

Terraprobe

*Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing*

**FOUNDATION INVESTIGATION AND DESIGN REPORT
HIGHWAY 17/508 INTERIM INTERCHANGE DB-2020-4024
NEW CULVERTS INCLUDING
CULVERT SITES 29X-0435/C0, 29X-0436/C0, 29X-0437/C0
MINISTRY OF TRANSPORTATION, ONTARIO
EASTERN REGION
GEOCRES NO.: CULVERT 1N, 31F-237, CULVERT 9N, 31F-238, CULVERT 10N, 31F-239**

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PART A – FOUNDATION INVESTIGATION REPORT

**HIGHWAY 17/508 INTERIM INTERCHANGE
NEW CULVERTS INCLUDING
CULVERT SITES 29X-0435/C0, 29X-0436/C0, 29X-0437/C0
COUNTY OF RENFREW, ONTARIO
CONTRACT NUMBER DB-2020-4024**



1.0 INTRODUCTION

Terraprobe has been retained by Associated Engineering (Ont.) Ltd. (AE) on behalf of Aecon Group Inc. (Aecon) to provide foundation engineering services in support of detailed designs for the proposed interim interchange on Highway 17 at the intersection of County Road 508/County Road 54, in the County of Renfrew, Ontario.

This project is based on the Ministry of Transportation, Ontario (MTO) Design Build Minor Request for Proposals titled "*Highway 17 Interim Interchange at County Road 508, Eastern Region*", *Contract Number. DB-2040-4024*. The terms of reference and scope of work for the foundation engineering services are outlined in MTO's RFP.

Nine new culverts will be constructed and one existing culvert will be replaced as part of this project. This report presents the factual data on the subsurface conditions at these culvert sites.

2.0 SITE DESCRIPTION

The site is located at the intersection of Highway 17 with Calabogie Road (County Road 508) and McLean Drive (County Road 54), approximately 11 km west of Arnprior, Ontario. The key plan on the Borehole Locations and Soil Strata Drawings, provides an overview of the site location.

Highway 17 is an east-west oriented two-lane undivided highway of rural cross-section. Calabogie Road and McLean drive are two-lane local roads with rural cross-sections. The topography is flat consisting of cultivated land for the most part with stands of deciduous and coniferous trees and a few wetland areas. Approximately 240 m east of the intersection is a watercourse that flows from south-west to north-east under Highway 17 towards the Ottawa River.

3.0 INVESTIGATION PROCEDURES

3.1 Current Investigations

The field work for this aspect of this project was carried out during the period March 15 to April 06, 2021 and February 28 to March 01, 2022. Twenty-one boreholes were drilled and sampled to depths ranging from 8.1 m to 11.9 m below ground surface. Dynamic Cone Penetration tests were also performed below a depth of 8.1 m at two borehole locations. The approximate borehole locations are shown on Drawings 1 and 2.

Based on drawings provided by Associated Engineering, the boreholes were staked out and surveyed for coordinates and geodetic elevation by Terraprobe's staff, with a Trimble R10 Receiver connected to the Global Navigation Satellite System.

The boreholes were drilled with truck-mounted and track-mounted drill rigs supplied and operated by a specialist drilling contractor. Terraprobe's staff observed and recorded the drilling, sampling and in situ testing operations and logged the boreholes.

Samples of the overburden soils were obtained at intervals of 0.75 m and 1.5 m depth using a 50 mm outer diameter (O.D.) split-spoon sampler in conjunction with the Standard Penetration Testing (SPT) procedures

as specified in ASTM Method D 1586¹. Relatively undisturbed samples of the clay soils were also collected with thin-walled Shelby Tube samplers. In the silty clay to clay deposit an MTO 'N' vane was used to perform in-situ field vane tests, in order to determine the undrained shear strength of the soil. Dynamic Cone Penetration tests were also performed in Boreholes 3N-1 and C9-3 from a depth of 8.1 m below ground surface to depths of 12.2 m and 19.8 m respectively.

Ground water conditions in the open boreholes were observed during and immediately following the drilling operations and standpipe piezometers consisting of a 50 mm diameter PVC pipe with a slotted screen were installed in Boreholes 1N-2, 3N/4N-2, 5N-1, C9/7N-1, 8N-2, 9N-1, 10N-2 and 11N-1 to permit longer term ground water level monitoring. The boreholes were backfilled in accordance with current MTO procedures and Ontario Regulation 903 (as amended).

The recovered soil samples were subjected to Visual Identification (VI) and select soil samples were also subjected to a laboratory testing programme consisting of natural moisture content, grain size distribution analyses and Atterberg Limits determinations, in accordance with MTO and/or ASTM Standards as appropriate.

3.2 Previous Investigation

Subsurface investigations were carried out at this site in two stages. Preliminary investigations were carried out in 2004 by Thurber Engineering Limited (Thurber) of Oakville, Ontario and Golder Associates Limited (Golder) of Ottawa, Ontario, carried out subsurface investigations at this site in 2019. Reference is made to the following report:

- Golder Associates Ltd., *"Foundation Investigation and Design, Highway 17/508 Partial Interchange, Renfrew County, Ontario. GWP 4232-15-00, WP 4013-16-01. Geocres Number: 31F-207"*, dated June 28, 2019.

The following data from the Golder and Thurber investigations were also used as part of this study.

- Three boreholes (numbered 508-1, 508-2, and 508-3) advanced to depths ranging from 19.1 m to 22.7 m below ground surface;
- Sixteen boreholes (numbered 18-101, 18-102, 18-201 to 18-204, 18-301 to 18-310) advanced to depths ranging from 12.9 m to 24.1 m below ground surface;
- Six Cone Penetration Tests (CPT's) (numbered 18-402, 18-404, 18-405, 18-406, 18-407 and 18-408) advanced to depths ranging from 10.8 m to 23.7 m below ground surface; and
- Two Seismic Cone Penetration Tests (SCPT's) (numbered 18-401 and 18-403) advanced to depths of 11.3 m and 24.3 m below ground surface.

The approximate borehole locations and cone penetration test soundings are shown on Drawings 1 and 2. The Record of Borehole sheets and associated laboratory test results are provided in Appendix A2 and B2 respectively.

¹ ASTM D1586 – Standard Test Method for Standard Penetration Tests and Split Barrel Sampling of Soils.

The CPT and SCPT soundings were carried out by ConeTec Investigations Ltd. (ConeTec) of Richmond Hill, Ontario. Details on the field testing procedures and the test results are presented in ConeTec's report provided in Appendix C.

3.3 Borehole Locations

The borehole and cone penetration test locations in MTM NAD83 northing and easting coordinates, the ground surface elevations referenced to geodetic datum and investigated depths, are summarized in the following tables.

| Borehole ID | MTM NAD 83 Coordinates (Zone 9) | | Ground Surface Elevation (m) | Depth (m) |
|--------------------------------------------------------|---------------------------------|-------------|------------------------------|-----------|
| | Northing (m) | Easting (m) | | |
| Previous Investigations (Golder 2019 and Thurber 2004) | | | | |
| BH 18-101 | 5 033 304.9 | 304 385.1 | 130.1 | 20.2 |
| BH 18-102 | 5 033 377.1 | 304 447.3 | 130.2 | 22.4 |
| BH 18-201 | 5 033 208.3 | 304 081.2 | 131.9 | 21.4 |
| BH 18-202 | 5 033 293.1 | 304 367.8 | 130.2 | 14.5 |
| BH 18-203 | 5 033 393.1 | 304 468.5 | 130.1 | 17.8 |
| BH 18-204 | 5 033 440.3 | 304 674.3 | 129.7 | 17.6 |
| BH 18-301 | 5 033 312.4 | 304 070.6 | 130.9 | 16.5 |
| BH 18-302 | 5 033 164.7 | 304 175.0 | 130.3 | 15.2 |
| BH 18-303 | 5 033 210.6 | 304 262.1 | 130.1 | 12.9 |
| BH 18-304 | 5 033 245.5 | 304 303.7 | 130.6 | 14.4 |
| BH 18-305 | 5 033 444.6 | 304 526.7 | 130.9 | 24.1 |
| BH 18-306 | 5 033 481.7 | 304 558.5 | 130.1 | 22.0 |
| BH 18-307 | 5 033 549.6 | 304 628.6 | 129.7 | 21.1 |
| BH 18-308 | 5 033 466.0 | 304 454.5 | 129.6 | 22.4 |
| BH 18-309 | 5 033 230.6 | 304 372.0 | 129.8 | 18.6 |
| BH 18-310 | 5 033 404.1 | 304 728.6 | 131.0 | 18.0 |
| SCPT 18-401 | 5 033 275.1 | 304 348.8 | 130.0 | 11.3 |
| CPT 18-402 | 5 033 410.2 | 304 487.4 | 129.8 | 23.0 |
| SCPT 18-403 | 5 033 515.9 | 304 595.2 | 129.4 | 24.3 |
| CPT 18-404 | 5 033 183.8 | 304 221.3 | 130.3 | 16.5 |
| CPT 18-405 | 5 033 211.1 | 304 285.4 | 130.1 | 10.8 |
| CPT 18-406 | 5 033 258.9 | 304 451.0 | 129.5 | 17.4 |
| CPT 18-407 | 5 033 430.6 | 304 397.5 | 129.8 | 14.7 |
| CPT 18-408 | 5 033 486.0 | 304 529.4 | 129.6 | 23.7 |
| BH 508-1 | 5 033 313.1 | 304 380.2 | 130.1 | 19.1 |
| BH 508-2 | 5 033 342.1 | 304 413.2 | 129.9 | 22.7 |
| BH 508-3 | 5 033 370.4 | 304 450.6 | 130.1 | 21.5 |



| Borehole ID | MTM NAD 83 Coordinates (Zone 9) | | Ground Surface Elevation (m) | Depth (m) |
|-------------------------------------|---------------------------------|-------------|------------------------------|-----------|
| | Northing (m) | Easting (m) | | |
| Current Investigations (Terraprobe) | | | | |
| BH 1N-1 | 5 032 995.7 | 303 784.4 | 132.9 | 8.1 |
| BH 1N-2 | 5 033 004.1 | 303 799.0 | 132.7 | 8.1 |
| BH 3N-1 | 5 033 282.9 | 304 012.6 | 131.3 | 12.2 |
| BH 4N-1 | 5 033 290.8 | 304 070.4 | 131.2 | 8.1 |
| BH 3N/4N-2 | 5 033 296.7 | 304 040.9 | 131.2 | 8.2 |
| BH 5N-1 | 5 033 319.3 | 304 349.5 | 130.3 | 8.2 |
| BH 5N-2 | 5 033 343.0 | 304 361.9 | 131.3 | 8.1 |
| BH 5N-3 | 5 033 350.9 | 304 345.9 | 130.8 | 8.1 |
| BH C9/7N-1 | 5 033 301.8 | 304 551.0 | 130.6 | 8.1 |
| BH 7N-2 | 5 033 369.9 | 304 607.6 | 128.9 | 8.1 |
| BH C9-2 | 5 033 291.0 | 304 516.3 | 130.5 | 8.1 |
| BH C9-3 | 5 033 291.4 | 304 490.8 | 129.6 | 19.8 |
| BH 8N-1 | 5 033 666.5 | 304 764.3 | 130.3 | 8.1 |
| BH 8N-2 | 5 033 683.1 | 304 758.4 | 129.6 | 8.1 |
| BH 9N-1 | 5 033 377.6 | 304 726.3 | 128.0 | 8.2 |
| BH 9N-2 | 5 033 373.0 | 304 743.3 | 127.2 | 8.1 |
| BH 10N-1 | 5 033 376.3 | 304 825.2 | 127.9 | 8.4 |
| BH 10N-2 | 5 033 392.2 | 304 842.7 | 128.1 | 8.8 |
| BH 11N-1 | 5 033 243.8 | 304 415.8 | 129.7 | 8.1 |
| BH 11N-2 | 5 033 280.5 | 304 429.6 | 128.9 | 8.1 |
| BH B1 | 5 033 281.5 | 304 351.7 | 130.2 | 11.9 |

4.0 REGIONAL GEOLOGY

The site lies within the physiographic region known as the Ottawa Valley Clay Plain. The Ottawa Valley Clay Plain generally consists of relatively thick marine clay, and silty clay deposits commonly known as Champlain Sea Clay or Leda Clay. These deposits are usually underlain by relatively thin glacial till deposits that are further underlain by bedrock. The bedrock in this region consists of meta-sedimentary rocks and tectonic breccias of the Grenville Supergroup and Flinton Group.

5.0 SUBSURFACE CONDITIONS

For the Terraprobe study, reference is made to the Record of Borehole Sheets in Appendix A1. Details of the encountered soil stratigraphy are presented in this appendix and on the “*Borehole Locations and Soil Strata*” drawings. An overall description of the stratigraphy is provided in the following paragraphs for the Terraprobe study. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

The stratigraphic boundaries shown on the Record of Boreholes and on the interpreted stratigraphic sections are inferred from non-continuous soil sampling and therefore represent transitions between soil types rather than exact planes of geological change. The subsurface conditions will vary between and beyond the borehole locations.



In summary, topsoil and organics, a flexible pavement and fill soils consisting of very loose to compact sand and gravel to gravelly sand, very loose to very dense silty sand to sand, and soft to stiff silty clay were encountered at the site. The fill materials are underlain by a native deposit of very soft to very stiff silty clay to clay that is in turn underlain by very dense gravel and sand. The ground surface is also submerged at some locations in the wetland areas.

The Record of Boreholes and laboratory test results from the previous investigations are provided in Appendix A2 and B2 respectively. The subsurface conditions for these studies are described in the Golder 2019 report and are not repeated in this report.

5.1 Ice

Boreholes 9N-1, 10N-1 and 10N-2 were drilled in the winter and these boreholes were extended through layers of ice ranging from 125 mm to 760 mm in thickness. During warm weather conditions the ground surface at these borehole locations will be submerged.

5.2 Topsoil and Organics

At some borehole locations the ground surface is underlain by topsoil layers ranging in thickness from 80 mm to 450 mm. Layers of decayed wood ranging in thickness from 50 mm to 700 mm were also encountered at some borehole locations. Topsoil and organic layer thicknesses will vary between and beyond the borehole locations.

5.3 Flexible Pavement

Boreholes 5N-2, C9/7N-1 and C9-2 were drilled through the Highway 17 shoulders and encountered granular fill consisting of sand and gravel to gravelly sand. Borehole 8N-1 was drilled through McLean Drive main lane and encountered a flexible pavement consisting of 105 mm asphaltic concrete underlain by 375 mm of gravelly sand granular fill.

The locations, thicknesses and base elevations of the granular pavement fill are summarized in the following table.

| Borehole No. | Fill Thickness (mm) | Fill Base Elevation (m) |
|--------------|---------------------|-------------------------|
| BH 5N-2 | 595 | 130.7 |
| BH C9/7N-1 | 600 | 130.0 |
| BH C9-2 | 560 | 129.9 |
| BH 8N-1 | 375 | 129.8 |

Standard Penetration tests carried out in the sand and gravel to gravelly sand fill measured SPT N-values that range from 15 blows to 53 blows for 0.3 m of penetration indicating a compact to very dense relative density. The natural water contents of two samples of the granular fill are 3% and 4% by weight.

The grain size distribution curves of two samples of the granular fill are presented on Figure B1-1 in Appendix B1. The results show a grain size distribution consisting of 31% and 43% gravel, 49% and 55% sand, 12% silt, 2% clay and 8% silt and clay size particles.



5.4 Fill – Sand and Gravel to Gravelly Sand

Fill material consisting of sand and gravel to gravelly sand was encountered at Boreholes 1N-1 and 1N-2 that were drilled adjacent to Calabogie Road's shoulder. The locations, thicknesses, depths and base elevations of the sand and gravel to gravelly sand fill are summarized in the following table.

| Borehole No. | Fill Thickness (m) | Fill Depth (m) | Fill Base Elevation (m) |
|--------------|--------------------|----------------|-------------------------|
| BH 1N-1 | 1.3 | 1.4 | 131.5 |
| BH 1N-2 | 0.3 | 0.5 | 132.2 |

Standard Penetration tests performed in the sand and gravel to gravelly sand fill measured SPT N-values that range from 3 blows to 15 blows for 0.3 m of penetration, indicating a very loose to compact relative density. The natural water content of two samples of the sand and gravel to gravelly sand fill are 8% and 11% by weight.

A grain size distribution test was carried out on a sample of the gravelly sand fill and the Terraprobe's grain size distribution curve is provided in Figure B1-1, in Appendix B1. The test results show a grain size distribution consisting of 34% gravel, 50% sand, 13% silt, and 3% clay size particles.

5.5 Fill – Silty Sand to Sand

Silty sand to sand fill material was encountered at this site. The locations, thicknesses, depths and base elevations of the silty sand to sand fill are summarized in the following table.

| Borehole No. | Fill Thickness (m) | Fill Depth (m) | Fill Base Elevation (m) |
|--------------|--------------------|----------------|-------------------------|
| BH 1N-2 | 0.9 | 1.4 | 131.3 |
| BH 5N-1 | 0.5 | 0.7 | 129.6 |
| BH 5N-2 | 1.5 | 2.1 | 129.2 |
| BH 5N-3 | 1.0 | 1.4 | 129.4 |
| BH C9/7N-1 | 1.3 | 1.9 | 128.7 |
| BH C9-2 | 1.5 | 2.1 | 128.4 |
| BH C9-3 | 0.7 | 1.4 | 128.2 |
| BH 8N-1 | 0.9 | 1.4 | 128.9 |
| BH 8N-2 | 0.5 | 0.7 | 128.9 |

Standard Penetration tests performed in the silty sand to sand fill measured SPT N-values that range from 4 blows to 71 blows for 0.3 m of penetration, indicating a very loose to very dense relative density. The natural water content of samples of the silty sand to sand fill range from 8% to 15% by weight.

Grain size distribution tests were carried out on five samples of the silty sand to sand fill and the Terraprobe's grain size distribution curves are provided in Figure B1-2, in Appendix B1. The test results show a grain size distribution consisting of 0% to 12% gravel, 56% to 90% sand, 8% to 22% silt, and 2% to 20% clay size particles.



5.6 Fill – Silty Clay

Silty clay fill material was encountered at this site. The locations, thicknesses, depths and base elevations of the silty clay fill are summarized in the following table.

| Borehole No. | Fill Thickness (m) | Fill Depth (m) | Fill Base Elevation (m) |
|--------------|--------------------|----------------|-------------------------|
| BH 3N-1 | 0.2 | 0.7 | 130.6 |
| BH 4N-1 | 0.6 | 0.7 | 130.5 |
| BH 3N/4N-2 | 0.5 | 0.7 | 130.5 |
| BH C9-2 | 0.8 | 2.9 | 127.6 |
| BH C9-3 | 0.7 | 2.1 | 127.5 |
| BH B1 | 0.9 | 1.1 | 129.1 |

Standard Penetration tests performed in the silty clay fill measured SPT N-values that range from 2 blows to 12 blows for 0.3 m of penetration, indicating a soft to stiff consistency. The natural water content of samples of the silty clay fill generally ranges from 34% to 38% by weight and a value of 70% was recorded for a sample that included organic inclusions.

A grain size distribution test was carried out on a sample of the silty clay fill and the Terraprobe's grain size distribution curve is provided in Figure B1-3, in Appendix B1. The test results show a grain size distribution consisting of 0% gravel, 6% sand, 54% silt, and 40% clay size particles.

A sample of the silty clay fill was also subjected to Atterberg limits tests. The test results are presented in Figure B1-4 in Appendix B1. The results indicate that the silty clay fill is a cohesive deposit of high plasticity (CH). The Atterberg limits test results are summarized below.

| | |
|---------------------------|-----|
| Liquid Limit: | 56% |
| Plastic Limit: | 29% |
| Plasticity Index: | 27% |
| Natural Moisture Content: | 38% |

5.7 Silty Clay to Clay

The site is underlain by a silty clay to clay deposit. The upper portion of the silty clay to clay deposit is a weathered crust. The locations, thicknesses, depths and base elevations of the silty clay to clay deposit are summarized in the following table with the values in parentheses denoting information related to the weathered crust.

| Borehole No. | Thickness (m) | Depth (m) | Base Elevation (m) |
|--------------|---------------|---------------|--------------------|
| BH 1N-1 | 6.7 (1.5) | 8.1* (2.9) | 124.8 (130.0) |
| BH 1N-2 | 6.7 (1.5) | 8.1* (2.9) | 124.6 (129.8) |
| BH 3N-1 | 7.4 (3.0) | 8.1 (3.7) | 123.2 (127.6) |
| BH 4N-1 | 7.4 (2.2) | 8.1* (2.9) | 123.1 (128.3) |

* Borehole termination depth.



| Borehole No. | Thickness (m) | Depth (m) | Base Elevation (m) |
|--------------|---------------|---------------|--------------------|
| BH 3N/4N-2 | 7.5 (3.0) | 8.2* (3.7) | 123.0 (127.5) |
| BH 5N-1 | 7.5 (3.0) | 8.2* (3.7) | 122.1 (126.6) |
| BH 5N-2 | 6.0 (1.6) | 8.1* (3.7) | 123.2 (127.6) |
| BH 5N-3 | 6.7 (2.3) | 8.1* (3.7) | 122.7 (127.1) |
| BH C9/7N-1 | 6.2 (1.8) | 8.1* (3.7) | 122.5 (126.9) |
| BH 7N-2 | 7.6 (1.6) | 8.1* (2.1) | 120.8 (126.8) |
| BH C9-2 | 5.2 (1.5) | 8.1* (4.4) | 122.4 (126.1) |
| BH C9-3 | 6.0 (0.8) | 8.1* (2.9) | 121.5 (126.7) |
| BH 8N-1 | 6.7 (1.5) | 8.1* (2.9) | 122.2 (127.4) |
| BH 8N-2 | 7.4 (1.4) | 8.1* (2.1) | 121.5 (127.5) |
| BH 9N-1 | 8.1 (2.2) | 8.2* (2.3) | 119.8 (125.7) |
| BH 9N-2 | 8.0 (2.0) | 8.1* (2.1) | 119.1 (125.1) |
| BH 10N-1 | 8.1 (2.2) | 8.4* (2.5) | 119.5 (125.4) |
| BH 10N-2 | 8.1 (2.1) | 8.8* (2.9) | 119.3 (125.2) |
| BH 11N-1 | 7.4 (2.2) | 8.1* (2.9) | 121.6 (126.8) |
| BH 11N-2 | 7.4 (1.5) | 8.1* (2.9) | 120.8 (126.0) |
| BH B1 | 10.5 (4.2) | 11.6 (5.3) | 118.6 (124.9) |

* Borehole termination depth.

The N-values of Standard Penetration tests carried out in the weathered silty clay to clay crust range from 3 blows to 19 blows per 0.3 m of penetration. Based on these results, the consistency of the weathered silty clay to clay crust is described as generally stiff to very stiff with occasional soft zones.

The N-values of Standard Penetration tests carried out in the lower portion of the silty clay to clay deposit range from 0 blows (weight of hammer) to 8 blows per 0.3 m of penetration. Field vane tests measured in-situ undrained shear strengths that range from 36 kPa to at least 100 kPa. Based on these results the lower portion of the silty clay to clay deposit has a generally firm to stiff consistency with occasional very soft to soft and very stiff zones.

The in-situ undrained shear strength values obtained from the current investigation as well as the values reported by the previous investigations are presented on Figure B1-5, in Appendix B1. The variation of undrained shear strength with elevation plot, illustrates higher undrained shear strength values in the

weathered silty clay to clay crust and lower undrained shear strength values in the underlying silty clay to clay deposit.

The corresponding soil sensitivity classifications (April 01, 2018 errata to Canadian Foundation Engineering Manual [CFEM], 2006), the reported sensitivity values on the record of borehole sheets, as well as the values reported on the “*Summary of Sensitivities Versus Elevation*” plot provided by Golder 2019 (Figure B29, in Appendix B2) are summarized in the following table.

| Investigation | Reported Sensitivity Values | Percent Occurrence (%) Sensitivity Range/Soil Class | | | | |
|------------------------|-----------------------------|--------------------------------------------------------|-------------------------------|------------------------|-------------------------------|---------------------|
| | | 0.0 – 2.0 Low Sensitivity | 2.0 – 4.0 Medium Sensitive | 4.0 – 8.0 Sensitive | 8.0 – 16.0 Extra Sensitive | >16.0 Quick Clay |
| Current Investigation | 2.3 – 10.0 | 0% | 29% | 68% | 3% | 0% |
| Thurber 2004 | 2.6 – 10.0 | 0% | 42% | 53% | 5% | 0% |
| Golder 2019 BH Logs | 2.6 – 59.4 | 0% | 1% | 26% | 24% | 39% |
| Golder 2019 Figure B29 | 1.0 – 33.1 | 27% | 27% | 22% | 13% | 11% |

A comparison of the sensitivity values obtained as part of the current investigation and the sensitivity values reported by the previous investigations shows a reasonable agreement between Terraprobe's and Thurber 2004 findings but there is a wider range of sensitivity values reported by Golder. Based on this comparison and our visual examination of the samples, it is our opinion that the silty clay to clay deposit is generally a Medium Sensitive to Sensitive soil.

Forty-five samples of the silty clay to clay deposit were subjected to grain size distribution tests. The Terraprobe's grain size distribution curves are illustrated in Figures B1-6 to B 1-11, in Appendix B1. The test results show a grain size distribution consisting of 0% gravel, 0% to 33% sand, 27% to 62% silt, and 30% to 71% clay sized particles.

Forty-five samples of the silty clay to clay deposit were also subjected to Atterberg limits tests. Terraprobe's test results are plotted on the plasticity charts, Figures B1-12 to B 1-17, in Appendix B1. The results indicate a cohesive deposit of generally intermediate to high plasticity (CI to CH) with layers of low plasticity clay (CL). The Atterberg limits test results are summarized below.

| | |
|---------------------------|------------|
| Liquid Limit: | 34% to 62% |
| Plastic Limit: | 18% to 29% |
| Plasticity Index: | 13% to 34% |
| Natural Moisture Content: | 23% to 58% |

Atterberg Limits tests results from the current investigation as well as the test results reported by the previous investigations are plotted against elevation and presented on Figure B1-18, in Appendix B1. These results illustrate that the natural moisture contents of the tested samples are typically lower than the liquid limits within the weathered crust and higher than the liquid limits below the weathered crust.

The moisture content of samples of the silty clay to clay deposit varies between 23% and 76% and the unit weight of six tested samples from the current and previous investigations range from 16.3 kN/m³ to 17.3 kN/m³.

One-dimensional consolidation tests were performed by Golder and Thurber on samples of the silty clay to clay deposit obtained from Boreholes 18-101, 18-102, and 508-1. The test results are presented in Appendix B2 and relevant details are summarized in the following table.



| Borehole/Sample No. | Type of Test | Sample Depth/Elevation (m) | Unit Weight (kN/m ³) | σ'_p (kPa) | σ'_{v0} (kPa) | C_c | C_r | e_o |
|---------------------|--------------|----------------------------|----------------------------------|-------------------|----------------------|-------|-------|-------|
| 18-101 / 11 | IL | 11.9 / 118.2 | 17.0 | 205 | 100 | 1.03 | 0.025 | 1.42 |
| 18-102 / 10 | IL | 10.5 / 119.7 | 16.3 | 205 | 97 | 1.20 | 0.035 | 1.68 |
| 18-101 / 9 | CRS | 8.8 / 121.3 | - | 218 | 79 | 0.69 | 0.027 | 1.35 |
| 18-101 / 10 | CRS | 9.9 / 120.2 | - | 227 | 87 | 0.86 | 0.026 | 1.36 |
| 18-102 / 8 | CRS | 7.3 / 122.9 | - | 152 | 75 | 0.81 | 0.040 | 1.68 |
| 18-102 / 12 | CRS | 13.1 / 117.1 | - | 245 | 117 | 1.08 | 0.033 | 1.38 |
| 508-1 / TW1 | IL | 11.9 / 121.0 | 16.9 | 220 | 84 | 0.74 | 0.066 | 1.40 |

Where:

- σ'_{v0} = Effective overburden pressure
- σ'_p = Preconsolidation pressure;
- C_c = Compression index;
- C_r = Recompression index;
- e_o = Initial void ratio;
- IL = Incremental loading oedometer consolidation test; and
- CRS = Constant rate of strain consolidation test.

The preconsolidation pressures derived from the consolidation test data are higher than the effective overburden pressures suggesting that the silty clay to clay deposit is overconsolidated. The CPT/SCPT data provided in Appendix C also indicate an overconsolidated silty clay to clay deposit.

Terraprobe carried out consolidated undrained triaxial compression tests on samples of the silty clay to clay deposit over a range of stress conditions and the results are presented in Figures B1-19 to B1-22, in Appendix B1. The results of the consolidated undrained triaxial compression tests are summarized in the following table.

| Borehole/Sample No. | Sample Depth (m) | Sample Elevation (m) | ϕ' (degree) | c' (kPa) |
|---------------------|------------------|----------------------|------------------|------------|
| BH B1A, Sample 3 | 7.6 – 8.2 | 122.6 – 122.0 | 27 | 25 |

Where:

- ϕ' = effective angle of internal friction; and
- c' = effective cohesion intercept.

Golder carried out consolidated drained triaxial compression tests on four samples of the silty clay to clay deposit. Unconsolidated undrained triaxial compression tests were also carried out on three samples of the silty clay to clay deposit by Golder. The results of the Golder test programme are provided in Appendix B2 and are also summarized in the table below.

| Borehole No./Sample No. | Type of Test | Effective cohesion, c' (kPa) | Undrained Shear Strength, S_u (kPa) |
|-------------------------|--------------|--------------------------------|---------------------------------------|
| 18-102 / 13 | CD | 47 | - |
| 18-102 / 7 | CD | 33 | - |
| 18-101 / 13 | CD | 40 | - |
| 18-101 / 6 | CD | 30 | - |
| 18-101 / 13 | UU | - | 35 |
| 18-102 / 13 | UU | - | 38 |
| 18-101 / 6 | UU | - | 59 |



5.7.1 Gravel and Sand

A gravel and sand deposit was encountered at Borehole B1. The gravel and sand deposit is approximately 0.3 m thick and extends to a borehole termination depth of 11.9 m below ground surface (elevation 118.3 m).

A Standard Penetration test performed in the gravel and sand deposit measured a SPT N-value of more than 100 blows for 0.3 m of penetration, indicating a very dense relative density. The natural water content of a sample of the gravel and sand deposit is 7% by weight.

A grain size distribution test was carried out on a sample of the gravel and sand deposit and the Terraprobe's grain size distribution curve is provided in Figure B1-23, in Appendix B1. The test results show a grain size distribution consisting of 46% gravel, 41% sand, 10% silt, and 3% clay size particles.

5.8 Ground Water Levels

Ground water conditions were observed during and upon completion of drilling. Standpipe piezometers were installed in Boreholes 1N-2, 3N/4N-2, 5N-1, C9/7N-1, 8N-2, 9N-1, 10N-2 and 11N-1. Summarized below are the ground water levels that were measured on separate visits after the completion of drilling.

| Borehole No. | Date | Water Levels | |
|--------------|----------------|------------------------|---------------|
| | | Depth (m) | Elevation (m) |
| BH 1N-2 | June 17, 2021 | 1.0 | 131.7 |
| | March 25, 2022 | 0.2 | 132.5 |
| BH 3N/4N-2 | June 17, 2021 | 1.1 | 130.1 |
| | March 01, 2022 | 1.3 | 129.9 |
| BH 5N-1 | June 17, 2021 | 0.9 | 129.4 |
| | March 01, 2022 | Not Accessible/Damaged | NA |
| BH C9/7N-1 | June 17, 2021 | 2.7 | 127.9 |
| | March 01, 2022 | Not Accessible/Damaged | NA |
| BH 8N-2 | June 17, 2021 | 1.5 | 128.1 |
| | March 01, 2022 | Not Accessible/Damaged | NA |
| BH 9N-1 | March 25, 2022 | 0.0 | 128.0 |
| | April 13, 2022 | -0.1* | 128.1 |
| | April 27, 2022 | -0.1* | 128.1 |
| BH 10N-2 | March 25, 2022 | 0.5 | 127.6 |
| | April 13, 2022 | 0.4* | 127.7 |
| | April 27, 2022 | 0.4* | 127.7 |
| BH 11N-1 | June 17, 2021 | 0.8 | 128.9 |
| | March 01, 2022 | 0.4 | 129.3 |

* Standing water above ground surface.

The ground water levels are expected to follow the ground surface topography and can be expected to fluctuate seasonally as well as in response to major weather events. The ground water levels will also be influenced by standing water in wetland areas and the free water level in the watercourse that flows across the site from south-west to north-east.



6.0 MISCELLANEOUS

The investigation was carried out using equipment supplied and operated by OGS Inc. of Almonte, Ontario, and the field operations were organized by Mr. Dhruvish Halari, EIT, and Mr. Jake McGowan, CET. The routine laboratory tests and consolidated undrained triaxial compression testing were carried out at Terraprobe's Brampton laboratory.

This report was prepared by Mr. Ala Abu Obeid, M.Sc., P.Eng., PMP (Englobe Corp.), and reviewed by Mr. Seth Zhang, P.Eng. (Terraprobe Inc.).

Please take note that, The Palmholding Co Ltd ("Palmholding") wholly owned Terraprobe inc., Terraprobe Design Ltd and 714222 Ontario Ltd, however in connection with the sale of all of the shares of Palmholding, to Englobe Corp as of the effective date of February 28, 2021, Englobe Corp became the sole shareholder of Palmholding. Englobe Corp. and Terraprobe, an Englobe Company (previously known as Terrarprobe Inc.) ("Terraprobe") are affiliated companies. Terraprobe has commissioned Englobe Corp. to complete this report, however Terraprobe remains fully liable as per the agreement entered into by Terraprobe and Associated Engineering (Ont.) Ltd.

Terraprobe



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Associate



PART B – FOUNDATION DESIGN REPORT

**HIGHWAY 17/508 INTERIM INTERCHANGE
NEW CULVERTS INCLUDING
CULVERT SITES 29X-0435/C0, 29X-0436/C0, 29X-0437/C0
COUNTY OF RENFREW, ONTARIO
CONTRACT NUMBER DB-2020-4024**

7.0 DISCUSSION AND ENGINEERING RECOMMENDATIONS

7.1 General

This report presents interpretation of the geotechnical data in the factual report and presents geotechnical design recommendations in support of detailed designs for the proposed interim interchange on Highway 17 at the intersection of County Road 508/County Road 54.

This report was prepared in the context of a design-build contract. The discussion and recommendations presented in this report are based on our understanding of the project and our interpretation of the factual data obtained from the subsurface investigations. If conditions are encountered during construction that are different than what is understood at the time this report was prepared, based on the subsurface conditions and testing described herein; Terraprobe shall be consulted to update, supplement or otherwise revise these recommendations as appropriate.

Nine new culverts will be installed and one existing culvert will be replaced as part of this project. The proposed culvert locations, their dimensions and type are provided in the following table.

| Culvert ID | Location | Size / Type |
|------------|----------------------------------------|-----------------------------------------|
| 1N | Russet Drive Sta. 5+018 | 3000 mm x 1200 mm x 20 m Concrete Box |
| 3N | W - N/S Ramp, Sta.40+670 | 1800 mm x 900 mm x 18.6 m Concrete Box |
| 4N | N/S - E Interim Ramp Sta. 18+149 | 1800 mm x 900 mm x 19.9 m Concrete Box |
| 5N | Highway 17, Sta. 18+002 | 1800 mm x 900 mm x 31.6 m Concrete Box |
| 7N | Milton Stewart Connection, Sta. 30+115 | 2400 mm x 1800 mm x 42.1 m Concrete Box |
| 8N | McLean Drive, Sta. 9+515 | 1450 mm x 950 mm x 24.1 m CSPA |
| 9 | Highway 17, Sta. 18+179 | 2400 mm x 1800 mm x 42.2 m Concrete Box |
| 9N | Milton Stewart Connection, Sta. 30+288 | 3000 mm x 1800 mm x 25.8 m Concrete Box |
| 10N | E – N/S Interim Ramp, Sta. 91+907 | 3000 mm x 1800 mm x 31.3 m Concrete Box |
| 11N | Creek New Alignment, Sta. 0+675 | 2400 mm x 1800 mm x 42.1 m Concrete Box |

7.2 Consequence and Site Understanding Classification

The culverts will support traffic on Highway 17 as well as the interchange ramps and sideroads with the potential to impact this transportation corridor as well as alternative transportation corridors or structures. Therefore, a “typical consequence level” is considered appropriate as outlined in Section 6.5 of the *Canadian Highway Bridge Design Code (CHBDC) S6-19*.

A “typical degree of site and prediction model understanding” has been utilized given the scope of the foundation investigation and laboratory testing programme.

The consequence factor (ψ) and geotechnical resistance factors (ϕ_{gu} & ϕ_{gs}) used for designs and stipulated in Clause 6.5.2 and Clause 6.9 of the CHBDC S6-19, are based on a “typical consequence level” and a “typical degree of site and prediction model understanding”.

7.3 Seismic Design

7.3.1 Importance Category & Seismic Site Classification

Ground conditions for seismic site characterization were established based on the field investigation and laboratory testing data. The average shear wave velocity values and the average undrained shear strength in the upper 30 m of soil below founding level were used to define the seismic site classification in accordance with Table 4.1 of the CHBDC. Based on this methodology and the data, the structures shall be designed based on Site Class D.

7.3.2 Spectral Response Values

The CHBDC requires that the seismic hazard values associated with the design earthquake be established based on the National Building Code of Canada (NBCC). These values, Peak Ground Acceleration (PGA), Peak Ground Velocity (PGV) and Spectral Acceleration (Sa) can be obtained from the Geological Survey of Canada (GSC) “2015 National Building Code of Canada Seismic Hazard Calculator” and are for a reference ground condition of Site Class C.

In accordance with Section 4.4.3.3 of the CHBDC, the NBCC values were adjusted to reflect local site conditions i.e., Site Class D. As per Section 4.4.3.3 of the CHBDC, the value of PGA_{ref} for use with Tables 4.2 to 4.9 was taken as 80% of the PGA since the $Sa(0.2)/PGA$ ratio is less than 2.0. A PGA_{ref} value of 0.180 for the 2,475 year return was used. The NBCC spectral response values and the site-specific design values are tabulated below.

| NBCC Seismic Hazard Values | | | | | | | |
|---------------------------------------------------------|--------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|
| 2% Exceedance in 50 years (2,475 Year Return Period) | | | | | | | |
| PGA (g) | PGV (m/s) | Sa (0.2) (g) | Sa (0.5) (g) | Sa (1.0) (g) | Sa (2.0) (g) | Sa (5.0) (g) | Sa (10.0) (g) |
| 0.225 | 0.160 | 0.351 | 0.192 | 0.098 | 0.048 | 0.013 | 0.005 |
| Site Specific Design Seismic Hazard Values Site Class D | | | | | | | |
| 2% Exceedance in 50 years (2,475 Year Return Period) | | | | | | | |
| PGA (g) | PGV (m/s) | S (0.2) (g) | S (0.5) (g) | S (1.0) (g) | S (2.0) (g) | S (5.0) (g) | S (10.0) (g) |
| 0.256 | 0.213 | 0.393 | 0.256 | 0.139 | 0.070 | 0.020 | 0.007 |

7.4 Foundation Alternatives

The subsurface conditions at this site are suitable for supporting box culverts and the Corrugated Steel Pipe Arch (CSPA) culvert strip footings. Therefore, other foundation alternatives such as deep foundations are not warranted. Box culverts and spread footings have a high probability of acceptable structural performance and these installations require relatively shallow excavations. However, it is necessary to maintain an undisturbed footing subgrade during construction.

7.5 Geotechnical Resistances

The recommended founding depths and geotechnical resistances for concrete box culverts and up to 0.5 m wide CSPA strip footings founded on undisturbed competent native soils are provided in the following table.

| Borehole Number | Existing Ground Surface Elevation (m) | Recommended Bottom of Footing Level Below Existing Ground Surface (m) | Footing Elevation* (m) | Factored Geotechnical Resistance at ULS (kPa) | Factored Geotechnical Resistance at SLS (kPa) | Ground Bearing Surface |
|------------------------------------------------------------|---------------------------------------|-----------------------------------------------------------------------|------------------------|-----------------------------------------------|-----------------------------------------------|------------------------|
| Culvert 1N – Russet Drive, Sta. 5+018 | | | | | | |
| 1N-1 | 132.9 | 1.4 – 2.4 | 131.5 to 130.5 | 100 | 75 | Silty Clay to Clay |
| 1N-2 | 132.7 | 1.4 – 2.4 | 131.3 to 130.3 | 100 | 75 | Silty Clay to Clay |
| Culvert 3N – W-N/S Ramp, Sta. 40+670 | | | | | | |
| 3N-1 | 131.3 | 0.7 – 1.7 | 130.6 – 129.6 | 100 | 75 | Silty Clay to Clay |
| 3N/4N-2 | 131.2 | 0.7 – 1.7 | 130.5 – 129.5 | 100 | 75 | Silty Clay to Clay |
| Culvert 4N – N/S – E Interim Ramp, Sta. 18+149 | | | | | | |
| 3N/4N-2 | 131.2 | 0.7 – 1.7 | 130.6 – 129.6 | 100 | 75 | Silty Clay to Clay |
| 4N-1 | 131.2 | 0.7 – 1.7 | 130.6 – 129.6 | 100 | 75 | Silty Clay to Clay |
| Culvert 5N – Highway 17, Sta. 18+002 | | | | | | |
| 5N-1 | 130.3 | 0.7 – 2.2 | 129.6 – 128.1 | 100 | 75 | Silty Clay to Clay |
| 5N-2 | 131.3 | 2.1 – 3.2 | 129.2 – 128.1 | 100 | 75 | Silty Clay to Clay |
| 5N-3 | 130.8 | 1.4 – 2.7 | 129.4 – 128.1 | 100 | 75 | Silty Clay to Clay |
| Culvert 7N – Milton Stewart Connection, Sta. 30+115 | | | | | | |
| C9/7N-1 | 130.6 | 1.9 – 3.9 | 128.7 – 126.7 | 100 | 75 | Silty Clay to Clay |
| 7N-2 | 128.9 | 0.5 – 2.2 | 128.4 – 126.7 | 100 | 75 | Silty Clay to Clay |
| Culvert 8N – McLean Drive, Sta. 9+515 | | | | | | |
| 8N-1 | 130.3 | 1.4 – 3.1 | 128.9 to 127.2 | 100 | 75 | Silty Clay to Clay |
| 8N-2 | 129.6 | 0.7 – 2.4 | 128.9 to 127.2 | 100 | 75 | Silty Clay to Clay |
| Culvert 9 – Highway 17, Sta. 18+179 | | | | | | |
| C9/7N-1 | 130.6 | 1.9 – 3.9 | 128.7 – 126.7 | 100 | 75 | Silty Clay to Clay |
| C9-2 | 130.5 | 2.9 – 3.8 | 127.6 – 126.7 | 100 | 75 | Silty Clay to Clay |
| C9-3 | 129.6 | 2.1 – 2.9 | 127.5 – 126.7 | 100 | 75 | Silty Clay to Clay |
| Culvert 9N – Milton Stewart Connection, Sta. 30+288 | | | | | | |
| 9N-1 | 128.0 | 0.2 – 1.9 | 127.8 – 126.1 | 100 | 75 | Silty Clay to Clay |
| 9N-2 | 127.2 | 0.1 – 1.1 | 127.1 – 126.1 | 100 | 75 | Silty Clay to Clay |
| Culvert 10N – E-N/S Interim Ramp, Sta. 91+907 | | | | | | |
| 10N-1 | 127.9 | 0.3 – 2.1 | 127.6 – 125.8 | 100 | 75 | Silty Clay to Clay |
| 10N-2 | 128.1 | 0.8 – 2.3 | 127.3 – 125.8 | 100 | 75 | Silty Clay to Clay |
| Culvert 11N – Creek New Alignment, Sta. 0+675 | | | | | | |
| 11N-1 | 129.7 | 0.7 – 2.4 | 129.0 – 127.3 | 100 | 75 | Silty Clay to Clay |
| 11N-2 | 128.9 | 0.7 – 1.6 | 128.2 – 127.3 | 100 | 75 | Silty Clay to Clay |

* Raise the grade with Granular A material where culvert design inverts are higher than the recommended founding elevation. Soft/weak soils if encountered at the bearing surface must be removed and replaced with Granular "A" compacted to 95% SPMDD. Keep excavations dry.

The factored ULS and SLS values tabulated above are for vertical, concentric loads only. Effects of load inclination and eccentricity should be taken into account as outlined in Clause 6.10 of the CHBDC S6-19.

Tabulated below are the total, immediate and consolidation settlements corresponding to the SLS values provided in the table above. The estimated time for consolidation settlement to be complete is also provided.

| Culvert ID | Total Settlement (mm) | Immediate Settlement (mm) | Consolidation Settlement (mm) | Remarks |
|------------|-----------------------|---------------------------|-------------------------------|--------------------------------------------------------------------|
| 1N | 35 | 10 | 25 | Consolidation settlement essentially complete in less than 1 month |
| 3N | 35 | 10 | 25 | Consolidation settlement essentially complete in less than 1 month |
| 4N | 35 | 10 | 25 | Consolidation settlement essentially complete in less than 1 month |
| 5N | 35 | 10 | 25 | Consolidation settlement essentially complete in less than 1 month |
| 7N | 40 | 5 | 35 | Consolidation settlement essentially complete in 1 month |
| 8N | 20 | 5 | 15 | Consolidation settlement essentially complete in less than 1 month |
| 9 | 40 | 5 | 35 | Consolidation settlement essentially complete in 1 month |
| 9N | 40 | 15 | 25 | Consolidation settlement essentially complete in less than 1 month |
| 10N | 40 | 15 | 25 | Consolidation settlement essentially complete in less than 1 month |
| 11N | 35 | 10 | 25 | Consolidation settlement essentially complete in less than 1 month |

The box culverts shall be supported on bedding consisting of Granular "A" material placed and compacted to 95% of the materials SPMDD in accordance with OPSS.PROV 902 and OPSS.PROV 501. The bedding material is also helpful as a cover to protect the silty clay to clay soils that are susceptible to loosening/softening and degradation on exposure to water and construction traffic. A non-woven geotextile fabric with a Filtration Opening Size (FOS) of 100 microns shall be installed at the silty clay to clay/bedding interface to prevent soil migration. At the discretion of the foundation engineer supervising the culvert installation, the bedding should also be reinforced at the base with a biaxial or triaxial geogrid to provide support and stability during bedding placement and compaction. No backfill or precast units shall be placed until the depth of the excavation and the character of the foundation have been approved by a foundation engineer.

7.6 Horizontal Geotechnical Resistances

The ultimate geotechnical horizontal resistance should be evaluated in accordance with Clause 6.10.4 of the CHBDC S6-19. In accordance with Clause 6.10.4 of the CHBDC S6-19, the ultimate geotechnical horizontal resistance within the ground, close to the ground-structure interface (R_{ug}) and; the ultimate geotechnical horizontal shear resistance at the interface between the footing and the ground (R_{ui}), shall be derived based on the following effective angle of internal friction values (ϕ').

- OPSS Granular A bedding – internal friction angle $\phi' = 35^\circ$; and
- Silty Clay to Clay – internal friction angle $\phi' = 27^\circ$.

Along the interface between a shallow foundation and ground, an effective friction angle (δ'_i) equivalent to 2/3 of the soil's effective angle of internal friction (ϕ') shall be used.

The ultimate geotechnical horizontal resistance, R_u , shall be taken as the lesser of R_{ug} and R_{ui} . A geotechnical resistance factor of 0.8 should be applied in accordance with the recommendations of the Canadian Foundation Engineering Manual, 4th Ed. (2006).

7.7 Lateral Earth Pressure

7.7.1 Static Conditions

Earth pressures are generally calculated using the following expression:

$$P_h = K(\gamma h + q)$$

P_h = horizontal pressure on the wall (kPa)

K = lateral earth pressure coefficient

γ = unit weight of retained soil (kN/m³)

h = depth below top of fill where pressure is computed (m)

q = value of any surcharge (kPa)

Earth pressures acting on the structure should be computed in accordance with Clause 6.12 of the CHBDC S6-19 and according to Clause 6.12.3 of the CHBDC S6-19; a compaction surcharge should also be added. For soils with an angle of internal friction ranging from 30° to 35° the magnitude should be 12 kPa at the top of the fill decreasing linearly to 0 kPa at a depth of 1.7 m; or decreasing linearly to 0 kPa at a depth of 2.0 m for soils with an angle of internal friction that exceeds 35° . Compaction equipment including hand operated vibratory equipment should comply with OPSS.PROV 501.

The lateral earth pressure coefficients are dependent on the material used as backfill and typical values are provided in the following table.

| Wall Condition | Lateral Earth Pressure Coefficient (K) | | | |
|-----------------------------------------|-----------------------------------------------------------------------------------------------------|----------------------------------------|------------------------------------------------------------------------------|----------------------------------------|
| | OPSS Granular A or OPSS Granular B Type II $\phi = 35^\circ$; $\gamma = 22.8 \text{ kN/m}^3$ | | OPSS Granular B Type I $\phi = 32^\circ$; $\gamma = 21.2 \text{ kN/m}^3$ | |
| | Horizontal Surface Behind Wall | Sloping Surface Behind Wall (2H:1V) | Horizontal Surface Behind Wall | Sloping Surface Behind Wall (2H:1V) |
| Active (Unrestrained Wall) | 0.27 | 0.39* | 0.31 | 0.47* |
| At rest (Restrained Wall) | 0.43 | - | 0.47 | - |
| Passive (Movement Towards Soil Mass) | 3.70 | - | 3.30 | - |

* For wing walls.

The lateral earth pressure coefficients provided in the table above are “ultimate” values that require certain structural movements for the respective conditions to be mobilized. The values to use in design can be estimated from Figure C6.27 in the Commentary to the CHBDC S6.1-19.

7.7.2 Seismic Conditions

In accordance with Section 4.6 of the CHBDC, seismic loads shall be considered in the design. The designs shall take into consideration:

- The wall should be designed to withstand the combined static lateral loads plus the earthquake induced loads;
- The horizontal seismic coefficient (k_h) used to calculate the seismic active pressure coefficient is taken as 1.0 times the PGA for structures that do not permit lateral yielding and 0.5 times PGA for structures that permit lateral yielding; and
- Where sloping backfill exists above the top of the wall, the weight of the backfill above the top of the wall should be treated as a surcharge when calculating the lateral earth pressure under seismic conditions.

The Mononobe-Okabe (M-O) method was used to calculate the active earth pressure coefficients for yielding and non-yielding walls assuming that the angle of friction between the wall and backfill material is 0.5ϕ . The seismic active earth pressure coefficients provided in the following table may be used for designs.

| Wall Condition | Seismic Active Earth Pressure Coefficients (K) | |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| | OPSS Granular A or OPSS Granular B Type II $\phi = 35^\circ$; $\delta = 17.5^\circ$ $\gamma = 22.8 \text{ kN/m}^3$ | OPSS Granular B Type I $\phi = 32^\circ$; $\delta = 16.0^\circ$ $\gamma = 21.2 \text{ kN/m}^3$ |
| | Horizontal Surface Behind Wall | Horizontal Surface Behind Wall |
| K_{AE} (Yielding Wall) | 0.32 | 0.36 |
| K_{AE} (Non-Yielding Wall) | 0.43 | 0.48 |

7.8 Design Frost Depth

To provide adequate protection against frost penetration as per OPSD 3090.101, the frost penetration depth is 1.8 m of earth cover below the lowest surrounding grade. For frost protection purposes it is not necessary to found a box culvert at or below the frost depth. The box structure is tolerant of small magnitudes of movement related to freeze-thaw cycles, should these occur. However, frost treatment for a box culvert should conform to OPSD 803.010.

7.9 Culvert Bedding and Backfill

The recommended backfill and cover geometry for concrete culverts is illustrated in OPSD 803.010. Prior to placing bedding and backfill material, all organic material and any fill soils found within the footprint of the new box culverts and the footings of the CSPC culvert should be removed. Bedding for box culverts shall consist of OPSS Granular "A" material placed and compacted to 95% of the materials SPMD in accordance with OPSS 422 as amended by SSP 422S01. Additional bedding requirements that may be imposed by the supplier must also be followed. Alternatively, specifically if construction is carried out under wet conditions, a bedding and levelling course consisting of 19 mm clear stone as per OPSS.PROV 1004 should be used (wrapped with geotextiles), which would aid in dewatering applications.

Equal heights of backfill should be maintained on both sides of the structures during all stages of backfill placement, and backfilling operations should be carried out in accordance with OPSS.PROV 902 and OPSS 422. Heavy compaction equipment should not be used adjacent to the walls and roof of the culverts. Compaction equipment should be restricted in accordance with OPSS.PROV 501.

The excavated soil can be used for backfilling purposes provided they are free of organics and other deleterious material. To achieve the specified compaction, soils must neither be too wet nor too dry of their optimum moisture content. Soils that are too wet (such as the silty clay to clay) cannot be used immediately because the material will have to be dried to a moisture content of $2\% \pm$ of optimum. If the construction operations are time sensitive, the use of imported granular material may be considered. Soils that are dry of optimum can be used immediately provided that the material is moisture conditioned (i.e., water added) to achieve a moisture content of $2\% \pm$ of optimum.

7.10 Erosion Protection

Erosion protection should be provided at culvert inlets and outlets (including their slopes and sides) to prevent erosion of the bedding and backfill material surrounding the culverts. Design of an erosion protection scheme for the stream bed as well as at the culvert inlet and outlet areas will depend on hydrologic, hydraulic and/or other concerns.

We recommend that a qualified Hydraulics Engineer be consulted to design the specifics of the channels, culvert outlets and inlets (i.e., thickness and extent of protection) and scour depth. Footings must also be placed below the scour depth.

7.11 Embankment Construction

Embankment construction should be carried out in accordance with OPSS.PROV 206 and OPSS.PROV 209. Earth fill embankments shall be constructed at a side slope geometry of 3 Horizontal: 1 Vertical (3H:1V). The earth fill should be placed in lifts not exceeding 300 mm (before compaction), and each lift should be uniformly compacted to at least 95 % of the material's SPMD.

Topsoil, deleterious material, soft/loose/ unsuitable soils shall be removed below the footprint area of the embankment. At the toe of the proposed embankment the topsoil, deleterious material, soft/loose/ unsuitable soils shall be removed within an envelope given by an imaginary slope extending upwards to ground surface at an inclination not steeper than 1H:1V from the toe of the proposed embankment. Bonding between existing fill and new fill should be carried out by benching in accordance with OPSS 208.010.

Proper erosion control measures should be implemented both during construction and permanently. Temporary erosion and sediment control must be provided in accordance with OPSS.PROV 804 and OPSS.PROV 805. Embankment slopes not consisting of rock fill shall be reinstated with permanent erosion protection in accordance with OPSS.PROV 803.

7.12 Excavations

All excavations shall be carried out in accordance with the guidelines outlined in the *Occupational Health and Safety Act (OHSA) and Regulations for Construction Projects*. Where workers must enter excavations

extending deeper than 1.2 m, the trench walls must be suitably sloped and/or braced in accordance with the OHSA. Within the envisaged depths of temporary excavations, the OHSA soil classifications are:

- Fill – Type 3 soils above ground water and Type 4 soils below ground water; and
- Silty Clay to Clay – Type 4 soils.

The side slopes of temporary excavations may be formed no steeper than 1H:1V for Type 3 soils and 3H:1V or flatter for Type 4 soils. Excavations should be carried out in accordance with OPSS.PROV 902.

7.13 Temporary Protection Systems

Decisions regarding shoring methods and sequencing are the responsibility of the Contractor. Temporary protection systems should be designed in accordance with OPSS.PROV 539 and the designs should be carried out by a licensed Professional Engineer experienced in shoring design.

The shape of the soil pressure distribution diagram behind a temporary protection system depends upon the type of soil to be supported and the amount of movement that can be permitted. The protection system can be restrained, fixed or flexible and the sequence of work will alter the shape of the pressure diagram during the various construction phases.

Earth pressure computations must also take into account the ground water level. Above the ground water level, earth pressure is computed using the bulk unit weight of the retained soil. Below the ground water level, the earth pressures are computed using the submerged unit weight of the soil. A hydrostatic pressure is also applied if the retained soil is not fully drained.

Flexible shoring should be designed on the basis of the active earth pressure coefficient (K_a). In this case, the performance level should be Level 2 – Angular Distortion 1:200 but shall not be more than 25 mm. Where limited shoring movement (Performance Level 1A or 1B) is required, the design should be based on the at rest earth pressure coefficient (K_o). For “kick out” design the lateral resistance should be computed on the basis of the passive earth pressure coefficient (K_p). It should be noted that the lateral earth pressure coefficients chosen for design require certain movements for the active and passive conditions to be mobilized.

The appropriate lateral earth pressure parameters for use in the design of structures subject to unbalanced earth pressures are provided in the following table. The active earth pressure coefficients are based on the assumption that the ground surface behind the temporary protection system is horizontal. Where the retained ground is sloping, the lateral earth pressure coefficients must be adjusted to account for the slope and, these earth pressure coefficients can be estimated from the equations provided on Figures C6.28 and C6.29 of the Commentary to CHBDC S6-19.

| Stratigraphic Unit | Friction Angle ϕ (degrees) | Unit Weight γ (kN/m ³) | Active Earth Pressure Coefficient | At - Rest Earth Pressure Coefficient | Passive Earth Pressure Coefficient |
|-----------------------------|---------------------------------------|-------------------------------------------------|-----------------------------------|--------------------------------------|------------------------------------|
| | | | K_a | K_o | K_p |
| Fill Material | 28 | 19 | 0.36 | 0.53 | 2.77 |
| Silty Clay to Clay | 27 | 17 | 0.38 | 0.55 | 2.66 |
| Lower Cohesionless Deposits | 30 | 20 | 0.33 | 0.50 | 3.00 |

The lateral earth pressure coefficients given above are “ultimate values” and require specific wall movements for the active and passive conditions to be mobilized. The values to use in design can be estimated from Figure C6.27 in the Commentary to the CHBDC, S6-19.

For the design of temporary shoring in cohesive silty clay soils, the ultimate horizontal resistance can be estimated as $4c_u$, where c_u is the undrained shear strength of the silty clay in this zone.

It is envisaged that a temporary protection system such as an interlocking sheet pile wall will be required to install the culverts on Highway 17. Global stability assessments were carried out for an interlocking sheet pile arrangement installed adjacent to the highway centre line. No global stability concerns are anticipated for sheet pile systems installed to a depth of 4 m below the highway pavement. Therefore, the depth of embedment of the sheet pile arrangement will be controlled by the shoring performance level requirements i.e., Performance Level 2. We recommend that temporary protection systems be cut off at the frost depth i.e., 1.8 m below ground surface after they are no longer required.

7.14 Ground Water Control

While the design of the dewatering system is the Contractor’s responsibility, provided herein are general approaches to ground water control. Surface water and ground water control will be necessary to enable construction where excavations extend below the ground water table. We recommend temporarily diverting the flow of creek water away from the construction area. Cofferdams and interceptor perimeter trenches should also be installed to prevent surface water from entering the excavation. Gravity drainage and pumping from strategically placed filtered sumps are practical dewatering systems that can be employed.

The Ontario Ministry of Environment and Climate Change (MOECC) requires a Permit to Take Water (PTTW) for any ground water and storm water takings in excess of 400 m³/day. If the ground water and storm water taking is between 50 m³/day and 400 m³/day, then the activity must be registered on the Environmental Activity and Sector Registry (EASR).

7.15 Construction Concerns

During construction, the Design Builder should employ experienced geotechnical staff to observe construction activities related to foundation and embankment construction. Potential construction concerns include, but are not necessarily limited to:

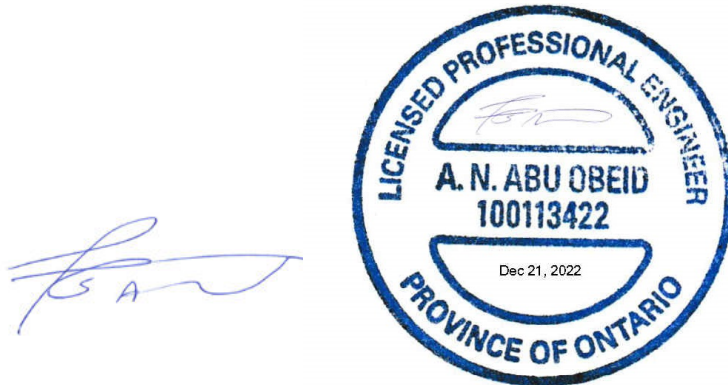
- managing ground water at the excavation base to prevent disturbance of the founding subgrade of the culvert footings;
- continuous management of the erodible site soils by ensuring that temporary erosion and sediment control measures are provided at all times; and
- pollution, siltation or disruption of environmentally sensitive areas.

8.0 CLOSURE

This report was prepared by Mr. Ala Abu Obeid, M.Sc., P.Eng., PMP (Englobe Corp.), and reviewed by Mr. Seth Zhang, P.Eng. (Terraprobe Inc.).

Please take note that, The Palmholding Co Ltd ("Palmholding") wholly owned Terraprobe inc., Terraprobe Design Ltd and 714222 Ontario Ltd, however in connection with the sale of all of the shares of Palmholding, to Englobe Corp as of the effective date of February 28, 2021, Englobe Corp became the sole shareholder of Palmholding. Englobe Corp. and Terraprobe, an Englobe Company (previously known as Terraprobe Inc.) ("Terraprobe") are affiliated companies. Terraprobe has commissioned Englobe Corp. to complete this report, however Terraprobe remains fully liable as per the agreement entered into by Terraprobe and Associated Engineering (Ont.) Ltd.

Terraprobe



Ala Abu Obeid, M.Sc., P.Eng., PMP
Technical Director- Geotechnical (Englobe Corp.)



Seth Zhang, P.Eng.
Associate



REFERENCES

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- Canadian Geotechnical Society, 2006. *Canadian Foundation Engineering Manual*, 4th Edition. The Canadian Geotechnical Society c/o BiTech Publisher Ltd, British Columbia.
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- Kulhawy, F. H., and Mayne, P. W. 1990. *Manual on Estimating Soil Properties for Foundation Design, Report EL-6800*, Electric Power Research Institute Inc.
- Nagaraj, T. S., and Murthy, B. R. S. 1985. *Prediction of the Preconsolidation Pressure and Recompression Index of Soils*. Geotechnical Testing Journal, American Society for Testing and Materials, Vol. 8, No. 4.
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Ontario Provincial Standard Specifications (OPSS)

| | |
|----------------|-----------------------------------------------------------------------------------------------|
| OPSS.PROV 206 | Construction Specification For Grading. |
| OPSS.PROV 209 | Construction Specification For Embankments Over Swamps And Compressible Soils. |
| OPSS 422 | Construction Specification For Precast Reinforced Concrete Box Culverts in Open Cut. |
| OPSS.PROV 501 | Construction Specification For Compacting. |
| OPSS.PROV 539 | Construction Specification For Temporary Protection Systems. |
| OPSS.PROV 803 | Construction Specification For Vegetative Cover. |
| OPSS.PROV 804 | Construction Specification For Temporary Erosion Control. |
| OPSS.PROV 805 | Construction Specification For Temporary Sediment Control. |
| OPSS.PROV 902 | Construction Specification For Excavating and Backfilling – Structures. |
| OPSS.PROV 1010 | Material Specification for Aggregates – Base, Subbase, Select Subgrade and Backfill Material. |
| OPSS.PROV 1205 | Material Specification For Clay Seal |
| SSP 422S01 | Amendment to OPSS 422 |

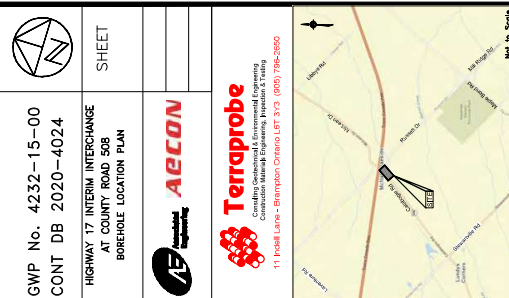
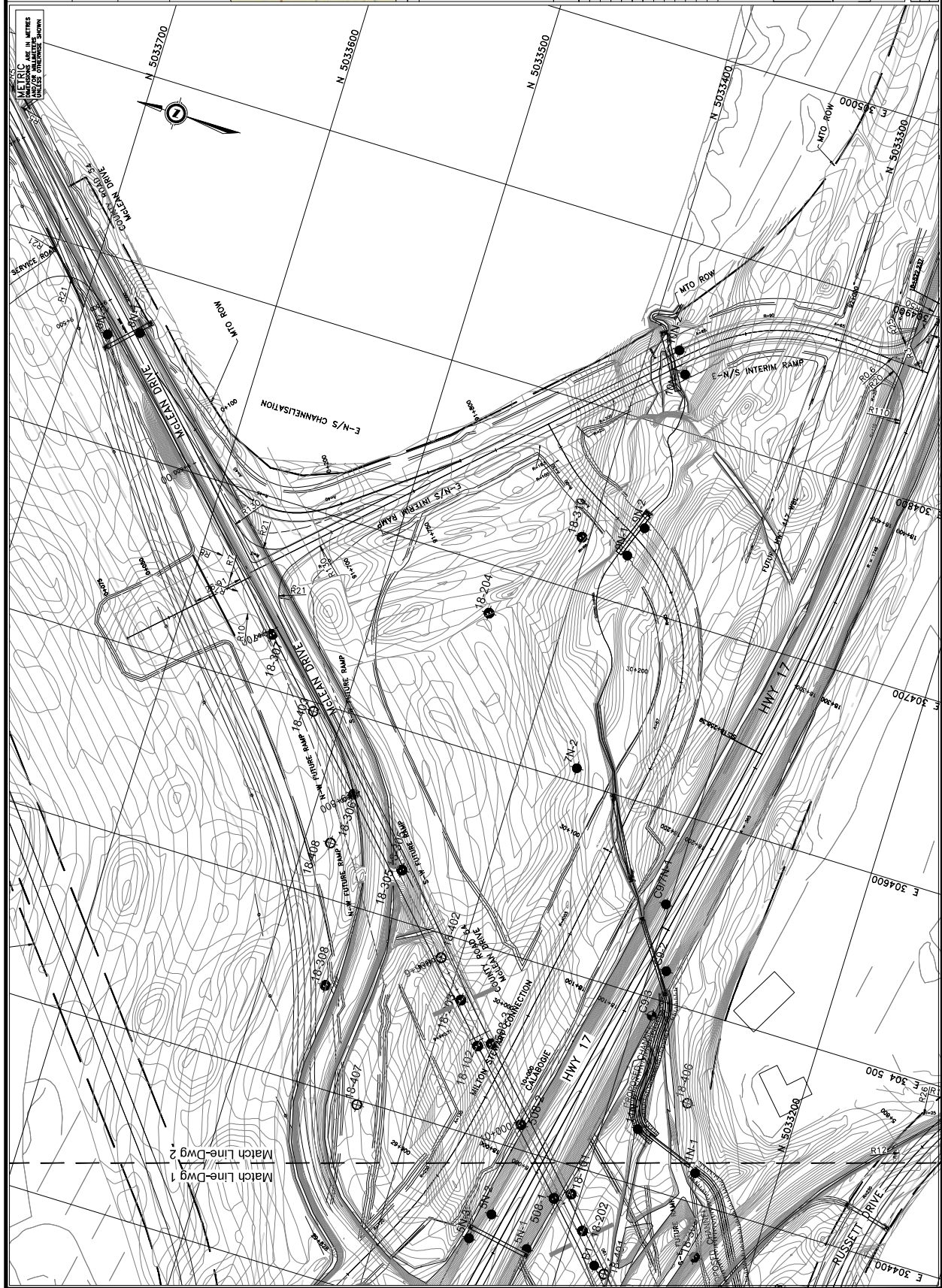
Ontario Provincial Standard Drawings (OPSD)

| | |
|---------------|---------------------------------------------------------------------------------|
| OPSD 208.010 | Benching Of Earth Slopes. |
| OPSD 803.010 | Backfill And Cover For Concrete Culverts With Spans Less Than Or Equal To 3.0 m |
| OPSD 3090.101 | Foundation, Frost Penetration Depths For Southern Ontario |



DRAWINGS






| KEY PLAN | |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LEGEND | <p>Bore Hole (Current Investigation)</p> <p>Bore Hole And Cone (Current Investigation)</p> <p>Bore Hole (Previous Investigation)</p> <p>Cone Penetration Test/Sismic Cone Penetration Test (Previous Investigation)</p> |

[illegible]

SCALE

A horizontal scale bar with a black and white checkered pattern. It has markings at 25, 0, 25, and 50m. The bar is oriented vertically in the image.

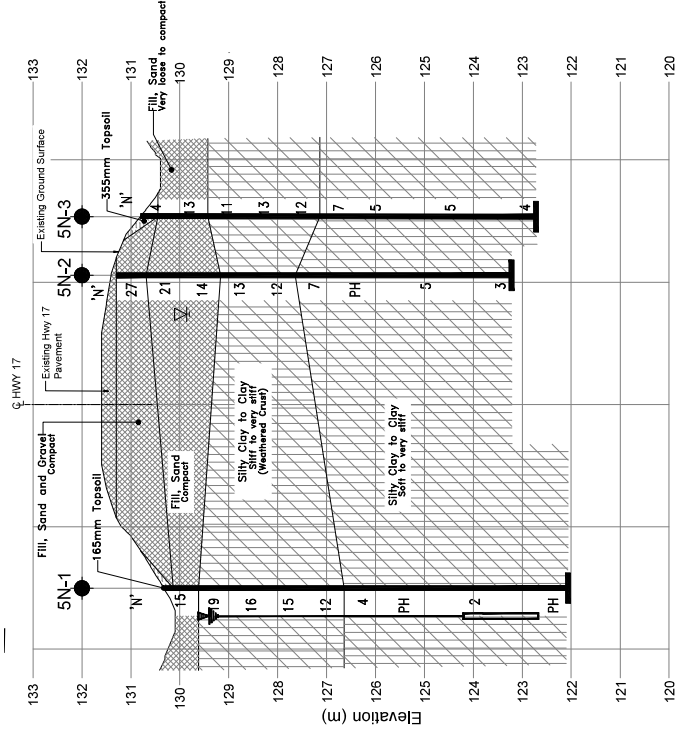
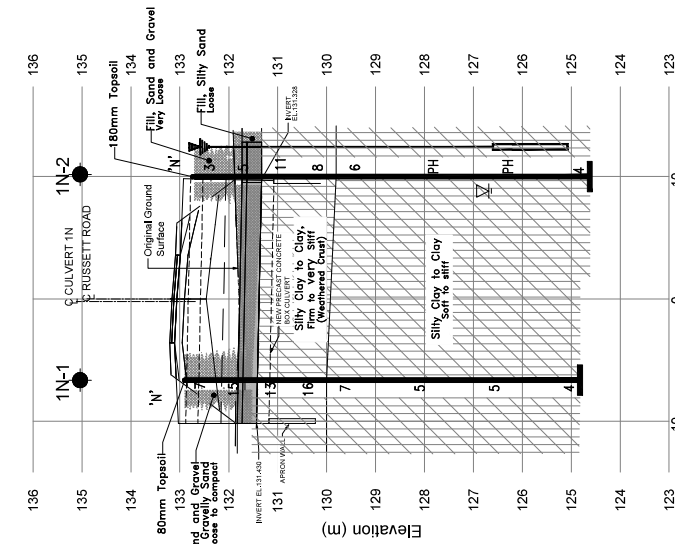
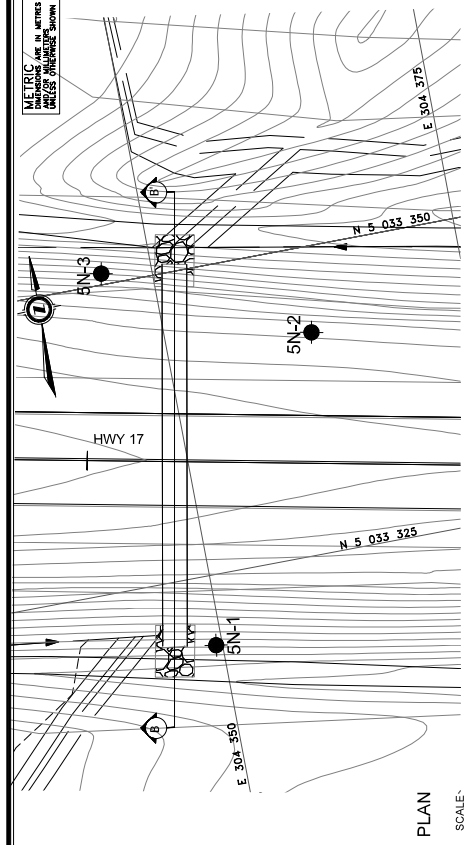
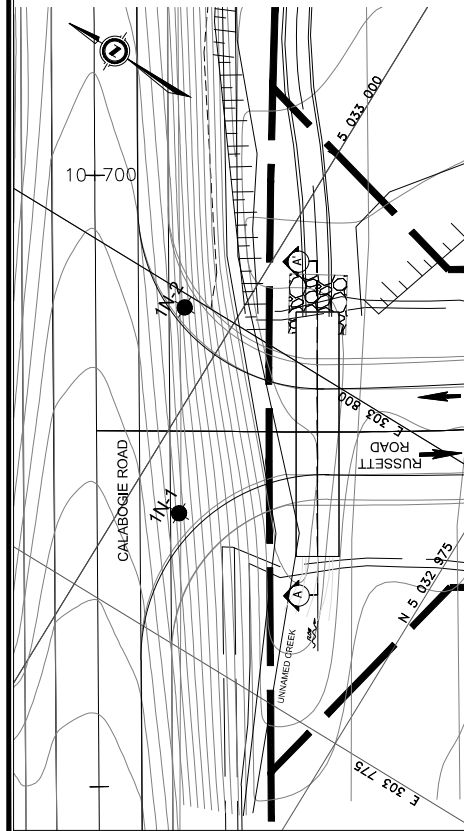
NOTE

This drawing is for subsurface information only. Surface details and features are for conceptual illustration. The subsurface conditions can be expected to vary between and beyond the borehole locations.

REFERENCE

Drawings provided in digital format by Associated Engineering, received on May 10, 2022.

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| SUB'D. | SD | CMD. | SD | DATE: | May 2022 | SITE | -- | | | | |
| DRAWN: | KC | CMD. | RA | APPR: | RA | DMG. | 2 | | | | |



| KEY PLAN | | LEGEND | | COORDINATES | | ELEV. (m) | | NORMING (m) | | EXTENS (m) | |
|----------|-----------------------------------------|-------------|-----------|-------------|--|-----------|--|-------------|--|------------|--|
| | Bore Hole | | | | | | | | | | |
| | Dynamic Cone Penetration Test | | | | | | | | | | |
| | Bore Hole And Core | | | | | | | | | | |
| "N" | Blows/0.3m (Std Pen Test, 475 +/- blow) | | | | | | | | | | |
| "C" | Blows/0.3m (60° Cone, 475 +/- blow) | | | | | | | | | | |
| | WT at Time of Investigation | | | | | | | | | | |
| | WT in Piezometer | | | | | | | | | | |
| | Rock Quality Designation | | | | | | | | | | |
| | Piezometer | | | | | | | | | | |
| | Auger Refusal | | | | | | | | | | |
| A/R | | | | | | | | | | | |
| Blk No. | | | | | | | | | | | |
| 11A-1 | 132.9 | 5 033 895.7 | 303 763.4 | | | | | | | | |
| 11A-2 | 132.7 | 5 033 904.1 | 303 799.0 | | | | | | | | |
| 11A-3 | 130.3 | 5 033 918.9 | 303 546.5 | | | | | | | | |
| 11A-4 | 131.3 | 5 033 943.0 | 303 861.9 | | | | | | | | |
| 11A-5 | 130.8 | 5 033 959.9 | 303 542.9 | | | | | | | | |

NOTE

This drawing is for subsurface information only. The proposed boundaries shown on this drawing are for information only and may not be consistent with final design configuration as shown elsewhere in the contract documents.

The boundaries between soil strata have been established only for information purposes. The drawing does not control the boundaries as determined from geological relationships.

The complete foundation investigation and design report for this project and other related documents may be examined at the Materials Engineering and Research Office, Dornier, Inc., 10000 Highway 100, Suite 100, Dallas, Texas 75243.

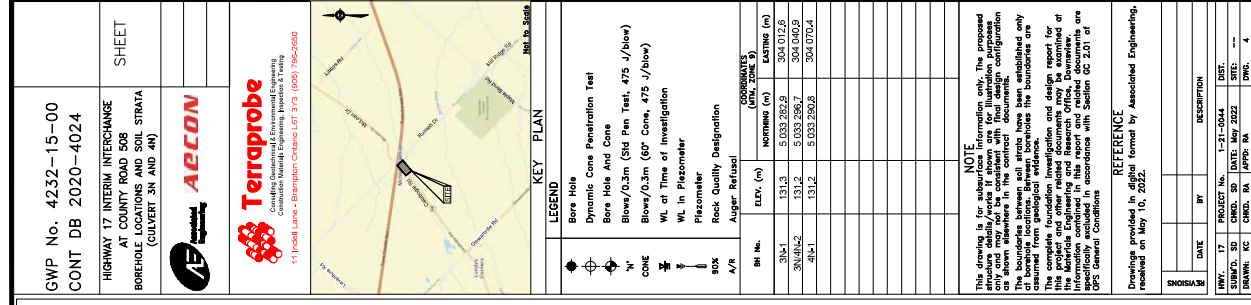
Information contained in this report and related documents are not to be used for any purpose other than that for which they were prepared, without the written consent of Dornier, Inc.

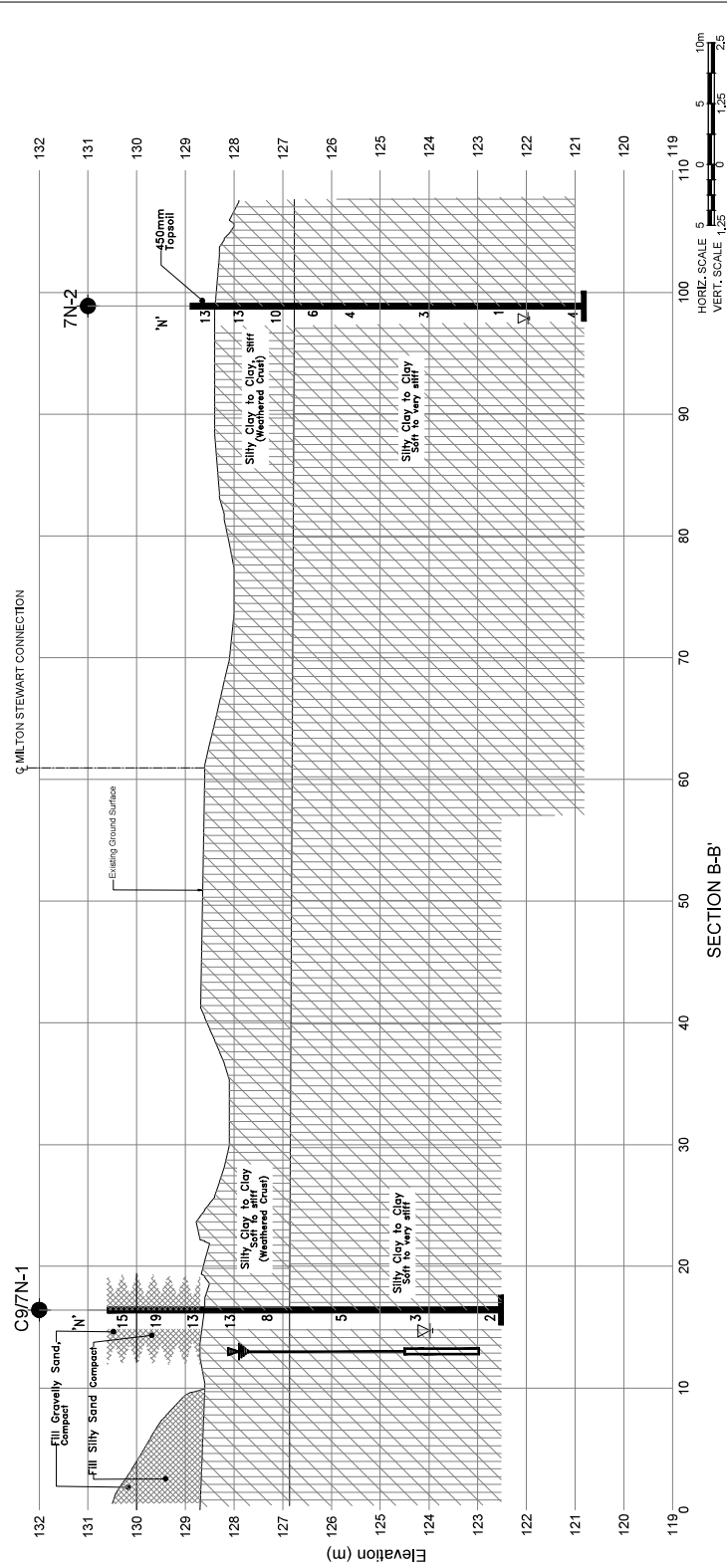
GPS Interpretation Consultants










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Drawings provided in digital format by Associated Engineering, received on May 10, 2022.

REFERENCE





| KEY PLAN | | LEGEND | | NOTES | |
|-----------------------------------------------------------------------------------|---------------------------------------|------------------------------------|-----------|-------|--|
|  | Bore Hole | | | | |
|  | Dynamic Cone Penetration Test | | | | |
|  | Bore Hole And Cone | | | | |
|  | Blows/0.3m (Std Pen Test, 475 J/blow) | | | | |
|  | Blows/0.3m (60° Cone, 475 J/blow) | | | | |
|  | WL at Time of Investigation | | | | |
|  | Piezometer | | | | |
|  | Rock Quality Designation | | | | |
|  | Auger Refusal | | | | |
| A/R | | COORDINATES (Easting, Northing) | | | |
| BH | ELE ¹ , (m) | NORTHING | EASTING | | |
| C97/94 | 130.6 | 5,033,301.8 | 304,551.0 | | |
| 7/94-2 | 128.9 | 5,033,369.9 | 304,607.8 | | |

NOTE

This drawing is for subsurface information only. The proposed boundaries shown on this drawing are for information only and may not be consistent with final design configuration or boundaries elsewhere in the contract documents.

The boundaries between soil strata have been established only at boring locations. Between borings the boundaries are assumed to be continuous.

The complete foundation investigation and design report for this project and other related documents may be examined at the Materials Engineering and Research Office, Damesville. Information contained in this report and related documents are not to be used for any other project without the written consent of the Engineer in accordance with Section 05.01.01 of the RFP Special Conditions.

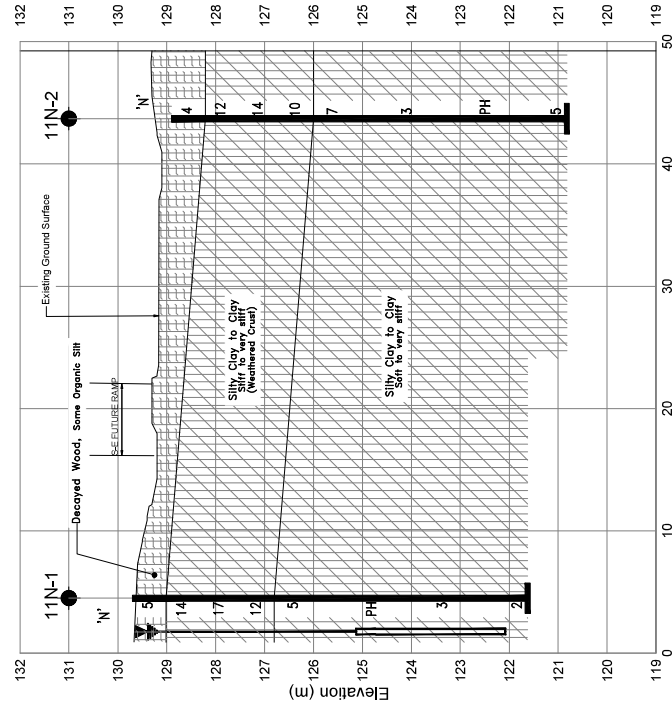
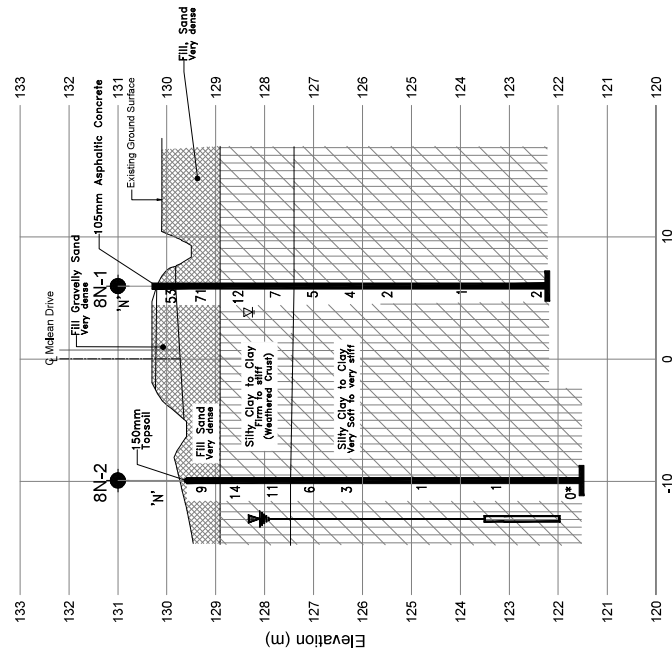
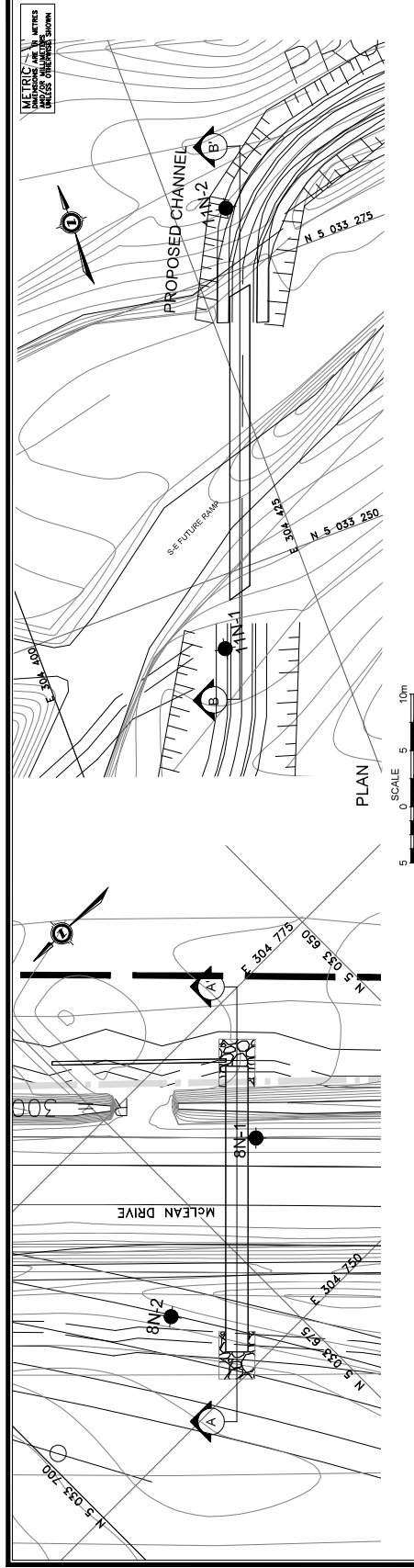
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| HWY. | 17 | PROJECT No. | 1-21-0044 | DIST. |
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| DRAWN: KC | CHCD. | BA | APPD: RA | DWG. 5 |





| KEY PLAN | | | | | |
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| | LEGEND | | | | |
| | Bore Hole | DYNAMIC CONE PENETRATION TEST | | | |
| | Dynamic Cone Penetration Test | | | | |
| | Bore Hole And Core | | | | |
| "N" | Blores/0.3m (Std Pen Test, 475 J/blow) | | | | |
| CONE | Blores/0.3m (60° Pen Cone, 475 J/blow) | | | | |
| | WL at Time of Investigation | | | | |
| | Piezometer | | | | |
| | Rock Quality Designation | | | | |
| A/R | Auger Refusal | | | | |
| | | COORDINATES (UTM Zone 48Q UTM Easting, UTM Northing) | | | |
| BN No. | ELEV. (m) | NORTHING | EASTING | | |
| 8N+1 | 130.3 | 5 033 666.5 | 304 764.3 | | |
| 8N+2 | 129.6 | 5 033 663.1 | 304 755.4 | | |
| 11N+1 | 128.7 | 5 033 243.8 | 304 415.8 | | |
| 11N+2 | 128.2 | 5 033 280.5 | 304 429.6 | | |

NOTE

This drawing is for submittal and information only. The proposed structure details reflect it as shown for illustration purposes only and may not be consistent with final design configuration on board elsewhere in the contract documents.

The boundaries between soil strata have been established only for information purposes. This drawing does not involve the boundaries as assumed from geological evidence.

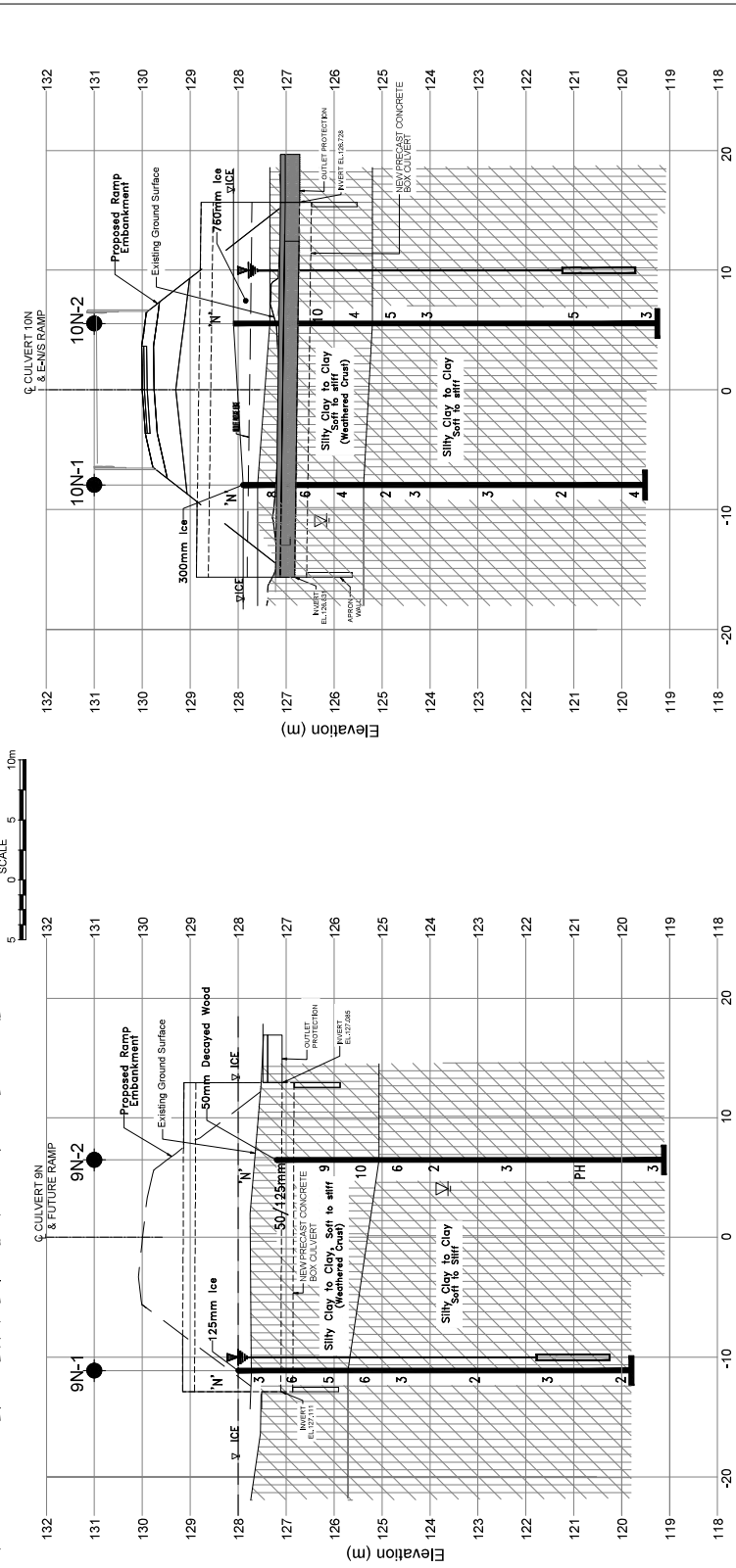
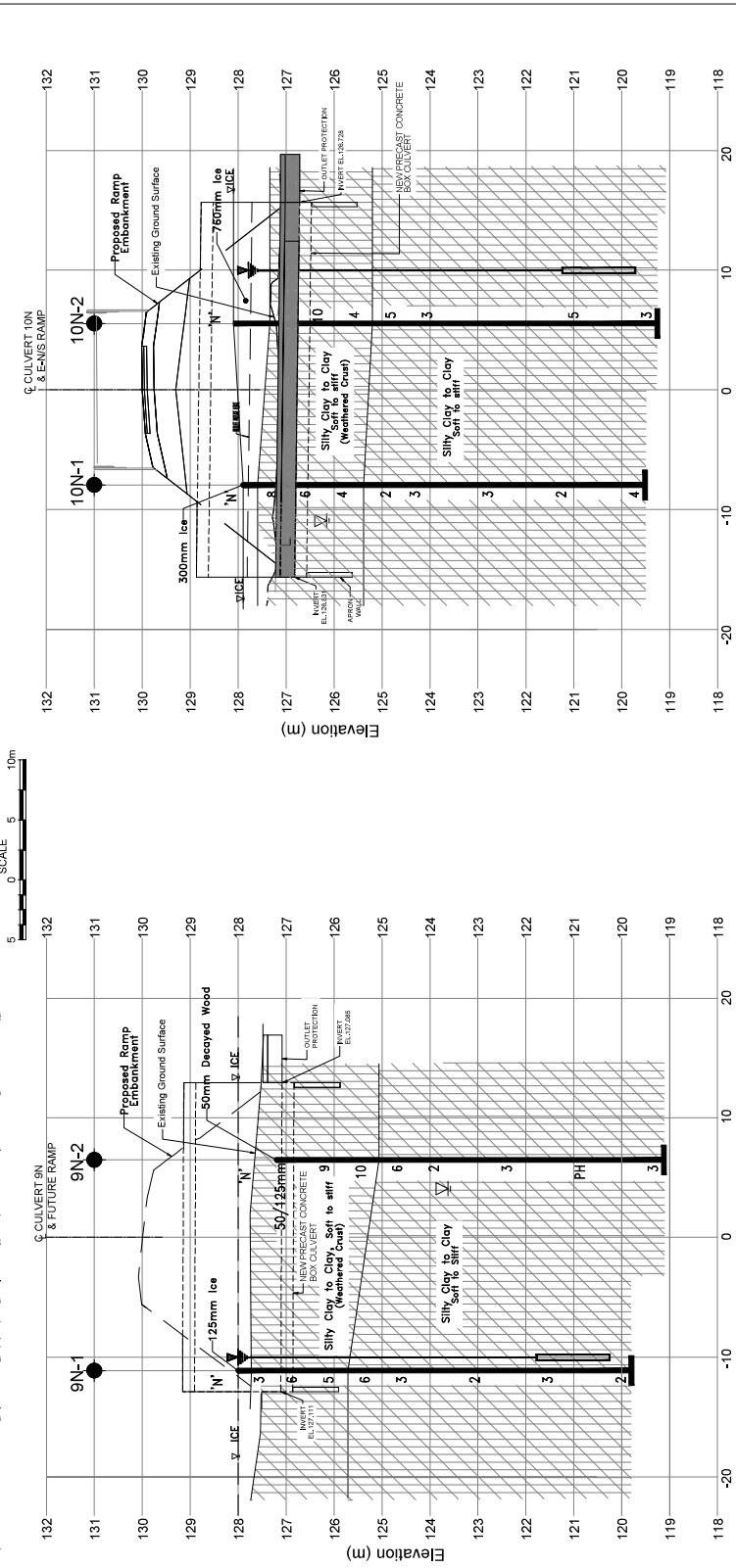
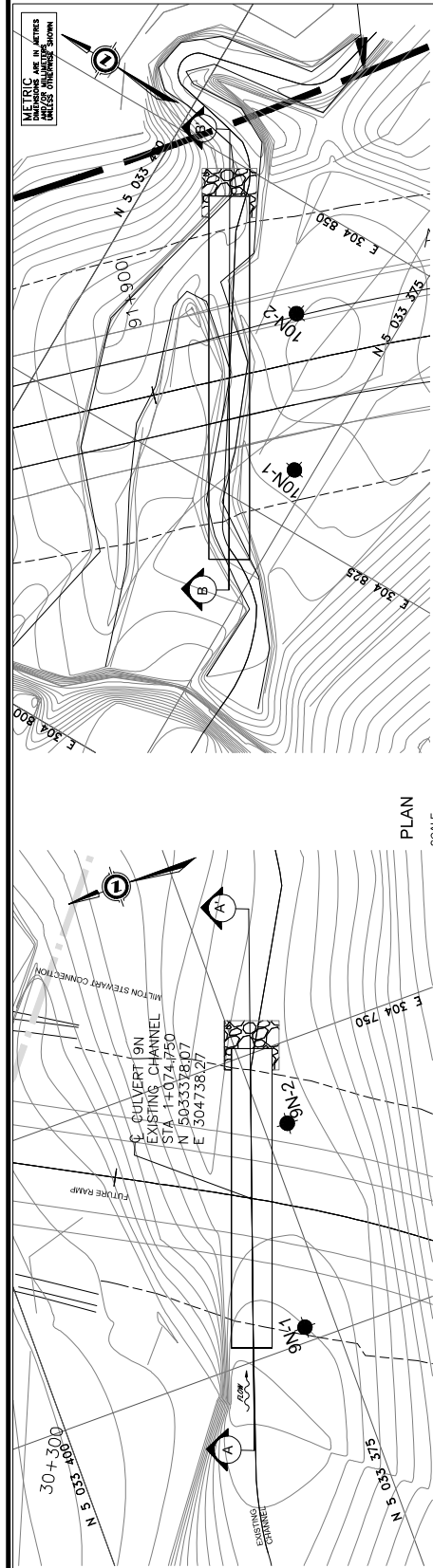
The complete foundation investigation and design report for this project and other related documents may be examined at the Materials Engineering and Research Office, Dominion. Information contained in this report and related documents are not to be used for any other project without the written consent of the Corps of Engineers in accordance with Section 65.01 of the General Conditions.





















035 (Reprint Conditions)

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| <p>REFERENCE</p> <p>Drawings provided in digital format by Associated Engineering, Inc., 10000 E. 1st Ave., Suite 100, Denver, CO 80231.</p> |
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| SUBM'D. SD | CHGD. | SD DATE: | May 2022 | SITE: -- |
| DRAWN: | KC | CHGD. RA | APPD: RA | DWG. 7 |



| KEY PLAN | | NOT IN SCALE |
|-----------------------------------------------------------------------------------|------------------------------------------|--------------|
| LEGEND | | |
|  | Bore Hole | |
|  | Dynamic Cone Penetration Test | |
|  | Bore Hole And Core | |
|  | Blores/0.3m (Std Pen Test, 475 +/- blow) | |
|  | Blores/0.3m (60° Cone, 475 +/- blow) | |
|  | WL at Time of Investigation | |
|  | WL in Piezometer | |
|  | Piezometer | |
|  | Rock Quality Designation | |
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[illegible]

NOTE

This drawing is for submittal to the Corps for construction only. The proposed structure details/works if shown are for illustration purposes only and may not be consistent with final design configuration at storm shoreline in the contract documents.

The boundaries between soil strata have been established only for illustration purposes. The boundaries are not to be construed as assumed from geological evidence.

The complete foundation investigation and design report for this project and other related documents may be examined at the Maritime Engineering and Research Office, Damascus, Virginia. The report is available for public review and may be specifically excluded in accordance with Section 605.2.01 of the OCS General Conditions.

| REFERENCE |
|------------------------------------------------------------------------------------------|
| Drawings provided in digital format by Associated Engineering, received on May 10, 2022. |

| REVIEWS | | DATE | BY | DESCRIPTION |
|---------|----|-------------|----|----------------|
| HWY. | 17 | PROJECT No. | | 1-21-0044 |
| SUBW'D. | SD | CHKD. | SD | DATE: May 2022 |
| DRAWN: | KC | CHKD. | RA | SITE: --- |
| | | | | APPR: RA |
| | | | | DWG: 8 |

APPENDIX A1

Record of Borehole Sheets

(Current Investigation)



EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg. FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

| c_u (kPa) | 0 – 12 | 12 – 25 | 25 – 50 | 50 – 100 | 100 – 200 | >200 |
|-------------|-----------|---------|---------|----------|------------|------|
| | VERY SOFT | SOFT | FIRM | STIFF | VERY STIFF | HARD |

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

| N (BLOWS/0.3m) | 0 – 5 | 5 – 10 | 10 – 30 | 30 – 50 | >50 |
|----------------|------------|--------|---------|---------|------------|
| | VERY LOOSE | LOOSE | COMPACT | DENSE | VERY DENSE |

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND/OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY IS:

| RQD (%) | 0 – 25 | 25 – 50 | 50 – 75 | 75 – 90 | 90 – 100 |
|---------|-----------|---------|---------|---------|-----------|
| | VERY POOR | POOR | FAIR | GOOD | EXCELLENT |

JOINTING AND BEDDING:

| SPACING | 50mm | 50 – 300mm | 0.3m – 1m | 1m – 3m | >3m |
|----------|------------|------------|------------|---------|------------|
| JOINTING | VERY CLOSE | CLOSE | MOD. CLOSE | WIDE | VERY WIDE |
| BEDDING | VERY THIN | THIN | MEDIUM | THICK | VERY THICK |

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

| | | | |
|----|---------------------|----|---------------------------|
| SS | SPLIT SPOON | TP | THINWALL PISTON |
| WS | WASH SAMPLE | OS | OSTERBERG SAMPLE |
| ST | SLOTTED TUBE SAMPLE | RC | ROCK CORE |
| BS | BLOCK SAMPLE | PH | TW ADVANCED HYDRAULICALLY |
| CS | CHUNK SAMPLE | PM | TW ADVANCED MANUALLY |
| TW | THINWALL OPEN | FS | FOIL SAMPLE |

STRESS AND STRAIN

| | | |
|--------------------------------------|-----|-------------------------------|
| u_w | kPa | PORE WATER PRESSURE |
| r_u | 1 | PORE PRESSURE RATIO |
| σ | kPa | TOTAL NORMAL STRESS |
| σ' | kPa | EFFECTIVE NORMAL STRESS |
| τ | kPa | SHEAR STRESS |
| $\sigma_1, \sigma_2, \sigma_3$ | kPa | PRINCIPAL STRESSES |
| ϵ | % | LINEAR STRAIN |
| $\epsilon_1, \epsilon_2, \epsilon_3$ | % | PRINCIPAL STRAINS |
| E | kPa | MODULUS OF LINEAR DEFORMATION |
| G | kPa | MODULUS OF SHEAR DEFORMATION |
| μ | 1 | COEFFICIENT OF FRICTION |

MECHANICAL PROPERTIES OF SOIL

| | | |
|----------------|-------------------|--------------------------------------|
| m_v | kPa ⁻¹ | COEFFICIENT OF VOLUME CHANGE |
| C_c | 1 | COMPRESSION INDEX |
| C_s | 1 | SWELLING INDEX |
| C_{α} | 1 | RATE OF SECONDARY CONSOLIDATION |
| C_v | m ² /s | COEFFICIENT OF CONSOLIDATION |
| H | m | DRAINAGE PATH |
| T_v | 1 | TIME FACTOR |
| U | % | DEGREE OF CONSOLIDATION |
| σ'_{vo} | kPa | EFFECTIVE OVERBURDEN PRESSURE |
| σ'_p | kPa | PRECONSOLIDATION PRESSURE |
| τ_f | kPa | SHEAR STRENGTH |
| c' | kPa | EFFECTIVE COHESION INTERCEPT |
| ϕ' | - ° | EFFECTIVE ANGLE OF INTERNAL FRICTION |
| c_u | kPa | APPARENT COHESION INTERCEPT |
| ϕ_u | - ° | APPARENT ANGLE OF INTERNAL FRICTION |
| τ_R | kPa | RESIDUAL SHEAR STRENGTH |
| τ_r | kPa | REMOULDED SHEAR STRENGTH |
| S_r | 1 | SENSITIVITY = c_u / τ_r |

PHYSICAL PROPERTIES OF SOIL




| | | | | | | | | |
|----------------|-------------------|--------------------------------|-----------|------|-------------------------------------|-----------|-------------------|---------------------------------------------------------|
| ρ_s | kg/m ³ | DENSITY OF SOLID PARTICLES | e | 1, % | VOID RATIO | e_{min} | 1, % | VOID RATIO IN DENSEST STATE |
| γ_s | kN/m ³ | UNIT WEIGHT OF SOLID PARTICLES | n | 1, % | POROSITY | I_D | 1 | DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$ |
| ρ_w | kg/m ³ | DENSITY OF WATER | w | 1, % | WATER CONTENT | D | mm | GRAIN DIAMETER |
| γ_w | kN/m ³ | UNIT WEIGHT OF WATER | S_r | % | DEGREE OF SATURATION | D_n | mm | n PERCENT - DIAMETER |
| ρ | kg/m ³ | DENSITY OF SOIL | w_L | % | LIQUID LIMIT | C_u | 1 | UNIFORMITY COEFFICIENT |
| γ | kN/m ³ | UNIT WEIGHT OF SOIL | w_p | % | PLASTIC LIMIT | h | m | HYDRAULIC HEAD OR POTENTIAL |
| ρ_d | kg/m ³ | DENSITY OF DRY SOIL | w_S | % | SHRINKAGE LIMIT | q | m ³ /s | RATE OF DISCHARGE |
| γ_d | kN/m ³ | UNIT WEIGHT OF DRY SOIL | I_p | % | PLASTICITY INDEX = $(w_L - w_p)$ | v | m/s | DISCHARGE VELOCITY |
| ρ_{sat} | kg/m ³ | DENSITY OF SATURATED SOIL | I_L | 1 | LIQUIDITY INDEX = $(w - w_p)/I_p$ | i | 1 | HYDRAULIC GRADIENT |
| γ_{sat} | kN/m ³ | UNIT WEIGHT OF SATURATED SOIL | I_C | 1 | CONSISTENCY INDEX = $(w_L - w)/I_p$ | k | m/s | HYDRAULIC CONDUCTIVITY |
| ρ' | kg/m ³ | DENSITY OF SUBMERGED SOIL | e_{max} | 1, % | VOID RATIO IN LOOSEST STATE | j | kN/m ³ | SEEPAGE FORCE |
| γ' | kN/m ³ | UNIT WEIGHT OF SUBMERGED SOIL | | | | | | |

RECORD OF BOREHOLE No 1N-1

1 of 1

METRIC

G.W.P. _____ LOCATION _____ Coords: E:303784.4 N:5032995.7 (MTM, ZONE 9) ORIGINATED BY DH
 DIST _____ HWY 17 BOREHOLE TYPE HOLLOW STEM AUGERS COMPILED BY SD
 DATUM GEODETIC DATE 2021-3-31 CHECKED BY RA

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------|------|---------------|----------------------------|-----------------|---------------------------------------------|----|---------------------------------------------------------------|----|-----|-----------------------------------------------------|---------------------------------------------------|----------------------------------|----------------------------|----------------|
| ELEV DEPTH (m) | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | SPT 'N' VALUE | | | SHEAR STRENGTH (kPa) | | | | | | | WATER CONTENT (%) | | |
| | | | | | | | | 20 | 40 | 60 | 80 | 100 | | | ○ UNCONFINED ● QUICK TRIAXIAL | + FIELD VANE X LAB VANE | w _p |
| 132.9 | GROUND SURFACE | | | | | | | | | | | | | | | | |
| 131.5 | 80mm TOPSOIL |  | 1 | SS | 7 | | | | | | | | | | 34 50 13 3 | | |
| | | | | | | | | | | | | | | | | | |
| 1.4 | FILL, sand and gravel to gravelly sand, trace to some silt, trace clay, trace organics, loose to compact, grey to 0.6m brown below, wet | | 2 | SS | 15 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 130.0 | SILTY CLAY to CLAY, trace to some sand, trace gravel, firm to very stiff, brown, wet (WEATHERED CRUST) |  | 3 | SS | 13 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 2.9 | | | 4 | SS | 16 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | SILTY CLAY to CLAY, trace sand, trace gravel, soft to very stiff, grey, wet |  | 5 | SS | 7 | | | | | | | | | | | | |
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| 124.8 | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 8.1 | | | 8 | SS | 4 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |

END OF BOREHOLE

RECORD OF BOREHOLE No 1N-2

1 of 1

METRIC

G.W.P. _____ LOCATION _____ Coords: E:303799 N:5033004.1 (MTM, ZONE 9) ORIGINATED BY DH
 DIST _____ HWY 17 BOREHOLE TYPE HOLLOW STEM AUGERS COMPILED BY SD
 DATUM GEODETIC DATE 2021-3-31 CHECKED BY RA

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | |
|----------------------|-------------------------------------------------------------------------------------------|------------|---------|------|---------------|----------------------------|--------------------------------------------------------------|---------------------------------------------|--|---------------------------------------------------------|--|--------------|-----------------------------------------------------|---------------------------------------------------|-----------------------------------|--|--|
| ELEV DEPTH (m) | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | SPT 'N' VALUE | | | SHEAR STRENGTH (kPa) | | | | | | | WATER CONTENT (%) | | |
| | | | | | | | | 20 40 60 80 100 | | | | | | | W _p W W _L | | |
| | | | | | | | ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE | | | | | | | | | | |
| | | | | | | | 20 40 60 80 100 | | | | | 10 20 30 | | | | | |
| 132.7 | GROUND SURFACE | | | | | | | | | | | | | | GR SA SI CL | | |
| 132.5 | 180mm TOPSOIL | | 1 | SS | 3 | | | | | | | | | | | | |
| 0.2 | | | | | | | | | | | | | | | | | |
| 132.2 | FILL, sand and gravel, trace to some silt, trace organics, very loose, brown, moist | | 2 | SS | 5 | | | | | | | | | | 2 56 22 20 | | |
| 0.5 | | | | | | | | | | | | | | | | | |
| | FILL, silty sand, some clay to clayey, trace gravel, loose, brown, wet | | | | | | | | | | | | | | | | |
| 131.3 | | | 3 | SS | 11 | | | | | | | | | | | | |
| 1.4 | SILTY CLAY to CLAY, trace to some sand, trace gravel, stiff, brown, wet (WEATHERED CRUST) | | | | | | | | | | | | | | | | |
| | | | 4 | SS | 8 | | | | | | | | | | | | |
| 129.8 | | | | | | | | | | | | | | | | | |
| 2.9 | SILTY CLAY to CLAY, trace sand, trace gravel, soft to stiff, grey, wet | | 5 | SS | 6 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 6 | TW | PH | | | | | | | | | | 0 4 34 62 | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 7 | TW | PH | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 8 | SS | 4 | | | | | | | | | | | | |
| 124.6 | | | | | | | | | | | | | | | | | |
| 8.1 | | | | | | | | | | | | | | | | | |

END OF BOREHOLE

Unstabilized water level measured at 6.1 m below ground surface upon completion of drilling.

Piezometer installation consists of a 50 mm diameter PVC pipe with a 1.5m slotted screen.

WATER LEVEL READINGS

| Date | Water Depth (m) | Elevation (m) |
|--------------|-----------------|---------------|
| Jun 17, 2021 | 1.0 | 131.7 |
| Mar 25, 2022 | 0.2 | 132.5 |

RECORD OF BOREHOLE No 3N-1

1 of 1

METRIC

G.W.P. _____ LOCATION _____ Coords: E:304012.6 N:5033282.9 (MTM, ZONE 9) ORIGINATED BY DH
 DIST _____ HWY 17 BOREHOLE TYPE SOLID STEM AUGERS COMPILED BY SD
 DATUM GEODETIC DATE 2021-4-5 CHECKED BY RA

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|---------|------|---------------|----------------------------|-----------------|---------------------------------------------|----|---------------------------------------------------------|----|-----|-------------------------------------------------|---------------------------------------------------|-------------------|--|-------------------|
| ELEV DEPTH (m) | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | SPT 'N' VALUE | | | SHEAR STRENGTH (kPa) | | | | | | | WATER CONTENT (%) | | |
| | | | | | | | | | | | | | | | | | |
| 131.3 | GROUND SURFACE | | | | | | | 20 | 40 | 60 | 80 | 100 | w _p | w | w _L | | GR SA SI CL |
| | 450mm TOPSOIL | | 1 | SS | 2 | | 131 | | | | | | | | | | |
| 130.8 | FILL, silty clay, some sand to sandy, trace to some gravel, some organics, soft, brown, wet SILTY CLAY to CLAY, trace sand, trace gravel, stiff to very stiff, brown, wet (WEATHERED CRUST) | | 2 | SS | 17 | | 130 | | | | | | | | | | |
| 0.5 | | | | | | | 129 | | | | | | | | | | |
| 130.6 | | | 3 | SS | 19 | | 128 | | | | | | | | | | |
| 0.7 | | | 4 | SS | 15 | | 127 | | | | | | | | | | |
| | | | 5 | SS | 9 | | 126 | | | | | | | | | | |
| 127.6 | SILTY CLAY to CLAY, trace sand, trace gravel, soft to very stiff, grey, wet | | | | | | 125 | | | | | | | | | | |
| 3.7 | | | 6 | SS | 8 | | 124 | | | | | | | | | | |
| | | | | | | | 123 | | | | | | | | | | |
| | | | 7 | SS | 3 | | 122 | | | | | | | | | | |
| 123.2 | Dynamic Cone Penetration Test (DCPT) performed from 8.1m to 12.2m. | | 8 | SS | 4 | | 121 | | | | | | | | | | |
| 8.1 | | | | | | | 120 | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 119.1 | | | | | | | | | | | | | | | | | |
| 12.2 | | | | | | | | | | | | | | | | | |

END OF BOREHOLE

Unstabilized water level measured at
7.8 m below ground surface; borehole
was open upon completion of drilling.

file: 1-21-0044 bh logs.gpj

RECORD OF BOREHOLE No 3N/4N-2

1 of 1

METRIC

G.W.P. _____ LOCATION _____ Coords: E:304040.9 N:5033296.7 (MTM, ZONE 9) ORIGINATED BY DH
 DIST _____ HWY 17 BOREHOLE TYPE HOLLOW STEM AUGERS COMPILED BY SD
 DATUM GEODETIC DATE 2021-3-19 CHECKED BY RA

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | |
|----------------------|-------------------------------------------------------------------------------------------------|------------|---------|------|---------------|----------------------------|-----------------|---------------------------------------------|--|--|--|--|----------------------------------------|-----------------------------------------|---------------------------------------|-------------------------|---------------------------------------------------|-------------------|--|--|
| ELEV DEPTH (m) | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | SPT 'N' VALUE | | | SHEAR STRENGTH (kPa) | | | | | | | | | | WATER CONTENT (%) | | |
| | | | | | | | | 20 40 60 80 100 | | | | | | | | | | 10 20 30 | | |
| | | | | | | | | | | | | | | | | | | | | |
| 131.2 | GROUND SURFACE | | | | | | | | | | | | | | | | | | | |
| 131.0 | 150mm TOPSOIL | | 1 | SS | 2 | | 131 | | | | | | | | 70 | | | | | |
| 0.2 | FILL, silty clay, some sand, some organics, soft, brown, wet | | | | | | | | | | | | | | | | | | | |
| 130.5 | | | 2 | SS | 11 | | 130 | | | | | | | | LL=56 | | 0 14 37 49 | | | |
| 0.7 | SILTY CLAY to CLAY, trace sand, trace gravel, stiff to very stiff, brown, wet (WEATHERED CRUST) | | | | | | | | | | | | | | 61 | | | | | |
| | | | 3 | SS | 16 | | | | | | | | | | | | | | | |
| | | | 4 | SS | 13 | | 129 | | | | | | | | LL=55 | | 0 4 37 59 | | | |
| | | | 5 | SS | 11 | | 128 | | | | | | | | | | | | | |
| 127.5 | | | 6 | SS | 5 | | 127 | | | | | | | | | | | | | |
| 3.7 | SILTY CLAY to CLAY, trace sand, trace gravel, soft to very stiff, grey, wet | | 7 | SS | 3 | | 126 | | | | | | | | LL=51 | | 0 0 35 65 | | | |
| | | | 8 | SS | 2 | | 125 | | | | | | | | 50 | | | | | |
| | | | 9 | TW | PH | | 124 | | | | | | | | | | | | | |
| 123.0 | | | | | | | 123 | | | | | | | | | | | | | |
| 8.2 | | | | | | | | | | | | | | | | | | | | |

END OF BOREHOLE

Piezometer installation consists of a 50 mm diameter PVC pipe with a 1.5m long slotted screen.

WATER LEVEL READINGS

| Date | Water Depth (m) | Elevation (m) |
|--------------|-----------------|---------------|
| Jun 17, 2021 | 1.1 | 130.1 |
| Mar 1, 2022 | 1.3 | 129.9 |

RECORD OF BOREHOLE No 4N-1

1 of 1

METRIC

G.W.P. _____ LOCATION _____ Coords: E:304070.4 N:5033290.8 (MTM, ZONE 9) ORIGINATED BY DH
 DIST _____ HWY 17 _____ BOREHOLE TYPE SOLID STEM AUGERS COMPILED BY SD
 DATUM GEODETIC DATE 2021-3-18 CHECKED BY RA

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | |
|----------------------|--------------------------------------------------------------------------------------------------------------|------------|---------|------|---------------|----------------------------|--------------------|---------------------------------------------------------------------------------|--|---------------------------------------------------------|--|--------------|---------------------------------------------------------|---------------------------------------------------|-------------------|--|--|
| ELEV DEPTH (m) | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | SPT 'N' VALUE | | | SHEAR STRENGTH (kPa) | | | | | | | WATER CONTENT (%) | | |
| | | | | | | | | | | | | | | | w_p w w_L | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | 20 40 60 80 100 | | | | | | | | | |
| | | | | | | | | ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE ● QUICK TRIAXIAL × LAB VANE | | | | | | | | | |
| | | | | | | | | 20 40 60 80 100 | | | | | | | | | |
| 131.2 | GROUND SURFACE | | | | | | | | | | | | | | | | |
| 130.5 | 140mm TOPSOIL | | 1 | SS | 4 | | 131 | | | | | | | | | | |
| 0.7 | FILL, silty clay, trace to some sand, trace gravel, trace to some organics, soft to firm, brown, moist | | 2 | SS | 15 | | 130 | | | | | ○ | | | | | |
| | SILTY CLAY to CLAY, some sand, trace gravel, stiff to very stiff, brown, wet (WEATHERED CRUST) | | 3 | SS | 12 | | 129 | | | | | I ○ LL=54 | 0 2 37 61 | | | | |
| | | | 4 | SS | 9 | | 128 | | | | | ○ | | | | | |
| 128.3 | | | 5 | SS | 5 | | 127 | | | | | | | | | | |
| 2.9 | SILTY CLAY to CLAY, trace sand, trace gravel, soft to very stiff, grey, wet | | 6 | TW | PH | | 126 | | | | | | | | | | |
| | | | 7 | SS | 3 | | 125 | | | | | I ○ LL=48 | 0 0 42 58 | | | | |
| | | | 8 | SS | 2 | | 124 | | | | | 49 ○ | | | | | |
| 123.1 | | | | | | | | | | | | | | | | | |
| 8.1 | | | | | | | | | | | | | | | | | |

END OF BOREHOLE

Unstabilized water level measured at
7.0 m below ground surface; borehole
was open upon completion of drilling.

RECORD OF BOREHOLE No 5N-1

1 of 1

METRIC

G.W.P. _____ LOCATION _____ Coords: E:304349.5 N:5033319.3 (MTM, ZONE 9) ORIGINATED BY DH
 DIST _____ HWY 17 BOREHOLE TYPE HOLLOW STEM AUGERS COMPILED BY SD
 DATUM GEODETIC DATE 2021-3-17 CHECKED BY RA

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | |
|----------------------|-------------------------------------------------------------------------------------------------|------------|---------|------|---------------|----------------------------|-----------------|---------------------------------------------|----|---------------------------------------------------------------|-----|--------------------------------------|---------------------------------------------------|--------------------------------------|--|--|
| ELEV DEPTH (m) | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | SPT 'N' VALUE | | | SHEAR STRENGTH (kPa) | | | | | | WATER CONTENT (%) | | |
| | | | | | | | | | | | | | | w _p w w _L | | |
| 130.3 | GROUND SURFACE | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 130.1 0.2 | 165mm TOPSOIL | | 1 | SS | 15 | | | | | | | | 4 69 20 7 | | | |
| 129.6 0.7 | FILL, sand, some silt to silty, some organics, trace gravel, trace clay, compact, brown, wet | | 2 | SS | 19 | | | | | | | | | | | |
| | SILTY CLAY to CLAY, trace sand, trace gravel, stiff to very stiff, brown, wet (WEATHERED CRUST) | | 3 | SS | 16 | | | | | | | | | | | |
| | | | 4 | SS | 15 | | | | | | | | | | | |
| | | | 5 | SS | 12 | | | | | | | | | | | |
| 126.6 3.7 | SILTY CLAY to CLAY, trace sand, trace gravel, soft to very stiff, grey, wet | | 6 | SS | 4 | | | | | | | | 0 1 36 63 | | | |
| | | | 7 | TW | PH | | | | | | | | | | | |
| | | | 8 | SS | 2 | | | | | | | | 0 1 42 57 | | | |
| | | | | | | | | | | | | | | | | |
| 122.1 | | | 9 | TW | PH | | | | | | | | | | | |

END OF BOREHOLE

Piezometer installation consists of a 50 mm diameter PVC pipe with a 1.5m long slotted screen.

WATER LEVEL READINGS

| Date | Water Depth (m) | Elevation (m) |
|--------------|----------------------------|---------------|
| Jun 17, 2021 | 0.9 | 129.4 |
| Mar 1, 2022 | damaged/ not accessible | n/a |

RECORD OF BOREHOLE No 5N-2

1 of 1

METRIC

G.W.P. _____ LOCATION _____ Coords: E:304361.9 N:5033343 (MTM, ZONE 9) ORIGINATED BY DH
 DIST _____ HWY 17 BOREHOLE TYPE SOLID STEM AUGERS COMPILED BY SD
 DATUM GEODETIC DATE 2021-3-30 CHECKED BY RA

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT w _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | |
|----------------------|-----------------------------------------------------------------------------------|------------|---------|------|---------------|----------------------------|-----------------|---------------------------------------------|--|--|--|--|----------------------------------------|-----------------------------------------|---------------------------------------|-------------------------|---------------------------------------------------|----------------------------|--|--|
| ELEV DEPTH (m) | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | SPT 'N' VALUE | | | SHEAR STRENGTH (kPa) | | | | | | | | | | WATER CONTENT (%) | | |
| | | | | | | | | 20 40 60 80 100 | | | | | | | | | | 10 20 30 | | |
| | | | | | | | | ○ UNCONFINED ● QUICK TRIAXIAL | | | | | | | | | | + FIELD VANE × LAB VANE | | |
| 131.3 | GROUND SURFACE | | | | | | | | | | | | | | | | GR SA SI CL | | | |
| 130.7 | 595mm FILL, sand and gravel, trace silt, compact, brown, dry to moist | | 1 | SS | 27 | ▽ | 131 | | | | | | | | | | 43 49 (8) | | | |
| 0.6 | FILL, sand, some silt to silty, trace to some gravel, compact, brown, wet | | 2 | SS | 21 | | | | | | | | | | | | 12 75 11 2 | | | |
| | | | 3 | SS | 14 | | 130 | | | | | | | | | | | | | |
| 129.2 | SILTY CLAY to CLAY, trace sand, trace gravel, stiff, brown, wet (WEATHERED CRUST) | | 4 | SS | 13 | | 129 | | | | | | | | | | | | | |
| 2.1 | | | 5 | SS | 12 | | 128 | | | | | | | | | | | | | |
| 127.6 | SILTY CLAY to CLAY, trace sand, trace gravel, soft to very stiff, grey, wet | | 6 | SS | 7 | | 127 | | | | | | | | | | | | | |
| 3.7 | | | 7 | TW | PH | | | | | | | | | | | | | | | |
| | | | 8 | SS | 5 | | 126 | | | | | | | | | | | | | |
| | | | 9 | SS | 3 | | 125 | | | | | | | | | | | | | |
| 123.2 | | | | | | | 124 | | | | | | | | | | 0 7 35 58 | | | |
| 8.1 | | | | | | | | | | | | | | | | | | | | |

END OF BOREHOLE

Unstabilized water level measured at 1.5 m below ground surface upon completion of drilling.

RECORD OF BOREHOLE No 5N-3

1 of 1

METRIC

G.W.P. _____ LOCATION _____ Coords: E:304345.9 N:5033350.9 (MTM, ZONE 9) ORIGINATED BY JM
 DIST _____ HWY 17 BOREHOLE TYPE SOLID STEM AUGERS COMPILED BY SD
 DATUM GEODETIC DATE 2021-4-6 CHECKED BY RA

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | | |
|----------------------|-----------------------------------------------------------------------------------------|------------|---------|------|---------------|----------------------------|-----------------|---------------------------------------------|----|----|---------------------------------------------------------|-----|------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------|--|--|--|--|
| ELEV DEPTH (m) | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | SPT 'N' VALUE | | | SHEAR STRENGTH (kPa) | | | | | WATER CONTENT (%) | | | | | | |
| | | | | | | | | | | | | | W _p W W _L | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| 130.8 | GROUND SURFACE | | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | | | |
| 130.4 | 355mm TOPSOIL | | 1 | SS | 4 | | 130 | | | | | | | | | | | | |
| 129.4 | FILL, sand, some silt to silty, trace to some gravel, very loose to compact, brown, wet | | 2 | SS | 13 | | | | | | | | | | | | | | |
| 129.4 | SILTY CLAY to CLAY, trace sand, trace gravel, stiff, brown, wet (WEATHERED CRUST) | | 3 | SS | 11 | | 129 | | | | | | | | | | | | |
| | | | 4 | SS | 13 | | 128 | | | | | | | | | | | | |
| | | | 5 | SS | 12 | | | | | | | | | | | | | | |
| 127.1 | SILTY CLAY to CLAY, trace sand, trace gravel, soft to very stiff, grey, wet | | 6 | SS | 7 | | 127 | | | | | | | | | | | | |
| | | | 7 | SS | 5 | | 126 | | | | | | | | | | | | |
| | | | 8 | SS | 5 | | 125 | | | | | | | | | | | | |
| | | | 9 | SS | 4 | | 124 | | | | | | | | | | | | |
| 122.7 | | | | | | | 123 | | | | | | | | | | | | |
| 8.1 | | | | | | | | | | | | | | | | | | | |

END OF BOREHOLE

RECORD OF BOREHOLE No C9/7N-1

1 of 1

METRIC

G.W.P. _____ LOCATION _____ Coords: E:304551 N:5033301.8 (MTM, ZONE 9) ORIGINATED BY JM
 DIST _____ HWY 17 BOREHOLE TYPE HOLLOW STEM AUGERS COMPILED BY SD
 DATUM GEODETIC DATE 2021-4-6 CHECKED BY RA

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|----------------------|-------------------------------------------------------------------------------------------|------------|---------|------|---------------|----------------------------|-----------------|---------------------------------------------|----|----|----|-----|---------------------------------------------------------|---|-------|---------------------------------------------------------|---------------------------------------------------|
| ELEV DEPTH (m) | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | SPT 'N' VALUE | | | SHEAR STRENGTH (kPa) | | | | | WATER CONTENT (%) | | | | |
| | | | | | | | | 20 | 40 | 60 | 80 | 100 | w_p | w | w_L | | |
| | | | | | | | | | | | | | | | | | |
| 130.6 | GROUND SURFACE | | | | | | | | | | | | | | | | |
| 130.0 | 600mm FILL, gravelly sand, trace to some silt, compact, brown, moist | | 1 | SS | 15 | | | | | | | | | | | | |
| 0.6 | FILL, silty sand, some gravel to gravelly, trace clay, compact, brown, moist to wet | | 2 | SS | 19 | | | | | | | | | | | | |
| 128.7 | | | 3 | SS | 13 | | | | | | | | | | | | |
| 1.9 | SILTY CLAY to CLAY, trace sand, trace gravel, soft to stiff, brown, wet (WEATHERED CRUST) | | 4 | SS | 13 | | | | | | | | | | | | |
| | | | 5 | SS | 8 | | | | | | | | | | | | |
| 126.9 | | | | | | | | | | | | | | | | | |
| 3.7 | SILTY CLAY to CLAY, trace sand, trace gravel, soft to very stiff, grey, wet | | 6 | SS | 5 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 7 | SS | 3 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 122.5 | | | 8 | SS | 2 | | | | | | | | | | | | |
| 8.1 | | | | | | | | | | | | | | | | | |

END OF BOREHOLE

Unstabilized water level measured at 6.7 m below ground surface completion of drilling.

Piezometer installation consists of a 50 mm diameter PVC pipe with a 1.5m slotted screen.

WATER LEVEL READINGS

| Date | Water Depth (m) | Elevation (m) |
|--------------|----------------------------|---------------|
| Jun 17, 2021 | 2.7 | 127.9 |
| Mar 1, 2022 | damaged/ not accessible | n/a |

RECORD OF BOREHOLE No 7N-2

1 of 1

METRIC

G.W.P. _____ LOCATION _____ Coords: E:304607.6 N:5033369.9 (MTM, ZONE 9) ORIGINATED BY JM
 DIST _____ HWY 17 BOREHOLE TYPE SOLID STEM AUGERS COMPILED BY SD
 DATUM GEODETIC DATE 2021-4-5 CHECKED BY RA

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | |
|----------------------|----------------------------------------------------------------------------------------------------------|------------|---------|------|---------------|----------------------------|--------------------|---------------------------------------------|----|----|---------------------------------------------------------------------------|-----|--------------------------------------|---------------------------------------------------------|---------------------------------------------------|--|--|--|
| ELEV DEPTH (m) | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | SPT 'N' VALUE | | | SHEAR STRENGTH (kPa) | | | | | WATER CONTENT (%) | | | | | |
| | | | | | | | | | | | | | w _p w w _L | | | | | |
| | | | | | | | | | | | | | | | | | | |
| 128.9 | GROUND SURFACE | | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | | |
| | 450mm TOPSOIL | | 1 | SS | 13 | | | | | | | | | | | | | |
| 128.4 | SILTY CLAY to CLAY, trace to some sand, trace gravel, some organics, stiff, brown, wet (WEATHERED CRUST) | | | | | | 128 | | | | | | | | | | | |
| 0.5 | | | 2 | SS | 13 | | | | | | | | | | | | | |
| | | | 3 | SS | 10 | | | | | | | | | | | | | |
| 126.8 | SILTY CLAY to CLAY, trace sand, trace gravel, soft to very stiff, grey, wet | | | | | | 127 | | | | | | | | | | | |
| 2.1 | | | 4 | SS | 6 | | | | | | | | | | | | | |
| | | | 5 | SS | 4 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | 6 | SS | 3 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | 7 | SS | 1 | | | | | | | | | | | | | |
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| | | | 8 | SS | 4 | | | | | | | | | | | | | |
| 120.8 | | | | | | | | | | | | | | | | | | |
| 8.1 | | | | | | | | | | | | | | | | | | |

DYNAMIC CONE PENETRATION RESISTANCE PLOT

20 40 60 80 100

SHEAR STRENGTH (kPa)

○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL X LAB VANE

20 40 60 80 100

PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT

w_p w w_L

WATER CONTENT (%)

10 20 30

UNIT WEIGHT

γ

kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

| | | | | | | | | | | | | | | | | | | |
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END OF BOREHOLE

Unstabilized water level measured at 7.0 m below ground surface completion of drilling.

RECORD OF BOREHOLE No C9-2

1 of 1

METRIC

G.W.P. _____ LOCATION _____ Coords: E:304516.3 N:5033291 (MTM, ZONE 9) ORIGINATED BY DH
 DIST _____ HWY 17 BOREHOLE TYPE HOLLOW STEM AUGERS COMPILED BY SD
 DATUM GEODETIC DATE 2021-3-18 CHECKED BY RA

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|----------------------|-----------------------------------------------------------------------------------------------------------------|------------|---------|------|---------------|----------------------------|-----------------|---------------------------------------------|----|----|----|-----|---------------------------------------------------------|---|----------------|---------------------------------------------------------|---------------------------------------------------|
| ELEV DEPTH (m) | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | SPT 'N' VALUE | | | SHEAR STRENGTH (kPa) | | | | | WATER CONTENT (%) | | | | |
| | | | | | | | | 20 | 40 | 60 | 80 | 100 | w _p | w | w _L | | |
| | | | | | | | | | | | | | | | | | |
| 130.5 | GROUND SURFACE | | | | | | | | | | | | | | | GR SA SI CL | |
| 129.9 | 560mm FILL, gravelly sand, some silt, trace clay, very dense, brown, dry | | 1 | SS | 51 | | | | | | | | | | | 31 55 12 2 | |
| 0.6 | FILL, sand, some silt, some silt to silty, trace gravel, trace clay, compact to very dense, brown, moist to wet | | 2 | SS | 52 | | | | | | | | | | | | |
| | | | 3 | SS | 29 | | | | | | | | | | | 6 82 10 2 | |
| 128.4 | FILL, silty clay, trace to some sand, trace gravel, stiff, grey, moist to wet | | 4 | SS | 11 | | | | | | | | | | | | |
| 2.1 | | | | | | | | | | | | | | | | | |
| 127.6 | SILTY CLAY to CLAY, trace sand, trace gravel, firm to stiff, brown, wet (WEATHERED CRUST) | | 5 | SS | 12 | | | | | | | | | | | 0 2 35 63 | |
| 2.9 | | | 6 | SS | 8 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 126.1 | SILTY CLAY to CLAY, trace sand, trace gravel, soft to very stiff, grey, wet | | 7 | SS | 5 | | | | | | | | | | | | |
| 4.4 | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 8 | SS | 3 | | | | | | | | | | | | |
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END OF BOREHOLE

Unstabilized water level measured at 7.3 m below ground surface; borehole was open upon completion of drilling.

RECORD OF BOREHOLE No C9-3

1 of 2

METRIC

G.W.P. _____ LOCATION _____ Coords: E:304490.8 N:5033291.4 (MTM, ZONE 9) ORIGINATED BY DH
DIST _____ HWY 17 BOREHOLE TYPE SOLID STEM AUGERS COMPILED BY SD
DATUM GEODETIC DATE 2021-3-17 CHECKED BY RA

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | | |
|----------------------|-----------------------------------------------------------------------------------------------------|------------|---------|------|---------------|----------------------------|-----------------|---------------------------------------------|----|----|----|-----|-------------------------------------------------|---------------------------------------------------|--|--|--|--|
| ELEV DEPTH (m) | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | SPT 'N' VALUE | | | SHEAR STRENGTH (kPa) | | | | | | | | | | |
| | | | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | | |
| 129.6 | GROUND SURFACE | | | | | | | | | | | | | | | | | |
| 129.4 0.2 | 165mm TOPSOIL | | 1 | SS | 4 | | 129 | | | | | | | | | | | |
| 128.9 0.7 | FILL, silty clay to clayey silt, sandy, trace gravel, some organics, soft to firm, brown, wet | | 2 | SS | 12 | | 128 | | | | | | | | | | | |
| 128.2 1.4 | FILL, silty sand, trace to some gravel, trace clay, compact, brown, wet | | 3 | SS | 10 | | 127 | | | | | | | | | | | |
| 127.5 2.1 | FILL, silty clay, trace sand, stiff, brown, wet | | 4 | SS | 7 | | 126 | | | | | | | | | | | |
| 126.7 2.9 | SILTY CLAY to CLAY, some sand, trace gravel, firm, brown, wet (WEATHERED CRUST) | | 5 | SS | 5 | | 125 | | | | | | | | | | | |
| | SILTY CLAY to CLAY, trace sand, trace gravel, soft to very stiff, grey, wet | | 6 | SS | 3 | | 124 | | | | | | | | | | | |
| | | | 7 | SS | 4 | | 123 | | | | | | | | | | | |
| | | | 8 | SS | 2 | | 122 | | | | | | | | | | | |
| 121.5 8.1 | Dynamic Cone Penetration Test (DCPT) performed from 8.1m to 19.8m. | | | | | | 121 | | | | | | | | | | | |
| | | | | | | | 120 | | | | | | | | | | | |
| | | | | | | | 119 | | | | | | | | | | | |
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| | | | | | | | 116 | | | | | | | | | | | |
| | | | | | | | 115 | | | | | | | | | | | |

Continued Next Page

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No C9-3

2 of 2

METRIC

G.W.P. _____ LOCATION _____ Coords: E:304490.8 N:5033291.4 (MTM, ZONE 9) ORIGINATED BY DH
 DIST _____ HWY 17 BOREHOLE TYPE SOLID STEM AUGERS COMPILED BY SD
 DATUM GEODETIC DATE 2021-3-17 CHECKED BY RA

| SOIL PROFILE | | SAMPLES | | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT w_p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | |
|----------------------|--------------------------------------------------------------------|------------|--------|------|---------------|----------------------------|--------------------|---------------------------------------------|----|----|----|-----|---------------------------|---------------------------------------|--------------------------|-----------------------------------------------------|---------------------------------------------------|-------------------|--|--|
| ELEV DEPTH (m) | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | SPT 'N' VALUE | | | SHEAR STRENGTH (kPa) | | | | | | | | | | WATER CONTENT (%) | | |
| | | | | | | | | | | | | | | | | | | | | |
| | (continued) | | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | | | | |
| | | | | | | | | ○ UNCONFINED | | | | | | | | | | | | |
| | | | | | | | | ● QUICK TRIAXIAL | | | | | | | | | | | | |
| | | | | | | | | + FIELD VANE | | | | | | | | | | | | |
| | | | | | | | | × LAB VANE | | | | | | | | | | | | |
| | | | | | | | | 20 | 40 | 60 | 80 | 100 | | 10 | 20 | 30 | | | | |
| 109.8 | Dynamic Cone Penetration Test (DCPT) performed from 8.1m to 19.8m. | | | | | | | | | | | | | | | | | | | |
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END OF BOREHOLE

Unstabilized water level measured at
1.5 m below ground surface upon
completion of drilling.

RECORD OF BOREHOLE No 8N-1

1 of 1

METRIC

G.W.P. _____ LOCATION _____ Coords: E:304764.3 N:5033666.5 (MTM, ZONE 9) ORIGINATED BY DH
 DIST _____ HWY 17 BOREHOLE TYPE SOLID STEM AUGERS COMPILED BY SD
 DATUM GEODETIC DATE 2021-3-29 CHECKED BY RA

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | | | | |
|----------------------|-------------------------------------------------------------------------------------------|------------|---------|------|---------------|----------------------------|--------------------|----------------------------------------------------------------------------------------------|--|--|--|--|-------------------------------------------------|---------------------------------------------------|--|--|--|--|--|--|
| ELEV DEPTH (m) | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | SPT 'N' VALUE | | | 20 40 60 80 100 | | | | | | | | | | | | |
| | | | | | | | | SHEAR STRENGTH (kPa) | | | | | | | | | | | | |
| | | | | | | | | ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE | | | | | | | | | | | | |
| 20 40 60 80 100 | | | | | | | | PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L | | | | | | | | | | | | |
| | | | | | | | | WATER CONTENT (%) | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| 130.3 | GROUND SURFACE | | | | | | | | | | | | | | | | | | | |
| 129.8 | 105mm ASPHALTIC CONCRETE | | 1 | SS | 53 | | 130 | | | | | | | | | | | | | |
| 0.5 | 375mm FILL, gravelly sand, trace to some silt, very dense, brown, moist | | 2 | SS | 71 | | | | | | | | | 0 90 8 2 | | | | | | |
| 128.9 | FILL, sand, trace to some silt, trace clay, very dense, brown, wet | | | | | | | | | | | | | | | | | | | |
| 1.4 | SILTY CLAY to CLAY, trace sand, trace gravel, firm to stiff, brown, wet (WEATHERED CRUST) | | 3 | SS | 12 | | 129 | | | | | | | | | | | | | |
| | | | 4 | SS | 7 | | 128 | | | | | | | | | | | | | |
| 127.4 | SILTY CLAY to CLAY, trace sand, trace gravel, very soft to stiff, grey, wet | | 5 | SS | 5 | | 127 | | | | | | | | | | | | | |
| 2.9 | | | 6 | SS | 4 | | 126 | | | | | | | | | | | | | |
| | | | 7 | SS | 2 | | | | | | | | | | | | | | | |
| | | | | | | | 125 | | | | | | | | | | | | | |
| | | | 8 | SS | 1 | | 124 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| 122.2 | | | 9 | SS | 2 | | 123 | | | | | | | | | | | | | |
| 8.1 | | | | | | | | | | | | | | 0 0 38 62 | | | | | | |

END OF BOREHOLE

Unstabilized water level measured at 2.1 m below ground surface borehole was open upon completion of drilling.

RECORD OF BOREHOLE No 8N-2

1 of 1

METRIC

G.W.P. _____ LOCATION _____ Coords: E:304758.4 N:5033683.1 (MTM, ZONE 9) ORIGINATED BY DH
 DIST _____ HWY 17 BOREHOLE TYPE HOLLOW STEM AUGERS COMPILED BY SD
 DATUM GEODETIC DATE 2021-4-1 CHECKED BY RA

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | |
|----------------------|-----------------------------------------------------------------------------------|------------|---------|------|---------------|----------------------------|-------------------------|---------------------------------------------|--|---------------------------------------------------------|--|-----------------------------------------------------|---------------------------------------------------|----------------------------------------------------------------------------------------------------|--|--|
| ELEV DEPTH (m) | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | SPT 'N' VALUE | | | SHEAR STRENGTH (kPa) | | | | | | WATER CONTENT (%) | | |
| | | | | | | | | | | | | | | W _p W W _L | | |
| | | | | | | | | | | | | | | O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE | | |
| | | | | | | | 20 40 60 80 100 | | | 10 20 30 | | | | | | |
| 129.6 | GROUND SURFACE | | | | | | | | | | | | | | | |
| 129.4 0.2 | 150mm TOPSOIL | | 1 | SS | 9 | | | | | | | | | | | |
| 128.9 0.7 | FILL, sand, some silt to silty, trace clay, trace organics, loose, brown, wet | | 2 | SS | 14 | | | | | | | | | | | |
| | SILTY CLAY to CLAY, trace sand, trace gravel, stiff, brown, wet (WEATHERED CRUST) | | 3 | SS | 11 | | | | | | | | | | | |
| 127.5 2.1 | SILTY CLAY to CLAY, trace sand, trace gravel, very soft to very stiff, grey, wet | | 4 | SS | 6 | | | | | | | | | | | |
| | | | 5 | SS | 3 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | 6 | SS | 1 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | 7 | SS | 1 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
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| 121.5 8.1 | | | 8 | SS | 0* | | | | | | | | | | | |

END OF BOREHOLE

*Sampler sinking under weight of hammer and/or rods.

Piezometer installation consists of a 50 mm diameter PVC pipe with a 1.5m long slotted screen.

WATER LEVEL READINGS

| Date | Water Depth (m) | Elevation (m) |
|--------------|----------------------------|---------------|
| Jun 17, 2021 | 1.5 | 128.1 |
| Mar 1, 2022 | damaged/ not accessible | n/a |

RECORD OF BOREHOLE No 9N-1

1 of 1

METRIC

G.W.P. _____ LOCATION _____ Coords: E:304726.3 N:5033377.6 (MTM, ZONE 9) ORIGINATED BY DH
 DIST _____ HWY 17 BOREHOLE TYPE HOLLOW STEM AUGERS COMPILED BY SD
 DATUM GEODETIC DATE 2022-3-1 CHECKED BY RA

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT | NATURAL MOISTURE CONTENT | LIQUID LIMIT | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|----------------------|------------------------------------------------------------------------------------------------------------------------|------------|--------|------|----------------------------|-----------------|---------------------------------------------|-----------------|------------------|--------------------------------|-----------------|----------------------------|---------------------------------------------------|
| ELEV DEPTH (m) | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | SPT 'N' VALUE | | 20 40 60 80 100 | 20 40 60 80 100 | W _p | W | W _L | | |
| 128.0 | GROUND SURFACE | | | | | | | | | | | | |
| | 125mm ICE | | | | | | | | | | | | |
| | SILTY CLAY to CLAY, trace sand to sandy, trace gravel, some organic to 1.4m, soft to firm, grey, wet (WEATHERED CRUST) | | 1 | SS | 3 | | | | | | | 76 | |
| | | | 2 | SS | 6 | | | | | | | LL=46 | 0 29 35 36 |
| | | | 3 | SS | 5 | | | | | | | | |
| 125.7 | | | 4 | SS | 6 | | | | | | | 48 | 0 0 31 69 |
| 2.3 | SILTY CLAY to CLAY, trace sand, soft to stiff, grey, wet | | 5 | SS | 3 | | | | | | | LL=54 | |
| | | | 6 | SS | 2 | | | | | | | 62 | sampler wet at 4.7m |
| | | | 7 | SS | 3 | | | | | | | | |
| | | | 8 | SS | 2 | | | | | | | 57 | |
| 119.8 | | | | | | | | | | | | | |
| 8.2 | | | | | | | | | | | | | |

END OF BOREHOLE

Piezometer installation consists of a 50 mm diameter PVC pipe with a 1.5m long slotted screen.

WATER LEVEL READINGS

| Date | Water Depth (m) | Elevation (m) |
|--------------|-----------------|---------------|
| Mar 25, 2022 | 0.0 | 128.0 |
| Apr 13, 2022 | -0.1 (ag)* | 128.1 |
| Apr 27, 2022 | -0.1 (ag)* | 128.1 |

RECORD OF BOREHOLE No 9N-2

1 of 1

METRIC

G.W.P. _____ LOCATION _____ Coords: E:304743.3 N:5033373 (MTM, ZONE 9) ORIGINATED BY DH
 DIST _____ HWY 17 BOREHOLE TYPE HOLLOW STEM AUGERS COMPILED BY SD
 DATUM GEODETIC DATE 2022-3-1 CHECKED BY RA

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | PLASTIC LIMIT w _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | |
|----------------------|-------------|------------|---------|------|---------------|----------------------------|-----------------|---------------------------------------------|----|----|----|----------------------------------------|-----------------------------------------|---------------------------------------|-------------------------|---------------------------------------------------|-------------------|
| ELEV DEPTH (m) | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | SPT 'N' VALUE | | | SHEAR STRENGTH (kPa) | | | | | | | | | WATER CONTENT (%) |
| | | | | | | | | 20 | 40 | 60 | 80 | | | | | | |

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|--------------|----------------------------------------------------------------------------------------------------------|--|---|----|------------|--|--|--|--|--|--|--|--|--|--|-------------|--|
| 127.2 | GROUND SURFACE | | 1 | SS | 50 / 125mm | | | | | | | | | | | GR SA SI CL | |
| 125.1 2.1 | 50mm DECAYED WOOD | | 2 | SS | 9 | | | | | | | | | | | 0 6 29 65 | |
| | SILTY CLAY to CLAY, trace to some sand, trace gravel, trace organics, stiff, grey, wet (WEATHERED CRUST) | | 3 | SS | 10 | | | | | | | | | | | | |
| | | | 4 | SS | 6 | | | | | | | | | | | | |
| | | | 5 | SS | 2 | | | | | | | | | | | | |
| | | | 6 | SS | 3 | | | | | | | | | | | | |
| | | | 7 | TW | PH | | | | | | | | | | | | |
| | | | 8 | SS | 3 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 119.1 8.1 | | | | | | | | | | | | | | | | 0 0 31 69 | |

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END OF BOREHOLE

Unstabilized water level measured at 3.7 m below ground surface; borehole was open upon completion of drilling.

RECORD OF BOREHOLE No 10N-1

1 of 1

METRIC

G.W.P. _____ LOCATION _____ Coords: E:304825.2 N:5033376.3 (MTM, ZONE 9) ORIGINATED BY DH
 DIST _____ HWY 17 BOREHOLE TYPE HOLLOW STEM AUGERS COMPILED BY SD
 DATUM GEODETIC DATE 2022-2-28 CHECKED BY RA

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | |
|----------------------|--------------------------------------------------------------------------------------------------|------------|---------|------|---------------|----------------------------|-------------------------|----------------------------------------------------------------------------------------------------|--|---------------------------------------------------------|--------------|----|---------------------------------------------------------|---------------------------------------------------|---------------------------------------------------------------------------|--|--|
| ELEV DEPTH (m) | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | SPT 'N' VALUE | | | SHEAR STRENGTH (kPa) | | | | | | | W _p W W _L WATER CONTENT (%) | | |
| | | | | | | | | ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE | | | | | | | | | |
| | | | | | | | 20 40 60 80 100 | | | | 10 20 30 | | GR SA SI CL | | | | |
| 127.9 | GROUND SURFACE | | | | | | | | | | | | | | | | |
| 127.6 | 300mm ICE | | | | | | | | | | | | | | | | |
| 0.3 | SILTY CLAY to CLAY, trace to some sand, trace gravel, soft to stiff, grey, wet (WEATHERED CRUST) | | 1 | SS | 8 | | | | | | | 64 | 0 1 29 70 | | | | |
| | | | 2 | SS | 6 | | | | | | | 48 | | | | | |
| | | | | | | | | | | | LL=62 | | | | | | |
| | | | 3 | SS | 4 | | | | | | | | | | | | |
| 125.4 | SILTY CLAY to CLAY, trace sand, soft to stiff, grey, wet | | 4 | SS | 2 | | | | | | | | 0 0 34 66 | | | | |
| | | | 5 | SS | 3 | | | | | | | 58 | | | | | |
| | | | | | | | | | | | | | | | | | |
| 2.5 | | | 6 | SS | 3 | | | | | | | | | | | | |
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| | | | 7 | SS | 2 | | | | | | | | 55 | | | | |
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RECORD OF BOREHOLE No 10N-2

1 of 1

METRIC

G.W.P. _____ LOCATION _____ Coords: E:304842.7 N:5033392.2 (MTM, ZONE 9) ORIGINATED BY DH
 DIST _____ HWY 17 BOREHOLE TYPE HOLLOW STEM AUGERS COMPILED BY SD
 DATUM GEODETIC DATE 2022-2-28 CHECKED BY RA

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | PLASTIC LIMIT | NATURAL MOISTURE CONTENT | LIQUID LIMIT | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | | |
|----------------------|--------------------------------------------------------------------------------------------------|------------|---------|------|---------------|----------------------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--------------------------------|-----------------|---------------------------------------------------------|---------------------------------------------------|-------------------|---|----------------|--|
| ELEV DEPTH (m) | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | SPT 'N' VALUE | | | SHEAR STRENGTH (kPa) | | | | | | WATER CONTENT (%) | | | |
| | | | | | | | | 20 40 60 80 100 | | | | | | W _P | W | W _L | |
| | | | | | | | | <div><div></div><div></div><div></div><div></div><div></div></div> <div>○ UNCONFINED ● QUICK TRIAXIAL</div> <div><div></div><div></div><div></div><div></div><div></div></div> <div>+ FIELD VANE X LAB VANE</div> | | | | | | | | | |
| 128.1 | GROUND SURFACE | | | | | | | | | | | | | | | | |
| | 760mm ICE | | | | | | | | | | | | | | | | |
| 127.3 | SILTY CLAY to CLAY, trace to some sand, trace gravel, soft to stiff, grey, wet (WEATHERED CRUST) | | | | | | | | | | | | 0 0 29 71 | | | | |
| 0.8 | | | 1 | SS | 6 | | | | | | | | | | | | |
| | | | 2 | SS | 10 | | | | | | | | | | | | |
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| 125.2 | SILTY CLAY to CLAY, trace sand, soft to stiff, grey, wet | | | | | | | | | | | | 0 0 39 61 | | | | |
| 2.9 | | | 4 | SS | 5 | | | | | | | | | | | | |
| | | | 5 | SS | 3 | | | | | | | | | | | | |
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END OF BOREHOLE

Piezometer installation consists of a 50 mm diameter PVC pipe with a 1.5m long slotted screen.

WATER LEVEL READINGS

| Date | Water Depth (m) | Elevation (m) |
|--------------|-----------------|---------------|
| Mar 25, 2022 | 0.5 | 127.6 |
| Apr 13, 2022 | 0.4 | 127.7 |
| Apr 27, 2022 | 0.4 | 127.7 |

RECORD OF BOREHOLE No 11N-1

1 of 1

METRIC

G.W.P. _____ LOCATION _____ Coords: E:304415.8 N:5033243.8 (MTM, ZONE 9) ORIGINATED BY DH
 DIST _____ HWY 17 BOREHOLE TYPE HOLLOW STEM AUGERS COMPILED BY SD
 DATUM GEODETIC DATE 2021-3-16 CHECKED BY RA

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|----------------------|-------------------------------------------------------------------------------------------------|------------|---------|------|---------------|----------------------------|-----------------|---------------------------------------------|--|--|--|--|-----------------------------------------------------------------------------|--|----|-----------------------------------------------------|---------------------------------------------------|
| ELEV DEPTH (m) | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | SPT 'N' VALUE | | | 20 40 60 80 100 | | | | | W _p W W _L | | | | |
| | | | | | | | | SHEAR STRENGTH (kPa) | | | | | WATER CONTENT (%) | | | | |
| | | | | | | | | ○ UNCONFINED ● QUICK TRIAXIAL | | | | | + FIELD VANE X LAB VANE | | | | |
| 129.7 | GROUND SURFACE | | | | | | | | | | | | | | | | |
| 129.0 | DECAYED WOOD, trace to some organic silt | | 1 | SS | 5 | | | | | | | | | | 57 | | |
| 0.7 | SILTY CLAY to CLAY, trace sand, trace gravel, stiff to very stiff, brown, wet (WEATHERED CRUST) | | 2 | SS | 14 | | | | | | | | | | | | |
| | | 3 | SS | 17 | | | | | | | | | | | | | |
| | | 4 | SS | 12 | | | | | | | | | | | | | |
| | | 5 | SS | 5 | | | | | | | | | | | | | |
| 126.8 | SILTY CLAY to CLAY, trace sand, trace gravel, soft to very stiff, grey, wet | | 6 | TW | PH | | | | | | | | | | | | |
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| 121.6 | | | 8 | SS | 2 | | | | | | | | | | 47 | | |
| 8.1 | | | | | | | | | | | | | | | | | |

END OF BOREHOLE

Piezometer installation consists of a 50 mm diameter PVC pipe with a 1.5m long slotted screen.

WATER LEVEL READINGS

| Date | Water Depth (m) | Elevation (m) |
|--------------|-----------------|---------------|
| Jun 17, 2021 | 0.8 | 128.9 |
| Mar 1, 2022 | 0.4 | 129.3 |

RECORD OF BOREHOLE No 11N-2

1 of 1

METRIC

G.W.P. _____ LOCATION _____ Coords: E:304429.6 N:5033280.5 (MTM, ZONE 9) ORIGINATED BY DH
 DIST _____ HWY 17 BOREHOLE TYPE HOLLOW STEM AUGERS COMPILED BY SD
 DATUM GEODETIC DATE 2021-3-16 CHECKED BY RA

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | PLASTIC LIMIT w _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | | | |
|----------------------|------------------------------------------------------------------------------------------------------------|------------|---------|------|---------------|----------------------------|-----------------|---------------------------------------------|----|----|----------------------------------------|-----------------------------------------|---------------------------------------|-------------------------|---------------------------------------------------|-------------------|--|--|--|--|
| ELEV DEPTH (m) | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | SPT 'N' VALUE | | | SHEAR STRENGTH (kPa) | | | | | | | | WATER CONTENT (%) | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| 128.9 | GROUND SURFACE | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | | | | | |
| | DECAYED WOOD, trace to some organic silt | | 1 | SS | 4 | | | | | | | | | | | | | | | |
| 128.2 | SILTY CLAY to CLAY, trace sand to sandy, trace gravel, trace organics, stiff, brown, wet (WEATHERED CRUST) | | 2 | SS | 12 | | | | | | | | | | | | | | | |
| 0.7 | | | 3 | SS | 14 | | | | | | | | | | | | | | | |
| | | | 4 | SS | 10 | | | | | | | | | | | | | | | |
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| 126.0 | SILTY CLAY to CLAY, trace sand, trace gravel, soft to very stiff, grey, wet | | 5 | SS | 7 | | | | | | | | | | | | | | | |
| 2.9 | | | | | | | | | | | | | | | | | | | | |
| | | | 6 | SS | 3 | | | | | | | | | | | | | | | |
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END OF BOREHOLE

Unable to turn vane at 4.4m below ground surface.

APPENDIX A2

Record of Borehole Sheets

(Previous Investigations)



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 |
| FoS | factor of safety |

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 |
| ν | Poisson's ratio |
| σ | total stress |
| σ' | effective stress ($\sigma' = \sigma - u$) |
| σ'_{vo} | initial effective overburden stress |
| $\sigma_1, \sigma_2, \sigma_3$ | principal stress (major, 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 = $(w_l - w_p)$ |
| 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 | 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 |

* Density symbol is ρ . Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

Notes: 1
2

$\tau = c' + \sigma' \tan \phi'$
shear strength = (compressive strength)/2

LIST OF ABBREVIATIONS

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

I. SAMPLE TYPE

| | |
|----|---------------------|
| AS | Auger sample |
| BS | Block sample |
| CS | Chunk sample |
| DS | Denison type sample |
| FS | Foil sample |
| RC | Rock core |
| SC | Soil core |
| SS | Split-spoon |
| ST | Slotted tube |
| TO | Thin-walled, open |
| TP | Thin-walled, piston |
| WS | Wash sample |

II. 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.) drive open sampler for a distance of 300 mm (12 in.)

Dynamic Cone Penetration Resistance; N_d :

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

Piezo-Cone Penetration Test (CPT)

A electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm² pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

III. SOIL DESCRIPTION

(a) Non-Cohesive (Cohesionless) Soils

| Condition | N Blows/300 mm or Blows/ft |
|------------|-------------------------------|
| Very loose | 0 to 4 |
| Loose | 4 to 10 |
| Compact | 10 to 30 |
| Dense | 30 to 50 |
| Very dense | over 50 |

(b) Cohesive Soils

| Consistency | kPa | psf |
|-------------|------------|----------------|
| Very soft | 0 to 12 | 0 to 250 |
| Soft | 12 to 25 | 250 to 500 |
| Firm | 25 to 50 | 500 to 1,000 |
| Stiff | 100 to 200 | 1,000 to 2,000 |
| Very stiff | over 200 | over 4,000 |

IV. SOIL TESTS

| | |
|-----------------|-----------------------------------------------------------------------------------------------------|
| w | water content |
| w _p | plastic limit |
| 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, G_s) |
| DS | direct shear test |
| 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 | field vane (LV-laboratory vane test) |
| γ | unit weight |

Note: 1 Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

V. MINOR SOIL CONSTITUENTS

| Per cent by Weight | Modifier |
|--------------------|-------------|
| 0 to 10 | Trace |
| 10 to 20 | Some |
| 20 to 35 | (ey) or (y) |
| over 35 | And |

| Example |
|-----------------|
| Trace sand |
| Some sand |
| Sandy |
| Sand and Gravel |

LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERINGS STATE

Fresh: no visible sign of weathering

Faintly weathered: weathering limited to the surface of major discontinuities.

Slightly weathered: penetrative weathering developed on open discontinuity surfaces but only slight weathering of rock material.

Moderately weathered: weathering extends throughout the rock mass but the rock material is not friable.

Highly weathered: weathering extends throughout rock mass and the rock material is partly friable.

Completely weathered: rock is wholly decomposed and in a friable condition but the rock and structure are preserved.

BEDDING THICKNESS

| Description | Bedding Plane Spacing |
|---------------------|-----------------------|
| Very thickly 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 300 mm |
| 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.

CORE CONDITION

Total Core Recovery (TCR)

The percentage of solid drill core recovered regardless of quality or length, measured relative to the length of the total core run.

Solid Core Recovery (SCR)

The percentage of solid drill core, regardless of 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 100 mm length, as measured along the centerline axis of the core, relative to the length of the total core run. RQD varies from 0% for completely broken core to 100% for core in solid segments.

DISCONTINUITY DATA

Fracture Index

A count of the number of discontinuities (physical separations) in the rock core, including both naturally occurring fractures and mechanically induced breaks caused by drilling.

Dip with Respect to 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.

Description and Notes

An abbreviation description of the discontinuities, whether naturally occurring separations such as fractures, bedding planes and foliation planes or mechanically induced features caused by drilling such as ground or shattered core and mechanically separated bedding or foliation surfaces. Additional information concerning the nature of fracture surfaces and infillings are also noted.

Abbreviations

| | |
|---------------------|-------------------|
| JN Joint | PL Planar |
| FLT Fault | CU Curved |
| SH Shear | UN Undulating |
| VN Vein | IR Irregular |
| FR Fracture | K Slickensided |
| SY Stylolite | PO Polished |
| BD Bedding | SM Smooth |
| FO Foliation | SR Slightly Rough |
| CO Contact | RO Rough |
| AXJ Axial Joint | VR Very Rough |
| KV Karstic Void | |
| MB Mechanical Break | |

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTO\HWY17\CALABOGIE_17-508\02_DATA\GINT\1663816.GPJ GAL-GTA.GDT 19-6-28 ZS

+³, ×³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

| PROJECT | | 1663816-13000 | | RECORD OF BOREHOLE No 18-101 | | SHEET 2 OF 2 | | METRIC | | | | | | | | | |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------|------------------------------|------------|--------------------------------------------------------------------------------|--|------------------------------------------|--|-----------------------------------------------------|---|----------------|---|---------------------------------------|----|----|------------|
| G.W.P. | | 4232-15-00 | | LOCATION | | N 5033304.9; E 304385.1 NAD 1983 MTM ZONE 9 (LAT. 45.439680; LONG. -76.505300) | | ORIGINATED BY PH/TKG | | | | | | | | | |
| DIST | | Eastern HWY 17 | | BOREHOLE TYPE | | Wash Boring, HWT Casing/Rotary Drill, HQ3 Core | | COMPILED BY ZS | | | | | | | | | |
| DATUM | | CGVD8 | | DATE | | May 31-June 4, 2018 | | CHECKED BY WAM | | | | | | | | | |
| SOIL PROFILE | | SAMPLES | | GROUND WATER CONDITIONS | | ELEVATION SCALE | | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | UNIT WEIGHT | | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | | W _p | W | W _L | γ | GR | SA | SI | CL |
| 114.9 | --- | | | | | | | | | | | | | | | | |
| 15.2 | (SM/ML) SAND and SILT, trace to some clay, trace gravel, contains cobbles Compact Grey Wet | | 14 | SS | 25 | | | | | | | | | | | | |
| | | | 15 | SS | 19 | | | | | | | | | | | | |
| 113.3 | | | 16 | RC | DD | | | | | | | | | | | | |
| 16.8 | Marble (BEDROCK) Bedrock cored from depths of 16.8 m to 20.2 m For bedrock coring details refer to Record of Drillhole 18-101 | | 17 | SS | 100/0.08 | | | | | | | | | | | | |
| | | | 1 | RC | REC 100% | | | | | | | | | | | | RQD = 96% |
| | | | 2 | RC | REC 100% | | | | | | | | | | | | RQD = 100% |
| | | | 3 | RC | REC 100% | | | | | | | | | | | | RQD = 99% |
| | | | 4 | RC | REC 100% | | | | | | | | | | | | RQD = 59% |
| 109.9 | END OF BOREHOLE | | | | | | | | | | | | | | | | |
| 20.2 | NOTES: 1. Water level in well screen at a depth of 1.6 m below ground surface (Elev. 128.5 m), measured on Sept. 11, 2018. | | | | | | | | | | | | | | | | |

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTO\HWY17\CALABOGIE_17-50802_DATA\GINT1663816.GPJ GAL-CTA.GDT 19-6-28 ZS

PROJECT: 1663816-13000
LOCATION: N 5033304.9 ;E 304385.1
INCLINATION: -90° AZIMUTH: —

RECORD OF DRILLHOLE: 18-101

DRILLING DATE: May 31-June 4, 2018
DRILL RIG: CME 75
DRILLING CONTRACTOR: Downing Drilling

SHEET 1 OF 1
DATUM: CGVD8

| DEPTH SCALE METRES | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (m) | RUN No. | NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY | | | | | | | | | | | | | | FEATURES | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | | | | RECOVERY | | R.Q.D. % | FRACT. INDEX PER 0.25m | DISCONTINUITY DATA | HYDRAULIC CONDUCTIVITY K, cm/sec | | | WEATH- ERING INDEX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | TOTAL CORE % | SOLID CORE % | TYPE AND SURFACE DESCRIPTION | Jr | | | | Ja | 10 ⁻⁵ | 10 ⁻⁴ | 10 ⁻³ | 10 ⁻² | W1 | W2 | W3 | W4 | W5 | | W6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 17 | Rotary Drill HQ3 Core | BEDROCK SURFACE | | 113.31 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | </ |

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| PROJECT | | 1663816-13000 | | RECORD OF BOREHOLE No 18-102 | | SHEET 2 OF 2 | | METRIC | | | | | | | | | | |
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| G.W.P. | | 4232-15-00 | | LOCATION | | N 5033377.1; E 304447.3 NAD 1983 MTM ZONE 9 (LAT. 45.440330; LONG. -76.504510) | | ORIGINATED BY PH | | | | | | | | | | |
| DIST | | Eastern HWY 17 | | BOREHOLE TYPE | | Wash Boring, HWT Casing/Rotary Drill, HQ3 Core | | COMPILED BY ZS | | | | | | | | | | |
| DATUM | | CGVD8 | | DATE | | June 7-11, 2018 | | CHECKED BY WAM | | | | | | | | | | |
| SOIL PROFILE | | SAMPLES | | GROUND WATER CONDITIONS | | ELEVATION SCALE | | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | UNIT WEIGHT | | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | | |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | | W _p | W | W _L | γ | GR | SA | SI | CL | |
| 114.7 | (CL/CI) SILTY CLAY Stiff Grey Wet |  | | | | | | | | | | | | | | | | |
| 15.5 | | | | | | | | | | | | | | | | | | |
| | | | 14 | TP | WR | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | 15 | SS | WH | | | | | | | | | | | | | |
| 111.0 | (ML) Sandy SILT, some gravel Wet | | 16 | SS | >50 | | | | | | | | | | | | | |
| 19.4 | Marble (BEDROCK) | | | | | | | | | | | | | | | | | |
| | Bedrock cored from depths of 19.4 m to 21.0 m | | 1 | RC | REC 100% | | | | | | | | | | | | RQD = 86% | |
| | For bedrock coring details refer to Record of Drillhole 18-102 | | | | | | | | | | | | | | | | | |
| 109.3 | Sandstone (BEDROCK) | | | | | | | | | | | | | | | | | |
| 21.0 | | | | | | | | | | | | | | | | | | |
| 108.8 | Marble (BEDROCK) | | 2 | RC | REC 97% | | | | | | | | | | | | RQD = 71% | |
| 21.4 | | | | | | | | | | | | | | | | | | |
| 107.8 | END OF BOREHOLE | | | | | | | | | | | | | | | | | |
| 22.4 | NOTES: 1. Water level in well screen at a depth of 2.3 m below ground surface (Elev. 127.9 m), measured on Sept. 11, 2018. | | | | | | | | | | | | | | | | | |

SHEET 1 OF 1

DATUM: CGVD8

DRILLING CONTRACTOR: Downing Drilling

[illegible]

DEPTH SCALE

1 : 50

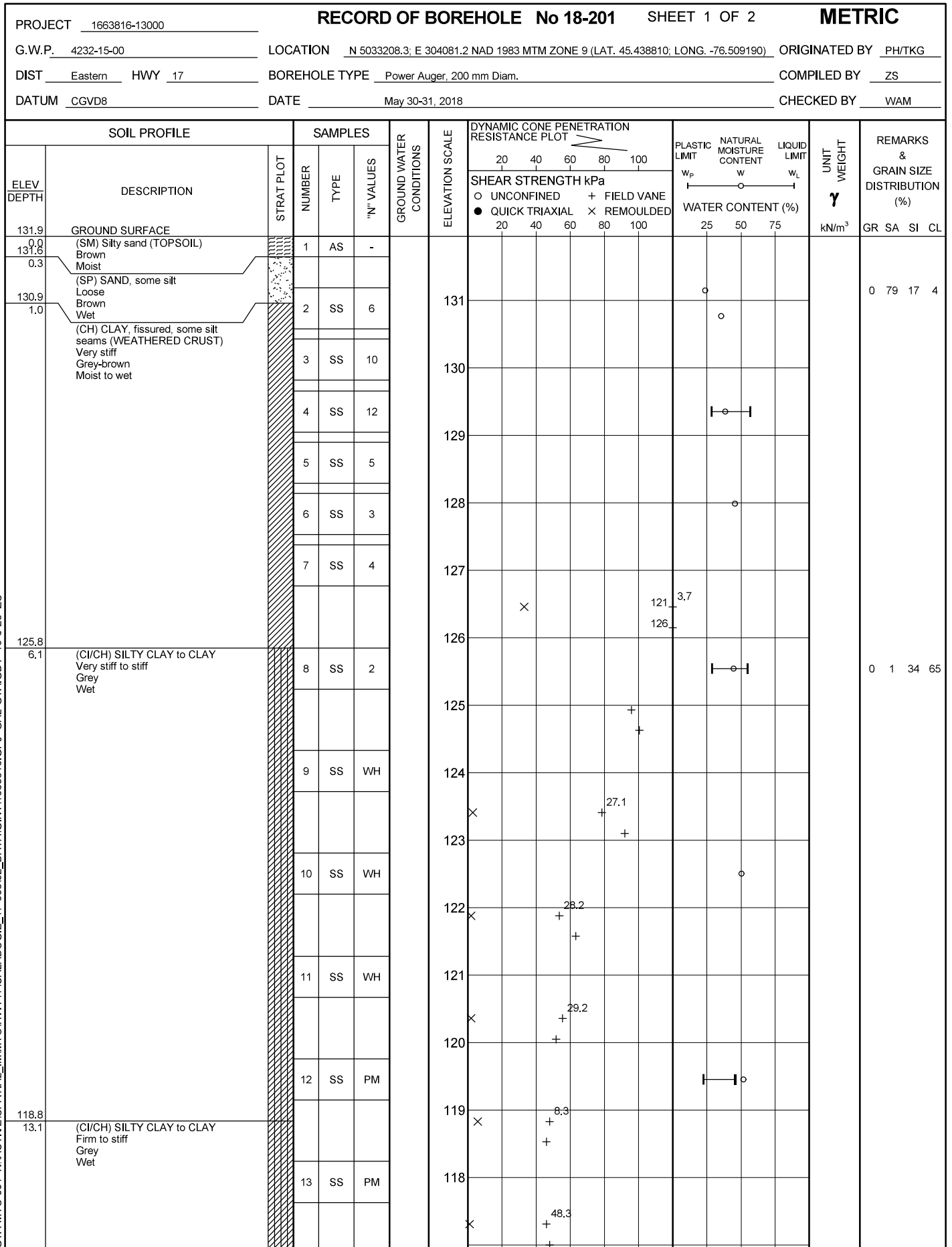


GOLDER

LOGGED: PH

CHECKED:

GTA-RCK 031 N:\ACTIVE\SPATIAL IM\IMTO\HWY17\CALABOGIE 17-508\02 DATA\GIN\T1663816.GPJ GAL-MISS.GDT 19-6-28 ZS



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+ 3, X 3: Numbers refer to Sensitivity O 3% STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTOHWY17\CALABOGIE_17-50802_DATA\GINT1663816.GPJ GAL-CTA.GDT 19-6-28 ZS

+³, ×³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

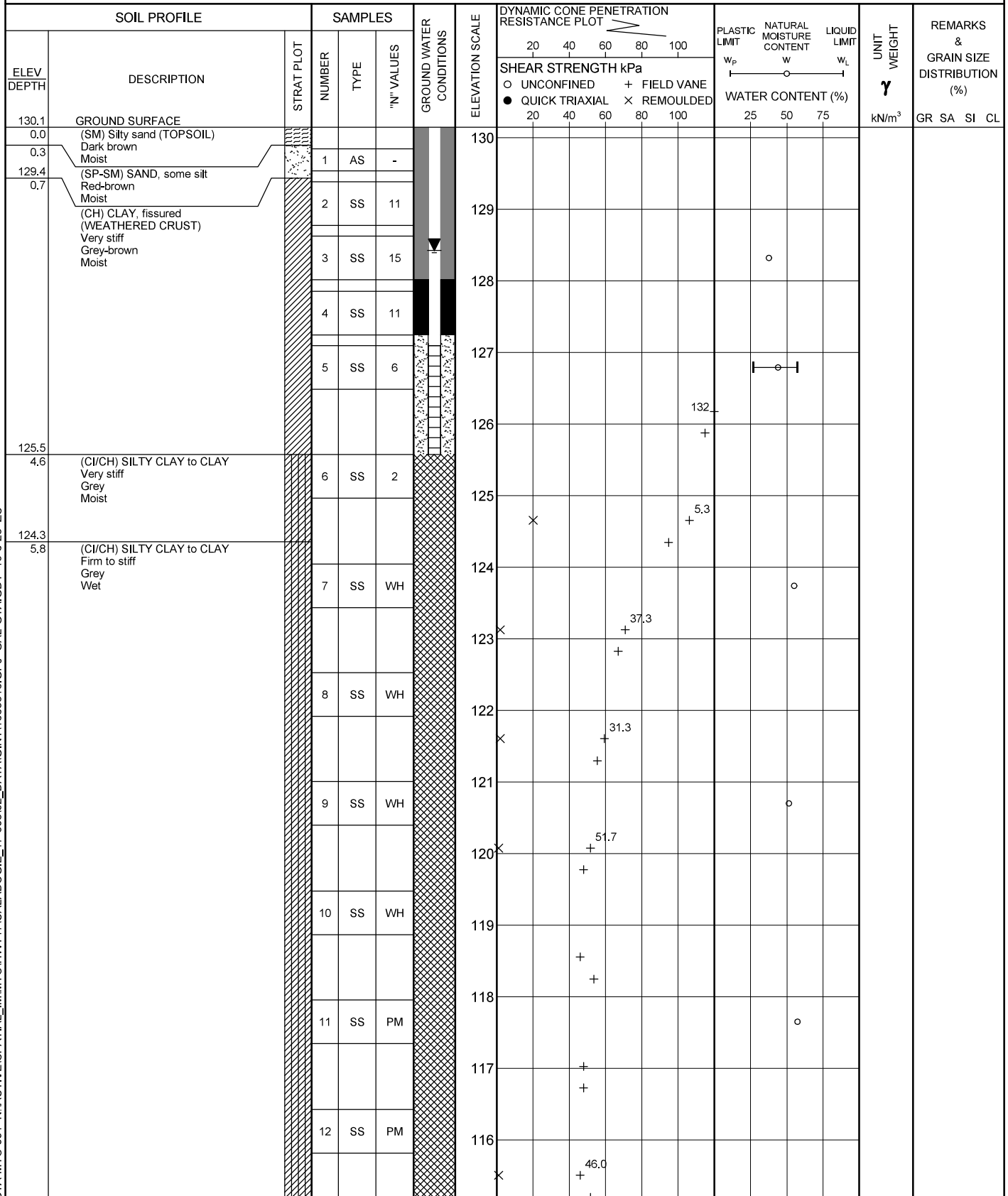
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+³, ×³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

| | | | | | | | |
|-----------------------------------|--|------------------------------------------------------------------------------------------------|--|-------------------------|--|---------------|--|
| PROJECT <u>1663816-13000</u> | | RECORD OF BOREHOLE No 18-202 | | SHEET 2 OF 2 | | METRIC | |
| G.W.P. <u>4232-15-00</u> | | LOCATION <u>N 5033293.1; E 304367.8 NAD 1983 MTM ZONE 9 (LAT. 45.439570; LONG. -76.505520)</u> | | ORIGINATED BY <u>PH</u> | | | |
| DIST <u>Eastern</u> HWY <u>17</u> | | BOREHOLE TYPE <u>Power Auger, 200 mm Diam.</u> | | COMPILED BY <u>ZS</u> | | | |
| DATUM <u>CGVD8</u> | | DATE <u>June 5, 2018</u> | | CHECKED BY <u>WAM</u> | | | |

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT LIMIT | | | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------|------------|---------|------|------------|----------------------------|-----------------|---------------------------------------------|---|------------|------------------|---|-----------------------------------------------------------------|-------------------|----------------|--------------------------------------|---------------------------------------------------|----|----|----|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | W _P | W | W _L | | GR | SA | SI | CL |
| | | | | | | | | ○ UNCONFINED | + | FIELD VANE | ● QUICK TRIAXIAL | × | REMOULDED | WATER CONTENT (%) | | | | | | |
| | END OF BOREHOLE AUGER REFUSAL | | | | | | | | | | | | | | | | | | | |
| | NOTES: 1. Water level in well screen at a depth of 2.4 m below ground surface (Elev. 127.8 m), measured on Sept. 11, 2018. | | | | | | | | | | | | | | | | | | | |

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| PROJECT 1663816-13000 | | RECORD OF BOREHOLE No 18-203 | | SHEET 1 OF 2 | | METRIC | |
| G.W.P. 4232-15-00 | | LOCATION N 5033393.1; E 304468.5 NAD 1983 MTM ZONE 9 (LAT. 45.440470; LONG. -76.504240) | | ORIGINATED BY PH | | | |
| DIST Eastern HWY 17 | | BOREHOLE TYPE Power Auger, 200 mm Diam. | | COMPILED BY ZS | | | |
| DATUM CGVD8 | | DATE June 12, 2018 | | CHECKED BY WAM | | | |



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+ 3, X 3: Numbers refer to Sensitivity O 3% STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTOHWY17\CALABOGIE_17-50802_DATA\GINT1663816.GPJ GAL-CTA.GDT 19-6-28 ZS

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|-----------------------------------|--|------------------------------------------------------------------------------------------------|--|-------------------------|--|---------------|--|
| PROJECT <u>1663816-13000</u> | | RECORD OF BOREHOLE No 18-203 | | SHEET 2 OF 2 | | METRIC | |
| G.W.P. <u>4232-15-00</u> | | LOCATION <u>N 5033393.1; E 304468.5 NAD 1983 MTM ZONE 9 (LAT. 45.440470; LONG. -76.504240)</u> | | ORIGINATED BY <u>PH</u> | | | |
| DIST <u>Eastern</u> HWY <u>17</u> | | BOREHOLE TYPE <u>Power Auger, 200 mm Diam.</u> | | COMPILED BY <u>ZS</u> | | | |
| DATUM <u>CGVD8</u> | | DATE <u>June 12, 2018</u> | | CHECKED BY <u>WAM</u> | | | |

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|---------|------|------------|----------------------------|------------------------------|---------------------------------------------|---------------------------------|--------------------------------------------------------|--|--|---------------------------------------------------------|----------------------------------------------------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 40 60 80 100 | W _P W W _L | | | | | |
| SHEAR STRENGTH kPa | | | | | | | | WATER CONTENT (%) | | | | | | |
| --- CONTINUED FROM PREVIOUS PAGE --- | | | | | | | ○ UNCONFINED + FIELD VANE | | | | | | | |
| | | | | | | | ● QUICK TRIAXIAL × REMOULDED | | | | | | | |
| | | | | | | | 20 40 60 80 100 | | | 25 50 75 | | | | |
| | (CI/CH) SILTY CLAY to CLAY Firm to stiff Grey Wet | | 13 | SS | PM | | 115 | | | | | | | 0 0 39 61 |
| | | | | | | | 114 | 29.2 | | | | | | |
| | | | 14 | SS | PM | | 113 | | | | | | | |
| 112.5 | | | | | | | | | | | | | | |
| 17.8 | (SM) SILTY SAND, some gravel Grey Wet END OF BOREHOLE AUGER REFUSAL NOTES: 1. Water level in well screen at a depth of 2.6 m below ground surface (Elev. 127.5 m), measured on Sept. 11, 2018. | | 15 | SS | 50/0.08 | | | | | | | | | |

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GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTOHWY17\CALABOGIE_17-508\02_DATA\GINT\1663816.GPJ GAL-GTA.GDT 19-6-28 ZS

+³, ×³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

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|-----------------------------------|--|------------------------------------------------------------------------------------------------|--|-------------------------|--|---------------|--|
| PROJECT <u>1663816-13000</u> | | RECORD OF BOREHOLE No 18-204 | | SHEET 2 OF 2 | | METRIC | |
| G.W.P. <u>4232-15-00</u> | | LOCATION <u>N 5033440.3; E 304674.3 NAD 1983 MTM ZONE 9 (LAT. 45.440900; LONG. -76.501610)</u> | | ORIGINATED BY <u>PH</u> | | | |
| DIST <u>Eastern</u> HWY <u>17</u> | | BOREHOLE TYPE <u>Power Auger, 200 mm Diam.</u> | | COMPILED BY <u>ZS</u> | | | |
| DATUM <u>CGVD8</u> | | DATE <u>June 19, 2018</u> | | CHECKED BY <u>WAM</u> | | | |

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | | | |
|---------------|--------------------------------------------------------------------------------|------------|---------|------|------------|----------------------------|-----------------|---------------------------------------------|----|------------|---------------------------------------------------------|---|-------------------|--------------------------------------|---------------------------------------------------|----|----------------|----|----|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | WATER CONTENT (%) | | | GR | SA | SI | CL | |
| | | | | | | | | ○ UNCONFINED | + | FIELD VANE | ● QUICK TRIAXIAL | × | REMOULDED | | W _p | W | W _L | | | |
| | --- CONTINUED FROM PREVIOUS PAGE --- | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | | | | | |
| | (CI/CH) SILTY CLAY to CLAY Firm to stiff Grey Wet | | 13 | SS | PM | | | | + | | | | | ○ | | | | | | |
| 112.9 | | | | | | | | | + | | | | | | | | | | | |
| 16.8 | (SM) Gravelly SILTY SAND, trace to some clay (TILL) Loose Grey Wet | | 14 | SS | 8 | | | | | | | | ○ | | | | | 28 | 41 | |
| 112.1 | | | | | | | | | | | | | | | | | | 23 | 8 | |
| 17.6 | END OF BOREHOLE AUGER REFUSAL | | | | | | | | | | | | | | | | | | | |



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| PROJECT | | 1663816-13000 | | RECORD OF BOREHOLE No 18-301 | | SHEET 1 OF 2 | | METRIC | | | | | |
|---------------|----------------------------------------------------------------------------------|----------------|---------|------------------------------|------------|--------------------------------------------------------------------------------|-----------------|---------------------------------------------------------------------------------|---------------------------------------|-------------------------------|--------------------------------|------------------|-------------|
| G.W.P. | | 4232-15-00 | | LOCATION | | N 5033312.4; E 304070.6 NAD 1983 MTM ZONE 9 (LAT. 45.439740; LONG. -76.509320) | | ORIGINATED BY PH/TKG | | | | | |
| DIST | | Eastern HWY 17 | | BOREHOLE TYPE | | Power Auger, 200 mm Diam. | | COMPILED BY ZS | | | | | |
| DATUM | | CGVD8 | | DATE | | May 29, 2018 | | CHECKED BY WAM | | | | | |
| SOIL PROFILE | | | SAMPLES | | | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | | |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED | PLASTIC LIMIT W _P | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | GR SA SI CL |
| 130.9 | GROUND SURFACE | | | | | | | | | | | | |
| 0.0 | (CL-ML) Silty clay to clayey silt (TOPSOIL) | | | | | | | | | | | | |
| 0.2 | Dark grey-brown Moist | | | | | | | | | | | | |
| | (CH) CLAY (WEATHERED CRUST) | | 1 | SS | 13 | | 130 | | | | | | |
| | Very stiff Grey-brown Moist to wet | | 2 | SS | 13 | | 129 | | | | | | |
| | | | 3 | SS | 8 | | 128 | | | | | | 0 0 32 68 |
| | | | 4 | SS | 5 | | 127 | | | | | | |
| | | | 5 | SS | 3 | | 126 | | | | | | |
| | | | 6 | SS | 2 | | 125 | | | | | | |
| 125.9 | (CI/CH) SILTY CLAY to CLAY | | | | | | 124 | | | | | | |
| 5.0 | Stiff Grey Wet | | 7 | SS | WH | | 123 | | | | | | |
| | | | 8 | SS | WH | | 122 | | | | | | |
| | | | 9 | SS | WH | | 121 | | | | | | |
| | | | 10 | SS | WH | | 120 | | | | | | |
| | | | 11 | SS | WH | | 119 | | | | | | |
| 117.8 | (SM/ML) Gravelly SAND and SILT, trace clay, contains cobbles and boulders (TILL) | | | | | | 118 | | | | | | |
| 13.1 | Compact Grey Wet | | 12 | SS | 11 | | 117 | | | | | | 26 38 31 5 |

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+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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| PROJECT | | RECORD OF BOREHOLE No 18-301 | | | | SHEET 2 OF 2 | | METRIC | | | | | | | | | |
|---------------------|-----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------|-----------------------------------------------------------------------------------------|------------|------------------------------------------|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|----|-----|-------------|----------------------------------------------------------|---------------------------------------|--|------------------------|-------------|
| 1663816-13000 | | G.W.P. 4232-15-00 | | LOCATION N 5033312.4; E 304070.6 NAD 1983 MTM ZONE 9 (LAT. 45.439740; LONG. -76.509320) | | ORIGINATED BY PH/TKG | | | | | | | | | | | |
| DIST Eastern HWY 17 | | BOREHOLE TYPE Power Auger, 200 mm Diam. | | COMPILED BY ZS | | | | | | | | | | | | | |
| DATUM CGVD8 | | DATE May 29, 2018 | | CHECKED BY WAM | | | | | | | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT | | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE |  SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED | | | | | W _p — W — W _L WATER CONTENT (%) | | | γ kN/m ³ | GR SA SI CL |
| | | | | | | | 20 | 40 | 60 | 80 | 100 | 25 | 50 | 75 | | | |
| 114.4 | (SM/ML) Gravelly SAND and SILT, trace clay, contains cobbles and boulders (TILL) Compact Grey Wet |  | 13 | SS | 19 | | 115 | | | | | | | | | | |
| 16.5 | END OF BOREHOLE AUGER REFUSAL NOTE: 1. Sample 12 between 13.7 m and 14.3 m is non-plastic (NP) | | | | | | | | | | | | | | | | |

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| PROJECT 1663816-13000 | | RECORD OF BOREHOLE No 18-302 | | SHEET 1 OF 2 | | METRIC | |
| G.W.P. 4232-15-00 | | LOCATION N 5033164.7; E 304175.0 NAD 1983 MTM ZONE 9 (LAT. 45.438410; LONG. -76.507990) | | ORIGINATED BY PH/TKG | | | |
| DIST Eastern HWY 17 | | BOREHOLE TYPE Power Auger, 200 mm Diam. | | COMPILED BY ZS | | | |
| DATUM CGVD8 | | DATE May 28, 2018 | | CHECKED BY WAM | | | |

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|--------------------|----------------------------|------------|---------|------|------------|----------------------------|--------------------|---------------------------------------------|-----------------|-----------------------------------------------------|----------|--|--------------------------------------|---------------------------------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 40 60 80 100 | 20 40 60 80 100 | W _P W W _L | 25 50 75 | | | |
| SHEAR STRENGTH kPa | | | | | | | | WATER CONTENT (%) | | | | | | |
| | | | | | | | | ○ UNCONFINED + FIELD VANE | | | | | | |
| | | | | | | | | ● QUICK TRIAXIAL × REMOULDED | | | | | | |
| 130.3 | GROUND SURFACE | | | | | | | | | | | | | |
| 0.0 | (ML) Sandy silt (TOPSOIL) | | 1 | AS | - | | | | | | | | | |
| 130.0 | Dark brown | | 2 | AS | - | | | | | | | | | |
| | Moist | | | | | | | | | | | | | |
| 0.6 | (SP) SAND | | 3 | SS | 10 | | | | | | | | | |
| | Brown | | | | | | | | | | | | | |
| | Wet | | | | | | | | | | | | | |
| | (CH) CLAY, fissured | | | | | | | | | | | | | |
| | (WEATHERED CRUST) | | | | | | | | | | | | | |
| | Very stiff | | 4 | SS | 10 | | | | | | | | | |
| | Grey-brown | | | | | | | | | | | | | |
| | Moist to wet | | | | | | | | | | | | | |
| | | | 5 | SS | 5 | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | 6 | SS | 4 | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | 7 | SS | 2 | | | | | | | | | |
| 125.7 | | | | | | | | | | | | | | |
| 4.6 | (CI/CH) SILTY CLAY to CLAY | | 8 | SS | 2 | | | | | | | | | |
| | Very stiff to stiff | | | | | | | | | | | | | |
| | Grey | | | | | | | | | | | | | |
| | Wet | | | | | | | | | | | | | |
| | | | 9 | SS | 1 | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | 10 | SS | WH | | | | | | | | | |
| | | | | | | | | | | | | | | |
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| | | | 11 | SS | WH | | | | | | | | | |
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| | | | | | | | | | | | | | | |
| | | | 12 | SS | WH | | | | | | | | | |
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+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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+³, ×³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE



+³, ×³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

| PROJECT | | RECORD OF BOREHOLE No 18-304 | | | | SHEET 1 OF 1 | | METRIC | | | | | |
|---------------|-------------------------------------------------------------------------------------------------------------------|------------------------------|---------|------|------------|-------------------------|-----------------|------------------------------------------|-----------------|---------------------------------|----------------------------------------------|---------------------------------------|-------------------------------|
| G.W.P. | | LOCATION | | | | ORIGINATED BY | | PH | | | | | |
| DIST | | BOREHOLE TYPE | | | | COMPILED BY | | ZS | | | | | |
| DATUM | | DATE | | | | CHECKED BY | | WAM | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 40 60 80 100 | 20 40 60 80 100 | PLASTIC LIMIT W _P | | | NATURAL MOISTURE CONTENT W |
| 130.6 | GROUND SURFACE | | | | | | | | | | | | |
| 0.0 | (SP/GP) Sand and gravel, trace to some silt (FILL) Brown Moist | | 1 | AS | - | | | | | | | | 32 60 7 1 |
| 129.5 | | | 2 | SS | 7 | | | | | | | | |
| 129.2 | (CL-ML) Silty clay to clayey silt (TOPSOIL) Dark grey Moist | | 3 | SS | 7 | | | | | | | | |
| 1.4 | (CH) CLAY, fissured, contains silty fine sand seams (WEATHERED CRUST) Very stiff Grey-brown Moist to wet | | 4 | SS | 7 | | | | | | | | |
| | | | 5 | SS | 4 | | | | | | | | |
| 126.0 | | | | | | | | | | | | | |
| 4.6 | (CI/CH) SILTY CLAY to CLAY Stiff Grey Wet | | 6 | SS | 1 | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | 7 | SS | 1 | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | 8 | SS | WH | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | 9 | SS | WH | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | 10 | SS | WH | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | 11 | SS | 1 | | | | | | | | |
| 117.5 | | | | | | | | | | | | | |
| 13.1 | (SM) Gravelly SILTY SAND, trace clay (TILL) Compact Grey Wet | | 12 | SS | 14 | | | | | | | | |
| | | | 13 | SS | 28 | | | | | | | | 23 54 20 3 |
| 116.2 | | | | | | | | | | | | | |
| 14.4 | END OF BOREHOLE AUGER REFUSAL | | | | | | | | | | | | |

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTA-MTO 001 N\ACTIVE\SPATIAL_IMMTOHWY17\CALABOGIE_17-50802_DATA\GINT1663816.GPJ GAL-CTA.GDT 19-6-28 ZS

| | | | | | | | |
|-----------------------------------|--|------------------------------------------------------------------------------------------------|--|-------------------------|--|---------------|--|
| PROJECT <u>1663816-13000</u> | | RECORD OF BOREHOLE No 18-305 | | SHEET 2 OF 2 | | METRIC | |
| G.W.P. <u>4232-15-00</u> | | LOCATION <u>N 5033444.6; E 304526.7 NAD 1983 MTM ZONE 9 (LAT. 45.440930; LONG. -76.503490)</u> | | ORIGINATED BY <u>PH</u> | | | |
| DIST <u>Eastern</u> HWY <u>17</u> | | BOREHOLE TYPE <u>Power Auger, 200 mm Diam.</u> | | COMPILED BY <u>ZS</u> | | | |
| DATUM <u>CGVD8</u> | | DATE <u>June 13, 2018</u> | | CHECKED BY <u>WAM</u> | | | |

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL | |
|--------------------------------------|----------------------------------------------------|------------|---------|------|------------|-------------------------|-----------------|------------------------------------------|----|----|----|-----|-----------------------------------------------------|---|----------------|-------------------------------------------|------------------------------------------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | SHEAR STRENGTH kPa | | | | | WATER CONTENT (%) | | | | | |
| | | | | | | | | 20 | 40 | 60 | 80 | 100 | W _p | W | W _L | | | |
| --- CONTINUED FROM PREVIOUS PAGE --- | | | | | | | | | | | | | | | | | | |
| | (CL/CI) SILTY CLAY Firm to stiff Grey Wet | | 14 | SS | PM | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | 15 | SS | WR | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | 16 | SS | WR | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | 17 | SS | WR | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | 18 | SS | PM | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | 19 | SS | PM | | | | | | | | | | | | | |
| 106.8 | | | | | | | | | | | | | | | | | | |
| 24.1 | END OF BOREHOLE | | | | | | | | | | | | | | | | | |

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTO\HWY17\CALABOGIE_17-50802_DATA\GINT\1663816.GPJ GAL-CTA.GDT 19-6-28 ZS

$+$ \times \circ : Numbers refer to Sensitivity \circ 3% STRAIN AT FAILURE

| | | | | | | | |
|-----------------------|--|-----------------------------------------------------------------------------------------|--|------------------|--|---------------|--|
| PROJECT 1663816-13000 | | RECORD OF BOREHOLE No 18-306 | | SHEET 2 OF 2 | | METRIC | |
| G.W.P. 4232-15-00 | | LOCATION N 5033481.7; E 304558.5 NAD 1983 MTM ZONE 9 (LAT. 45.441270; LONG. -76.503090) | | ORIGINATED BY PH | | | |
| DIST Eastern HWY 17 | | BOREHOLE TYPE Power Auger, 200 mm Diam. | | COMPILED BY ZS | | | |
| DATUM CGVD8 | | DATE June 18, 2018 | | CHECKED BY WAM | | | |

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | | | | |
|---------------|----------------------------------------------------------------------------------|------------|---------|------|------------|----------------------------|-----------------|---------------------------------------------|----|---------------------------------------------------------|----|-----|--------------------------------------|---------------------------------------------------|----|----|----|----|----|----|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | WATER CONTENT (%) | | | GR | SA | SI | CL |
| | | | | | | | | 20 | 40 | 60 | 80 | 100 | | 25 | 50 | 75 | | | | |
| | --- CONTINUED FROM PREVIOUS PAGE --- | | | | | | | | | | | | | | | | | | | |
| | (CI/CH) SILTY CLAY to CLAY Stiff Grey Wet | | 13 | SS | PM | | 115 | | | | | | | | | | | | | |
| | | | | | | | 114 | | | | | | | | | | | | | |
| | | | 14 | SS | PM | | 113 | | | | | | | | | | | | | |
| | | | | | | | 112 | | | | | | | | | | | | | |
| | | | 15 | SS | PM | | 111 | | | | | | | | | | | | | |
| | | | | | | | 110 | | | | | | | | | | | | | |
| | | | 16 | SS | PM | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| 108.9 | | | | | | | 109 | | | | | | | | | | | | | |
| 21.2 | (SM) Gravelly SILTY SAND, trace to some gravel (TILL) Loose Grey Wet | | 17 | SS | 8 | | | | | | | | | | | 23 | 47 | 21 | 9 | |
| 108.2 | | | | | | | | | | | | | | | | | | | | |
| 22.0 | END OF BOREHOLE | | | | | | | | | | | | | | | | | | | |

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTO\HWY17\CALABOGIE_17-50802_DATA\GINT1663816.GPJ GAL-CTA.GDT 19-6-28 ZS

+³, ×³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

+³, ×³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTO\HWY17\CALABOGIE_17-508\02_DATA\GINT\1663816.GPJ GAL-GTA.GDT 19-6-28 ZS

+³, ×³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

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|-----------------------------------|--|-------------------------------------------------------------------------------------------------|--|-------------------------|--|---------------|--|
| PROJECT <u>1663816-13000</u> | | RECORD OF BOREHOLE No 18-308 | | SHEET 2 OF 2 | | METRIC | |
| G.W.P. <u>4232-15-00</u> | | LOCATION <u>N 5033466.0; E 3044454.5 NAD 1983 MTM ZONE 9 (LAT. 45.441130; LONG. -76.504420)</u> | | ORIGINATED BY <u>PH</u> | | | |
| DIST <u>Eastern</u> HWY <u>17</u> | | BOREHOLE TYPE <u>Power Auger, 200 mm Diam.</u> | | COMPILED BY <u>ZS</u> | | | |
| DATUM <u>CGVD8</u> | | DATE <u>June 14, 2018</u> | | CHECKED BY <u>WAM</u> | | | |

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL | |
|---------------|------------------------------------------------------------|------------|---------|------|------------|----------------------------|-----------------|-----------------------------------------------------------|--|--|--------------------------------------------------------|--|--|---------------------------------------------------------|----------------------------------------------------------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | WATER CONTENT (%) | | | | | |
| | | | | | | | | ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED | | | W _P W W _L | | | | | |
| | | | | | | | | 20 40 60 80 100 20 40 60 80 100 | | | 25 50 75 | | | | | |
| | --- CONTINUED FROM PREVIOUS PAGE --- | | | | | | 114 | | | | | | | | | |
| | (CI/CH) SILTY CLAY to CLAY Firm to stiff Grey Wet | | 12 | SS | PM | | | | | | | | | | | |
| | | | | | | | 113 | | | | | | | | | |
| | | | 13 | SS | PM | | | | | | | | | | | |
| | | | | | | | 112 | | | | | | | | | |
| | | | | | | | 111 | | | | | | | | | |
| | | | 14 | SS | PM | | | | | | | | | | | |
| | | | | | | | 110 | | | | | | | | | |
| | | | 15 | SS | PM | | | | | | | | | | | |
| | | | | | | | 109 | | | | | | | | | |
| | | | | | | | 108 | | | | | | | | | |
| 107.8 | | | 16 | SS | WR | | | | | | | | | | | |
| 21.8 | (SM) Silty SAND, trace gravel Compact Grey Wet | | 17 | SS | 19 | | | | | | | | | | | |
| 107.2 | | | | | | | | | | | | | | | | |
| 22.4 | END OF BOREHOLE | | | | | | | | | | | | | | | |

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTO\HWY17\CALABOGIE_17-50802_DATA\GINT\1663816.GPJ GAL-CTA.GDT 19-6-28 ZS

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| PROJECT 1663816-13000 | | RECORD OF BOREHOLE No 18-309 | | SHEET 1 OF 2 | | METRIC | |
| G.W.P. 4232-15-00 | | LOCATION N 5033230.6; E 304372.0 NAD 1983 MTM ZONE 9 (LAT. 45.439010; LONG. -76.505470) | | ORIGINATED BY PH | | | |
| DIST Eastern HWY 17 | | BOREHOLE TYPE Power Auger, 200 mm Diam. | | COMPILED BY ZS | | | |
| DATUM CGVD8 | | DATE June 7, 2018 | | CHECKED BY WAM | | | |

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | |
|---------------|-----------------------------------------------------------------------------------|------------|---------|------|------------|----------------------------|-------------------------|---------------------------------------------------------------|-------------------|---------------------------------------------------------|---|----------------|---------------------------------------------------------|---------------------------------------------------|--|------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | W _P | W | W _L | | GR SA SI CL | | | |
| | | | | | | | | ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED | WATER CONTENT (%) | | | | | | | | |
| 129.8 | GROUND SURFACE | | | | | | 20 40 60 80 100 | | | | | | | | | | |
| 0.0 | (SP) Gravelly sand, trace silt (FILL) Brown Moist | | 1 | AS | - | | | | | | | | | | | | |
| 129.0 | | | | | | | | | | | | | | | | | |
| 0.8 | (SM) SILTY SAND, contains organic matter (ALLUVIUM) Loose Brown Moist | | 2 | SS | 4 | | | | | | | | | | | 0 60 25 15 | |
| 128.6 | | | | | | | | | | | | | | | | | |
| 1.2 | (CH) CLAY, fissured (WEATHERED CRUST) Very stiff Grey-brown Moist to wet | | 3 | SS | 8 | | | | | | | | | | | | |
| | | | 4 | SS | 10 | | | | | | | | | | | | |
| | | | 5 | SS | 6 | | | | | | | | | | | | |
| | | | 6 | SS | 2 | | | | | | | | | | | | |
| 123.9 | (CI/CH) SILTY CLAY to CLAY Stiff Grey Wet | | 7 | SS | 2 | | | | | | | | | | | | |
| 5.9 | | | 8 | SS | WH | | | | | | | | | | | | |
| | | | 9 | SS | WH | | | | | | | | | | | | |
| | | | 10 | SS | WH | | | | | | | | | | | | |
| | | | 11 | SS | WH | | | | | | | | | | | | |
| | | | 12 | SS | WH | | | | | | | | | | | | |
| 114.9 | | | | | | | | | | | | | | | | | |


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+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTOHWY17\CALABOGIE_17-50802_DATA\GINT1663816.GPJ GAL-CTA.GDT 19-6-28 ZS

| | | | | | | | | | |
|-----------------------------------|--|------------------------------------------------------------------------------------------------|--|--|--|-------------------------|--|---------------|--|
| PROJECT <u>1663816-13000</u> | | RECORD OF BOREHOLE No 18-309 | | | | SHEET 2 OF 2 | | METRIC | |
| G.W.P. <u>4232-15-00</u> | | LOCATION <u>N 5033230.6; E 304372.0 NAD 1983 MTM ZONE 9 (LAT. 45.439010; LONG. -76.505470)</u> | | | | ORIGINATED BY <u>PH</u> | | | |
| DIST <u>Eastern</u> HWY <u>17</u> | | BOREHOLE TYPE <u>Power Auger, 200 mm Diam.</u> | | | | COMPILED BY <u>ZS</u> | | | |
| DATUM <u>CGVD8</u> | | DATE <u>June 7, 2018</u> | | | | CHECKED BY <u>WAM</u> | | | |

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------|------|------------|----------------------------|-----------------|---------------------------------------------|----|----|----|-----|-----------------------------------------------------|---|----------------|----------------------------------------------|------------------------------------------------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | W _p | W | W _L | | |
| | | | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 14.9 | (SP/GP) SAND and GRAVEL, some silt, contains cobbles (TILL) Compact Grey Wet |  | 13 | SS | 10 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 14 | SS | 10 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 111.2 | | | 15 | SS | 72/0.23 | | | | | | | | | | | | |
| 18.6 | END OF BOREHOLE AUGER REFUSAL | | | | | | | | | | | | | | | | |

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTO\HWY17\CALABOGIE_17-50802_DATA\GINT\1663816.GPJ GAL-CTA.GDT 19-6-28 ZS

| | | | | | | | |
|------------------------------|--|------------------------------------------------------------------------------------------------|--|-------------------------|--|---------------|--|
| PROJECT 1663816-13000 | | RECORD OF BOREHOLE No 18-310 | | SHEET 1 OF 2 | | METRIC | |
| G.W.P. 4232-15-00 | | LOCATION N 5033404.1; E 304728.6 NAD 1983 MTM ZONE 9 (LAT. 45.440570; LONG. -76.500910) | | ORIGINATED BY PH | | | |
| DIST Eastern HWY 17 | | BOREHOLE TYPE Power Auger, 200 mm Diam. | | COMPILED BY ZS | | | |
| DATUM CGVD8 | | DATE June 20, 2018 | | CHECKED BY WAM | | | |

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC NATURAL LIQUID LIMIT | | | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|--------------|--------------------------------------------------------------------------------------|------------|---------|------|------------|-------------------------|-----------------|------------------------------------------|-----------------|------------------------------|---|----------------|----------------------|---------------------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 40 60 80 100 | 20 40 60 80 100 | W _p | W | W _L | | |
| 131.0 | GROUND SURFACE | | | | | | | | | | | | | |
| 0.0 | (SM) Silty sand (TOPSOIL) Dark brown Moist | | | | | | | | | | | | | |
| 0.4 | (SP-SM) SAND, some silt Wet | | | | | | | | | | | | | |
| | (CH) CLAY, fissured (WEATHERED CRUST) Very stiff Grey-brown Moist to wet | | 1 | SS | 10 | | | | | | | | | |
| | | | 2 | SS | 9 | | | | | | | | | |
| | | | 3 | SS | 6 | | | | | | | | | |
| | | | 4 | SS | 5 | | | | | | | | | |
| 126.9 | | | | | | | | | | | | | | |
| 4.1 | (CI/CH) SILTY CLAY to CLAY Stiff Grey Wet | | 5 | SS | WH | | | | | | | | | |
| | | | 6 | SS | WH | | | | | | | | | |
| | | | 7 | SS | PM | | | | | | | | | |
| | | | 8 | SS | PM | | | | | | | | | |
| | | | 9 | SS | PM | | | | | | | | | |
| | | | 10 | SS | PM | | | | | | | | | |
| | | | 11 | SS | PM | | | | | | | | | |

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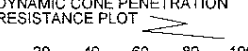
+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTOHWY17\CALABOGIE_17-50802_DATA\GINT1663816.GPJ GAL-CTA.GDT 19-6-28 ZS

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTO\HWY17\CALABOGIE_17-508\02_DATA\GIN\1663816.GPJ GAL-GTA.GDT 19-6-28 ZS

+³, ×³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

METRIC

| SOIL PROFILE | | | SAMPLES | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT  | PLASTIC LIMIT W _P | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------|------|-------------------------|-----------------|--------------------------------------------------------------------------------------------------------------------------------|---------------------------------|-------------------------------|--------------------------------|---------------------------------------|------------------------------------------------------|
| ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | | | | | | | | |
| 130.1 | | | | | | | | | | | | |
| 0.0 | TOPSOIL (250mm) | | | | | | | | | | | |
| 129.9 | | | | | | | | | | | | |
| 0.3 | Silty CLAY to CLAY , trace sand seams, trace rootlets to 1.4m Very Stiff to Stiff Brown to Grey Moist to Wet (CI-CH) | | 1 | SS | 5 | | | | | | | |
| | | | 2 | SS | 20 | | | | | | | |
| | | | 3 | SS | 17 | | | | | | | |
| | | | 4 | SS | 18 | | | | | | | |
| | | | 5 | SS | 10 | | | | | | | |
| | | | 6 | SS | 7 | | | | | | | |
| | becoming stiff to firm grey/ brown | | 7 | SS | 5 | | | | | | | |
| | grey | | 8 | SS | 2 | | | | | | | |
| | becoming firm to soft | | 1 | TW | PH | | | | | | 16.9 | consolidation test performed |

+ 3, × 3: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 508-1

2 OF 3

METRIC

G.W.P. 647-92-00 LOCATION N 5 033 313.1 E 304 380.2 (County Road 508) ORIGINATED BY SL
 HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, NQ Coring COMPILED BY SS
 DATUM Geodetic DATE 22.09.03 - 23.09.03 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|---------|------|-------------------------------------------|----------------------------|-----------------|---------------------------------------------|-----------------|-----------------|-----------------|-------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 40 60 80 100 | 20 40 60 80 100 | 20 40 60 80 100 | 20 40 60 80 100 | | |
| | | | | | | | | SHEAR STRENGTH kPa | | | | | |
| | | | | | | | | ○ UNCONFINED + FIELD VANE | | | | | |
| | | | | | | | | ● QUICK TRIAXIAL x LAB VANE | | | | | |
| | | | | | | | | WATER CONTENT (%) | | | | | |
| | | | | | | | | 20 40 60 80 100 | 20 40 60 80 100 | 20 40 60 80 100 | 20 40 60 80 100 | | |
| 116.8 | Silty CLAY to CLAY, with silt seams/ partings Firm to Soft Grey Wet (CI-CH) | | 9 | SS | 2 | | | 6.5 | | | | | 0 1 60 40 |
| 116.3 | SAND, some silt, trace gravel, trace clay Compact (inferred) Grey Wet (SP) | | 11 | SS | 38 | | | 4.8 | | | | | 1 80 12 7 |
| 116.1 | GRAVEL, some sand, occasional cobbles Dense Grey Wet (GP) frequent cobbles below 14.9m | | 1 | GS | | | | 3.1 | | | | | |
| 114.1 | CRYSTALLINE LIMESTONE, (BEDROCK) Fresh to slightly weathered, very thinly bedded, grey with dark grey and white subvertical banding, occasional iron oxide staining at joints, very strong Subvertical joints from 16.31m to 16.36m, 16.38m to 16.41m, 16.59m to 16.61m, 17.09m to 17.15m, 17.42m to 17.48m, 17.88m to 17.91m, 18.14m to 18.16m, 18.42m to 18.44m, 18.54m to 18.59m, 18.67m to 18.64m, 19.02m to 19.13m Broken Rock core from 18.16m to 18.21m | | 1 | RUN | 3 5 2 1 2 4 4 2 3 | | | | | | | | RUN 1# TCR=100%, SCR=100%, RQD=40%, UCS=127MPa RUN 2# TCR=100%, SCR=98%, RQD=72%, UCS=146MPa RUN 3# TCR=100%, SCR=100%, RQD=83%, UCS=121MPa |
| 111.0 | END OF BOREHOLE AT 19.13m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 2.13m slotted screen. | | | | | | | | | | | | |
| 19.1 | | | | | | | | | | | | | |

Continued Next Page

+ 3, x 3 : Numbers refer to
Sensitivity

20
15-5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 508-1

3 OF 3

METRIC

G.W.P. 647-92-00 LOCATION N 5 033 313.1 E 304 380.2 (County Road 508) ORIGINATED BY SL
 HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, NQ Coring COMPILED BY SS
 DATUM Geodetic DATE 22.09.03 - 23.09.03 CHECKED BY SKP

| SOIL PROFILE | | SAMPLES | | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT Y kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|-----------------------------------------------------------------------------------------------------------------------------|------------|--------|------|------------|----------------------------|-----------------|---------------------------------------------|----|----|----|-----|-----------------------------------------------------|---|----------------|------------------------------------------|------------------------------------------------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 | 40 | 60 | 80 | 100 | W _p | W | W _L | | |
| 110.1 | | | | | | | | | | | | | | | | | |
| 20.0 | WATER LEVEL READINGS: DATE ELEVATION (m) 22/10/2003 127.9 18/12/2003 128.9 04/02/2004 128.2 11/03/2004 128.5 | | | | | | | | | | | | | | | | |

RECORD OF BOREHOLE No 508-2

1 OF 3

METRIC

G.W.P. 647-92-00 LOCATION N 5 033 342.1 E 304 413.2 (County Road 508) ORIGINATED BY SL
 HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, NQ Coring COMPILED BY SS
 DATUM Geodetic DATE 19.09.03 - 22.09.03 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|-----------------------|------------------------------------------------------------------------|------------|---------|------|------------|----------------------------|-----------------|---------------------------------------------|-----------------|-----------------|-----------------|-------------------------------------------------|---------------------------------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 40 60 80 100 | 20 40 60 80 100 | 20 40 60 80 100 | 20 40 60 80 100 | | |
| 129.9 0.0 129.7 | TOPSOIL (250mm) | | | | | | | | | | | | |
| 0.3 129.2 | SAND Compact Reddish Brown Moist | | 1 | SS | 11 | | 129 | | | | | | |
| 0.7 | Silty CLAY to CLAY Very Stiff to Stiff Brown Moist (CI-CH) | | 2 | SS | 22 | | 128 | | | | | | |
| | gray/ brown | | 3 | SS | 15 | | 127 | | | | | | |
| | gray | | 4 | SS | 14 | | 126 | | | | | | |
| | becoming firm to stiff | | 5 | SS | 8 | | 125 | | | | | | |
| | with silt seams/ partings | | 6 | SS | 8 | | 124 | | | | | | |
| | occasional silt pockets | | 7 | SS | 4 | | 123 | | | | | | |
| | | | 8 | SS | 3 | | 122 | | | | | | |
| | | | 9 | SS | 2 | | 121 | | | | | | |
| 119.9 | | | | | | | 120 | | | | | | |

Continued Next Page

+ 3, x 3: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 508-2

2 OF 3

METRIC

G.W.P. 647-92-00 LOCATION N 5 033 342.1 E 304 413.2 (County Road 508) ORIGINATED BY SL
 HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, NQ Coring COMPILED BY SS
 DATUM Geodetic DATE 19.09.03 - 22.09.03 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|--------------------------------------------------------------------------------------------|------------|---------|------|------------|----------------------------|-----------------|---------------------------------------------|-----------------|-----------------|-------------------------------------------------|---------------------------------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 40 60 80 100 | 20 40 60 80 100 | 20 40 60 80 100 | | |
| 10.0 | Silty CLAY to CLAY, with silt seams/ partings Firm to Soft Grey Wet (CI-CH) | | 1 | TW | PH | | 119 | 5.3 + | | | | |
| | | | 10 | SS | 2 | | 118 | 3.5 + | | | | |
| | | | 11 | SS | 1 | | 117 | 3.2 + | | | | |
| | | | 12 | SS | 2 | | 116 | | | | | |
| | | | 13 | SS | 1 | | 115 | 3.5 + | | | | |
| | | | 14 | SS | 29 | | 114 | | | | | |
| | | | | | | | 113 | | | | | |
| | | | | | | | 112 | | | | | |
| 111.9 | | | | | | | 111 | | | | | |
| 18.0 | SAND, trace to some silt | | | | | | | | | | | |
| 111.5 | Grey | | | | | | | | | | | |
| 18.4 | Wet (SP) | | | | | | | | | | | |
| | Silty SAND, some gravel, occasional cobbles Compact Grey Wet (TILL) (SM/GP) | | | | | | | | | | | |
| 110.3 | | | | | | | | | | | | |
| 19.6 | CRYSTALLINE LIMESTONE, (BEDROCK) | | | | | | | | | | | |

Continued Next Page

+ 3, x 3: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

ONTM14 7450-508.GPJ 30/04/04

METRIC

| SOIL PROFILE | | | | SAMPLES | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|--------|---------|----------------------------|-------------------------|-----------------|------------------------------------------|----|----|-----------------------------------------------------|-----|----------------|----------------------------------------------|---------------------------------------|----------------------------------------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 | 40 | 60 | 80 | 100 | W _P | | | W |
| 107.2 | Fresh to slightly weathered, very thinly bedded, grey with dark grey and white subvertical banding, strong to very strong Subvertical joints at 20.02m, from 20.19m to 20.24m, 20.6m to 20.65m, 21.54m to 21.59m, 21.72m to 21.77m, 22.05m to 22.07m, 22.22m to 22.25m, 22.56m to 22.58m, 22.66m to 22.68m Vertical joint from 22.23m to 22.43m | | 1 | RUN | 3 3 3 0 | | 109 | | | | | | | | | RUN 1# TCR=97%, SCR=97%, RQD=88%, UCS=116MPa |
| 22.7 | END OF BOREHOLE AT 22.68m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.04m slotted screen. WATER LEVEL READINGS: DATE ELEVATION (m) 22/10/2003 127.8 18/12/2003 128.8 04/02/2004 128.2 11/03/2004 128.4 | | 2 | RUN | 1 1 2 1 1 2 | | 108 | | | | | | | | | RUN 2# TCR=98%, SCR=98%, RQD=85%, UCS=149MPa |

RECORD OF BOREHOLE No 508-3

1 OF 3

METRIC

G.W.P. 647-92-00 LOCATION N 5 033 370.4 E 304 450.6 (County Road 508) ORIGINATED BY SL
 HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, NQ Coring COMPILED BY SS
 DATUM Geodetic DATE 18.09.03 - 18.09.03 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|---------------------------------------------------------------------------------------------------|------------|---------|------|------------|----------------------------|-----------------|---------------------------------------------|-----------------|-----------------|-------------------------------------------------|---------------------------------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 40 60 80 100 | 20 40 60 80 100 | 20 40 60 80 100 | | |
| 130.1 | | | | | | | | | | | | |
| 130.0 | TOPSOIL (150mm) | | | | | | | | | | | |
| 0.2 | SAND, some silt Loose Reddish Brown Moist | | 1 | SS | 3 | | 130 | | | | | |
| 129.4 | | | | | | | | | | | | |
| 0.7 | Silty CLAY to CLAY, trace sand Very Stiff to Stiff Brown to Grey Moist to Wet (CI-CH) | | 2 | SS | 19 | | 129 | | | | | |
| | | | 3 | SS | 14 | | 128 | | | | | |
| | | | 4 | SS | 10 | | 127 | | | | | |
| | | | 5 | SS | 9 | | 126 | | | | | |
| | | | 6 | SS | 6 | | 125 | | | | | |
| | | | 7 | SS | 4 | | 124 | | | | | |
| | | | 8 | SS | 3 | | 123 | | | | | |
| | | | 9 | SS | 2 | | 122 | | | | | |
| | | | | | | | 121 | | | | | |
| 120.1 | | | | | | | | | | | | |

becoming stiff to firm
with silt seams/ partings

4.44

6.75

Continued Next Page

+ 3, x 3: Numbers refer to Sensitivity 20 15 10 (% STRAIN AT FAILURE

RECORD OF BOREHOLE No 508-3

2 OF 3

METRIC

G.W.P. 647-92-00 LOCATION N 5 033 370.4 E 304 450.6 (County Road 508) ORIGINATED BY SL
HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, NQ Coring COMPILED BY SS
DATUM Geodetic DATE 18.09.03 - 18.09.03 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|---------|------|-----------------------|----------------------------|-----------------|---------------------------------------------|------------------------------------|-------------------------------------|-------------------------------------------------|------------------------------------------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 40 60 80 100 | PLASTIC LIMIT W _P | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | |
| 10.0 | Silty CLAY to CLAY, with silt seams/ partings Firm to Soft Grey Wet (CI-CH) | | 10 | SS | 3 | | 120 | 5.56 | | | | |
| | | | | | | | 119 | | | | | |
| | | | | | | | 118 | 3.71 | | | | |
| | | | 11 | SS | 1 | | 117 | | | | | 0 0 45 55 |
| | | | | | | | 116 | 4.33 | | | | |
| | | | 12 | SS | 2 | | 115 | | | | | |
| | | | | | | | 114 | 2.8 | | | | |
| | soft to firm | | 13 | SS | 4 | | 113 | | | | | |
| | | | | | | | 112 | 3 | | | | |
| | | | 14 | SS | 2 | | 111 | | | | | |
| | frequant cobbles below 17.8m auger refusal at 18.28m | | | | | | 110 | 2.57 | | | | |
| 111.6 | | | | | FI | | 109 | | | | | |
| 18.5 | CRYSTALLINE LIMESTONE, (BEDROCK) Slightly weathered, very thinly bedded, grey and light brown with dark grey and white subvertical banding, occasional iron oxide staining at joints, very strong to strong Subvertical joints from 18.49m to 18.54, 18.64m to 18.75m, 18.8m to | | 1 | RUN | 4 2 2 2 2 | | 108 | | | | | RUN 1# TCR=100%, SCR=100%, RQD=77%, UCS=157MPa |

Continued Next Page

+ 3, x 3: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 508-3

3 OF 3

METRIC

G.W.P. 647-92-00 LOCATION N 5 033 370.4 E 304 450.6 (County Road 508) ORIGINATED BY SL
 HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, NQ Coring COMPILED BY SS
 DATUM Geodetic DATE 18.09.03 - 18.09.03 CHECKED BY SKP

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|---------|------|-----------------------|----------------------------|------------------------|---------------------------------------------|-----------------|-----------------------------------------------------------|----------|--|-------------------------------------------------|------------------------------------------------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 40 60 80 100 | 20 40 60 80 100 | W P W W L | 20 40 60 | | | |
| 108.5 | 18.97m, 19.02m to 19.05m, 19.38m to 19.43m, 19.86m to 19.91m, 20.55m, 20.78m to 20.8m, 21.11m to 21.16m, 21.34m to 21.41m, 21.46m to 21.49m | | 2 | RUN | 4 4 1 1 4 | | 110 109 | | | | | | | RUN 2# TCR=100%, SCR=97%, ROD=70%, UCS=98MPa |
| 21.5 | END OF BOREHOLE AT 21.54mm. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS: DATE ELEVATION (m) 22/10/2003 127.7 18/12/2003 129.1 04/02/2004 129.0 11/03/2004 129.1 | | | | | | | | | | | | | |

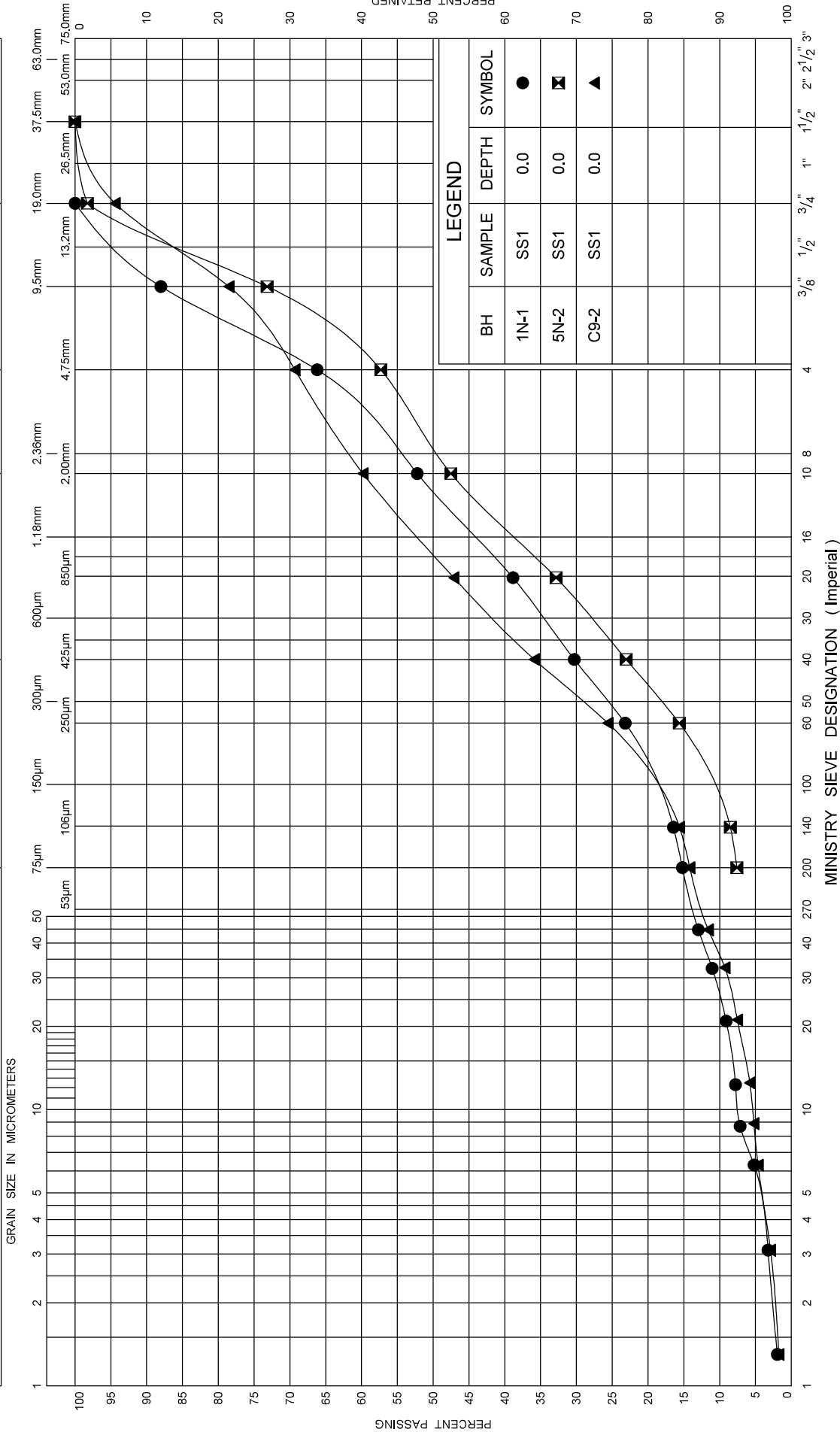
APPENDIX B1

Field & Laboratory Test Results (Current Investigations)



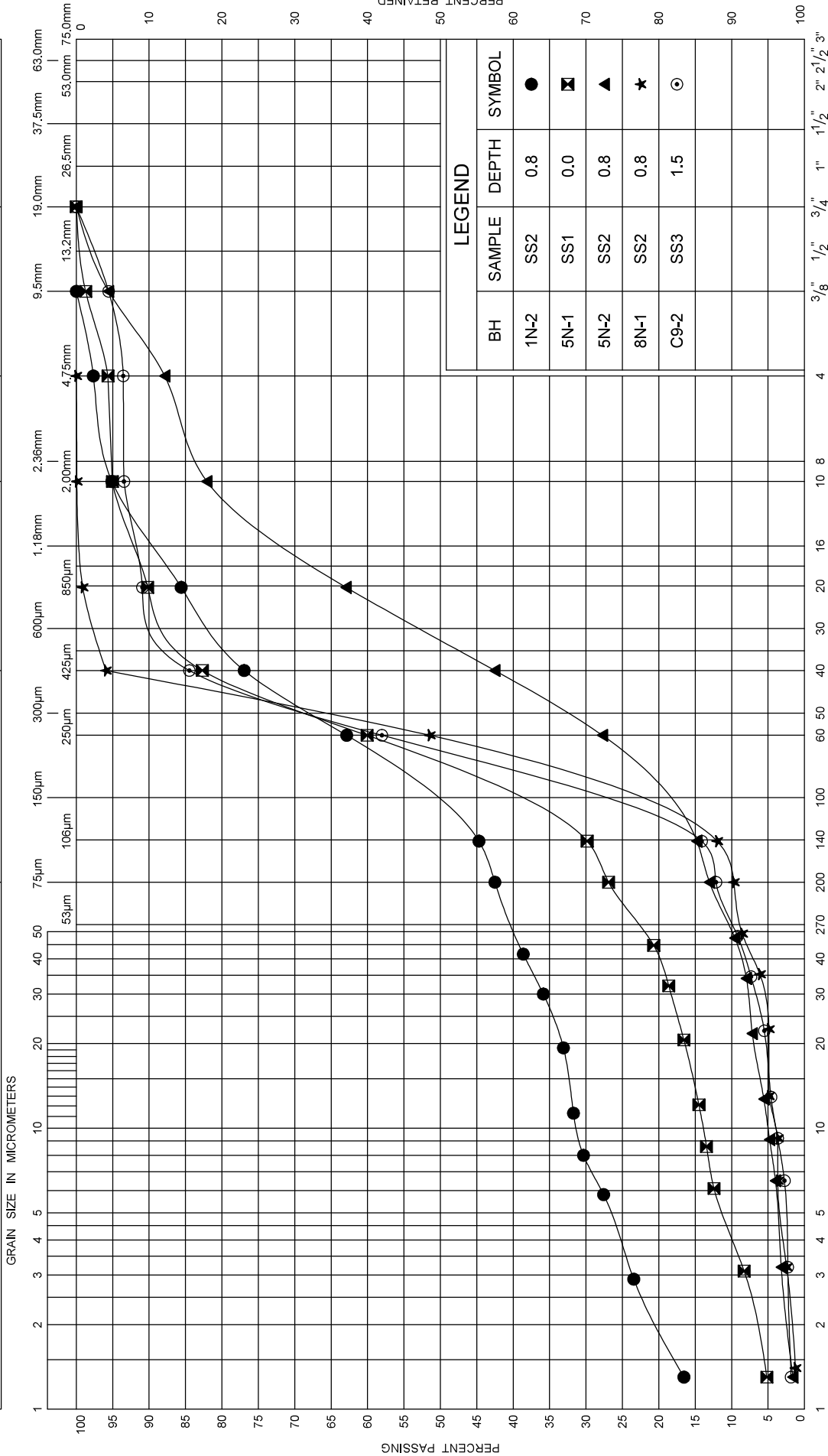
UNIFIED SOIL CLASSIFICATION SYSTEM

| CLAY & SILT | | SAND | | | GRAVEL | |
|-------------|--|------|--|--------|--------|--------|
| | | Fine | | Medium | Fine | Coarse |



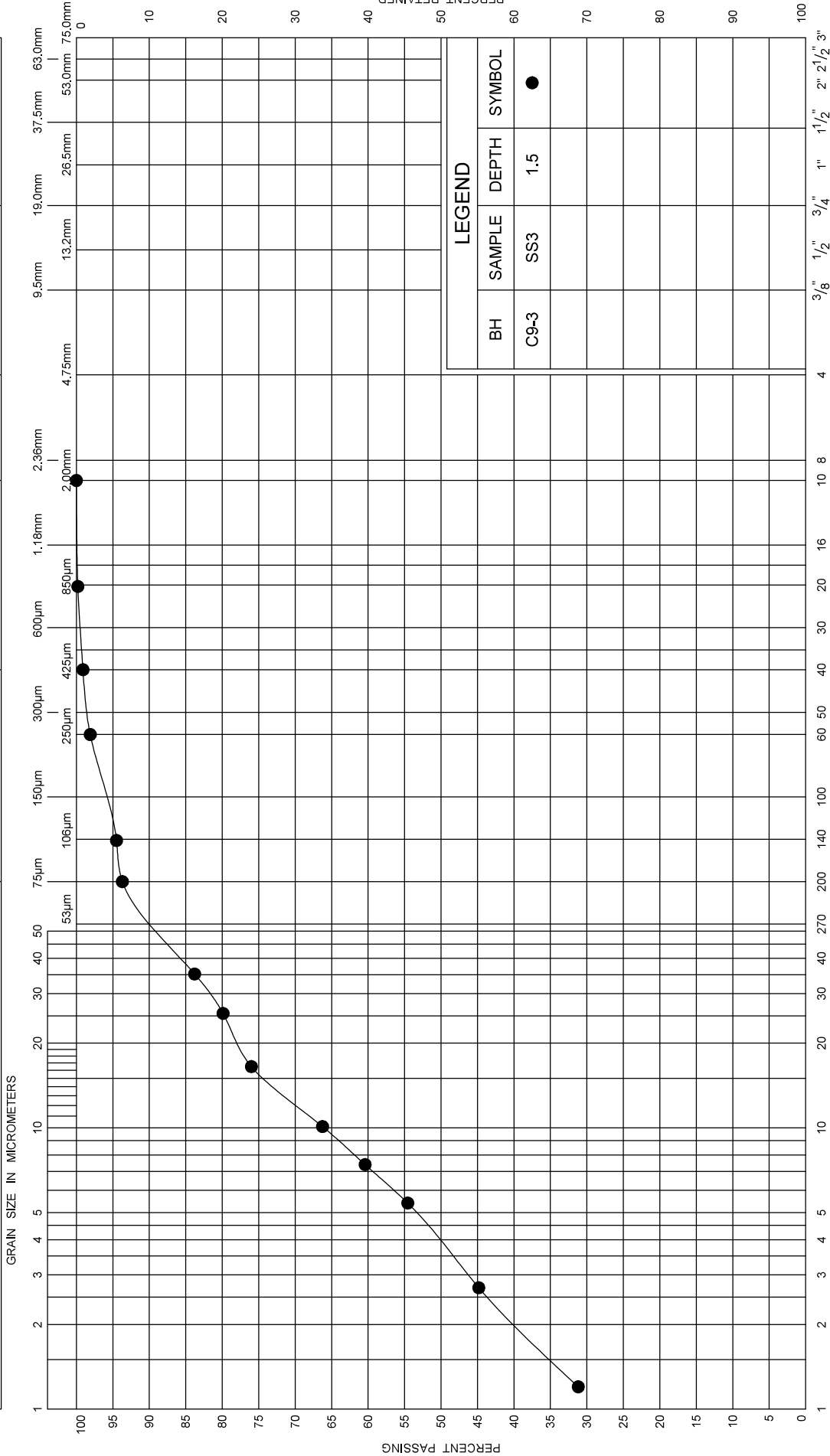
UNIFIED SOIL CLASSIFICATION SYSTEM

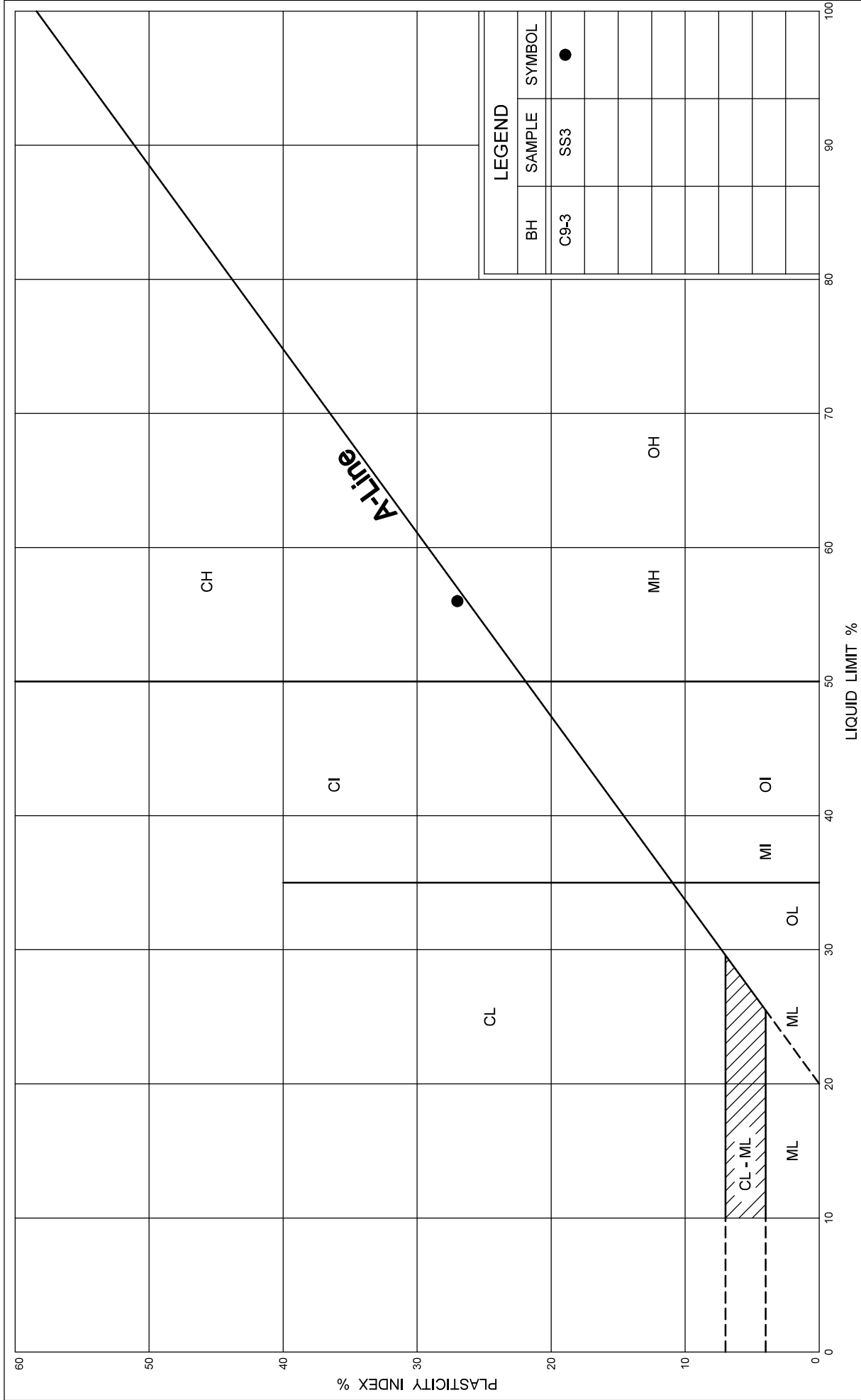
| CLAY & SILT | | SAND | | | GRAVEL | |
|-------------|--|------|--------|--------|--------|--------|
| | | Fine | Medium | Coarse | Fine | Coarse |



UNIFIED SOIL CLASSIFICATION SYSTEM

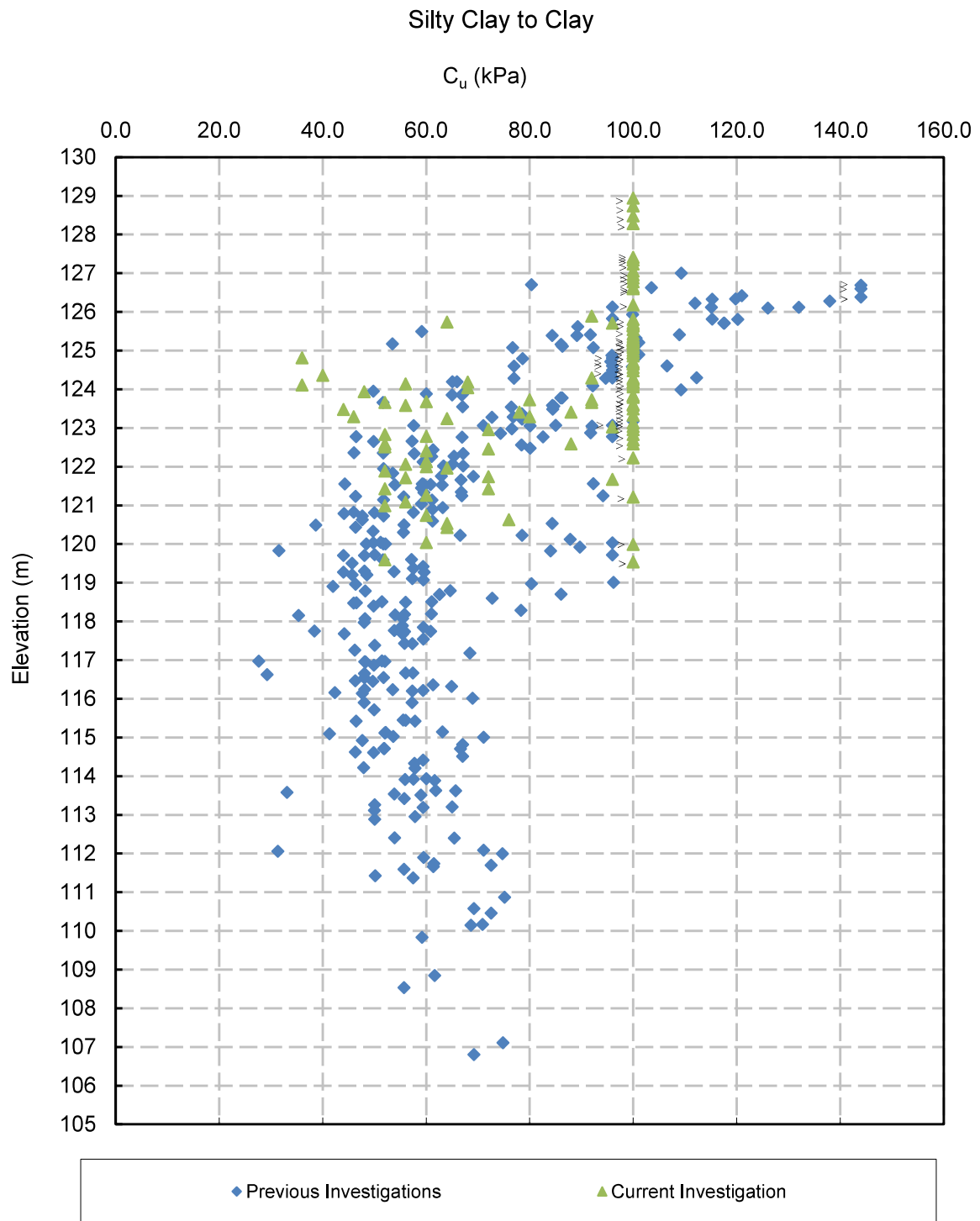
| CLAY & SILT | | SAND | | | GRAVEL | |
|-------------|--|------|--------|--------|--------|--------|
| | | Fine | Medium | Coarse | Fine | Coarse |





IN-SITU UNDRAINED SHEAR STRENGTH

FIGURE B1-5



Project No. : 1-21-0044
Date : May, 2022

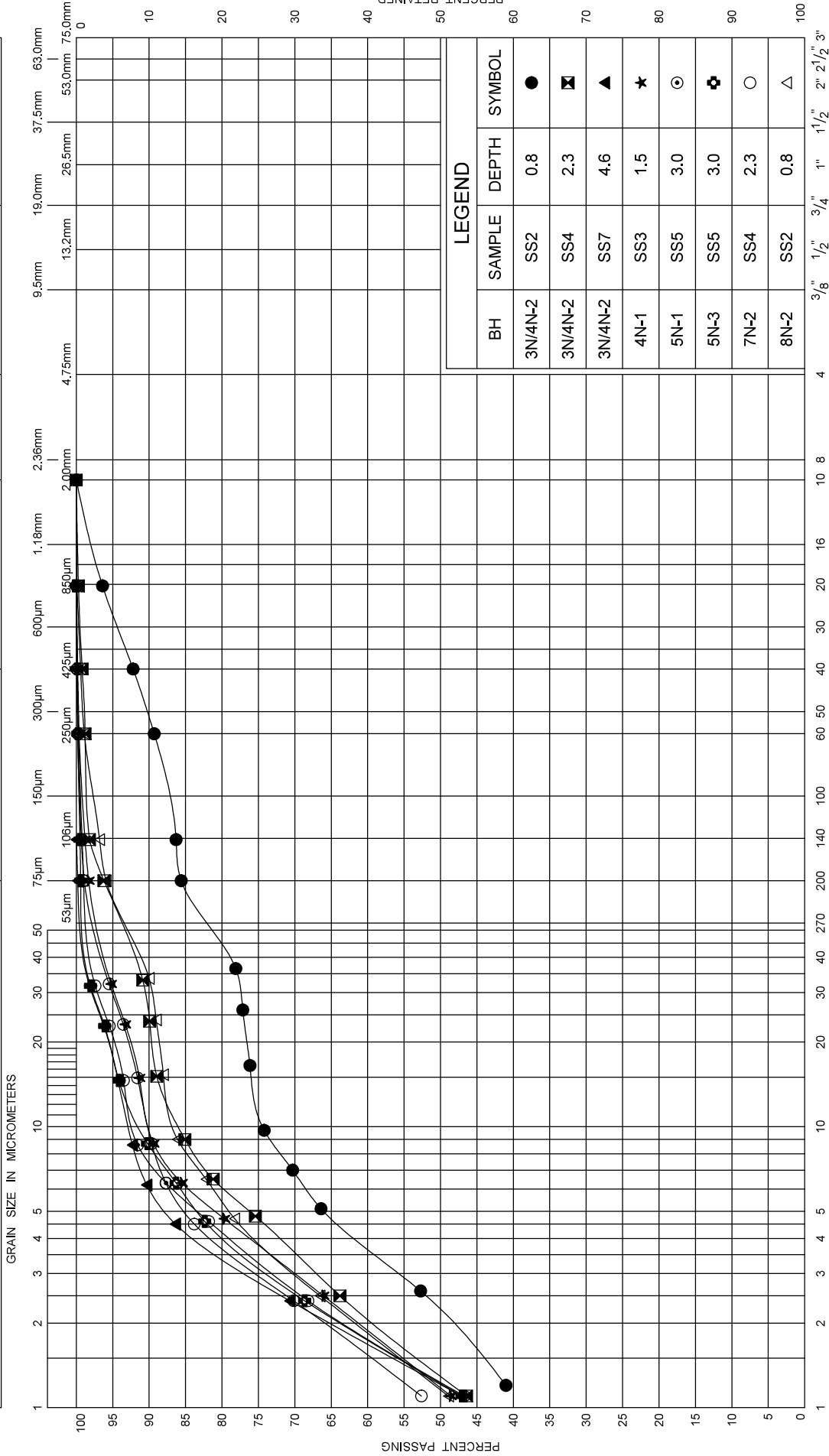


Terraprobe

Prepared by : SD
Checked by : RA

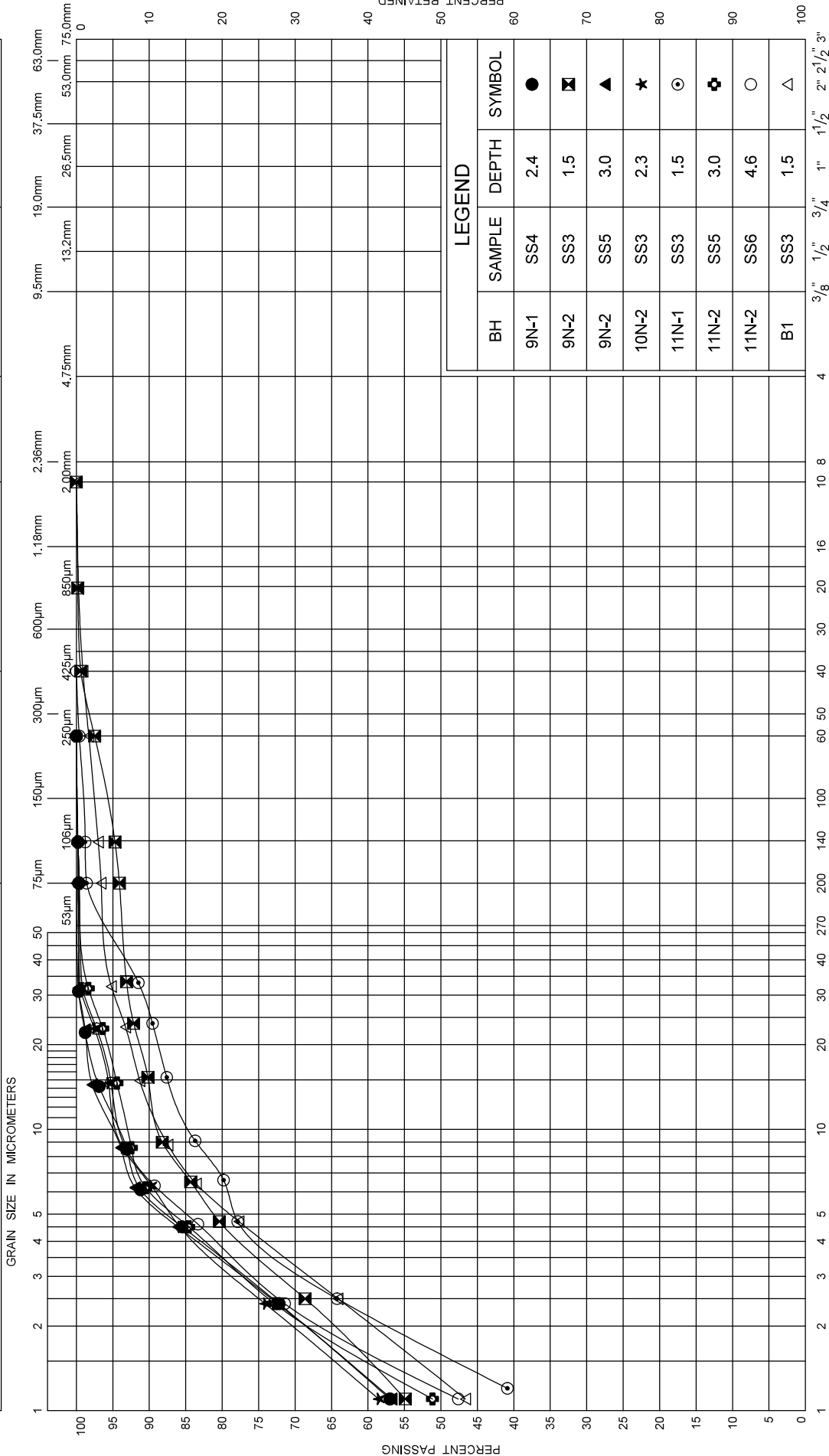
UNIFIED SOIL CLASSIFICATION SYSTEM

| CLAY & SILT | | SAND | | | GRAVEL | |
|-------------|--|------|--|--------|--------|--------|
| | | Fine | | Medium | Fine | Coarse |

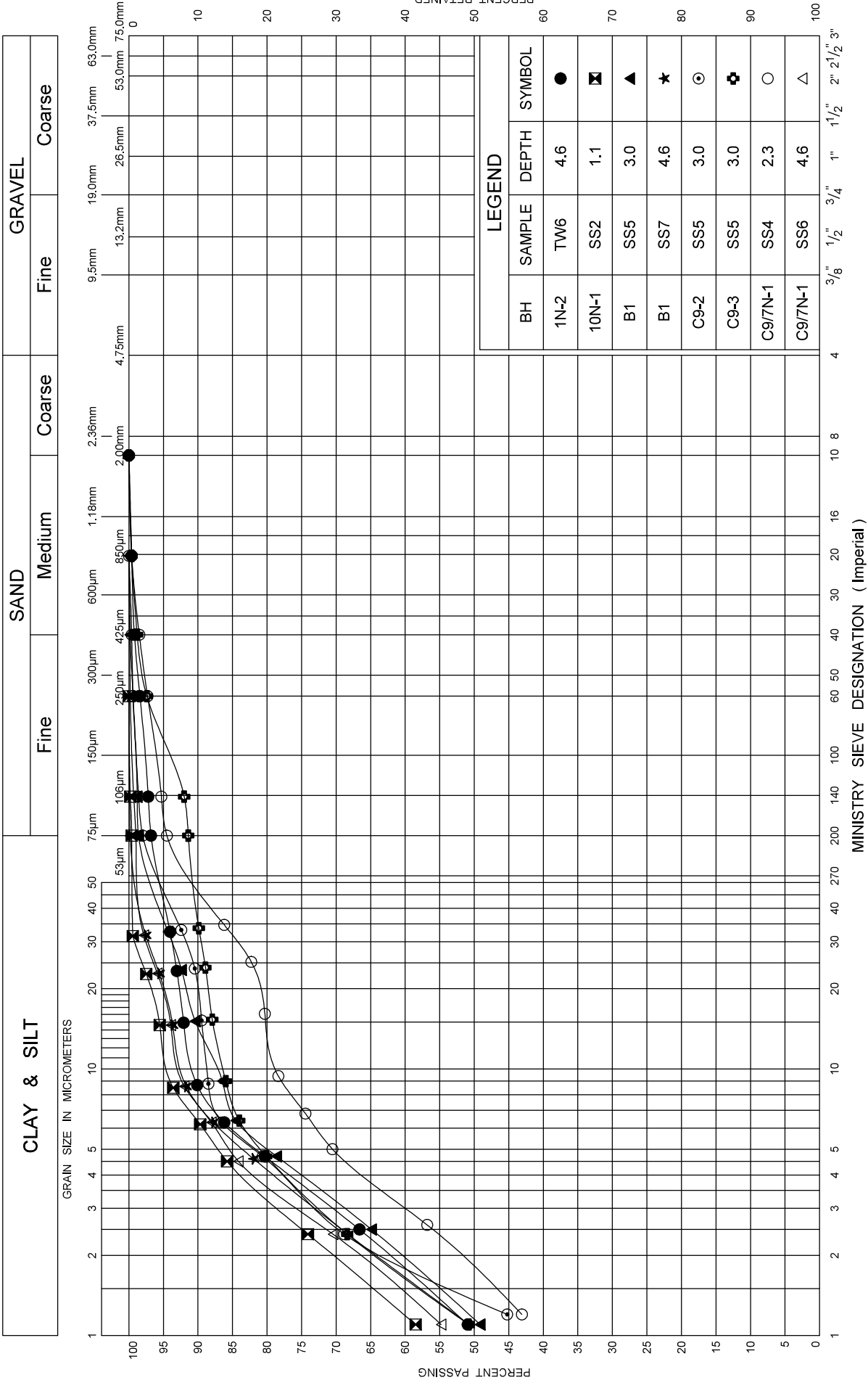


UNIFIED SOIL CLASSIFICATION SYSTEM

| CLAY & SILT | | SAND | | | GRAVEL | |
|-------------|--|------|--------|--------|--------|--------|
| | | Fine | Medium | Coarse | Fine | Coarse |

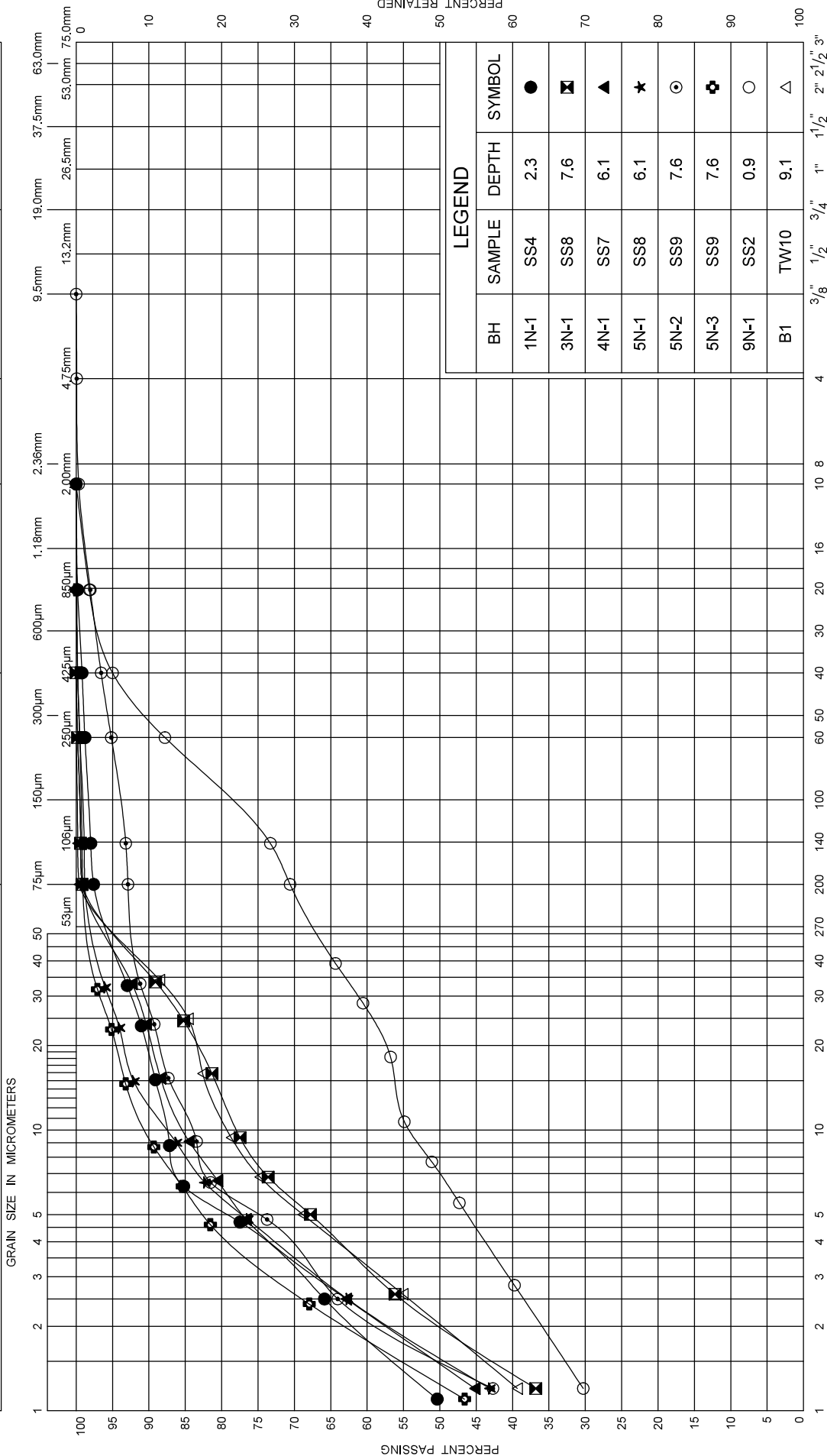


UNIFIED SOIL CLASSIFICATION SYSTEM



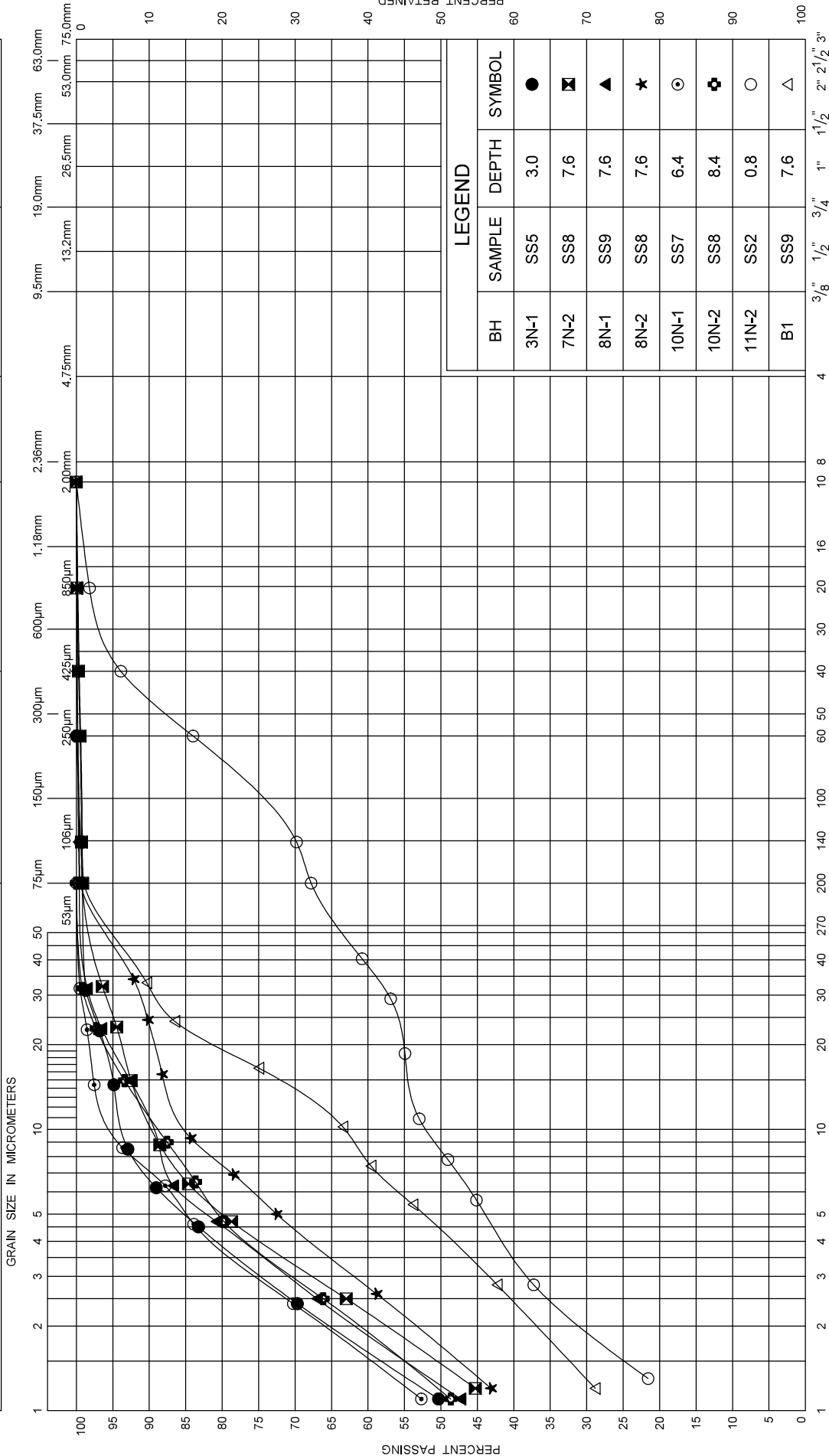
UNIFIED SOIL CLASSIFICATION SYSTEM

| CLAY & SILT | | SAND | | | GRAVEL | |
|-------------|--|------|--------|--------|--------|--------|
| | | Fine | Medium | Coarse | Fine | Coarse |



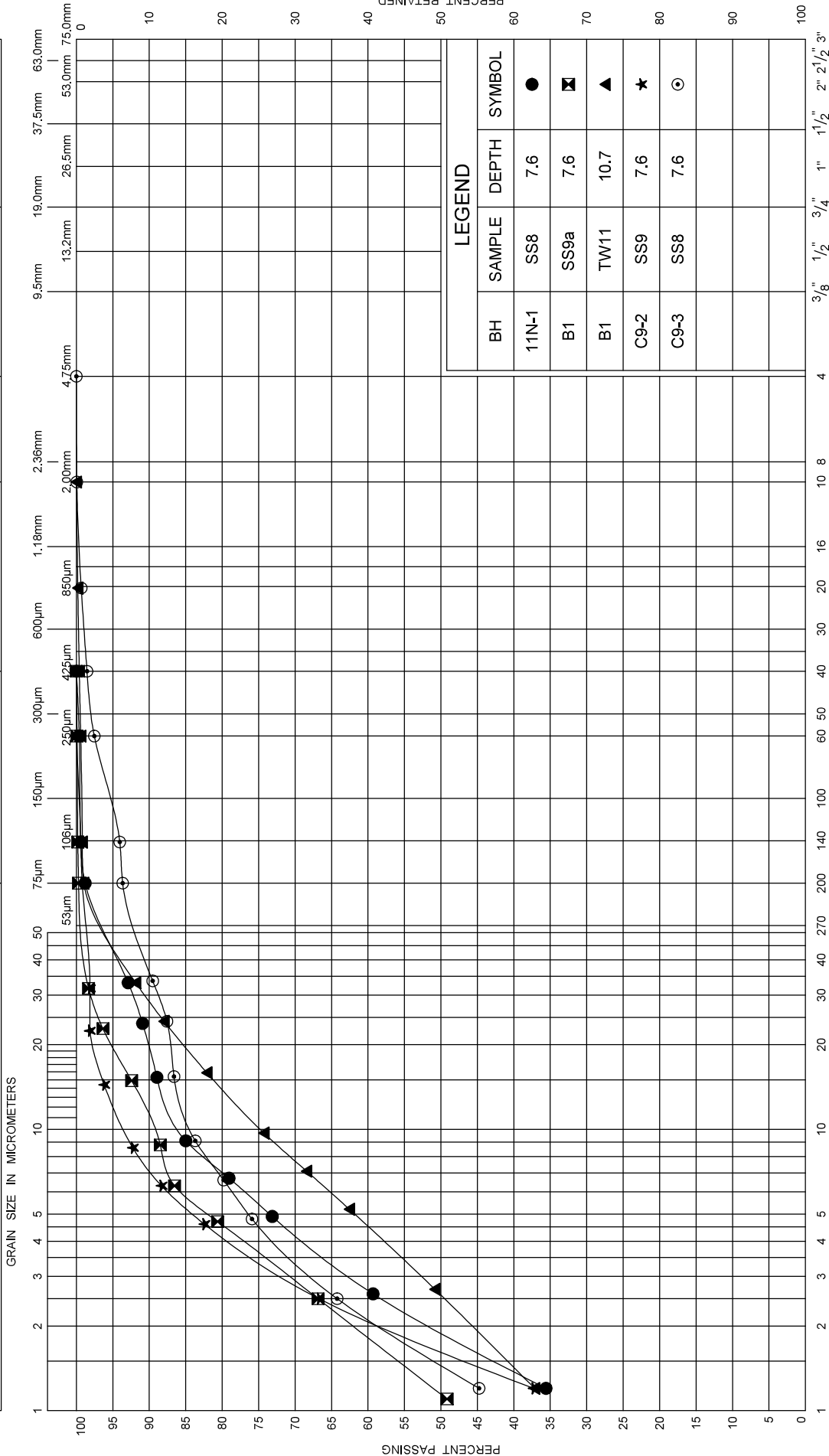
UNIFIED SOIL CLASSIFICATION SYSTEM

| CLAY & SILT | | SAND | | | GRAVEL | |
|-------------|--|------|--------|--------|--------|--------|
| | | Fine | Medium | Coarse | Fine | Coarse |



UNIFIED SOIL CLASSIFICATION SYSTEM

| CLAY & SILT | | SAND | | | GRAVEL | |
|-------------|--|------|--------|--------|--------|--------|
| | | Fine | Medium | Coarse | Fine | Coarse |

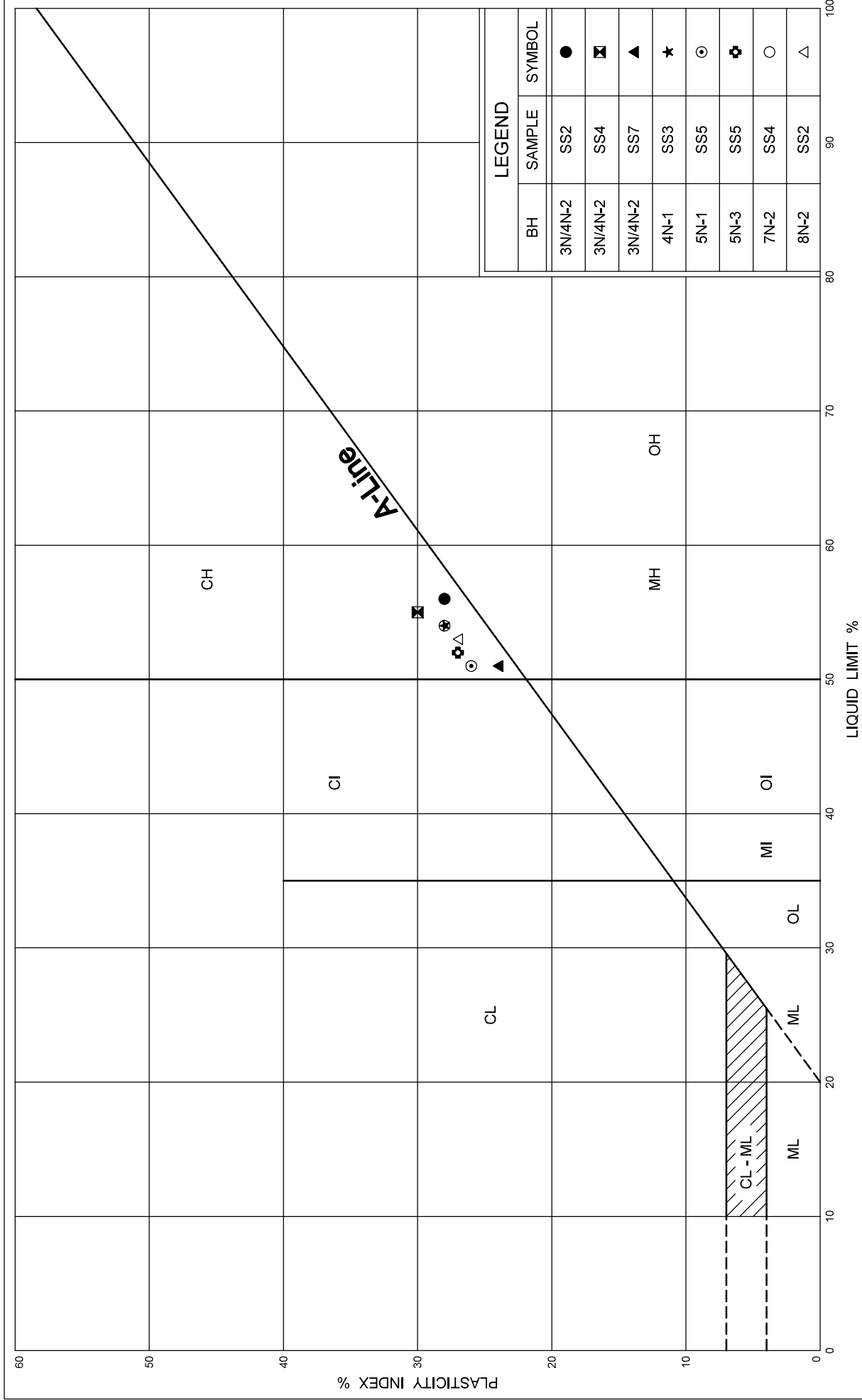


Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
SILTY CLAY TO CLAY

FIG No B1-11

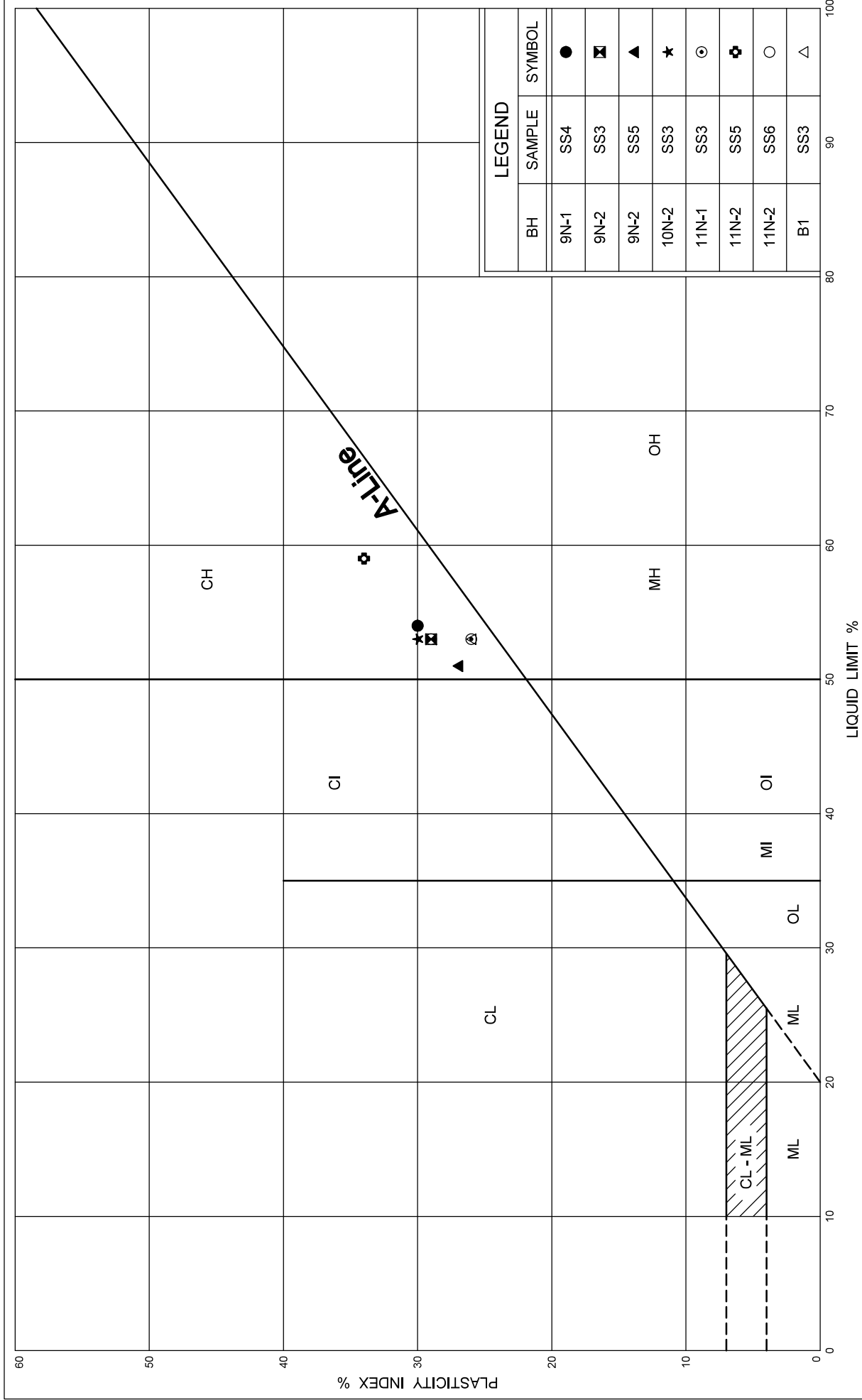
G W P

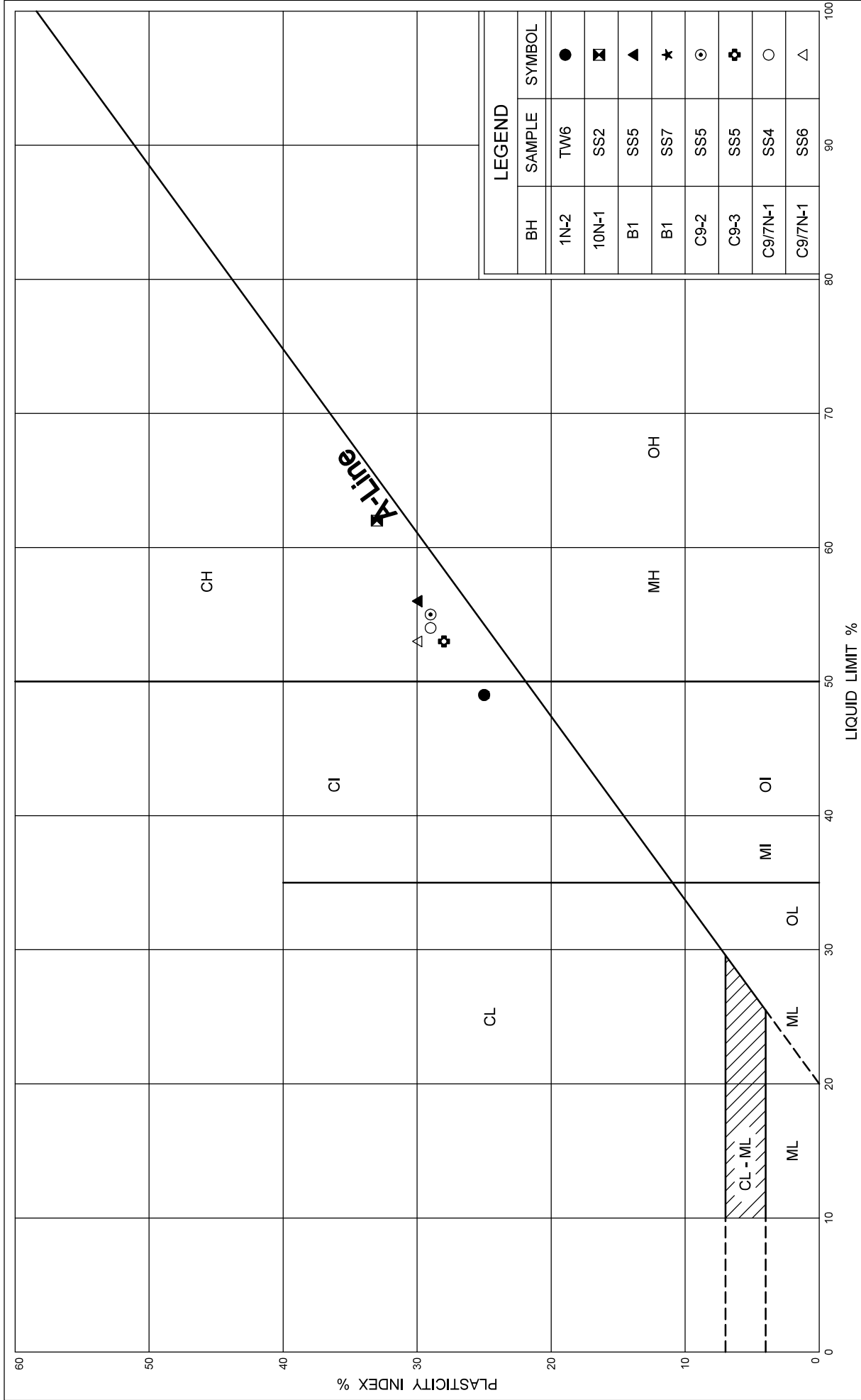


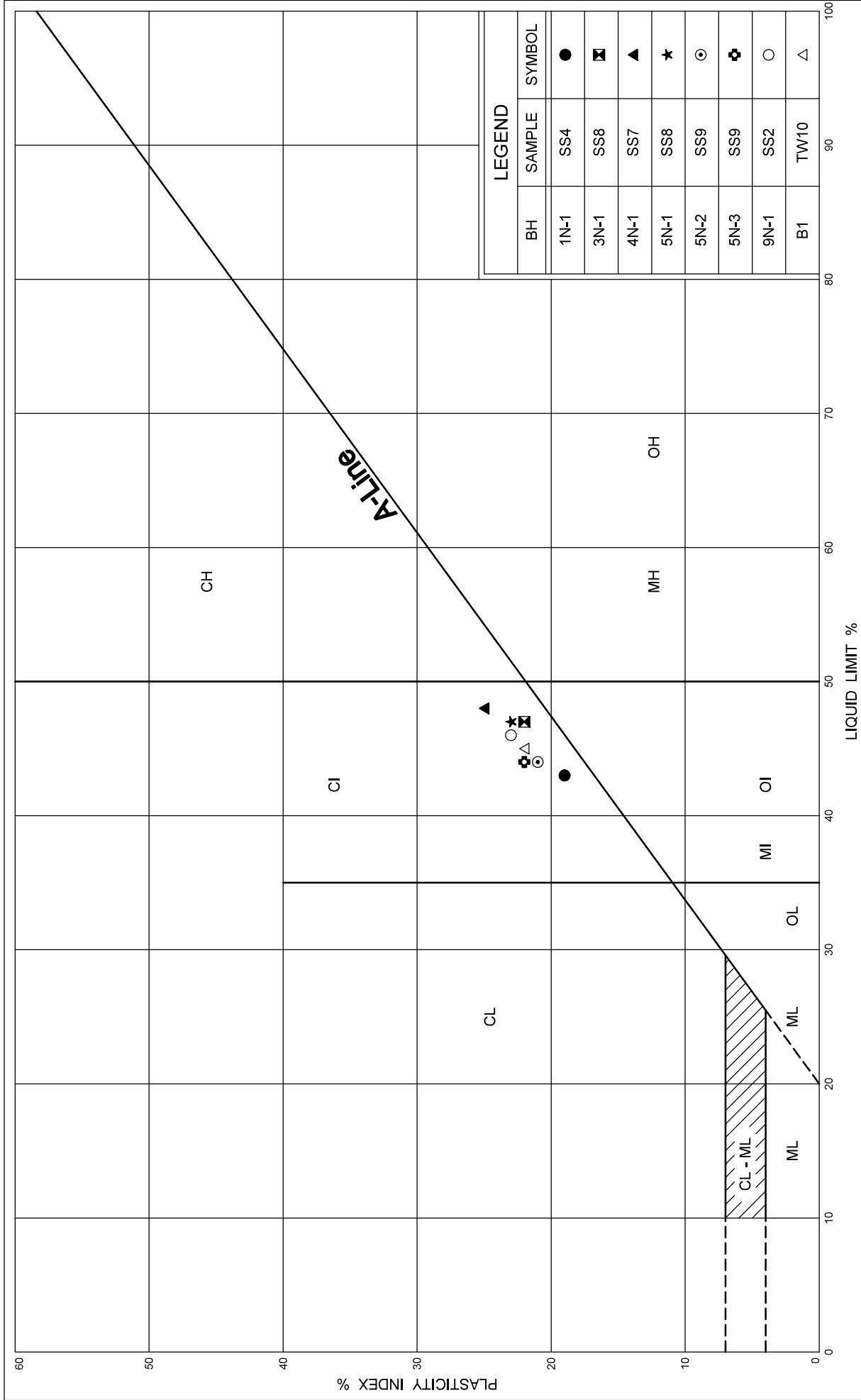
PLASTICITY CHART
SILTY CLAY TO CLAY

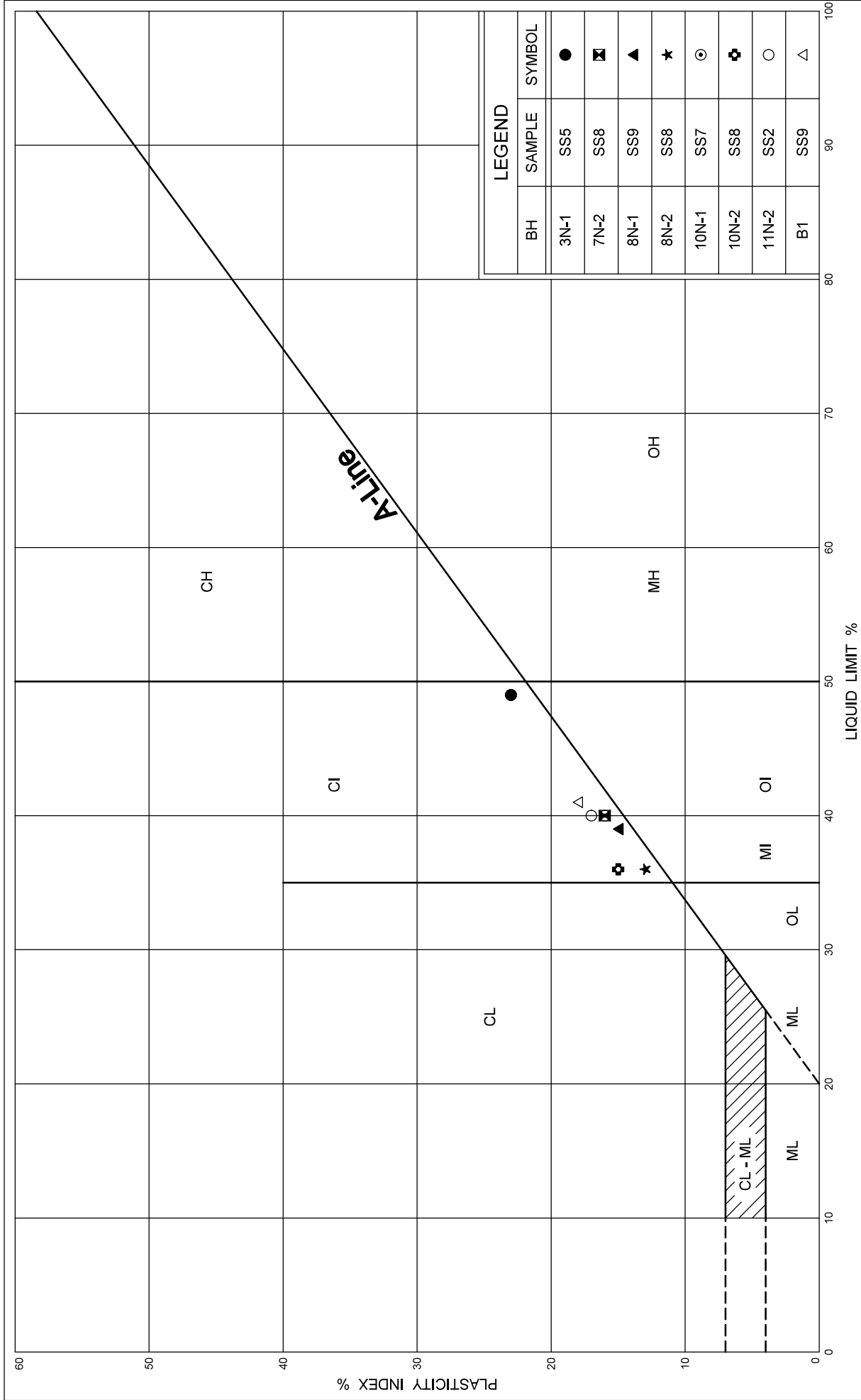
FIG No B1-12

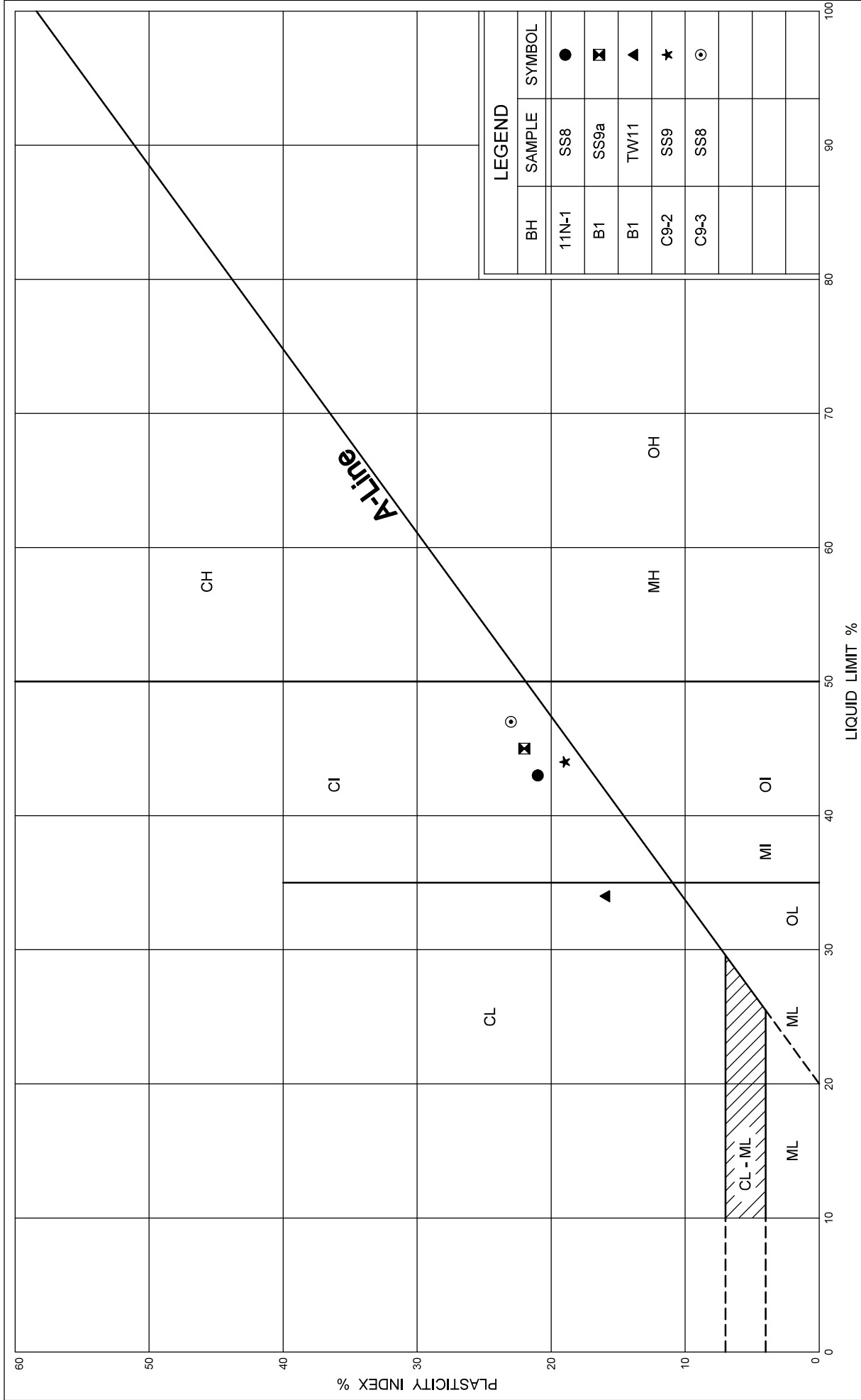
G W P











**CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
(ASTM D4767-11)**

Figure B1-19

SPECIMEN IDENTIFICATION

| | | | |
|----------------------|-----------|----------------------|--------------------|
| Borehole/Sample No.: | B1A - TW3 | Sample Type: | Intact |
| Sample Depth (m): | 7.6 - 8.2 | Soil Classification: | Silty Clay to Clay |
| Liquid Limit: | 45% | Specific Gravity: | 2.751 |
| Plastic limit: | 23% | | |

INITIAL SPECIMEN DIMENSIONS AND PROPERTIES

| Test No.: | 1 | 2 | 3 |
|------------------------------------------------|--------|--------|--------|
| Specimen Height, (mm) | 141.1 | 140.8 | 140.1 |
| Specimen Diameter, (mm) | 69.3 | 69.6 | 69.7 |
| Natural Water Content (Cuttings/Specimen), (%) | 49.1% | 49.5% | 47.5% |
| Void Ratio | 1.342 | 1.354 | 1.305 |
| Degree Of Saturation, (%) | 100.6% | 100.5% | 100.1% |
| Dry Unit Weight (kN/m ³) | 11.49 | 11.43 | 11.68 |

CONSOLIDATION

| | | | |
|-----------------------------------------------------------|-------|-------|-------|
| Cell Pressure, σ_3 , (kPa) | 425 | 500 | 650 |
| Back Pressure, (kPa) | 350 | 350 | 350 |
| Pore Pressure Parameter "B" | 0.96 | 96 | 0.96 |
| Effective Consolidation Stress, σ_c , (kPa) | 75 | 150 | 300 |
| Water Content After Consolidation, (%) | 50.1% | 49.1% | 46.1% |
| Void Ratio After Consolidation | 1.376 | 1.347 | 1.264 |
| Degree Of Saturation After Consolidation, (%) | 36.4% | 36.4% | 36.4% |
| Dry Unit Weight After Consolidation, (kN/m ³) | 11.3 | 11.5 | 11.9 |

SHEARING/FAILURE

| | | | |
|------------------------------------------------------------------|-------|------|------|
| Max. Deviator Stress, $(\sigma_1 - \sigma_3)$, (kPa) | 140 | 189 | 270 |
| Effective Major Principal Stress At Failure, σ'_1 , (kPa) | 178 | 252 | 385 |
| Effective Minor Principal Stress At Failure, σ'_3 , (kPa) | 38 | 63 | 115 |
| Axial Strain At Maximum $(\sigma_1 - \sigma_3)$, (%) | 10.3% | 1.8% | 2.2% |
| Average Rate of Strain, (%/hr) | 1.00 | 1.00 | 2.00 |
| Time to Failure, (hr) | 10.4 | 1.9 | 1.1 |

Test Notes:

| | | | |
|--------------------------------------------|----------------------------|----------------------------|----------------------------|
| Specimen Saturation Method | Dry | Dry | Dry |
| Failure Criterion | Max. $\sigma_1 - \sigma_3$ | Max. $\sigma_1 - \sigma_3$ | Max. $\sigma_1 - \sigma_3$ |
| Membrane Thickness Correction Applied, Y/N | N | N | N |

Project No.: 1-21-0044

Date: May, 2021



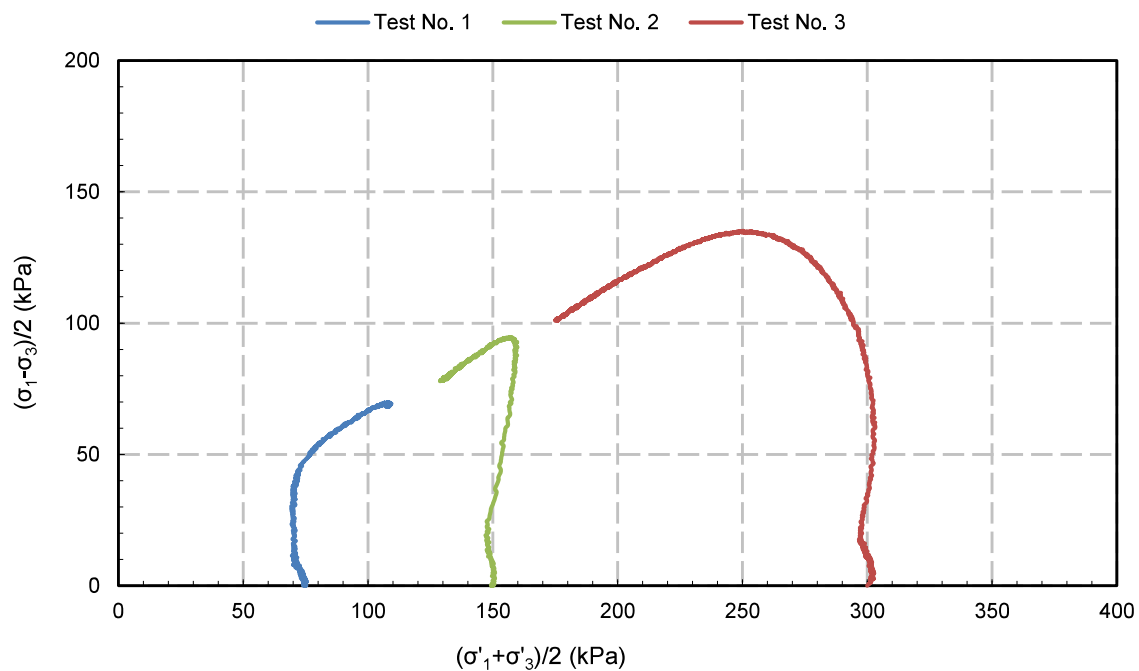
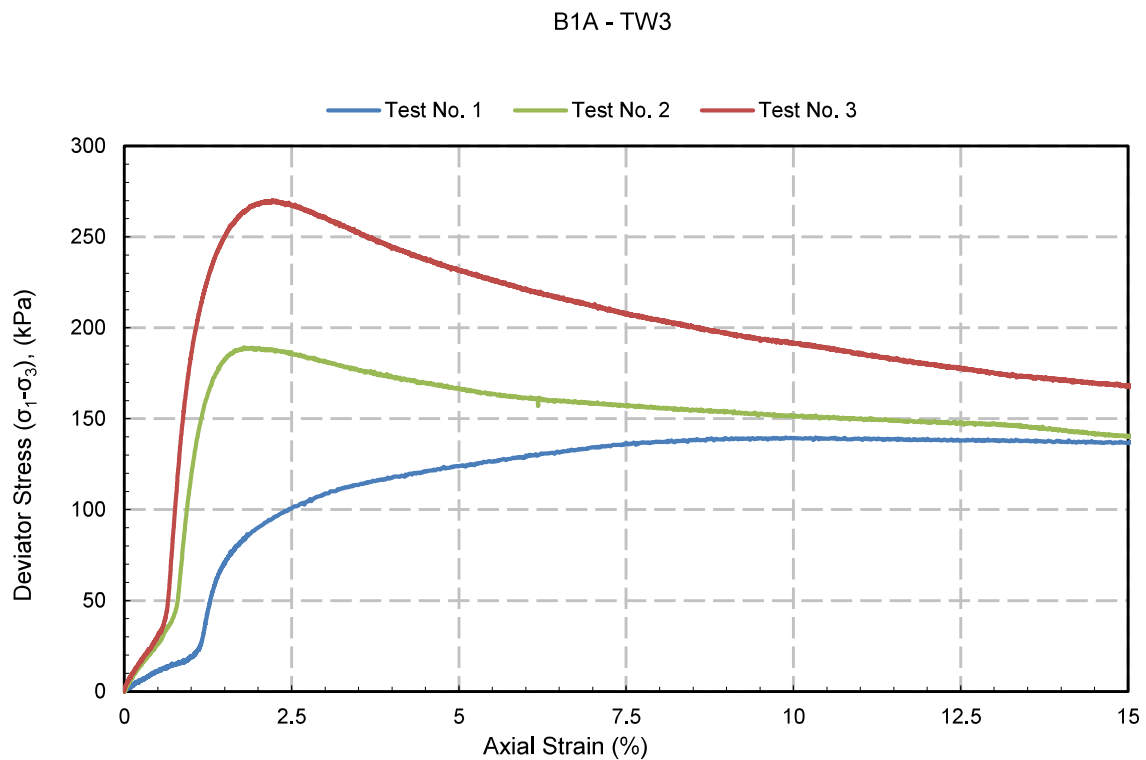
Terraprobe Inc.

Prepared By : SD

Checked By : RA

**CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
(ASTM D4767-11)**

Figure B1-20



Project No.: 1-21-0044
Date: May, 2021

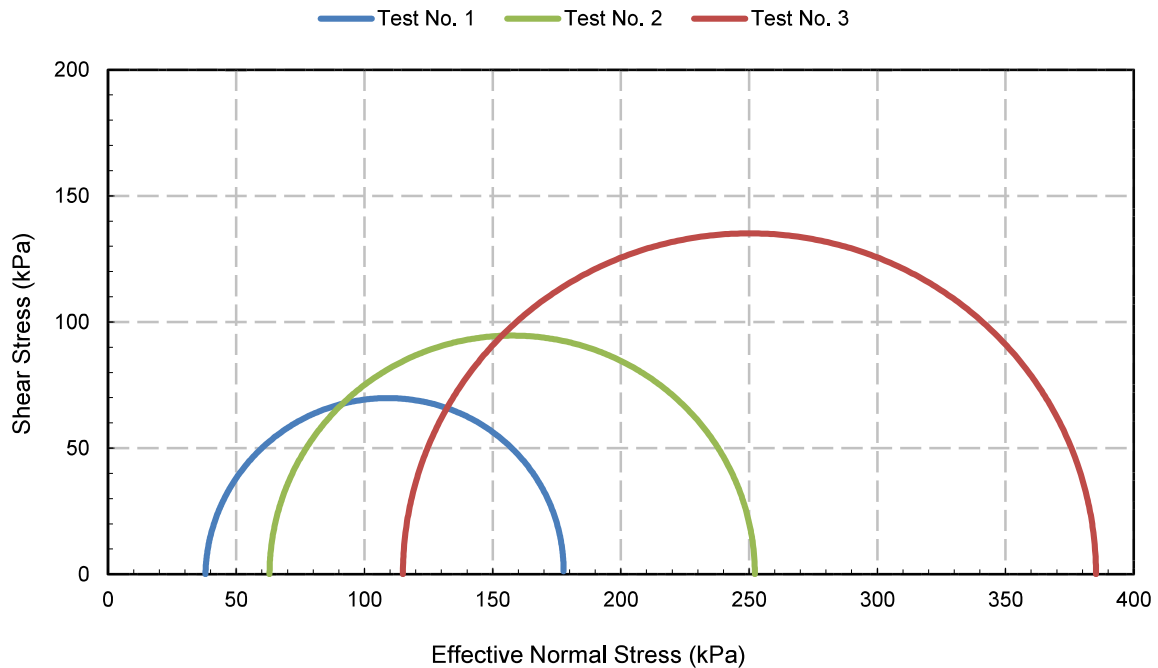
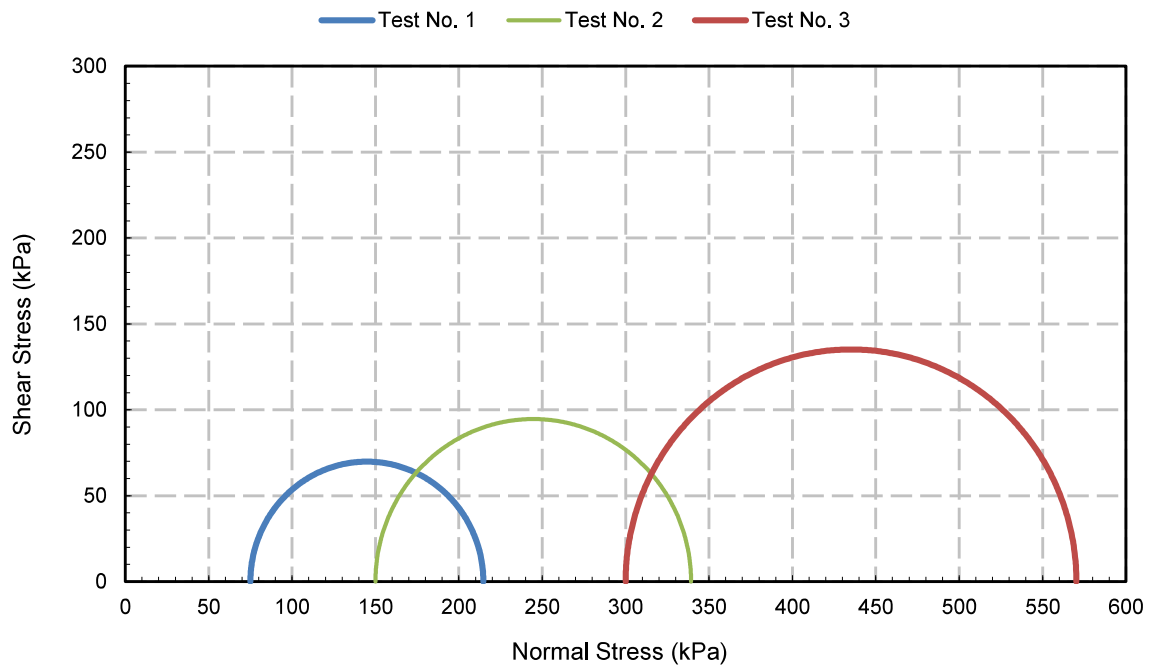


Prepared By : SD
Checked By : RA

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST (ASTM D4767-11)

Figure B1-21

B1A - TW3



Project No.: 1-21-0044
Date: May, 2021

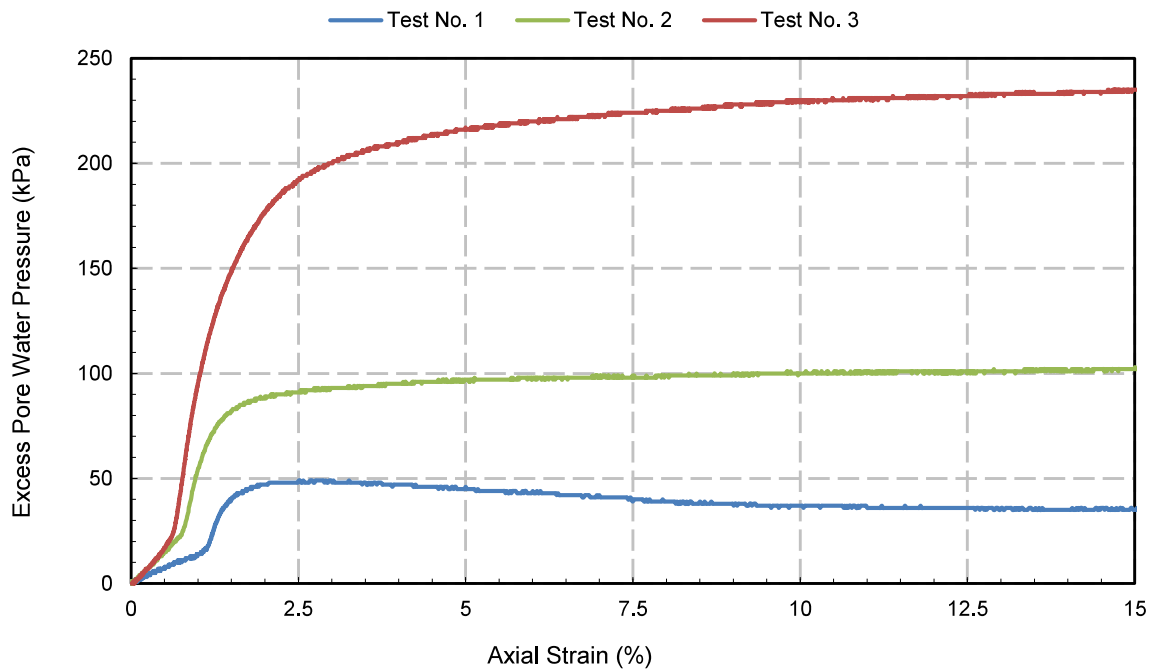
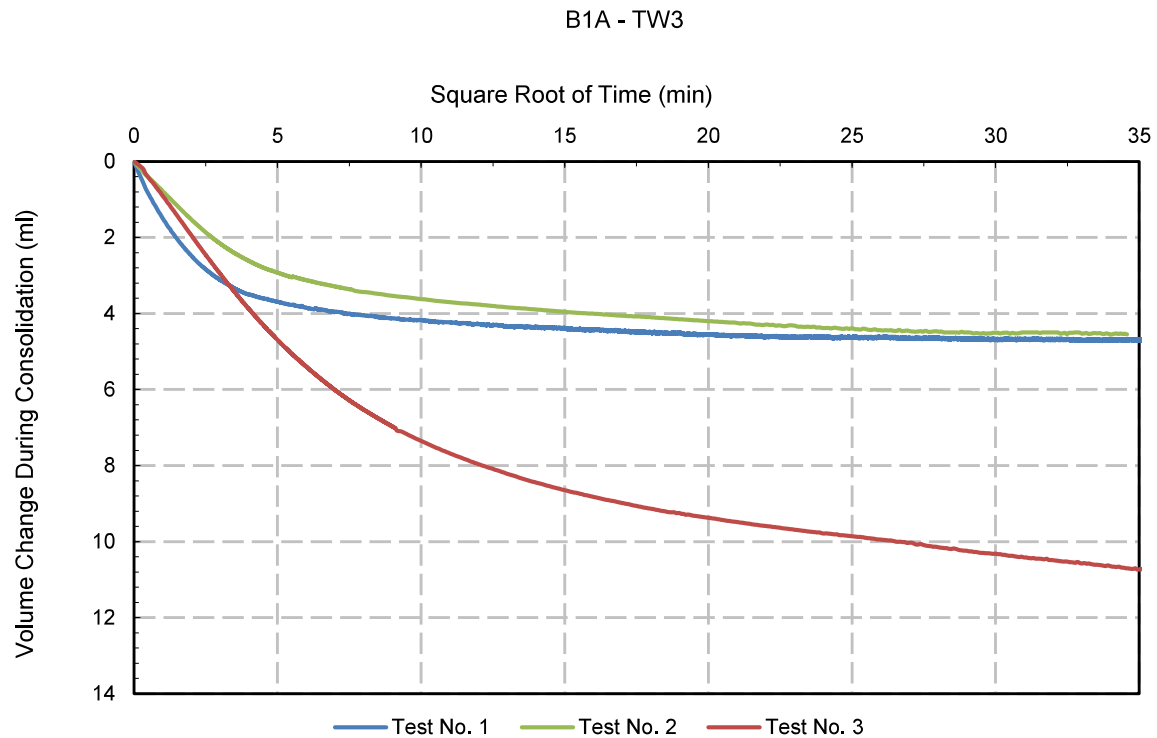


Terraprobe Inc.

Prepared By : SD
Checked By : RA

**CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
(ASTM D4767-11)**

Figure B1-22



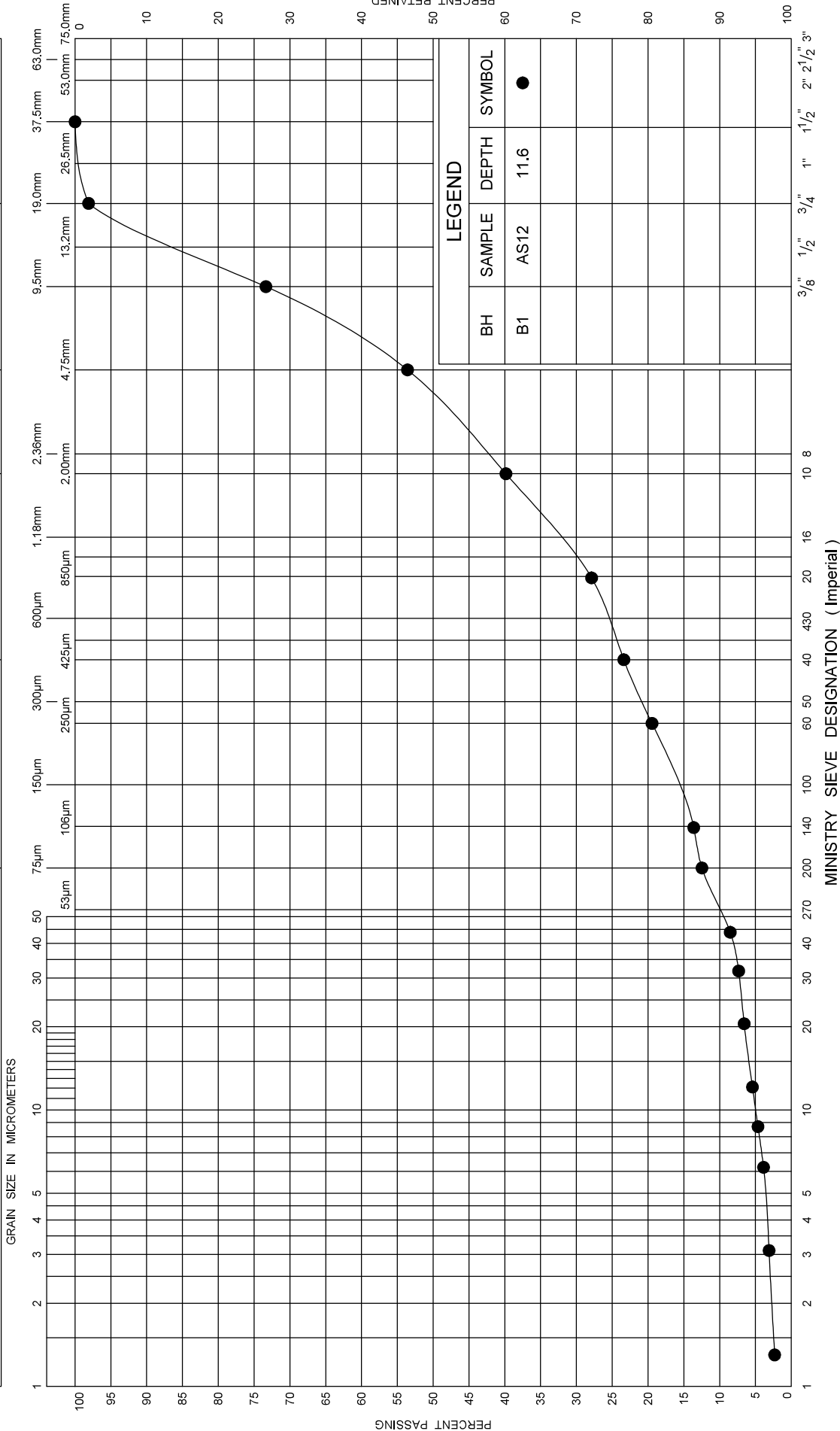
Project No.: 1-21-0044
Date: May, 2021



Prepared By : SD
Checked By : RA

UNIFIED SOIL CLASSIFICATION SYSTEM

| CLAY & SILT | | SAND | | | GRAVEL | | |
|-------------|--|------|--|--------|--------|------|--------|
| | | Fine | | Medium | Coarse | Fine | Coarse |



APPENDIX B2

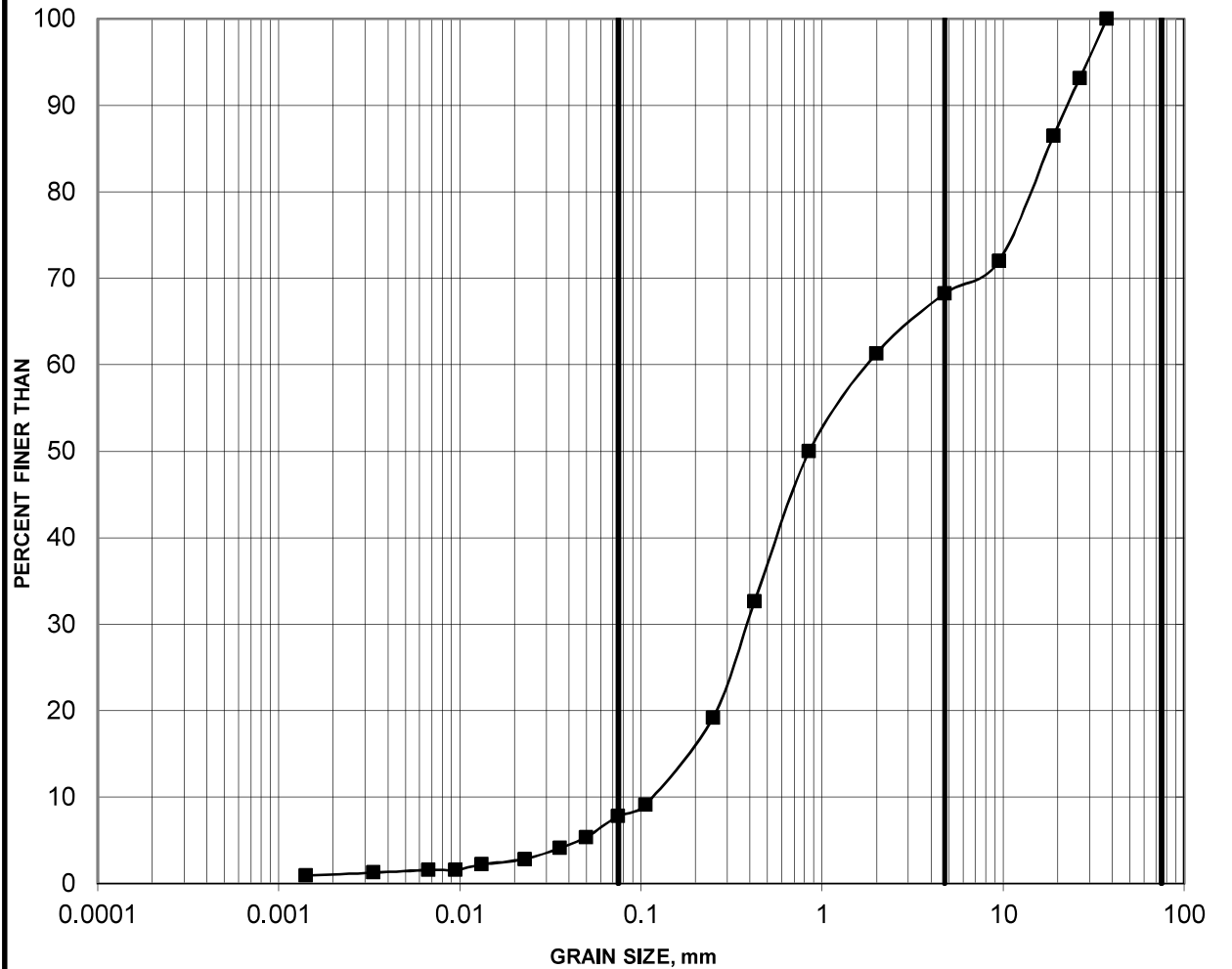
Field & Laboratory Test Results (Previous Investigations)



GRAIN SIZE DISTRIBUTION

FIGURE B1

SAND AND GRAVEL (FILL)

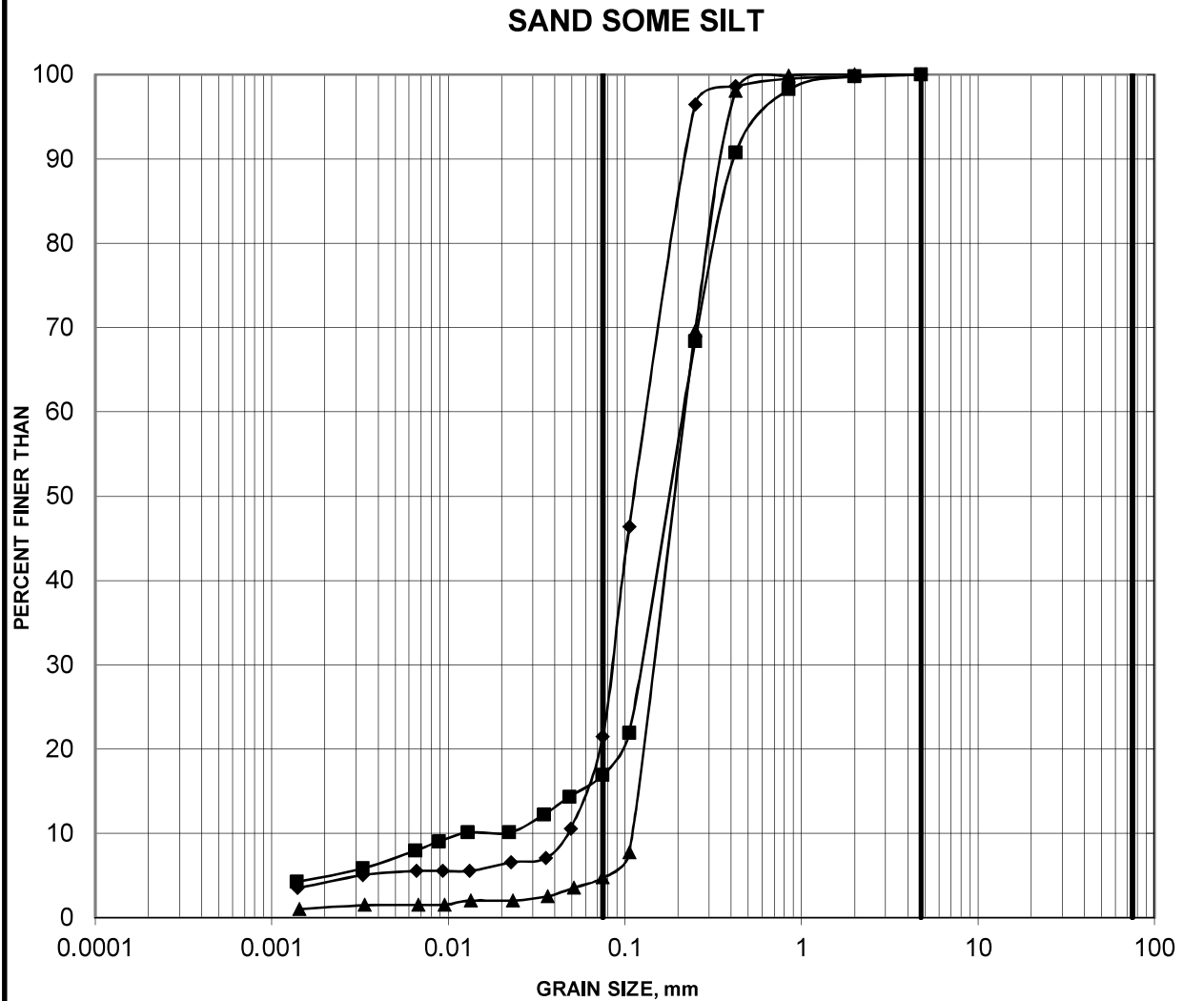


| | | | | | | |
|---------------|-----------|--------|--------|-------------|--------|----------------|
| SILT AND CLAY | FINE | MEDIUM | COARSE | FINE | COARSE | COBBLE SIZE |
| | SAND SIZE | | | GRAVEL SIZE | | |

| Borehole | Sample | Depth (m) |
|----------|--------|-----------|
| 18-304 | 1 | 0.00-0.46 |

GRAIN SIZE DISTRIBUTION

FIGURE B2

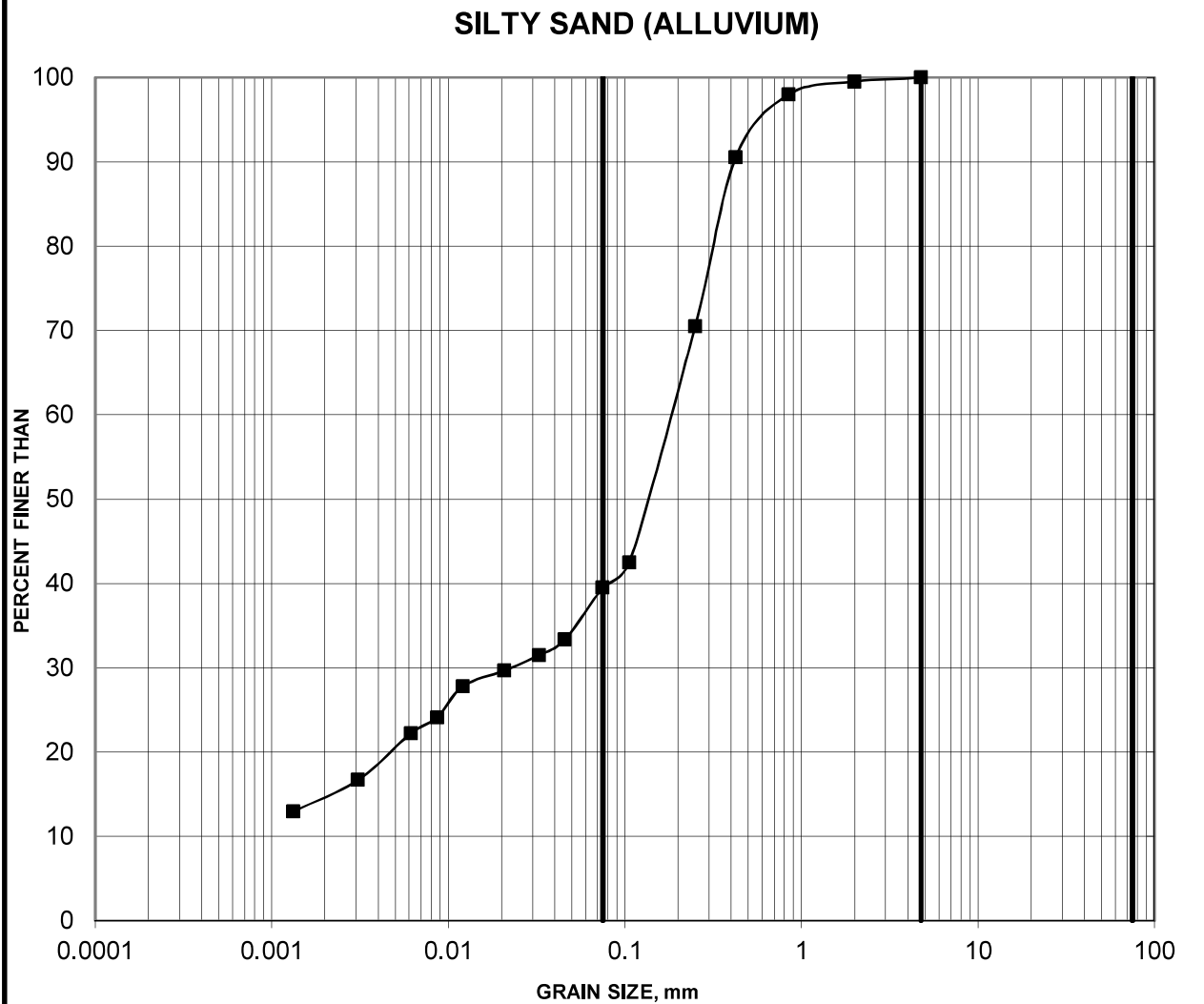


| | | | | | | |
|---------------|-----------|--------|--------|-------------|--------|----------------|
| SILT AND CLAY | FINE | MEDIUM | COARSE | FINE | COARSE | COBBLE SIZE |
| | SAND SIZE | | | GRAVEL SIZE | | |

| Borehole | Sample | Depth (m) |
|----------|--------|-----------|
| ■ 18-102 | 1B | 0.21-0.70 |
| ◆ 18-201 | 2A | 0.61-0.99 |
| ▲ 18-204 | 1 | 0.15-0.61 |

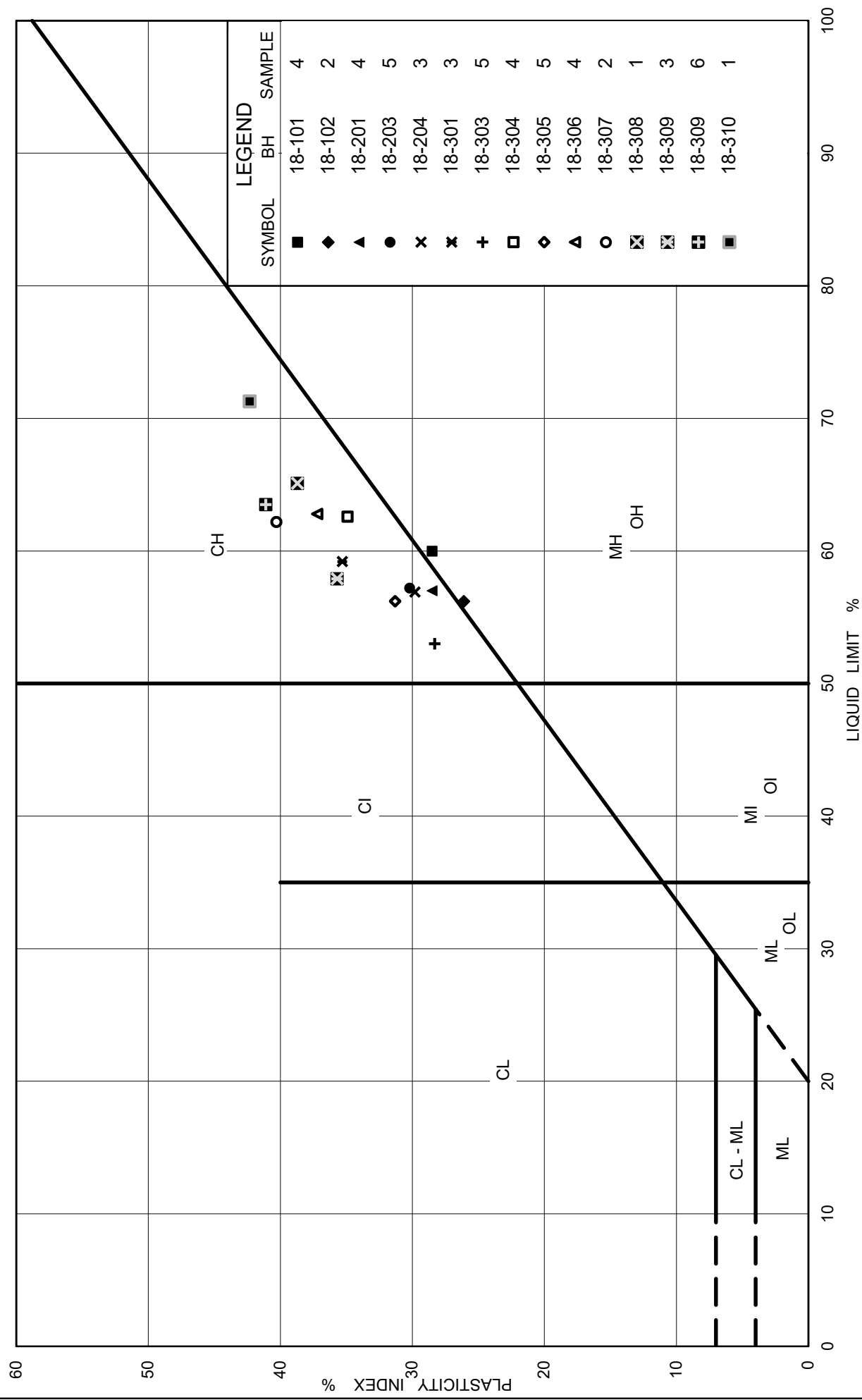
GRAIN SIZE DISTRIBUTION

FIGURE B3



| | | | | | | |
|---------------|-----------|--------|--------|-------------|--------|----------------|
| SILT AND CLAY | FINE | MEDIUM | COARSE | FINE | COARSE | COBBLE SIZE |
| | SAND SIZE | | | GRAVEL SIZE | | |

| Borehole | Sample | Depth (m) |
|----------|--------|-----------|
| 18-309 | 2A | 0.76-1.17 |



PLASTICITY CHART WEATHERED CLAY TO CLAYEY SILT

Ministry of Transportation



FIG No. B4

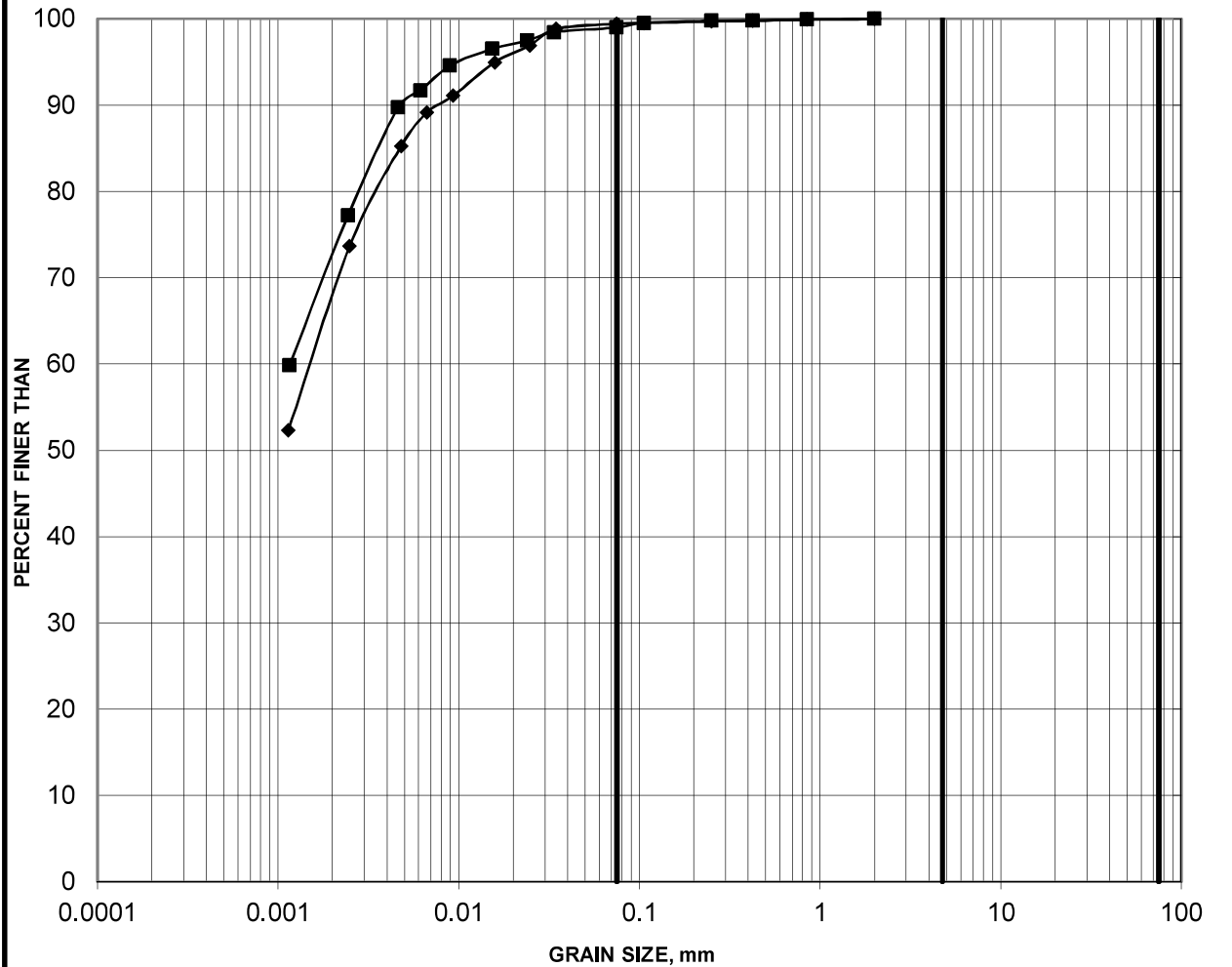
Project No. 1663816/13000

Compiled By : MI Checked By : CW

GRAIN SIZE DISTRIBUTION

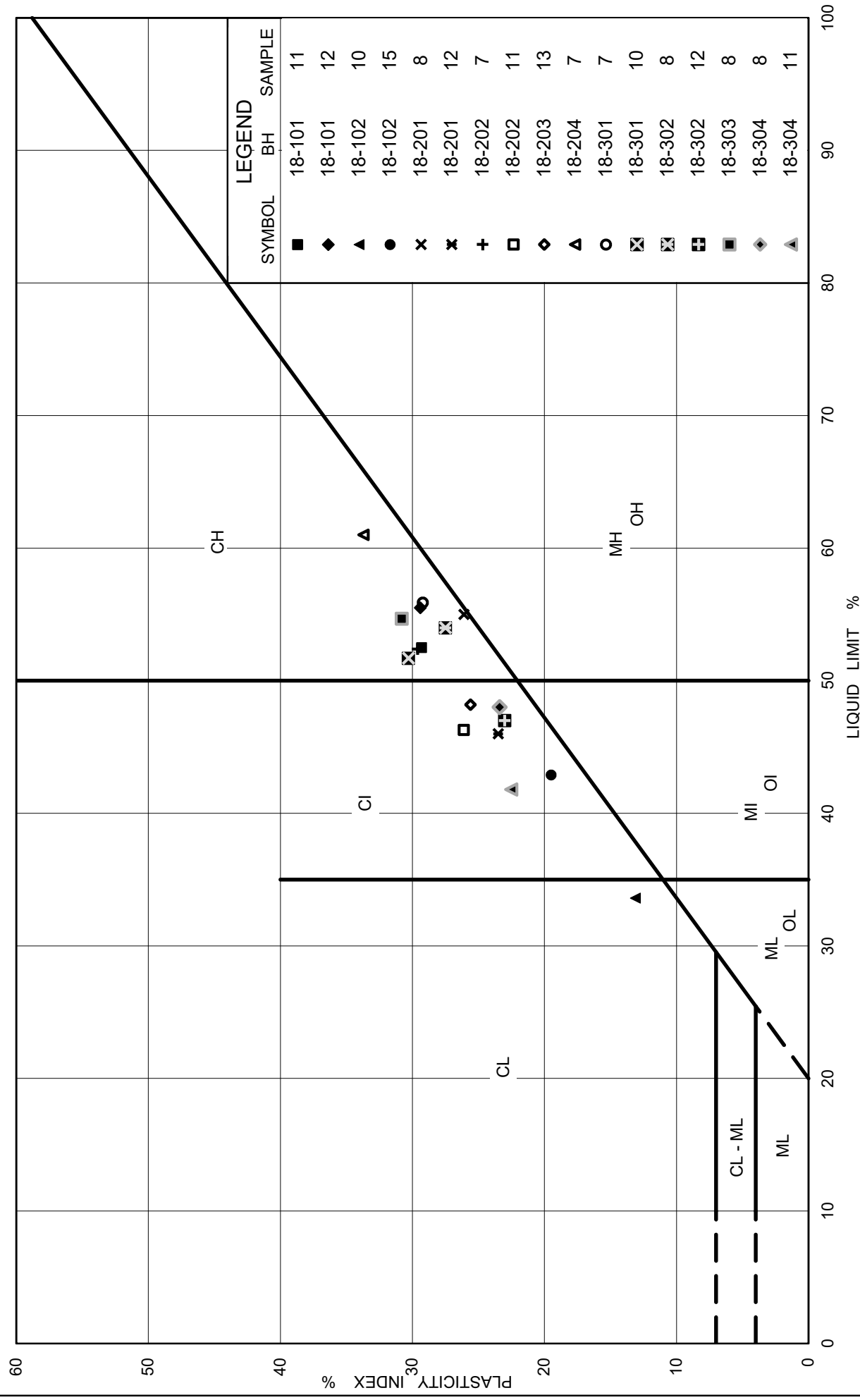
FIGURE B5

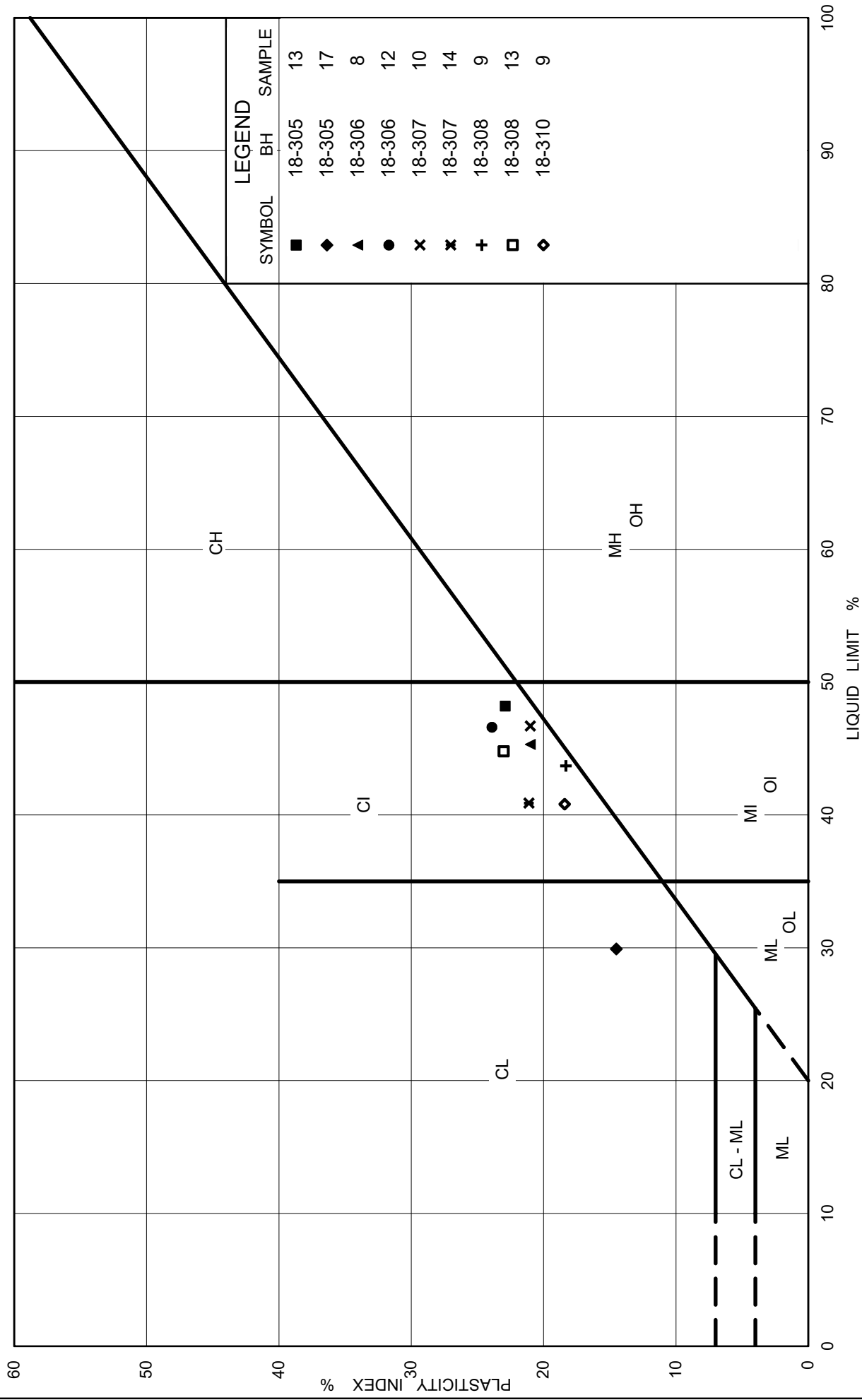
CLAY TO CLAYEY SILT (WEATHERED CRUST)



| | | | | | | |
|---------------|-----------|--------|--------|-------------|--------|----------------|
| SILT AND CLAY | FINE | MEDIUM | COARSE | FINE | COARSE | COBBLE SIZE |
| | SAND SIZE | | | GRAVEL SIZE | | |

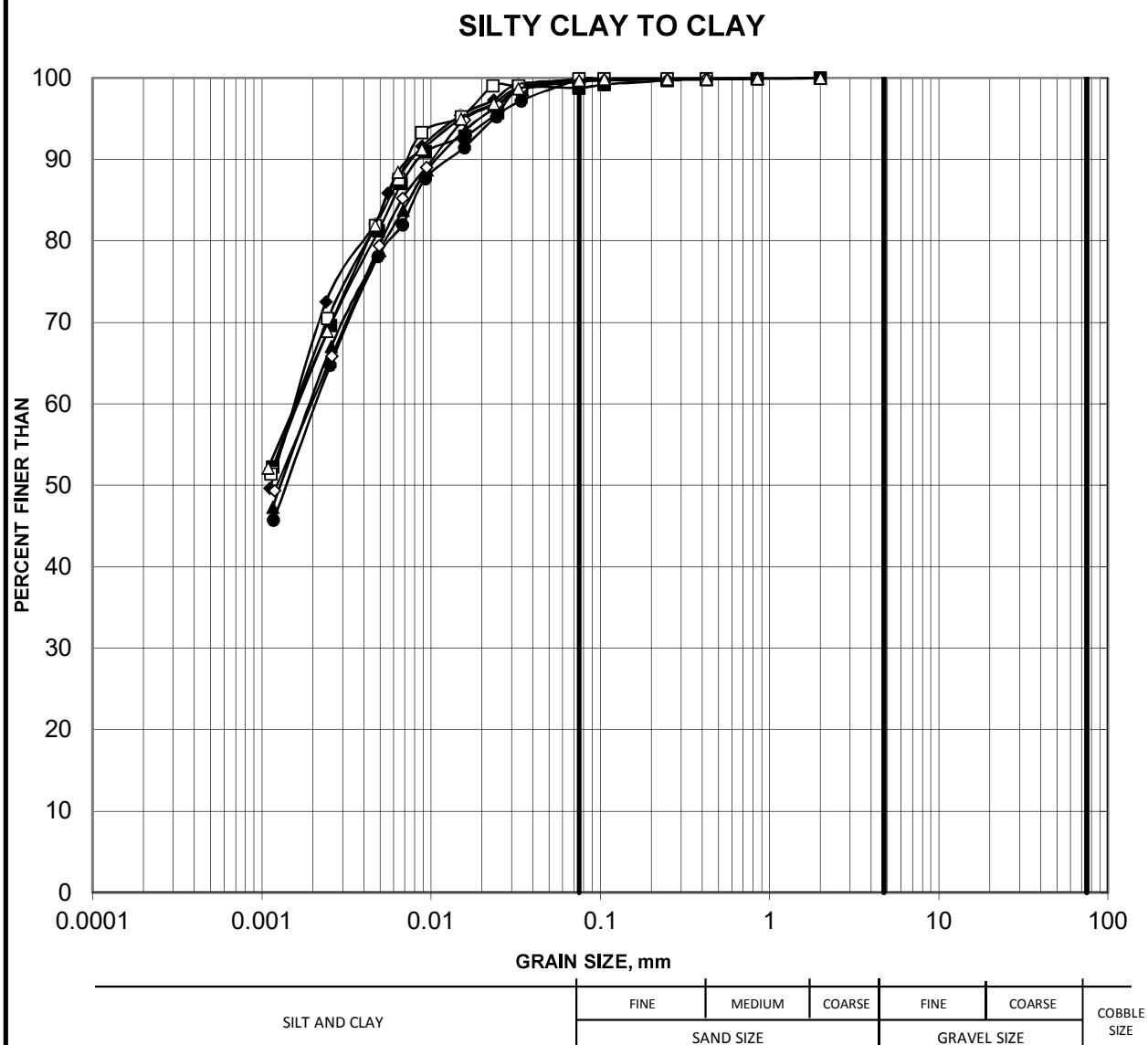
| Borehole | Sample | Depth (m) |
|----------|--------|-----------|
| 18-101 | 4 | 1.83-2.44 |
| 18-301 | 3 | 2.29-2.90 |



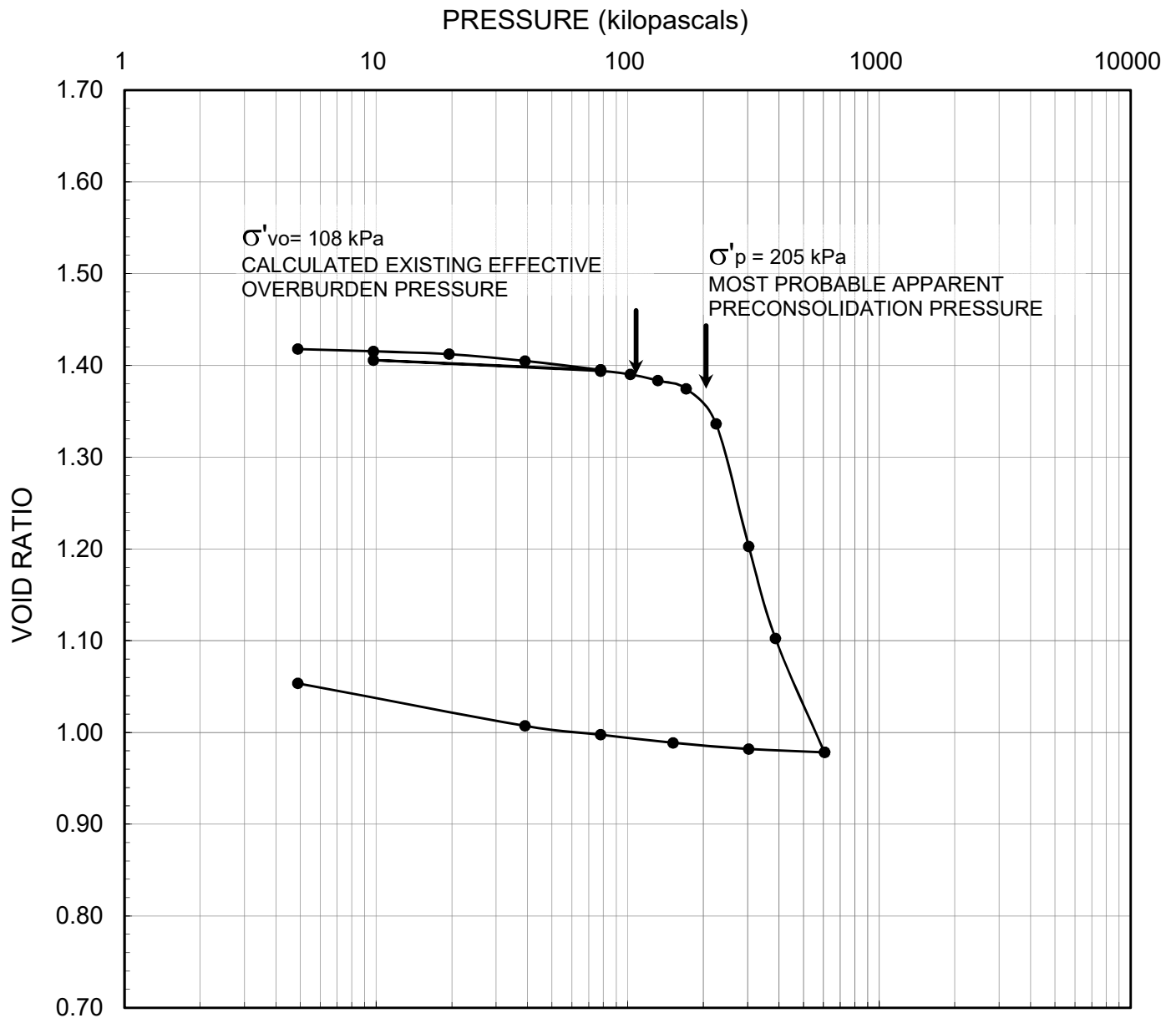


GRAIN SIZE DISTRIBUTION

FIGURE B7



| Borehole | Sample | Depth (m) |
|----------|--------|-------------|
| ■ 18-201 | 8 | 6.10-6.71 |
| ◆ 18-202 | 7 | 6.10-6.71 |
| ▲ 18-203 | 13 | 15.24-15.85 |
| ● 18-302 | 12 | 10.67-11.28 |
| □ 18-305 | 13 | 13.72-14.33 |
| ◇ 18-306 | 12 | 13.72-14.33 |
| △ 18-307 | 10 | 10.67-11.28 |



LEGEND

| | | | | |
|----------------|--------|--------------|---------------|------------------------------|
| Borehole: | 18-101 | $w_i = 50\%$ | $S_o = 99\%$ | $\gamma = 17 \text{ kN/m}^3$ |
| Sample: | 11 | $w_f = 38\%$ | $e_o = 1.42$ | $G_s = 2.79$ |
| Depth (m): | 11.9 | $w_l = 53\%$ | $C_c = 1.03$ | |
| Elevation (m): | 118.2 | $w_p = 23\%$ | $C_r = 0.012$ | |



GOLDER

| | |
|---------|----------|
| SCALE | AS SHOWN |
| DATE | 02/06/19 |
| CADD | N/A |
| ENTERED | MI |
| CHECK | CW |
| REVIEW | WAM |

TITLE

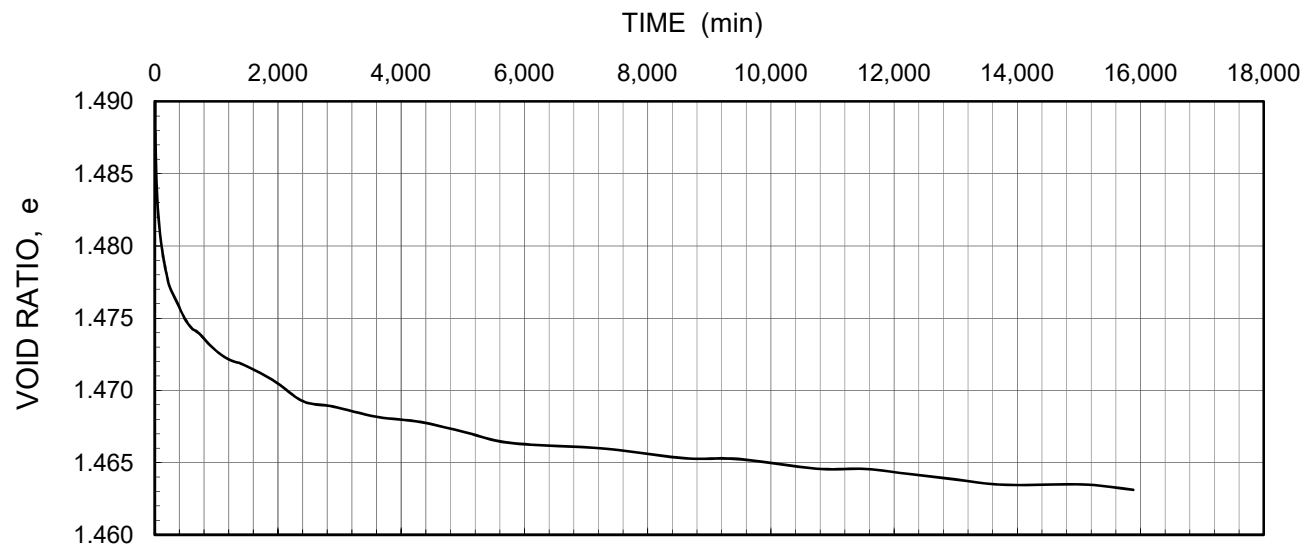
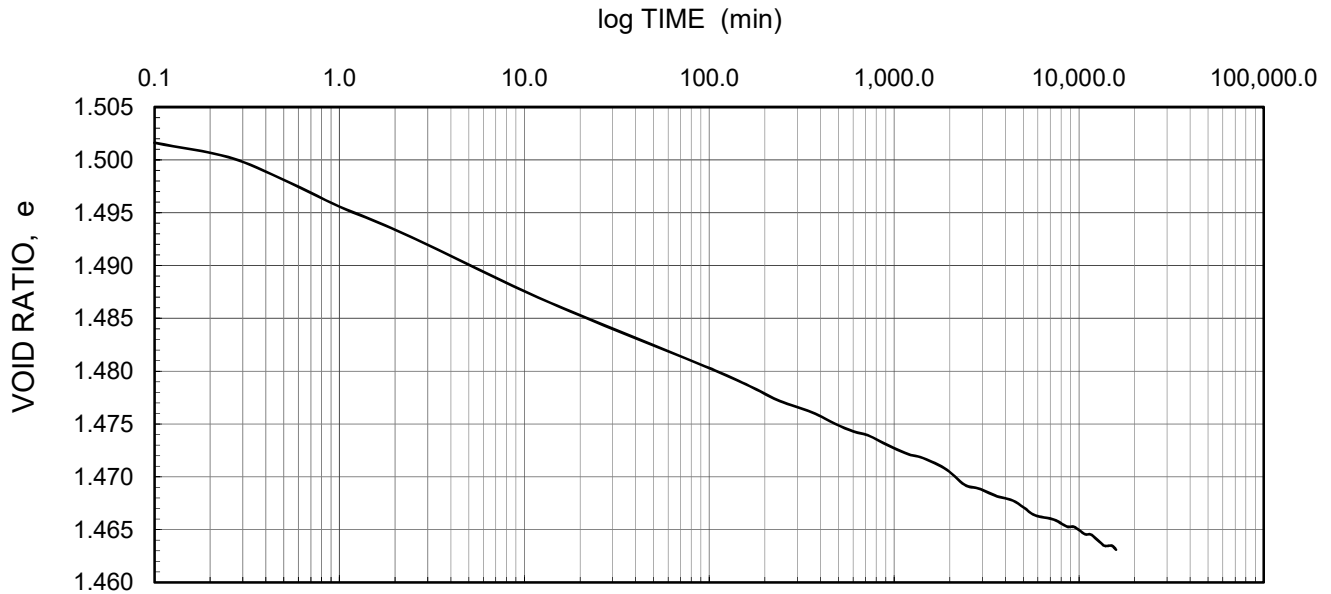
CONSOLIDATION TEST RESULTS

| | |
|-------------|-----------------------|
| FILE No. | Consolidation summary |
| PROJECT No. | 1663816/13000 |
| REV. | 0 |

FIGURE

B8

PRESSURE = 180 kPa



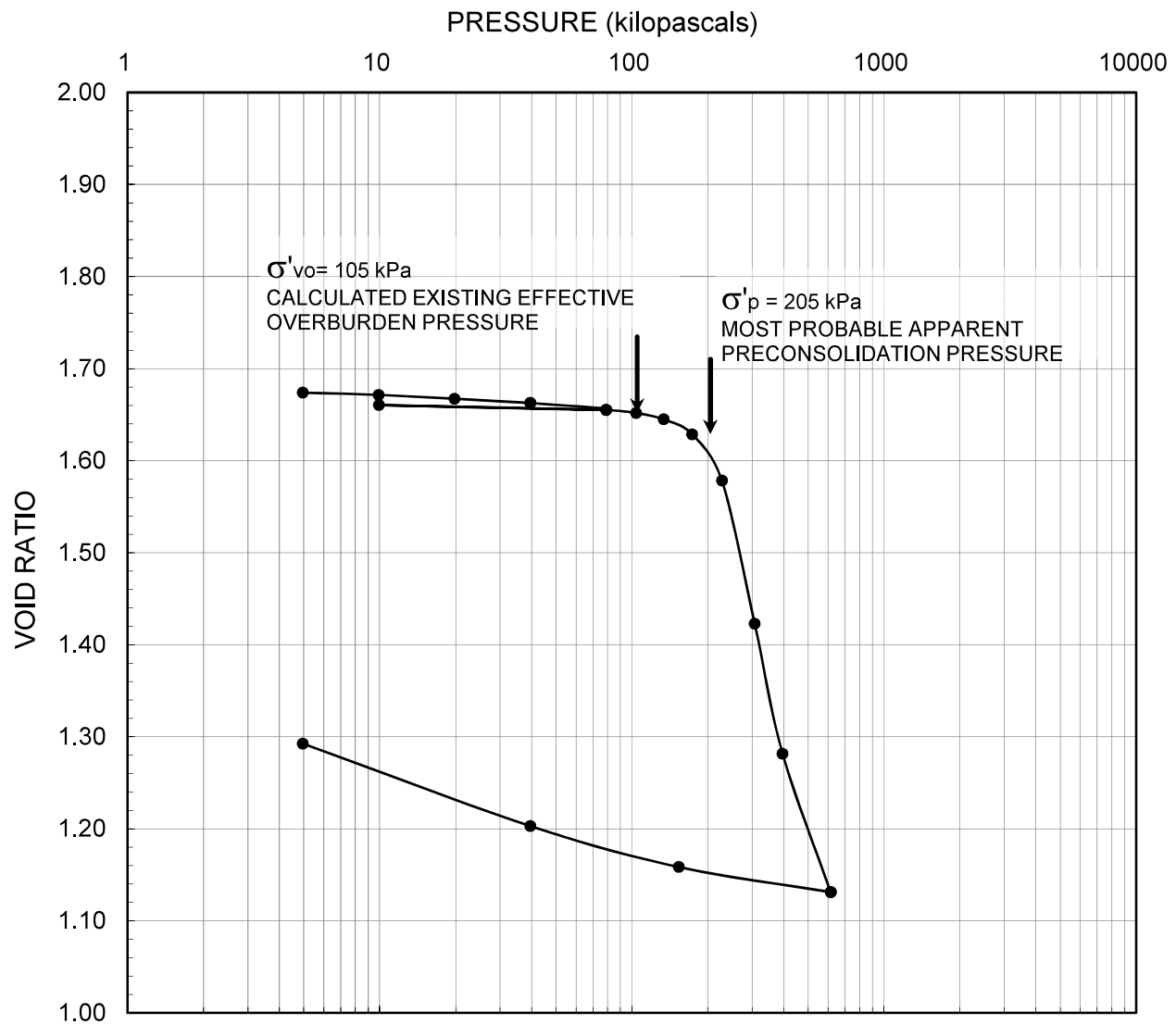
LEGEND

| | | |
|----------------------|--------------|---------------|
| Borehole: 18-101 | $w_i = 55\%$ | $S_o = 100\%$ |
| Sample: 11 | $w_f = 53\%$ | |
| Depth (m): 11.9 | $w_l = 53\%$ | |
| Elevation (m): 118.2 | $w_p = 23\%$ | |



| | |
|--------|----------|
| SCALE | AS SHOWN |
| DATE | 02/21/19 |
| DESIGN | N/A |
| CADD | MI |
| CHECK | CW |
| REVIEW | WAM |

| | | |
|-------------|--------------------------------------------------|--------|
| TITLE | SUMMARY OF SECONDARY COMPRESSION TEST | |
| FIGURE | | |
| FILE No. | Consolidation summary | |
| PROJECT No. | 1663816/13000 | REV. 0 |
| FIGURE | B9 | |



LEGEND

| | | | | |
|----------------|--------|--------------|---------------|---------------------------|
| Borehole: | 18-102 | $w_i = 60\%$ | $S_o = 99\%$ | $g = 16.3 \text{ kN/m}^3$ |
| Sample: | 10 | $w_f = 46\%$ | $e_o = 1.68$ | $G_s = 2.80$ |
| Depth (m): | 10.5 | $w_l = 34\%$ | $C_c = 1.20$ | |
| Elevation (m): | 119.7 | $w_p = 21\%$ | $C_r = 0.006$ | |



GOLDER

SCALE AS SHOWN TITLE

DATE 02-20-19

CADD N/A

ENTERED MI

CONSOLIDATION TEST RESULTS

FILE No. Consolidation summary

CHECK CW

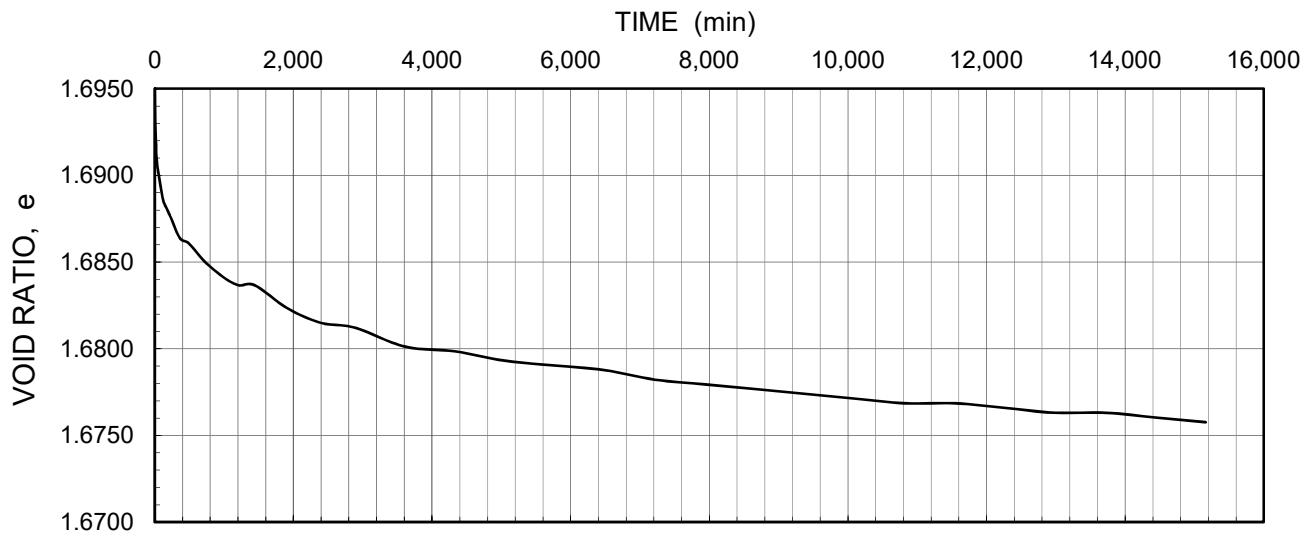
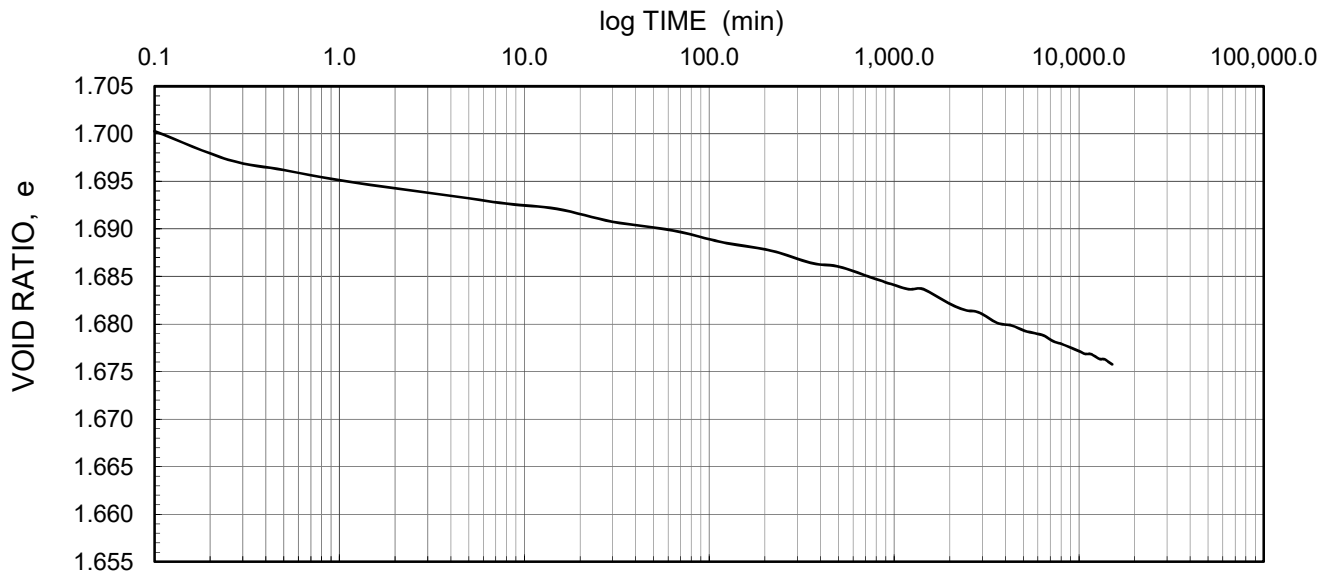
PROJECT No. 1663816/13000 REV. 0

REVIEW WAM

FIGURE

B10

PRESSURE = 180 kPa



LEGEND

| | | |
|----------------------|--------------|---------------|
| Borehole: 18-102 | $w_i = 60\%$ | $S_o = 100\%$ |
| Sample: 10 | $w_f = 60\%$ | |
| Depth (m): 10.4 | $w_l = 34\%$ | |
| Elevation (m): 119.8 | $w_p = 21\%$ | |



GOLDER

| | |
|--------|----------|
| SCALE | AS SHOWN |
| DATE | 02/21/19 |
| DESIGN | N/A |
| CADD | MI |

TITLE

**SUMMARY OF
SECONDARY COMPRESSION TEST**

FILE No. Consolidation summary
PROJECT No. 1663816/13000 REV. 0

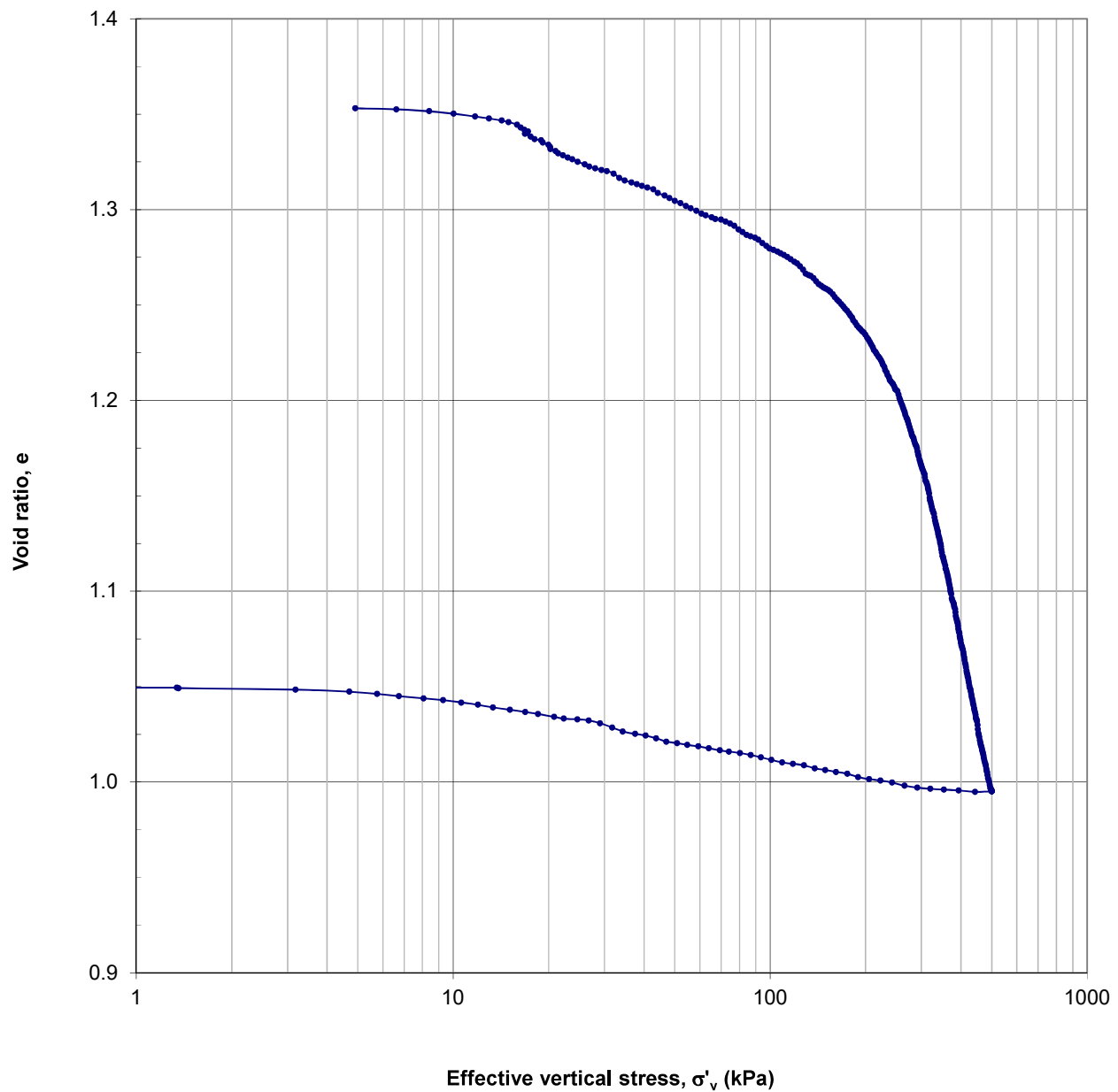
CHECK CW
REVIEW WAM

FIGURE

B11

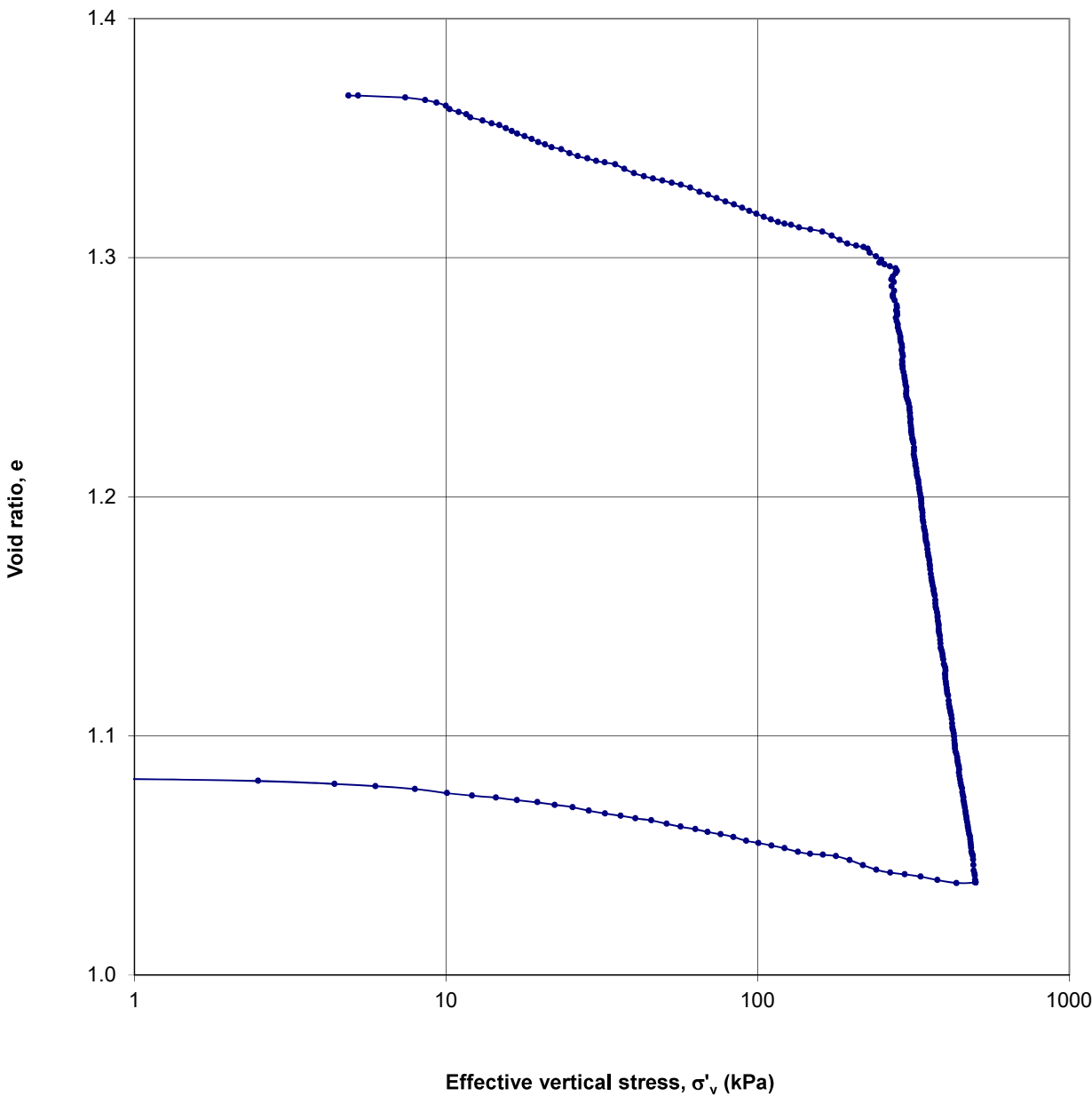
CRS TEST RESULTS
BOREHOLE 18-101 SAMPLE 9

FIGURE B12



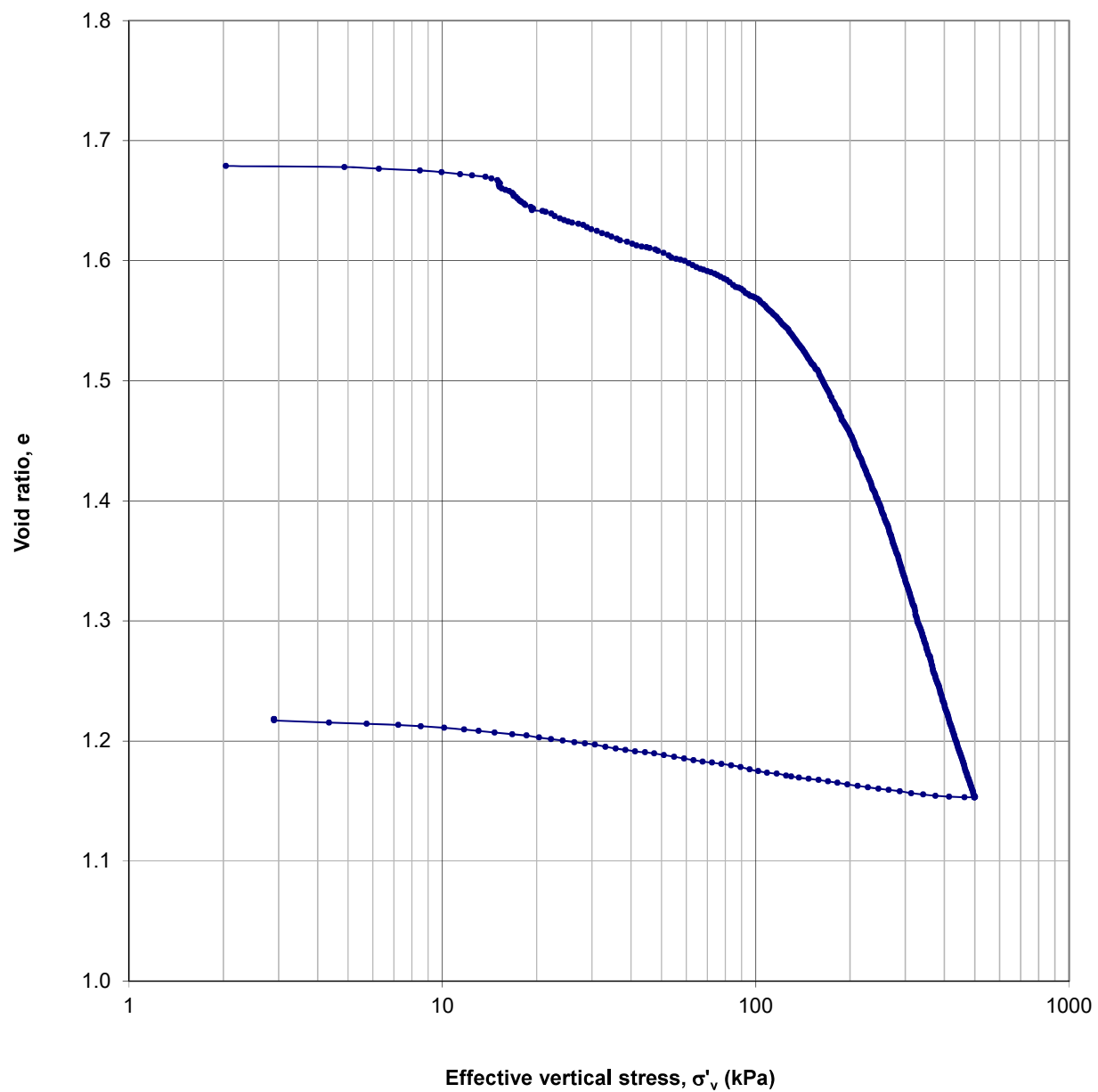
CRS TEST RESULTS
BOREHOLE 18-101 SAMPLE 10

FIGURE B13



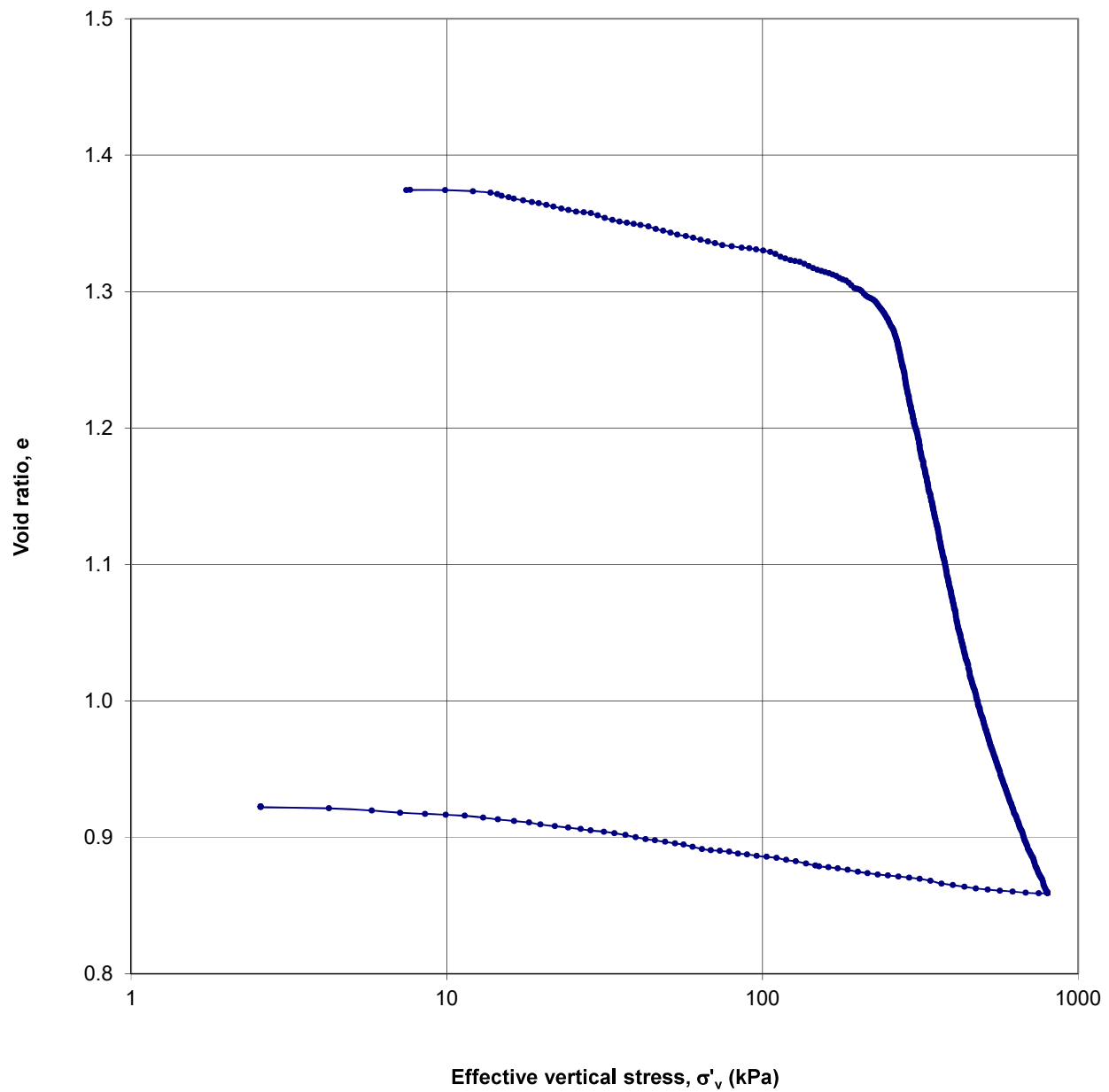
CRS TEST RESULTS
BOREHOLE 18-102 SAMPLE 8

FIGURE B14



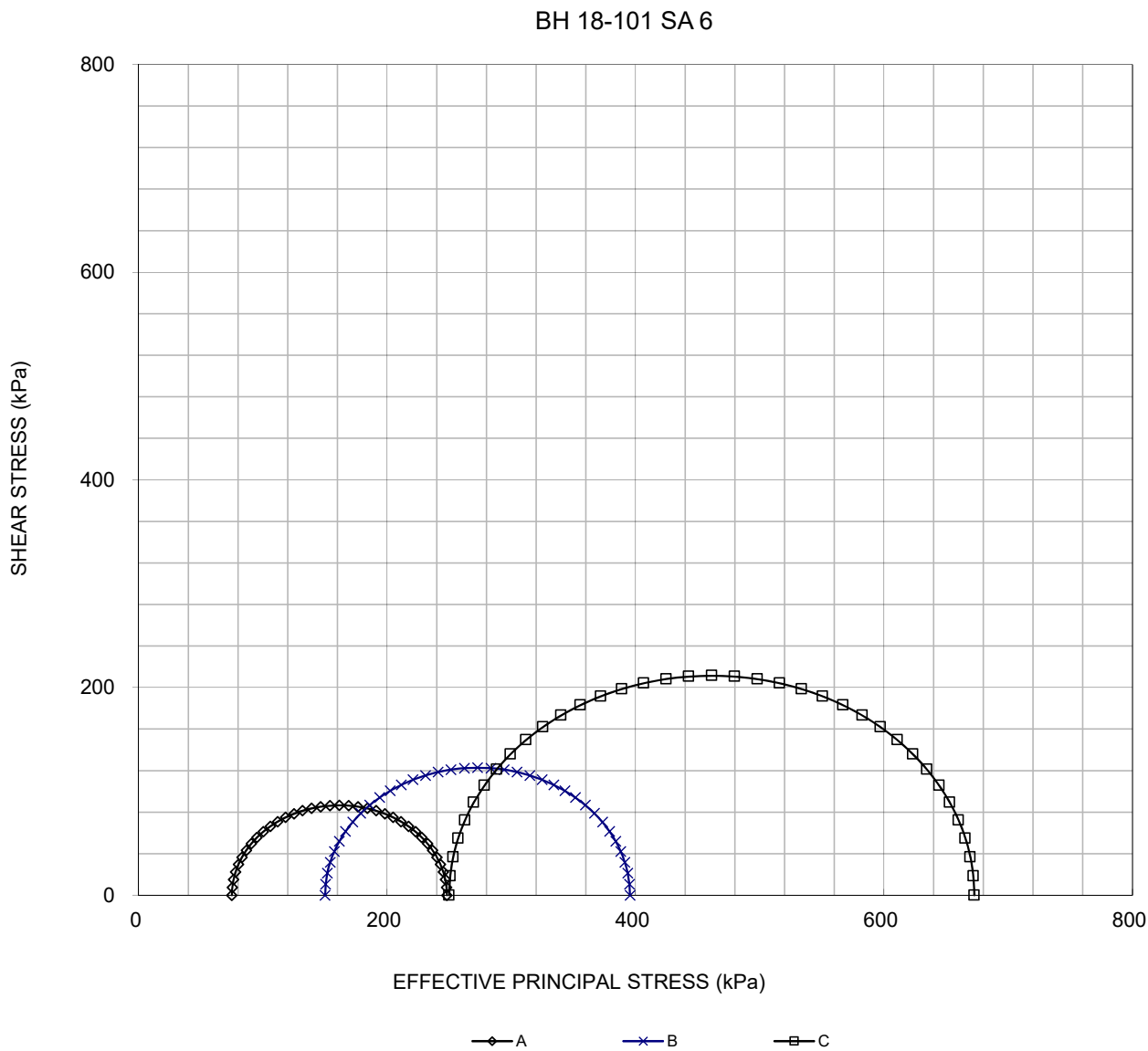
CRS TEST RESULTS
BOREHOLE 18-102 SAMPLE 12

FIGURE B15



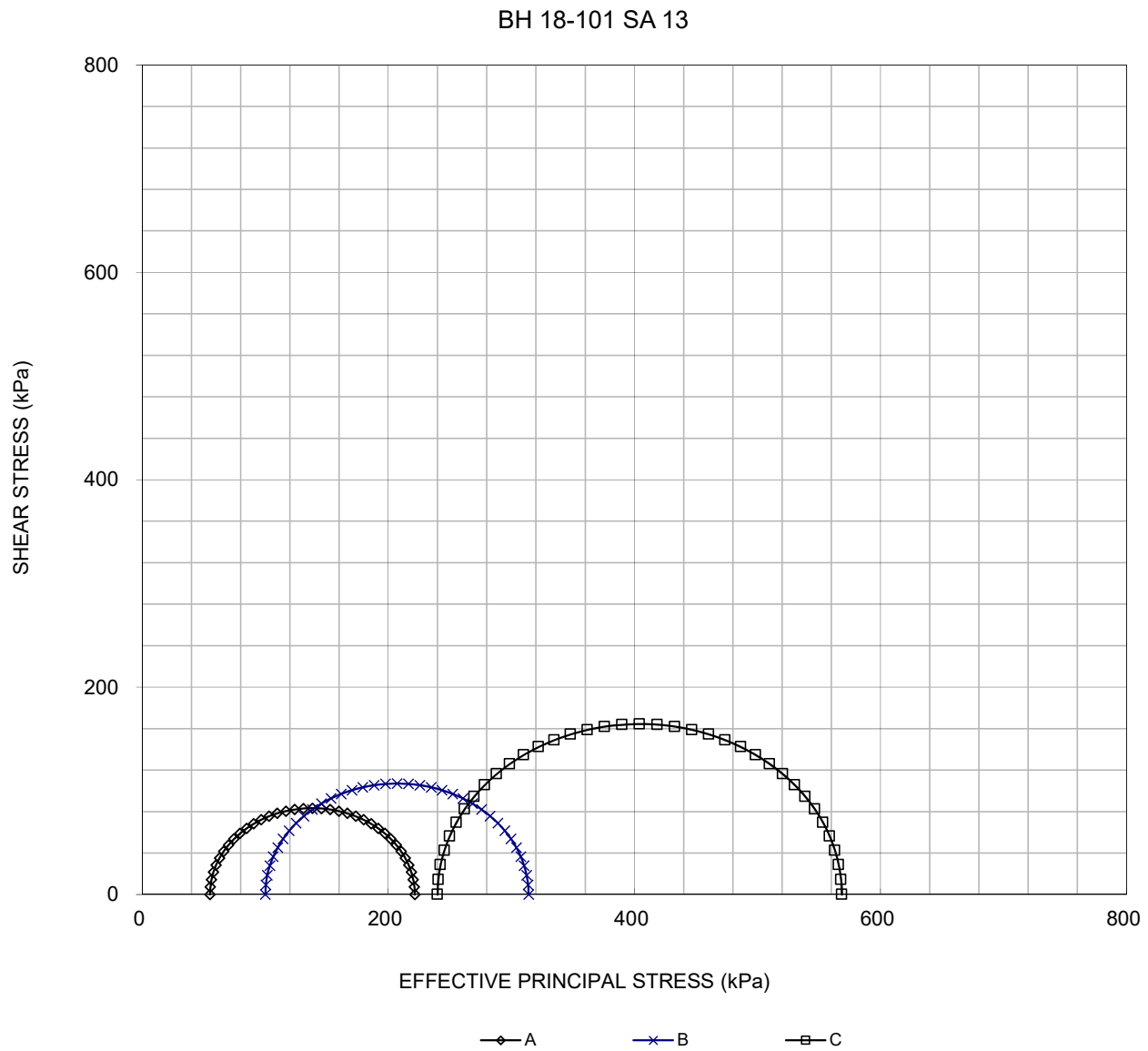
CONSOLIDATED DRAINED TRIAXIAL
ASTM D7181

FIGURE B16

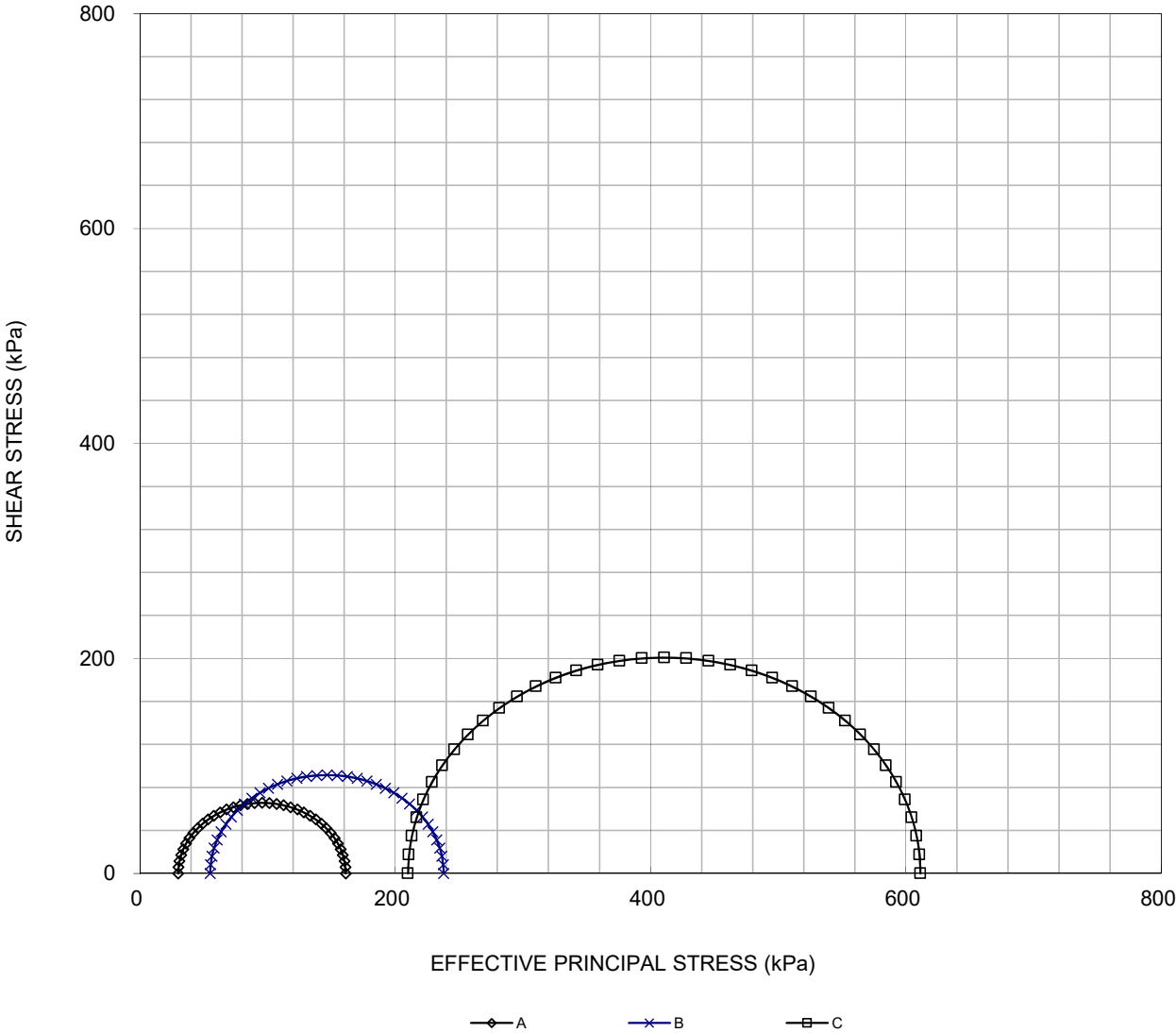


CONSOLIDATED DRAINED TRIAXIAL
ASTM D7181

FIGURE B17



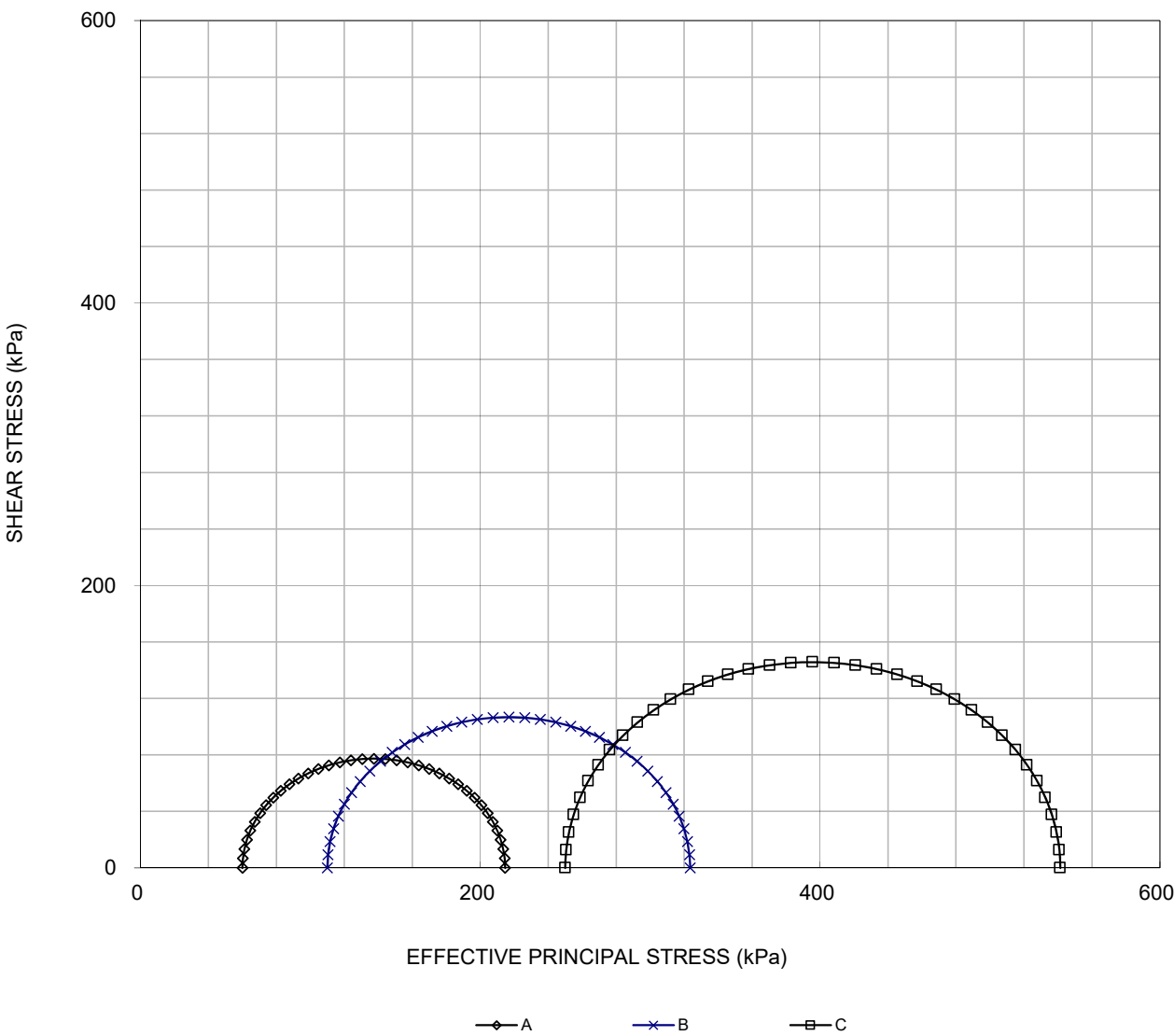
BH 18-102 SA 7

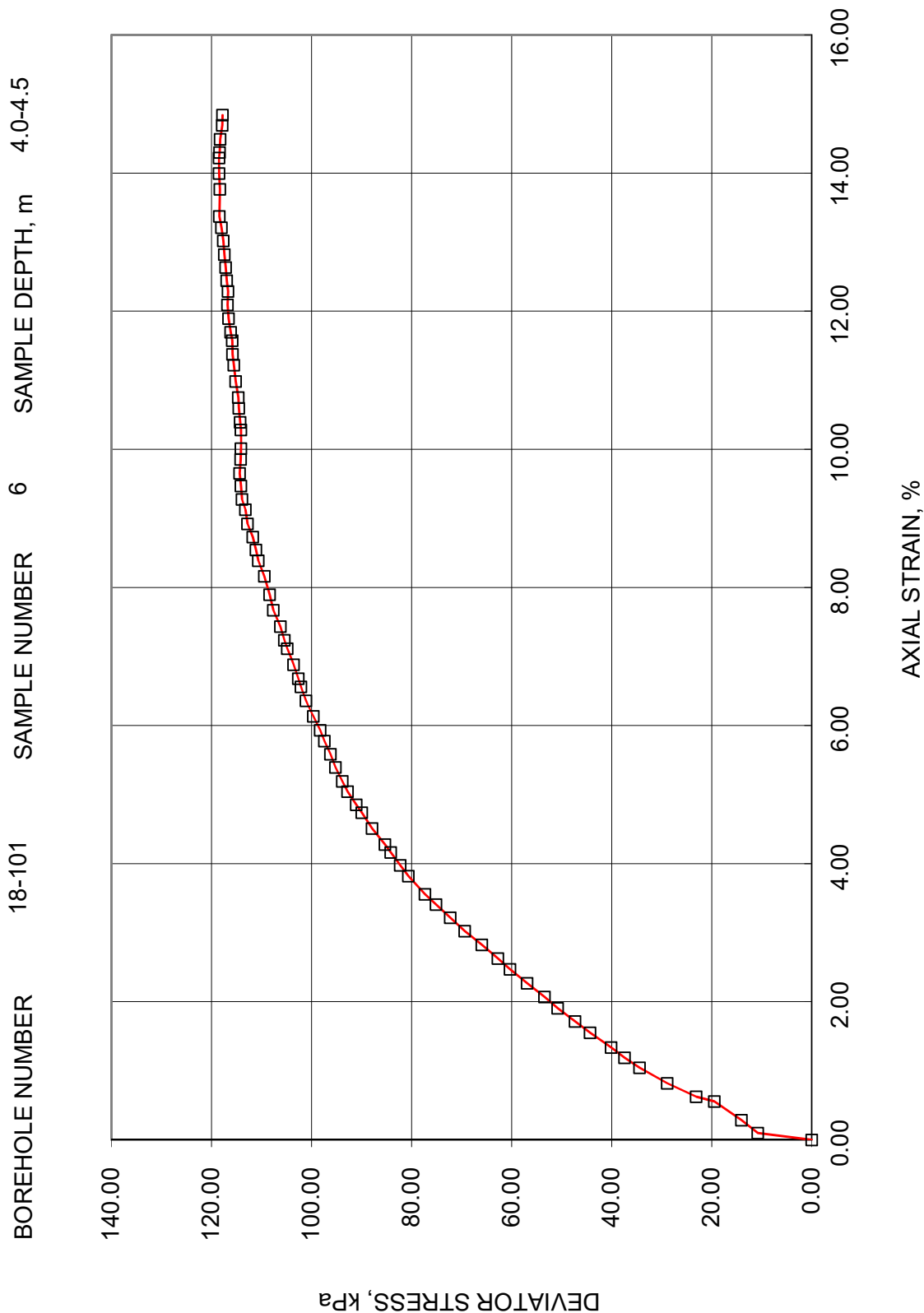


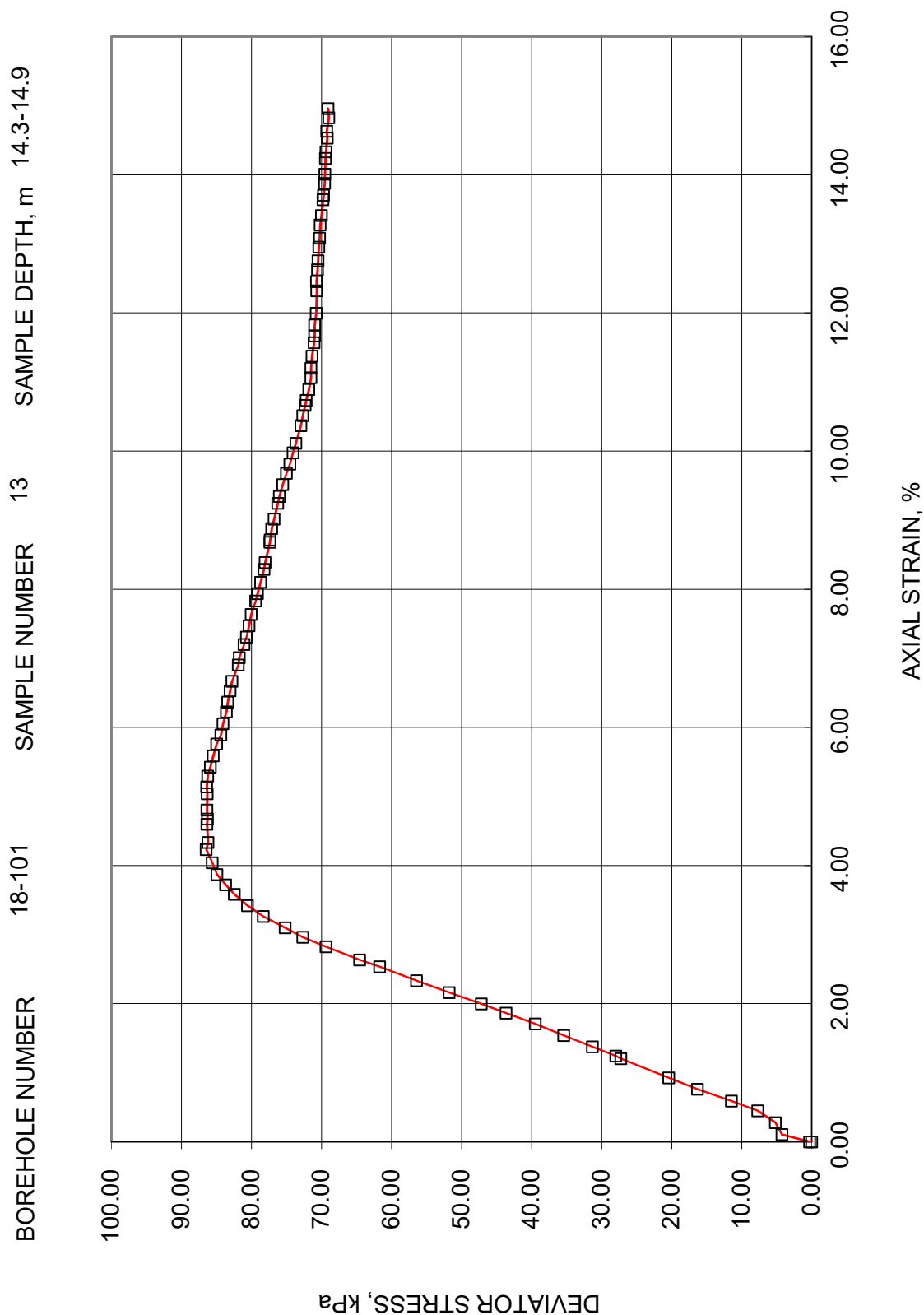
CONSOLIDATED DRAINED TRIAXIAL
ASTM D7181

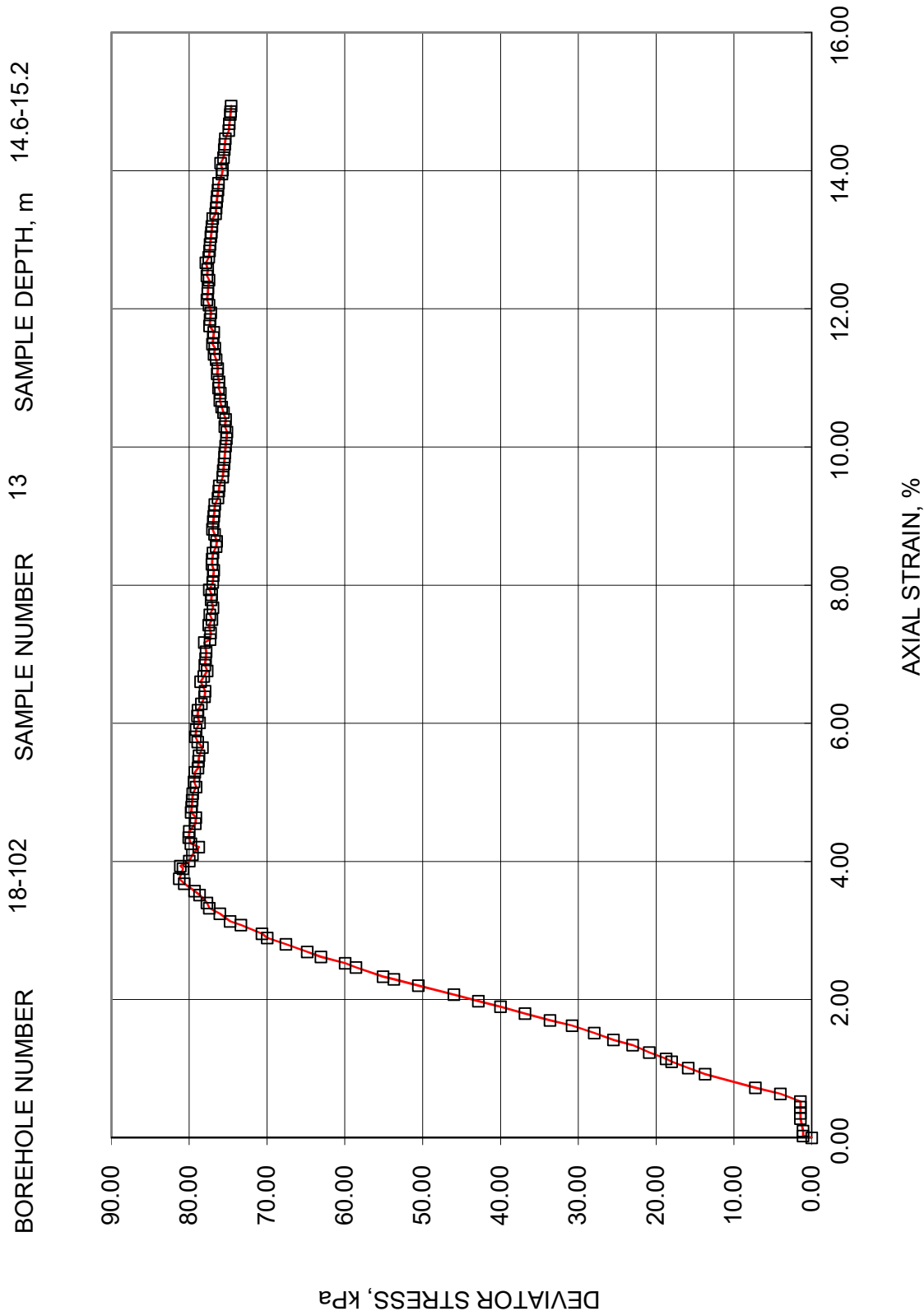
FIGURE B19

BH 18-102 SA 13





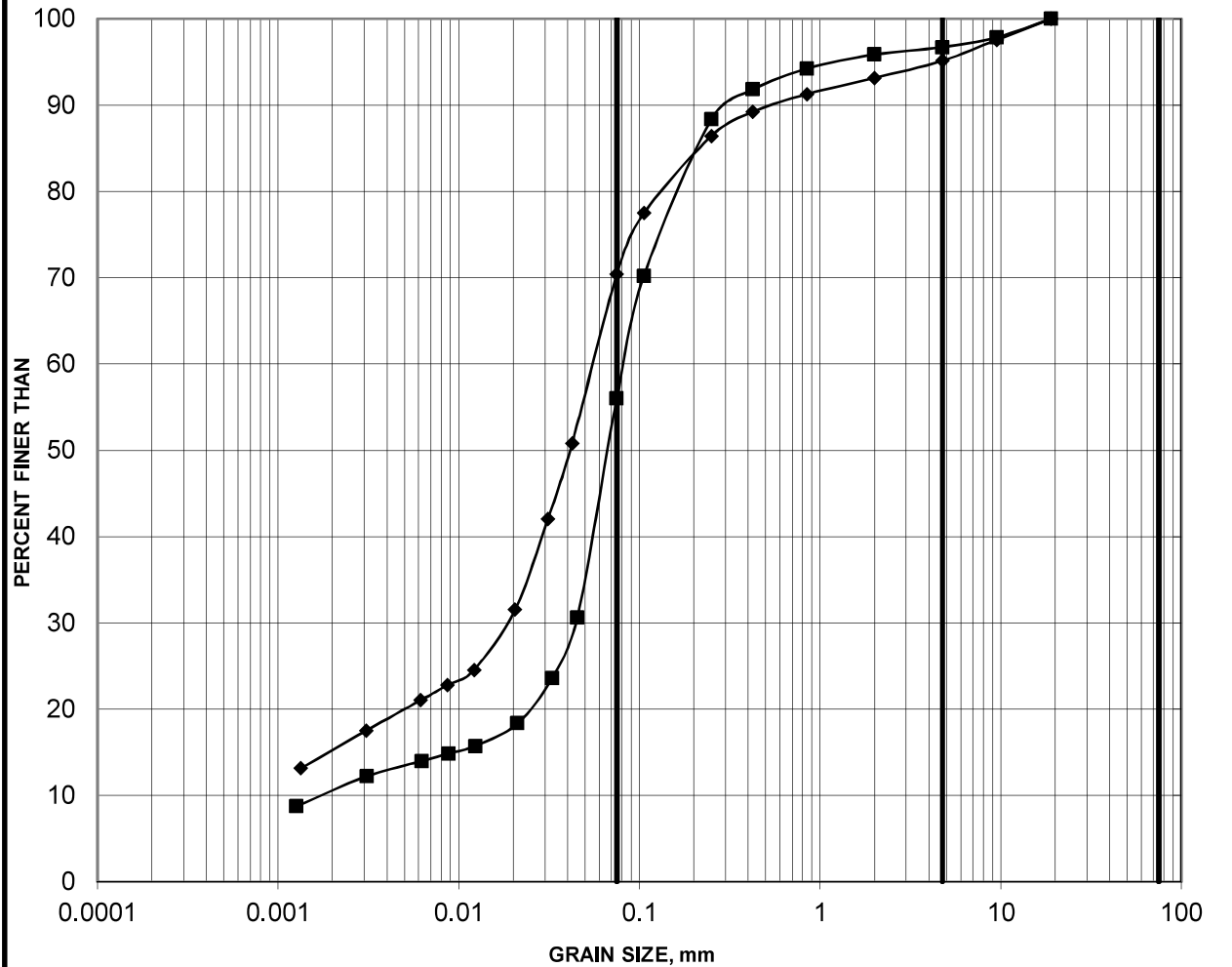




GRAIN SIZE DISTRIBUTION

FIGURE B23

SANDY SILT TO SAND AND SILT



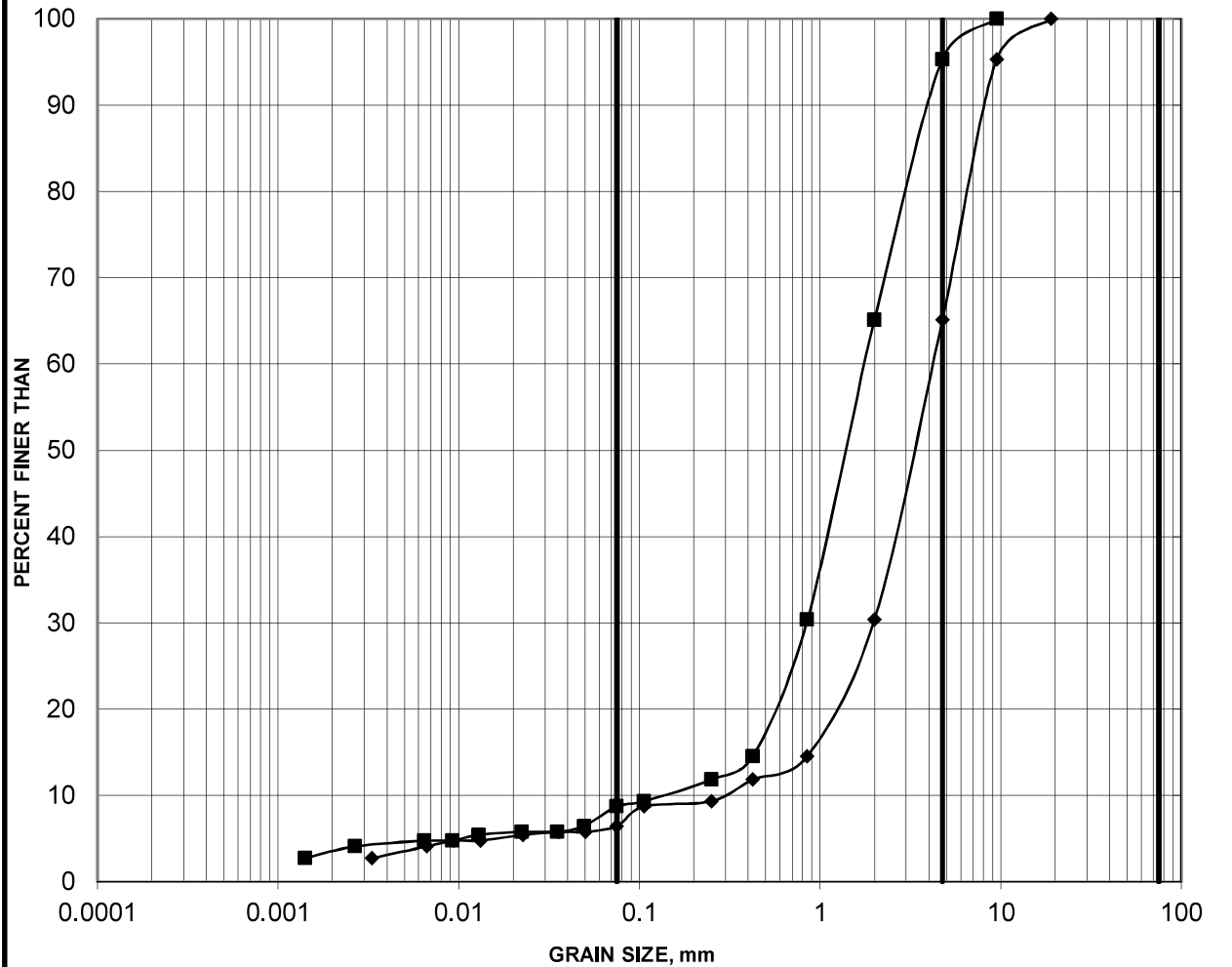
| | | | | | | |
|---------------|-----------|--------|--------|-------------|--------|-------------|
| SILT AND CLAY | FINE | MEDIUM | COARSE | FINE | COARSE | COBBLE SIZE |
| | SAND SIZE | | | GRAVEL SIZE | | |

| Borehole | Sample | Depth (m) |
|----------|--------|-------------|
| 18-101 | 14B | 15.24-15.54 |
| 18-303 | 10B | 11.13-11.28 |

GRAIN SIZE DISTRIBUTION

FIGURE B24

SAND AND GRAVEL TO SAND



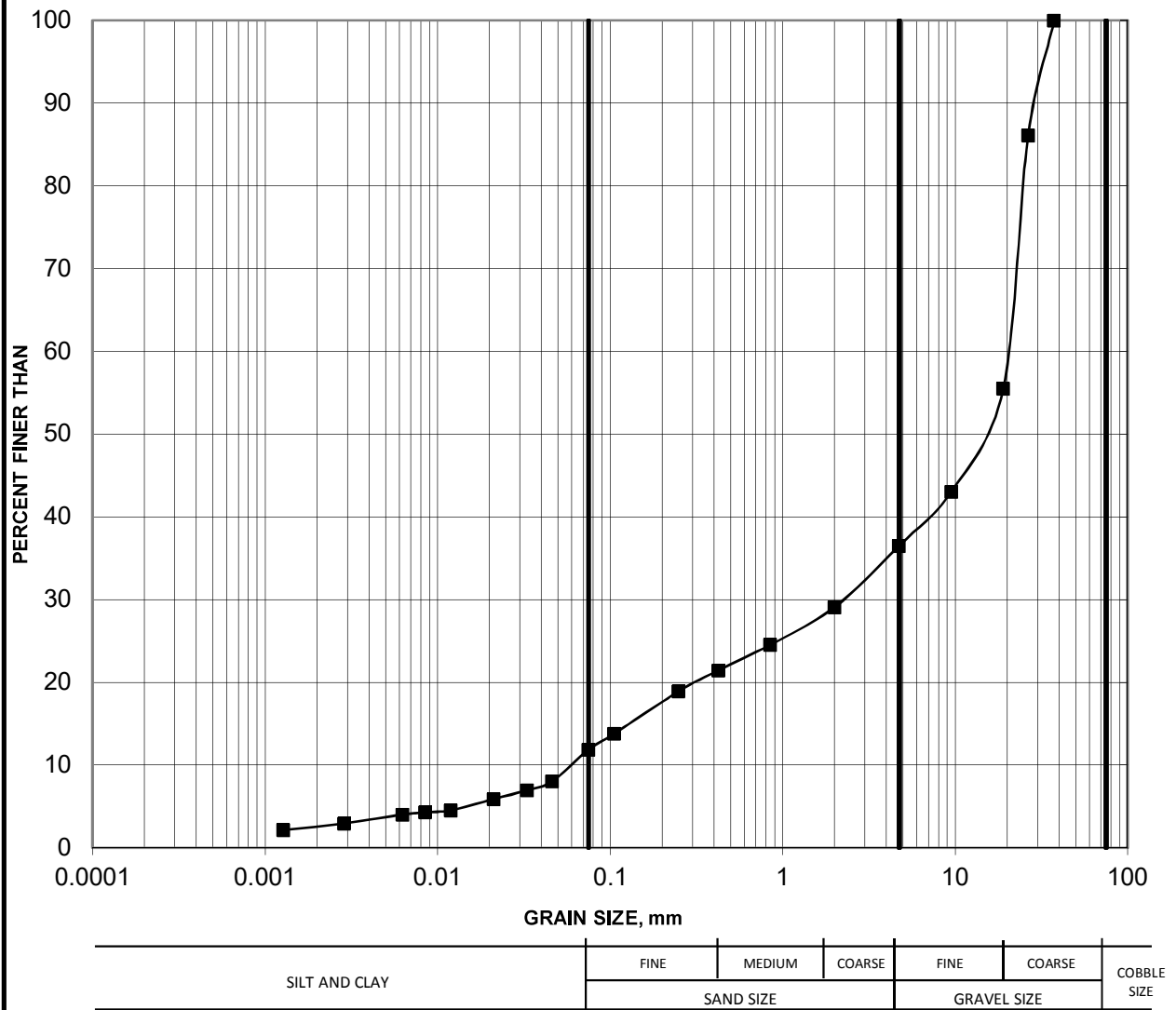
| | | | | | | |
|---------------|-----------|--------|--------|-------------|--------|----------------|
| SILT AND CLAY | FINE | MEDIUM | COARSE | FINE | COARSE | COBBLE SIZE |
| | SAND SIZE | | | GRAVEL SIZE | | |

| Borehole | Sample | Depth (m) |
|----------|--------|-------------|
| 18-201 | 19A | 20.88-21.03 |
| 18-202 | 13 | 13.72-14.33 |

GRAIN SIZE DISTRIBUTION

FIGURE B25

SANDY GRAVEL

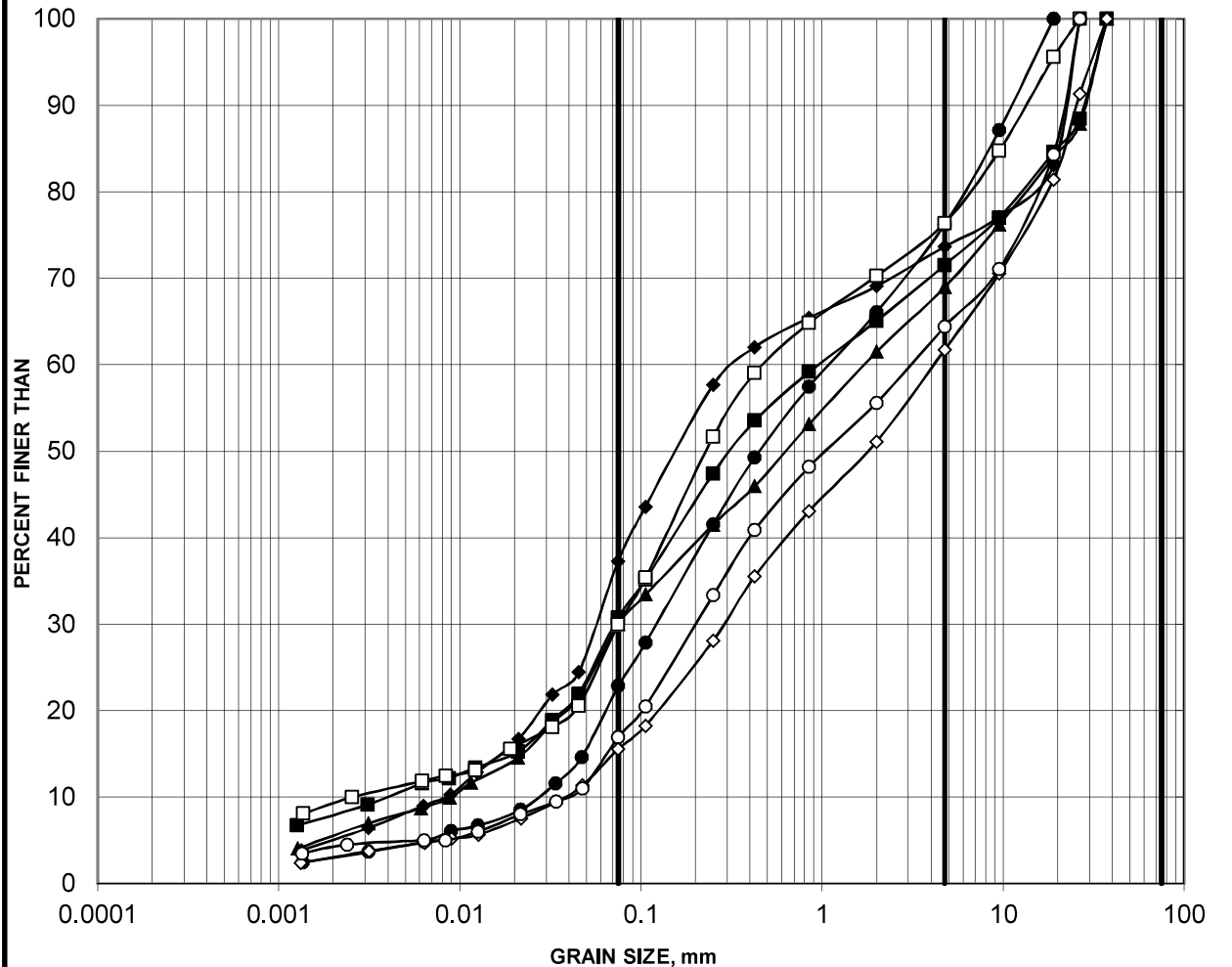


| Borehole | Sample | Depth (m) |
|----------|--------|-------------|
| 18-303 | 11 | 11.58-12.19 |

GRAIN SIZE DISTRIBUTION

FIGURE B26

GRAVELLY SILTY SAND, GRAVELLY SAND AND SILT, SILTY SAND
AND GRAVEL, GRAVELLY SAND SOME SILT TO SAND AND GRAVEL
SOME SILT (TILL)

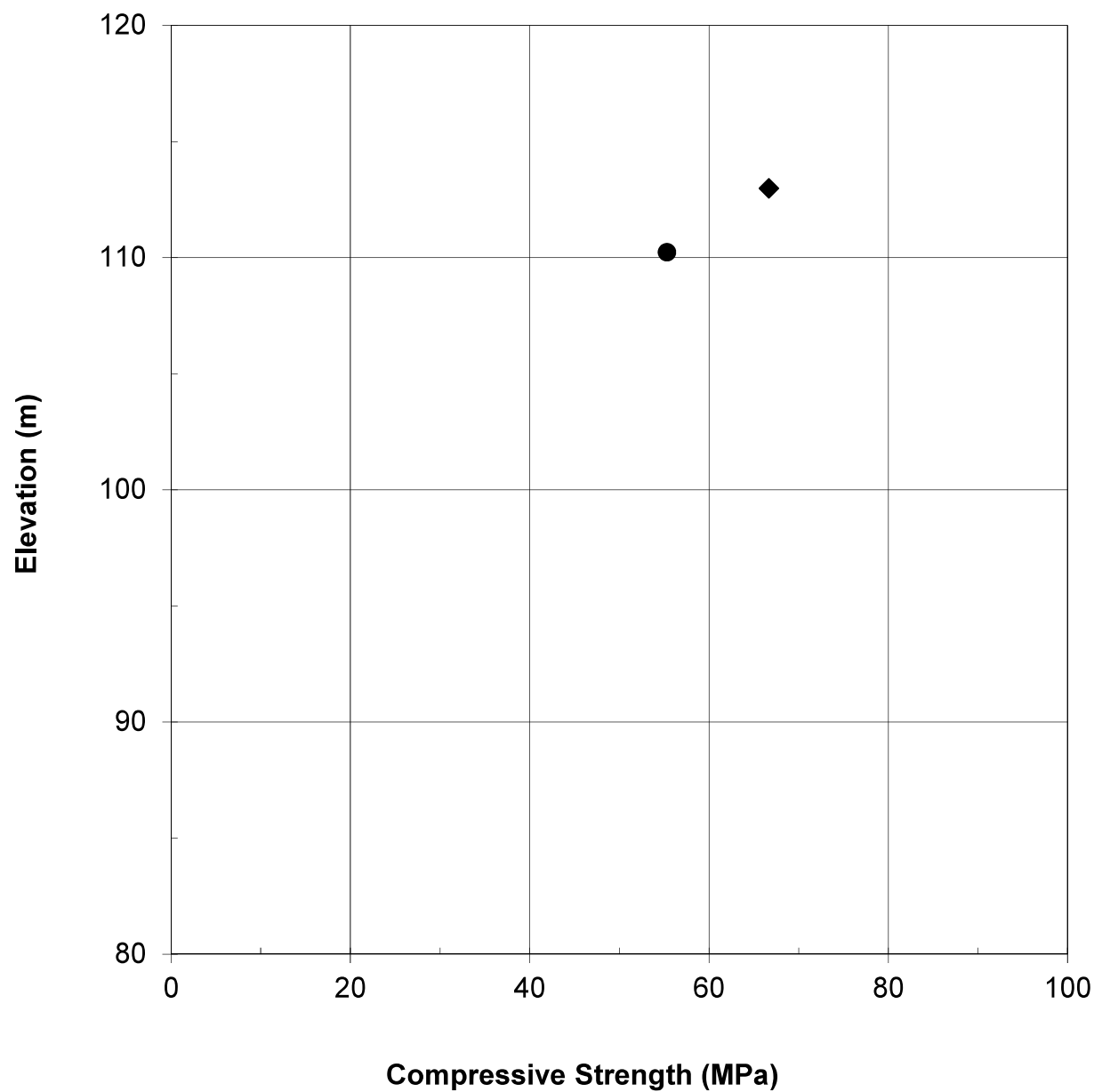


| | | | | | | |
|---------------|-----------|--------|--------|-------------|--------|----------------|
| SILT AND CLAY | FINE | MEDIUM | COARSE | FINE | COARSE | COBBLE SIZE |
| | SAND SIZE | | | GRAVEL SIZE | | |

| Borehole | Sample | Depth (m) |
|----------|--------|-------------|
| 18-204 | 14 | 16.76-17.37 |
| 18-301 | 12 | 13.72-14.33 |
| 18-302 | 15B | 14.63-14.94 |
| 18-304 | 13 | 13.72-14.33 |
| 18-306 | 17 | 21.34-21.95 |
| 18-309 | 14 | 16.76-17.37 |
| 18-310 | 13 | 16.76-17.37 |

**SUMMARY OF LABORATORY COMPRESSIVE STRENGTH
UNCONFINED COMPRESSION TESTS**

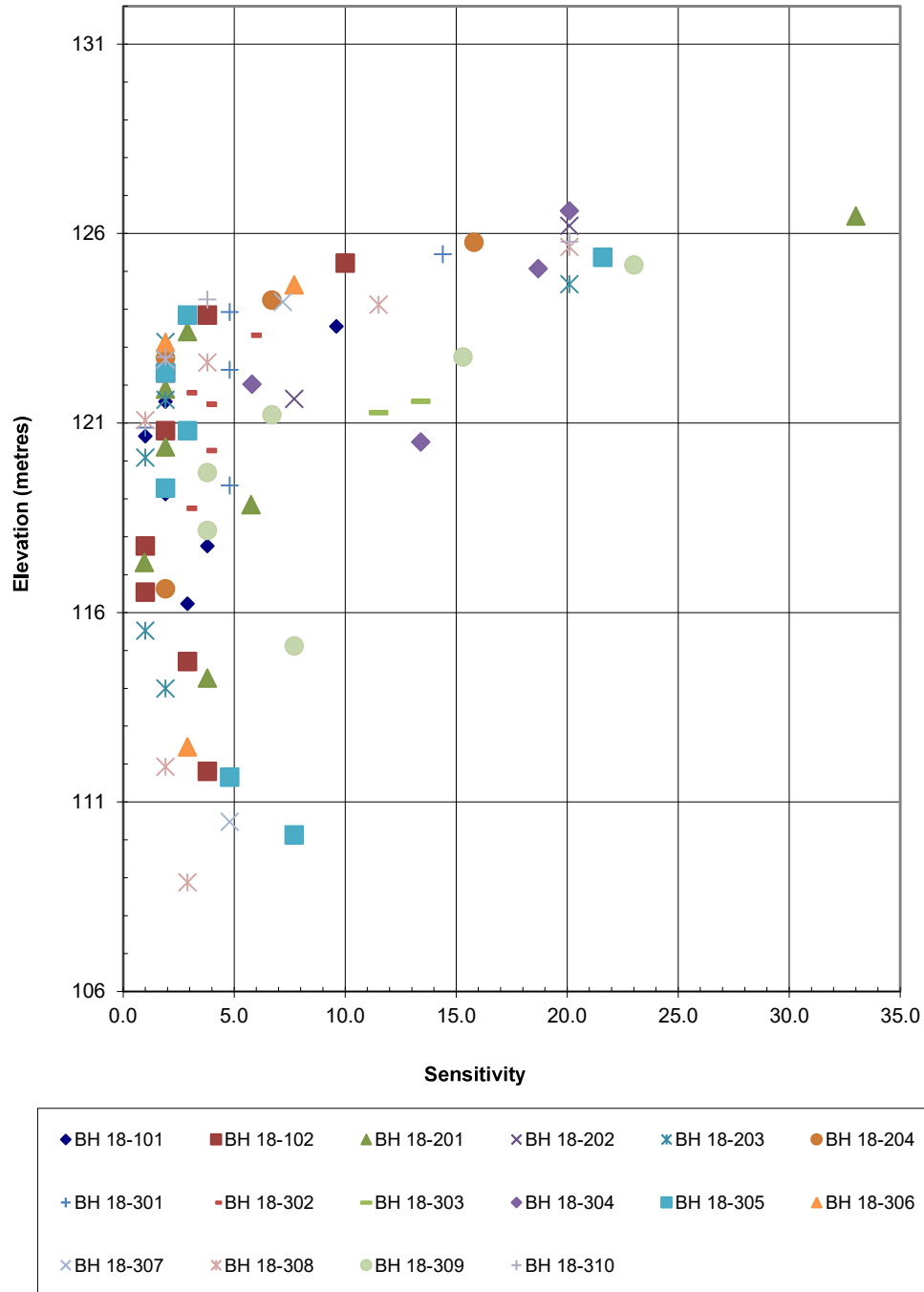
FIGURE B27



◆ 18-101 ● 18-102

SUMMARY OF SENSITIVITIES VERSUS ELEVATION

FIGURE B29



Date June 2019
Project 1663816-13000

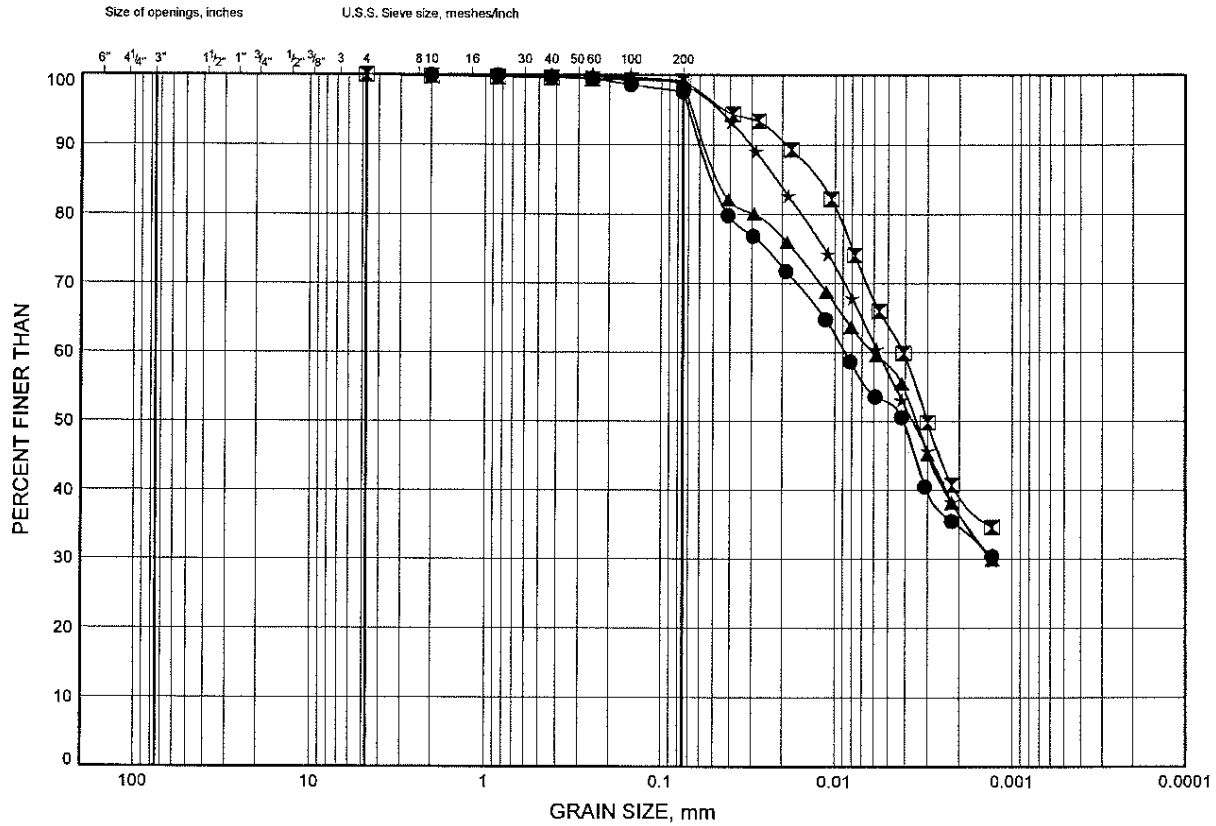
Golder Associates

Drawn WAM
Chkd _____

HWY 17 Twinning, Arnprior to Renfrew GRAIN SIZE DISTRIBUTION

FIGURE B1

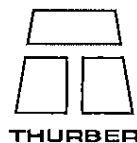
SILTY CLAY



| | | | | | | |
|----------------|--------|------|--------|--------|------|---------------|
| COBBLE SIZE | COARSE | FINE | COARSE | MEDIUM | FINE | SILT and CLAY |
| | GRAVEL | | SAND | | | FINE GRAINED |

| SYMBOL | BH | DEPTH (m) | ELEV. (m) |
|--------|-------|-----------|-----------|
| ● | 508-1 | 2.59 | 127.51 |
| ⊠ | 508-1 | 10.97 | 119.13 |
| ▲ | 508-2 | 3.35 | 126.55 |
| ★ | 508-2 | 12.50 | 117.40 |

Date March 2004
Project 647-92-00

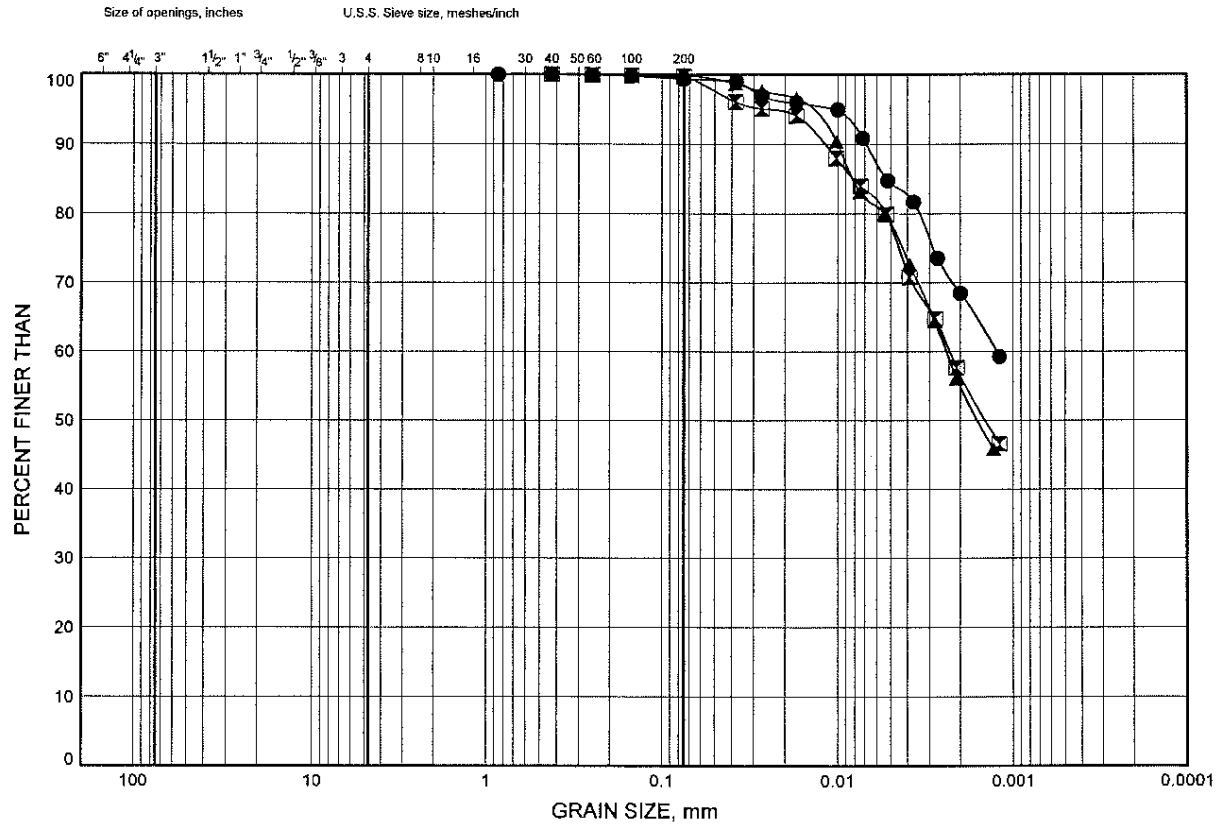


Prep'd SS
Chkd. RAA

HWY 17 Twinning, Amprior to Renfrew GRAIN SIZE DISTRIBUTION

FIGURE B2

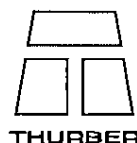
SILTY CLAY



| | | | | | | |
|----------------|--------|------|--------|--------|------|---------------|
| COBBLE SIZE | COARSE | FINE | COARSE | MEDIUM | FINE | SILT and CLAY |
| | GRAVEL | | SAND | | | FINE GRAINED |

| SYMBOL | BH | DEPTH (m) | ELEV. (m) |
|--------|-------|-----------|-----------|
| ● | 508-3 | 2.59 | 127.51 |
| ◻ | 508-3 | 4.88 | 125.22 |
| ▲ | 508-3 | 12.50 | 117.60 |

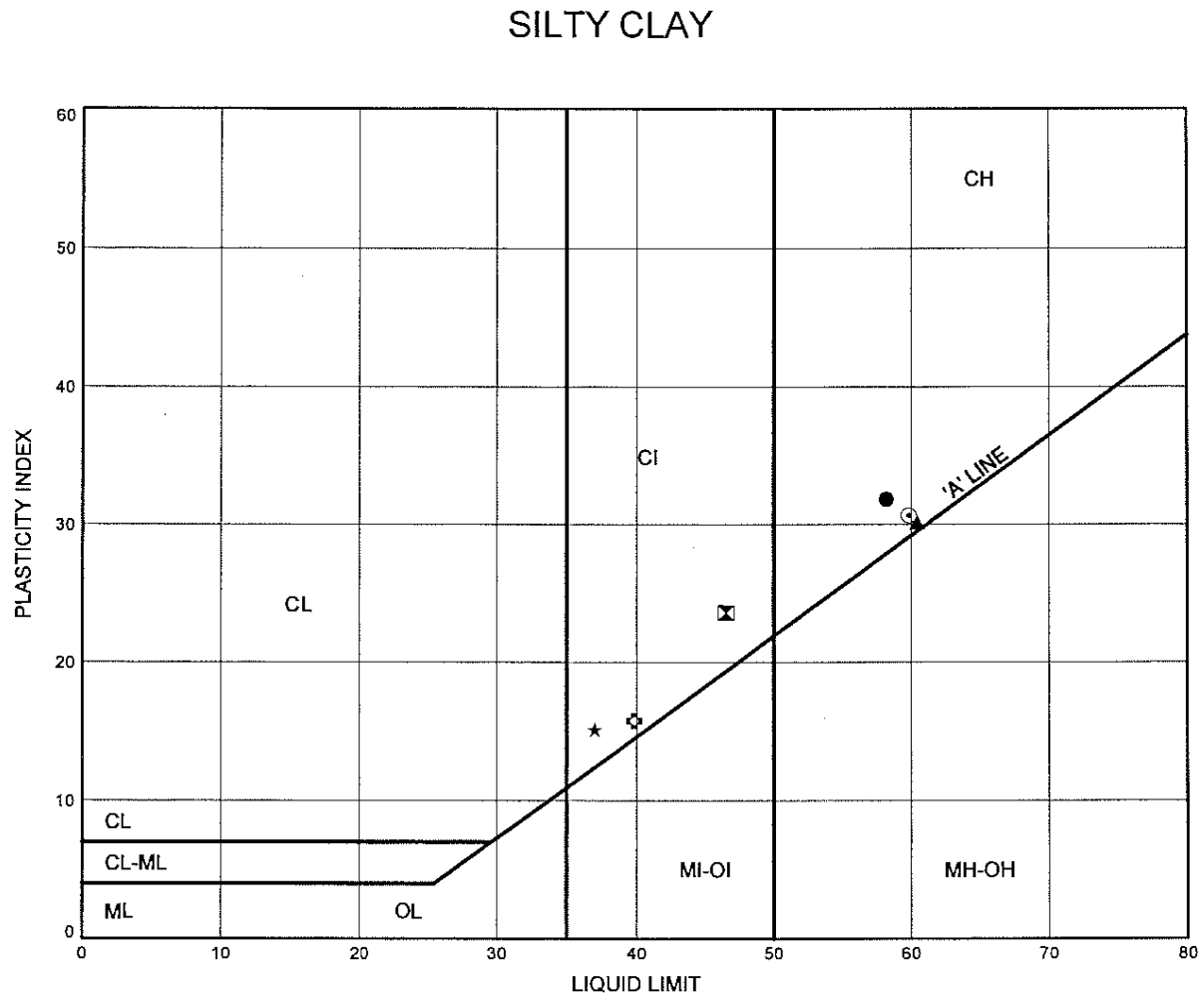
Date March 2004
Project 647-92-00



Prep'd SS
Chkd. RAA

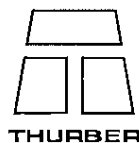
HWY 17 Twinning, Arnprior to Renfrew
ATTERBERG LIMITS TEST RESULTS

FIGURE B3



| SYMBOL | BH | DEPTH (m) | ELEV. (m) |
|--------|-------|-----------|-----------|
| ● | 508-1 | 2.59 | 127.51 |
| ⊠ | 508-1 | 10.97 | 119.13 |
| ▲ | 508-2 | 3.35 | 126.55 |
| ★ | 508-2 | 12.50 | 117.40 |
| ⊙ | 508-3 | 2.59 | 127.51 |
| ⊛ | 508-3 | 12.50 | 117.60 |

Date March 2004
 Project 647-92-00

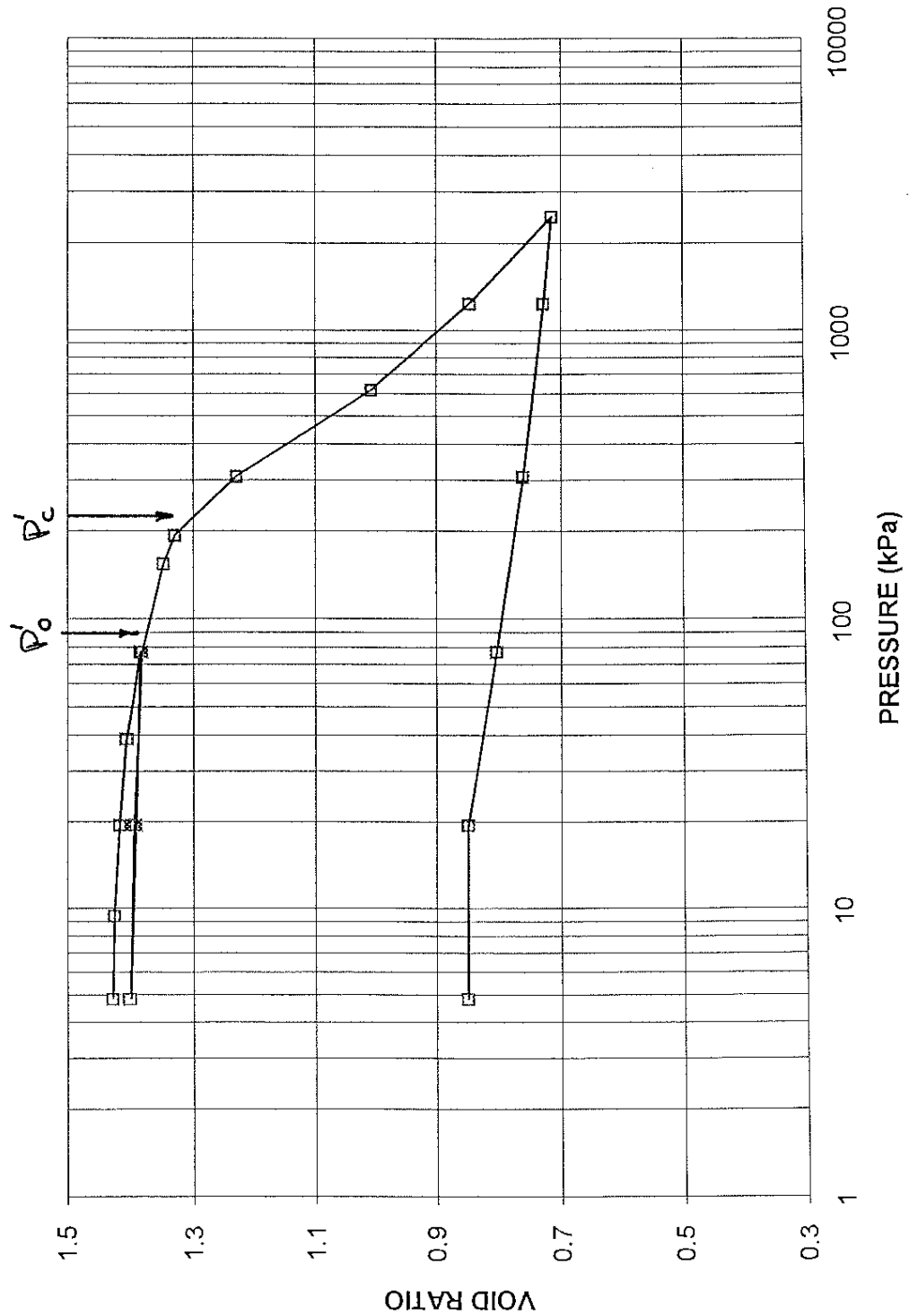


Prep'd SS
 Chkd. RAA

CONSOLIDATION TEST
VOID RATIO VS. LOG PRESSURE

FIGURE B4

CONSOLIDATION TEST
VOID RATIO vs. PRESSURE
BH 508-1 SA TW1



OEDOMETER CONSOLIDATION SUMMARY

SAMPLE IDENTIFICATION

| | | | |
|-----------------|-------------|-----------------|-----------|
| Project Number | 04-1116-011 | Sample Number | TW1 |
| Borehole Number | 508-1 | Sample Depth, m | 11.6-12.2 |

TEST CONDITIONS

| | | | |
|------------------|-----------|-------------------|----------|
| Test Type | Standard | Load Duration, hr | (0.8-24) |
| Oedometer Number | 7 | | |
| Date Started | 1/30/2004 | | |
| Date Completed | 2/11/2004 | | |

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

| | | | |
|-------------------------|--------|------------------------------------|-------|
| Sample Height, cm | 1.90 | Unit Weight, kN/m ³ | 16.93 |
| Sample Diameter, cm | 6.35 | Dry Unit Weight, kN/m ³ | 11.23 |
| Area, cm ² | 31.65 | Specific Gravity, measured | 2.78 |
| Volume, cm ³ | 60.13 | Solids Height, cm | 0.782 |
| Water Content, % | 50.76 | Volume of Solids, cm ³ | 24.76 |
| Wet Mass, g | 103.79 | Volume of Voids, cm ³ | 35.37 |
| Dry Mass, g | 68.84 | Degree of Saturation, % | 98.8 |

TEST COMPUTATIONS

| Pressure kPa | Corr. Height cm | Void Ratio | Average Height cm | t ₉₀ sec | cv, cm ² /s | mv m ² /kN | k cm/s |
|-----------------|-----------------------|---------------|-------------------------|------------------------|---------------------------|--------------------------|-----------|
| 0.00 | 1.900 | 1.428 | 1.900 | | | | |
| 4.83 | 1.900 | 1.428 | 1.900 | 13 | 5.89E-02 | 5.45E-05 | 3.14E-07 |
| 9.46 | 1.898 | 1.426 | 1.899 | 94 | 8.13E-03 | 1.93E-04 | 1.54E-07 |
| 19.51 | 1.892 | 1.418 | 1.895 | 85 | 8.95E-03 | 3.30E-04 | 2.89E-07 |
| 38.91 | 1.883 | 1.407 | 1.887 | 60 | 1.26E-02 | 2.31E-04 | 2.84E-07 |
| 77.57 | 1.867 | 1.386 | 1.875 | 60 | 1.24E-02 | 2.18E-04 | 2.65E-07 |
| 19.51 | 1.872 | 1.393 | 1.870 | | | | |
| 4.83 | 1.879 | 1.402 | 1.876 | | | | |
| 19.51 | 1.875 | 1.396 | 1.877 | 15 | 4.98E-02 | 1.43E-04 | 7.00E-07 |
| 77.57 | 1.864 | 1.382 | 1.870 | 31 | 2.39E-02 | 9.97E-05 | 2.34E-07 |
| 155.05 | 1.837 | 1.348 | 1.851 | 94 | 7.72E-03 | 1.83E-04 | 1.39E-07 |
| 193.95 | 1.823 | 1.330 | 1.830 | 586 | 1.21E-03 | 1.89E-04 | 2.25E-08 |
| 309.36 | 1.744 | 1.229 | 1.784 | 94 | 7.17E-03 | 3.60E-04 | 2.53E-07 |
| 618.55 | 1.570 | 1.007 | 1.657 | 304 | 1.91E-03 | 2.96E-04 | 5.56E-08 |
| 1237.39 | 1.444 | 0.846 | 1.507 | 211 | 2.28E-03 | 1.07E-04 | 2.40E-08 |
| 2475.52 | 1.341 | 0.714 | 1.393 | 146 | 2.82E-03 | 4.38E-05 | 1.21E-08 |
| 1237.39 | 1.351 | 0.727 | 1.346 | | | | |
| 309.36 | 1.377 | 0.760 | 1.364 | | | | |
| 77.57 | 1.410 | 0.802 | 1.394 | | | | |
| 19.51 | 1.446 | 0.848 | 1.428 | | | | |
| 4.83 | 1.447 | 0.849 | 1.447 | | | | |

Notes:

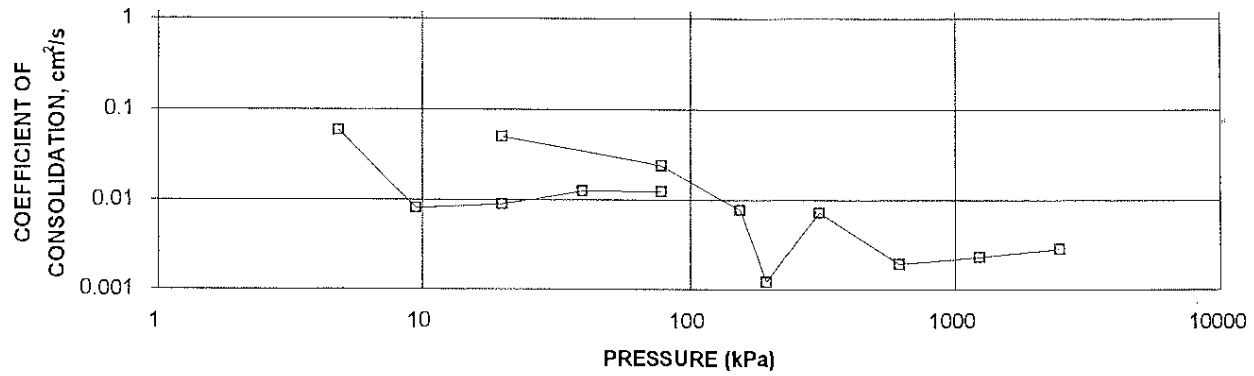
k calculated using cv based on $\dot{\epsilon}_0$ values.

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

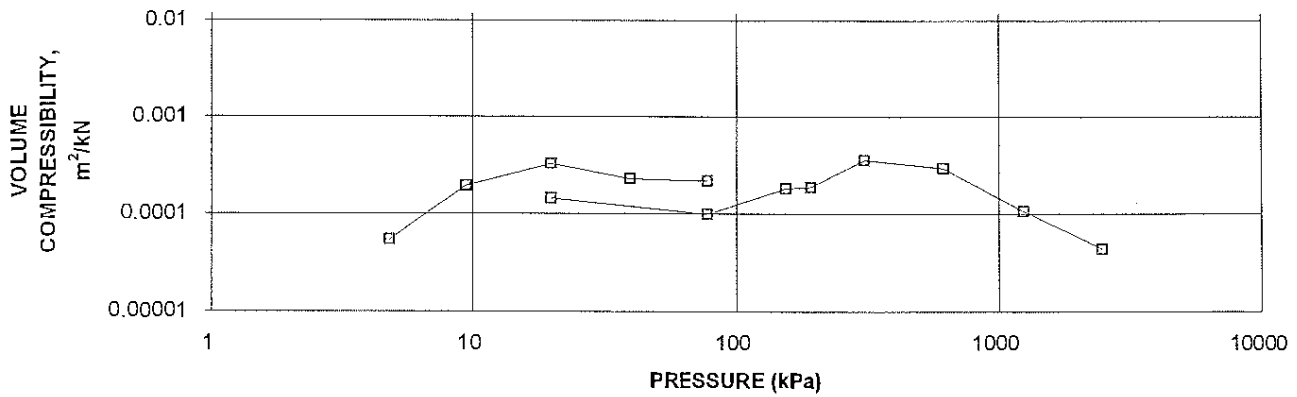
| | | | |
|-------------------------|-------|------------------------------------|-------|
| Sample Height, cm | 1.45 | Unit Weight, kN/m ³ | 19.52 |
| Sample Diameter, cm | 6.35 | Dry Unit Weight, kN/m ³ | 14.74 |
| Area, cm ² | 31.65 | Specific Gravity, measured | 2.78 |
| Volume, cm ³ | 45.80 | Solids Height, cm | 0.782 |
| Water Content, % | 32.44 | Volume of Solids, cm ³ | 24.76 |
| Wet Mass, g | 91.18 | Volume of Voids, cm ³ | 21.03 |
| Dry Mass, g | 68.84 | | |

OEDOMETER CONSOLIDATION SUMMARY

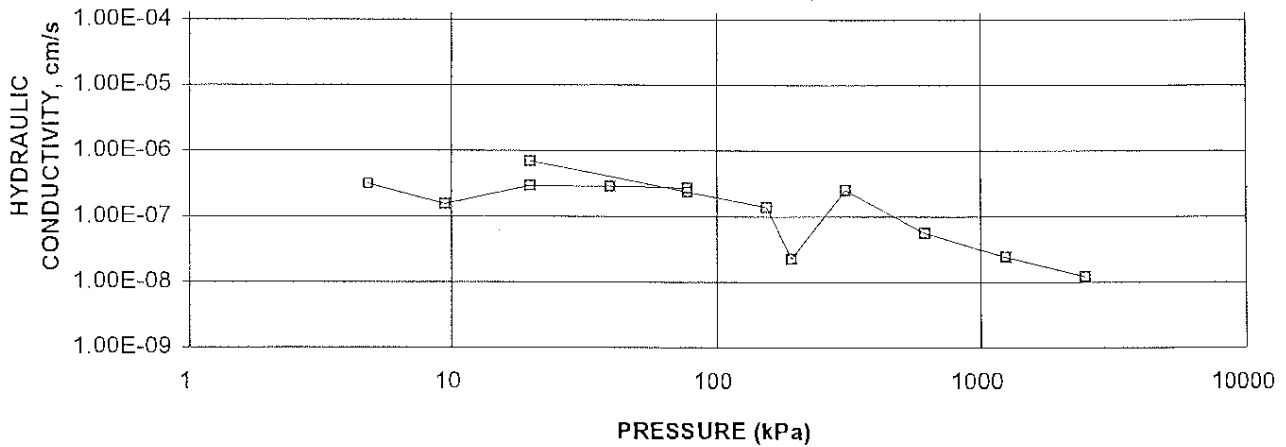
CONSOLIDATION TEST
CV cm²/s VS PRESSURE (kPa)
BH 508-1 SA TW1



CONSOLIDATION TEST
MV m²/kN vs PRESSURE (kPa)
BH 508-1 SA TW1



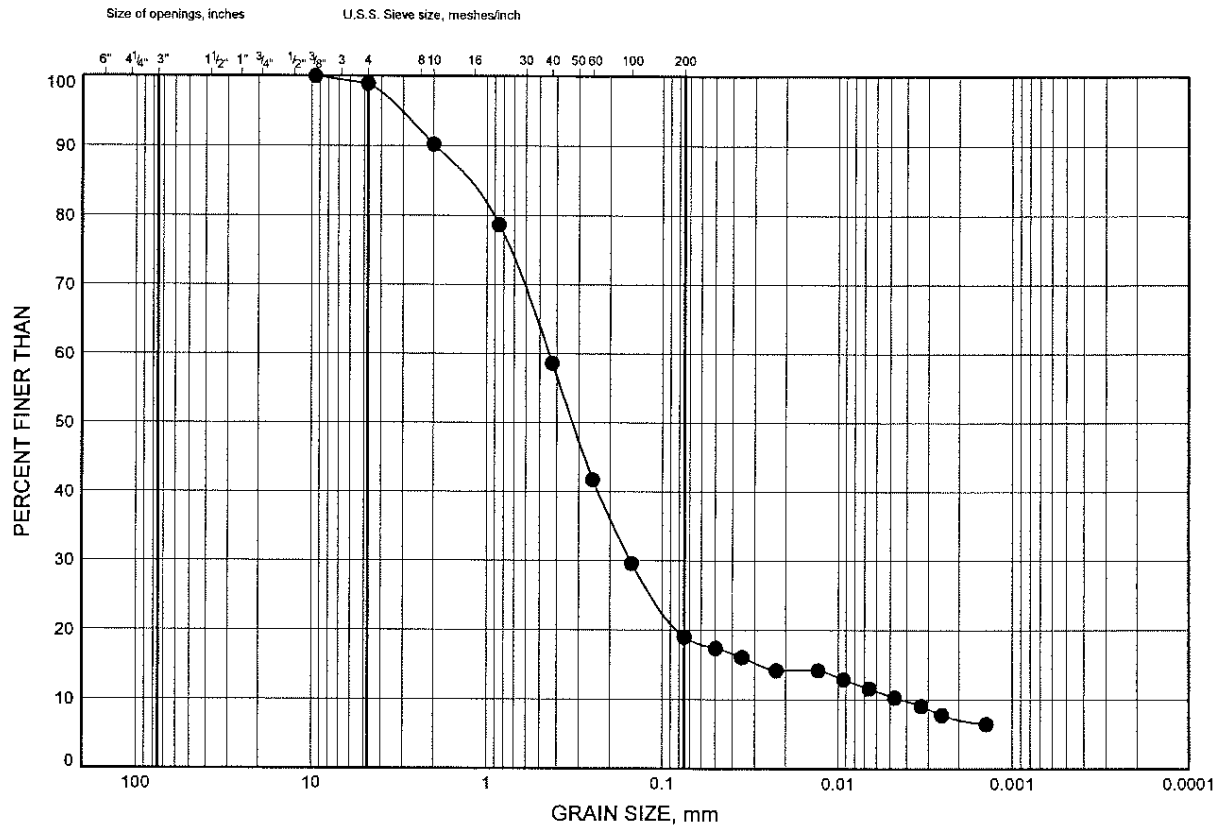
CONSOLIDATION TEST
HYDRAULIC CONDUCTIVITY vs PRESSURE
BH 508-1 SA TW1



HWY 17 Twinning, Arnprior to Renfrew GRAIN SIZE DISTRIBUTION

FIGURE B5

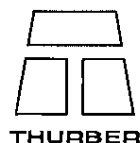
SAND



| | | | | | | |
|----------------|--------|------|--------|--------|------|---------------|
| COBBLE SIZE | COARSE | FINE | COARSE | MEDIUM | FINE | SILT and CLAY |
| | GRAVEL | | SAND | | | FINE GRAINED |

| SYMBOL | BH | DEPTH (m) | ELEV. (m) |
|--------|-------|-----------|-----------|
| ● | 508-1 | 13.87 | 116.23 |

Date April 2004
Project 647-92-00



Prep'd SS
Chkd. SP

APPENDIX C

Piezocone Penetration Testing Report



PRESENTATION OF SITE INVESTIGATION RESULTS

Hwy 17 and Hwy 508

Prepared for:

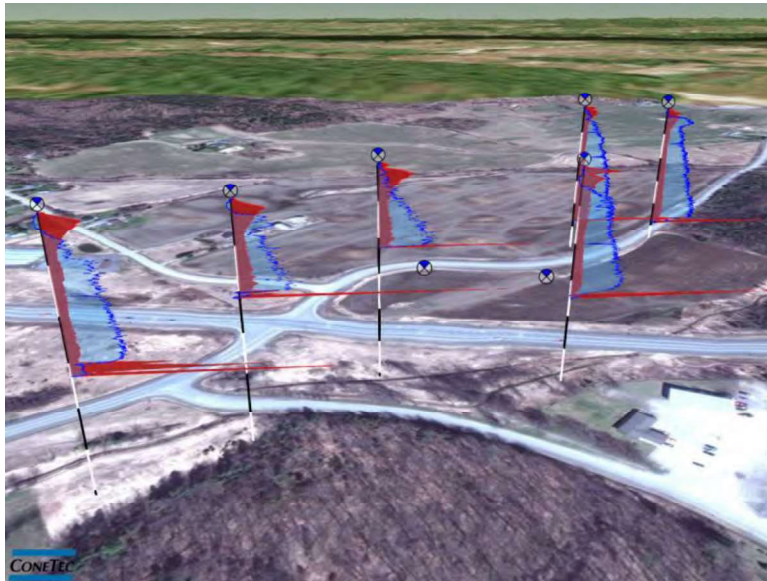
Golder Associates

ConeTec Job No: 18-05032

Project Start Date: 22-May-2018

Project End Date: 25-May-2018

Report Date: 31-May-2018



Prepared by:

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Introduction

The enclosed report presents the results of the site investigation program conducted by ConeTec Investigations Ltd. for Golder Associates near Hwy 17 and Hwy 508, Ontario. The program consisted six cone penetration tests (CPT) and two seismic cone penetration tests (SCPT).

Project Information

| Project | |
|------------------------|-------------------|
| Client | Golder Associates |
| Project | Hwy 17 & Hwy 508 |
| ConeTec project number | 18-05032 |

An aerial overview from Google Earth including the CPT locations is presented below.



| Rig Description | Deployment System | Test Type |
|--------------------|-------------------|-----------|
| Portable Track Rig | Portable | SCPT, CPT |

| Coordinates | | |
|-------------|--------------------|-------------|
| Test Type | Collection Method | EPSG Number |
| SCPT, CPT | Consumer grade GPS | 32618 |

| Cone Penetration Test (CPT) | |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Depth reference | Depths are referenced to the existing ground surface at the time of each test. |
| Tip and sleeve data offset | 0.1 meter This has been accounted for in the CPT data files. |
| Additional plots | Expanded range plots, advanced CPT plots with I_c , S_u , OCR and N160 (IC RW1998), Soil Behavior Type (SBT) scatter plots as well as seismic Vs plots have been included in the data release package. |

| Cone Penetrometers Used for this Project | | | | | | |
|------------------------------------------|-------------|-----------------------------------------|--------------------------------|--------------------|-----------------------|------------------------------|
| Cone Description | Cone Number | Cross Sectional Area (cm ²) | Sleeve Area (cm ²) | Tip Capacity (bar) | Sleeve Capacity (bar) | Pore Pressure Capacity (psi) |
| 330:T1500F15U500 | 330 | 15 | 225 | 1500 | 15 | 500 |
| Cone 330 was used for all CPT soundings. | | | | | | |

| Calculated Geotechnical Parameter Tables | |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Additional information | <p>The Normalized Soil Behaviour Type Chart based on Q_{tn} (SBT Q_{tn}) (Robertson, 2009) was used to classify the soil for this project. A detailed set of calculated CPT parameters have been generated and are provided in Excel format files in the release folder. The CPT parameter calculations are based on values of corrected tip resistance (q_t) sleeve friction (f_s) and pore pressure (u_2). Effective stresses are calculated based on unit weights that have been assigned to the individual soil behaviour type zones and the assumed equilibrium pore pressure profile.</p> <p>Soils were classified as either drained or undrained based on the Q_{tn} Normalized Soil Behaviour Type Chart (Robertson, 2009). Both drained and undrained parameters were calculated for soils that classified as Sand Mixtures (zone 5).</p> |

Limitations

This report has been prepared for the exclusive use of Golder Associates (Client) for the project titled "Hwy 17 & Hwy 508". The report's contents may not be relied upon by any other party without the express written permission of ConeTec Investigations Ltd. (ConeTec). ConeTec has provided site investigation services, prepared the factual data reporting and provided geotechnical parameter calculations consistent with current best practices. No other warranty, expressed or implied, is made.

The information presented in the report document and the accompanying data set pertain to the specific project, site conditions and objectives described to ConeTec by the Client. In order to properly understand the factual data, assumptions and calculations, reference must be made to the documents provided and their accompanying data sets, in their entirety.

The cone penetration tests (CPTu) are conducted using an integrated electronic piezocone penetrometer and data acquisition system manufactured by Adara Systems Ltd. of Richmond, British Columbia, Canada.

ConeTec's piezocone penetrometers are compression type designs in which the tip and friction sleeve load cells are independent and have separate load capacities. The piezocones use strain gauged load cells for tip and sleeve friction and a strain gauged diaphragm type transducer for recording pore pressure. The piezocones also have a platinum resistive temperature device (RTD) for monitoring the temperature of the sensors, an accelerometer type dual axis inclinometer and a geophone sensor for recording seismic signals. All signals are amplified down hole within the cone body and the analog signals are sent to the surface through a shielded cable.

ConeTec penetrometers are manufactured with various tip, friction and pore pressure capacities in both 10 cm² and 15 cm² tip base area configurations in order to maximize signal resolution for various soil conditions. The specific piezocone used for each test is described in the CPT summary table presented in the first Appendix. The 15 cm² penetrometers do not require friction reducers as they have a diameter larger than the deployment rods. The 10 cm² piezocones use a friction reducer consisting of a rod adapter extension behind the main cone body with an enlarged cross sectional area (typically 44 mm diameter over a length of 32 mm with tapered leading and trailing edges) located at a distance of 585 mm above the cone tip.

The penetrometers are designed with equal end area friction sleeves, a net end area ratio of 0.8 and cone tips with a 60 degree apex angle.

All ConeTec piezocones can record pore pressure at various locations. Unless otherwise noted, the pore pressure filter is located directly behind the cone tip in the "u₂" position (ASTM Type 2). The filter is 6 mm thick, made of porous plastic (polyethylene) having an average pore size of 125 microns (90-160 microns). The function of the filter is to allow rapid movements of extremely small volumes of water needed to activate the pressure transducer while preventing soil ingress or blockage.

The piezocone penetrometers are manufactured with dimensions, tolerances and sensor characteristics that are in general accordance with the current ASTM D5778 standard. ConeTec's calibration criteria also meets or exceeds those of the current ASTM D5778 standard. An illustration of the piezocone penetrometer is presented in Figure CPTu.

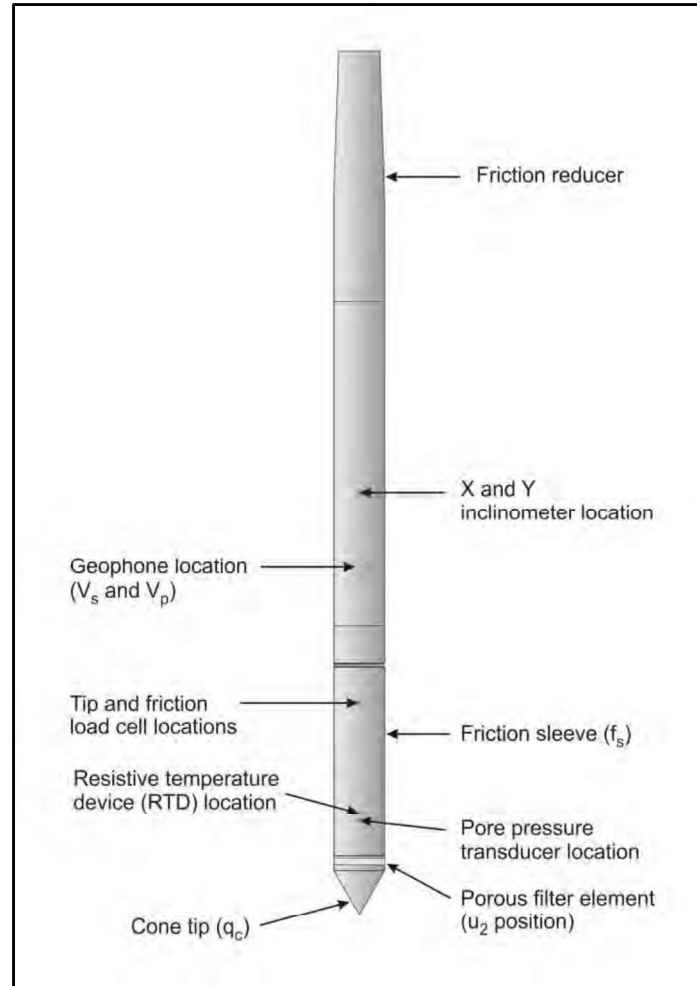


Figure CPTu. Piezocone Penetrometer (15 cm²)

The ConeTec data acquisition systems consist of a Windows based computer and a signal conditioner and power supply interface box with a 16 bit (or greater) analog to digital (A/D) converter. The data is recorded at fixed depth increments using a depth wheel attached to the push cylinders or by using a spring loaded rubber depth wheel that is held against the cone rods. The typical recording intervals are either 2.5 cm or 5.0 cm depending on project requirements; custom recording intervals are possible. The system displays the CPTu data in real time and records the following parameters to a storage media during penetration:

- Depth
- Uncorrected tip resistance (q_c)
- Sleeve friction (f_s)
- Dynamic pore pressure (u)
- Additional sensors such as resistivity, passive gamma, ultra violet induced fluorescence, if applicable

All testing is performed in accordance to ConeTec's CPT operating procedures which are in general accordance with the current ASTM D5778 standard.

Prior to the start of a CPTu sounding a suitable cone is selected, the cone and data acquisition system are powered on, the pore pressure system is saturated with either glycerine or silicone oil and the baseline readings are recorded with the cone hanging freely in a vertical position.

The CPTu is conducted at a steady rate of 2 cm/s, within acceptable tolerances. Typically one meter length rods with an outer diameter of 1.5 inches are added to advance the cone to the sounding termination depth. After cone retraction final baselines are recorded.

Additional information pertaining to ConeTec's cone penetration testing procedures:

- Each filter is saturated in silicone oil or glycerine under vacuum pressure prior to use
- Recorded baselines are checked with an independent multi-meter
- Baseline readings are compared to previous readings
- Soundings are terminated at the client's target depth or at a depth where an obstruction is encountered, excessive rod flex occurs, excessive inclination occurs, equipment damage is likely to take place, or a dangerous working environment arises
- Differences between initial and final baselines are calculated to ensure zero load offsets have not occurred and to ensure compliance with ASTM standards

The interpretation of piezocone data for this report is based on the corrected tip resistance (q_t), sleeve friction (f_s) and pore water pressure (u). The interpretation of soil type is based on the correlations developed by Robertson (1990) and Robertson (2009). It should be noted that it is not always possible to accurately identify a soil type based on these parameters. In these situations, experience, judgment and an assessment of other parameters may be used to infer soil behaviour type.

The recorded tip resistance (q_c) is the total force acting on the piezocone tip divided by its base area. The tip resistance is corrected for pore pressure effects and termed corrected tip resistance (q_t) according to the following expression presented in Robertson et al, 1986:

$$q_t = q_c + (1-a) \cdot u_2$$

where: q_t is the corrected tip resistance

q_c is the recorded tip resistance

u_2 is the recorded dynamic pore pressure behind the tip (u_2 position)

a is the Net Area Ratio for the piezocone (0.8 for ConeTec probes)

The sleeve friction (f_s) is the frictional force on the sleeve divided by its surface area. As all ConeTec piezocones have equal end area friction sleeves, pore pressure corrections to the sleeve data are not required.

The dynamic pore pressure (u) is a measure of the pore pressures generated during cone penetration. To record equilibrium pore pressure, the penetration must be stopped to allow the dynamic pore pressures to stabilize. The rate at which this occurs is predominantly a function of the permeability of the soil and the diameter of the cone.

The friction ratio (R_f) is a calculated parameter. It is defined as the ratio of sleeve friction to the tip resistance expressed as a percentage. Generally, saturated cohesive soils have low tip resistance, high

friction ratios and generate large excess pore water pressures. Cohesionless soils have higher tip resistances, lower friction ratios and do not generate significant excess pore water pressure.

A summary of the CPTu soundings along with test details and individual plots are provided in the appendices. A set of interpretation files were generated for each sounding based on published correlations and are provided in Excel format in the data release folder. Information regarding the interpretation methods used is also included in the data release folder.

For additional information on CPTu interpretations, refer to Robertson et al. (1986), Lunne et al. (1997), Robertson (2009), Mayne (2013, 2014) and Mayne and Peuchen (2012).

Shear wave velocity testing is performed in conjunction with the piezocone penetration test (SCPTu) in order to collect interval velocities. For some projects seismic compression wave (V_p) velocity is also determined.

ConeTec's piezocone penetrometers are manufactured with a horizontally active geophone (28 hertz) that is rigidly mounted in the body of the cone penetrometer, 0.2 meters behind the cone tip.

Shear waves are typically generated by using an impact hammer horizontally striking a beam that is held in place by a normal load. In some instances an auger source or an imbedded impulsive source maybe used for both shear waves and compression waves. The hammer and beam act as a contact trigger that triggers the recording of the seismic wave traces. For impulsive devices an accelerometer trigger may be used. The traces are recorded using an up-hole integrated digital oscilloscope which is part of the SCPTu data acquisition system. An illustration of the shear wave testing configuration is presented in Figure SCPTu-1.

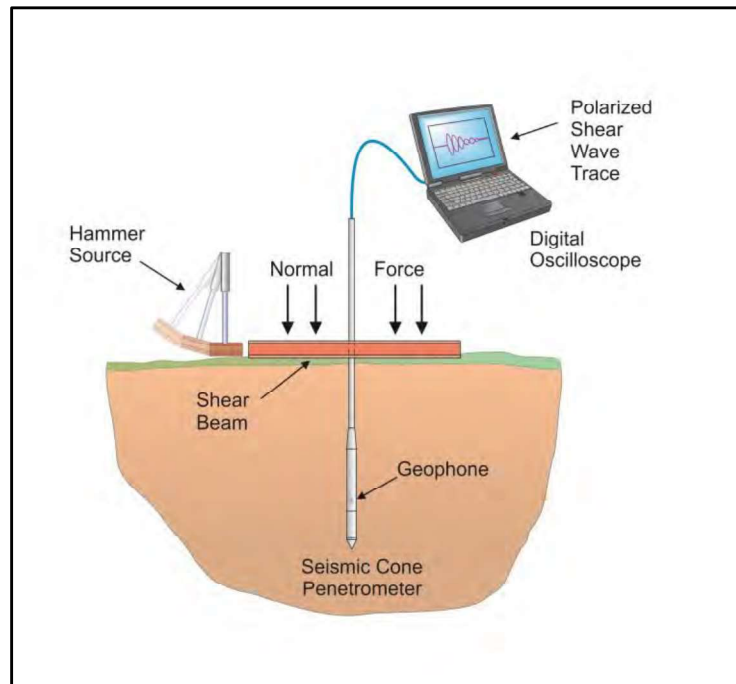


Figure SCPTu-1. Illustration of the SCPTu system

All testing is performed in accordance to ConeTec's SCPTu operating procedures.

Prior to the start of a SCPTu sounding, the procedures described in the Cone Penetration Test section are followed. In addition, the active axis of the geophone is aligned parallel to the beam (or source) and the horizontal offset between the cone and the source is measured and recorded.

Prior to recording seismic waves at each test depth, cone penetration is stopped and the rods are decoupled from the rig to avoid transmission of rig energy down the rods. Multiple wave traces are recorded for quality control purposes. After reviewing wave traces for consistency the cone is pushed to the next test depth (typically one meter intervals or as requested by the client). Figure SCPTu-2 presents an illustration of a SCPTu test.

For additional information on seismic cone penetration testing refer to Robertson et.al. (1986).

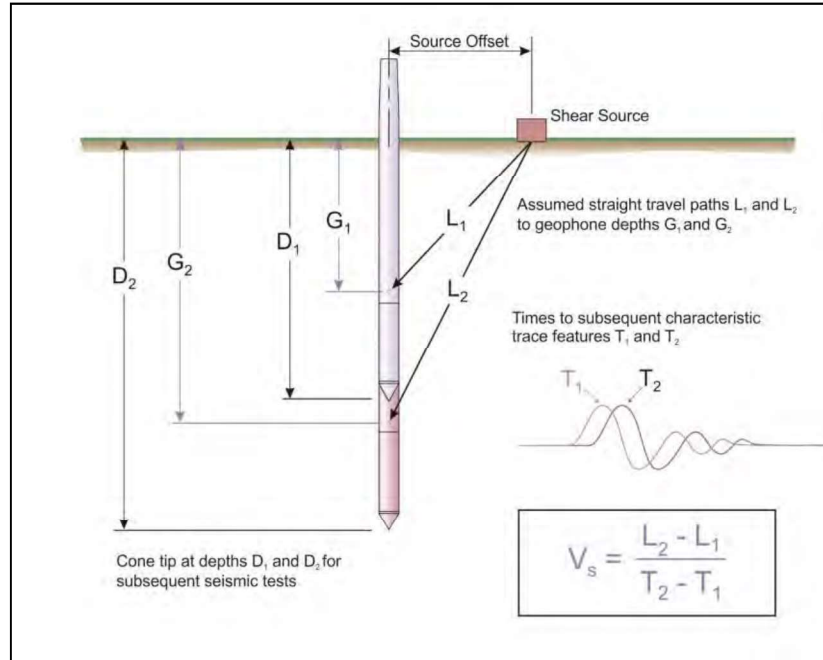


Figure SCPTu-2. Illustration of a seismic cone penetration test

Calculation of the interval velocities are performed by visually picking a common feature (e.g. the first characteristic peak, trough, or crossover) on all of the recorded wave sets and taking the difference in ray path divided by the time difference between subsequent features. Ray path is defined as the straight line distance from the seismic source to the geophone, accounting for beam offset, source depth and geophone offset from the cone tip.

The average shear wave velocity to a depth of 30 meters (V_{s30}) has been calculated and provided for all applicable soundings using an equation presented in Crow et al., 2012.

$$V_{s30} = \frac{\text{total thickness of all layers (30m)}}{\sum(\text{layer traveltimes})}$$

The layer travel times refers to the travel times propagating in the vertical direction, not the measured travel times from an offset source.

Tabular results and SCPTu plots are presented in the relevant appendix.

The cone penetration test is halted at specific depths to carry out pore pressure dissipation (PPD) tests, shown in Figure PPD-1. For each dissipation test the cone and rods are decoupled from the rig and the data acquisition system measures and records the variation of the pore pressure (u) with time (t).

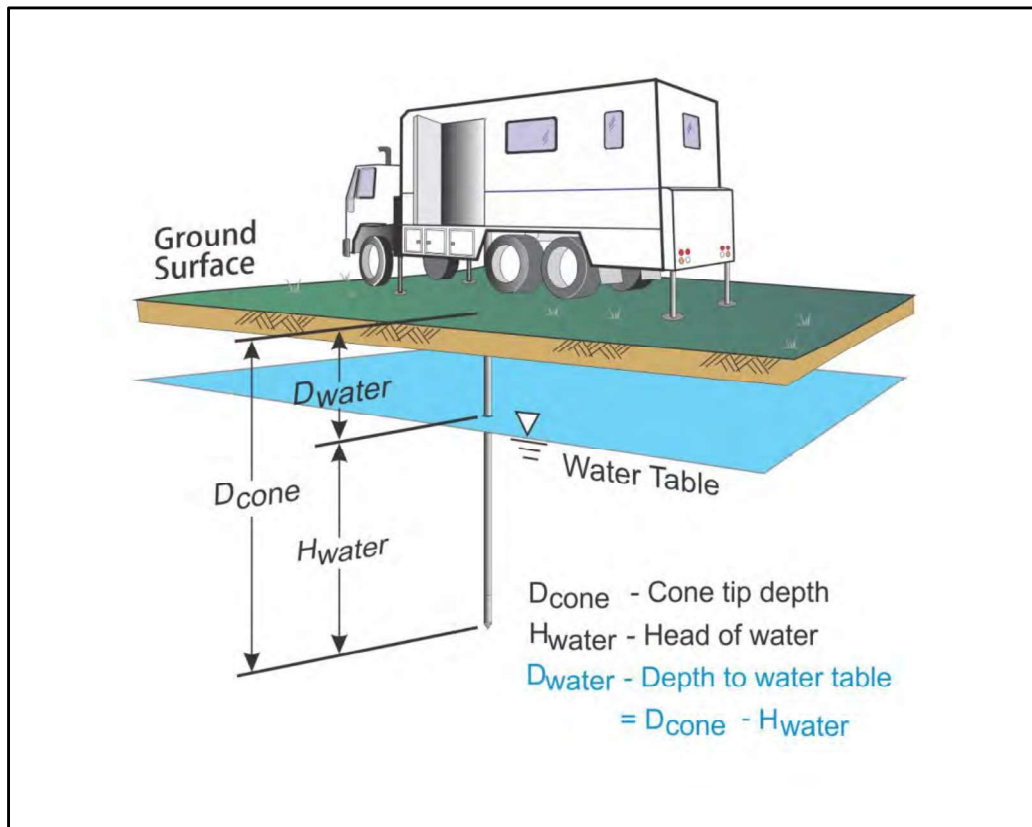


Figure PPD-1. Pore pressure dissipation test setup

Pore pressure dissipation data can be interpreted to provide estimates of ground water conditions, permeability, consolidation characteristics and soil behaviour.

The typical shapes of dissipation curves shown in Figure PPD-2 are very useful in assessing soil type, drainage, in situ pore pressure and soil properties. A flat curve that stabilizes quickly is typical of a freely draining sand. Undrained soils such as clays will typically show positive excess pore pressure and have long dissipation times. Dilative soils will often exhibit dynamic pore pressures below equilibrium that then rise over time. Overconsolidated fine-grained soils will often exhibit an initial dilatory response where there is an initial rise in pore pressure before reaching a peak and dissipating.

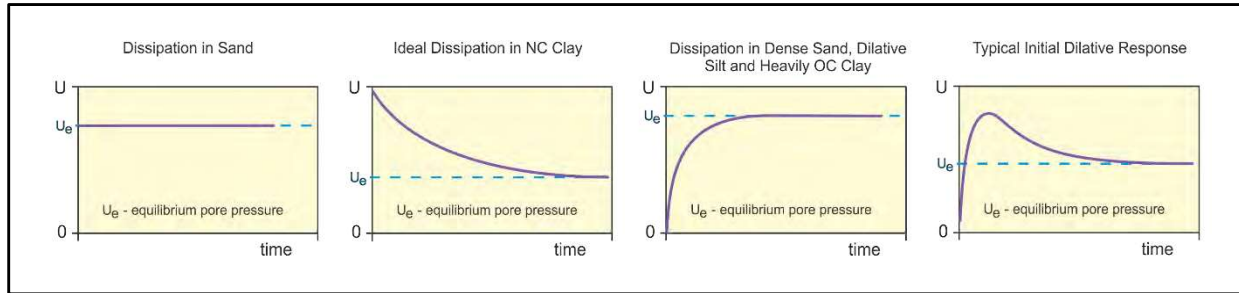


Figure PPD-2. Pore pressure dissipation curve examples

In order to interpret the equilibrium pore pressure (u_{eq}) and the apparent phreatic surface, the pore pressure should be monitored until such time as there is no variation in pore pressure with time as shown for each curve of Figure PPD-2.

In fine grained deposits the point at which 100% of the excess pore pressure has dissipated is known as t_{100} . In some cases this can take an excessive amount of time and it may be impractical to take the dissipation to t_{100} . A theoretical analysis of pore pressure dissipations by Teh and Houlsby (1991) showed that a single curve relating degree of dissipation versus theoretical time factor (T^*) may be used to calculate the coefficient of consolidation (c_h) at various degrees of dissipation resulting in the expression for c_h shown below.

$$c_h = \frac{T^* \cdot a^2 \cdot \sqrt{I_r}}{t}$$

Where:

- T^* is the dimensionless time factor (Table Time Factor)
- a is the radius of the cone
- I_r is the rigidity index
- t is the time at the degree of consolidation

Table Time Factor. T^* versus degree of dissipation (Teh and Houlsby, 1991)

| Degree of Dissipation (%) | 20 | 30 | 40 | 50 | 60 | 70 | 80 |
|---------------------------|-------|-------|-------|-------|-------|-------|------|
| $T^* (u_2)$ | 0.038 | 0.078 | 0.142 | 0.245 | 0.439 | 0.804 | 1.60 |

The coefficient of consolidation is typically analyzed using the time (t_{50}) corresponding to a degree of dissipation of 50% (u_{50}). In order to determine t_{50} , dissipation tests must be taken to a pressure less than u_{50} . The u_{50} value is half way between the initial maximum pore pressure and the equilibrium pore pressure value, known as u_{100} . To estimate u_{50} , both the initial maximum pore pressure and u_{100} must be known or estimated. Other degrees of dissipations may be considered, particularly for extremely long dissipations.

At any specific degree of dissipation the equilibrium pore pressure (u at t_{100}) must be estimated at the depth of interest. The equilibrium value may be determined from one or more sources such as measuring the value directly (u_{100}), estimating it from other dissipations in the same profile, estimating the phreatic surface and assuming hydrostatic conditions, from nearby soundings, from client provided information, from site observations and/or past experience, or from other site instrumentation.

For calculations of c_h (Teh and Houlsby, 1991), t_{50} values are estimated from the corresponding pore pressure dissipation curve and a rigidity index (I_r) is assumed. For curves having an initial dilatory response in which an initial rise in pore pressure occurs before reaching a peak, the relative time from the peak value is used in determining t_{50} . In cases where the time to peak is excessive, t_{50} values are not calculated.

Due to possible inherent uncertainties in estimating I_r , the equilibrium pore pressure and the effect of an initial dilatory response on calculating t_{50} , other methods should be applied to confirm the results for c_h .

Additional published methods for estimating the coefficient of consolidation from a piezocone test are described in Burns and Mayne (1998, 2002), Jones and Van Zyl (1981), Robertson et al. (1992) and Sully et al. (1999).

A summary of the pore pressure dissipation tests and dissipation plots are presented in the relevant appendix.

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The appendices listed below are included in the report:

- Cone Penetration Test Summary and Standard Cone Penetration Test Plots
- Expanded Range Cone Penetration Plots
- Advanced Cone Penetration Test Plots
- Seismic Cone Penetration Test Plots
- Seismic Cone Penetration Test Tabular Results
- Seismic Cone Penetration Test Time Domain Traces
- Soil Behavior Type (SBT) Scatter Plots
- Pore Pressure Dissipation Summary and Pore Pressure Dissipation Plots

Cone Penetration Test Summary and Standard Cone Penetration Test Plots



Job No: 18-05032
Client: Golder Associates
Project: Hwy 17 & Hwy 508
Start Date: 22-May-2018
End Date: 25-May-2018

CONE PENETRATION TEST SUMMARY

| Sounding ID | File Name | Date | Cone | Assumed Phreatic Surface ¹ (m) | Final Depth (m) | Northing ² (m) | Easting (m) | Refer to Notation Number |
|--------------|--------------------|-------------|------------------|-------------------------------------------|-----------------|---------------------------|-------------|--------------------------|
| SCPT18-BH401 | 18-05032_SP_BH-401 | 24-May-2018 | 330:T1500F15U500 | 0.6 | 11.325 | 5032871 | 382232 | 3 |
| CPT18-BH402 | 18-05032_CP_BH-402 | 22-May-2018 | 330:T1500F15U500 | 0.5 | 22.950 | 5032998 | 382371 | |
| SCPT18-BH403 | 18-05032_SP_BH-403 | 23-May-2018 | 330:T1500F15U500 | 0.5 | 24.250 | 5033083 | 382492 | |
| CPT18-BH404 | 18-05032_CP_BH-404 | 25-May-2018 | 330:T1500F15U500 | 0.5 | 16.450 | 5032777 | 382104 | |
| CPT18-BH405 | 18-05032_CP_BH-405 | 24-May-2018 | 330:T1500F15U500 | 0.5 | 10.775 | 5032805 | 382167 | |
| CPT18-BH406 | 18-05032_CP_BH-406 | 24-May-2018 | 330:T1500F15U500 | 0.5 | 17.425 | 5032851 | 382331 | 3 |
| CPT18-BH407 | 18-05032_CP_BH-407 | 22-May-2018 | 330:T1500F15U500 | 0.5 | 14.650 | 5033020 | 382280 | |
| CPT18-BH408 | 18-05032_CP_BH-408 | 23-May-2018 | 330:T1500F15U500 | 0.5 | 23.725 | 5033075 | 382417 | |

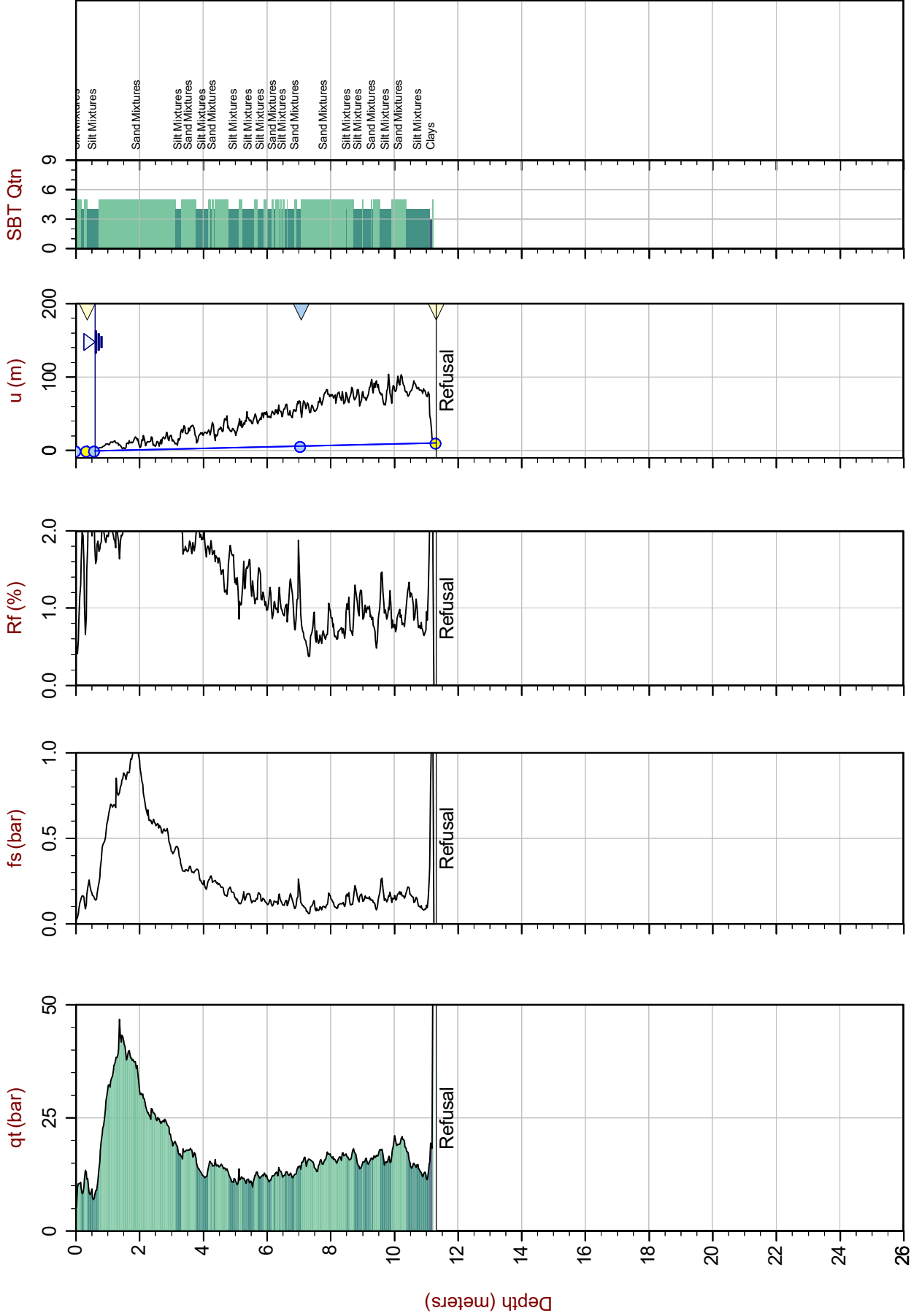
1. The assumed phreatic surface was based on dynamic pore pressure response, unless noted otherwise. Hydrostatic conditions were assumed for the calculated parameters.
2. Coordinates were acquired using consumer grade GPS equipment in datum WGS1984/UTM Zone 18 North.
3. The assumed phreatic surface was based on pore pressure dissipation tests.



Golder Associates

Job No: 18-05032
Date: 2018-05-24 08:11
Site: Hwy 17 & Hwy 508

Sounding: SCPT18-BH401
Cone: 330:T1500F15U500



Max Depth: 11.325 m / 37.16 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 18-05032_SP_BH401.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 18N N: 5032871m E: 3822322m
Sheet No: 1 of 1

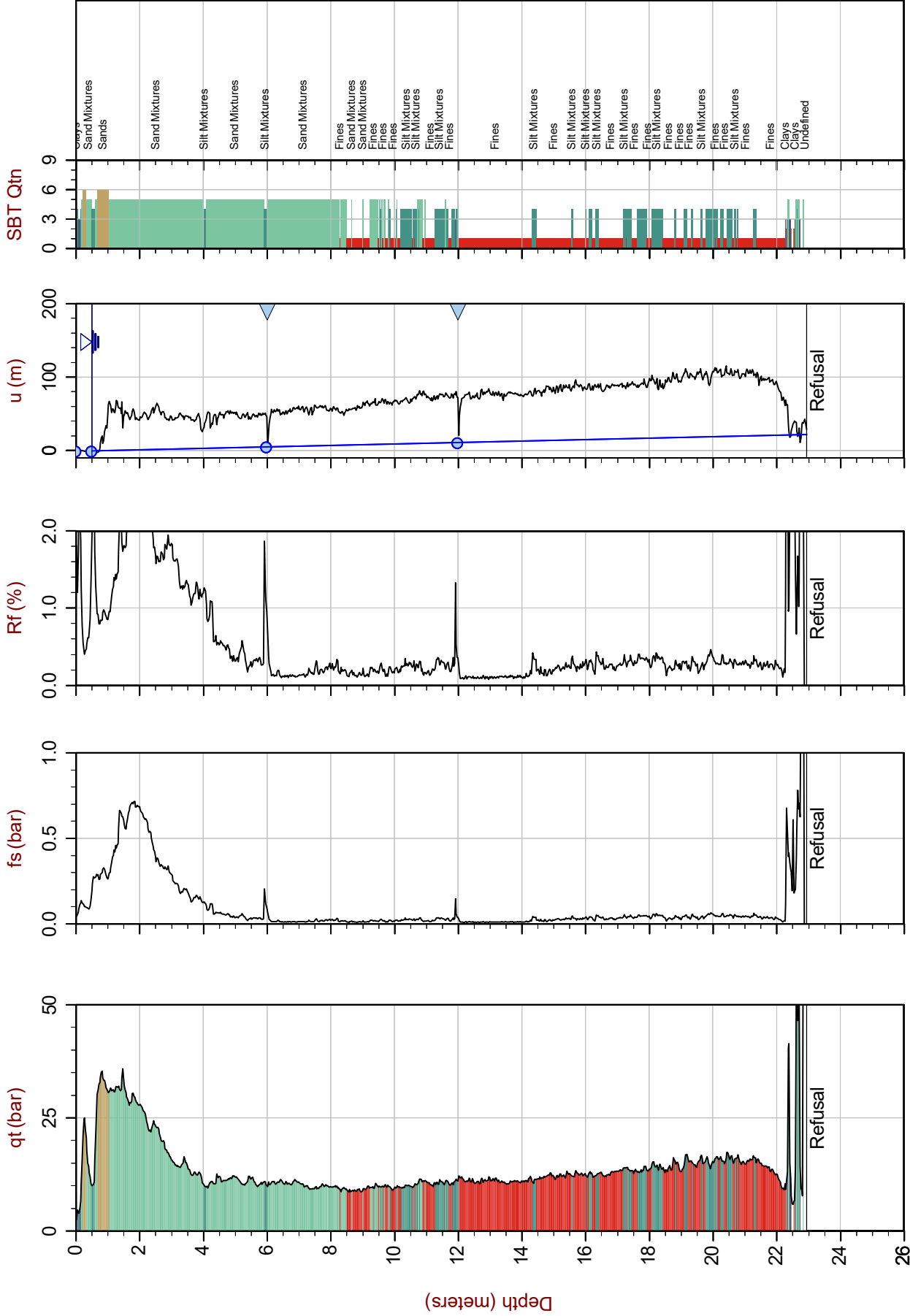
● Equilibrium Pore Pressure (Ueq) ● Assumed Ueq ▲ Dissipation, Ueq not achieved — Hydrostatic Line
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



Golder Associates

Job No: 18-05032
Date: 2018-05-22 10:51
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH402
Cone: 330:T1500F15U500



Max Depth: 22.950 m / 75.29 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 18-05032_CP_BH402.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 18N N: 5032998m E: 382371m
Sheet No: 1 of 1

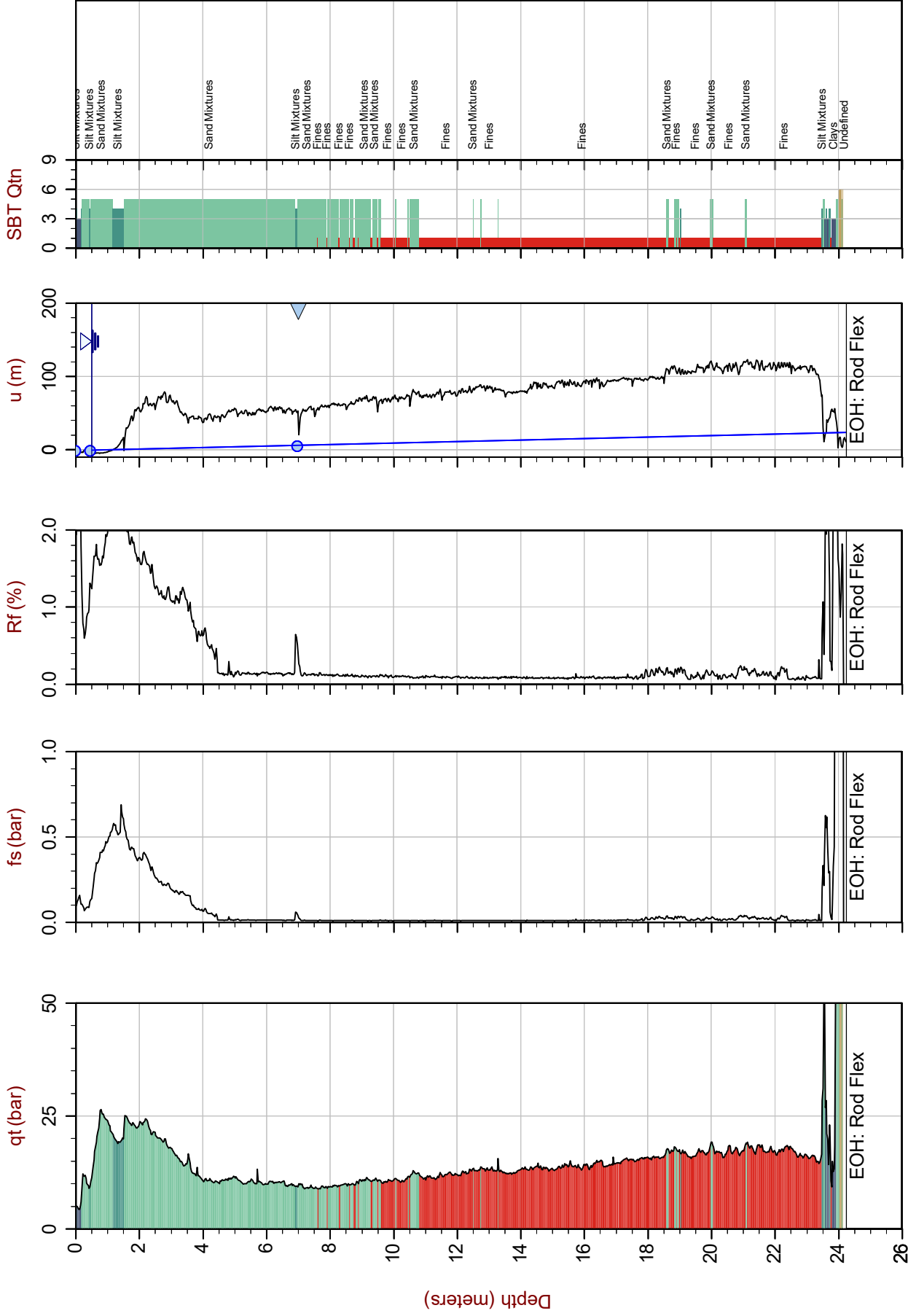
● Equilibrium Pore Pressure (Ueq) ▲ Dissipation, Ueq not achieved — Hydrostatic Line
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



Golder Associates

Job No: 18-05032
Date: 2018-05-23 12:14
Site: Hwy 17 & Hwy 508

Sounding: SCPT18-BH403
Cone: 330:T1500F15U500



Max Depth: 24.250 m / 79.56 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 18-05032_SP_BH403.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 18N N: 5033083m E: 382492m
Sheet No: 1 of 1

● Equilibrium Pore Pressure (Ueq)
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.
● Assumed Ueq
△ Dissipation, Ueq not achieved
◇ Dissipation, Ueq not achieved
— Hydrostatic Line



Sounding: CPT18-BH404

Cone: 330:T1500F15U500

Cone: 330:T1500F15U500



SBT: Robertson, 2009 and 2010
 Coords: UTM 18N N: 5032777m E: 382104m
 Sheet No: 1 of 1

- Assumed Ueq \blacktriangleleft Dissipation, Ueq achieved

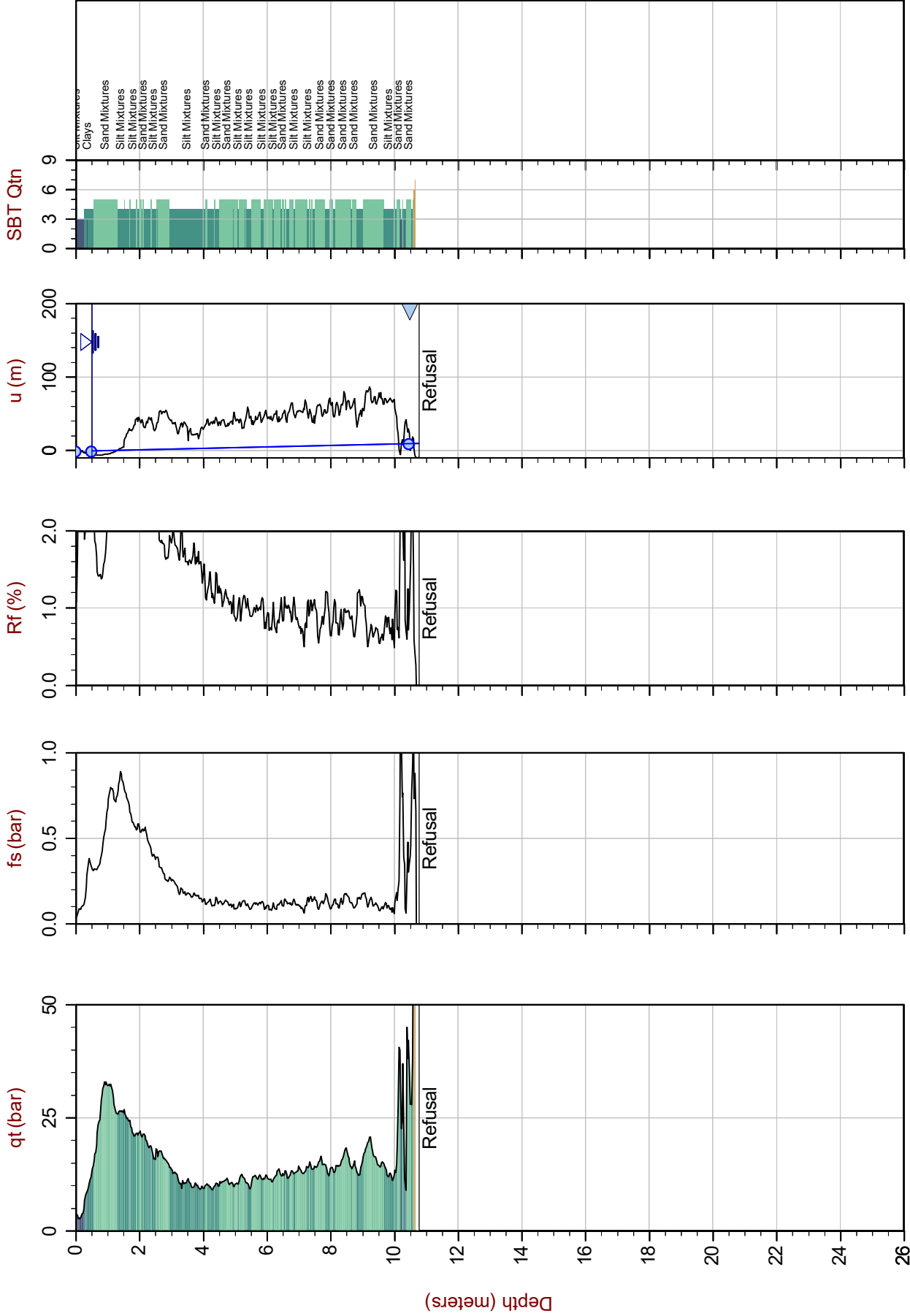
▼ Dissipation, U_{eq} not achieved — Hydrostatic Line



Golder Associates

Job No: 18-05032
Date: 2018-05-24 14:30
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH405
Cone: 330:T1500F15U500



Max Depth: 10.775 m / 35.35 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 18-05032_CP_BH405.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 18N N: 5032805m E: 382167m
Sheet No: 1 of 1

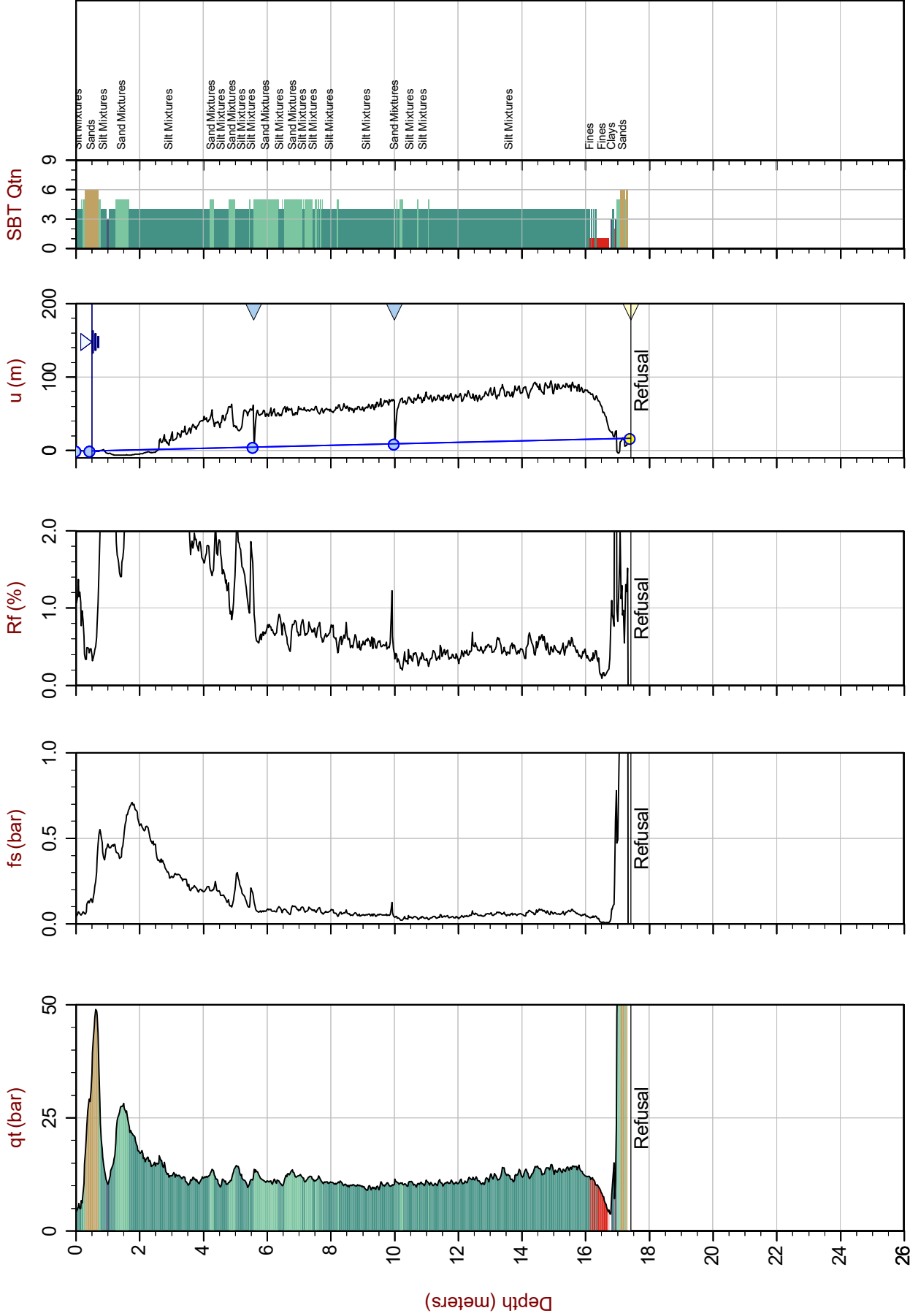
● Equilibrium Pore Pressure (Ueq) ● Assumed Ueq ▲ Dissipation, Ueq not achieved — Hydrostatic Line
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



Golder Associates

Job No: 18-05032
Date: 2018-05-24 10:28
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH406
Cone: 330:T1500F15U500



Max Depth: 17.425 m / 57.17 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 18-05032_CP_BH406.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 18N N: 5032851m E: 382331m
Sheet No: 1 of 1

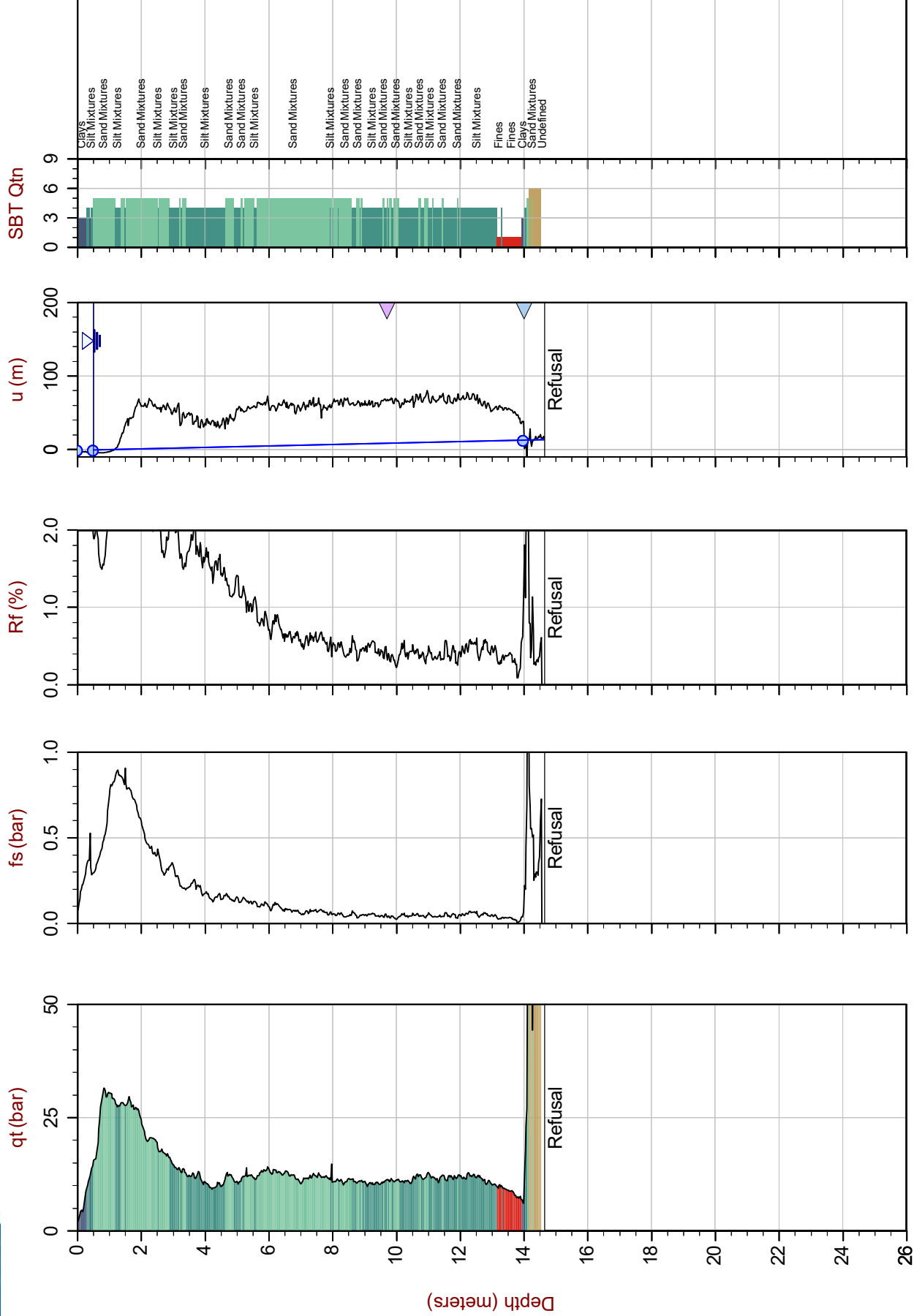
● Equilibrium Pore Pressure (Ueq) ▲ Assumed Ueq ▲ Dissipation, Ueq not achieved — Hydrostatic Line
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



Golder Associates

Job No: 18-05032
Date: 2018-05-22 14:13
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH407
Cone: 330:T1500F15U500



Max Depth: 14.650 m / 48.06 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 18-05032_CP_BH407.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 18N N: 5033020m E: 382280m
Sheet No: 1 of 1

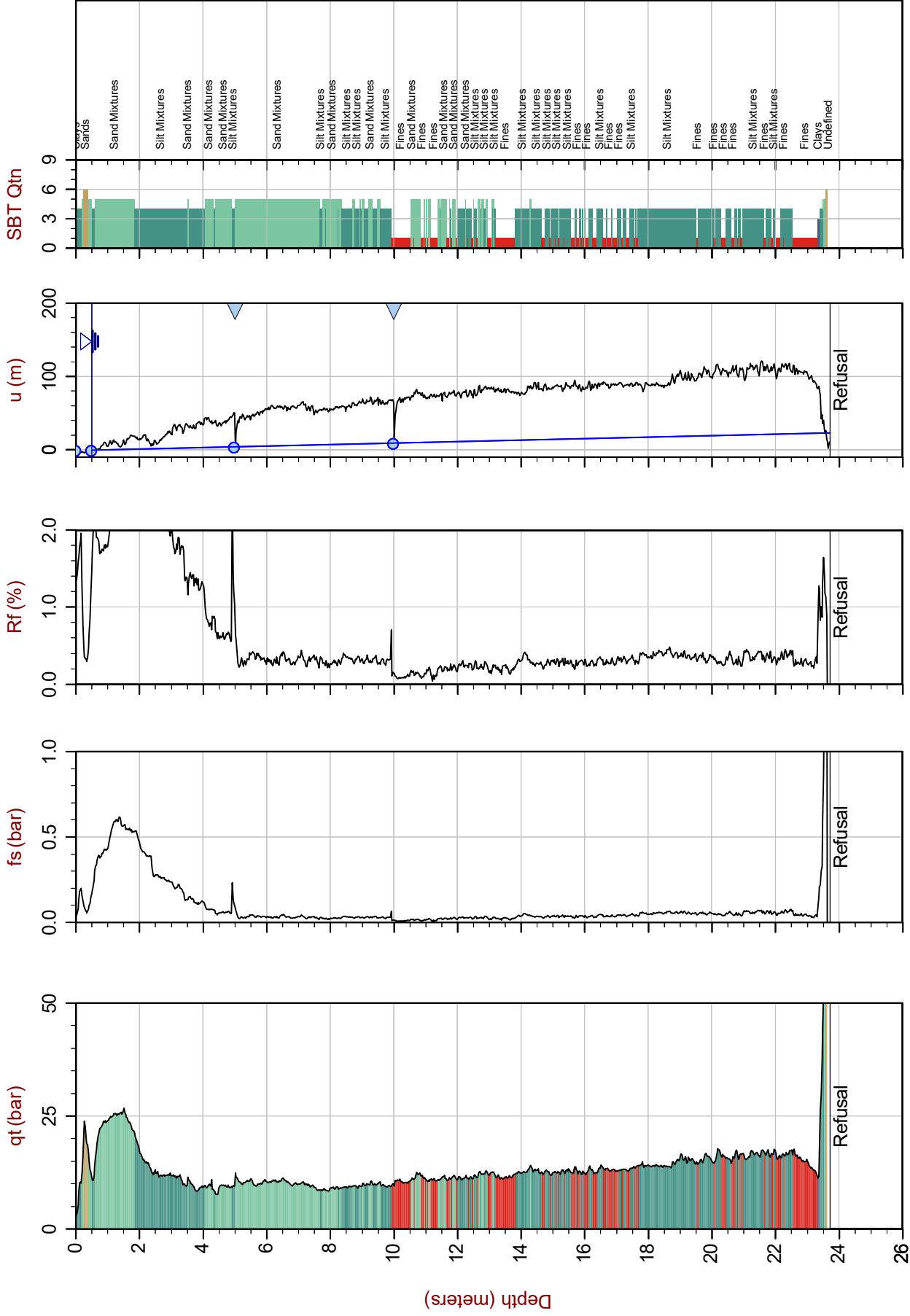
● Equilibrium Pore Pressure (Ueq) ▲ Assumed Ueq ▲ Dissipation, Ueq not achieved — Hydrostatic Line
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



Golder Associates

Job No: 18-05032
Date: 2018-05-23 08:43
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH408
Cone: 330:T1500F15U500



Max Depth: 23.725 m / 77.84 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 18-05032_CP_BH408.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 18N N: 5033075m E: 382417m
Sheet No: 1 of 1

● Equilibrium Pore Pressure (Ueq) ▲ Assumed Ueq ▼ Dissipation, Ueq not achieved — Hydrostatic Line
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

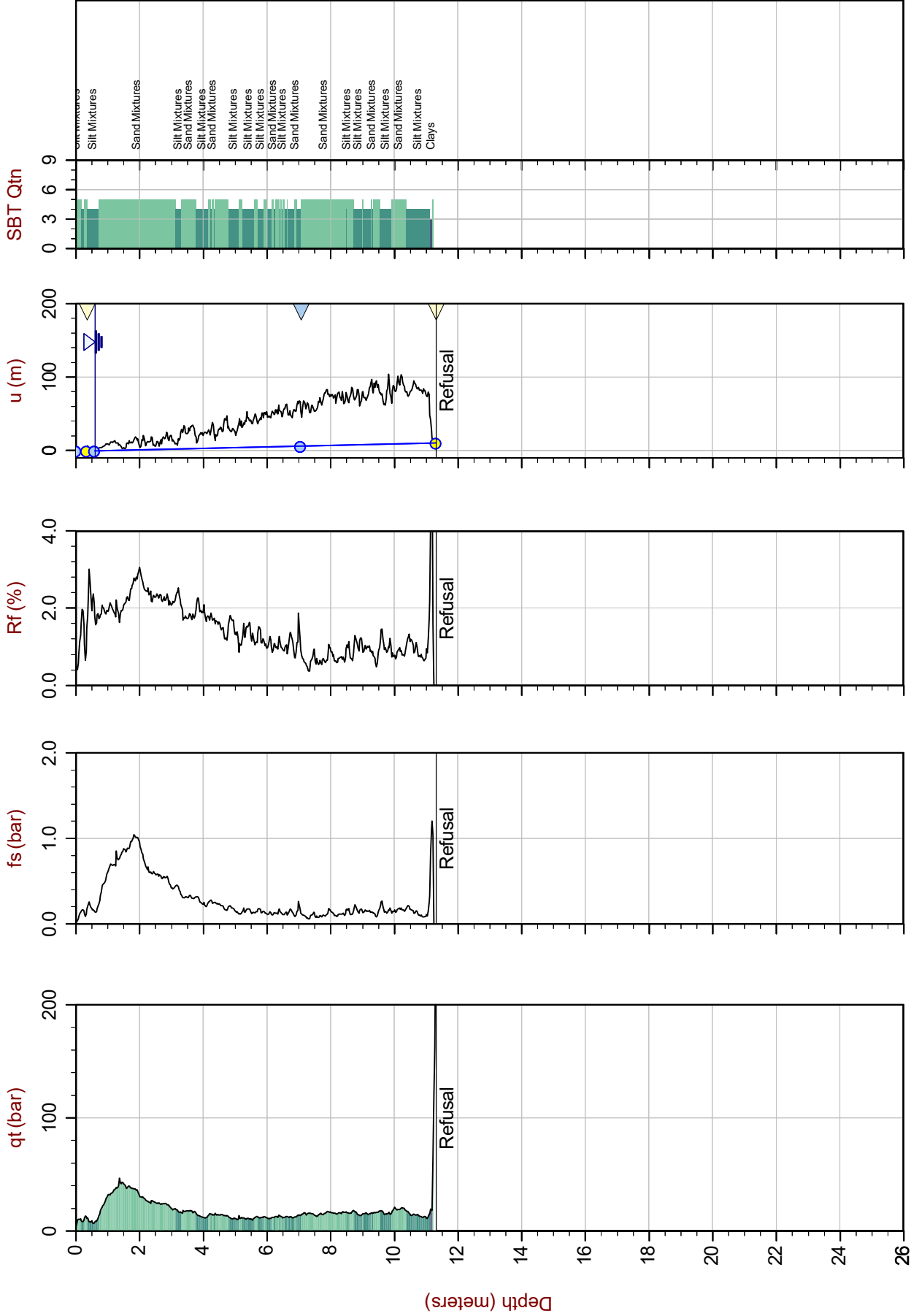
Expanded Range Cone Penetration Test Plots



Golder Associates

Job No: 18-05032
Date: 2018-05-24 08:11
Site: Hwy 17 & Hwy 508

Sounding: SCPT18-BH401
Cone: 330:T1500F15U500



Max Depth: 11.325 m / 37.16 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 18-05032_SP_BH401.COR
Unit Wt: SBTQtn (PKR2009)

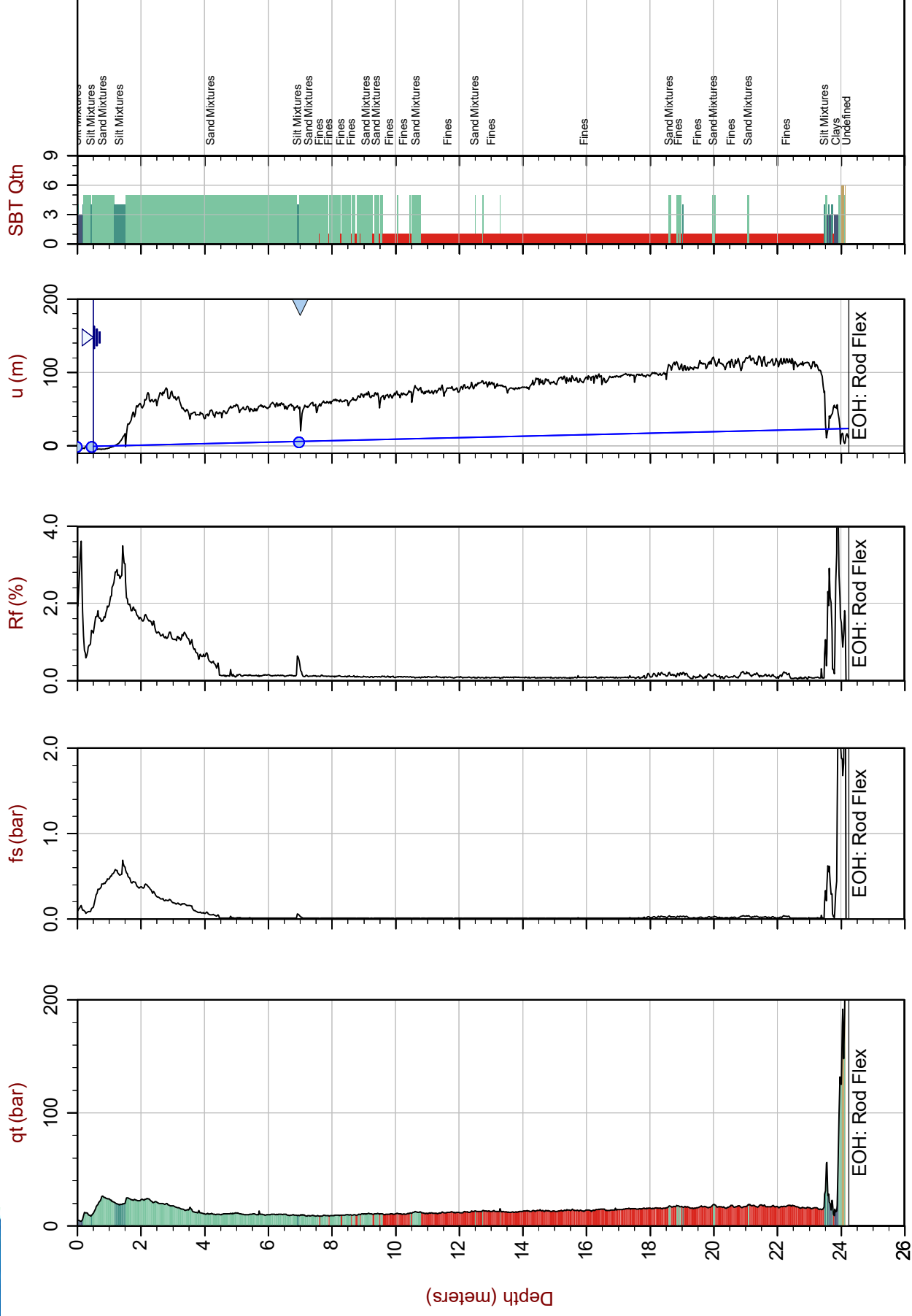
SBT: Robertson, 2009 and 2010
Coords: UTM 18N N: 5032871m E: 3822322m
Sheet No: 1 of 1

● Equilibrium Pore Pressure (Ueq) ● Assumed Ueq ▲ Dissipation, Ueq not achieved — Hydrostatic Line
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



Sounding: CPT18-BH402
Cone: 330:T1500F15U500





Max Depth: 24.250 m / 79.56 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 18-05032_SP_BH-403.COR
Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010
 Coords: UTM 18N N: 5033083m E: 382492m
 Sheet No: 1 of 1

- Equilibrium Pore Pressure (Ueq)
The reported coordinates were acquired

▼ Dissipation, U_{eq} achieved
equipment and are only approximate lo

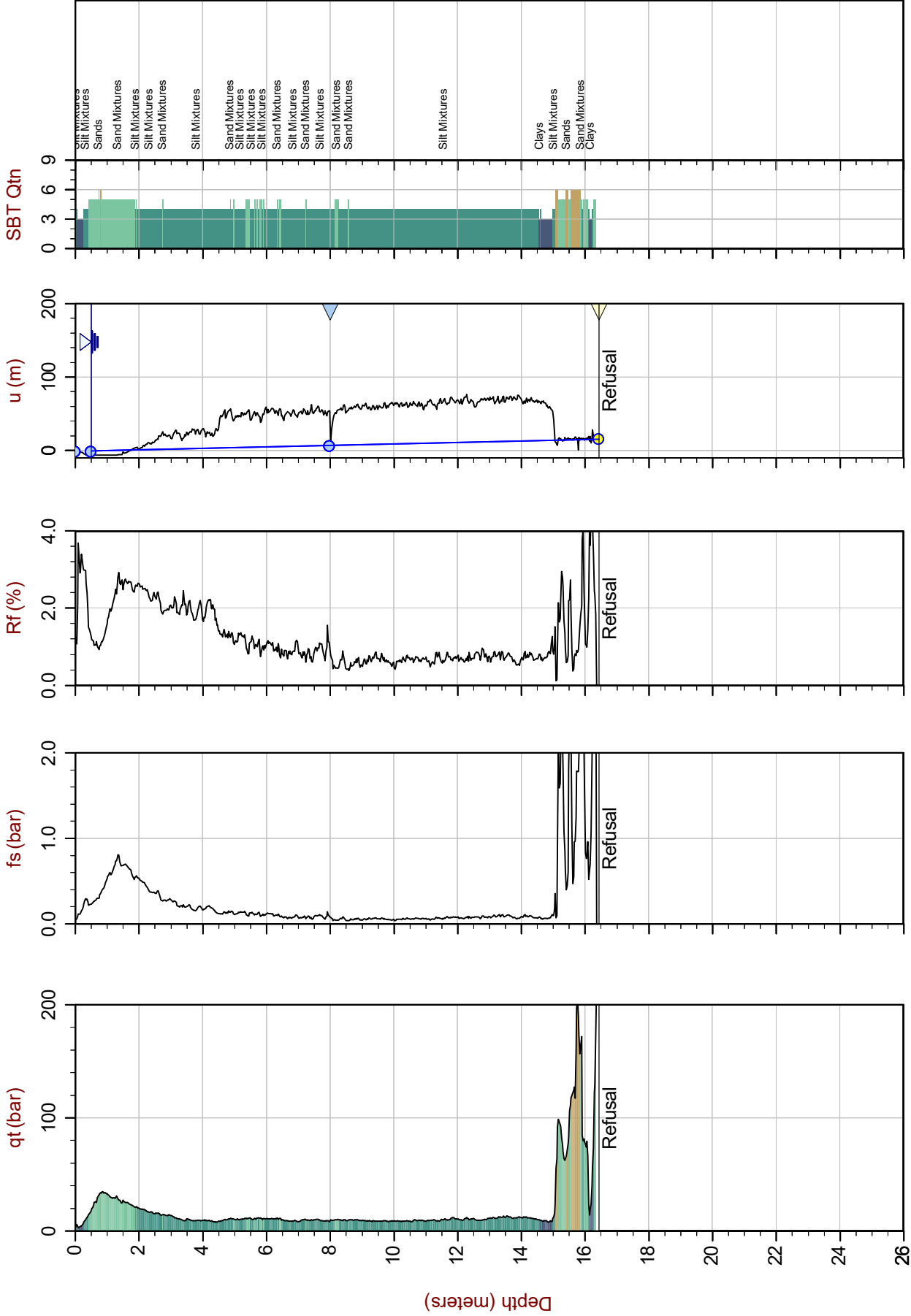
▼ Dissipation, Ueq not achieved — Hydrostatic Line



Golder Associates

Job No: 18-05032
Date: 2018-05-25 07:51
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH404
Cone: 330:T1500F15U500



Max Depth: 16.450 m / 53.97 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 18-05032_CP_BH404.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 18N N: 5032777m E: 382104m
Sheet No: 1 of 1

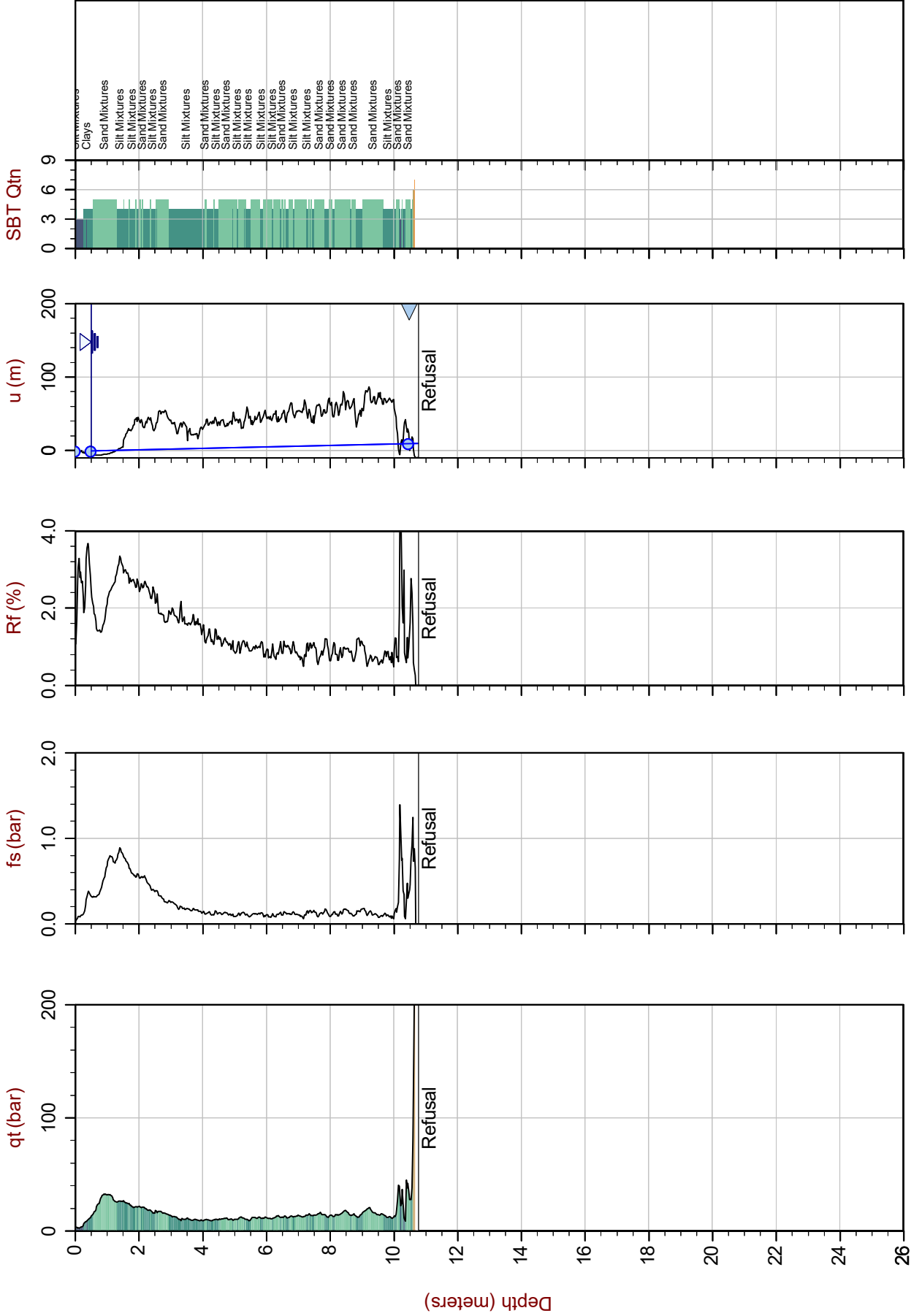
● Equilibrium Pore Pressure (Ueq) ▲ Dissipation, Ueq achieved ▲ Dissipation, Ueq not achieved — Hydrostatic Line
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



Golder Associates

Job No: 18-05032
Date: 2018-05-24 14:30
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH405
Cone: 330:T1500F15U500

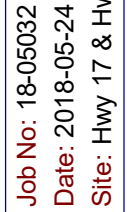


Max Depth: 10.775 m / 35.35 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

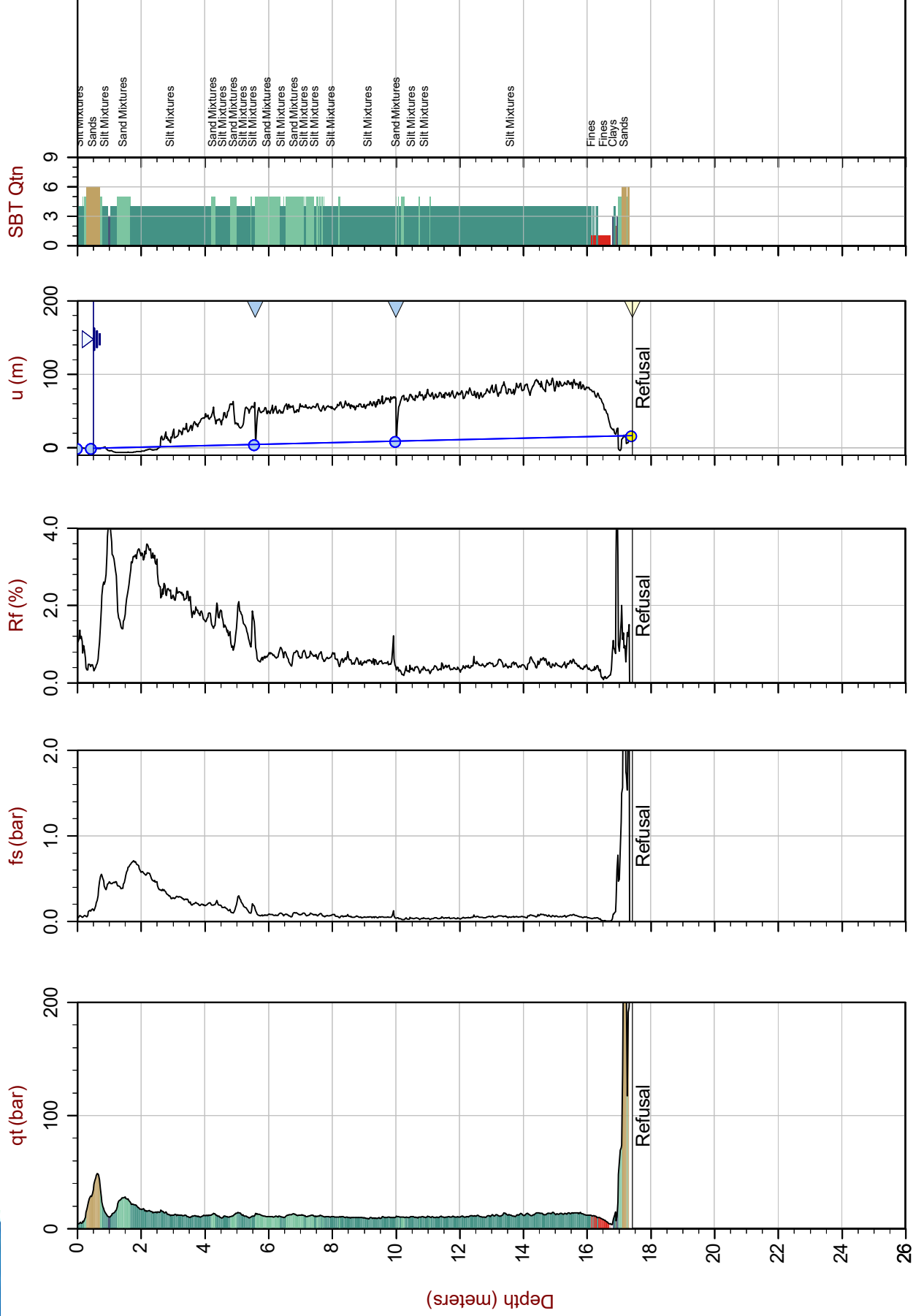
File: 18-05032_CP_BH405.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 18N N: 5032805m E: 382167m
Sheet No: 1 of 1

● Equilibrium Pore Pressure (Ueq) ▲ Assumed Ueq ▲ Dissipation, Ueq not achieved — Hydrostatic Line
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



Sounding: CPT18-BH406
Cone: 330:T1500F15U500



Max Depth: 17.425 m / 57.17 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 18-05032_CP_BH-406.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
 Coords: UTM 18N N: 5032851m E: 382331m
 Sheet No: 1 of 1

● Equilibrium Pore Pressure (Ueq) ● Assumed Ueq ▼ Dissipation, Ueq achieved ▼ Dissipation, Ueq not achieved — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



Site: Hwy 17 & Hwy 508

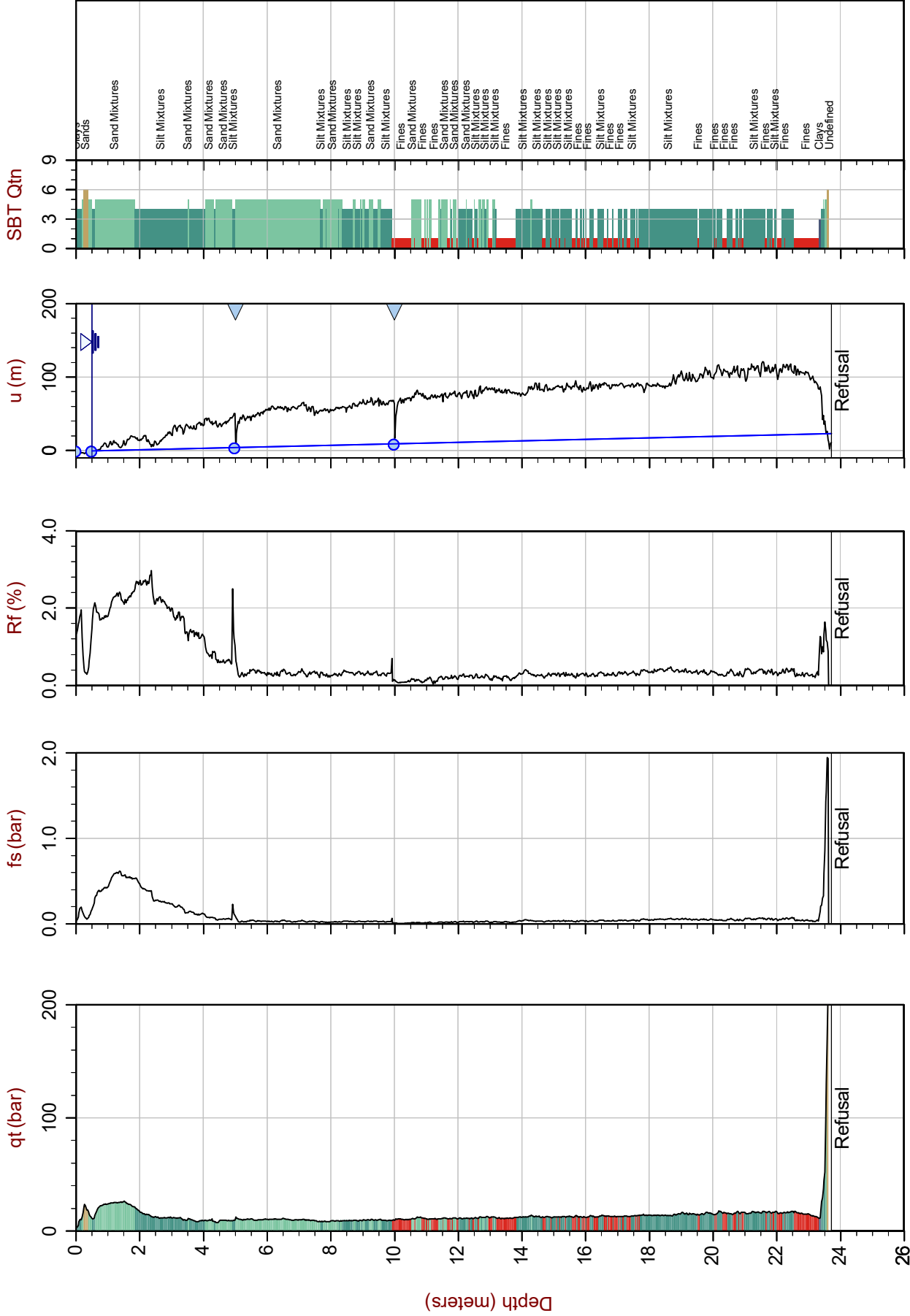




Golder Associates

Sounding: CPT18-BH408
Cone: 330:T1500F15U500

Job No: 18-05032
Date: 2018-05-23 08:43
Site: Hwy 17 & Hwy 508



Max Depth: 23.725 m / 77.84 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 18-05032_CP_BH408.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 18N N: 5033075m E: 382417m
Sheet No: 1 of 1

● Equilibrium Pore Pressure (Ueq) ▲ Dissipation, Ueq not achieved — Hydrostatic Line
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Advanced Cone Penetration Test Plots



Golder Associates

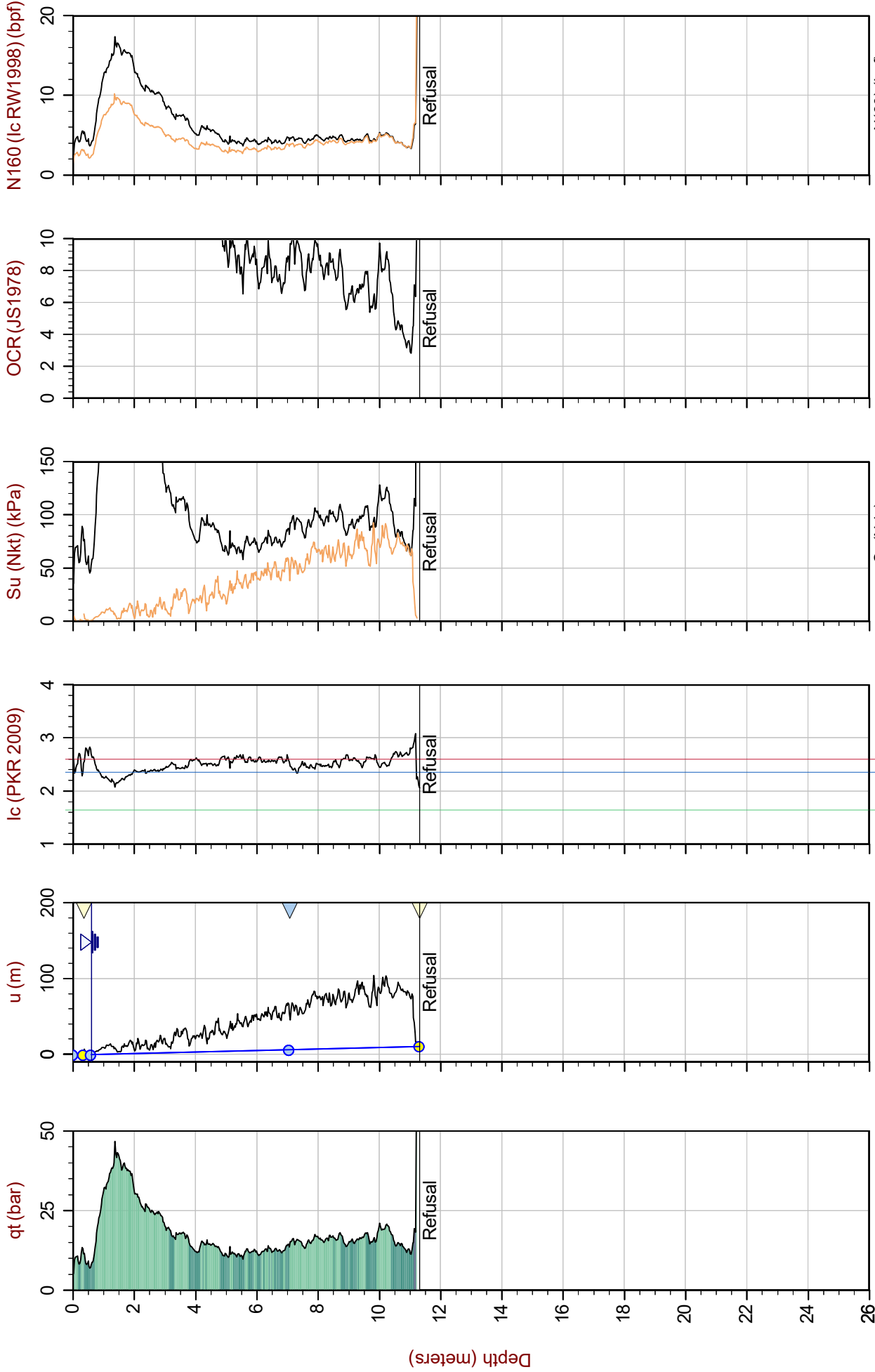
Job No: 18-05032

Date: 2018-05-24 08:11

Site: Hwy 17 & Hwy 508

Sounding: SCPT18-BH401

Cone: 330:T1500F15U500



Max Depth: 11.325 m / 37.16 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

● Equilibrium Pore Pressure (Ueq)

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

File: 18-05032_SP_BH401.COR
Unit Wt: SBTQin (PKR2009)
Su Nkt/Ndu: 15.0 / 10.0

● Assumed Ueq

△ Dissipation, Ueq

SBT: Robertson, 2009 and 2010
Coords: UTM 18N N: 5032871m E: 382232m
Sheet No: 1 of 1

△ Dissipation, Ueq not achieved

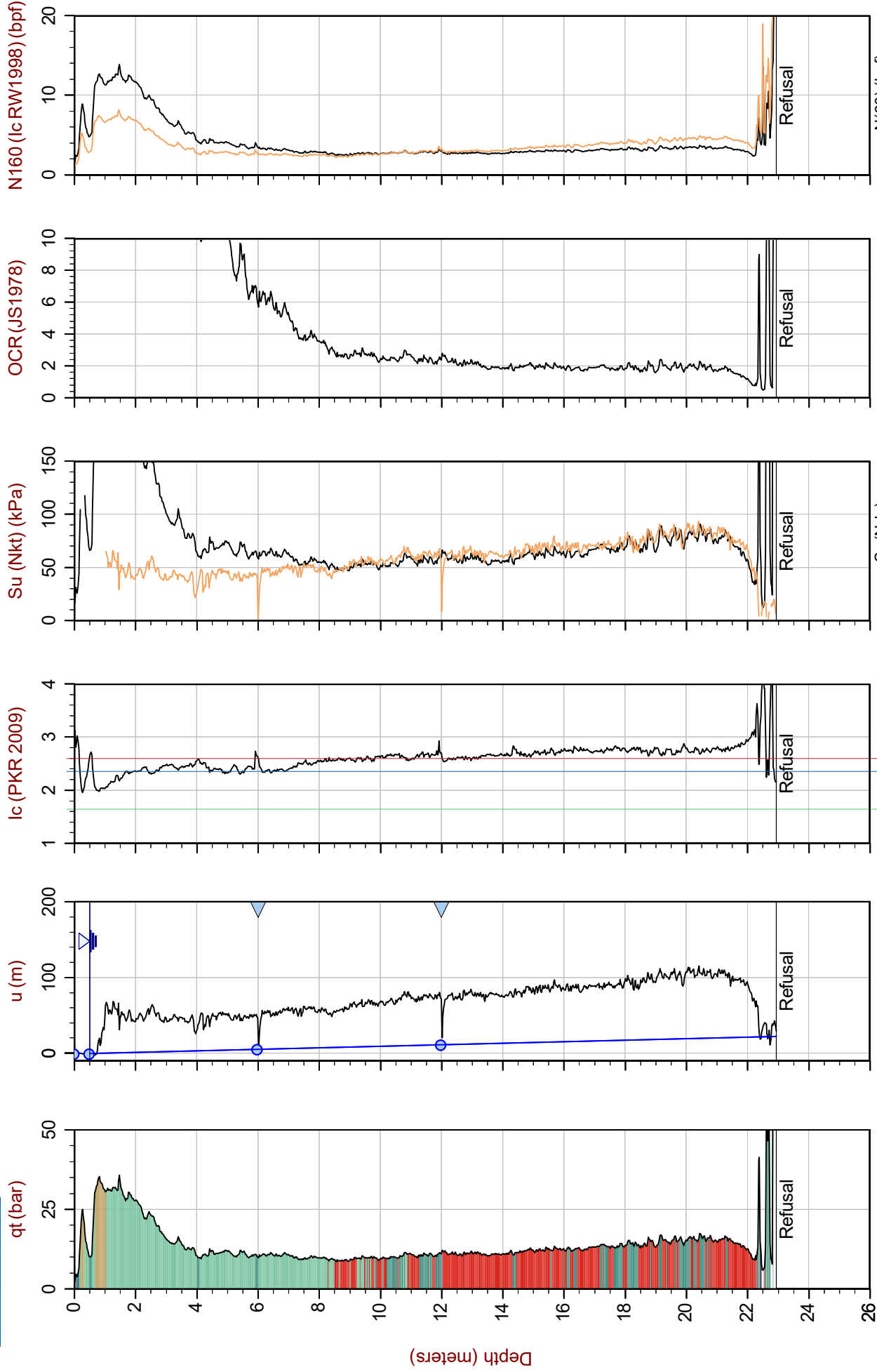
— Hydrostatic Line



Golder Associates

Job No: 18-05032
Date: 2018-05-22 10:51
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH402
Cone: 330:T1500F15U500



Max Depth: 22.950 m / 75.29 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 18-05032_CP_BH402.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 15.0 / 10.0

SBT: Robertson, 2009 and 2010
Coords: UTM 18N N: 5032998m E: 382371m
Sheet No: 1 of 1

● Equilibrium Pore Pressure (Ueq)
▲ Assumed Ueq
◆ Dissipation, Ueq not achieved
◆ Dissipation, Ueq achieved
— Hydrostatic Line

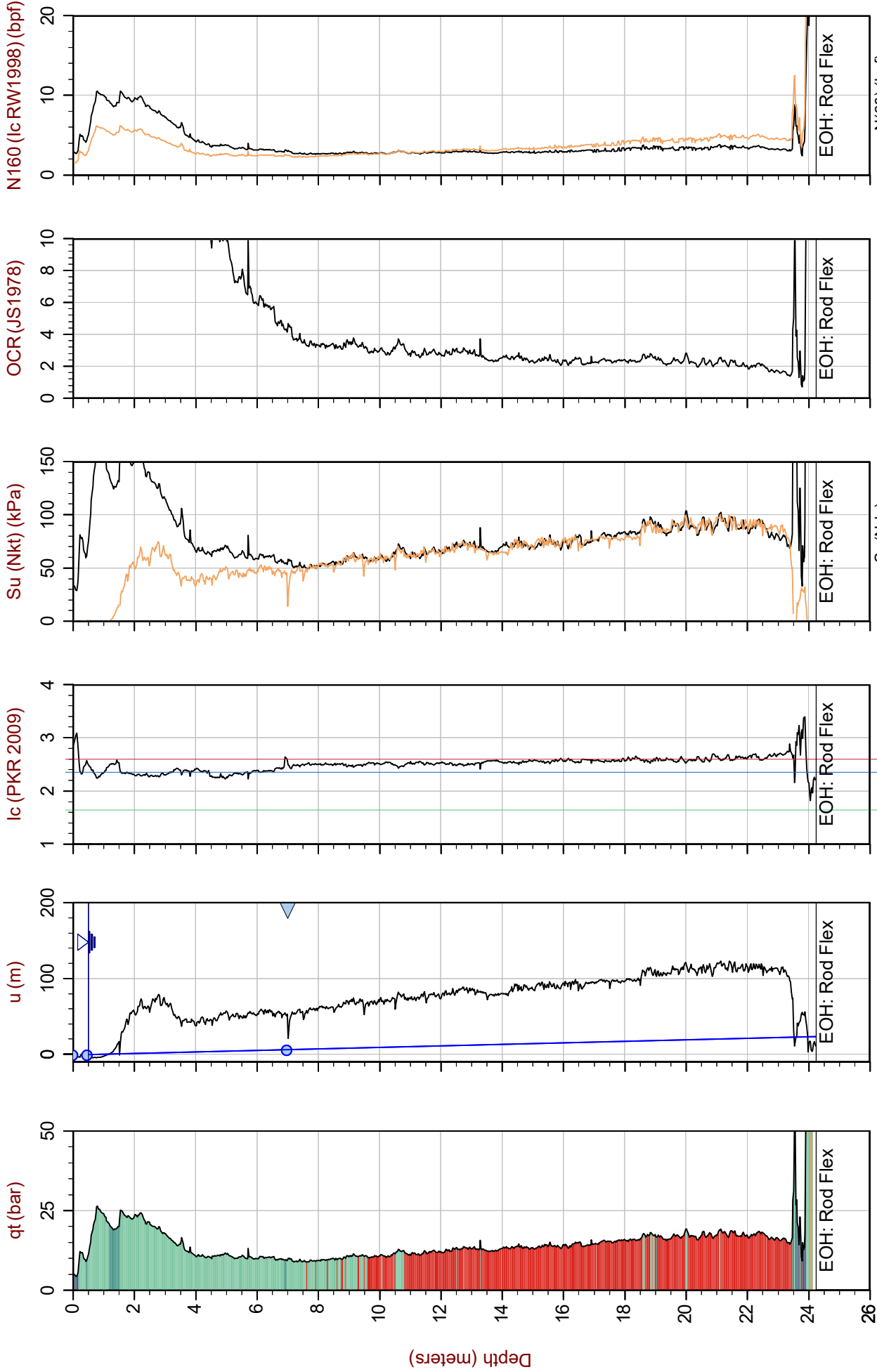
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



Golder Associates

Job No: 18-05032
Date: 2018-05-23 12:14
Site: Hwy 17 & Hwy 508

Sounding: SCPT18-BH403
Cone: 330:T1500F15U500



Max Depth: 24.250 m / 79.56 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 18-05032_SP_BH403.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 15.0 / 10.0

SBT: Robertson, 2009 and 2010
Coords: UTM 18N N: 5033083m E: 382492m
Sheet No: 1 of 1

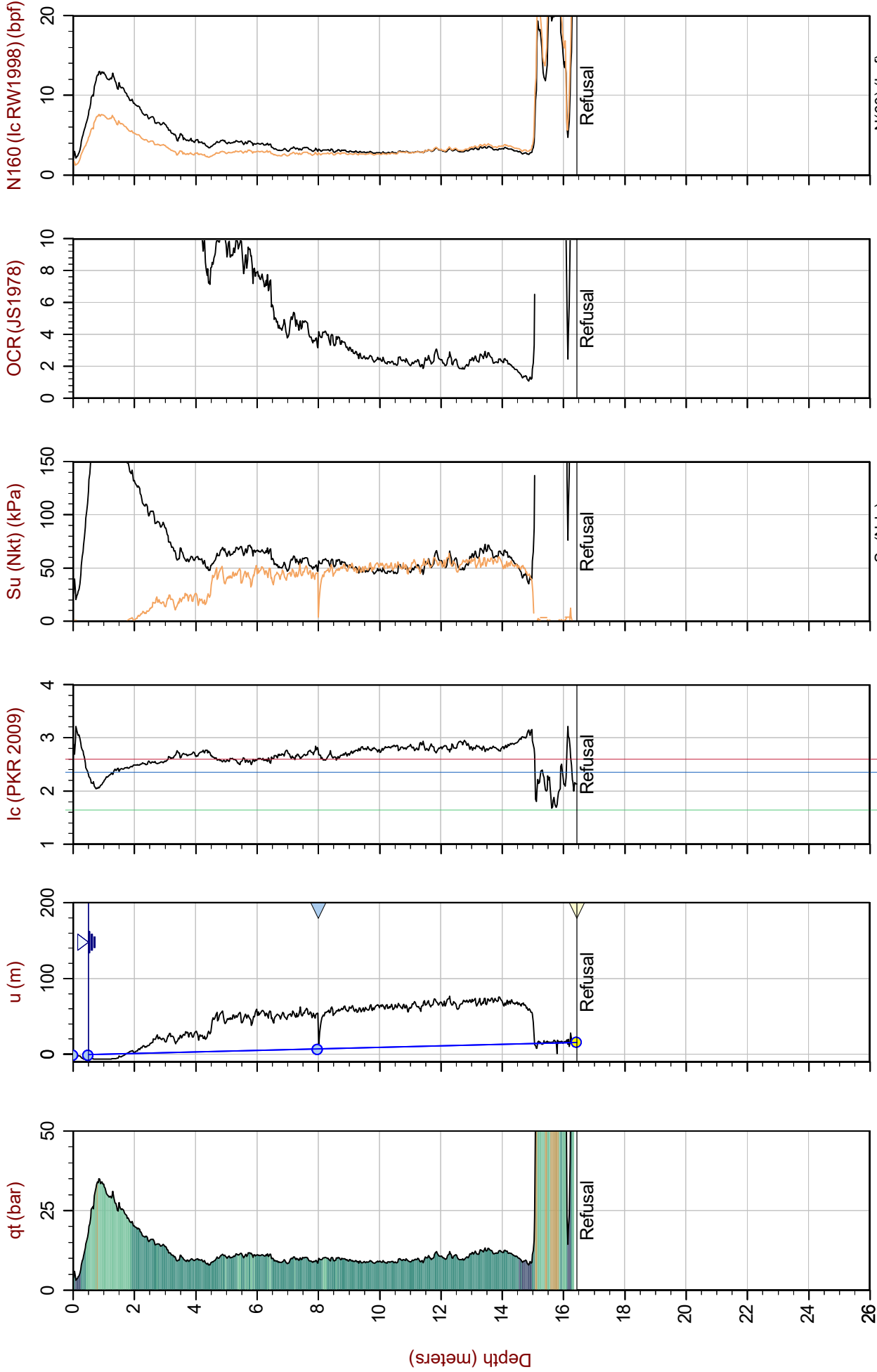
Legend:
● Equilibrium Pore Pressure (Ueq)
● Assumed Ueq
△ Dissipation, Ueq not achieved
▽ Dissipation, Ueq not achieved
— Hydrostatic Line



Golder Associates

Job No: 18-05032
Date: 2018-05-25 07:51
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH404
Cone: 330:T1500F15U500



Max Depth: 16.450 m / 53.97 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 18-05032_CP_BH404.COR
Unit Wt: SBTQin (PKR2009)
Su Nkt/Ndu: 15.0 / 10.0

SBT: Robertson, 2009 and 2010
Coords: UTM 18N N: 5032777m E: 382104m
Sheet No: 1 of 1

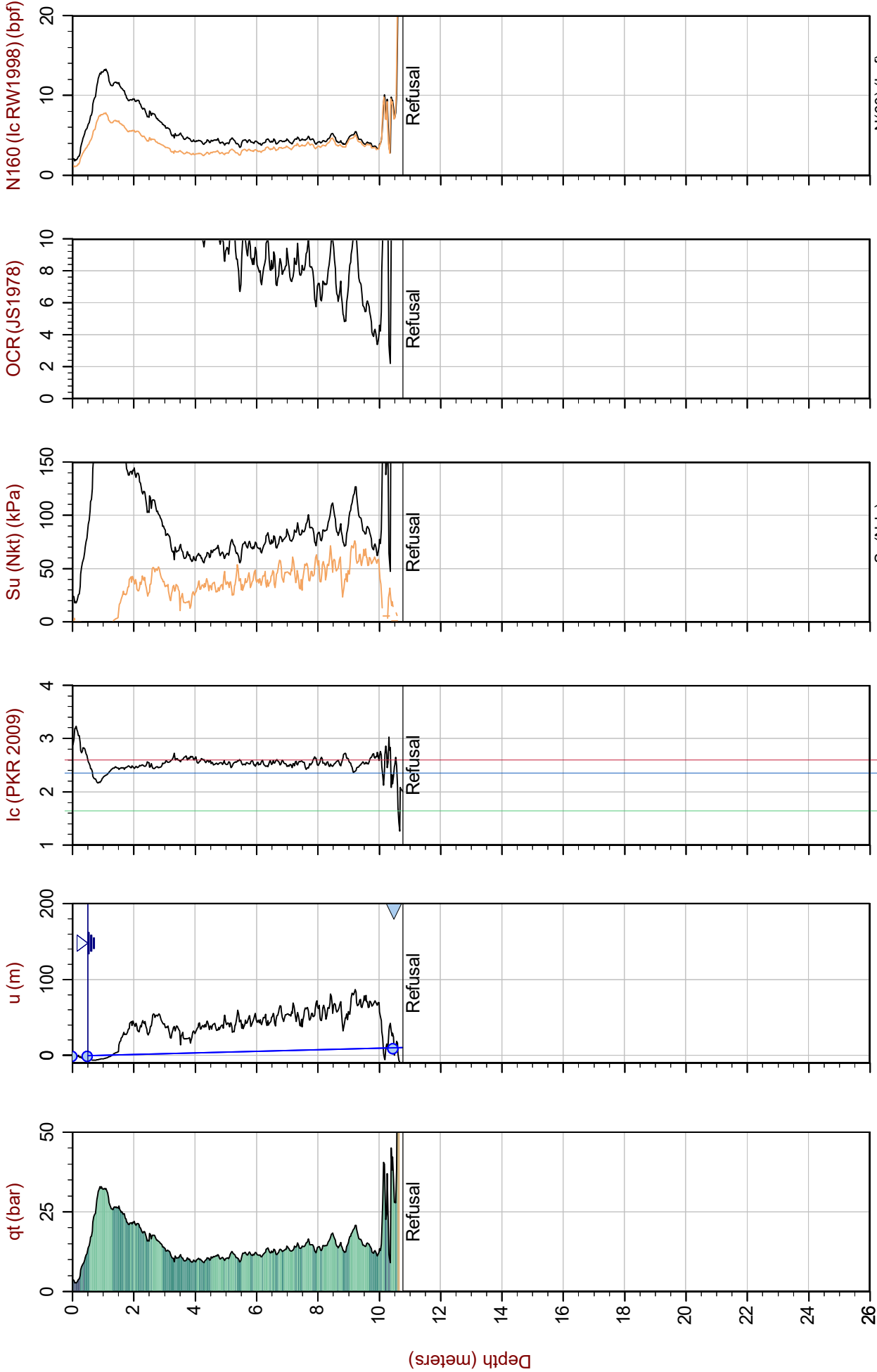
● Equilibrium Pore Pressure (Ueq) ▲ Assumed Ueq ▲ Dissipation, Ueq not achieved — Hydrostatic Line
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



Golder Associates

Job No: 18-05032
Date: 2018-05-24 14:30
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH405
Cone: 330:T1500F15U500



Max Depth: 10.775 m / 35.35 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

Equilibrium Pore Pressure (Ueq)
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

File: 18-05032_CP_BH405.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 15.0 / 10.0

Assumed Ueq
Dissipation, Ueq achieved
Dissipation, Ueq not achieved

SBT: Robertson, 2009 and 2010
Coords: UTM 18N N: 5032805m E: 382167m
Sheet No: 1 of 1

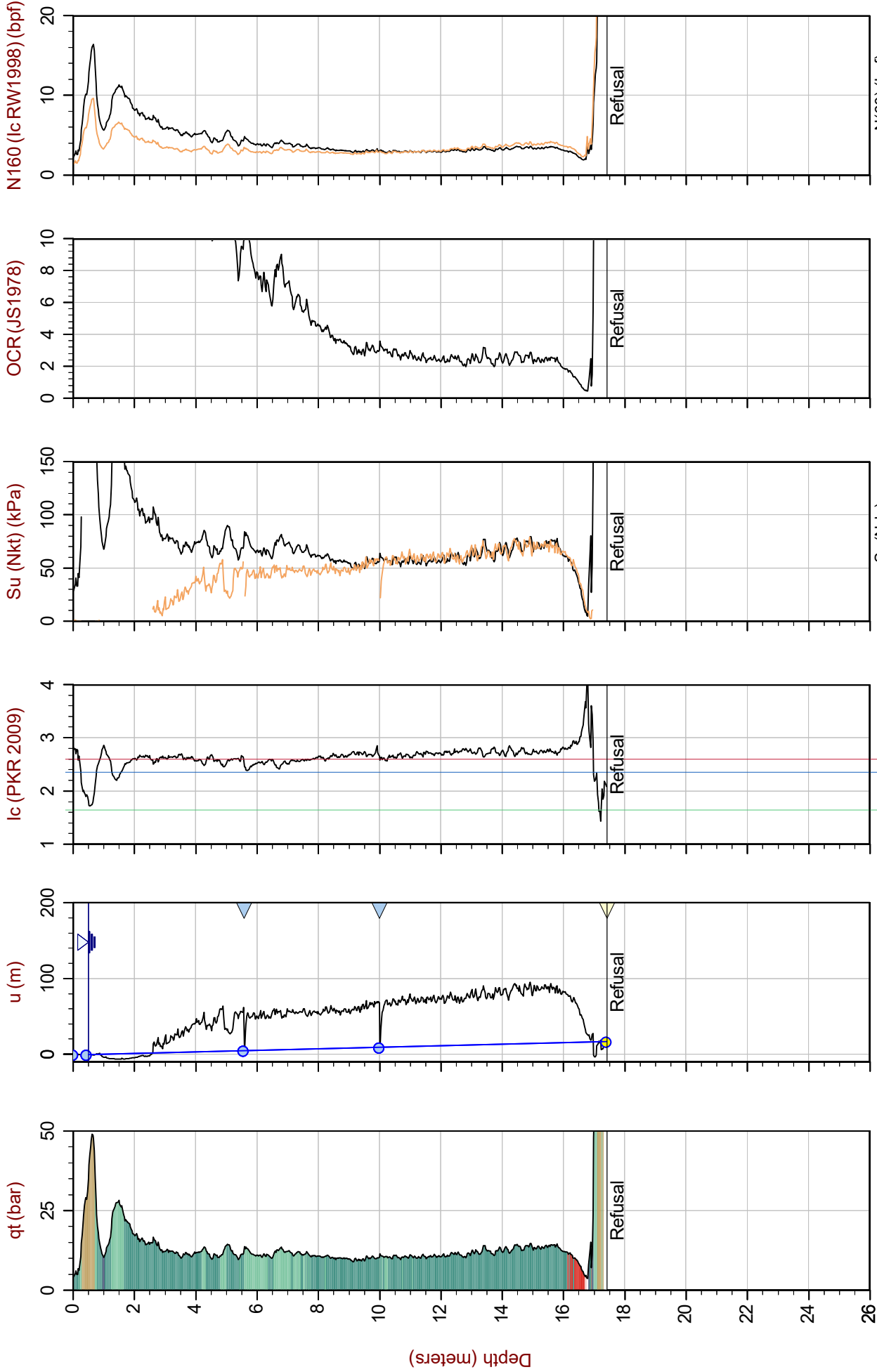
Hydrostatic Line



Golder Associates

Job No: 18-05032
Date: 2018-05-24 10:28
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH406
Cone: 330:T1500F15U500



Max Depth: 17.425 m / 57.17 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 18-05032_CP_BH406.COR
Unit Wt: SBTQin (PKR2009)
Su Nkt/Ndu: 15.0 / 10.0

SBT: Robertson, 2009 and 2010
Coords: UTM 18N N: 5032851m E: 382331m
Sheet No: 1 of 1

Legend:
● Assumed Ueq
▲ Dissipation, Ueq not achieved
◆ Dissipation, Ueq not achieved
— Hydrostatic Line

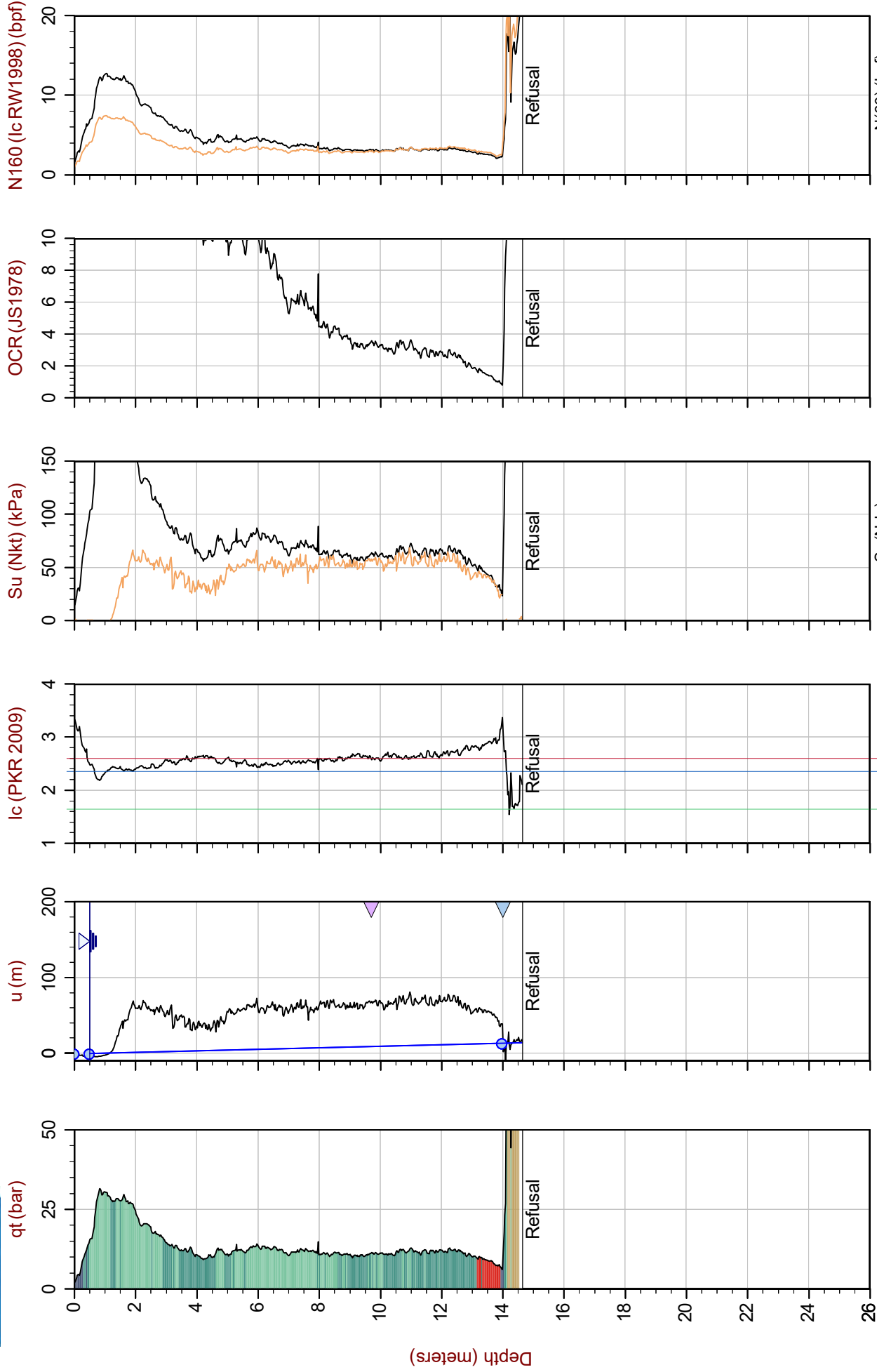
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



Golder Associates

Job No: 18-05032
Date: 2018-05-22 14:13
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH407
Cone: 330:T1500F15U500



Max Depth: 14.650 m / 48.06 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 18-05032_CP_BH407.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 15.0 / 10.0

SBT: Robertson, 2009 and 2010
Coords: UTM 18N N: 5033020m E: 382280m
Sheet No: 1 of 1

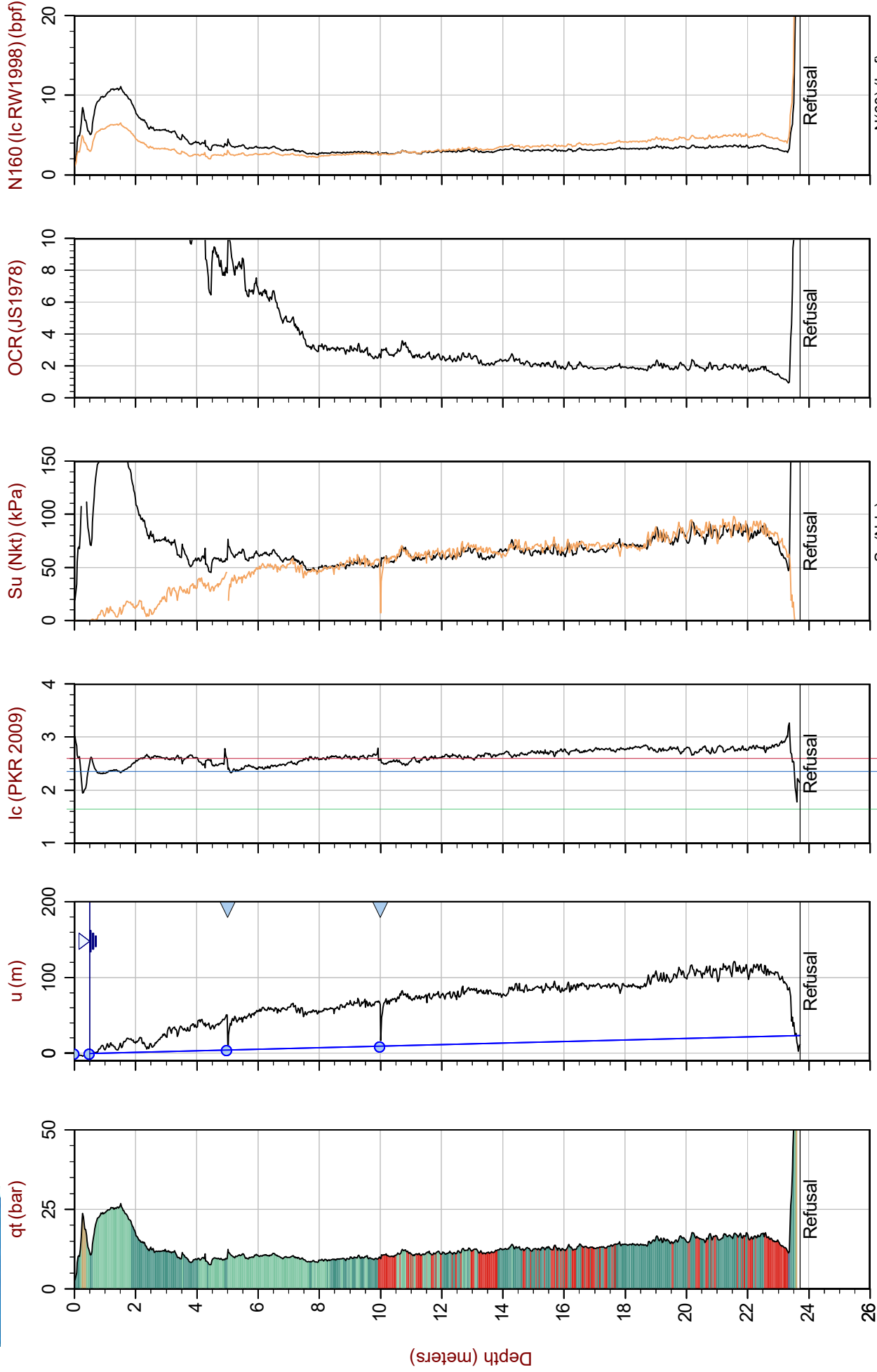
● Equilibrium Pore Pressure (Ueq) ● Assumed Ueq ▲ Dissipation, Ueq not achieved ▲ Dissipation, Ueq not achieved — Hydrostatic Line
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



Golder Associates

Job No: 18-05032
Date: 2018-05-23 08:43
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH408
Cone: 330:T1500F15U500



Max Depth: 23.725 m / 77.84 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

● Equilibrium Pore Pressure (Ueq)
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

File: 18-05032_CP_BH408.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 15.0 / 10.0

● Assumed Ueq
▼ Dissipation, Ueq not achieved
▲ Dissipation, Ueq not achieved

SBT: Robertson, 2009 and 2010
Coords: UTM 18N N: 5033075m E: 382417m
Sheet No: 1 of 1

— N(60) (bpf)
— Su(Ndu)
— Hydrostatic Line

Seismic Cone Penetration Test Plots



Golder Associates

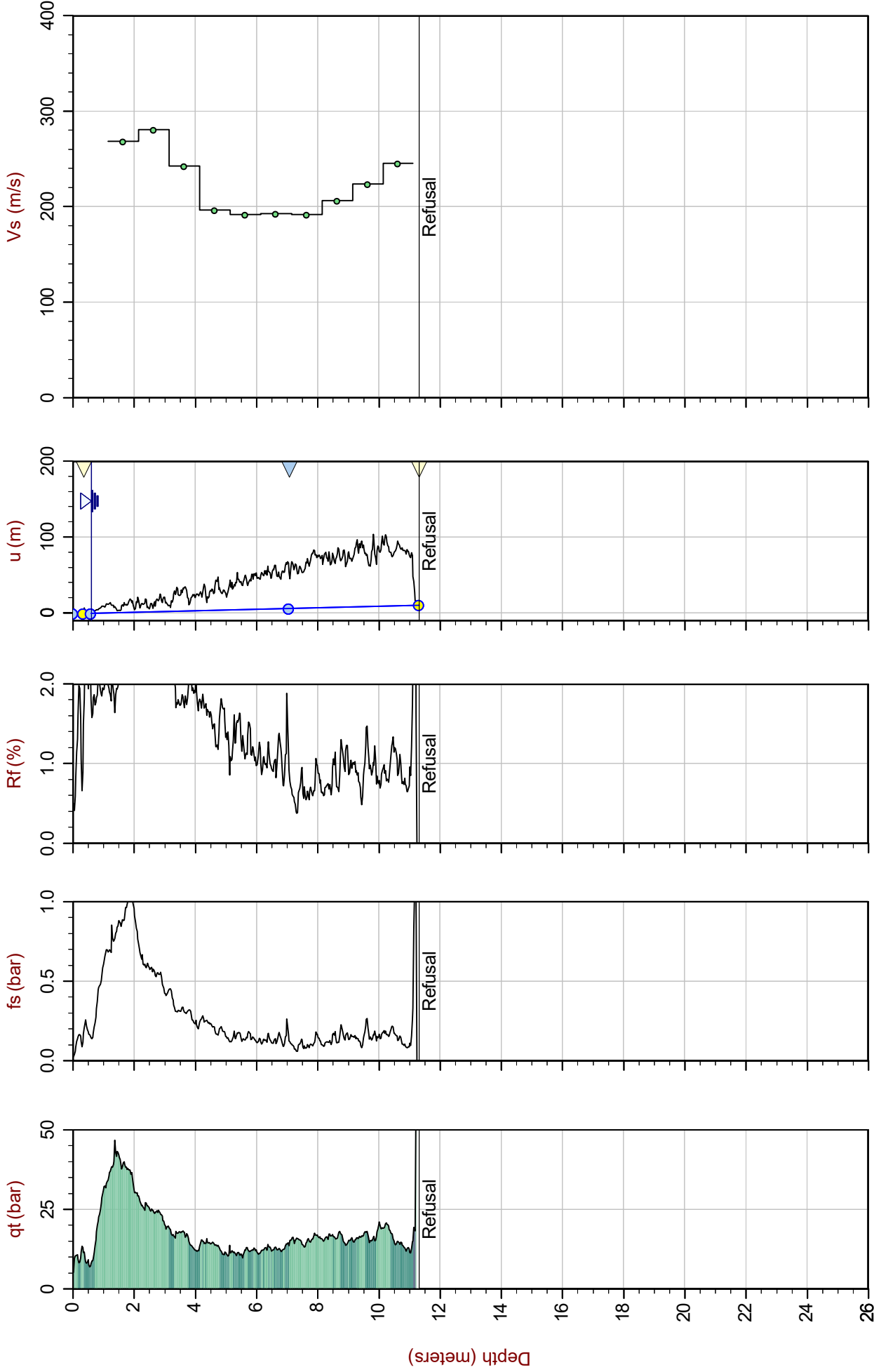
Job No: 18-05032

Date: 2018-05-24 08:11

Site: Hwy 17 & Hwy 508

Sounding: SCPT18-BH401

Cone: 330:T1500F15U500



Max Depth: 11.325 m / 37.16 ft

Depth Inc: 0.025 m / 0.082 ft

Avg Int: Every Point

Equilibrium Pore Pressure (Ueq)

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

File: 18-05032_SP BH-401.COR

Unit Wt: SBTQtn (PKR2009)

Assumed Ueq

Dissipation, Ueq not achieved

Hydrostatic Line

SBT: Robertson, 2009 and 2010

Coords: UTM 18N N: 5032871m E: 382232m

Sheet No: 1 of 1

Dissipation, Ueq not achieved

Hydrostatic Line



Golder Associates

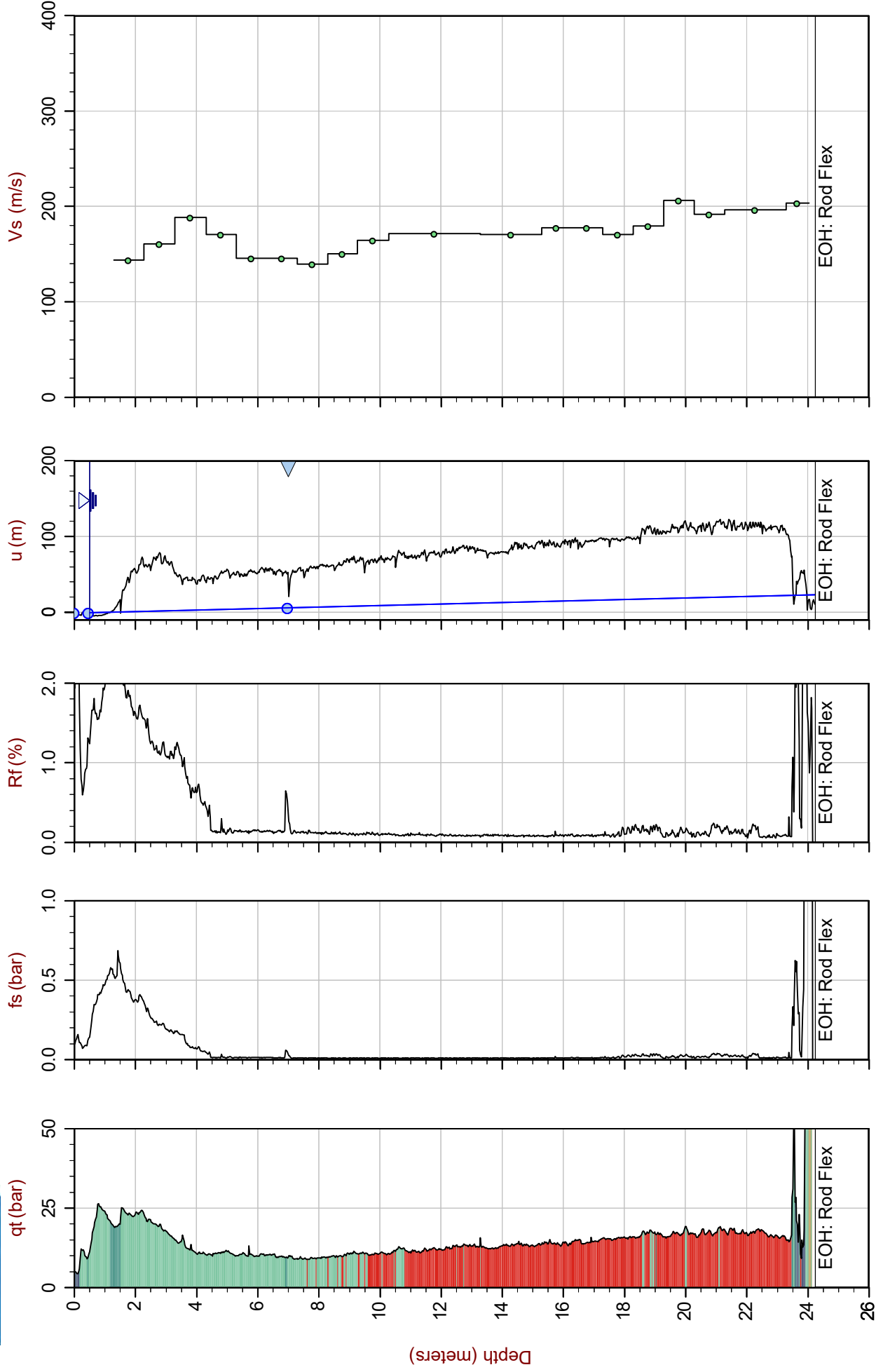
Job No: 18-05032

Date: 2018-05-23 12:14

Site: Hwy 17 & Hwy 508

Sounding: SCPT18-BH403

Cone: 330:T1500F15U500



Max Depth: 24.250 m / 79.56 ft

Depth Inc: 0.025 m / 0.082 ft

Avg Int: Every Point

File: 18-05032_SP_BH403.COR

Unit Wt: SBTQtn (PKR2009)

Equilibrium Pore Pressure (Ueq)

Assumed Ueq

Dissipation, Ueq not achieved

SBT: Robertson, 2009 and 2010

Coords: UTM 18N N: 5033083m E: 382492m

Sheet No: 1 of 1

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Seismic Cone Penetration Test Tabular Results



Job No: 18-05032
Client: Golder Associates
Project: Hwy 417 & Hwy 50
Sounding ID: SCPT18-BH401
Date: 24-May-2018

Seismic Source: Beam
Source Offset (m): 1.25
Source Depth (m): 0.00
Geophone Offset (m): 0.20

SCPT_u SHEAR WAVE VELOCITY TEST RESULTS - Vs

| Tip Depth (m) | Geophone Depth (m) | Ray Path (m) | Ray Path Difference (m) | Travel Time Interval (ms) | Interval Velocity (m/s) |
|---------------|--------------------|--------------|-------------------------|---------------------------|-------------------------|
| 1.35 | 1.15 | 1.70 | | | |
| 2.35 | 2.15 | 2.49 | 0.79 | 2.93 | 269 |
| 3.35 | 3.15 | 3.39 | 0.90 | 3.20 | 281 |
| 4.35 | 4.15 | 4.33 | 0.95 | 3.89 | 243 |
| 5.35 | 5.15 | 5.30 | 0.97 | 4.89 | 197 |
| 6.35 | 6.15 | 6.28 | 0.98 | 5.07 | 192 |
| 7.35 | 7.15 | 7.26 | 0.98 | 5.10 | 193 |
| 8.35 | 8.15 | 8.25 | 0.99 | 5.14 | 192 |
| 9.35 | 9.15 | 9.23 | 0.99 | 4.79 | 207 |
| 10.35 | 10.15 | 10.23 | 0.99 | 4.42 | 224 |
| 11.32 | 11.12 | 11.19 | 0.96 | 3.92 | 246 |



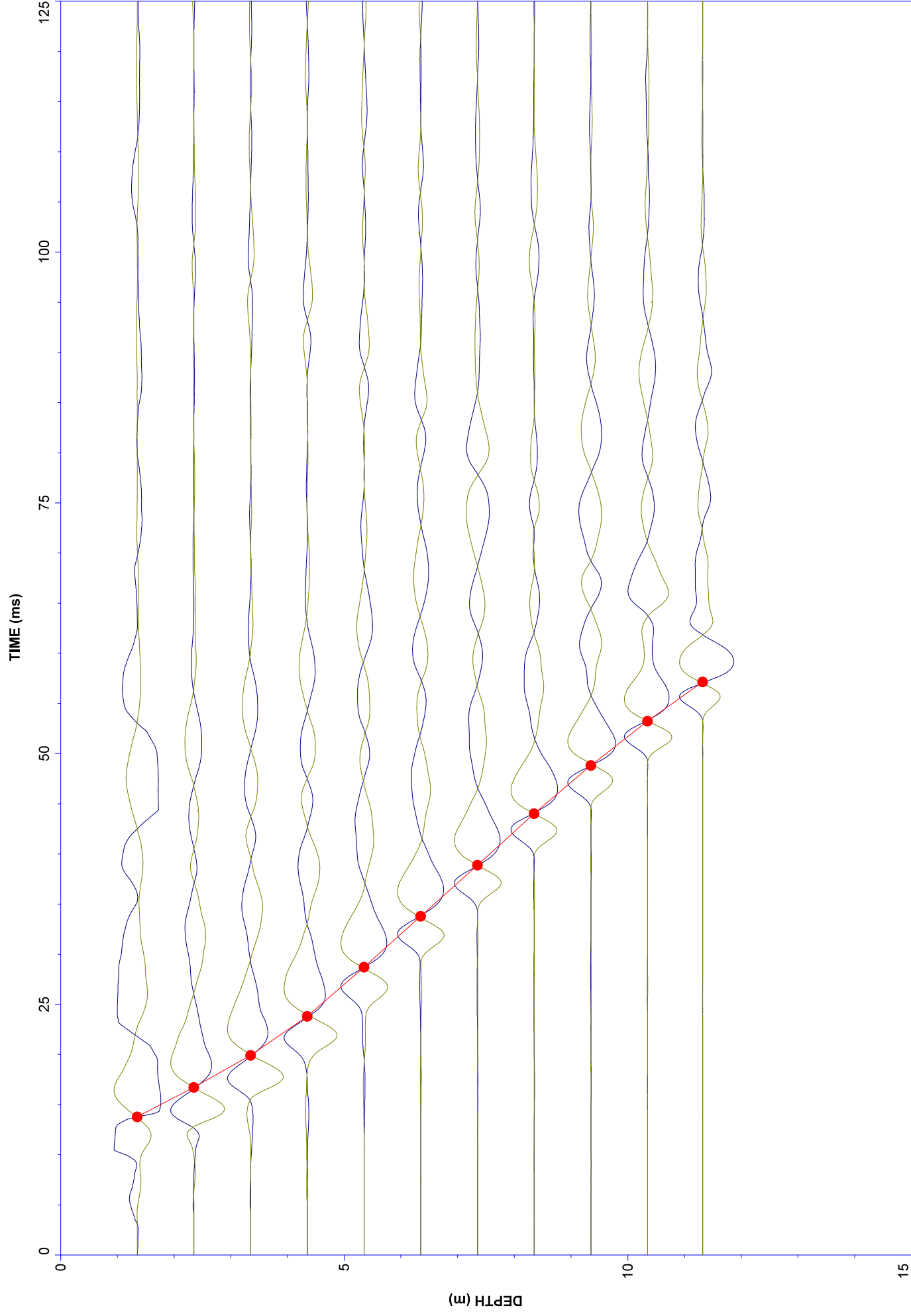
Job No: 18-05032
Client: Golder Associates
Project: Hwy 417 & Hwy 50
Sounding ID: SCPT18-BH403
Date: 23-May-2018

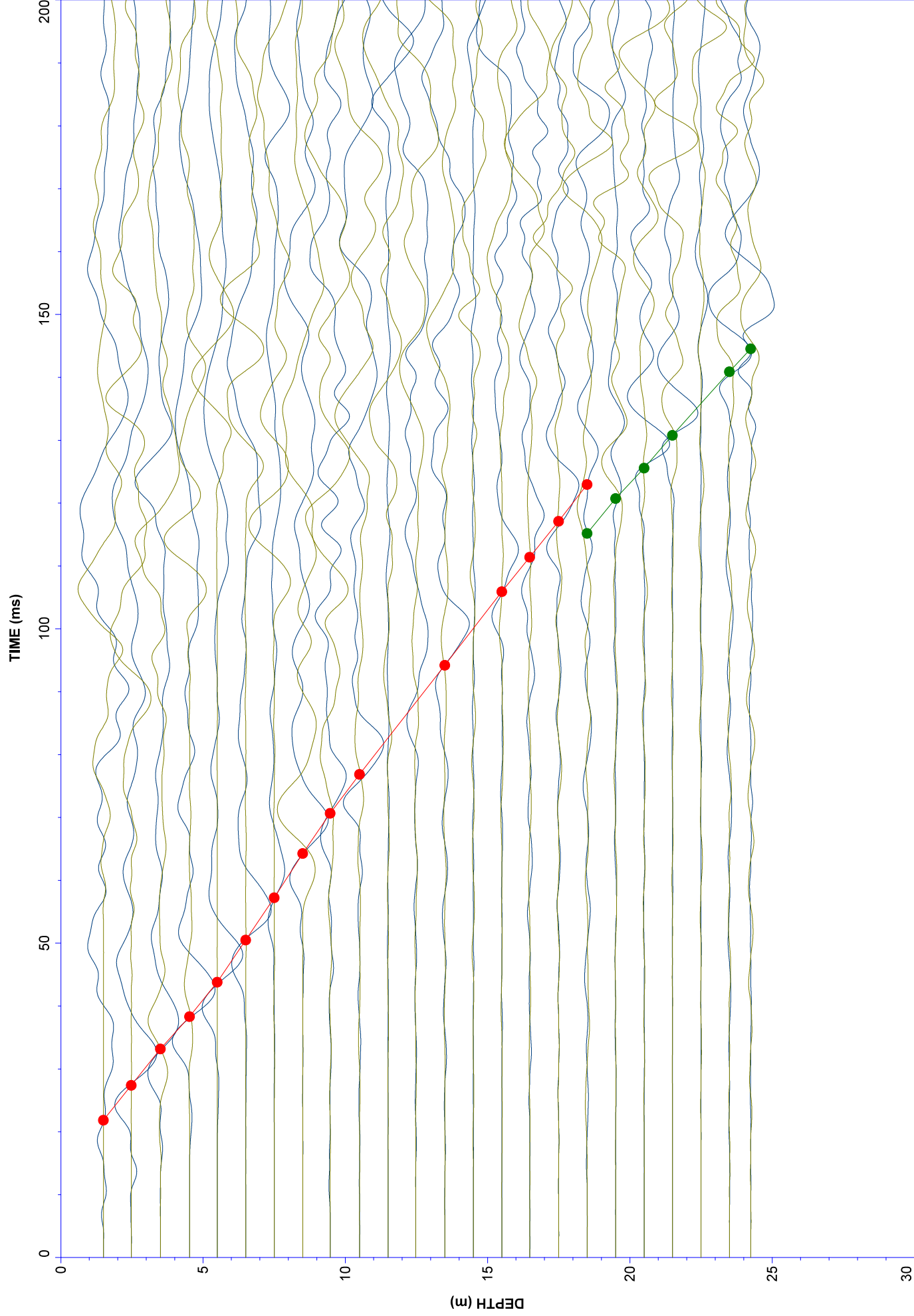
Seismic Source: Beam
Source Offset (m): 1.25
Source Depth (m): 0.00
Geophone Offset (m): 0.20

SCPT_u SHEAR WAVE VELOCITY TEST RESULTS - V_s

| Tip Depth (m) | Geophone Depth (m) | Ray Path (m) | Ray Path Difference (m) | Travel Time Interval (ms) | Interval Velocity (m/s) |
|---------------|--------------------|--------------|-------------------------|---------------------------|-------------------------|
| 1.50 | 1.30 | 1.80 | | | |
| 2.48 | 2.28 | 2.60 | 0.80 | 5.55 | 144 |
| 3.50 | 3.30 | 3.53 | 0.93 | 5.76 | 161 |
| 4.53 | 4.33 | 4.51 | 0.98 | 5.16 | 189 |
| 5.50 | 5.30 | 5.45 | 0.94 | 5.48 | 171 |
| 6.50 | 6.30 | 6.42 | 0.98 | 6.70 | 146 |
| 7.50 | 7.30 | 7.41 | 0.98 | 6.73 | 146 |
| 8.50 | 8.30 | 8.39 | 0.99 | 7.04 | 140 |
| 9.47 | 9.27 | 9.35 | 0.96 | 6.37 | 151 |
| 10.50 | 10.30 | 10.38 | 1.02 | 6.21 | 165 |
| 13.50 | 13.30 | 13.36 | 2.98 | 17.36 | 172 |
| 15.50 | 15.30 | 15.35 | 1.99 | 11.67 | 171 |
| 16.48 | 16.28 | 16.33 | 0.98 | 5.49 | 178 |
| 17.50 | 17.30 | 17.35 | 1.02 | 5.73 | 178 |
| 18.50 | 18.30 | 18.34 | 1.00 | 5.84 | 171 |
| 19.50 | 19.30 | 19.34 | 1.00 | 5.55 | 180 |
| 20.50 | 20.30 | 20.34 | 1.00 | 4.81 | 207 |
| 21.50 | 21.30 | 21.34 | 1.00 | 5.20 | 192 |
| 23.50 | 23.30 | 23.33 | 2.00 | 10.13 | 197 |
| 24.25 | 24.05 | 24.08 | 0.75 | 3.67 | 204 |

Seismic Cone Penetration Test Time Domain Traces





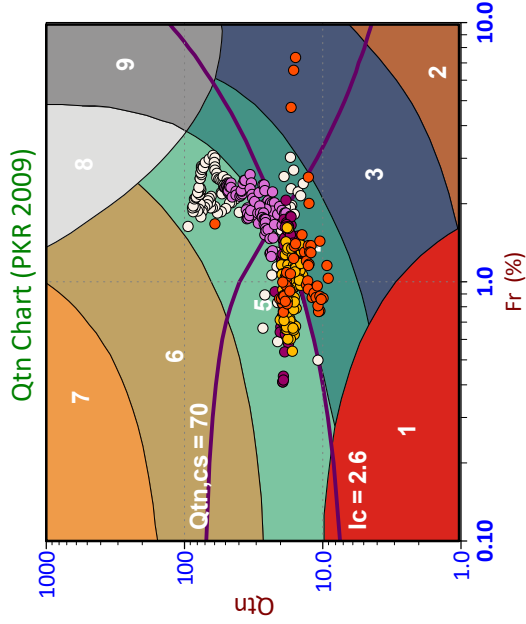
Soil Behaviour Type (SBT) Scatter Plots



Golder Associates

Job No: 18-05032
Date: 2018-05-24 08:11
Site: Hwy 17 & Hwy 508

Sounding: SCPT18-BH401
Cone: 330:T1500F15U500

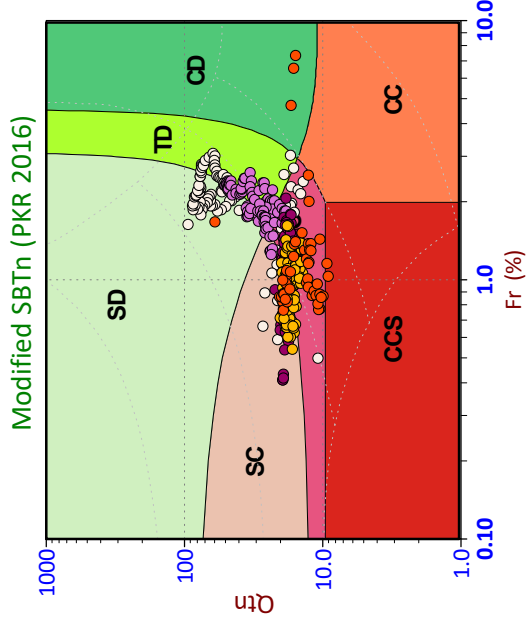


Depth Ranges

- >0.0 to 2.5 m
- >2.5 to 5.0 m
- >5.0 to 7.5 m
- >7.5 to 10.0 m
- >10.0 to 12.5 m
- >12.5 to 15.0 m
- >15.0 to 17.5 m
- >17.5 to 20.0 m
- >20.0 to 22.5 m
- >22.5 to 25.0 m
- >25.0 m

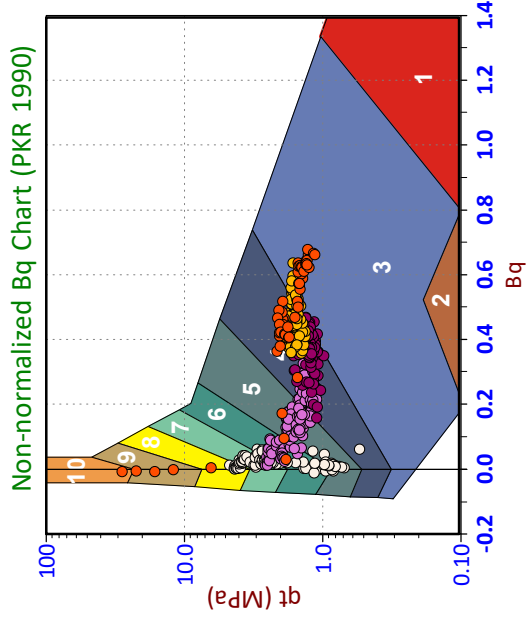
Legend

- Fines
- Fines
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained



Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)



Legend

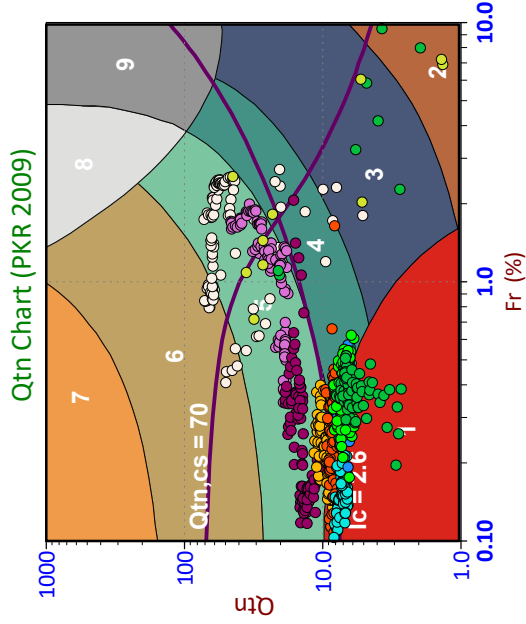
- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand



Golder Associates

Job No: 18-05032
Date: 2018-05-22 10:51
Site: Hwy 17 & Hwy 508

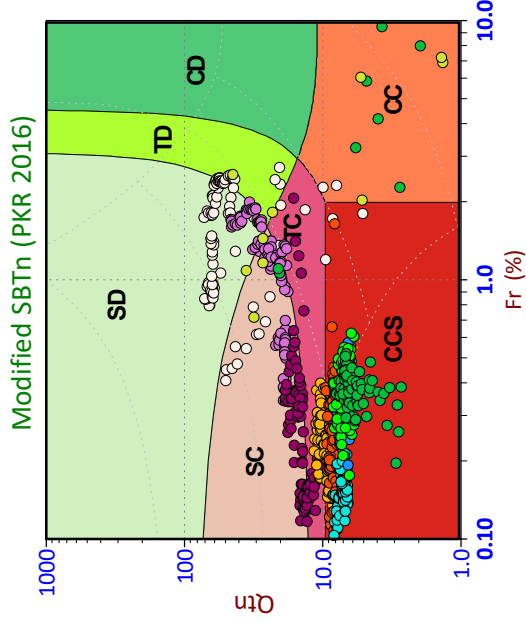
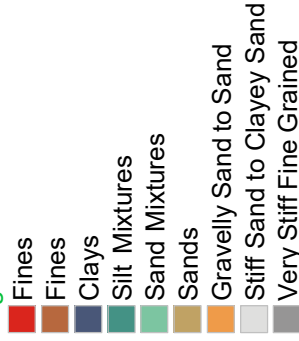
Sounding: CPT18-BH402
Cone: 330:T1500F15U500



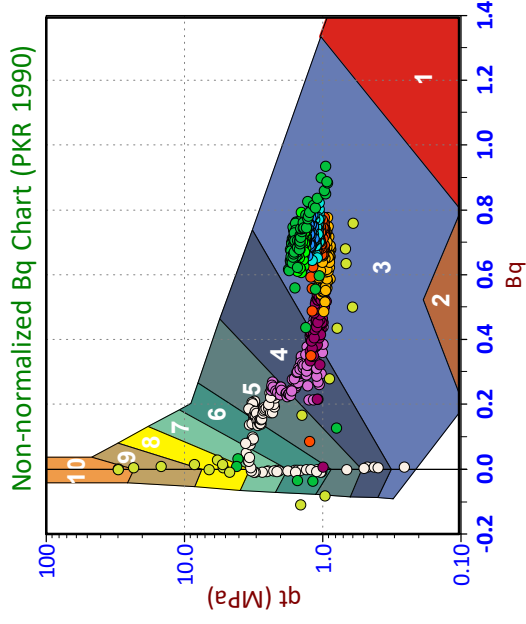
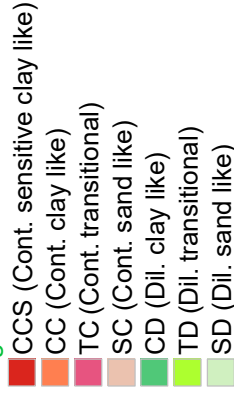
Depth Ranges



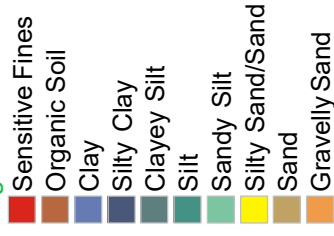
Legend



Legend



Legend

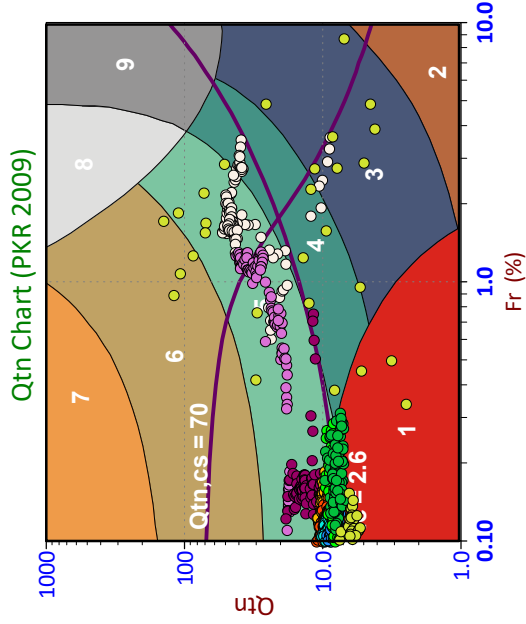




Golder Associates

Job No: 18-05032
Date: 2018-05-23 12:14
Site: Hwy 17 & Hwy 508

Sounding: SCPT18-BH403
Cone: 330:T1500F15U500

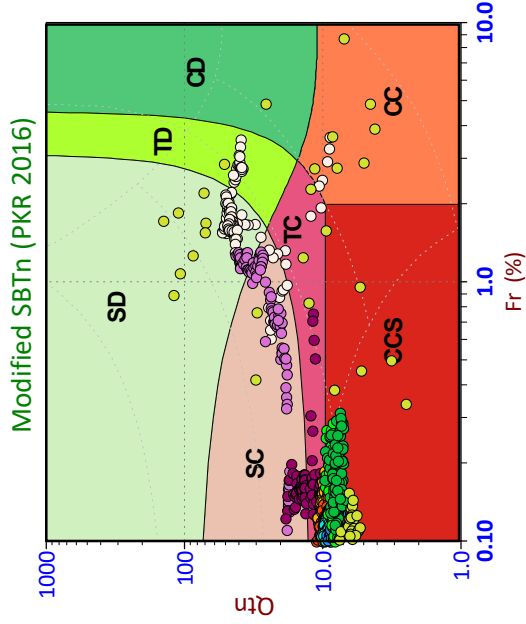


Depth Ranges

- >0.0 to 2.5 m
- >2.5 to 5.0 m
- >5.0 to 7.5 m
- >7.5 to 10.0 m
- >10.0 to 12.5 m
- >12.5 to 15.0 m
- >15.0 to 17.5 m
- >17.5 to 20.0 m
- >20.0 to 22.5 m
- >22.5 to 25.0 m
- >25.0 m

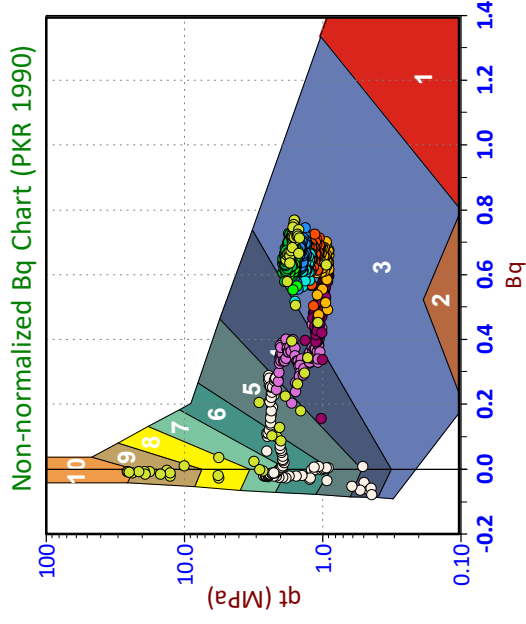
Legend

- Fines
- Fines
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained



Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)



Legend

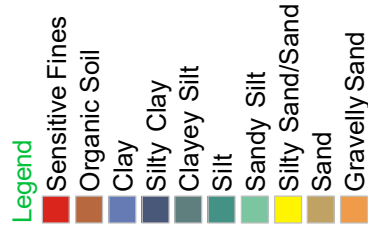
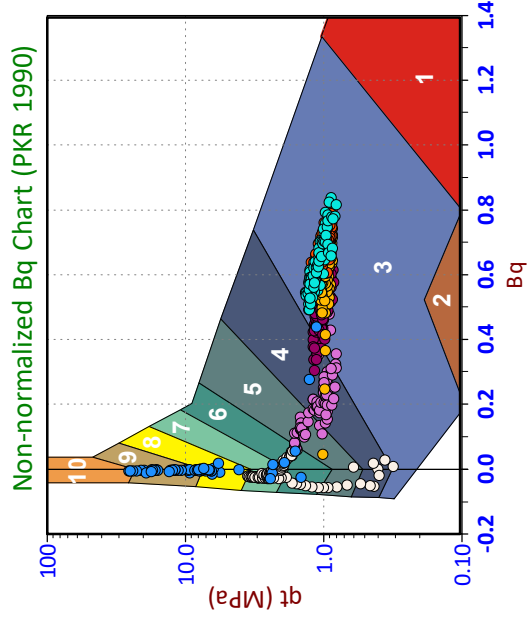
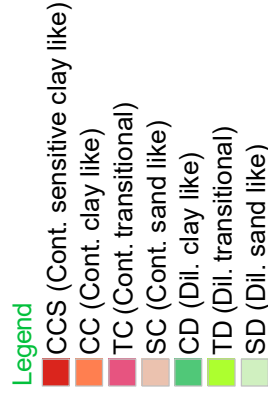
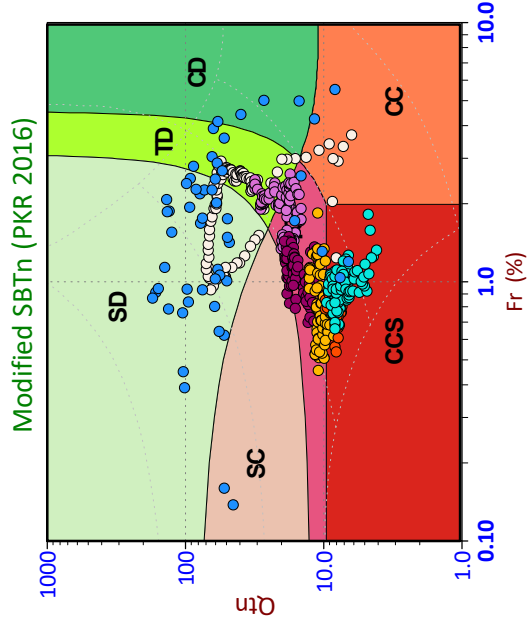
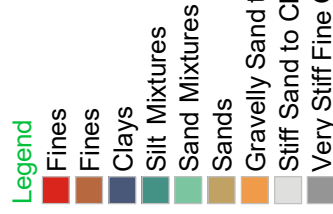
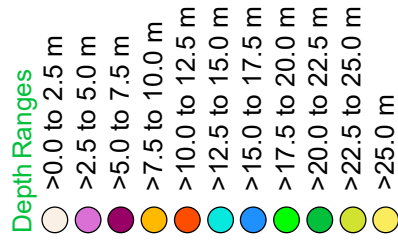
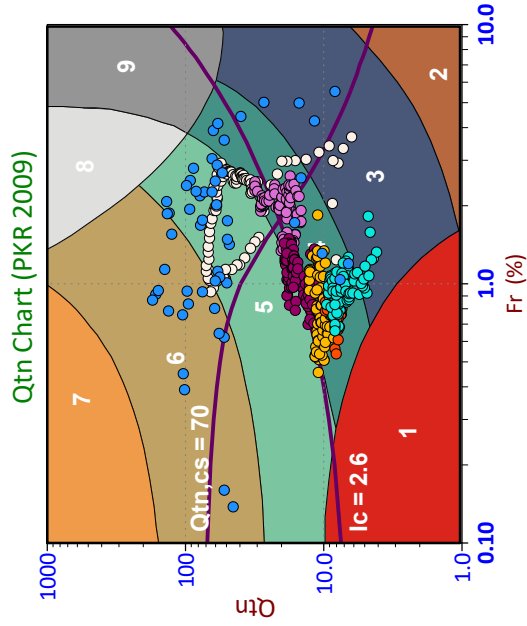
- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand



Golder Associates

Job No: 18-05032
Date: 2018-05-25 07:51
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH404
Cone: 330:T1500F15U500

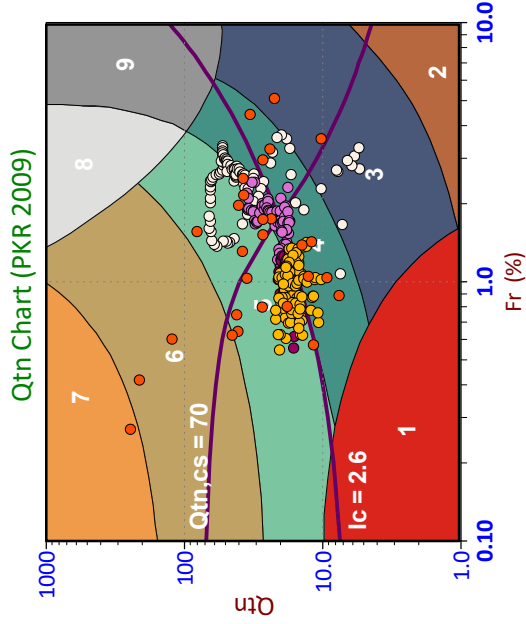




Golder Associates

Job No: 18-05032
Date: 2018-05-24 14:30
Site: Hwy 17 & Hwy 508

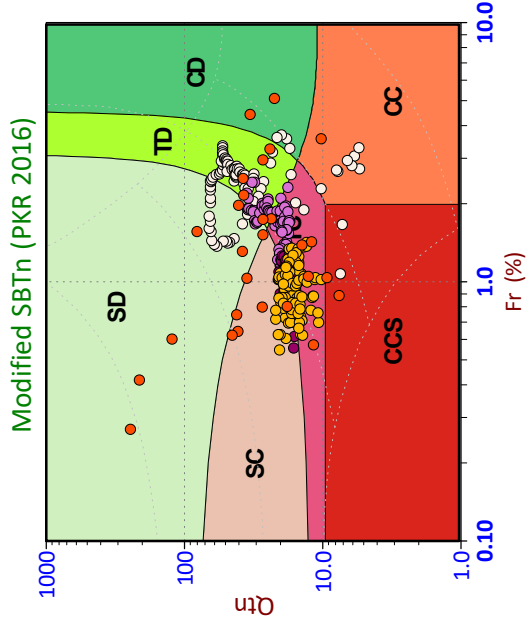
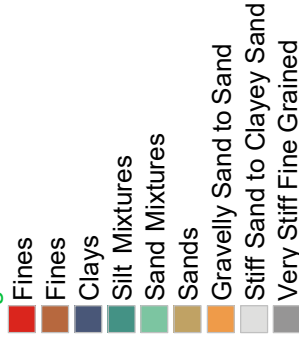
Sounding: CPT18-BH405
Cone: 330:T1500F15U500



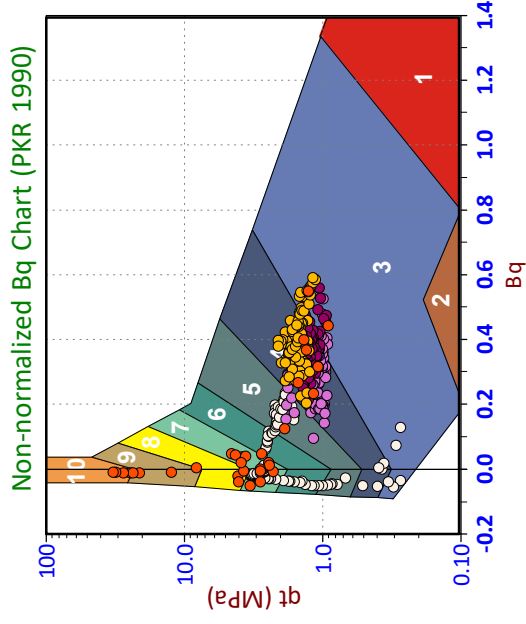
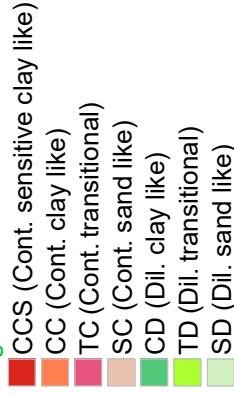
Depth Ranges



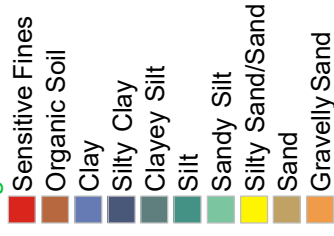
Legend



Legend



Legend

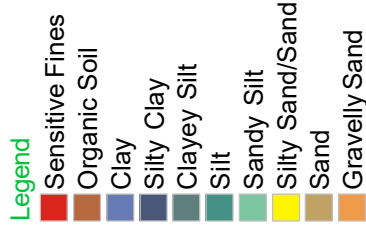
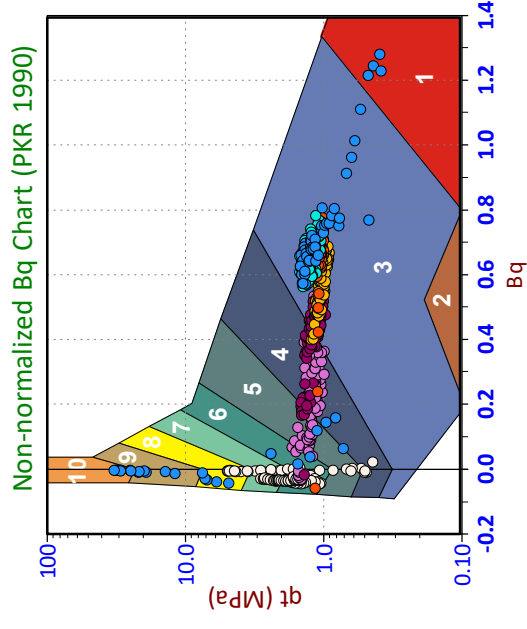
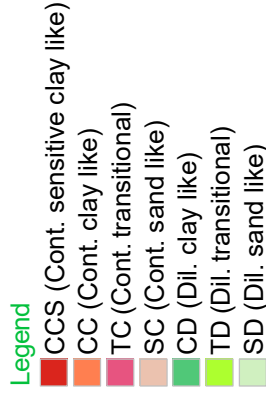
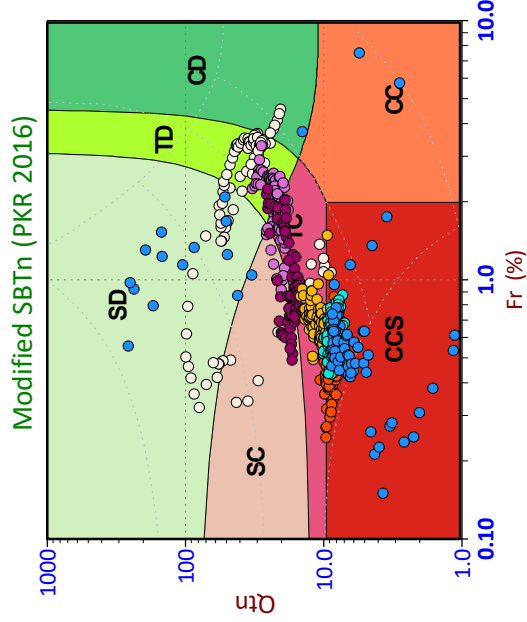
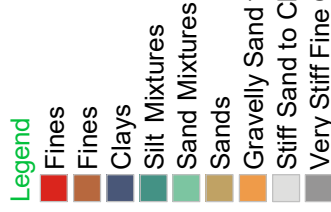
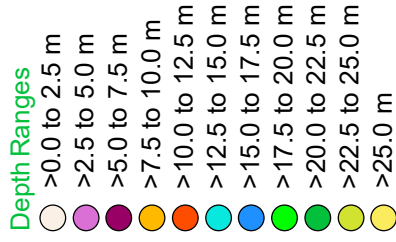
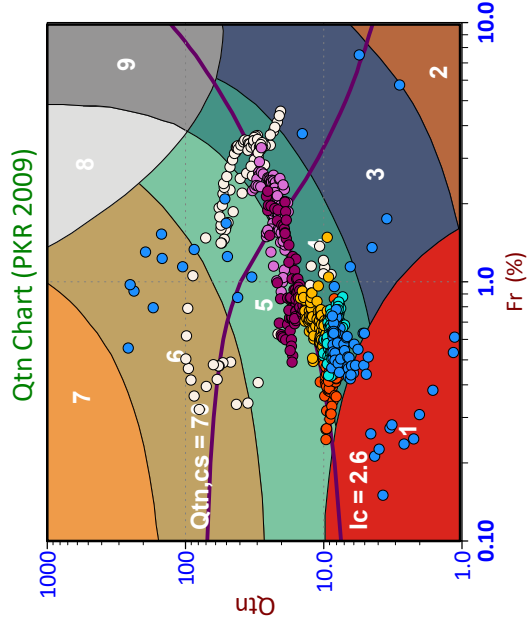




Golder Associates

Job No: 18-05032
Date: 2018-05-24 10:28
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH406
Cone: 330:T1500F15U500

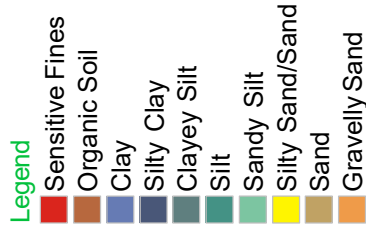
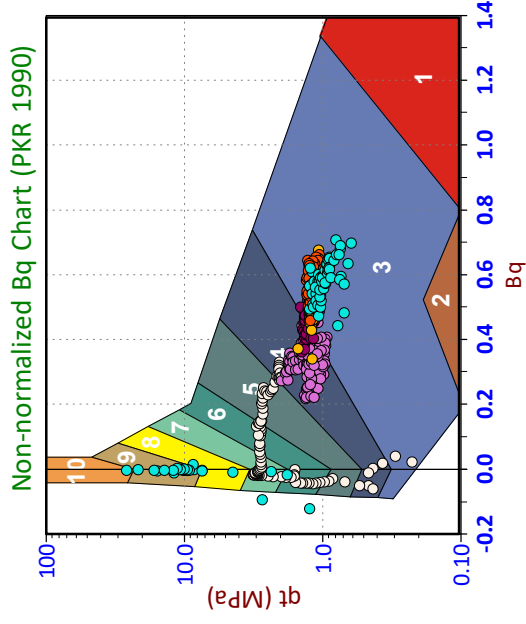
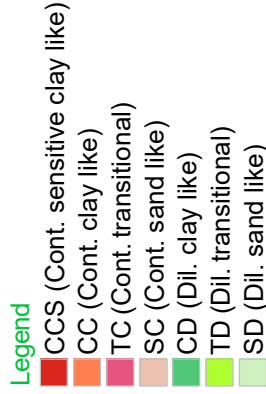
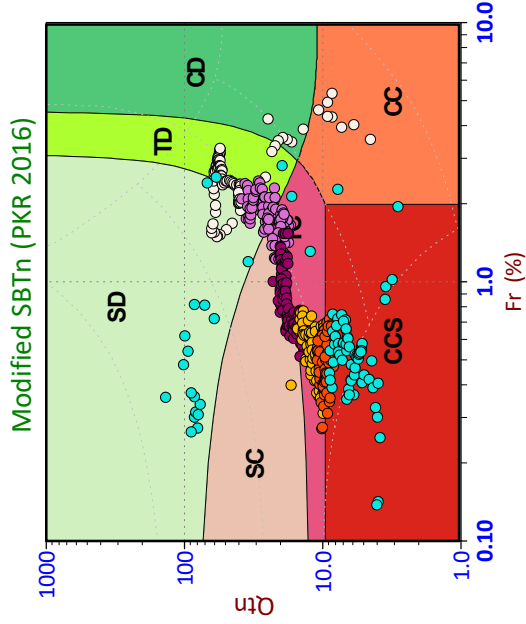
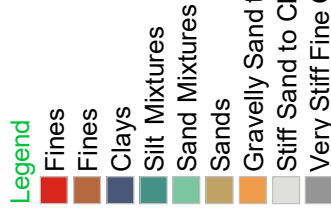
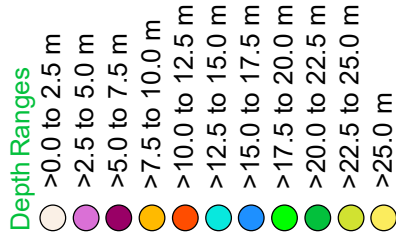
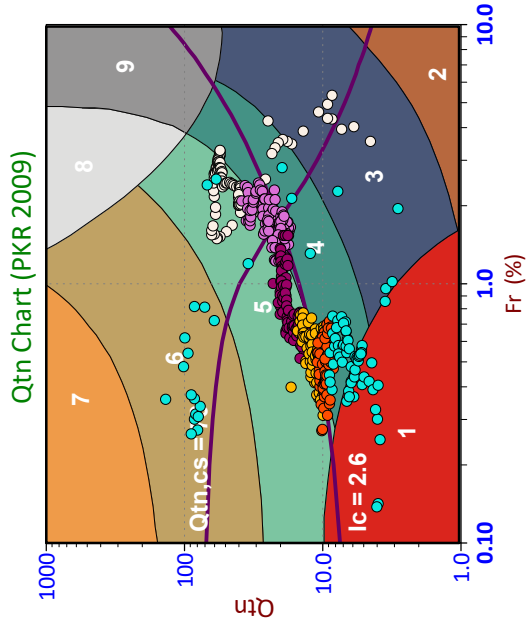




Golder Associates

Job No: 18-05032
Date: 2018-05-22 14:13
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH407
Cone: 330:T1500F15U500

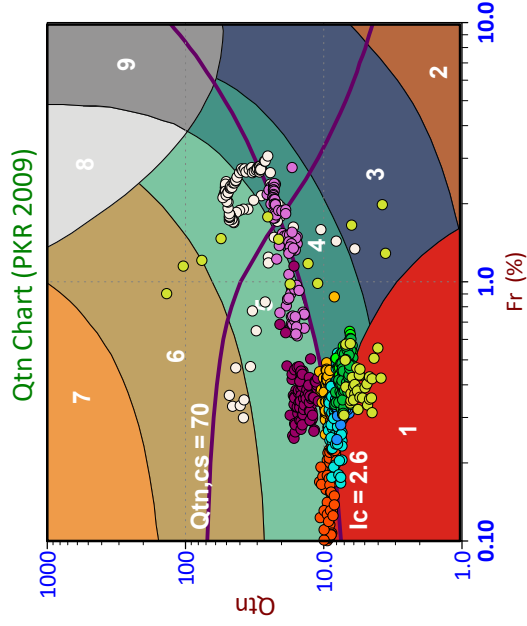




Golder Associates

Job No: 18-05032
Date: 2018-05-23 08:43
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH408
Cone: 330:T1500F15U500

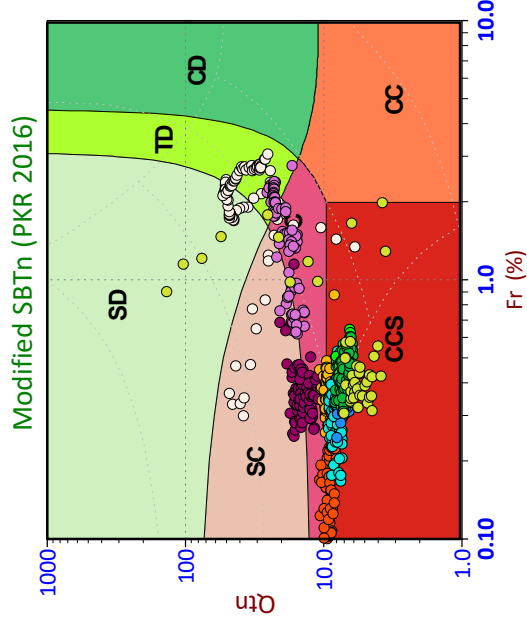


Depth Ranges

- >0.0 to 2.5 m
- >2.5 to 5.0 m
- >5.0 to 7.5 m
- >7.5 to 10.0 m
- >10.0 to 12.5 m
- >12.5 to 15.0 m
- >15.0 to 17.5 m
- >17.5 to 20.0 m
- >20.0 to 22.5 m
- >22.5 to 25.0 m
- >25.0 m

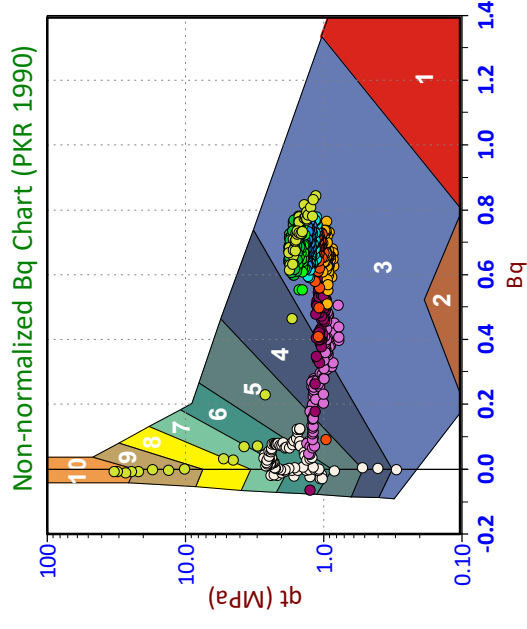
Legend

- Fines
- Fines
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained



Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)



Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand

Pore Pressure Dissipation Summary and Pore Pressure Dissipation Plots



Job No: 18-05032
Client: Golder Associates
Project: Hwy 17 & Hwy 508
Start Date: 22-May-2018
End Date: 25-May-2018

CPTu PORE PRESSURE DISSIPATION SUMMARY

| Sounding ID | File Name | Cone Area (cm ²) | Duration (s) | Test Depth (m) | Estimated Equilibrium Pore Pressure U_{eq} (m) | Calculated Phreatic Surface (m) | Estimated Phreatic Surface (m) | t_{50}^a (s) | Assumed Rigidity Index (I_r) | C_h^b (cm ² /min) |
|--------------|--------------------|---------------------------------|-----------------|----------------------|-----------------------------------------------------------|------------------------------------------|--------------------------------------|-------------------|----------------------------------------|-----------------------------------|
| SCPT18-BH401 | 18-05032_SP_BH-401 | 15 | 295 | 0.350 | 0.0 | | | | | |
| SCPT18-BH401 | 18-05032_SP_BH-401 | 15 | 1260 | 7.075 | Not achieved | | 0.6 | 331 | 100 | 2.1 |
| SCPT18-BH401 | 18-05032_SP_BH-401 | 15 | 300 | 11.325 | 10.8 | 0.6 | | | | |
| CPT18-BH402 | 18-05032_CP_BH-402 | 15 | 1800 | 6.000 | Not achieved | | 0.5 | 293 | 100 | 2.4 |
| CPT18-BH402 | 18-05032_CP_BH-402 | 15 | 2460 | 12.000 | Not achieved | | 0.5 | 662 | 100 | 1.1 |
| SCPT18-BH403 | 18-05032_SP_BH-403 | 15 | 1800 | 7.000 | Not achieved | | 0.5 | 435 | 100 | 1.6 |
| CPT18-BH404 | 18-05032_CP_BH-404 | 15 | 1800 | 8.000 | Not achieved | | 0.5 | 535 | 100 | 1.3 |
| CPT18-BH404 | 18-05032_CP_BH-404 | 15 | 360 | 16.450 | 16.8 | | | | | |
| CPT18-BH405 | 18-05032_CP_BH-405 | 15 | 1300 | 10.475 | Not achieved | | 0.5 | 121 | 100 | 5.8 |
| CPT18-BH406 | 18-05032_CP_BH-406 | 15 | 1200 | 5.575 | Not achieved | | 0.5 | 275 | 100 | 2.5 |
| CPT18-BH406 | 18-05032_CP_BH-406 | 15 | 1800 | 10.000 | Not achieved | | 0.5 | 770 | 100 | 0.9 |
| CPT18-BH406 | 18-05032_CP_BH-406 | 15 | 295 | 17.425 | 17.0 | 0.5 | | | | |
| CPT18-BH407 | 18-05032_CP_BH-407 | 15 | 425 | 9.700 | Not achieved | | | | | |
| CPT18-BH407 | 18-05032_CP_BH-407 | 15 | 1500 | 14.000 | Not achieved | | 0.5 | 47 | 100 | 15.0 |
| CPT18-BH408 | 18-05032_CP_BH-408 | 15 | 2200 | 5.000 | Not achieved | | 0.5 | 225 | 100 | 3.1 |
| CPT18-BH408 | 18-05032_CP_BH-408 | 15 | 1795 | 10.000 | Not achieved | | 0.5 | 611 | 100 | 1.1 |

a. Time is relative to where u_{max} occurred

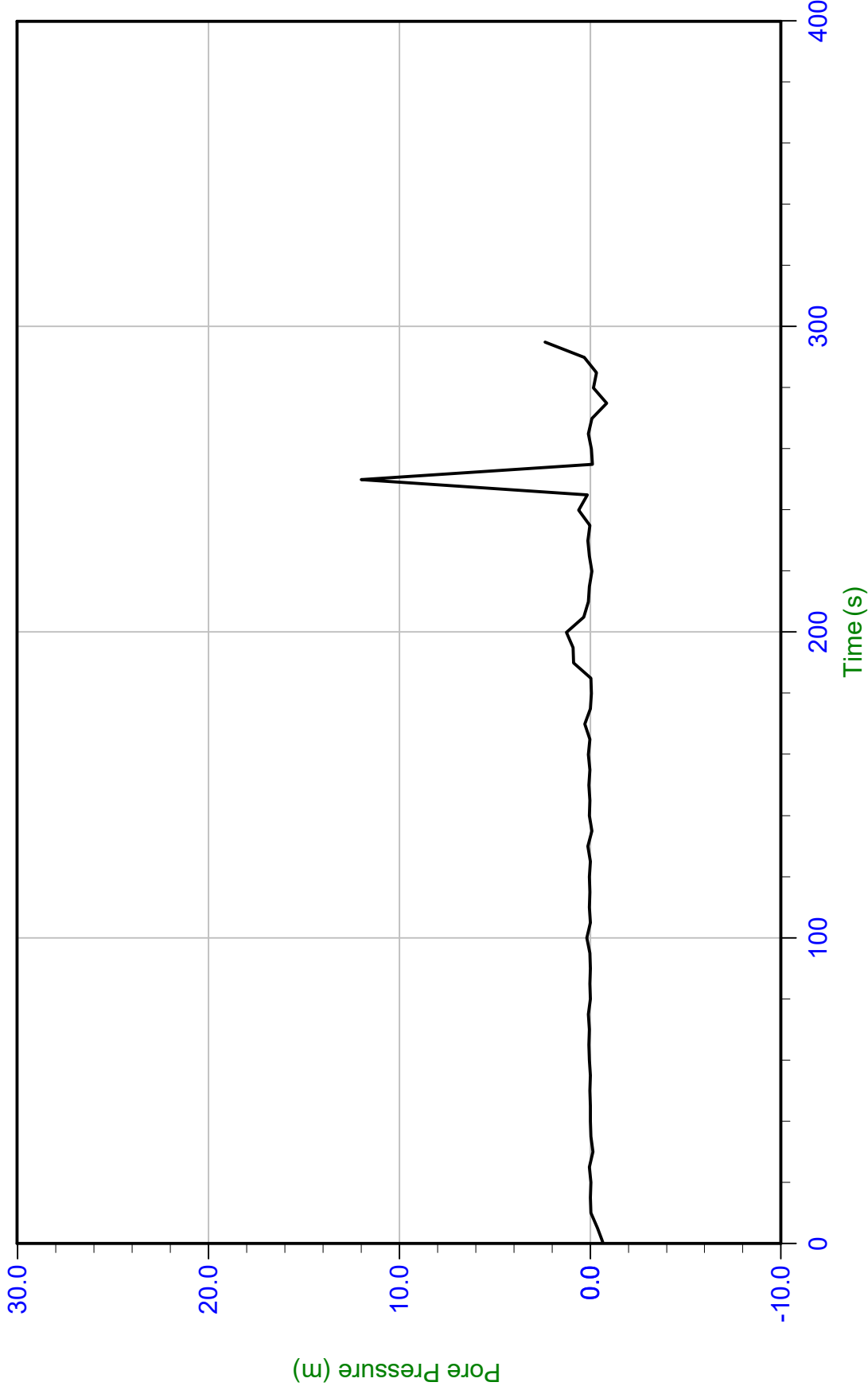
b. Houslsby and Teh, 1991



Golder Associates

Job No: 18-05032
Date: 05/24/2018 08:11
Site: Hwy 17 & Hwy 508

Sounding: SCPT18-BH401
Cone: 330:T1500F15U500 Area=15 cm²



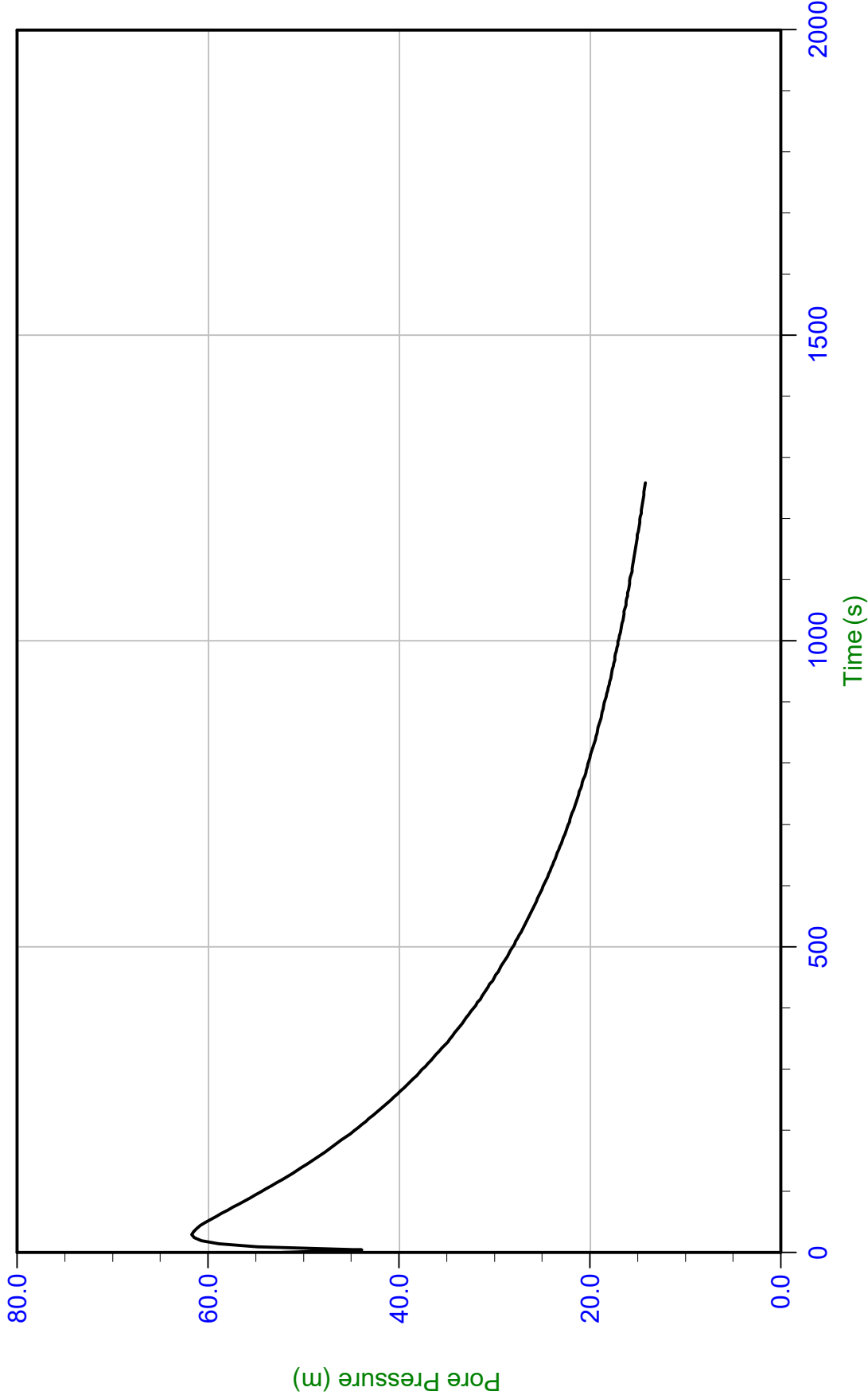
Trace Summary: Filename: 18-05032_SP_BH-401.PPF U Min: -0.9 m WT: 0.350 m / 1.148 ft
Depth: 0.350 m / 1.148 ft U Max: 12.0 m Ueq: 0.0 m
Duration: 295.0 s



Golder Associates

Job No: 18-05032
Date: 05/24/2018 08:11
Site: Hwy 17 & Hwy 508

Sounding: SCPT18-BH401
Cone: 330:T1500F15U500 Area=15 cm²



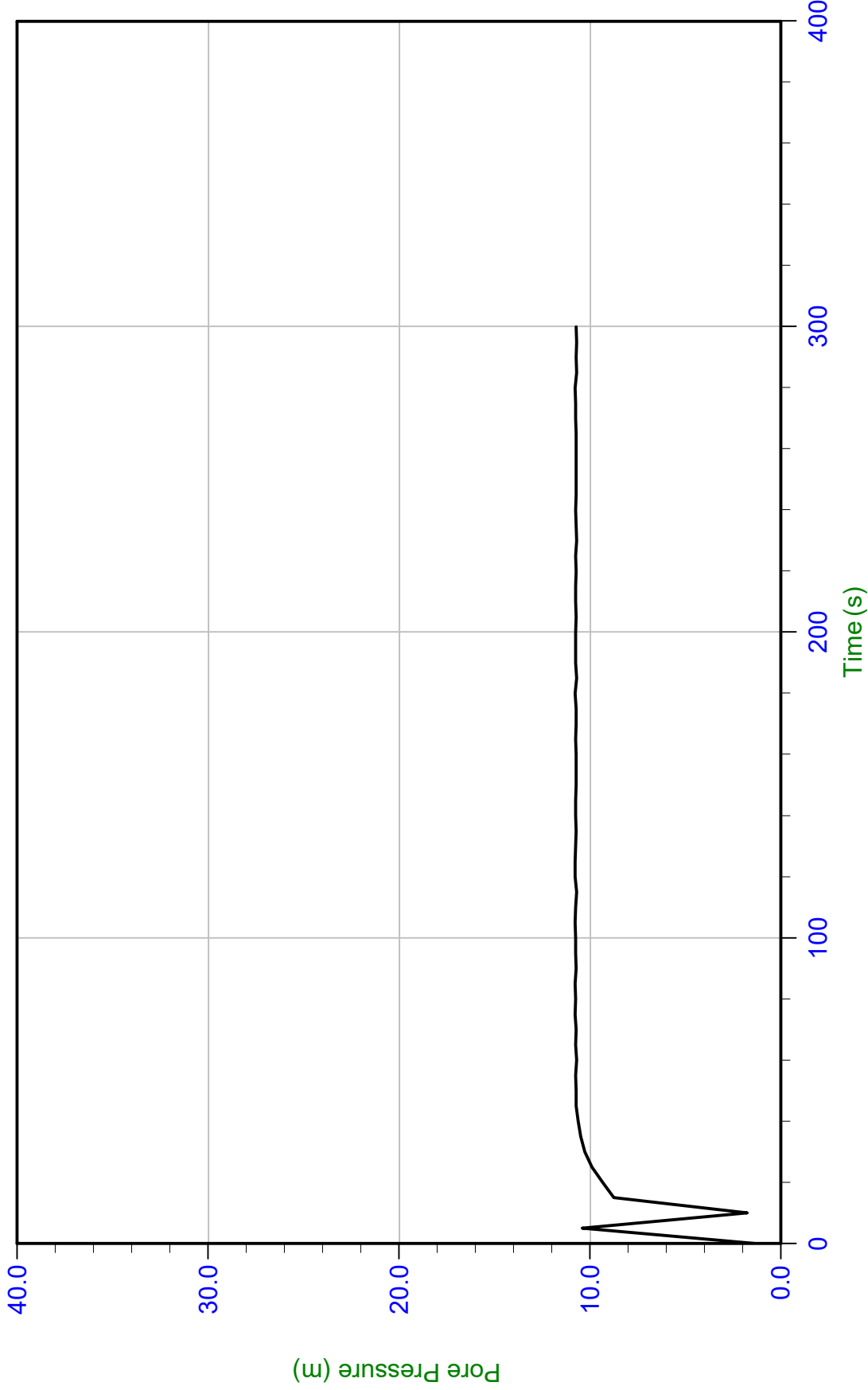
Trace Summary: Filename: 18-05032_SP_BH-401.PPF U Min: 14.2 m U Max: 61.7 m
Depth: 7.075 m / 23.212 ft
Duration: 1260.0 s
WT: 0.562 m / 1.844 ft
Ueq: 6.5 m
U(50): 34.12 m
T(50): 331.4 s
Ir: 100
Ch: 2.1 cm²/min



Golder Associates

Job No: 18-05032
Date: 05/24/2018 08:11
Site: Hwy 17 & Hwy 508

Sounding: SCPT18-BH401
Cone: 330:T1500F15U500 Area=15 cm²



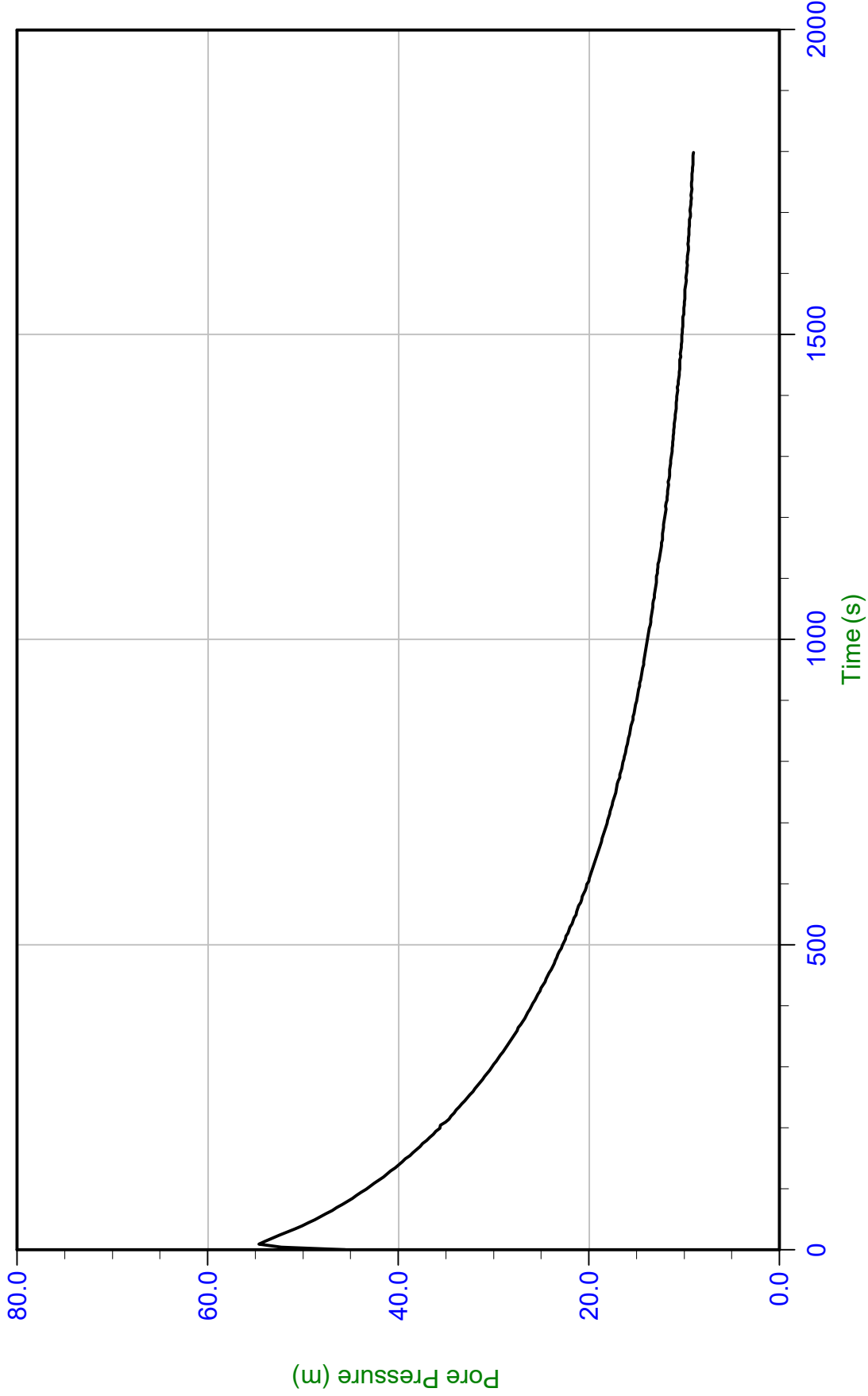
Trace Summary: Filename: 18-05032_SP_BH-401.PPF U Min: 1.4 m WT: 0.562 m / 1.844 ft
Depth: 11.325 m / 37.155 ft U Max: 10.8 m Ueq: 10.8 m
Duration: 300.0 s



Golder Associates

Job No: 18-05032
Date: 05/22/2018 10:51
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH402
Cone: 330:T1500F15U500 Area=15 cm²



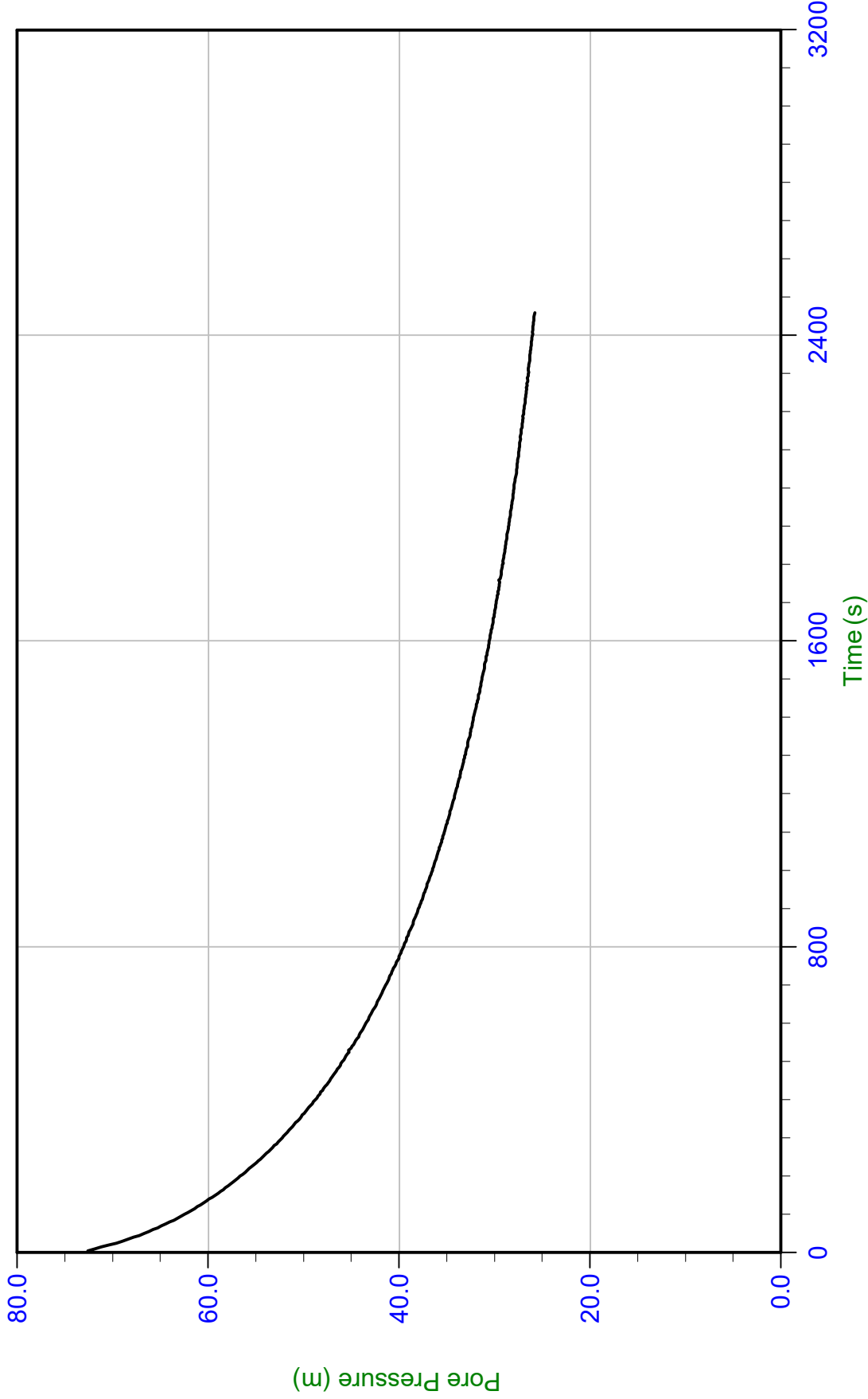
Trace Summary: Filename: 18-05032_CP_BH-402.PPF U Min: 9.0 m U Max: 54.6 m
Depth: 6.000 m / 19.685 ft
Duration: 1800.0 s
WT: 0.500 m / 1.640 ft T(50): 293.2 s
Ueq: 5.5 m Ir: 100
U(50): 30.06 m Ch: 2.4 cm²/min



Golder Associates

Job No: 18-05032
Date: 05/22/2018 10:51
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH402
Cone: 330:T1500F15U500 Area=15 cm²



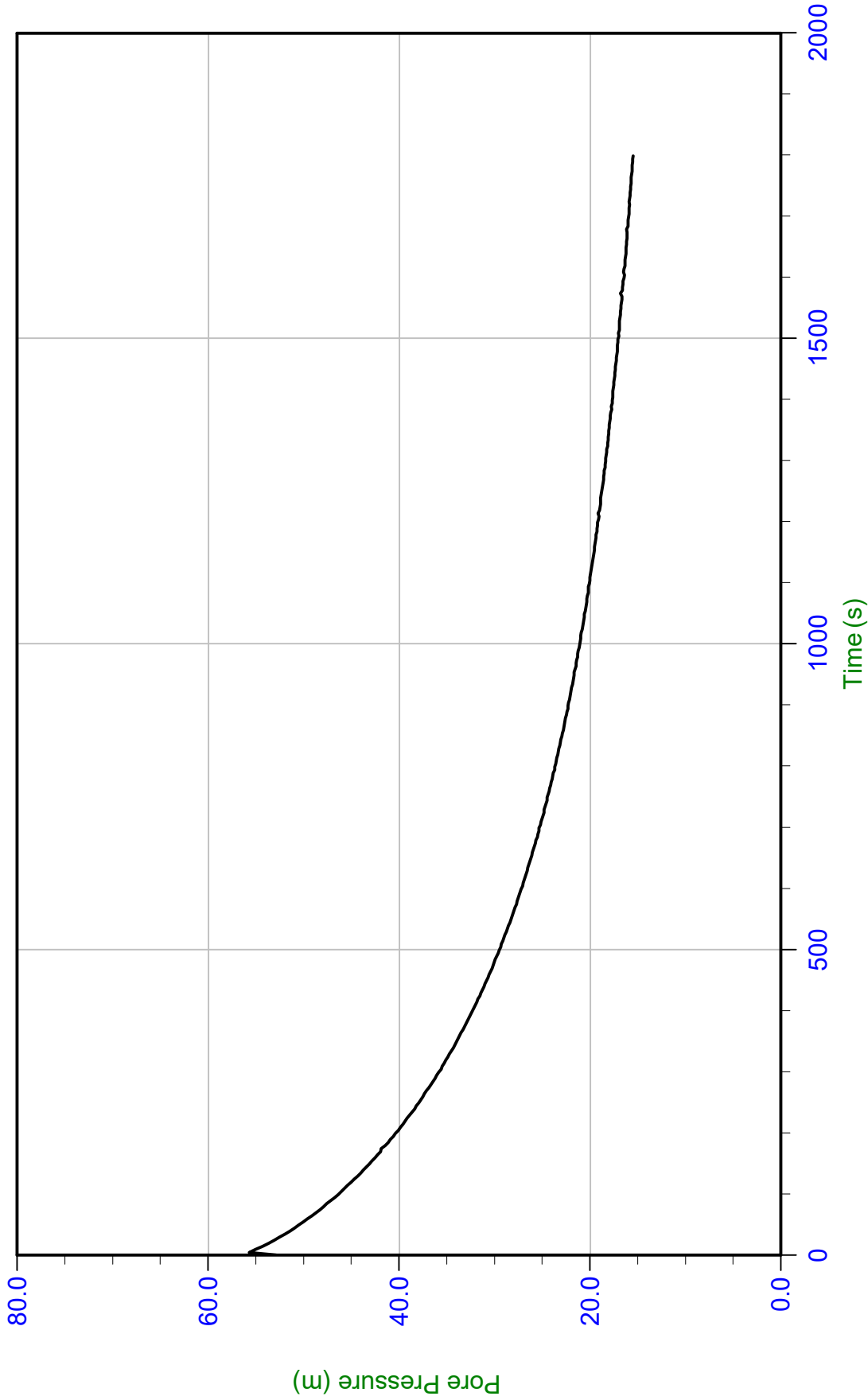
Trace Summary: Filename: 18-05032_CP_BH-402.PPF U Min: 25.8 m U Max: 72.6 m
Depth: 12.000 m / 39.370 ft
Duration: 2460.0 s
WT: 0.500 m / 1.640 ft
Ueq: 11.5 m
U(50): 42.05 m
T(50): 662.5 s
Ir: 100
Ch: 1.1 cm²/min



Golder Associates

Job No: 18-05032
Date: 05/23/2018 12:14
Site: Hwy 17 & Hwy 508

Sounding: SCPT18-BH403
Cone: 330:T1500F15U500 Area=15 cm²



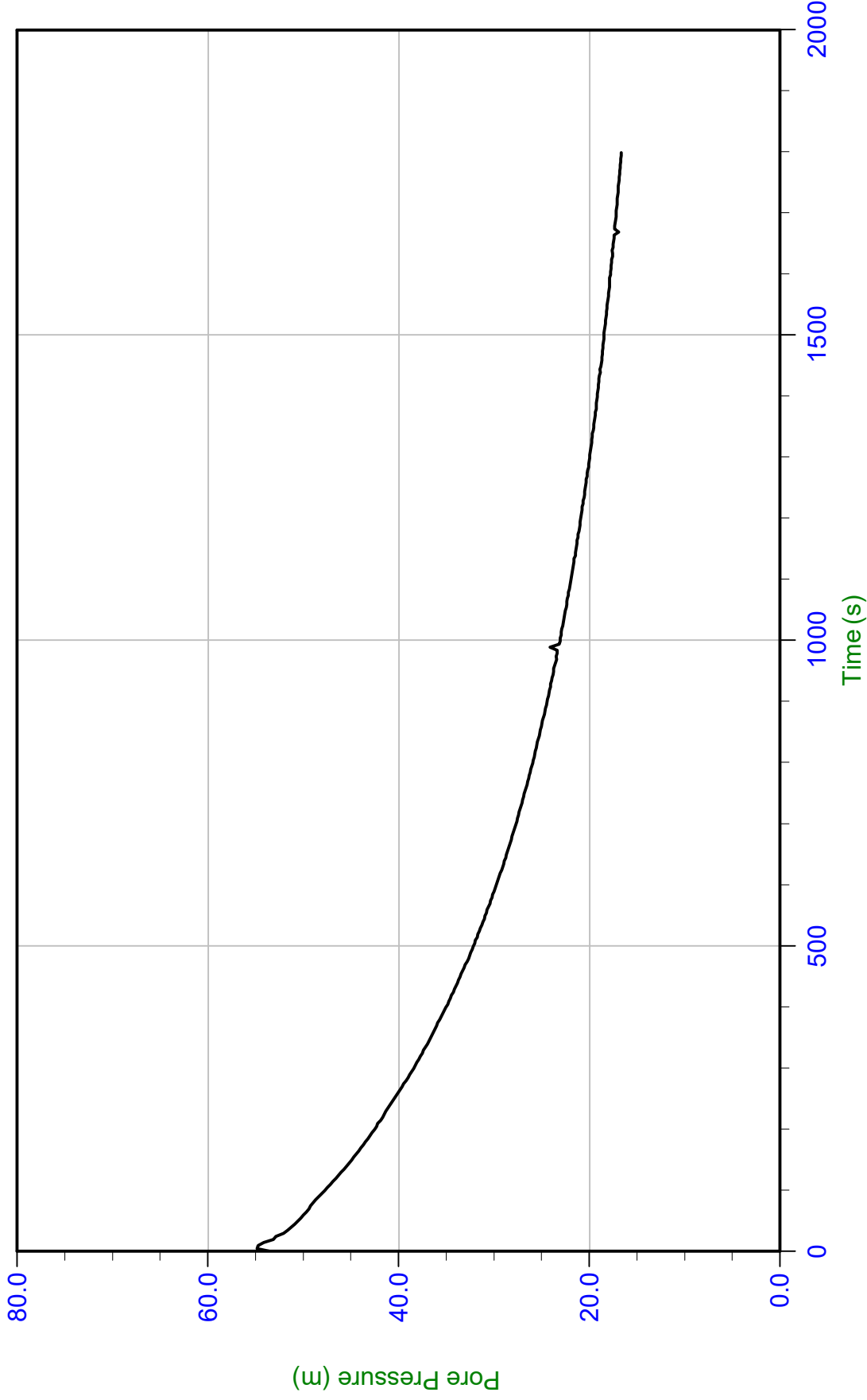
Trace Summary: Filename: 18-05032_SP_BH-403.PPF U Min: 15.5 m U Max: 55.7 m
Depth: 7.000 m / 22.966 ft
Duration: 1800.0 s
WT: 0.470 m / 1.542 ft
Ueq: 6.5 m
U(50): 31.12 m
T(50): 435.3 s
Ir: 100
Ch: 1.6 cm²/min



Golder Associates

Job No: 18-05032
Date: 05/25/2018 07:51
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH404
Cone: 330:T1500F15U500 Area=15 cm²



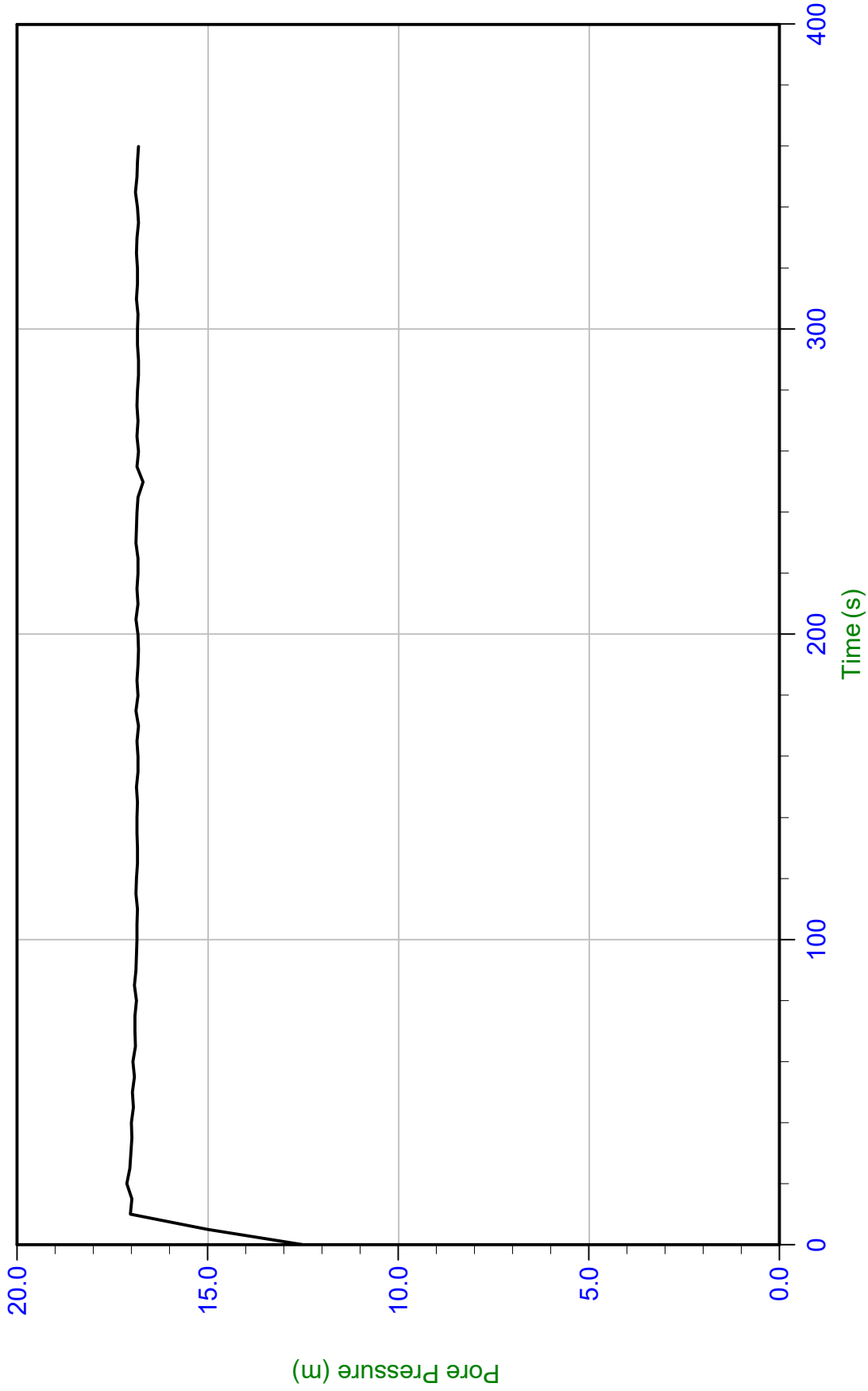
Trace Summary: Filename: 18-05032_CP_BH-404.PPF U Min: 16.7 m U Max: 54.9 m
Depth: 8.000 m / 26.246 ft
Duration: 1800.0 s
WT: 0.500 m / 1.640 ft T(50): 535.4 s
Ueq: 7.5 m Ir: 100
U(50): 31.18 m Ch: 1.3 cm²/min



Golder Associates

Job No: 18-05032
Date: 05/25/2018 07:51
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH404
Cone: 330:T1500F15U500 Area=15 cm²



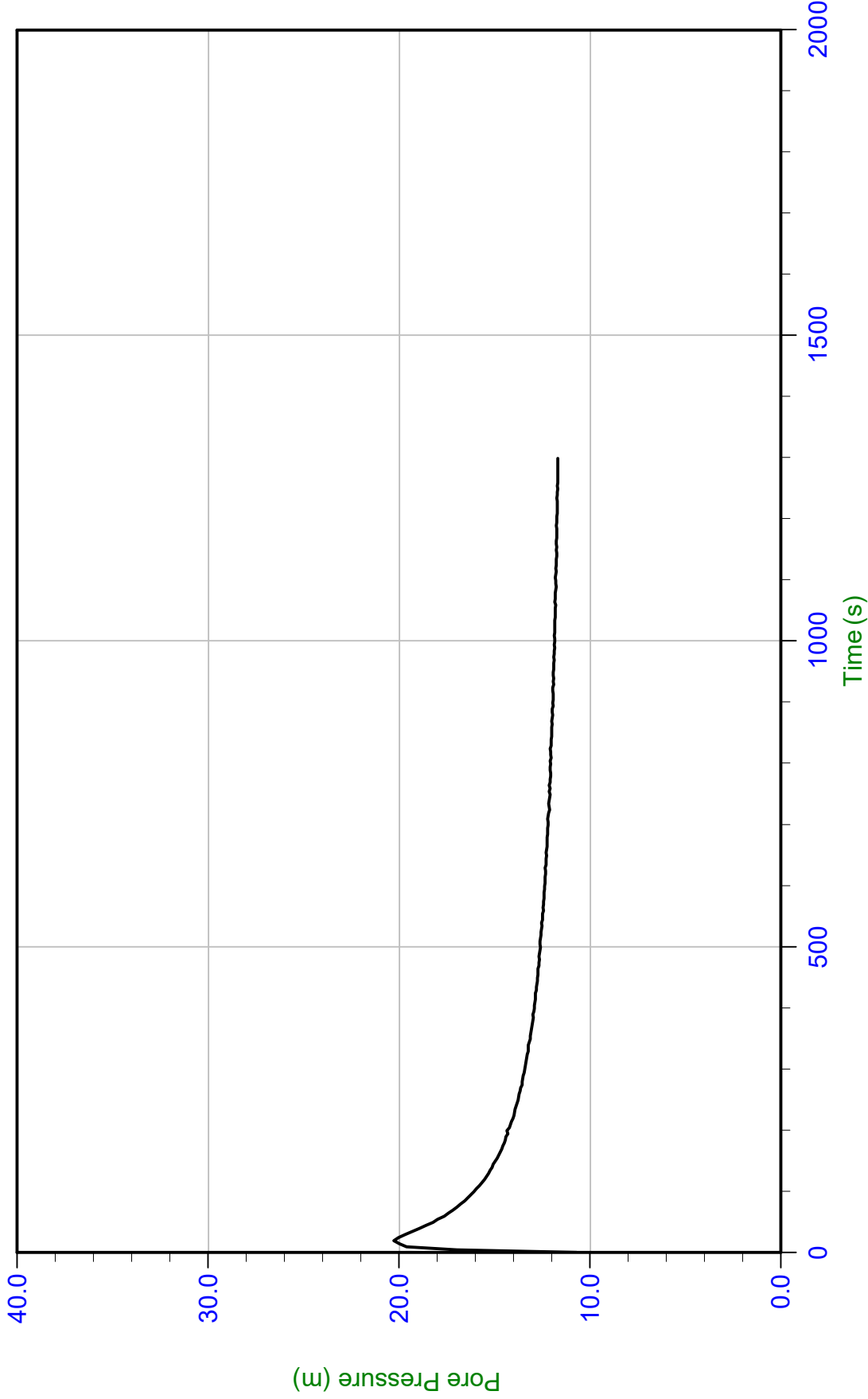
Trace Summary: Filename: 18-05032_CP_BH-404.PPF U Min: 12.5 m WT: -0.393 m / -1.290 ft
Depth: 16.450 m / 53.969 ft U Max: 17.1 m Ueq: 16.8 m
Duration: 360.0 s



Golder Associates

Job No: 18-05032
Date: 05/24/2018 14:30
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH405
Cone: 330:T1500F15U500 Area=15 cm²



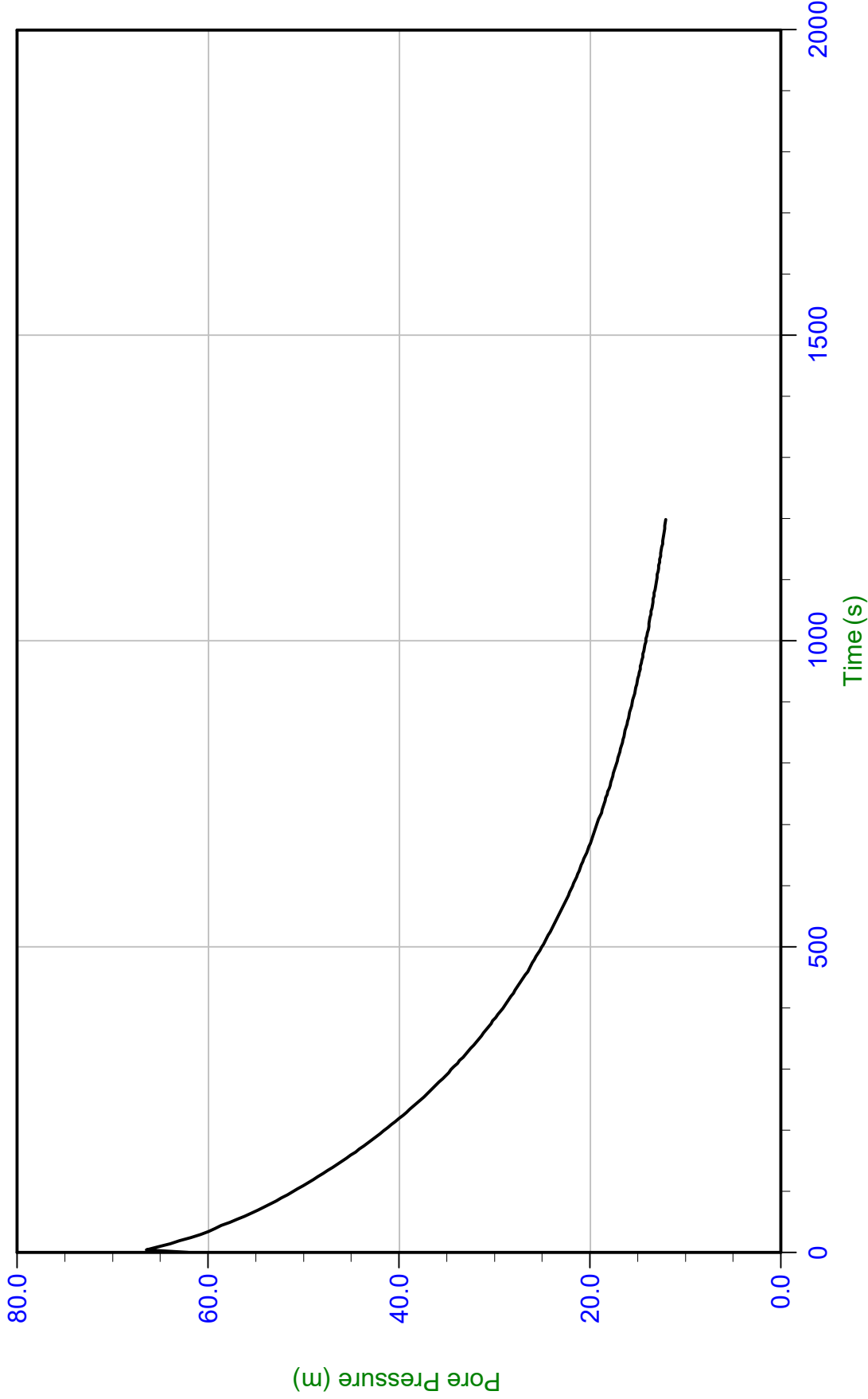
Trace Summary: Filename: 18-05032_CP_BH-405.PPF U Min: 10.7 m U Max: 20.3 m
Depth: 10.475 m / 34.366 ft
Duration: 1300.0 s
WT: 0.500 m / 1.640 ft
Ueq: 10.0 m
U(50): 15.12 m
T(50): 121.4 s
Ir: 100
Ch: 5.8 cm²/min



Golder Associates

Job No: 18-05032
Date: 05/24/2018 10:28
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH406
Cone: 330:T1500F15U500 Area=15 cm²



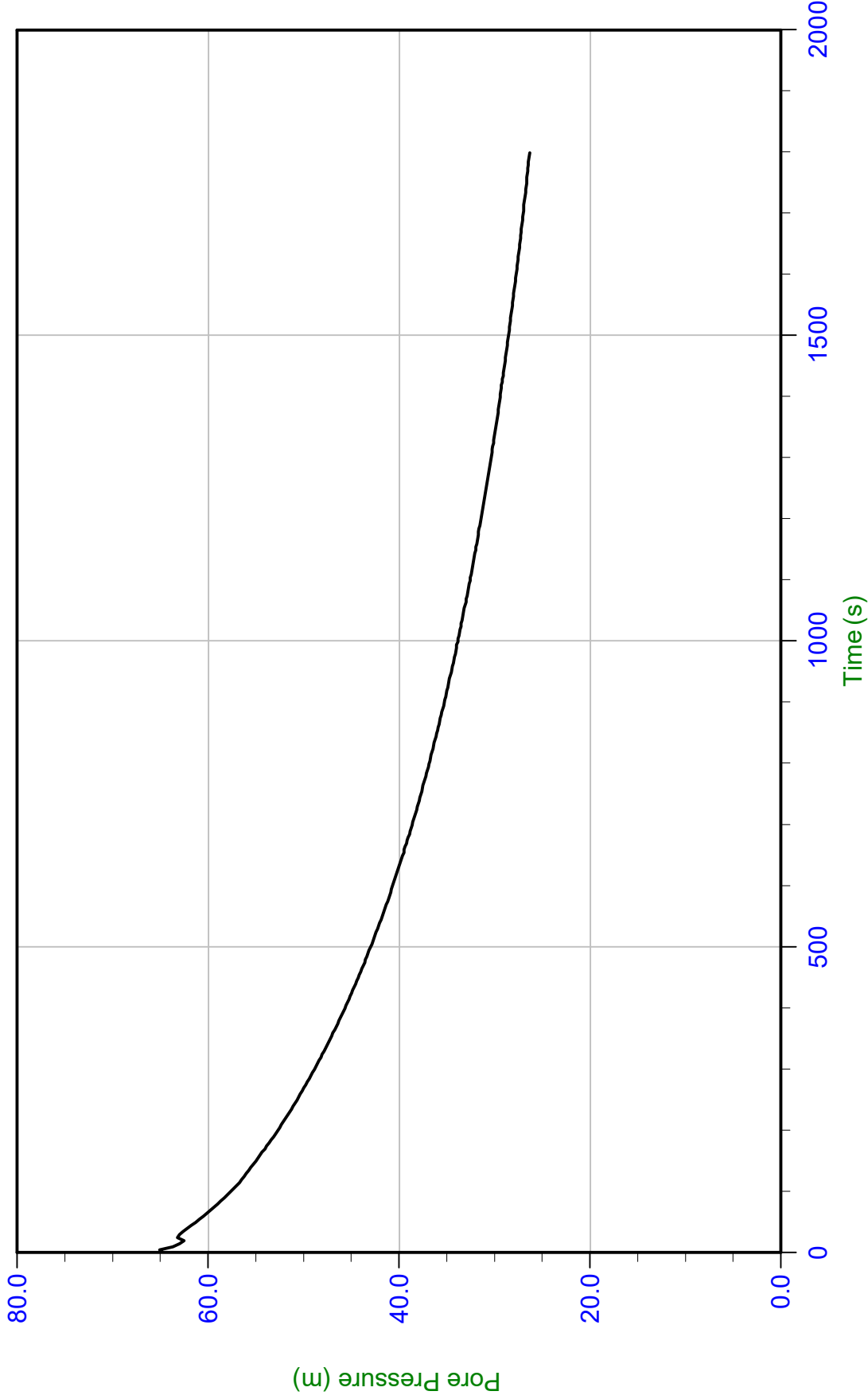
Trace Summary: Filename: 18-05032_CP_BH-406.PPF U Min: 12.1 m U Max: 66.5 m
Depth: 5.575 m / 18.290 ft
Duration: 1200.0 s
WT: 0.455 m / 1.493 ft
Ueq: 5.1 m
U(50): 35.79 m
T(50): 275.4 s
Ir: 100
Ch: 2.5 cm²/min



Golder Associates

Job No: 18-05032
Date: 05/24/2018 10:28
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH406
Cone: 330:T1500F15U500 Area=15 cm²



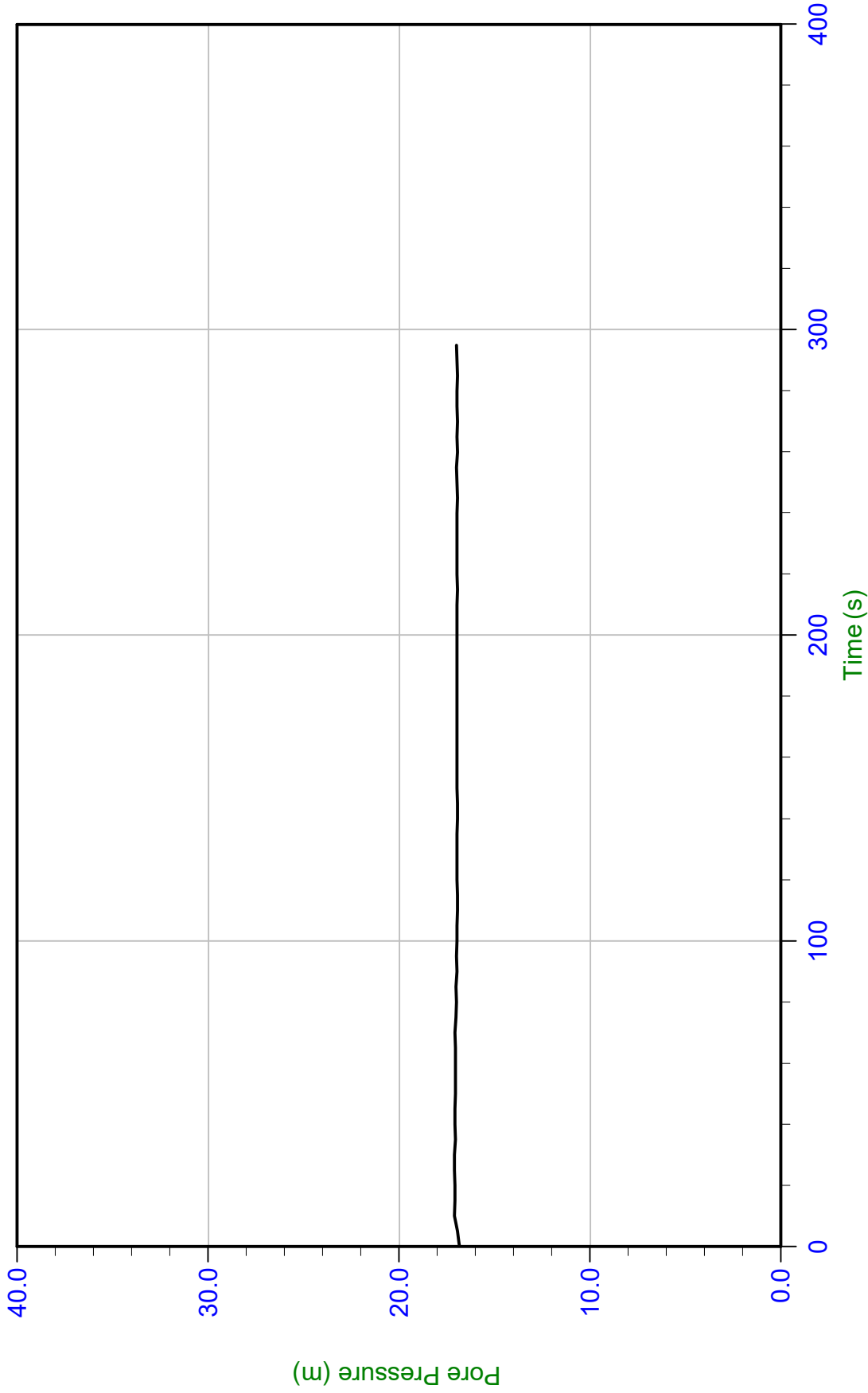
Trace Summary: Filename: 18-05032_CP_BH-406.PPF U Min: 26.3 m U Max: 65.1 m
Depth: 10.000 m / 32.808 ft
Duration: 1800.0 s
WT: 0.455 m / 1.493 ft T(50): 770.2 s
Ueq: 9.5 m Ir: 100
U(50): 37.31 m Ch: 0.9 cm²/min



Golder Associates

Job No: 18-05032
Date: 05/24/2018 10:28
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH406
Cone: 330:T1500F15U500 Area=15 cm²



Trace Summary: Filename: 18-05032_CP_BH-406.PPF U Min: 16.8 m WT: 0.455 m / 1.493 ft
Depth: 17.425 m / 57.168 ft U Max: 17.1 m Ueq: 17.0 m
Duration: 295.0 s



Golder Associates

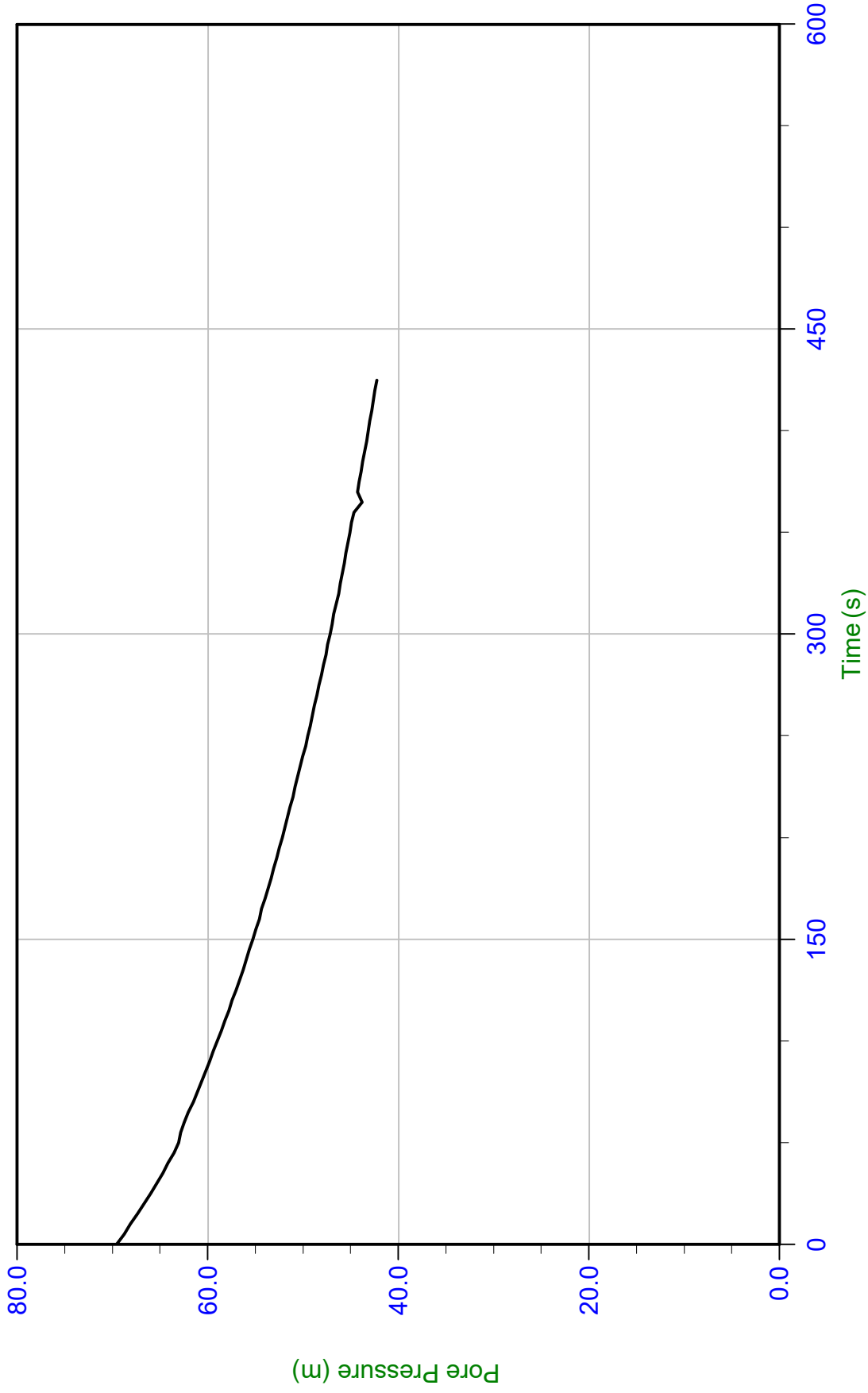
Job No: 18-05032

Date: 05/22/2018 14:13

Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH407

Cone: 330:T1500F15U500 Area=15 cm²



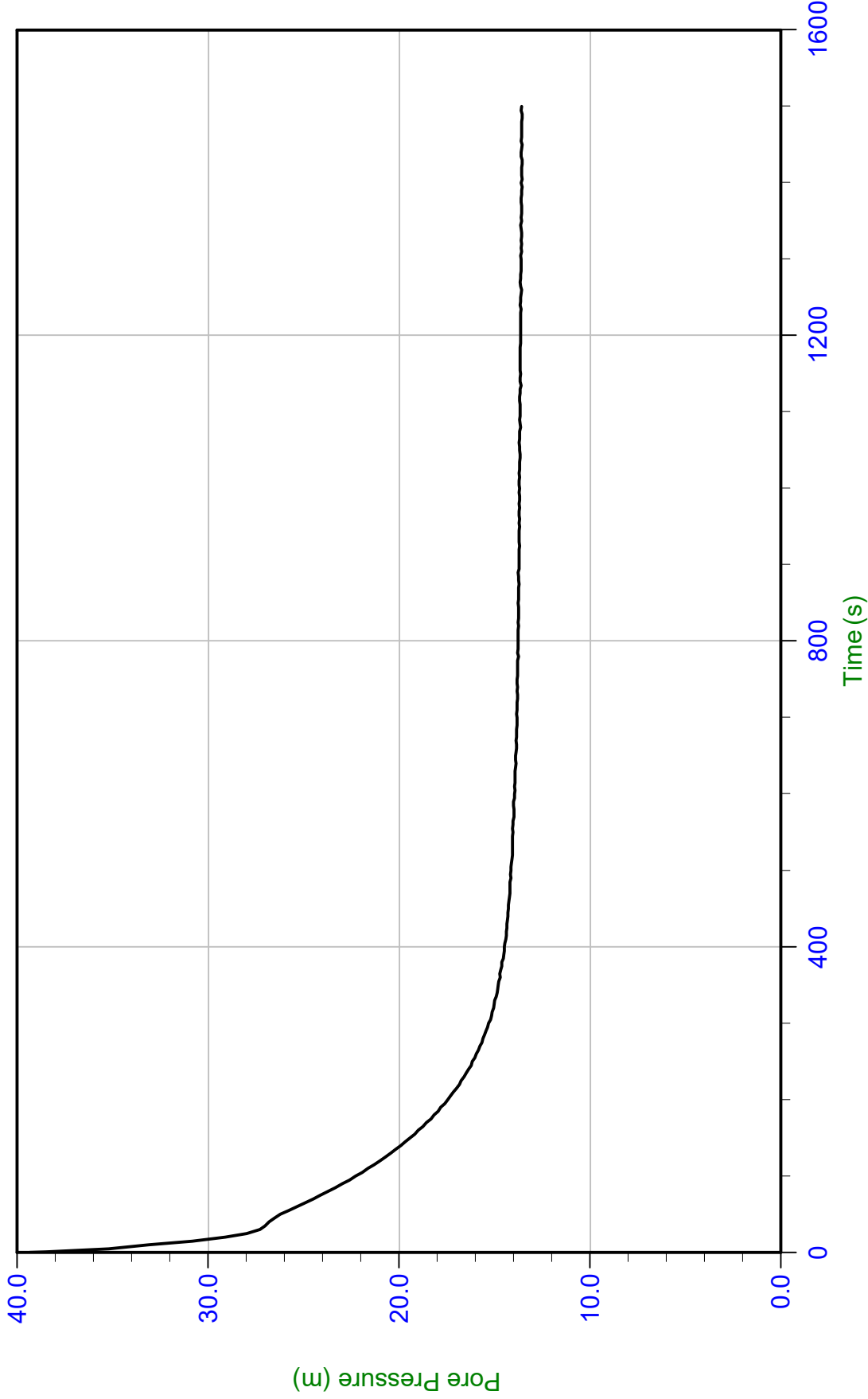
Trace Summary: Filename: 18-05032_CP_BH-407.PPF U Min: 42.3 m U Max: 69.6 m
Depth: 9.700 m / 31.824 ft
Duration: 425.0 s



Golder Associates

Job No: 18-05032
Date: 05/22/2018 14:13
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH407
Cone: 330:T1500F15U500 Area=15 cm²



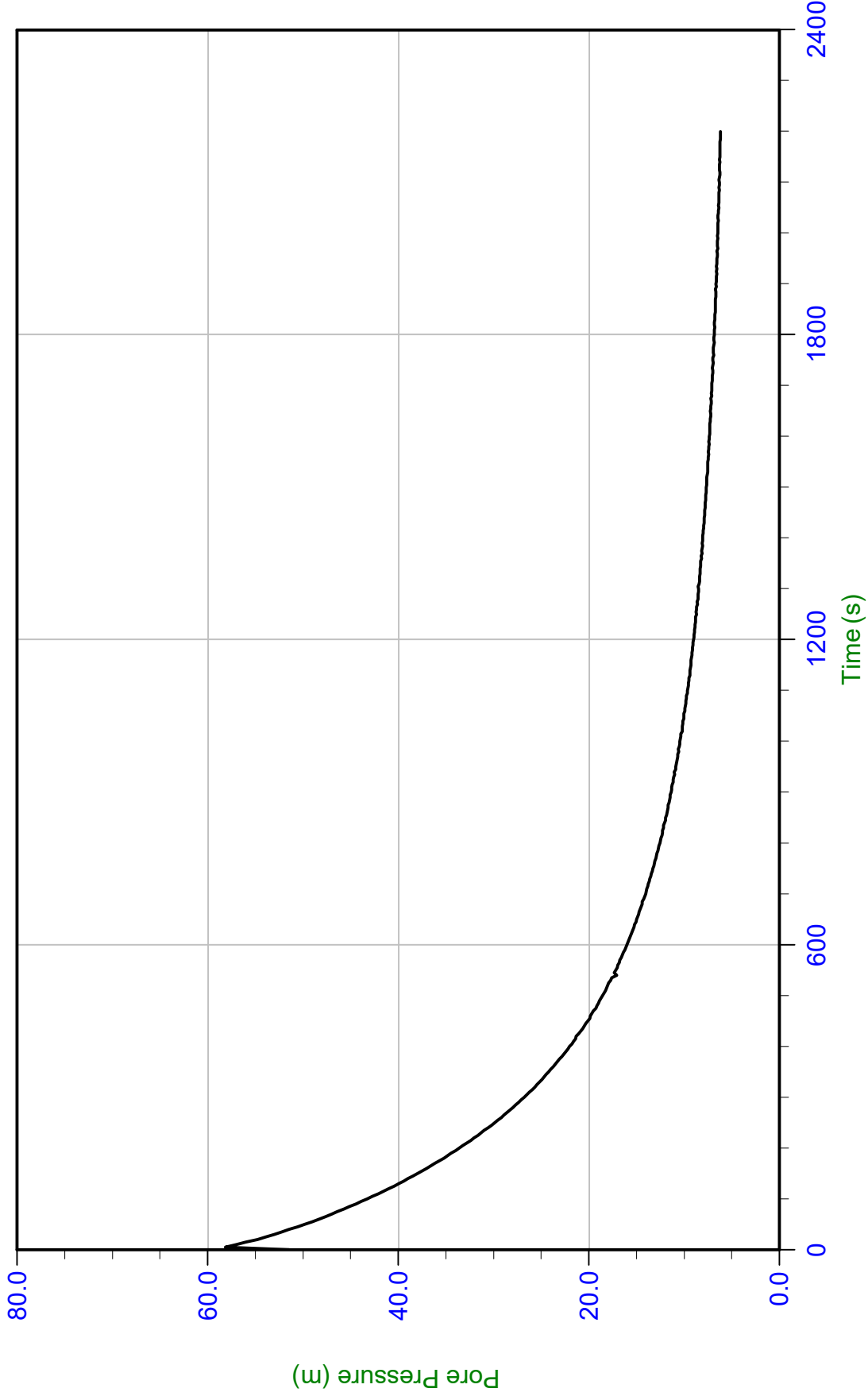
Trace Summary: Filename: 18-05032_CP_BH-407.PPF U Min: 13.6 m U Max: 39.3 m
Depth: 14.000 m / 45.931 ft
Duration: 1500.0 s
WT: 0.500 m / 1.640 ft T(50): 46.9 s
Ueq: 13.5 m Ir: 100
U(50): 26.42 m Ch: 15.0 cm²/min



Golder Associates

Job No: 18-05032
Date: 05/23/2018 08:43
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH408
Cone: 330:T1500F15U500 Area=15 cm²



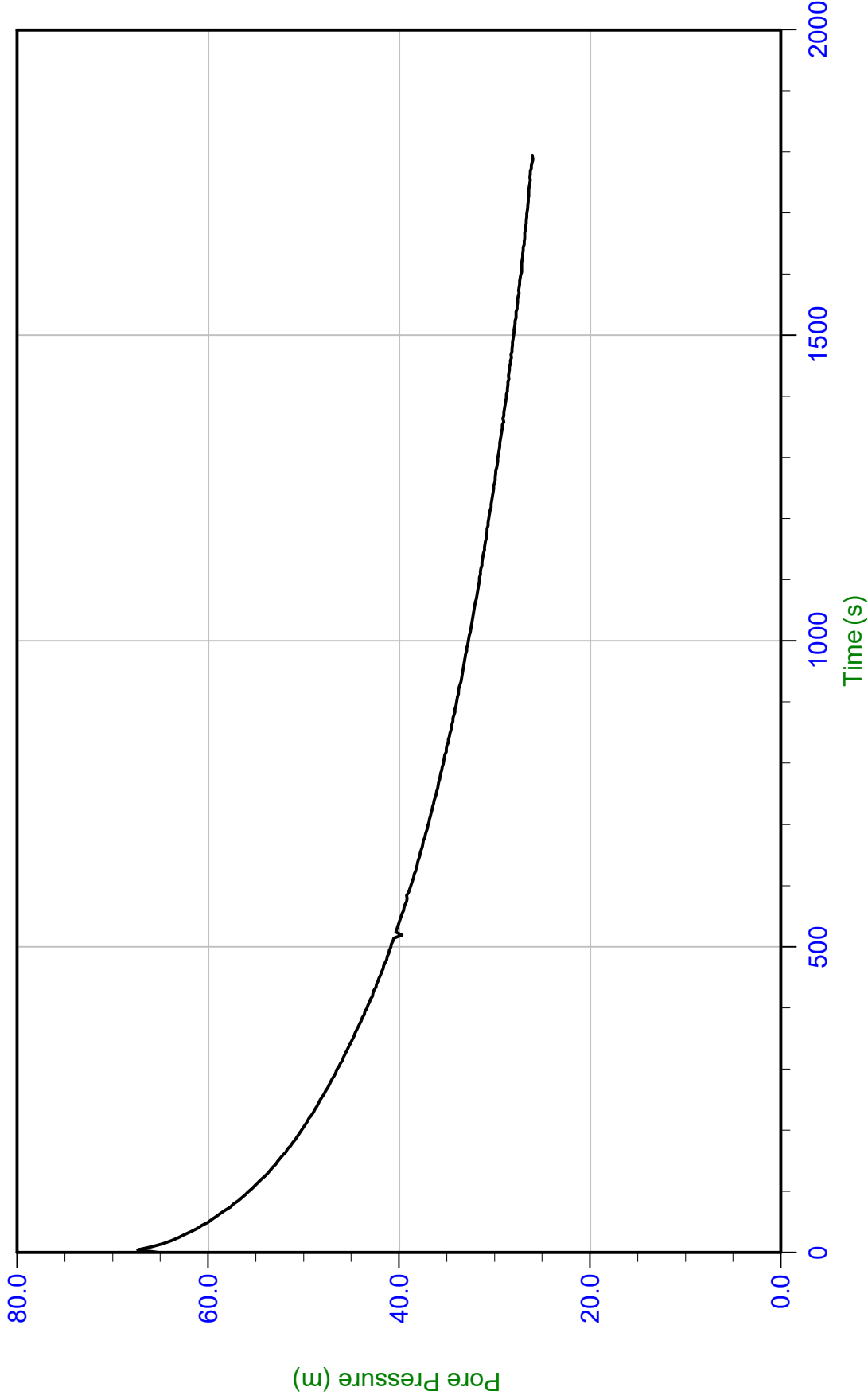
Trace Summary: Filename: 18-05032_CP_BH-408.PPF U Min: 6.2 m U Max: 58.1 m
Depth: 5.000 m / 16.404 ft
Duration: 2200.0 s
WT: 0.500 m / 1.640 ft
Ueq: 4.5 m
U(50): 31.32 m
T(50): 225.0 s
Ir: 100
Ch: 3.1 cm²/min



Golder Associates

Job No: 18-05032
Date: 05/23/2018 08:43
Site: Hwy 17 & Hwy 508

Sounding: CPT18-BH408
Cone: 330:T1500F15U500 Area=15 cm²



Trace Summary: Filename: 18-05032_CP_BH-408.PPF U Min: 26.0 m U Max: 67.4 m
Depth: 10.000 m / 32.808 ft
Duration: 1795.0 s
WT: 0.500 m / 1.640 ft T(50): 610.6 s
Ueq: 9.5 m Ir: 100
U(50): 38.45 m Ch: 1.1 cm²/min