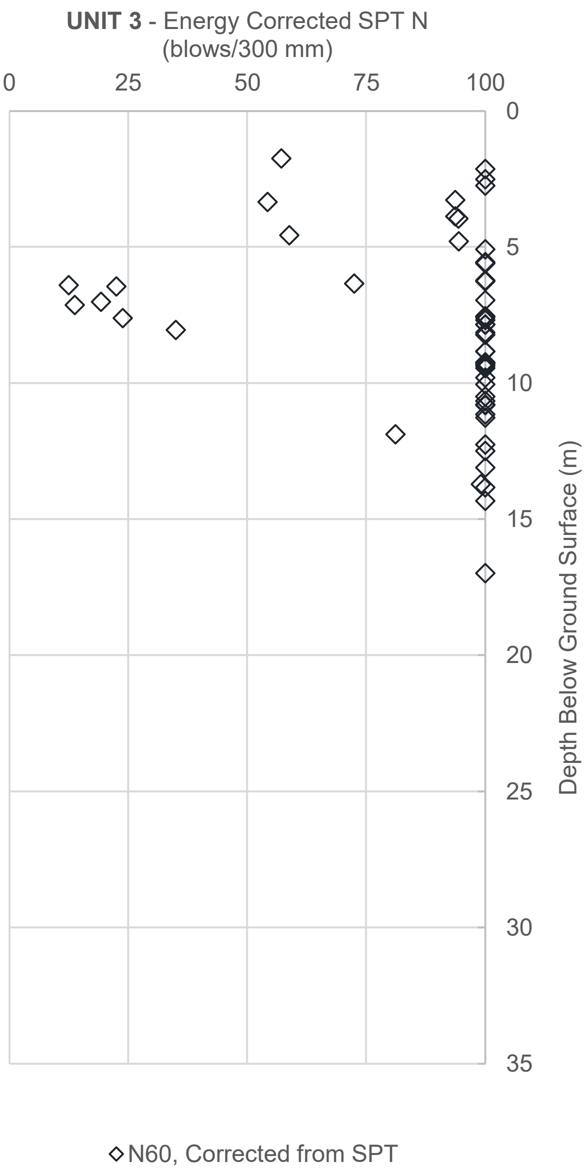
PROJECT NO.: **21451329**

TITLE: **INTERPRETED SOIL PARAMETER PROFILES,**
BASIC MATERIAL CHARACTERISTICS – UNIT 2B

PREPARED BY: YW DATE: March 2023 CHECKED BY: SP DATE: March 2023

WSP Canada Inc.
100 Scotia Court, Whitby, ON, L1N 8Y6, Canada
Tel: 905-723-2727 www.wsp.com





NOTE(S)

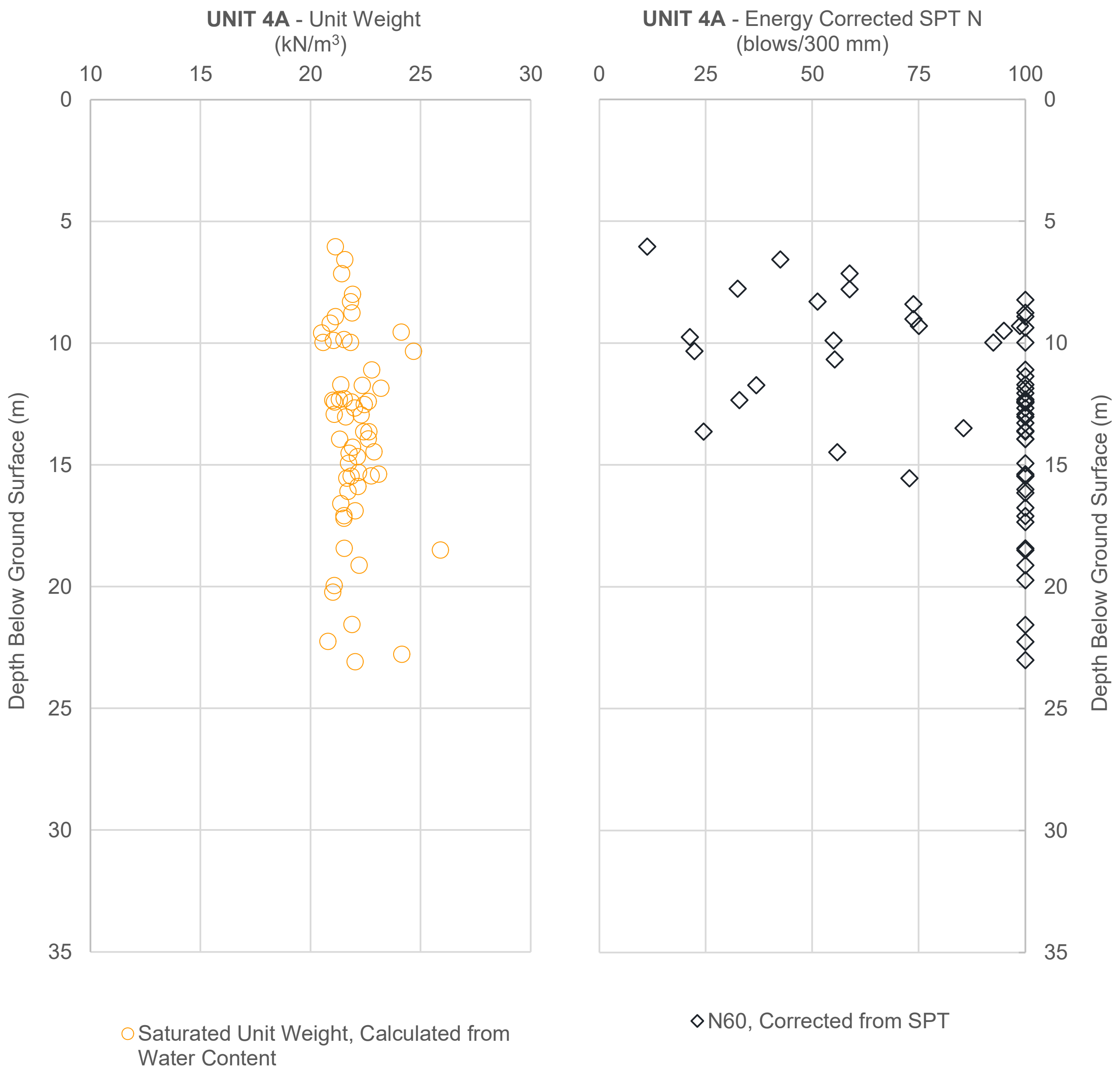
1. This figure is to be read in conjunction with the accompanying WSP Report No. 21451329-P2.
2. Saturated unit weight calculated from specific gravity and water content measured in laboratory (assumes 100% saturation).
3. SPT N_{60} represents the SPT N value corrected to 60% of the theortetical free-fall hammer energy.
4. SPT N_{60} value of 100 indicates practical refusal of split spoon sampler.

PROJECT: **PHASE II GEOTECHNICAL INVESTIGATION (CONDENSER COOLING WATER SYSTEM), DNNP**

PROJECT NO.: **21451329**

TITLE: **INTERPRETED SOIL PARAMETER PROFILES,**
BASIC MATERIAL CHARACTERISTICS – UNIT 3

PREPARED BY: YW DATE: March 2023 CHECKED BY: SP DATE: March 2023



NOTE(S)

1. This figure is to be read in conjunction with the accompanying WSP Report No. 21451329-P2.
2. Saturated unit weight calculated from specific gravity and water content measured in laboratory (assumes 100% saturation).
3. SPT N_{60} represents the SPT N value corrected to 60% of the theortetical free-fall hammer energy.
4. SPT N_{60} value of 100 indicates practical refusal of split spoon sampler.

PROJECT:	**PHASE II GEOTECHNICAL INVESTIGATION (CONDENSER COOLING WATER SYSTEM), DNNP**
PROJECT NO.:	**21451329**
TITLE:	**INTERPRETED SOIL PARAMETER PROFILES, BASIC MATERIAL CHARACTERISTICS – UNIT 4A**

PREPARED BY: YW DATE: March 2023 CHECKED BY: SP DATE: March 2023

WSP Canada Inc.
100 Scotia Court, Whitby, ON, L1N 8Y6, Canada
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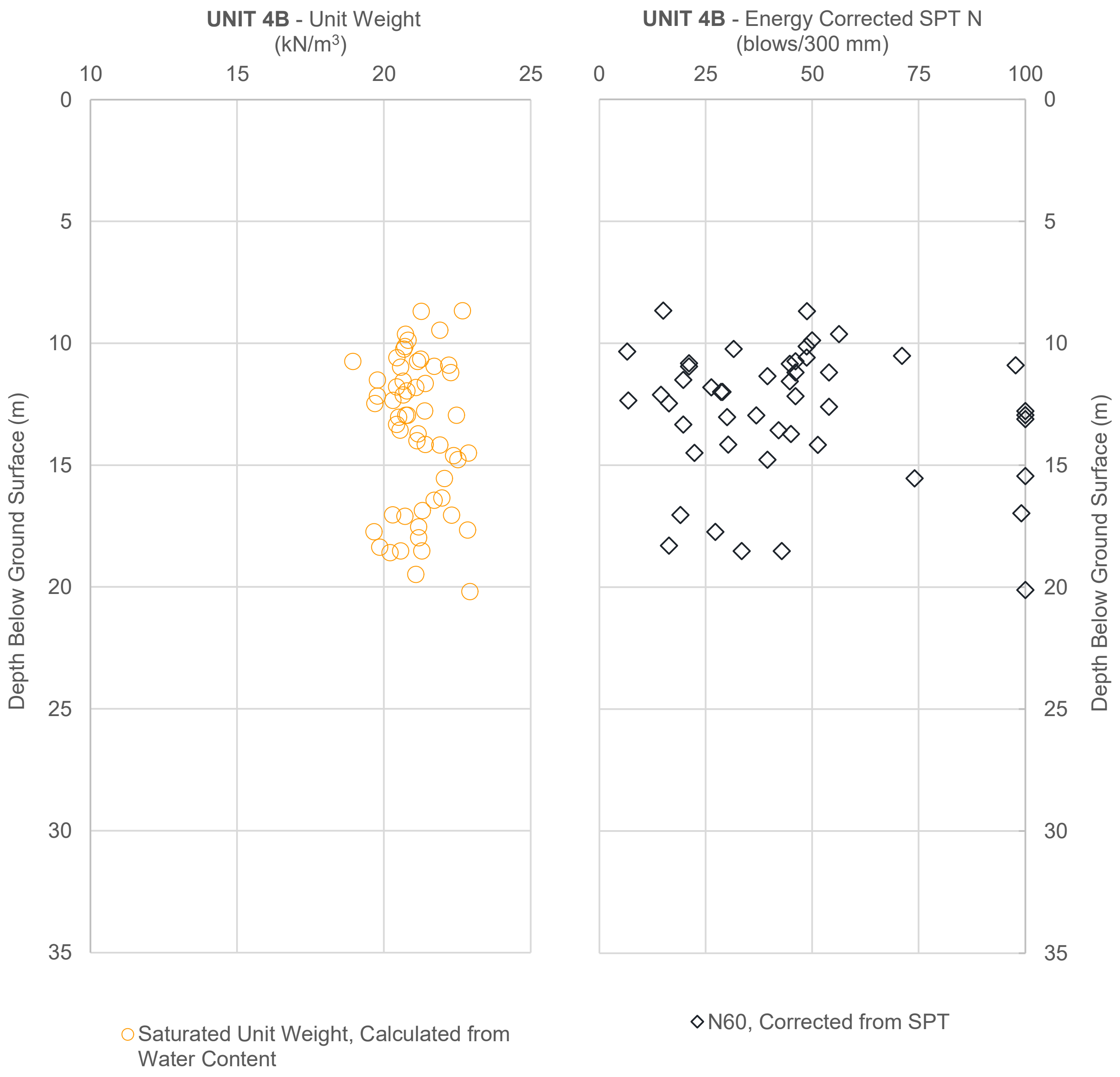
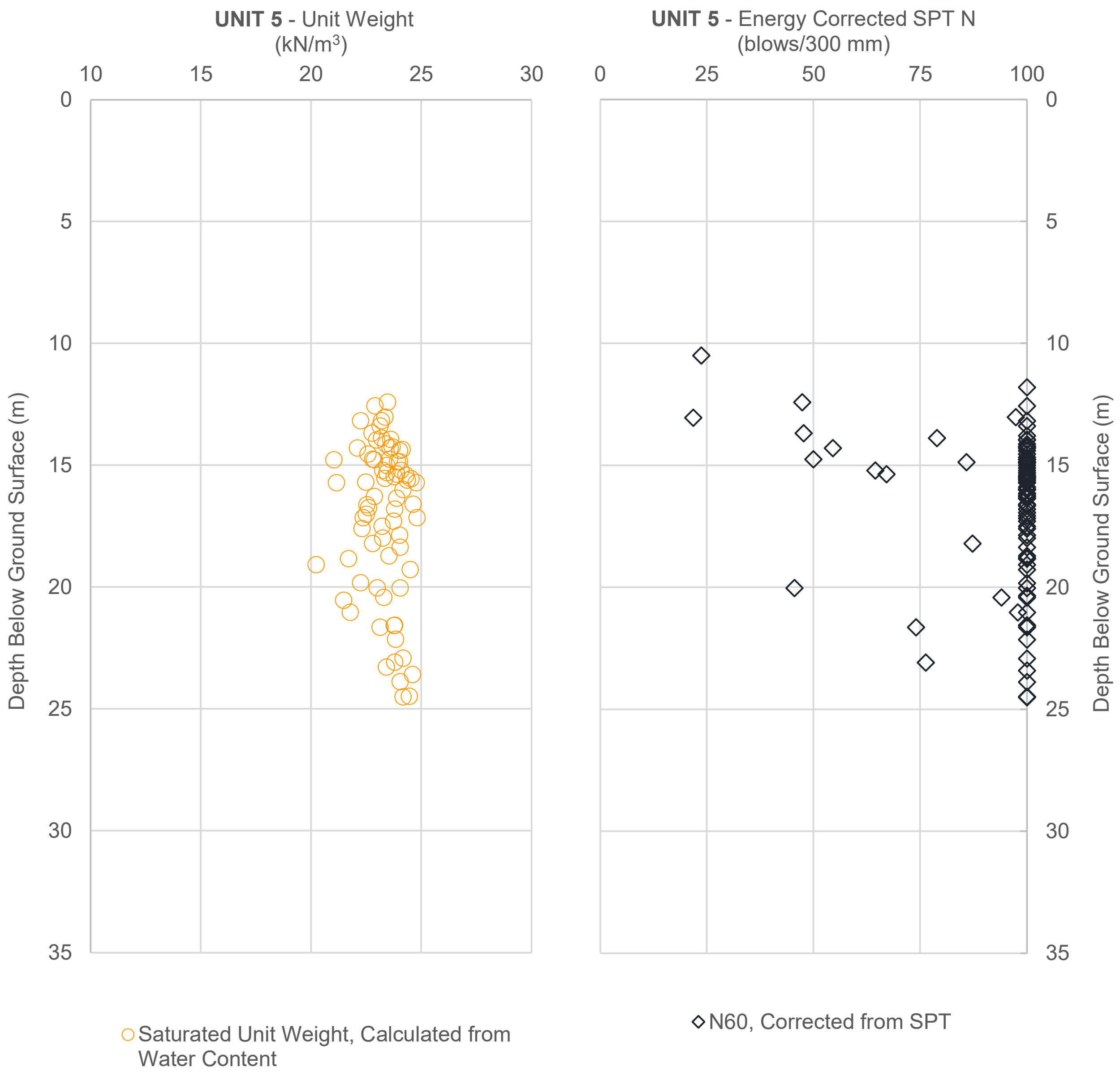


NOTE(S)

1. This figure is to be read in conjunction with the accompanying WSP Report No. 21451329-P2.
2. Saturated unit weight calculated from specific gravity and water content measured in laboratory (assumes 100% saturation).
3. SPT N_{60} represents the SPT N value corrected to 60% of the theortetical free-fall hammer energy.
4. SPT N_{60} value of 100 indicates practical refusal of split spoon sampler.

PROJECT:	**PHASE II GEOTECHNICAL INVESTIGATION (CONDENSER COOLING WATER SYSTEM), DNNP**
PROJECT NO.:	**21451329**
TITLE:	**INTERPRETED SOIL PARAMETER PROFILES, BASIC MATERIAL CHARACTERISTICS – UNIT 4B**

PREPARED BY: YW DATE: March 2023 CHECKED BY: SP DATE: March 2023



NOTE(S)

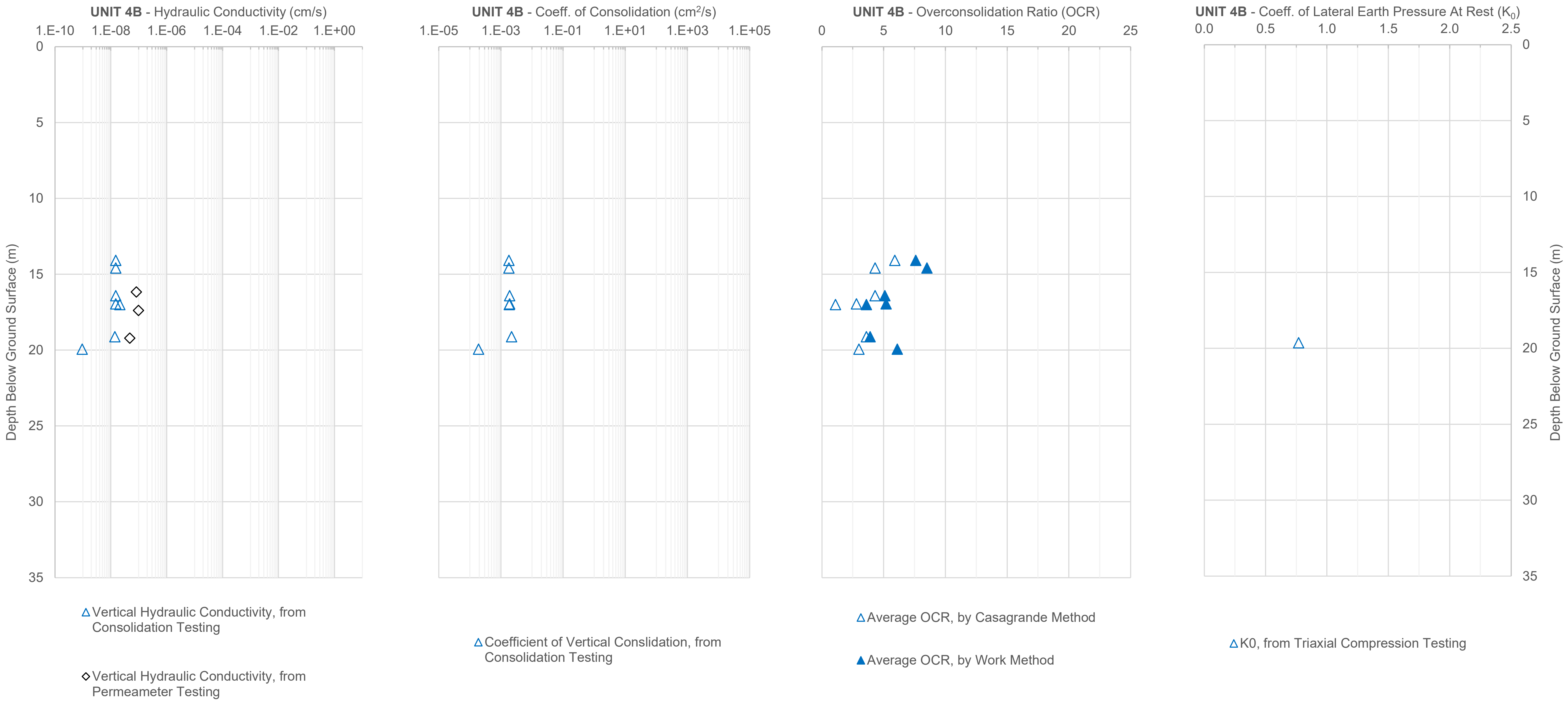
1. This figure is to be read in conjunction with the accompanying WSP Report No. 21451329-P2.
2. Saturated unit weight calculated from specific gravity and water content measured in laboratory (assumes 100% saturation).
3. SPT N_{60} represents the SPT N value corrected to 60% of the theortetical free-fall hammer energy.
4. SPT N_{60} value of 100 indicates practical refusal of split spoon sampler.

PROJECT: **PHASE II GEOTECHNICAL INVESTIGATION (CONDENSER COOLING WATER SYSTEM), DNNP**

PROJECT NO.: **21451329**

TITLE: **INTERPRETED SOIL PARAMETER PROFILES,
BASIC MATERIAL CHARACTERISTICS – UNIT 5**

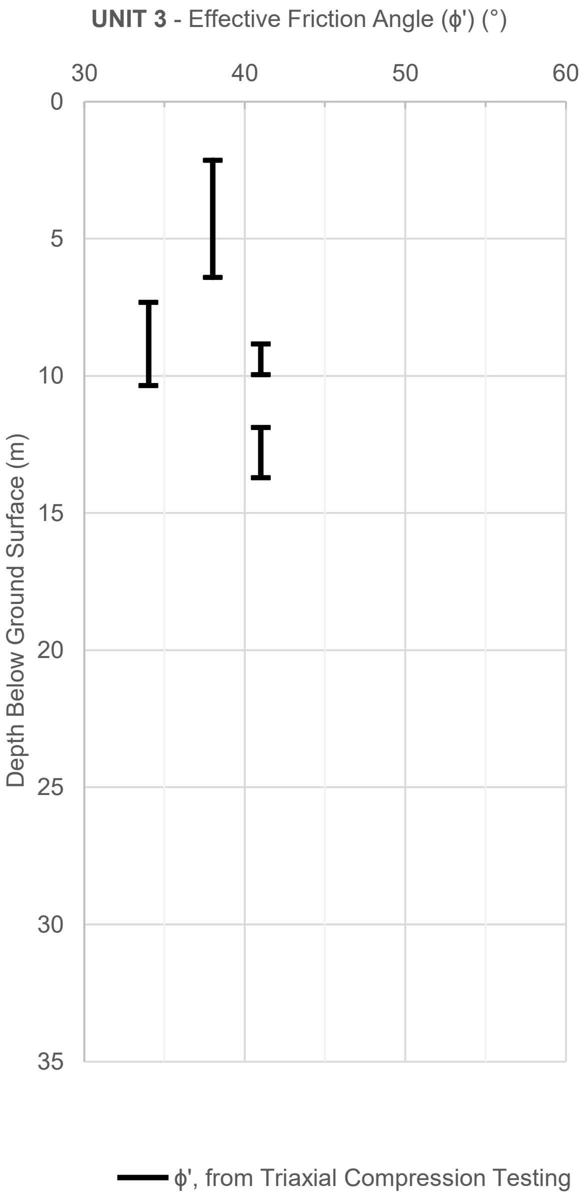
PREPARED BY: YW DATE: March 2023 CHECKED BY: SP DATE: March 2023

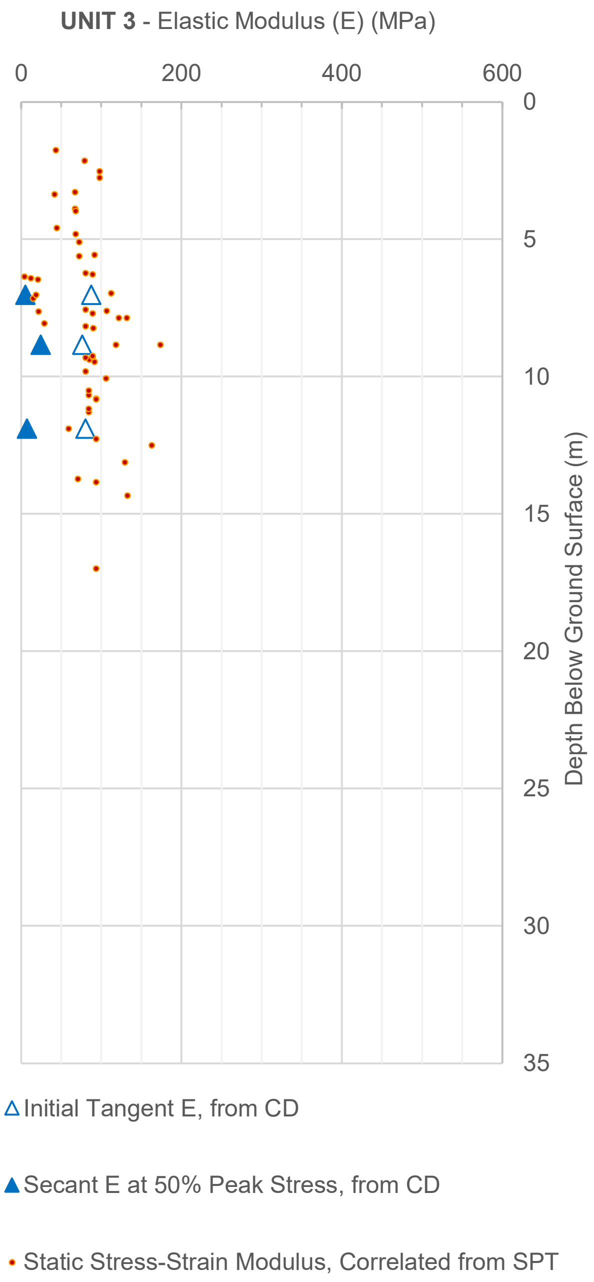


NOTE(S)
1. This figure is to be read in conjunction with the accompanying WSP Report No. 21451329-P2.
2. Bulk hydraulic conductivity from single well response testing by rising head or falling head method, reported at the average screen depth.
3. Coefficient of bulk consolidation from single well response testing calculated using coefficient of volume compressibility assumed from laboratory consolidation testing.
4. Vertical hydraulic conductivity and coefficient of vertical consolidation from one-dimensional consolidation testing taken at a stress level of 100 kPa in excess of the estimated in situ vertical effective stress for each tested specimen.
5. Coefficient of lateral earth pressure at rest interpreted from consolidated undrained triaxial testing, where specimen consolidated to approximate in situ vertical effective stress under no lateral strain conditions (i.e., K_0-consolidation).

PROJECT:	**PHASE II GEOTECHNICAL INVESTIGATION (CONDENSER COOLING WATER SYSTEM), DARLINGTON NEW NUCLEAR PROJECT**
TITLE:	**INTERPRETED SOIL PARAMETER PROFILES, HYDRAULIC AND VOLUME CHANGE BEHAVIOUR – UNIT 4B**
PROJECT NO.:	**21451329**

PREPARED BY: YW DATE: March 2023 CHECKED BY: SP DATE: March 2023





NOTE(S)

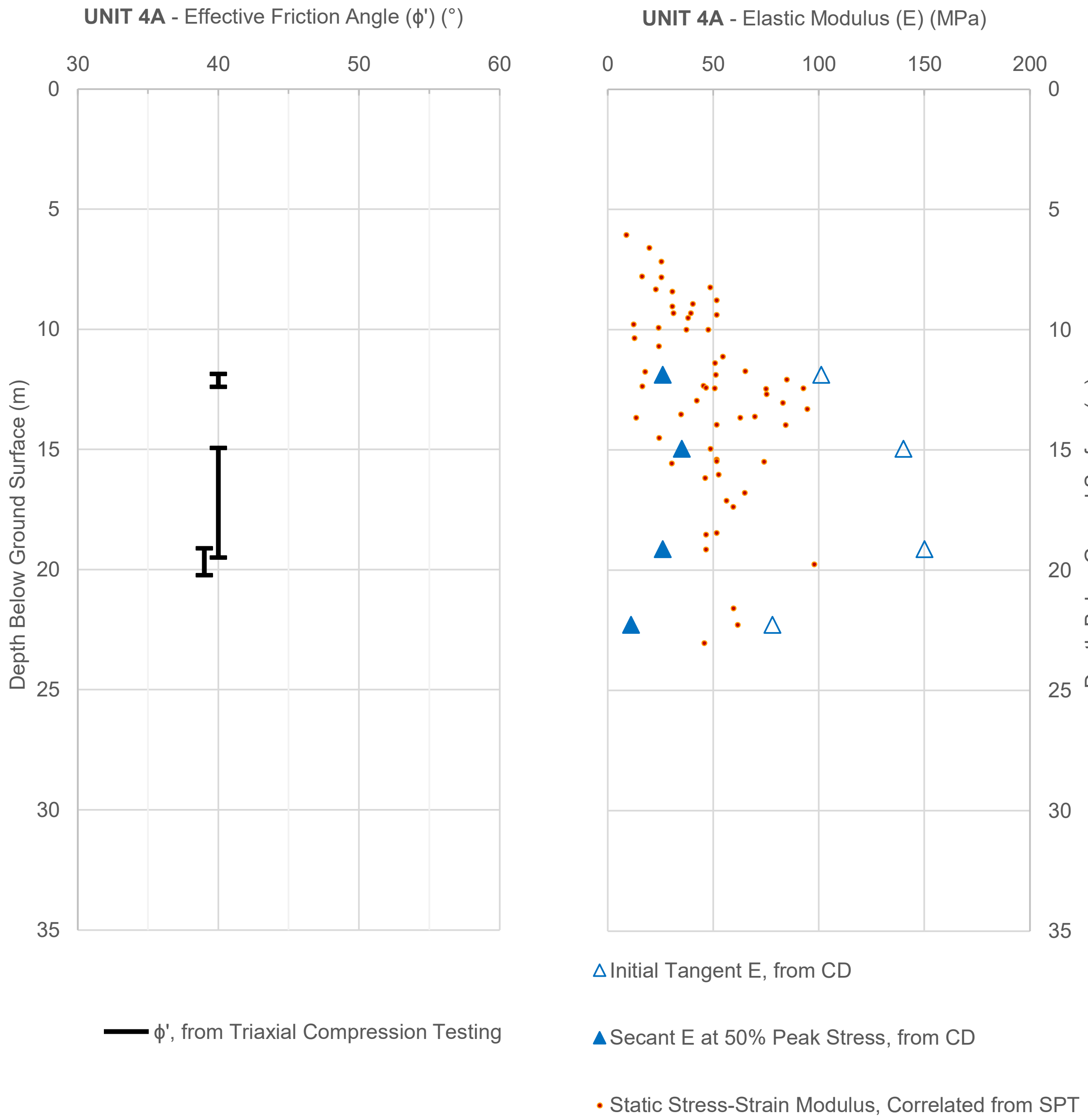
1. This figure is to be read in conjunction with the accompanying WSP Report No. 21451329-P2.
2. From consolidated drained (CD) triaxial testing, ϕ' interpreted from Mohr-Coulomb failure envelope constructed from 2 - 3 reconstituted specimens and plotted as constant over depth range of samples (assumes c'=0).
3. Initial tangent E and secant E at 50% peak stress interpreted from CD triaxials (reconstituted to ≈ in situ conditions).
4. Static Stress-Strain Modulus correlated from SPT N values for "gravelly sand" (see Table 5-6 in Bowles, 1997).

PROJECT: **PHASE II GEOTECHNICAL INVESTIGATION (CONDENSER COOLING WATER SYSTEM), DNNP**

PROJECT NO.: **21451329**

TITLE: **INTERPRETED SOIL PARAMETER PROFILES,**
SHEAR STRENGTH AND DEFORMATION BEHAVIOUR – UNIT 3

PREPARED BY: YW DATE: March 2023 CHECKED BY: SP DATE: March 2023

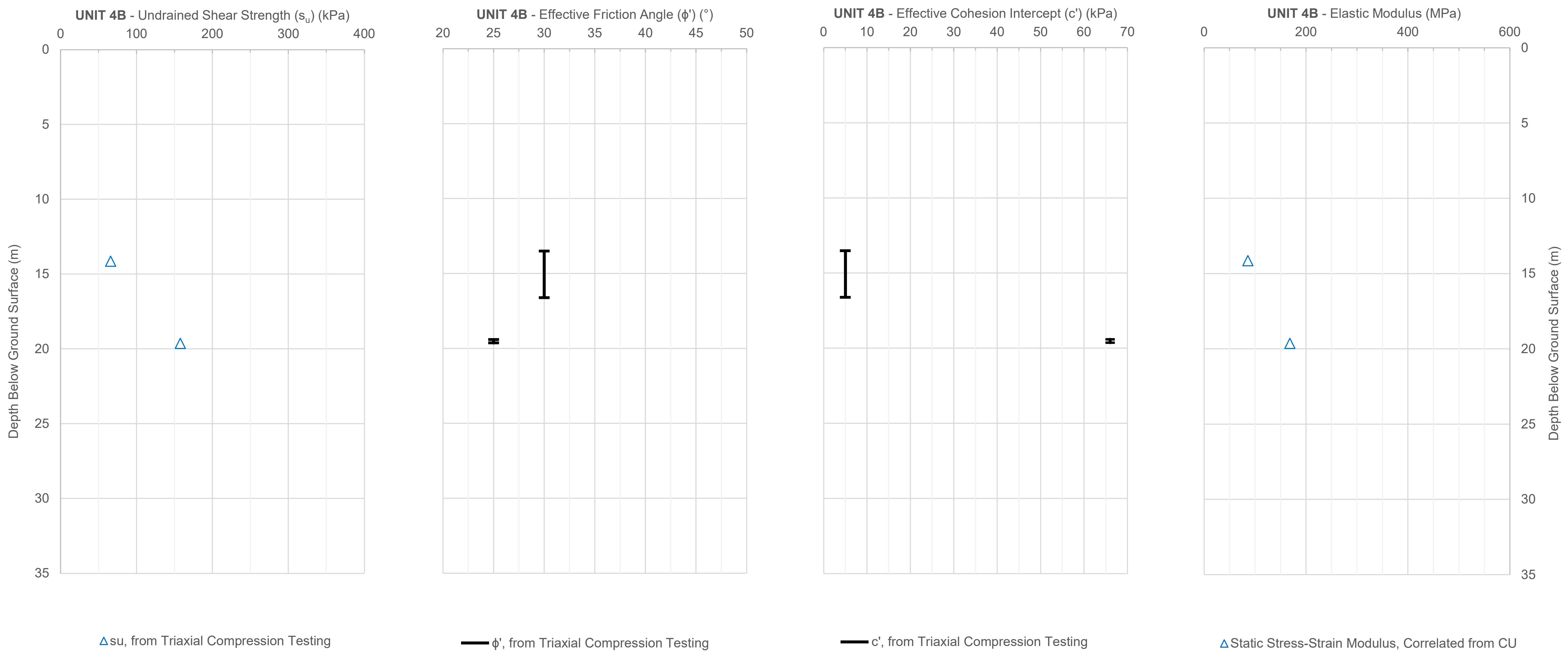


NOTE(S)

1. This figure is to be read in conjunction with the accompanying WSP Report No. 21451329-P2.
2. From consolidated drained (CD) triaxial testing, ϕ' interpreted from Mohr-Coulomb failure envelope constructed from 2 - 3 reconstituted specimens and plotted as constant over depth range of samples (assumes c'=0).
3. Initial tangent E and secant E at 50% peak stress interpreted from CD triaxials (reconstituted to ≈ in situ conditions).
4. Static Stress-Strain Modulus correlated from SPT N values for clayey sand (see Table 5-6 in Bowles, 1997).

PROJECT: **PHASE II GEOTECHNICAL INVESTIGATION (CONDENSER COOLING WATER SYSTEM), DNNP**
PROJECT NO.: **21451329**
TITLE: **INTERPRETED SOIL PARAMETER PROFILES,**
SHEAR STRENGTH AND DEFORMATION BEHAVIOUR – UNIT 4A

PREPARED BY: YW DATE: March 2023 CHECKED BY: SP DATE: March 2023



NOTE(S)
1. This figure is to be read in conjunction with the accompanying WSP Report No. 21451329-P2.
2. Undrained shear strength interpreted from consolidated undrained triaxial testing, where specimen consolidated to approximate in situ vertical effective stress.
3. From consolidated undrained triaxial testing, effective friction angle and effective cohesion intercept interpreted from Mohr-Coulomb failure envelope constructed from two to three specimen results. Effective friction angle and effective cohesion intercept from triaxial testing plotted as constant value over depth range of samples used to construct failure envelope.
4. Stress-Strain Elastic Moduli correlated from undrained shear strengths from consolidated undrained (CU) triaxial testing (representative of in situ conditions), where Es = 500su(OCR)0.5 (see Table 5-6 in Bowles, 1997).

PROJECT: **PHASE II GEOTECHNICAL INVESTIGATION (CONDENSER COOLING WATER SYSTEM), DARLINGTON NEW NUCLEAR PROJECT**

TITLE: **INTERPRETED SOIL PARAMETER PROFILES, SHEAR STRENGTH AND DEFORMATION BEHAVIOUR – UNIT 4B**

PROJECT NO.: **21451329**

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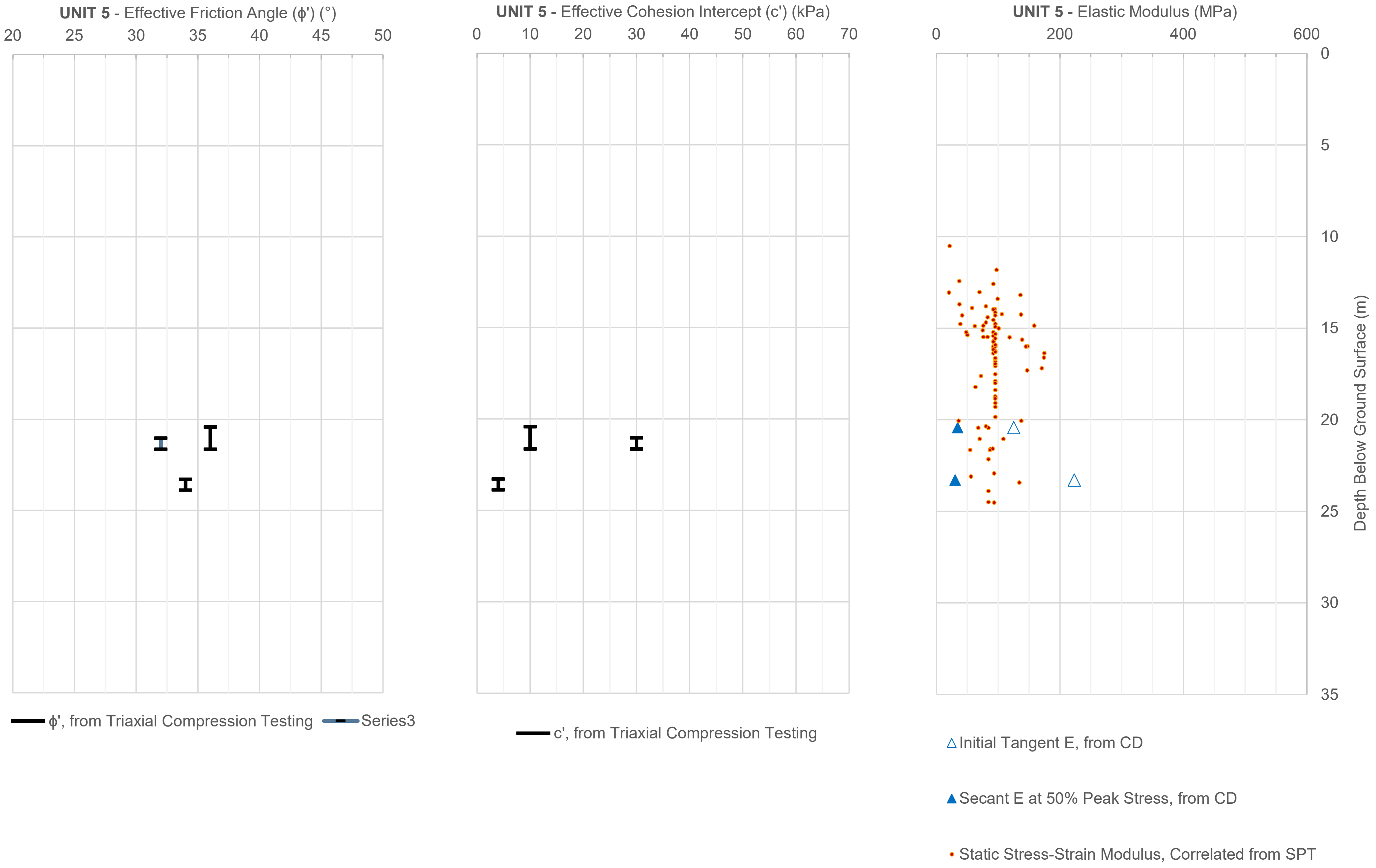

NOTE(S) 1. This figure is to be read in conjunction with the accompanying WSP Report No. 21451329-P2.

3. From consolidated drained triaxial testing, effective friction angle and effective cohesion intercept interpreted from Mohr-Coulomb failure envelope constructed from two to three specimen results. Effective friction angle and effective cohesion intercept from triaxial testing plotted as constant value over depth range of samples used to construct failure envelope.

3. Initial tangent elastic moduli and secant elastic moduli at 50% peak stress interpreted from conslidated drained triaxials (reconstituted to ≈ in situ conditions).

5. Static Stress-Strain Modulus correlated from SPT N values for gravelly sand (see Table 5-6 in Bowles, 1997).

PROJECT: **PHASE II GEOTECHNICAL INVESTIGATION (CONDENSER COOLING WATER SYSTEM), DARLINGTON NEW NUCLEAR PROJECT**

TITLE: **INTERPRETED SOIL PARAMETER PROFILES,**
SHEAR STRENGTH AND DEFORMATION BEHAVIOUR –
UNIT 5

PROJECT NO.: **21451329**

PREPARED BY: YW DATE: March 2023 CHECKED BY: SP DATE: March 2023

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