



THURBER ENGINEERING LTD.

**FOUNDATION INVESTIGATION REPORT
SHANTZ STATION ROAD UNDERPASS
HIGHWAY 7-NEW, KITCHENER TO GUELPH
G.W.P. 408-88-00**

GEOCRES No. 40P9-61

Latitude 43.504935 ° , Longitude -80.382280 °

Report

to

WSP

Date: July 20, 2020
File: 11375



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PART 1: FACTUAL INFORMATION

1. INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted at the site of the proposed bridge structure to carry Shantz Station Road over Highway 7-New in the Regional Municipality of Waterloo, Ontario. The proposed Shantz Station Road bridge is part of the Highway 7-New Project.

The purpose of the investigation was to explore the subsurface conditions at the site and, based on the data obtained, to provide a borehole location plan, records of boreholes, a stratigraphic profile, cross sections, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions under the potential foundation footprints was developed from the data obtained in the course of the investigation.

Thurber was retained by WSP to carry out the site investigation under the Ministry of Transportation Ontario (MTO) Agreement Order Number 3014-E-0013.

Reference has been made to information on subsurface conditions contained in a previous foundation report prepared for this site during the preliminary design phase. The title of the report is:

- Preliminary, Foundation Investigation and Design Report, Shantz Station Road (RR30) Underpass, Highway 7-New, Kitchener to Guelph, G.W.P. 408-88-00, Geocres No. 40P9-

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47, Report to Ministry of Transportation Ontario Southwestern Region, File: 15-64-17, dated September 2, 2008. (Reference 1).

2. SITE DESCRIPTION

At the site, the Highway 7-New alignment runs approximately parallel to and 350 m north of the existing Highway 7 alignment. The site lies approximately 7.5 km northeast of a developed area of the City of Kitchener and 6.5 km northwest of a developed area of the City of Guelph.

The site is generally flat and lies within an area of active farms and agricultural lands. There are farmsteads to the east and west of Shantz Station Road, near the proposed Highway 7 alignment.

Based on the Ontario Geological Survey Special Volume 2, The Physiography of Southern Ontario, Third Edition by Chapman and Putnam, the site lies within an area referred to as the Guelph Drumlin Field, an area of drumlinized till plain, also mapped as containing eskers. The till is described as stony and the occurrence of surface boulders is noted. Chapman and Putnam give a typical gradation of the till as being 50% sand, 35% silt and 15% clay. Swampy valleys are reported to occur between the drumlins and associated gravel terraces.

3. INVESTIGATION PROCEDURES

A detailed geotechnical investigation was conducted between June 30 and July 27, 2017, and consisted of drilling and sampling five boreholes (numbered SH16-01 to SH16-05) near the foundation units of the proposed underpass. Boreholes SH16-01 and SH16-05 were drilled at the north and south approach embankments respectively. Boreholes SH16-02, SH16-03 and SH16-04 were drilled near the approximate locations of the north abutment, pier and south abutment, respectively. The depths of the boreholes ranged from 6.1 m to 25.0 m (Elevations 323.4 to 305.7). The Record of Borehole sheets of the boreholes drilled during the present investigation, are included in Appendix A.

A preliminary foundation investigation was carried out between May 22 and June 3, 2008. Three boreholes, numbered 08-157, 08-158 and 08-159, were drilled near the north abutment, pier and



south abutment, respectively. The depths of the boreholes ranged from 20.0 m to 21.4 m (Elevations 309.2 to 308.6). The Record of Borehole sheets of the boreholes drilled during the previous investigation, are included in Appendix B.

The approximate locations of the boreholes from the previous and current investigations are shown on the attached Borehole Locations and Soil Strata Drawing in Appendix C. The coordinates and elevations of the current and previous boreholes are given on the drawings and on the individual Record of Borehole Sheets in Appendices A and B, respectively.

The ground surface elevations and coordinates of the recent as-drilled boreholes were provided by WSP.

Prior to commencing the site investigation, utility clearances were obtained for all borehole locations. Road occupancy permit was also obtained to complete site investigation.

During the current investigation, track-mounted D52 and truck-mounted CME75 drill rigs were used in conjunction with hollow-stem augers to advance the boreholes in the overburden soils. In general, soil samples were obtained at selected intervals using a 50mm diameter split spoon sampler in conjunction with the Standard Penetration Testing (SPT). NQ coring methods were used to advance Borehole SH16-02 3.1 m into bedrock. Boreholes SH16-03 and SH16-04 were advanced 3.3 m into refusal density soils as defined by SPT 'N' values of greater than 100 blows per 0.3 m of penetration.

The drilling, sampling and in-situ testing operations were supervised on a full-time basis by a member of Thurber's technical staff. The supervisor logged the boreholes and processed the recovered soil and rock samples for transport to Thurber's Oakville laboratory for further examination and testing.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Standpipe piezometers were installed in three selected boreholes (08-158, SH16-02 and SH16-04). Each piezometer consisted of a 25 mm Schedule 40 PVC pipe with a 1.5 m long slotted screen enclosed in a column of filter sand to permit groundwater level monitoring. Piezometer installation details, groundwater level observations and water level readings are



shown on the Record of Borehole sheets. Upon completion of the drilling operations, the boreholes without piezometers were abandoned in general accordance with Ontario Regulation 903 (as amended by O. Reg. 372/07). The details of standpipe piezometer installation and borehole completion are summarized in Table 3.1. The piezometer installations were decommissioned as per O.Reg. 903.

Table 3.1 – Borehole Completion Details

| Foundation Unit | Borehole Number | Borehole Depth / Base Elevation (m) | Piezometer Tip Depth / Elevation (m) | Completion Details |
|-----------------|-----------------|-------------------------------------|--------------------------------------|---|
| North Approach | SH16-01 | 9.8/321.1 | None Installed | Backfilled with bentonite and auger cuttings to surface. |
| North Abutment | 08-157 | 20.8/308.8 | None Installed | Backfilled with bentonite benseal grout to 1.5 m, holeplug from 1.5 m to 0.6 m, then auger cuttings to surface. |
| | SH16-02 | 25.0/305.7 | 19.8/310.9 | Bentonite holeplug from 25.0 m to 19.8 m, Piezometer with 3 m slotted screen installed with sand filter from 19.8 m to 16.2 m, bentonite holeplug from 16.2 m to 13.2 m, bentonite holeplug and auger cuttings from 13.2 m to 0.15 m, then cement to surface. |
| Pier | 08-158 | 21.4/308.6 | 21.4/308.6 | Piezometer with 1.5 m slotted screen installed with a sand filter to 19.1 m, holeplug from 19.1 m to 18.3 m, bentonite from 18.3 m to ground surface. |
| | SH16-03 | 21.4/309.0 | None Installed | Backfilled with bentonite holeplug and auger cutting to surface |
| South Abutment | 08-159 | 20.0/309.2 | None Installed | Grout from 20.0 m to 15.0 m, holeplug from 15.0 m to 3.0 m and auger cuttings from 3.0 m to ground surface. |
| | SH16-04 | 21.5/308.5 | 21.3/308.7 | Bentonite holeplug from 21.6 m to 21.3 m, Piezometer with 3 m slotted |



| Foundation Unit | Borehole Number | Borehole Depth / Base Elevation (m) | Piezometer Tip Depth / Elevation (m) | Completion Details |
|-----------------|-----------------|-------------------------------------|--------------------------------------|--|
| | | | | screen installed with sand filter from 21.3 m to 17.7 m, bentonite holeplug from 17.7 m to 12.2 m, auger cuttings from 12.2 m to 0.15, then cement to surface. |
| South Approach | SH16-05 | 6.1/323.4 | None Installed | Backfilled with bentonite holeplug and auger cutting to surface. |

4. LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. Selected samples were also subjected to grain size analysis and Atterberg Limits testing. All the laboratory tests were carried out in accordance with MTO and/or ASTM Standards, as appropriate. The results of the laboratory testing of current and previous investigations are summarized on the Record of Borehole sheets in Appendices A and B, and also presented on the figures included in Appendices A and B.

In order to assess the potential for sulphate attack on concrete foundations, as well as the potential for corrosion associated with the structure, a sample of the existing native silty clay till was collected. The sample was submitted to SGS Canada Inc., a CALA accredited analytical laboratory in Lakefield, Ontario, for analytical testing of corrosivity parameters and sulphate content. The results of the analytical testing are summarized in Section 6 and are presented in Appendix A.

5. DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets included in Appendices A and B. A general description of the stratigraphy, based on the conditions encountered in the boreholes, is given in the following paragraphs. However, the factual data presented on the Record of Borehole sheets takes precedence over this general description and



must be used for interpretation of the site conditions. It should be recognized and expected that soil conditions may vary between and beyond borehole locations.

In general, the subsurface conditions encountered at the site consisted of topsoil and/or cohesionless fill overlying native layers of loose to dense silt, loose to very dense gravelly sand, very stiff to hard silty clay till and very dense silty sand till/sandy silt till. Interbedded layers of sand, silty sand and silt were encountered at various depths within the silty clay till. Dolostone bedrock was contacted in one borehole below the cohesionless glacial till. Descriptions of the individual strata are presented below.

5.1 Topsoil

Topsoil was identified at the ground surface in Boreholes 08-157, 08-159, and SH16-03. The topsoil thickness ranged from 75 mm to 200 mm.

The topsoil thickness may vary between and beyond the borehole locations, and the limited data presented in this report should not be used for quantity estimation purposes.

5.2 Fill

Fill was encountered below the topsoil in Boreholes 08-157, and 08-159, and surficially in Boreholes 08-158, SH16-01, SH16-02, SH16-04 and SH16-05. The fill consisted of layers of brown to dark brown gravelly sand, sand, silty sand and silty clay. The thickness of the fill ranged from 0.5 m to 2.2 m, and the depth to the base ranged from 0.5 m to 2.2 m (Elevations 330.2 to 327.4).

SPT 'N' values of the cohesive fill were 4 and 11 blows per 0.3 m of penetration, indicating a firm to stiff consistency. The SPT 'N' values in the cohesionless fill varied from 6 to 48 blows per 0.3 m of penetration, indicating a loose to dense state. The natural moisture content ranged from 4 percent to 21 percent.

5.3 Gravelly Sand, Sand and Gravel, and Gravel



A layer of brown gravelly sand containing some silt was encountered in Boreholes SH16-01 at 3.0 m depth (Elevations 327.9). The thickness of the gravelly sand layer was 1.4 m. The depth to the base of the gravelly sand was 4.4 m (Elevations 326.4).

Brown sand and gravel was contacted within the silty clay till at 1.4 m depth (Elevation 328.1) in Borehole SH16-05. The thickness of the sand and gravel layer was 0.8 m.

SPT 'N' values in the gravelly sand, and sand and gravel ranged from 4 to 66 blows per 0.3 m of penetration indicating a compact to very dense relative density. . The natural moisture contents in the gravelly sand, sand and gravel, and gravel generally lay in the range of 6 percent to 9 percent.

The grain size distribution curve of a sand and gravel sample tested is presented on the Record of Borehole sheets and on Figure A1 of Appendix A. The result of a laboratory test carried out on a selected sample are as follows:

| Soil Particles | (%) |
|----------------|-----|
| Gravel | 39 |
| Sand | 37 |
| Silt and Clay | 24 |

5.4 Silt and Sandy Silt

Layers of brown silt and sandy silt containing some sand, trace to some gravel and trace to some clay were contacted at depths ranging from 0.1 m to 0.7 m (Elevations 330.2 to 329.3) in Boreholes SH16-01, SH16-03 and SH16-04. The thickness of the silt and sandy silt varied from 0.7 m to 3.8 m. The depth to the base of the silt and sandy silt ranged from 1.4 m to 5.9 m (Elevations 328.6 to 324.9).

Interbedded layers of silt and silty sand were encountered within the silty clay till/clayey silt till in Boreholes SH16-03, SH16-04, 08-157 and 08-159, at various elevations, generally ranging from 321.4 to 318.3. The thickness of these interbedded layers varied between 0.5 m and 1.6 m.



SPT 'N' values in the silt and sandy silt layers were 2 to 57 blows per 0.3 m of penetration, indicating a very loose to very dense state. The natural moisture contents of the silt and sandy silt generally lay in the range of 7 percent to 21 percent.

Grain size distribution curves of silt samples tested are presented on the Record of Borehole sheets and on Figure A2 and B3 of Appendices A and B, respectively. The results of laboratory tests carried out in the silt samples were as follows:

| Soil Particles | (%) |
|----------------|----------|
| Gravel | 0 to 1 |
| Sand | 15 to 16 |
| Silt | 76 to 80 |
| Clay | 4 to 7 |

5.5 Silty Clay, Silty Clay Till and Clayey Silt Till

An extensive deposit of silty clay, silty clay till and clayey silt till was contacted in all the boreholes at depths ranging from 0.5 m to 5.9 m (Elevations 329.5 to 324.9). The cohesive deposit contained trace to some gravel and trace to some silt. Although not specifically identified in the boreholes, glacial tills are known to contain cobbles and boulders. Interbedded layers of sand, silt, silty sand and gravel, were encountered within the silty clay till and clayey silt till and are described in other sections of this report. The thickness of the clayey silt till and silty clay till ranged from 12.1 m to 16.7 m, and locally 4.4 m in Borehole SH16-05 which was terminated at a shallower depth.

A 1.8 m thick layer of grey silty clay was encountered at 8.5 m depth (Elevation 321.1) in Borehole 08-157.

The depth to the base of the cohesive tills ranged from 15.7 m to 20.9 m (Elevations 313.7 to 309.8), and at 5.9 m (Elevation 323.6) in Borehole SH16-05.

Borehole SH16-01 was terminated within the silty clay till at 9.8 m depth (Elevation 321.1).



SPT 'N' values in the silty clay, silty clay till and clayey silt till ranged from 12 to greater than 100 blows per 0.3 m of penetration, indicating a stiff to hard consistency. The natural moisture contents of the silty clay, silty clay till and clayey silt till generally lay in the range of 5 percent to 38 percent.

Grain size distribution curves of silty clay, silty clay till and clayey silt till samples are presented on the Record of Borehole sheets and on Figures A3 and A4 of Appendix A, and Figures B1, B2 and B4 of Appendix B. The results of laboratory tests carried out in the cohesive soil samples were as follows:

| Soil Particles | (%) |
|----------------|----------|
| Gravel | 0 to 16 |
| Sand | 0 to 34 |
| Silt | 29 to 78 |
| Clay | 15 to 69 |

The results of Atterberg Limits are presented on the Record of Borehole sheets and on Figure A7 of Appendix A and Figures B6 to B8 Appendix B. The results of Atterberg Limits testing are summarized below:

| | |
|---------------|----------|
| Liquid Limit | 15 to 55 |
| Plastic Limit | 10 to 23 |

The above results show that the silty clay and clayey silt till/silty clay till are of low to high plasticity with group symbols of CL-ML, CL, CI and CH.

Glacial tills inherently contain cobbles and boulders.

5.6 Sand to Silty Sand

A layer of grey sand containing some silt and clay, and trace gravel was encountered in Borehole SH16-02 at a depth of 13.3 m (Elevation 317.4). The thickness of the sand layer was 3.0 m.



A 1.0-m thick layer of grey silty sand containing some gravel, was contacted within the silty clay till in Borehole SH16-04 at 5.9 m depth (Elevation 324.1).

The depth to the base of the sand and silty sand layers was at 16.3 m and 6.9 m (Elevations 314.4 and 323.2), respectively.

SPT 'N' values measured in the sand were 49 and 62 blows per 0.3 m of penetration, indicating a dense to very dense condition. An SPT 'N' value in the silty sand in Borehole SH16-04 was 100 blows per 0.075 m of penetration, indicating a very dense state. The natural moisture contents of the sand and silty sand generally lay in the range of 5 percent to 15 percent.

The grain size distribution curve of a sand sample tested is presented on the Record of Borehole sheets and on Figure A5 of Appendix A. The result of a laboratory test carried out on a selected sample are as follows:

| Soil Particles | (%) |
|----------------|-----|
| Gravel | 2 |
| Sand | 79 |
| Silt and Clay | 19 |

5.7 Sandy Silt Till, Silty Sand Till and Silt Till

Brown to grey sandy silt till and silty sand till containing some gravel to gravelly and trace clay was encountered below the silty clay till/clayey silt till in all the boreholes, except in Borehole SH16-01. The sandy silt till/silty sand till layers were contacted at depths ranging from 15.7 m to 20.9 m (Elevations 313.7 to 309.8). Clayey zones were encountered within the sandy silt till/silty sand till, near Elevations 311.6 to 309.6.

Upper layers of sandy silt till/silty sand till were contacted at 4.1 m and 5.9 m depth (Elevations 325.1 and 323.6) in Boreholes 08-159 and SH16-05.

A 700-mm thick layer of silt till was encountered at 10.2 m depth (Elevation 319.0) in Borehole 08-159.



The depth to the base of the silty sand till was at 21.9 m depth (Elevation 308.7) in Borehole SH16-02. The depth to the base of the sandy silt till was at 5.6 m (Elevation 323.5) in Borehole 08-159.

Boreholes SH16-03, SH16-04, 08-157, 08-158 and 08-159, were terminated within the sandy silt till/silty sand till at depths ranging from 20.0 m to 21.5 m (Elevations 309.2 to 308.4). Borehole SH16-05 was terminated within the silty sand till at 6.1 m depth (Elevation 323.5).

SPT 'N' values ranged from 65 blows per 0.3 m of penetration to greater than 100 blows per 0.05 m of penetration indicating a very dense relative density. The natural moisture contents generally lay in the range from 8 percent to 18 percent.

Grain size distribution curves for samples tested are presented on the Record of Borehole sheets and on Figure A6 of Appendix A and Figures B3 and B5 and Appendix B. The results of the laboratory tests carried out on sandy silt till/silty sand till samples are summarized as follows:

| Soil Particles | Sand and Silt Till (%) | Silt Till (%) |
|----------------|------------------------|---------------|
| Gravel | 4 to 23 | 0 |
| Sand | 40 to 47 | 8 |
| Silt | 23 to 41 | 82 |
| Clay | 7 to 15 | 10 |

Atterberg Limits tests were conducted in the clayey zone of the silty sand till/sandy silt till, and the results are presented on the Record of Borehole sheets and on Figure B9 of Appendix B. The results of Atterberg Limits testing are summarized below:

| | |
|---------------|----|
| Liquid Limit | 16 |
| Plastic Limit | 10 |

The above results show that the clayey zone is of low plasticity with a group symbol of CL-ML.



Although not specifically identified in the boreholes, this layer may contain cobbles and boulders which may account for some high SPT 'N' values and resistance to augering.

5.8 Bedrock

The overburden soils described above are underlain by dolostone bedrock, which was encountered at a depth of 21.9 m (Elevation 308.7) in Borehole SH16-02, and proven by coring 3.1 m into the rock. The bedrock was grey in colour. Occasional mechanical breaks were noted throughout the bedrock cores. The bedrock is generally described as moderately weathered.

Borehole SH16-02 was terminated within the bedrock at 25.0 m depth (Elevation 305.7).

Total Core Recovery (TCR) in the bedrock ranged from 98% and 100% with Solid Core Recovery (SCR) of 98% and 100%. The Rock Quality Designation (RQD) determined from the recovered cores was 53% to 86%, indicating fair to good rock quality.

The Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, ranged from 1 to 6. Average unconfined compressive strengths (UCS) of the rock were 94 MPa and 138 MPa, indicating the rock is strong to very strong. These estimated rock strength values are interpreted from point load tests that were conducted on rock cores recovered from the boreholes. A summary of the Point Load Test Results are presented in Appendix A.

5.9 Groundwater Conditions

Groundwater conditions were observed during drilling operations, and groundwater levels were measured in the open boreholes upon completion of drilling. Standpipe piezometers were installed in Boreholes 08-158, SH16-02 and SH16-04 to monitor the groundwater level at the site. The piezometers in SH16-02 and SH16-04 were damaged before water level reading could be taken. The groundwater levels measured in the open boreholes and in the standpipe piezometers are summarized in Table 5.1.

Table 5.1 – Water Level Measurements

| Foundation Unit | Borehole | Date | Water Level (m) | | Remark |
|-----------------|----------|------------------------------------|-----------------|------------|---|
| | | | Depth | Elevation | |
| North Approach | SH16-01 | June 30, 2017 | 6.1 | 324.7 | Open borehole |
| North Abutment | 08-157 | May 30, 2008 | Dry | - | Open borehole |
| | SH16-02 | July 26, 2017 December 18, 2017 | 9.1 - | 321.6 - | Open borehole Piezometer was damaged |
| Pier | 08-158 | May 28, 2008 | 6.8 | 323.2 | Piezometer |
| | | June 2, 2008 | 8.8 | 321.2 | |
| | | July 15, 2008 | 9.0 | 321.0 | |
| | | August 14, 2008 | 8.4 | 321.6 | |
| | SH16-03 | July 27, 2017 | 12.2 | 318.1 | Open borehole |
| South Abutment | 08-159 | June 3, 2008 | Dry | - | Open borehole |
| | SH16-04 | July 27, 2017 December 18, 2017 | 12.2 - | 317.8 - | Open borehole Piezometer was damaged |
| South Approach | SH16-05 | June 30, 2017 | Dry | - | Open borehole |

The groundwater levels above are short-term readings, and seasonal fluctuations of the groundwater levels are to be expected. The groundwater levels may be at a higher elevation after periods of significant or prolonged precipitation.

6. CORROSIVITY AND SULPHATE TEST RESULTS

A sample of the silty clay till from Borehole SH16-04 was submitted for analytical testing of corrosivity parameters and sulphate. The results of the analytical tests are shown in Table 6.1. The laboratory certificates of analysis are presented in Appendix A.

Table 6.1 – Analytical Test Results

| Parameter | Units (Soil) | Test Results |
|----------------------------|-----------------|--------------------------------|
| | | SH16-04 SS 4 Depth 2.3 m |
| | | (Native Silty Clay Till) |
| Sulphide | % | <0.02 |
| Chloride | µg/g | 94 |
| Sulphate | µg/g | 15 |
| pH | No unit | 9.11 |
| Electrical Conductivity | µS/cm | 144 |
| Resistivity | Ohms.cm | 6940 |
| Redox Potential | mV | 265 |

7. MISCELLANEOUS

Altech Drilling & Investigative Services of Elmira, Ontario supplied a track-mounted D52 drill rig and a truck-mounted CME75 drill rig and conducted the drilling, sampling and in-situ testing operations for the present investigation.

The coordinates for the boreholes were obtained with GPS equipment by Thurber, and the elevations were provided by WSP.

The drilling and sampling operations in the field for the current investigation were supervised on a full-time basis by Thurber field technicians.

Geotechnical laboratory testing was carried out at Thurber's geotechnical laboratory. Analytical laboratory testing was carried out by SGS Canada Inc.

Details of the previous investigation, conducted in 2008, are presented in Reference 1.



Overall supervision of the field program for the present investigation was conducted by Dr. Nancy Berg, P.Eng.. Interpretation of the data and preparation of the current report was carried out by Ms. R. Palomeque Reyna, P.Eng. and Dr. Nancy Berg, P.Eng.

Mr. Jason Lee, P.Eng. and Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations projects, reviewed the report.

Thurber Engineering Ltd.



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Appendix A

Record of Borehole Sheets, Laboratory Test Results, and Analytical Laboratory Test Results (Current Investigation)

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

| CLASSIFICATION | PARTICLE SIZE | VISUAL IDENTIFICATION |
|----------------|--------------------|---|
| Boulders | Greater than 200mm | same |
| Cobbles | 75 to 200mm | same |
| Gravel | 4.75 to 75mm | 5 to 75mm |
| Sand | 0.075 to 4.75mm | Not visible particles to 5mm |
| Silt | 0.002 to 0.075mm | Non-plastic particles, not visible to the naked eye |
| Clay | Less than 0.002mm | Plastic particles, not visible to the naked eye |

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

| TERMINOLOGY | PROPORTION |
|---------------------------------|---------------|
| Trace or Occasional | Less than 10% |
| Some | 10 to 20% |
| Adjective (e.g. silty or sandy) | 20 to 35% |
| And (e.g. sand and gravel) | 35 to 50% |

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

| DESCRIPTIVE TERM | UNDRAINED SHEAR STRENGTH (kPa) | APPROXIMATE SPT ⁽¹⁾ 'N' VALUE |
|------------------|--------------------------------|--|
| Very Soft | 12 or less | Less than 2 |
| Soft | 12 to 25 | 2 to 4 |
| Firm | 25 to 50 | 4 to 8 |
| Stiff | 50 to 100 | 8 to 15 |
| Very Stiff | 100 to 200 | 15 to 30 |
| Hard | Greater than 200 | Greater than 30 |

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer



4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

| DESCRIPTIVE TERM | SPT "N" VALUE |
|------------------|-----------------|
| Very Loose | Less than 4 |
| Loose | 4 to 10 |
| Compact | 10 to 30 |
| Dense | 30 to 50 |
| Very Dense | Greater than 50 |

5. LEGEND FOR RECORDS OF BOREHOLES

| | | | |
|---|---|--|------------------------|
| SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE | SS Split Spoon Sample | WS Wash Sample | AS Auger (Grab) Sample |
| | TW Thin Wall Shelby Tube Sample | TP Thin Wall Piston Sample | |
| | PH Sampler Advanced by Hydraulic Pressure | PM Sampler Advanced by Manual Pressure | |
| | WH Sampler Advanced by Self Static Weight | RC Rock Core | SC Soil Core |

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$


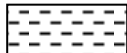



 Water Level
 Shear Strength Determination by Pocket Penetrometer

- (1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

UNIFIED SOILS CLASSIFICATION

| MAJOR DIVISIONS | | GROUP SYMBOL | TYPICAL DESCRIPTION |
|----------------------|---|--------------|---|
| COARSE GRAINED SOILS | GRAVEL AND GRAVELLY SOILS | GW | Well-graded gravels or gravel-sand mixtures, little or no fines. |
| | | GP | Poorly-graded gravels or gravel-sand mixtures, little or no fines. |
| | | GM | Silty gravels, gravel-sand-silt mixtures. |
| | | GC | Clayey gravels, gravel-sand-clay mixtures. |
| | SAND AND SANDY SOILS | SW | Well-graded sands or gravelly sands, little or no fines. |
| | | SP | Poorly-graded sands or gravelly sands, little or no fines. |
| | | SM | Silty sands, sand-silt mixtures. |
| | | SC | Clayey sands, sand-clay mixtures. |
| FINE GRAINED SOILS | SILTS AND CLAYS W _L < 50% | ML | Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity. |
| | | CL | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. (W _L < 30%). |
| | | CI | Inorganic clays of medium plasticity, silty clays. (30% < W _L < 50%). |
| | | OL | Organic silts and organic silty-clays of low plasticity. |
| | SILTS AND CLAYS W _L > 50% | MH | Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts. |
| | | CH | Inorganic clays of high plasticity, fat clays. |
| | | OH | Organic clays of medium to high plasticity, organic silts. |
| HIGHLY ORGANIC SOILS | | Pt | Peat and other highly organic soils. |
| CLAY SHALE | | | |
| SANDSTONE | | | |
| SILTSTONE | | | |
| CLAYSTONE | | | |
| COAL | | | |

EXPLANATION OF ROCK LOGGING TERMS

| <u>ROCK WEATHERING CLASSIFICATION</u> | | <u>SYMBOLS</u> | |
|---------------------------------------|---|---|-------------------|
| Fresh (FR) | No visible signs of weathering. | | |
| Fresh Jointed (FJ) | Weathering limited to the surface of major discontinuities. |  | CLAYSTONE |
| Slightly Weathered (SW) | Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material. |  | SILTSTONE |
| Moderately Weathered (MW) | Weathering extends throughout the rock mass, but the rock material is not friable. |  | SANDSTONE |
| Highly Weathered (HW) | Weathering extends throughout the rock mass and the rock is partly friable. |  | COAL |
| Completely Weathered (CW) | Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved. |  | Bedrock (general) |

| <u>DISCONTINUITY SPACING</u> | | <u>STRENGTH CLASSIFICATION</u> | | | |
|------------------------------|-----------------------|--------------------------------|---|---------------------|---|
| Bedding | Bedding Plane Spacing | Rock Strength | Approximate Uniaxial Compressive Strength | | Field Estimation of Hardness* |
| | | | (MPa) | (psi) | |
| Very thickly bedded | Greater than 2m | Extremely Strong | Greater than 250 | Greater than 36,000 | Specimen can only be chipped with a geological hammer |
| Thickly bedded | 0.6 to 2m | | | | |
| Medium bedded | 0.2 to 0.6m | Very Strong | 100-250 | 15,000 to 36,000 | Requires many blows of geological hammer to break |
| Thinly bedded | 60mm to 0.2m | Strong | 50-100 | 7,500 to 15,000 | Requires more than one blow of geological hammer to break |
| Very thinly bedded | 20 to 60mm | | | | |
| Laminated | 6 to 20mm | Medium Strong | 25.0 to 50.0 | 3,500 to 7,500 | Breaks under single blow of geological hammer. |
| Thinly Laminated | Less than 6mm | | | | |

| <u>TERMS</u> | | | | | | |
|-------------------------------------|--|-----------------------|-------------|--------------|--|--|
| Total Core Recovery: (TCR) | Core recovered as a percentage of total core run length. | Weak | 5.0 to 25.0 | 750 to 3,500 | Can be peeled by a pocket knife with difficulty Can be peeled by a pocket knife, crumbles under firm blows of geological pick. Indented by thumbnail | |
| Solid Core Recovery: (SCR) | Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run. | Very Weak | 1.0 to 5.0 | 150 to 750 | | |
| Rock Quality Designation: (RQD) | Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length. | Extremely Weak (Rock) | 0.25 to 1.0 | 35 to 150 | | |
| Uniaxial Compressive Strength (UCS) | Axial stress required to break the specimen | | | | | |
| Fracture Index: (FI) | Frequency of natural fractures per 0.3m of core run. | | | | | |

RECORD OF BOREHOLE No SH16-01

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Shantz Station Road, MTM NAD 83 Zone 10: N 4 818 763.6 E 233 428.9 ORIGINATED BY GA
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 2017.06.30 - 2017.06.30 LATITUDE 43.505385 LONGITUDE -80.382633 CHECKED BY JPL

| 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 | | | SHEAR STRENGTH kPa | | | | | | | | | | | | |
| 330.8 | GROUND SURFACE | | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | | | | |
| 0.0 | Gravelly SAND Dense Grey Moist (FILL) | | 1 | SS | 48 | | | | | | | | | | | | | | | |
| 330.2 | | | | | | | | | | | | | | | | | | | | |
| 0.7 | SILT, some sand, trace clay, trace gravel Loose to Dense Brown Moist | | 2 | SS | 5 | | 330 | | | | | | | | | | | | | |
| | | | 3 | SS | 9 | | 329 | | | | | | | | | | | | | |
| | | | 4 | SS | 32 | | 328 | | | | | | | | | | | | | |
| 327.9 | | | | | | | | | | | | | | | | | | | | |
| 3.0 | Gravelly SAND, some silt Very Dense Brown Moist | | 5 | SS | 66 | | 327 | | | | | | | | | | | | | |
| 326.4 | | | | | | | | | | | | | | | | | | | | |
| 4.4 | Dense Wet | | 6 | SS | 45 | | 326 | | | | | | | | | | | | 0 | 15 79 6 |
| 324.9 | | | | | | | 325 | | | | | | | | | | | | | |
| 5.9 | Silty CLAY, some sand to sandy, trace gravel Hard Grey Moist (TILL) | | 7 | SS | 66 | | 324 | | | | | | | | | | | | 3 | 25 47 25 |
| | Wet | | 8 | SS | 36 | | 323 | | | | | | | | | | | | | |
| | | | | | | | 322 | | | | | | | | | | | | | |
| | | | 9 | SS | 32 | | | | | | | | | | | | | | | |
| 321.1 | | | | | | | | | | | | | | | | | | | | |
| 9.8 | END OF BOREHOLE AT 9.8m. | | | | | | | | | | | | | | | | | | | |

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ONTMT4S2 MTO-11375(GINTDATA)\GPJ 2017TEMPLATE(MTO).GDT 6/1/20

RECORD OF BOREHOLE No SH16-01

2 OF 2

METRIC

GWP# 408-88-00 LOCATION Shantz Station Road, MTM NAD 83 Zone 10: N 4 818 763.6 E 233 428.9 ORIGINATED BY GA
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 2017.06.30 - 2017.06.30 LATITUDE 43.505385 LONGITUDE -80.382633 CHECKED BY JPL

| 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 | | |
| | Continued From Previous Page | | | | | | | | | | | | | | | | |
| | WATER LEVEL AT 6.1m. BOREHOLE BACKFILLED WITH BENTONITE AND AUGER CUTTINGS TO SURFACE. | | | | | | | | | | | | | | | | |

ONTMT4S2 MTO-11375(GINTDATA)\GPJ 2017TEMPLATE(MTO).GDT 6/1/20

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CONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 6/4/20

RECORD OF BOREHOLE No SH16-02

2 OF 3

METRIC

GWP# 408-88-00 LOCATION Shantz Station Road, MTM NAD 83 Zone 10: N 4 818 751.2 E 233 451.1 ORIGINATED BY OA
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY MFA
 DATUM Geodetic DATE 2017.07.25 - 2017.07.26 LATITUDE 43.505276 LONGITUDE -80.382356 CHECKED BY JPL

| 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 | "N" VALUES | | | 20 | 40 | 60 | 80 | | | | | |
| | Continued From Previous Page | | | | | | | | | | | | | | | |
| 317.4 | Silty CLAY , sandy, trace gravel Very Stiff to Hard Brown to Grey (TILL) | | 10 | SS | 100/ .175 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | 11 | SS | 23 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| 13.3 | SAND , some silt, trace clay, trace gravel Dense to Very Dense Grey Wet | | 12 | SS | 49 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | 13 | SS | 62 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| 314.4 | Silty CLAY , sandy, trace gravel Very Stiff to Hard Grey (TILL) | | 14 | SS | 22 | | | | | | | | | | | |
| 16.3 | | | | | | | | | | | | | | | | |
| | | | 15 | SS | 23 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | 16 | SS | 100/ | | | | | | | | | | | |

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METRIC

| | | | | | | | |
|----------------|---------|--|--|--------------------------|--|--|--|
| 30" x 30" x 5' | SAMPLES | | | DYNAMIC CONE PENETRATION | | | |
|----------------|---------|--|--|--------------------------|--|--|--|

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RECORD OF BOREHOLE No SH16-03

1 OF 3

METRIC

GWP# 408-88-00 LOCATION Shantz Station Road, MTM NAD 83 Zone 10: N 4 818 710.2 E 233 448.4 ORIGINATED BY GA
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
DATUM Geodetic DATE 2017.07.27 - 2017.07.27 LATITUDE 43.504907 LONGITUDE -80.382385 CHECKED BY JPL

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | 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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE | | | | | | | WATER CONTENT (%) W _P W W _L | | | |
| 330.3 | GROUND SURFACE | | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | | |
| 0.0 | TOPSOIL: (100mm) | | | | | | | | | | | | | | | | | |
| 0.1 | SILT, some clay, some gravel, trace sand, occasional organics Loose to Very Loose Brown Moist | | 1 | SS | 7 | | 330 | | | | | | | | ○ | | | |
| | | | 2 | SS | 3 | | 329 | | | | | | | | ○ | | | |
| | | | 3 | SS | 2 | | | | | | | | | | ○ | | | |
| 328.1 | | | | | | | | | | | | | | | | | | |
| 2.2 | Silty CLAY, trace to some sand, some gravel Very Stiff to Hard Brown Moist (TILL) | | 4 | SS | 18 | | 328 | | | | | | | | ○ | | | |
| | | | 5 | SS | 22 | | 327 | | | | | | | | ○ | — | | |
| | | | | | | | 326 | | | | | | | | | | | |
| | Grey | | 6 | SS | 23 | | | | | | | | | | ○ | | | |
| | | | | | | | 325 | | | | | | | | | | | |
| | | | 7 | SS | 74 | | 324 | | | | | | | | ○ | | | |
| | | | | | | | 323 | | | | | | | | | | | |
| | Stiff | | 8 | SS | 15 | | 322 | | | | | | | | ○ | | | |
| | | | | | | | | | | | | | | | | | | |
| 321.4 | | | | | | | | | | | | | | | | | | |
| 9.0 | SILT Dense Grey Wet | | 9 | SS | 50 | | 321 | | | | | | | | ○ | | | |
| 320.3 | | | | | | | | | | | | | | | | | | |

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RECORD OF BOREHOLE No SH16-03

2 OF 3

METRIC

GWP# 408-88-00 LOCATION Shantz Station Road, MTM NAD 83 Zone 10: N 4 818 710.2 E 233 448.4 ORIGINATED BY GA
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
DATUM Geodetic DATE 2017.07.27 - 2017.07.27 LATITUDE 43.504907 LONGITUDE -80.382385 CHECKED BY JPL

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | 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 | 20 40 60 80 100 | 20 40 60 80 100 | | |
| | Continued From Previous Page | | | | | | | | | | | | |
| 10.0 | Silty CLAY, some sand, trace gravel Very Stiff Grey Wet (TILL) | | 10 | SS | 28 | | 320 | | | | | | |
| | | | | | | | 319 | | | | | | |
| 318.3 | | | | | | | | | | | | | |
| 12.0 | SILT, some clay, trace sand, trace gravel Very Dense Grey Wet | | 11 | SS | 57 | | 318 | | | | | | |
| 317.4 | | | | | | | | | | | | | |
| 13.0 | Silty CLAY, trace to some sand, trace gravel Very Stiff to Stiff Grey Wet (TILL) | | 12 | SS | 22 | | 317 | | | | | | |
| | | | | | | | 316 | | | | | | |
| | | | | | | | 315 | | | | | | |
| | | | | | | | 314 | | | | | | |
| | | | | | | | 313 | | | | | | |
| | | | | | | | 312 | | | | | | |
| 312.2 | | | | | | | | | | | | | |
| 18.1 | Silty SAND, some gravel, some clay Very Dense Brown Wet (TILL) | | 15 | SS | 100/ .150 | | 312 | | | | | | |
| | | | | | | | 311 | | | | | | |
| | | | 16 | SS | 100/ | | | | | | | | |

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ONTMT4S2 MTO-11375(GINTDATA)\GPJ 2017TEMPLATE(MTO).GDT 6/1/20

RECORD OF BOREHOLE No SH16-03

3 OF 3

METRIC

GWP# 408-88-00 LOCATION Shantz Station Road, MTM NAD 83 Zone 10: N 4 818 710.2 E 233 448.4 ORIGINATED BY GA
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 2017.07.27 - 2017.07.27 LATITUDE 43.504907 LONGITUDE -80.382385 CHECKED BY JPL

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | | | 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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE | | | | | | | | | | | | WATER CONTENT (%) W _P W W _L |
| | Continued From Previous Page | | | | .175 | | | 20 | 40 | 60 | 80 | 100 | | | | | | | | |
| | Silty SAND, some gravel, some clay Very Dense Brown Wet (TILL) | | | | | | 310 | | | | | | | | | | | | | |
| 309.0 | Boulders | | 17 | SS | 100 | | 309 | | | | | | | | | | | | | |
| 21.4 | END OF BOREHOLE AT 21.4m UPON REFUSAL ON BOULDERS OR PROBABLE BEDROCK. WATER LEVEL AT 12.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND AUGER CUTTINGS TO SURFACE. | | | | .050 | | | | | | | | | | | | | | | |

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Sensitivity

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(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No SH16-04

1 OF 3

METRIC

GWP# 408-88-00 LOCATION Shantz Station Road, MTM NAD 83 Zone 10: N 4 818 684.8 E 233 480.5 ORIGINATED BY GA
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 2017.07.24 - 2017.07.24 LATITUDE 43.504681 LONGITUDE -80.381984 CHECKED BY JPL

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | 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 | | | | | | |
| 330.0 | GROUND SURFACE | | | | | | | 20 40 60 80 100 | | | | | | |
| 0.0 | Gravelly SAND, some silt Compact Brown Moist (FILL) | | 1 | SS | 23 | | | | | | | | | |
| 329.3 | | | | | | | | | | | | | | |
| 0.7 | Sandy SILT, some gravel Compact Brown Moist | | 2 | SS | 21 | | 329 | | | | | | | |
| 328.6 | | | | | | | | | | | | | | |
| 1.4 | Silty CLAY, trace sand, trace to some gravel Stiff to Very Stiff Brown Moist (TILL) | | 3 | SS | 10 | | 328 | | | | | | | |
| | | | 4 | SS | 27 | | | | | | | | | |
| | sandy Hard to Very Stiff | | 5 | SS | 37 | | 327 | | | | | | | |
| | | | | | | | 326 | | | | | | | |
| | Grey | | 6 | SS | 26 | | 325 | | | | | | | |
| | | | | | | | | | | | | | | |
| 324.1 | | | | | | | | | | | | | | |
| 5.9 | Silty SAND, some gravel Very Dense Grey Moist | | 7 | SS | 100/.075 | | 324 | | | | | | | |
| 323.2 | | | | | | | | | | | | | | |
| 6.9 | Hard | | | | | | 323 | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | 8 | SS | 80 | | 322 | | | | | | | |
| | | | | | | | | | | | | | | |
| | Wet | | 9 | SS | 66 | | 321 | | | | | | | |
| | | | | | | | | | | | | | | |

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ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 6/1/20

RECORD OF BOREHOLE No SH16-04

2 OF 3

METRIC

GWP# 408-88-00 LOCATION Shantz Station Road, MTM NAD 83 Zone 10: N 4 818 684.8 E 233 480.5 ORIGINATED BY GA
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
DATUM Geodetic DATE 2017.07.24 - 2017.07.24 LATITUDE 43.504681 LONGITUDE -80.381984 CHECKED BY JPL

| 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 | "N" VALUES | | | SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE | | | | | | | | |
| | | | | | | | 20 | 40 | 60 | 80 | 100 | 20 | 40 | 60 | | |
| | Continued From Previous Page | | | | | | | | | | | | | | | |
| | Silty CLAY, some sand, trace to some gravel Hard to Very Stiff Brown to Grey Wet (TILL) | | 10 | SS | 38 | | | | | | | | | | | 7 17 46 30 |
| | | | | | | | | | | | | | | | | |
| | | | 11 | SS | 17 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | 12 | SS | 21 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | Moist | | 13 | SS | 18 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| 313.7 | | | | | | | | | | | | | | | | |
| 16.3 | Silty SAND, some gravel to gravelly, trace to some clay Very Dense Grey Wet (TILL) | | 14 | SS | 83 | | | | | | | | | | | 15 46 26 13 |
| | | | | | | | | | | | | | | | | |
| | | | 15 | SS | 100/ 225 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | 16 | SS | 100/ | | | | | | | | | | | |

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ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 6/1/20

RECORD OF BOREHOLE No SH16-04

3 OF 3

METRIC

GWP# 408-88-00 LOCATION Shantz Station Road, MTM NAD 83 Zone 10: N 4 818 684.8 E 233 480.5 ORIGINATED BY GA
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
DATUM Geodetic DATE 2017.07.24 - 2017.07.24 LATITUDE 43.504681 LONGITUDE -80.381984 CHECKED BY JPL







| 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 | "N" VALUES | | | SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE | | | | | | | | | |
| | | | | | | | 20 | 40 | 60 | 80 | 100 | 20 | 40 | 60 | | | |
| | Continued From Previous Page | | | | | | | | | | | | | | | | |
| 308.5 | Silty SAND, some gravel to gravelly, trace to some clay Very Dense Grey Wet (TILL) | | 17 | SS | 100/ | | | | | | | | | | | 23 47 23 7 | |
| 21.5 | END OF BOREHOLE AT 21.5m. WATER LEVEL AT 12.2m UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.12.18 - - Piezometer was damaged | | | | .175 | | | | | | | | | | | | |

RECORD OF BOREHOLE No SH16-05

1 OF 1

METRIC

GWP# 408-88-00 LOCATION Shantz Station Road, MTM NAD 83 Zone 10: N 4 818 663.2 E 233 472.9 ORIGINATED BY GA
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
DATUM Geodetic DATE 2017.06.30 - 2017.06.30 LATITUDE 43.504486 LONGITUDE -80.382076 CHECKED BY JPL

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | 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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE | | | | | | | WATER CONTENT (%) w _p w w _L | | | |
| 329.5 | GROUND SURFACE | | | | | | | 20 | 40 | 60 | 80 | 100 | | 20 | 40 | 60 | | |
| 0.0 | Gravelly SAND Dense Brown Moist (FILL) |  | 1 | SS | 36 | | 329 | | | | | | | ○ | | | | |
| 328.9 | | | | | | | | | | | | | | | | | | |
| 0.7 | Silty CLAY, some sand, some gravel Stiff Brown Moist (TILL) |  | 2 | SS | 12 | | | | | | | | | ○ | | | | |
| 328.1 | | | | | | | 328 | | | | | | | | | | | |
| 1.4 | SAND and GRAVEL, some silt and clay Compact Brown Moist |  | 3 | SS | 14 | | | | | | | | | ○ | | | | |
| 327.3 | | | | | | | | | | | | | | | | | | |
| 2.2 | trace to some gravel, trace sand Very Stiff |  | 4 | SS | 22 | | 327 | | | | | | | ○ | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | 5 | SS | 29 | | 326 | | | | | | | ○ | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | 325 | | | | | | | ○ | | | | |
| | Hard |  | 6 | SS | 75 | | 324 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| 323.6 | | | | | | | | | | | | | | | | | | |
| 5.9 | Silty SAND, some gravel to gravelly, trace clay Very Dense Grey Wet (TILL) |  | 7 | SS | 50 | | | | | | | | | ○ | | | | |
| 323.4 | | | | | | | | | | | | | | | | | | |
| 6.1 | END OF BOREHOLE AT 6.1m UPON AUGER REFUSAL. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND AUGER CUTTINGS TO SURFACE. | | | | .050 | | | | | | | | | | | | | |

ONTMT4S2 MTO-11375(GINTDATA)GPJ 2017TEMPLATE(MTO).GDT 6/1/20

ONTARIO MOT GRAIN SIZE 2 MTO-11375(GINTDATA)\GPJ_ONTARIO MOT.GDT 6/1/20

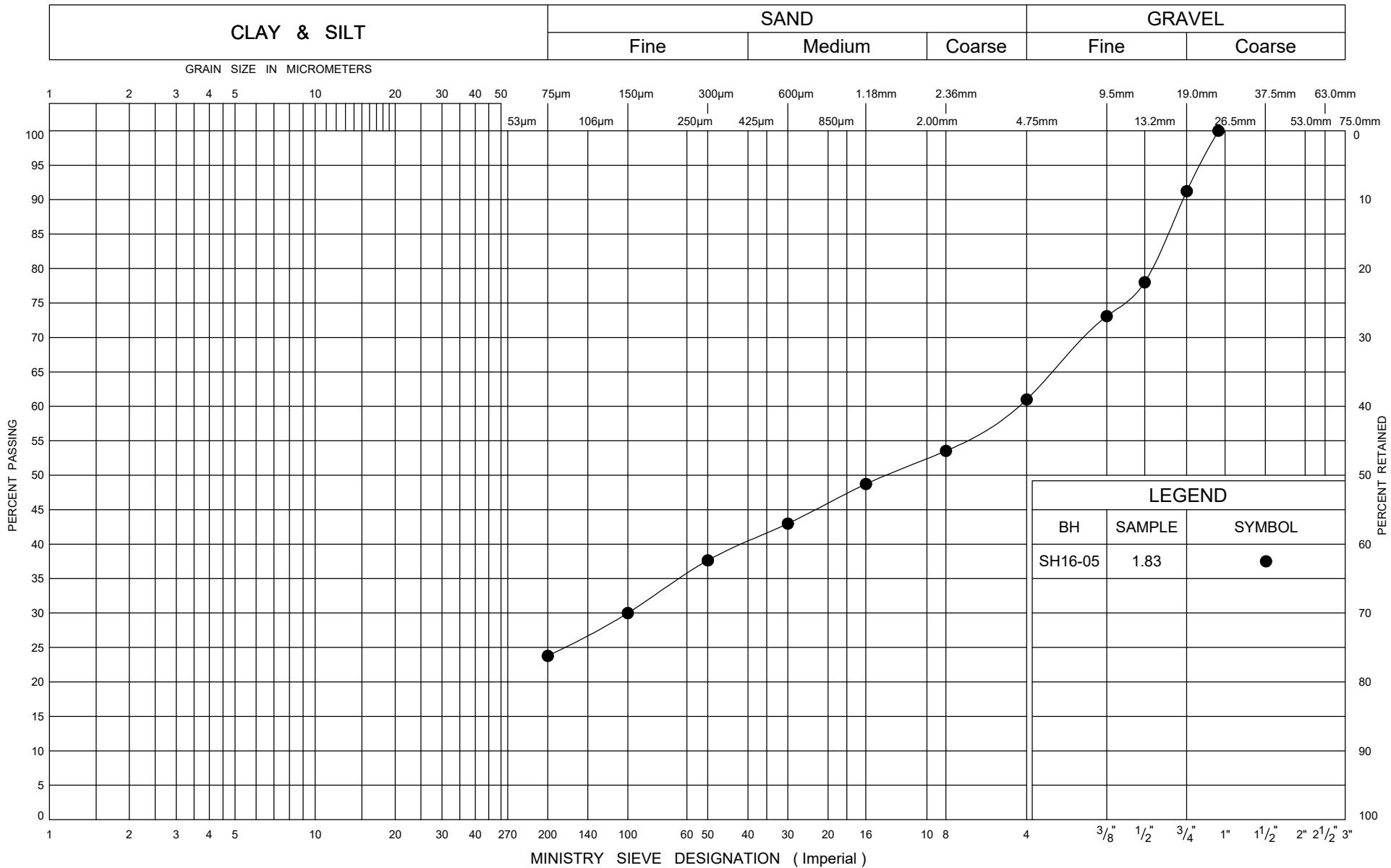
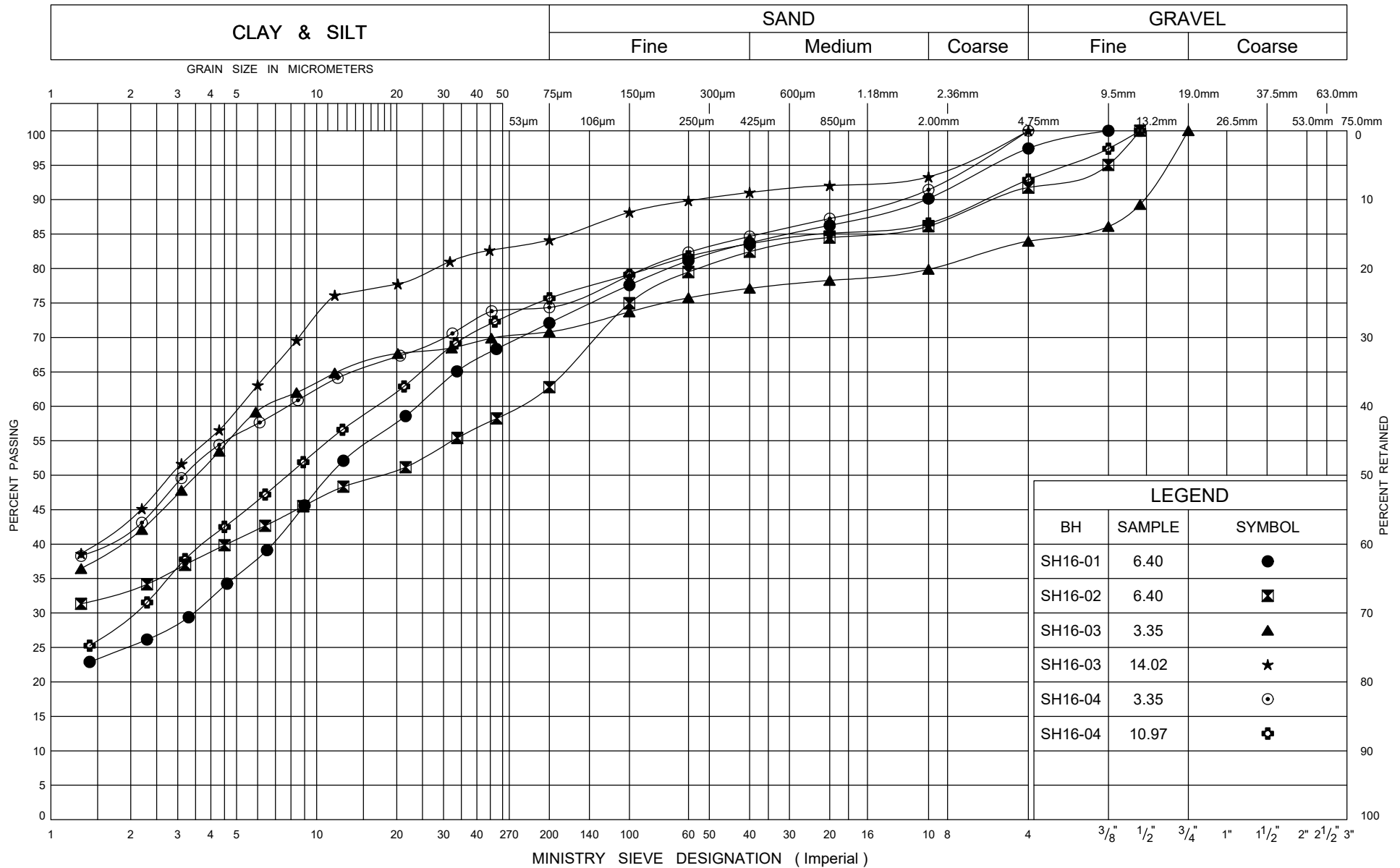




FIG No A2

W P 408-88-00

Shantz Station Road



Ministry of
Transportation

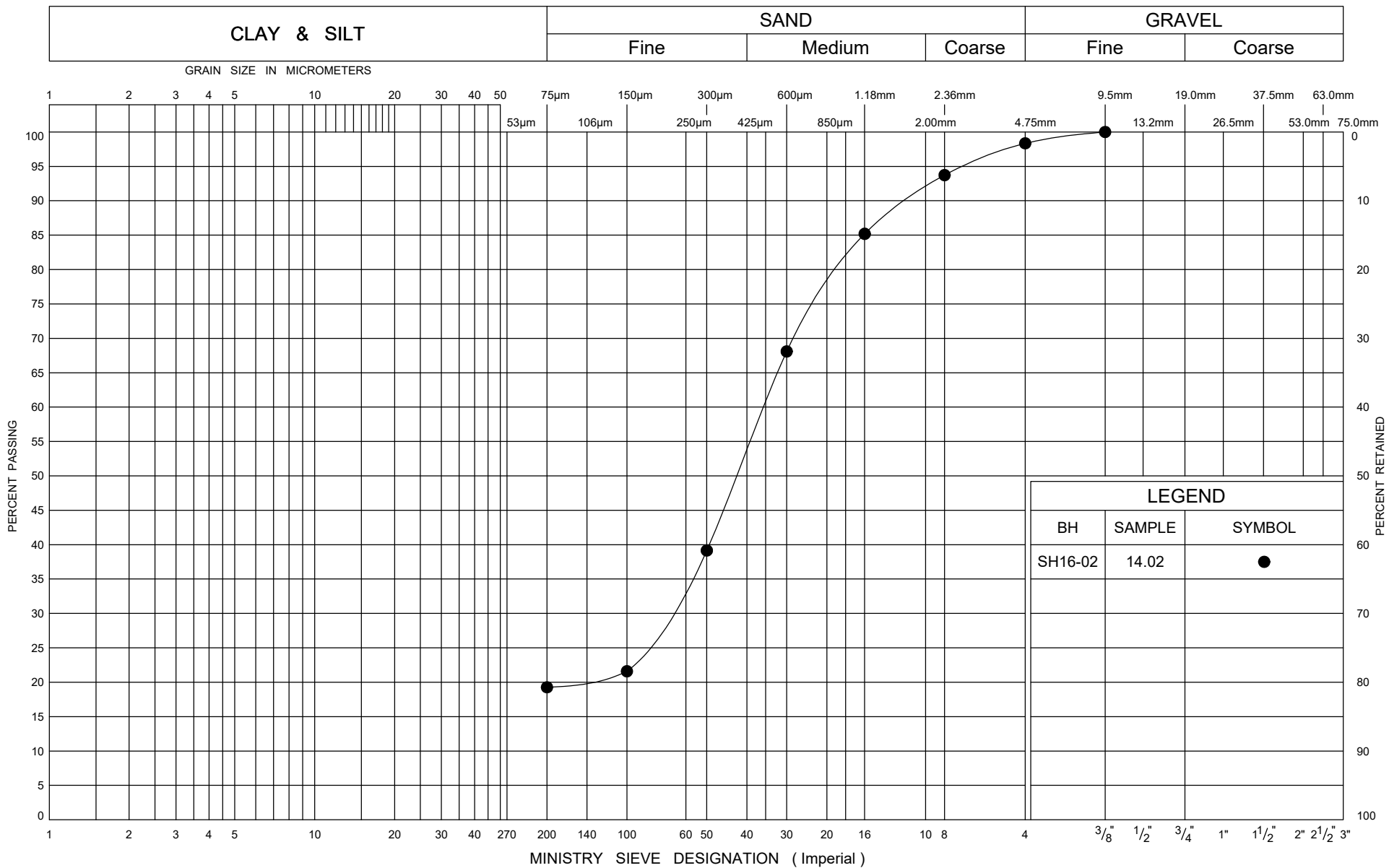
GRAIN SIZE DISTRIBUTION

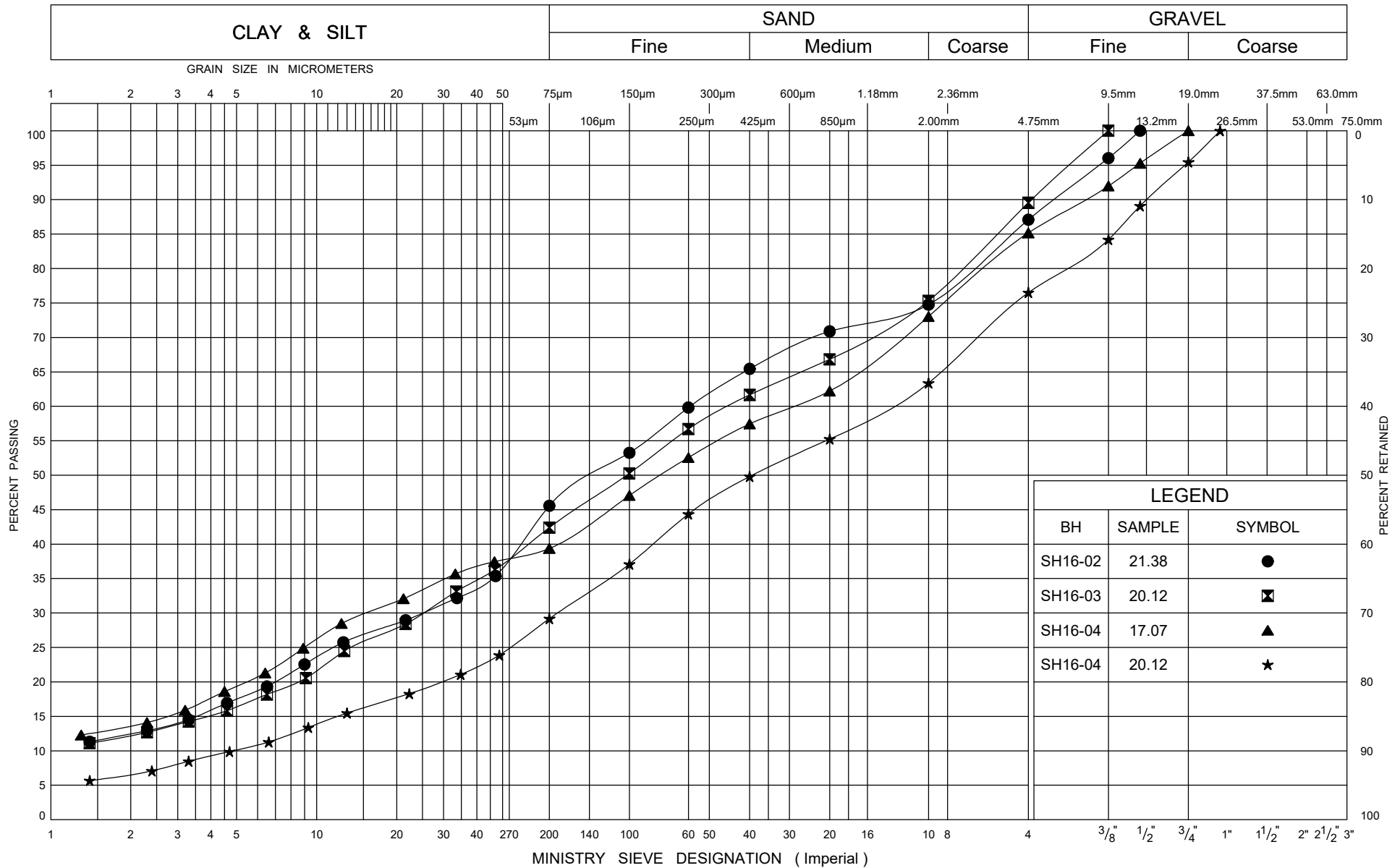
Silty CLAY TILL

FIG No C3

W P 408-88-00

Shantz Station Road





Ministry of
Transportation

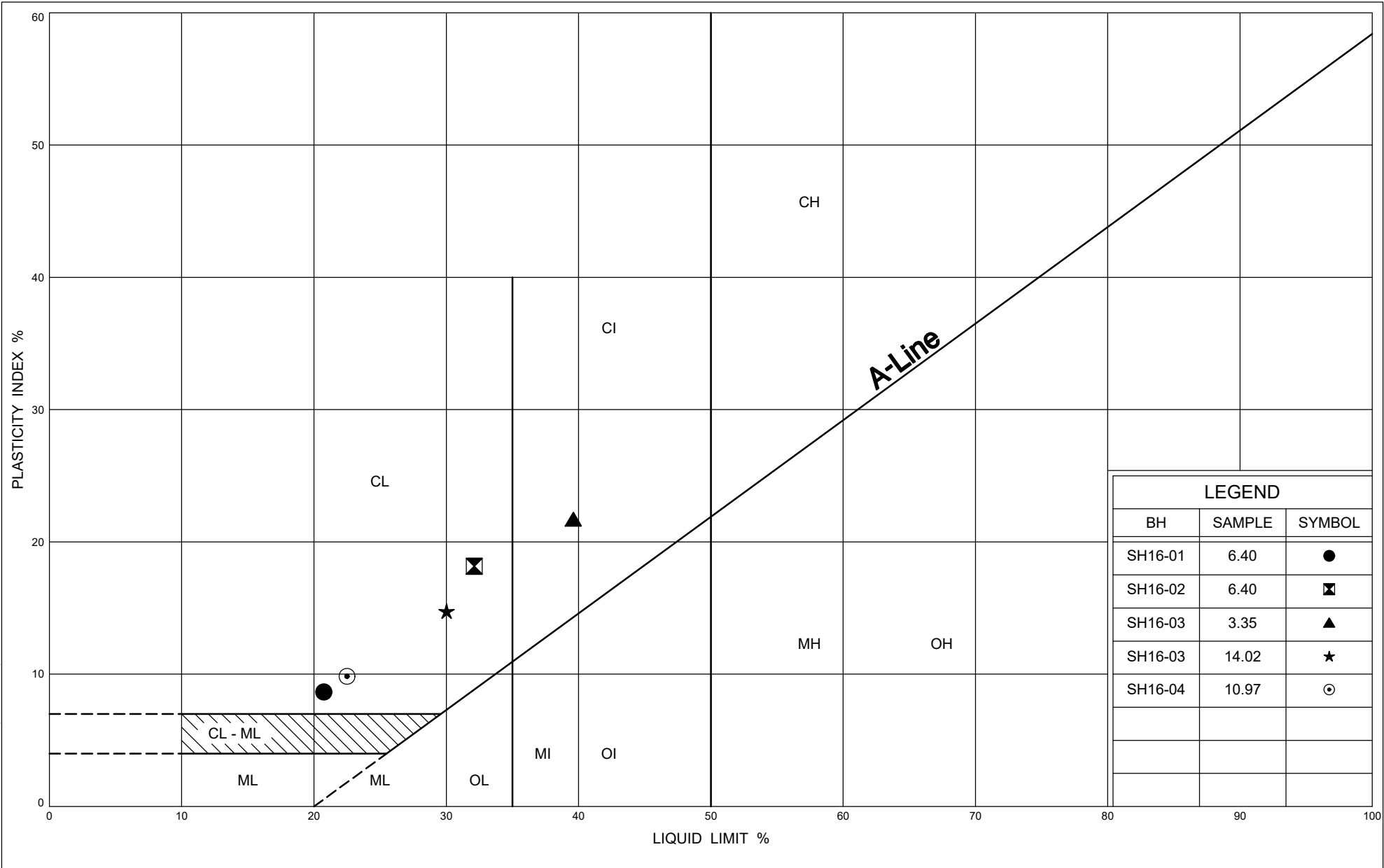
GRAIN SIZE DISTRIBUTION

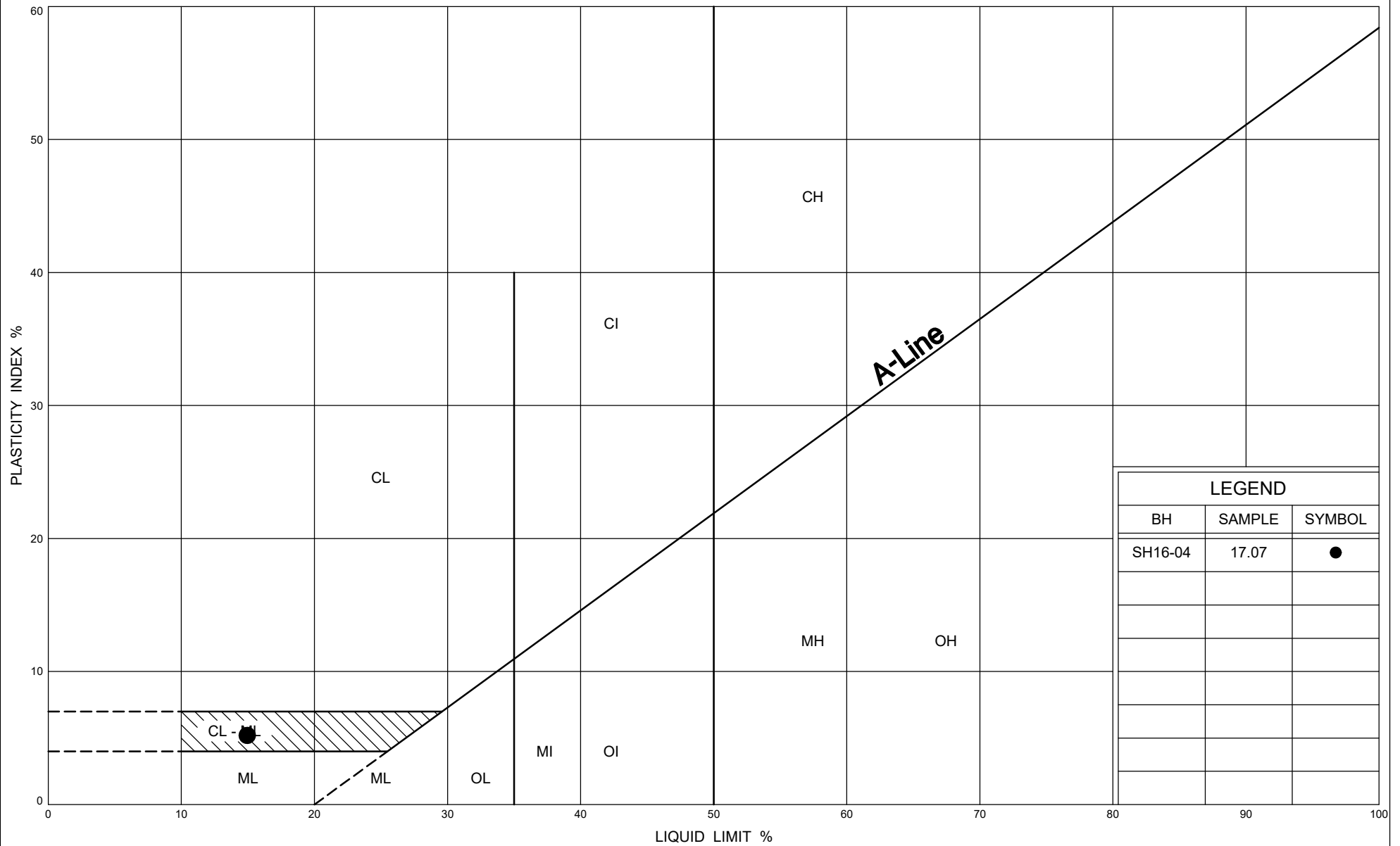
Silty SAND TILL

FIG No A5

W P 408-88-00

Shantz Station Road





Ministry of
Transportation

PLASTICITY CHART

Silty SAND TILL

FIG No G7

W P 408-88-00

Shantz Station Road



THURBER ENGINEERING LTD.

POINT LOAD TEST SHEET

ASTM D5731-08

Job No: 11375
Client: _____
Project Name: Hwy 7 Kitchener
Core Size: NQ BH No : SH-16-02

Date Drilled: July 26/17
Date Tested: Sep 5/17
Tester: JZ
Reviewed by: WM

| Test No. | Run No. | Depth (m) | Axial or Diametral | Gauge (MPa) | Diameter (mm) | Length (mm) | $I_{s(50)}$ (MPa) | UCS (MPa) | Rock Type | Rock Strength (after Hoek & Brown, 1997) |
|----------|---------|-----------|--------------------|-------------|---------------|-------------|-------------------|-----------|-----------|--|
| 1 | 1 | 21.9 | D | 13.4 | 47.0 | 220.4 | 5.6 | 134.0 | Limestone | Very Strong |
| 2 | 1 | 22.4 | A | 10.0 | 47.0 | 52.8 | 3.2 | 75.9 | Limestone | Strong |
| 3 | 1 | 22.9 | D | 7.1 | 47.0 | 147.6 | 2.9 | 70.7 | Limestone | Strong |
| 4 | 2 | 23.5 | D | 11.5 | 47.0 | 110.3 | 4.8 | 114.8 | Limestone | Very Strong |
| 5 | 2 | 24.2 | A | 19.4 | 47.0 | 60.6 | 5.5 | 132.5 | Limestone | Very Strong |
| 6 | 2 | 24.8 | D | 16.8 | 47.0 | 180.5 | 7.0 | 167.9 | Limestone | Very Strong |
| 7 | | | | | | | | | | |
| 8 | | | | | | | | | | |
| 9 | | | | | | | | | | |
| 10 | | | | | | | | | | |
| 11 | | | | | | | | | | |
| 12 | | | | | | | | | | |
| 13 | | | | | | | | | | |
| 14 | | | | | | | | | | |
| 15 | | | | | | | | | | |
| 16 | | | | | | | | | | |
| 17 | | | | | | | | | | |
| 18 | | | | | | | | | | |
| 19 | | | | | | | | | | |
| 20 | | | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | | | | | | | | | | |
| 24 | | | | | | | | | | |
| 25 | | | | | | | | | | |
| 26 | | | | | | | | | | |
| 27 | | | | | | | | | | |
| 28 | | | | | | | | | | |
| 29 | | | | | | | | | | |
| 30 | | | | | | | | | | |
| 31 | | | | | | | | | | |
| 32 | | | | | | | | | | |
| 33 | | | | | | | | | | |
| 34 | | | | | | | | | | |

* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1

Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

* Diametral Test should have $0.7 \times D$ on either side of test point.

* Correlation factor to obtain UCS values is 24.



FINAL REPORT

CA14400-MAR18 R

11375

Prepared for

Thurber Engineering Ltd.

First Page

CLIENT DETAILS

Client Thurber Engineering Ltd.

Address 103, 2010 Winston Park Drive
Oakville, ON
L6H 5R7.

Contact Rocio Reyna

Telephone 905-829-8666 x 263

Facsimile

Email rreyna@thurber.ca

Project 11375

Order Number

Samples Soil (12)

LABORATORY DETAILS

Project Specialist Deanna Edwards, B.Sc, C.Chem

Laboratory SGS Canada Inc.

Address 185 Concession St., Lakefield ON, K0L 2H0

Telephone 705-652-2000

Facsimile 705-652-6365

Email deanna.edwards@sgs.com

SGS Reference CA14400-MAR18

Received 03/19/2018

Approved 03/23/2018

Report Number CA14400-MAR18 R

Date Reported 03/23/2018

COMMENTS

Temperature of Sample upon Receipt: 2 degrees C

Cooling Agent Present: Yes

Custody Seal Present: No

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.

SIGNATORIES

Deanna Edwards, B.Sc, C.Chem





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FINAL REPORT

CA14400-MAR18 R

Client: Thurber Engineering Ltd.

Project: 11375

Project Manager: Rocío Reyna

Samplers: Kamil Feszak

PACKAGE: - Corrosivity Index (SOIL)

| Sample Number | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---------------|-------------|-------------|-------------|----------|--------------|-------------|-------------|--------------|
| Sample Name | BS16-04 SS4 | GH16-04 SS8 | RC16-02 SS3 | CR04 SS3 | EB 16-03 SS5 | SP16-04 SS7 | CV16-01 SS3 | GRB16-10 SS4 |
| Sample Matrix | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil |
| Sample Date | 21/03/2018 | | | | | | | |

| Parameter | Units | RL | Result | Result | Result | Result | Result | Result | Result | Result |
|-----------|-------|----|--------|--------|--------|--------|--------|--------|--------|--------|
|-----------|-------|----|--------|--------|--------|--------|--------|--------|--------|--------|

Corrosivity Index

| | | | | | | | | | | | |
|--------------------------|---------|-------|--|--------|--------|--------|--------|--------|------|--------|--------|
| Corrosivity Index | none | 1 | | 4.0 | 3.0 | 4.0 | 4.0 | 3.0 | 5.5 | 4.0 | 4.0 |
| Soil Redox Potential | mV | - | | 343 | 324 | 305 | 294 | 332 | 271 | 228 | 230 |
| Sulphide | % | 0.02 | | < 0.02 | < 0.02 | < 0.02 | < 0.02 | < 0.02 | 0.06 | < 0.02 | < 0.02 |
| pH | no unit | 0.05 | | 9.08 | 8.73 | 8.47 | 8.63 | 8.60 | 8.49 | 8.78 | 9.14 |
| Resistivity (calculated) | ohms.cm | -9999 | | 3860 | 3390 | 4630 | 3950 | 6100 | 2800 | 7520 | 8470 |

PACKAGE: - Corrosivity Index (SOIL)

| Sample Number | 13 | 14 | 15 | 16 |
|---------------|-------------|----------|-------------|--------------|
| Sample Name | HC16-05 SS3 | TR04-SS5 | SH16-04 SS4 | GRB16-21 SS4 |
| Sample Matrix | Soil | Soil | Soil | Soil |

| Parameter | Units | RL | Result | Result | Result | Result |
|-----------|-------|----|--------|--------|--------|--------|
|-----------|-------|----|--------|--------|--------|--------|

Corrosivity Index

| | | | | | | | |
|--------------------------|---------|-------|--|--------|--------|--------|--------|
| Corrosivity Index | none | 1 | | 4.0 | 4.0 | 3.0 | 4.0 |
| Soil Redox Potential | mV | - | | 314 | 250 | 265 | 246 |
| Sulphide | % | 0.02 | | < 0.02 | < 0.02 | < 0.02 | < 0.02 |
| pH | no unit | 0.05 | | 9.06 | 8.98 | 9.11 | 8.91 |
| Resistivity (calculated) | ohms.cm | -9999 | | 7810 | 10100 | 6940 | 8200 |



FINAL REPORT

CA14400-MAR18 R

Client: Thurber Engineering Ltd.

Project: 11375

Project Manager: Rocío Reyna

Samplers: Kamil Feszak

PACKAGE: - General Chemistry (SOIL)

| Sample Number | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---------------|-------------|-------------|-------------|----------|--------------|-------------|-------------|--------------|
| Sample Name | BS16-04 SS4 | GH16-04 SS8 | RC16-02 SS3 | CR04 SS3 | EB 16-03 SS5 | SP16-04 SS7 | CV16-01 SS3 | GRB16-10 SS4 |
| Sample Matrix | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil |
| Sample Date | 21/03/2018 | | | | | | | |

| Parameter | Units | RL | | Result | Result | Result | Result | Result | Result | Result |
|-----------|-------|----|--|--------|--------|--------|--------|--------|--------|--------|
|-----------|-------|----|--|--------|--------|--------|--------|--------|--------|--------|

General Chemistry

| | | | | | | | | | | | |
|--------------|-------|---|--|-----|-----|-----|-----|-----|-----|-----|-----|
| Conductivity | uS/cm | 2 | | 259 | 295 | 216 | 253 | 164 | 357 | 133 | 118 |
|--------------|-------|---|--|-----|-----|-----|-----|-----|-----|-----|-----|

PACKAGE: - General Chemistry (SOIL)

| Sample Number | 13 | 14 | 15 | 16 |
|---------------|-------------|----------|-------------|--------------|
| Sample Name | HC16-05 SS3 | TR04-SS5 | SH16-04 SS4 | GRB16-21 SS4 |
| Sample Matrix | Soil | Soil | Soil | Soil |

| Parameter | Units | RL | | Result | Result | Result | Result |
|-----------|-------|----|--|--------|--------|--------|--------|
|-----------|-------|----|--|--------|--------|--------|--------|

General Chemistry

| | | | | | | | |
|--------------|-------|---|--|-----|----|-----|-----|
| Conductivity | uS/cm | 2 | | 128 | 99 | 144 | 122 |
|--------------|-------|---|--|-----|----|-----|-----|

PACKAGE: - Metals and Inorganics (SOIL)

| Sample Number | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---------------|-------------|-------------|-------------|----------|--------------|-------------|-------------|--------------|
| Sample Name | BS16-04 SS4 | GH16-04 SS8 | RC16-02 SS3 | CR04 SS3 | EB 16-03 SS5 | SP16-04 SS7 | CV16-01 SS3 | GRB16-10 SS4 |
| Sample Matrix | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil |
| Sample Date | 21/03/2018 | | | | | | | |

| Parameter | Units | RL | | Result | Result | Result | Result | Result | Result | Result |
|-----------|-------|----|--|--------|--------|--------|--------|--------|--------|--------|
|-----------|-------|----|--|--------|--------|--------|--------|--------|--------|--------|

Metals and Inorganics

| | | | | | | | | | | | |
|----------|------|-----|--|-----|----|----|----|-----|-----|----|----|
| Sulphate | µg/g | 0.4 | | 140 | 92 | 11 | 69 | 6.5 | 356 | 68 | 22 |
|----------|------|-----|--|-----|----|----|----|-----|-----|----|----|

PACKAGE: - Metals and Inorganics (SOIL)

| Sample Number | 13 | 14 | 15 | 16 |
|---------------|-------------|----------|-------------|--------------|
| Sample Name | HC16-05 SS3 | TR04-SS5 | SH16-04 SS4 | GRB16-21 SS4 |
| Sample Matrix | Soil | Soil | Soil | Soil |

| Parameter | Units | RL | | Result | Result | Result | Result |
|-----------|-------|----|--|--------|--------|--------|--------|
|-----------|-------|----|--|--------|--------|--------|--------|

Metals and Inorganics

| | | | | | | | |
|----------|------|-----|--|----|-----|----|----|
| Sulphate | µg/g | 0.4 | | 22 | 2.4 | 15 | 11 |
|----------|------|-----|--|----|-----|----|----|



FINAL REPORT

CA14400-MAR18 R

Client: Thurber Engineering Ltd.

Project: 11375

Project Manager: Rocío Reyna

Samplers: Kamil Feszak

PACKAGE: - Other (ORP) (SOIL)

| Sample Number | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---------------|-------------|-------------|-------------|----------|--------------|-------------|-------------|--------------|
| Sample Name | BS16-04 SS4 | GH16-04 SS8 | RC16-02 SS3 | CR04 SS3 | EB 16-03 SS5 | SP16-04 SS7 | CV16-01 SS3 | GRB16-10 SS4 |
| Sample Matrix | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil |
| Sample Date | 21/03/2018 | | | | | | | |

| Parameter | Units | RL | | Result | Result | Result | Result | Result | Result | Result | Result |
|-------------|-------|-----|--|--------|--------|--------|--------|--------|--------|--------|--------|
| Other (ORP) | | | | | | | | | | | |
| Chloride | µg/g | 0.4 | | 34 | 50 | 12 | 71 | 4.8 | 7.6 | 13 | 67 |

PACKAGE: - Other (ORP) (SOIL)

| Sample Number | 13 | 14 | 15 | 16 |
|---------------|-------------|----------|-------------|--------------|
| Sample Name | HC16-05 SS3 | TR04-SS5 | SH16-04 SS4 | GRB16-21 SS4 |
| Sample Matrix | Soil | Soil | Soil | Soil |

| Parameter | Units | RL | | Result | Result | Result | Result |
|-------------|-------|-----|--|--------|--------|--------|--------|
| Other (ORP) | | | | | | | |
| Chloride | µg/g | 0.4 | | 71 | 22 | 94 | 68 |

PACKAGE: - PHCs (SOIL)

| Sample Number | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---------------|-------------|-------------|-------------|----------|--------------|-------------|-------------|--------------|
| Sample Name | BS16-04 SS4 | GH16-04 SS8 | RC16-02 SS3 | CR04 SS3 | EB 16-03 SS5 | SP16-04 SS7 | CV16-01 SS3 | GRB16-10 SS4 |
| Sample Matrix | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil |
| Sample Date | 21/03/2018 | | | | | | | |

| Parameter | Units | RL | | Result | Result | Result | Result | Result | Result | Result | Result |
|------------------|-------|-----|--|--------|--------|--------|--------|--------|--------|--------|--------|
| PHCs | | | | | | | | | | | |
| Moisture Content | % | 0.1 | | 14.5 | 0.2 | 12.8 | 8.6 | 1.2 | 19.9 | 5.5 | 8.7 |

PACKAGE: - PHCs (SOIL)

| Sample Number | 13 | 14 | 15 | 16 |
|---------------|-------------|----------|-------------|--------------|
| Sample Name | HC16-05 SS3 | TR04-SS5 | SH16-04 SS4 | GRB16-21 SS4 |
| Sample Matrix | Soil | Soil | Soil | Soil |

| Parameter | Units | RL | | Result | Result | Result | Result |
|------------------|-------|-----|--|--------|--------|--------|--------|
| PHCs | | | | | | | |
| Moisture Content | % | 0.1 | | 12.4 | 7.1 | 2.7 | 10.8 |

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-IENVIIC-LAK-AN-001

| Parameter | QC batch Reference | Units | RL | Method Blank | Duplicate | | LCS/Spike Blank | | | Matrix Spike / Ref. | | |
|-----------|--------------------|-------|-----|--------------|-----------|--------|--------------------|---------------------|------|---------------------|---------------------|------|
| | | | | | RPD | AC (%) | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | | Low | High | | Low | High |
| Chloride | DIO0288-MAR18 | µg/g | 0.4 | <0.4 | 2 | 20 | 100 | 80 | 120 | 101 | 75 | 125 |
| Sulphate | DIO0288-MAR18 | µg/g | 0.4 | <0.4 | 15 | 20 | 98 | 80 | 120 | 96 | 75 | 125 |

Carbon/Sulphur

Method: ASTM E1915-07A | Internal ref.: ME-CA-IENVIARD-LAK-AN-020

| Parameter | QC batch Reference | Units | RL | Method Blank | Duplicate | | LCS/Spike Blank | | | Matrix Spike / Ref. | | |
|-----------|--------------------|-------|------|--------------|-----------|--------|--------------------|---------------------|------|---------------------|---------------------|------|
| | | | | | RPD | AC (%) | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | | Low | High | | Low | High |
| Sulphide | ECS0025-MAR18 | % | 0.02 | <0.02 | ND | 20 | 111 | 80 | 120 | | | |

Conductivity

Method: SM 2510 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

| Parameter | QC batch Reference | Units | RL | Method Blank | Duplicate | | LCS/Spike Blank | | | Matrix Spike / Ref. | | |
|--------------|--------------------|-------|----|--------------|-----------|--------|--------------------|---------------------|------|---------------------|---------------------|------|
| | | | | | RPD | AC (%) | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | | Low | High | | Low | High |
| Conductivity | EWL0284-MAR18 | uS/cm | 2 | < 2 | 1 | 10 | 99 | 90 | 110 | NA | | |



FINAL REPORT

CA14400-MAR18 R

QC SUMMARY

pH
Method: SM 4500 | Internal ref.: ME-CA-|ENVIEWL-LAK-AN-001

| Parameter | QC batch Reference | Units | RL | Method Blank | Duplicate | | LCS/Spike Blank | | | Matrix Spike / Ref. | | |
|-----------|-----------------------|---------|------|-----------------|-----------|-----------|--------------------------|------------------------|------|--------------------------|------------------------|------|
| | | | | | RPD | AC (%) | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | | Low | High | | Low | High |
| pH | EWL0284-MAR18 | no unit | 0.05 | NA | 1 | | 101 | | | NA | | |

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate laboratory accuracy with sample matrix effects.

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.

RL Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

NA The sample was not analysed for this analyte

ND Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

This report must not be reproduced, except in full. This report supersedes all previous versions.

-- End of Analytical Report --



Request for Laboratory Services and CHAIN OF CUSTODY

No:

Page 1 of 2

SGS Environmental Services - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Toll Free: 877-747-7658 Fax: 705-652-6365
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361 Web: www.ca.sgs.com

Received By:

Enak Agsey

Received Date (mm/dd/yyyy): 03/15/2018 (mm/dd/yyyy)

Received Time: 11:00 AM

Laboratory Information Section - Lab use only

Received By (signature):

Custody Seal Present: ☒ NO

Custody Seal Intact: ☒ NO

Cooling Agent Present: ☒ ICE

Temperature Upon Receipt (°C): 7.0, 7.1, 7.2

LAB LIMS #:

707172

REPORT INFORMATION

Company: Thurber Eng.

Contact: Rogio Palomares Reyna

Address: 103-2010 Winstonpark Dr.

Oakville, ON

Phone: 905-829-8666 x260

Fax:

Email: rreynae@thurber.ca

INVOICE INFORMATION

☒ (same as Report Information)

Company:

Contact:

Address:

Phone:

Email:

PROJECT INFORMATION

Quotation #:

Project #:

P.O. #:

Site Location/ID:

TURNAROUND TIME (TAT) REQUIRED

☒ Regular TAT (5-7 days) TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 3pm or on weekends : TAT begins the next business day

☐ RUSH TAT (Additional Charges May Apply) ☐ 1 Day ☐ 2 Days ☐ 3-4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date: Rush Confirmation ID:

REGULATIONS

Regulation 153 (2011):

☐ Table 1 ☐ Res/Park ☐ Soil Texture:

☐ Table 2 ☐ Ind/Com ☐ Coarse

☐ Table 3 ☐ Agri/Other ☐ Medium

☐ Table ☐ Fine

Other Regulations:

☐ Reg 347/558 (3 Day min TAT)

☐ PWQO ☐ MMER

☐ CCME ☐ Other:

☐ MISA

Sewer By-Law:

☐ Sanitary

☐ Storm

Municipality:

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

SAMPLE IDENTIFICATION

DATE SAMPLED

TIME SAMPLED

OF BOTTLES

MATRIX

1 TR-04 -SSS

2 SH16-0A S54

3 GRB16-2 S54

4

5

6

7

8

9

10

June 2017

July 2017

Feb 2017

Soil

Soil

Soil

ANALYSIS REQUESTED

COMMENTS:

Field Filtered (F)

Preserved (P)

Observations/Comments/Special Instructions

Sampled By (NAME): KAMIL FESZAK

Relinquished by (NAME): Sarah Hashim

Signature: *[Signature]*

Signature: *[Signature]*

Date: 03/11/18

Date: 03/11/18

Pink Copy - Client

Yellow & White Copy - SGS

Revision #: 1.0

Date of Issue: 01 June, 2014



Request for Laboratory Services and CHAIN OF CUSTODY

SGS Environmental Services

- Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Toll Free: 877-747-7658 Fax: 705-652-6365

- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361 Web: www.ca.sgs.com

No:

Page 2 of 2

Received By: Enoch Forster

Received Date (mm/dd/yyyy): 03/17/2018 (mm/dd/yyyy)

Received Time: 11:00 AM

Laboratory Information Section - Lab use only

Received By (signature): [Signature]

Custody Seal Present: ☒

Custody Seal Intact: ☒

Cooling Agent Present: ☒

Temperature Upon Receipt (°C): 7.0, 7.1, 7.2

CA 14400-MAR-18

LAB LIMS #:

5x3

REPORT INFORMATION

Company: Thurber Eng.

Contact: Rocio Palomares Reyna

Address: 103-2010 Winston Dr. Oakville, ON

Phone: 905-824-8666

Fax: 905-824-8666

Email: preyna@thurber.ca

INVOICE INFORMATION

☒ (same as Report Information)

Company:

Contact:

Address:

Phone:

Fax:

Email:

PROJECT INFORMATION

Quotation #: 11375

Project #: 11375

P.O. #: 11375

Site Location/ID: 11375

TURNAROUND TIME (TAT) REQUIRED

TAT's are quoted in business days (exclude statutory holidays & weekends).

Samples received after 3pm or on weekends : TAT begins the next business day

☐ Regular TAT (5-7days) ☐ 1 Day ☐ 2 Days ☐ 3-4 Days

RUSH TAT (Additional Charges May Apply) ☐ 1 Day ☐ 2 Days ☐ 3-4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date: Rush Confirmation ID:

REGULATIONS

Regulation 153 (2011):

☐ Table 1 ☐ Res/Park ☐ Soil Texture:

☐ Table 2 ☐ Ind/Com ☐ Coarse

☐ Table 3 ☐ Agri/Other ☐ Medium

☐ Table ☐ Fine

Other Regulations:

☐ Reg 347/558 (3 Day min TAT)

☐ PWQO ☐ MMER

☐ CCME ☐ Other:

☐ MISA

Sewer By-Law:

☐ Sanitary

☐ Storm

Municipality:

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

SAMPLE IDENTIFICATION

| | DATE SAMPLED | TIME SAMPLED | # OF BOTTLES | MATRIX |
|----|--------------------|----------------|--------------|--------|
| 1 | BS16-04 | SS4 | 1 | Soil |
| 2 | GH16-04 | SS8 | 1 | |
| 3 | RC16-02 | SS3 | 1 | |
| 4 | LR04 | SS3 | 1 | |
| 5 | EB16-03 | SS5 | 1 | |
| 6 | EB16-03 | SS5 | 1 | |
| 7 | SP16-04 | SS4 | 1 | |
| 8 | CV16-01 | SS3 | 1 | |
| 9 | GRB16-10 | SS4 | 1 | |
| 10 | HC16-05 | SS3 | 1 | |

Observations/Comments/Special Instructions

ANALYSIS REQUESTED

Consent

COMMENTS:
Field Filtered (F)
Preserved (P)

DRINKING WATER SAMPLES (POTABLE WATER FOR HUMAN CONSUMPTION) MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

Sampled By (NAME): KAMIL FESZAK

Relinquished by (NAME): Sarah Hashemi

Signature: [Signature]

Signature: [Signature]

Date: 03/19/18

Date: 03/19/18

Pink Copy - Client

Yellow & White Copy - SGS

Revision #: 1.0

Date of Issue: 01 June, 2014



SAMPLE INTEGRITY REPORT

Project Number: 11375

ONTARIO REGULATION 153/04

SGS Sample ID CA 14400 - MAR 18

Date / Time Sampled See CoFC

Client Sample ID See CoFC

ALL

Sample Submission General Sample Integrity Violations

- | | |
|--|--------------------------|
| Temperature >10 C upon receipt if not sampled same day | <input type="checkbox"/> |
| No evidence of cooling trend initiated if sampled same day | <input type="checkbox"/> |
| Chain of Custody not submitted | <input type="checkbox"/> |
| Chain of Custody incomplete | <input type="checkbox"/> |
| Chain of Custody not signed / dated | <input type="checkbox"/> |
| Chain of Custody not a current version | <input type="checkbox"/> |
| Bottles / Samples listed on CoC but not received | <input type="checkbox"/> |
| Bottles / Samples received but not listed on the CoC | <input type="checkbox"/> |
| Sample container received empty | <input type="checkbox"/> |

Sample Specific Sample Integrity Violations

- | | | | | | | | |
|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Sample received past hold time | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Incorrect preservation (including no preservation where required) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Headspace present in VOC vial (aqueous) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Sample(s) received frozen | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Bottle(s) broken or damaged in transport | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Discrepancy between sample label and chain of custody | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Analysis requirements absent / unclear | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Missing or incorrect sample label(s) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Inappropriate sample container used | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Insufficient number of bottles received | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Limited sample volume | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Insufficient sample volume | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Sample contains multiple phases | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Sediment Log

- | | | | | | | | |
|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Groundwater samples contain visible sediment / particulate | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Groundwater contains greater than 1cm of sediment / particulate matter in bottle | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Additional Comments/Remarks:

No issues upon receipt



Initials:

KH



Appendix B

Record of Borehole Sheets and Laboratory Test Results (Previous Investigation)

RECORD OF BOREHOLE No 08-157

1 OF 3

METRIC

G.W.P. 408-88-00 LOCATION N 4 818 744.22 E 233 432.47 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008.05.30 - 2008.06.02 CHECKED BY RPR

| 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 | | |
| 329.6 | TOPSOIL: (75mm) | | | | | | | | | | | | |
| 0.0 0.1 | Silty SAND, trace rootlets Loose Dark Brown Moist (FILL) | | 1 | SS | 6 | | 329 | | | | | | |
| 328.2 | Silty, sandy CLAY, trace gravel Firm Brown (FILL) | | 2 | SS | 4 | | 328 | | | | | | |
| 327.4 | Silty CLAY, some sand, trace gravel Very Stiff to Hard Brown to Grey (TILL) | | 3 | SS | 20 | | 327 | | | | | | |
| | | | 4 | SS | 30 | | 326 | | | | | | |
| | | | 5 | SS | 28 | | 325 | | | | | | |
| | | | 6 | SS | 100 | | 324 | | | | | | |
| | occasional cobbles | | 7 | SS | 54 | | 323 | | | | | | |
| 321.1 | Silty CLAY Very Stiff Grey | | 8 | SS | 26 | | 322 | | | | | | |
| 8.5 | | | | | | | 321 | | | | | | |
| | | | | | | | 320 | | | | | | |

Continued Next Page

+ ³ X ³ Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-157

2 OF 3

METRIC

G.W.P. 408-88-00 LOCATION N 4 818 744 22 E 233 432 47 ORIGINATED BY SLL
HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
DATUM Geodetic DATE 2008.05.30 - 2008.06.02 CHECKED BY RPR

| 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 | LIQUID LIMIT w _L | |
| | Continued From Previous Page | | | | | | | | | | | | |
| 319.3 10.3 | Silty CLAY Very Stiff Grey | | | | | | | | | | | | |
| | SILT, some fine sand, trace clay Compact Grey Wet | | 9 | SS | 27 | | 319 | | | | | | 0 16 80 4 |
| 317.7 11.9 | Clayey SILT, trace to some sand Hard Grey (TILL) | | 10 | SS | 73 | | 318 | | | | | | |
| | | | | | | | 317 | | | | | | |
| | | | 11 | SS | 87 | | 316 | | | | | | 0 9 70 21 |
| 314.8 14.8 | Silty CLAY, trace sand, trace gravel, occasional cobbles Very Stiff Grey (TILL) | | 12 | SS | 22 | | 315 | | | | | | |
| | | | | | | | 314 | | | | | | 0 5 30 65 |
| | | | | | | | 313 | | | | | | |
| | | | 13 | SS | 22 | | 312 | | | | | | |
| | | | | | | | 311 | | | | | | |
| 310.4 19.2 | Sandy SILT, some clay, trace gravel Very Dense Grey (TILL) | | 14 | SS | 29 | | 310 | | | | | | |

Continued Next Page

+³ ×³

Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-157

3 OF 3

METRIC

G.W.P. 408-88-00 LOCATION N 4 818 744.22 E 233 432.47 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008.05.30 - 2008.06.02 CHECKED BY RPR

| 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 | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | |
| | Continued From Previous Page | | | | | | | | | | | | | |
| 308.8 | Sandy SILT, some clay, trace gravel Very Dense Grey (TILL) | | 15 | SS | 65 | | | | | | | | | GR SA SI CL 5 40 41 14 |
| 20.8 | END OF BOREHOLE AT 20.8m. AUGER REFUSAL AT 20.8m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE BENSEAL TO 1.5m, HOLEPLUG FROM 1.5m TO 0.6m, THEN CUTTINGS TO SURFACE. | | | | | | | | | | | | | |

RECORD OF BOREHOLE No 08-158

1 OF 3

METRIC

G.W.P. 408-88-00 LOCATION N 4 818 713.04 E 233 462.61 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008.05.22 - 2008.05.23 CHECKED BY RPR

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | UNIT WEIGHT Y 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 | | |
| 330.0 | | | | | | | | | | | | | |
| 0.0 | SAND, some gravel, mixed with clay, topsoil stained Dark Brown (FILL) | | | | | | 330 | | | | | | |
| 329.5 | | | | | | | | | | | | | |
| 0.5 | Silty CLAY, some sand to sandy, trace gravel, occasional cobbles Stiff to Hard Brown (TILL) | | 1 | SS | 14 | | 329 | | | | | | |
| | | | 2 | SS | 40 | | 328 | | | | | | |
| | | | 3 | SS | 67 | | 327 | | | | | | |
| | | | 4 | SS | 74 | | 326 | | | | | | |
| | becoming Grey | | 5 | SS | 46 | | 325 | | | | | | |
| | | | 6 | SS | 83 | | 324 | | | | | | |
| | | | 7 | SS | 61 | | 323 | | | | | | |
| | clay pockets | | 8 | SS | 20 | | 322 | | | | | | |
| 321.2 | | | | | | | 321 | | | | | | |
| 8.8 | SILT, some sand, trace gravel, trace clay Compact Grey Wet | | | | | | | | | | | | |
| 320.7 | | | | | | | | | | | | | |
| 9.3 | Clayey SILT, trace sand, trace gravel Very Stiff Grey: (TILL) | | | | | | | | | | | | |

Continued Next Page

+ 3, x 3: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-158

2 OF 3

METRIC

G.W.P. 408-86-00 LOCATION N 4 818 713.04 E 233 462.61 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008.05.22 - 2008.05.23 CHECKED BY RPR

| 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 | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | WATER CONTENT (%) | | | | | |
| | | | | | | | | 20 | 40 | 60 | | | | | | | 80 | 100 | 20 | 40 | 60 |
| | | | | | | | | ○ UNCONFINED | + FIELD VANE | ● QUICK TRIAXIAL | | | | | | | × LAB VANE | | | | |
| | Continued From Previous Page | | | | | | | | | | | | | | | | | | | | |
| | Clayey SILT, trace sand Hard Grey (TILL) | | 9 | SS | 51 | | 320 | | | | | | | | | | | | | | |
| | | | | | | | 319 | | | | | | | | 0 5 75 20 | | | | | | |
| | | | 10 | SS | 125 | | 318 | | | | | | | | | | | | | | |
| 316.7 | | | | | | | 317 | | | | | | | | | | | | | | |
| 13.3 | Silty CLAY, trace sand, trace gravel Hard to Very Stiff Grey (TILL) | | 11 | SS | 55 | | 316 | | | | | | | | | | | | | | |
| | | | 12 | SS | 31 | | 315 | | | | | | | | | | | | | | |
| | | | | | | | 314 | | | | | | | | | | | | | | |
| | Slow augering | | 13 | SS | 33 | | 313 | | | | | | | | 1 6 35 58 | | | | | | |
| 312.3 | | | | | | | 312 | | | | | | | | | | | | | | |
| 17.7 | Sandy SILT, some clay, trace gravel Very Dense Grey (TILL) | | 14 | SS | 100/ .175 | | 311 | | | | | | | | 4 42 39 15 | | | | | | |
| | | | 15 | SS | 100/ | | | | | | | | | | | | | | | | |

Continued Next Page

+ 3, x 3: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-158

3 OF 3

METRIC

G.W.P. 408-88-00 LOCATION N 4 818 713.04 E 233 462.61 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008.05.22 - 2008.05.23 CHECKED BY RPR

| 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 | 20 40 60 80 100 | | | | | |
| | Continued From Previous Page | | | | | | | | | | | | | |
| | Sandy SILT, some clay, trace gravel Very Dense Grey (TILL) | | | | | .125 | 310 | | | | | | | |
| 308.6 | | | 16 | SS | 100/ | | 309 | | | | | | | |
| 21.4 | END OF BOREHOLE AT 21.4m, AUGER REFUSAL ON PROBABLE BEDROCK OR BOULDER. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 2008.05.28 6.8 323.2 2008.06.02 8.8 321.2 2008.07.15 9.0 321.0 2008.08.14 8.4 321.6 | | | | | .100 | | | | | | | | |

RECORD OF BOREHOLE No 08-159

1 OF 3

METRIC

G.W.P. 408-88-00 LOCATION N 4 818 685.97 E 233 461.96 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008.06.03 - 2008.06.03 CHECKED BY RPR

| 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 | | |
| 329.2 | | | | | | | | | | | | |
| 0.0 | TOPSOIL: (200 mm) | | | | | | | | | | | |
| 0.2 | Silty CLAY, trace gravel, occasional topsoil staining Stiff Brown (FILL) | | 1 | SS | 11 | | 329 | | | | | |
| 327.8 | | | | | | | 328 | | | | | |
| 1.4 | Silty CLAY, some sand, trace gravel Hard Brown (TILL) | | 2 | SS | 63 | | | | | | | |
| | | | 3 | SS | 42 | | 327 | | | | | |
| | | | 4 | SS | 64 | | 326 | | | | | |
| 325.1 | | | | | | | | | | | | |
| 4.1 | Sandy SILT, some clay, trace to some gravel Very Dense Grey (TILL) | | 5 | SS | 100/ 150 | | 325 | | | | | |
| | | | | | | | 324 | | | | | |
| 323.6 | | | | | | | | | | | | |
| 5.6 | Silty CLAY, trace sand Very Stiff to Hard Grey (TILL) | | 6 | SS | 47 | | 323 | | | | | |
| | | | | | | | 322 | | | | | |
| | | | 7 | SS | 29 | | 321 | | | | | |
| | occasional sand seams | | | | | | 320 | | | | | |
| | | | 8 | SS | 46 | | | | | | | |

Continued Next Page

+³ ×³ Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-159

3 OF 3

METRIC

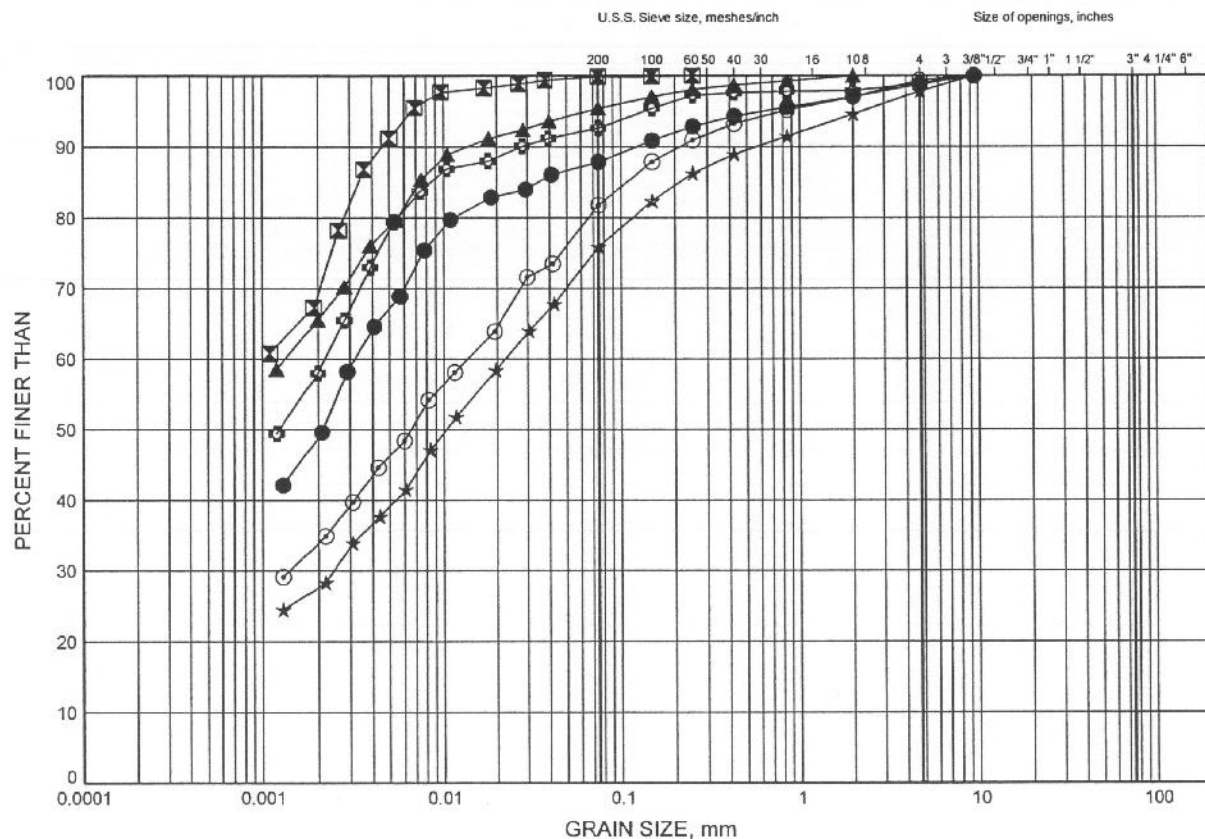
G.W.P. 408-88-00 LOCATION N 4 818 685.97 E 233 461.96 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008.06.03 - 2008.06.03 CHECKED BY RPR

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W _p W W _L | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|--|------------|---------|------|--------------|----------------------------|-----------------|--|---|--|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | | | |
| 20.0 | Continued From Previous Page END OF BOREHOLE AT 20.0m. AUGER REFUSAL ON PROBABLE BEDROCK OR BOULDER. BOREHOLE DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH GROUT TO 15.0m, HOLEPLUG TO 3.0m, THEN AUGER CUTTINGS TO SURFACE. | | 15 | SS | 100/ .025 | | | | | | |

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B1

Silty Clay Till



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

LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|--------|----------|-----------|-----------|
| ● | 08-157 | 3.35 | 326.25 |
| ⊠ | 08-157 | 9.45 | 320.15 |
| ▲ | 08-157 | 15.54 | 314.06 |
| ☆ | 08-158 | 3.35 | 326.65 |
| ⊙ | 08-158 | 7.92 | 322.08 |
| ⊕ | 08-158 | 15.54 | 314.46 |

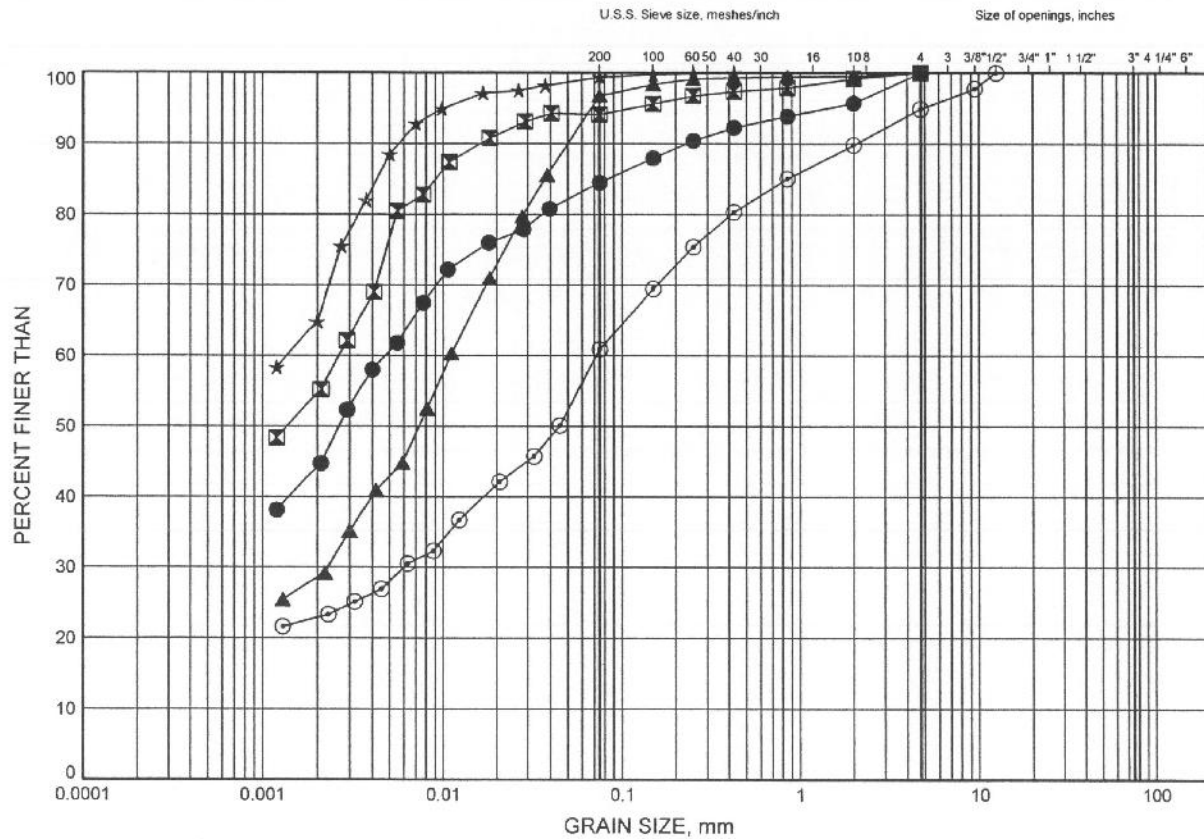


W.P.# 408-88-00
Prepared By MFA
Checked By RPR

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B2

Silty Clay Till



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

LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|--------|----------|-----------|-----------|
| ● | 08-159 | 2.59 | 326.61 |
| ⊠ | 08-159 | 6.40 | 322.80 |
| ▲ | 08-159 | 9.37 | 319.83 |
| ☆ | 08-159 | 14.02 | 315.18 |
| ⊙ | 08-159 | 15.49 | 313.71 |

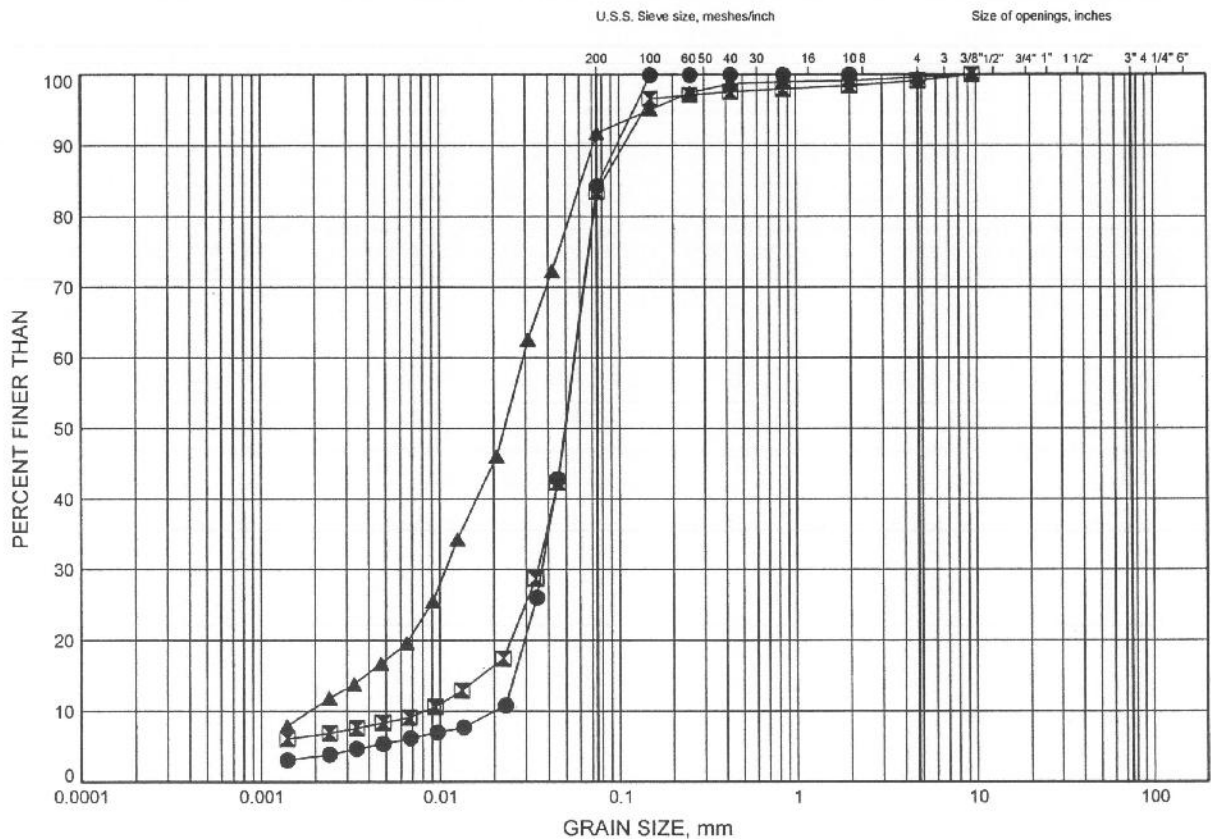


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Checked By RPR

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B3

Silt / Silt Till



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

LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|--------|----------|-----------|-----------|
| ● | 08-157 | 10.97 | 318.63 |
| ■ | 08-158 | 9.24 | 320.76 |
| ▲ | 08-159 | 10.79 | 318.41 |

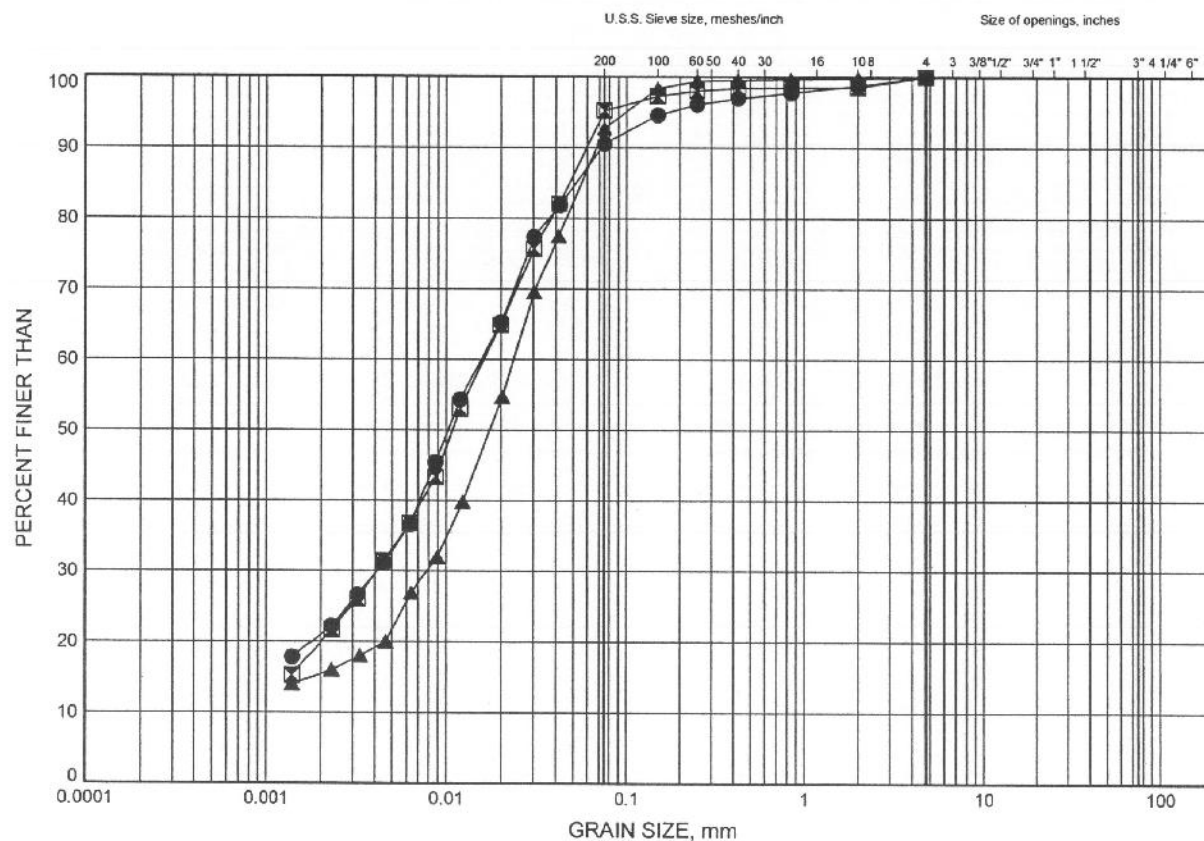


W.P.# 408-88-00
 Prepared By MFA
 Checked By RPR

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B4

Clayey Silt Till



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

LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|--------|----------|-----------|-----------|
| ● | 08-157 | 14.02 | 315.58 |
| ■ | 08-158 | 10.97 | 319.03 |
| ▲ | 08-158 | 12.50 | 317.50 |

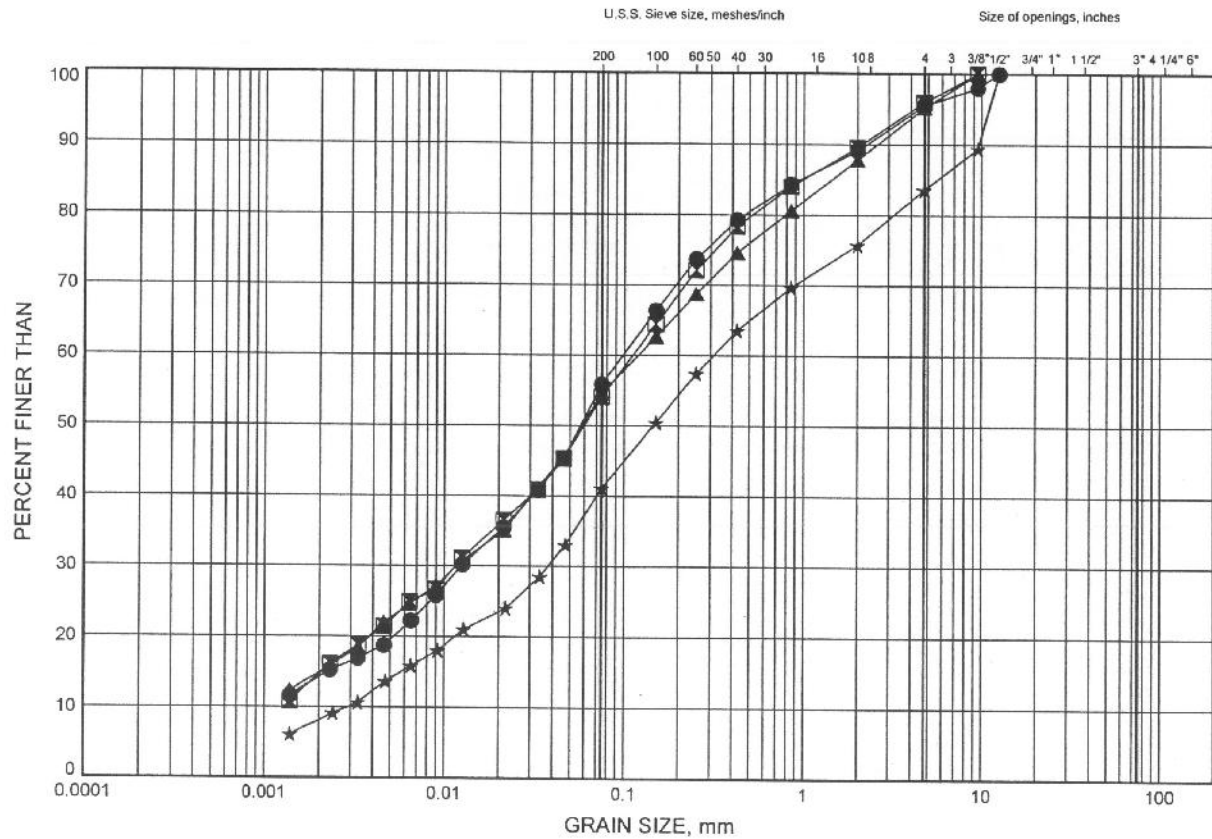


W.P.# 408-88-00
Prepared By MFA
Checked By RPR

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B5

Sandy Silt Till



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

LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|--------|----------|-----------|-----------|
| ● | 08-157 | 20.04 | 309.56 |
| ⊠ | 08-158 | 18.30 | 311.70 |
| ▲ | 08-159 | 4.72 | 324.48 |
| ★ | 08-159 | 16.89 | 312.31 |

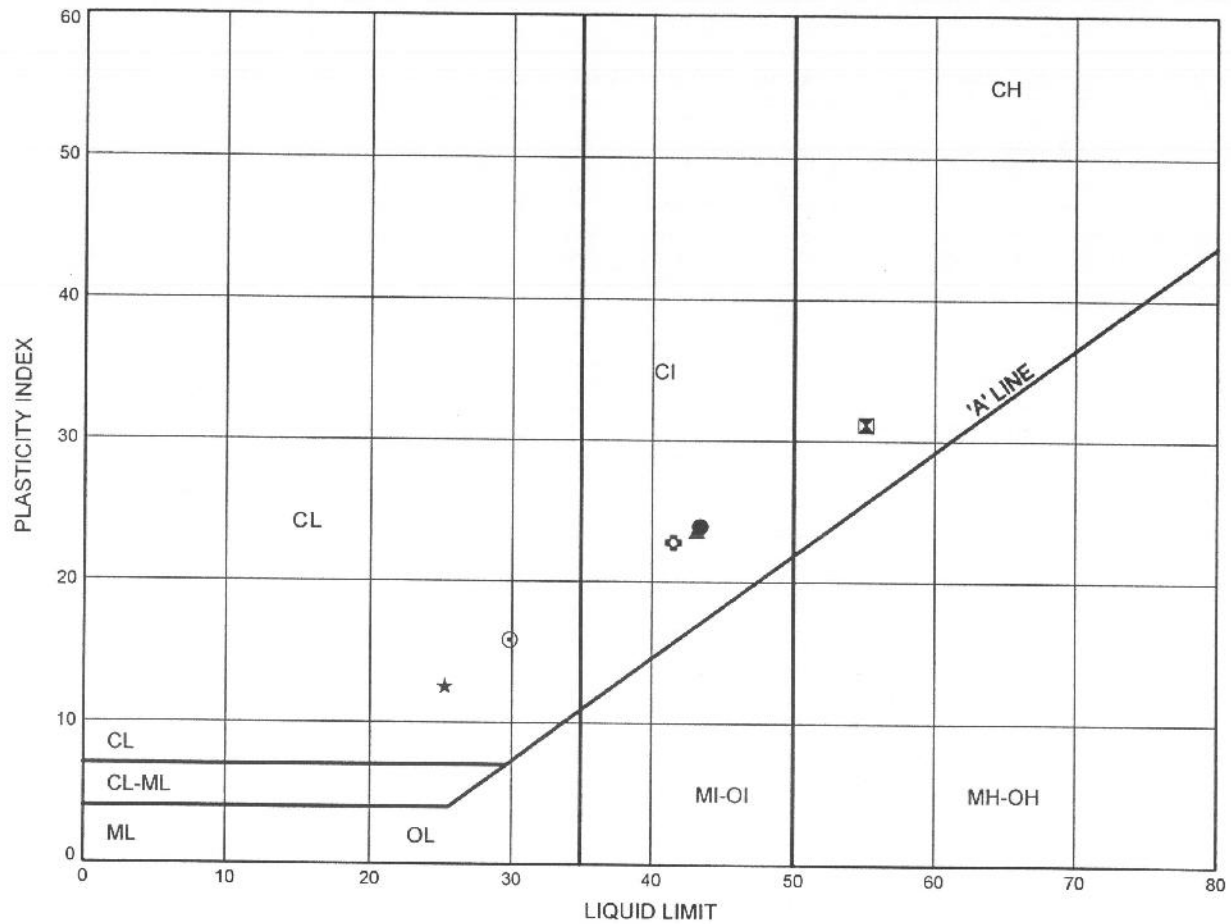


W.P.# 408-88-00
Prepared By MFA
Checked By RPR

Highway 7 - New ATTERBERG LIMITS TEST RESULTS

FIGURE B6

Silty Clay Till

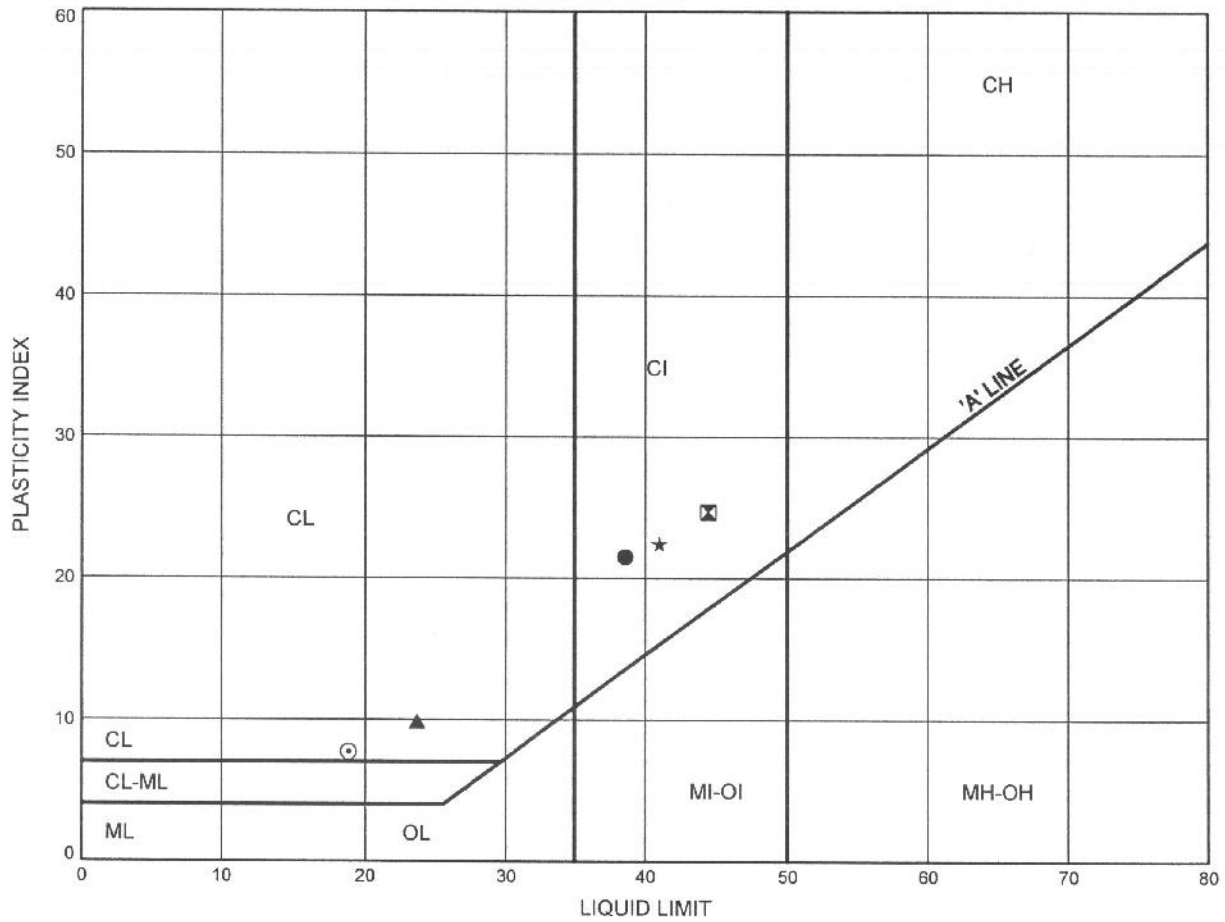


| SYMBOL | BH | DEPTH (m) | ELEV. (m) |
|--------|--------|-----------|-----------|
| ● | 08-157 | 3.35 | 326.25 |
| ⊠ | 08-157 | 9.45 | 320.15 |
| ▲ | 08-157 | 15.54 | 314.06 |
| ★ | 08-158 | 3.35 | 326.65 |
| ⊙ | 08-158 | 7.92 | 322.08 |
| ⊛ | 08-158 | 15.54 | 314.46 |

Highway 7 - New ATTERBERG LIMITS TEST RESULTS

FIGURE B7

Silty Clay Till



| SYMBOL | BH | DEPTH (m) | ELEV. (m) |
|--------|--------|-----------|-----------|
| ● | 08-159 | 2.59 | 326.61 |
| ⊠ | 08-159 | 6.40 | 322.80 |
| ▲ | 08-159 | 9.37 | 319.83 |
| ★ | 08-159 | 14.02 | 315.18 |
| ⊙ | 08-159 | 15.49 | 313.71 |



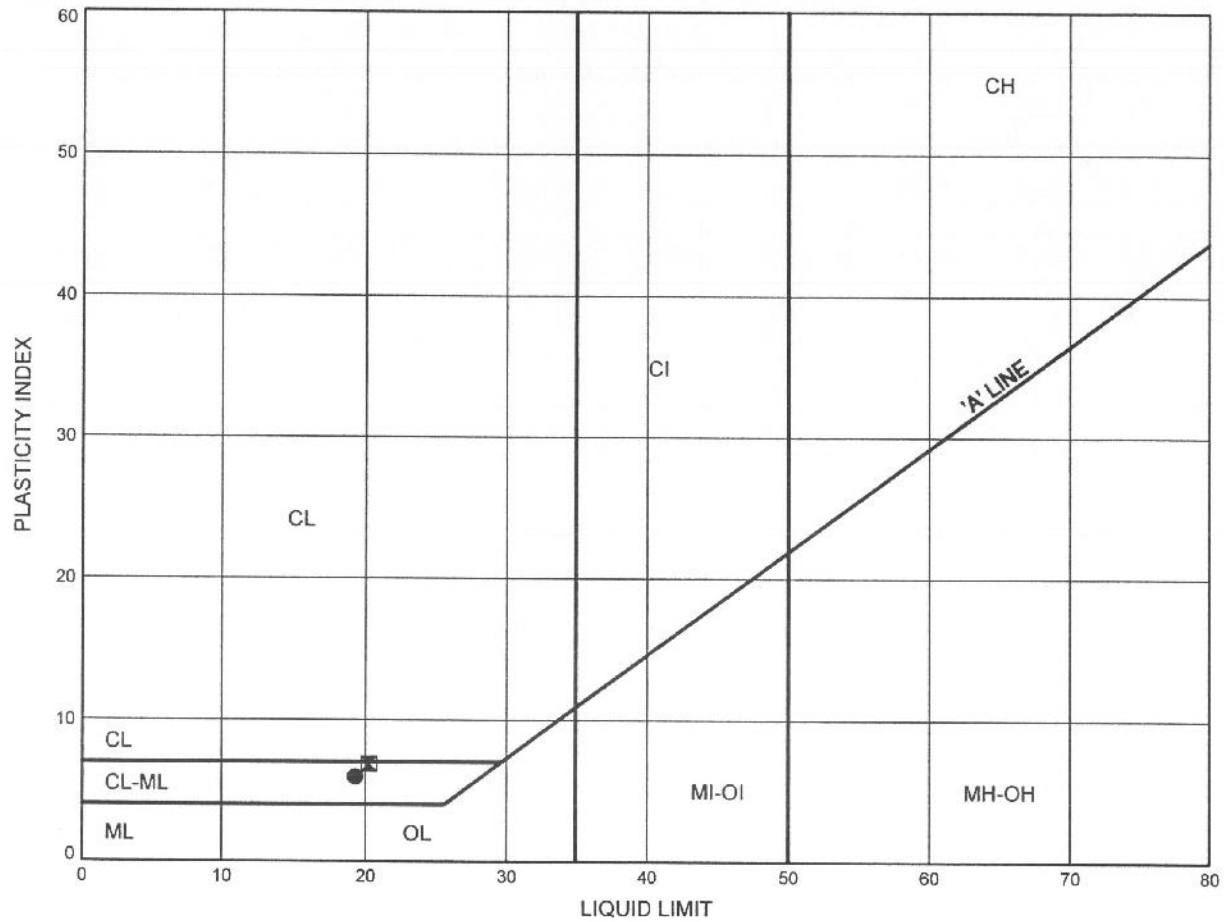
Date August 2008
 Project 408-88-00

Prep'd MFA
 Chkd. RPR

Highway 7 - New ATTERBERG LIMITS TEST RESULTS

FIGURE B8

Clayey Silt Till

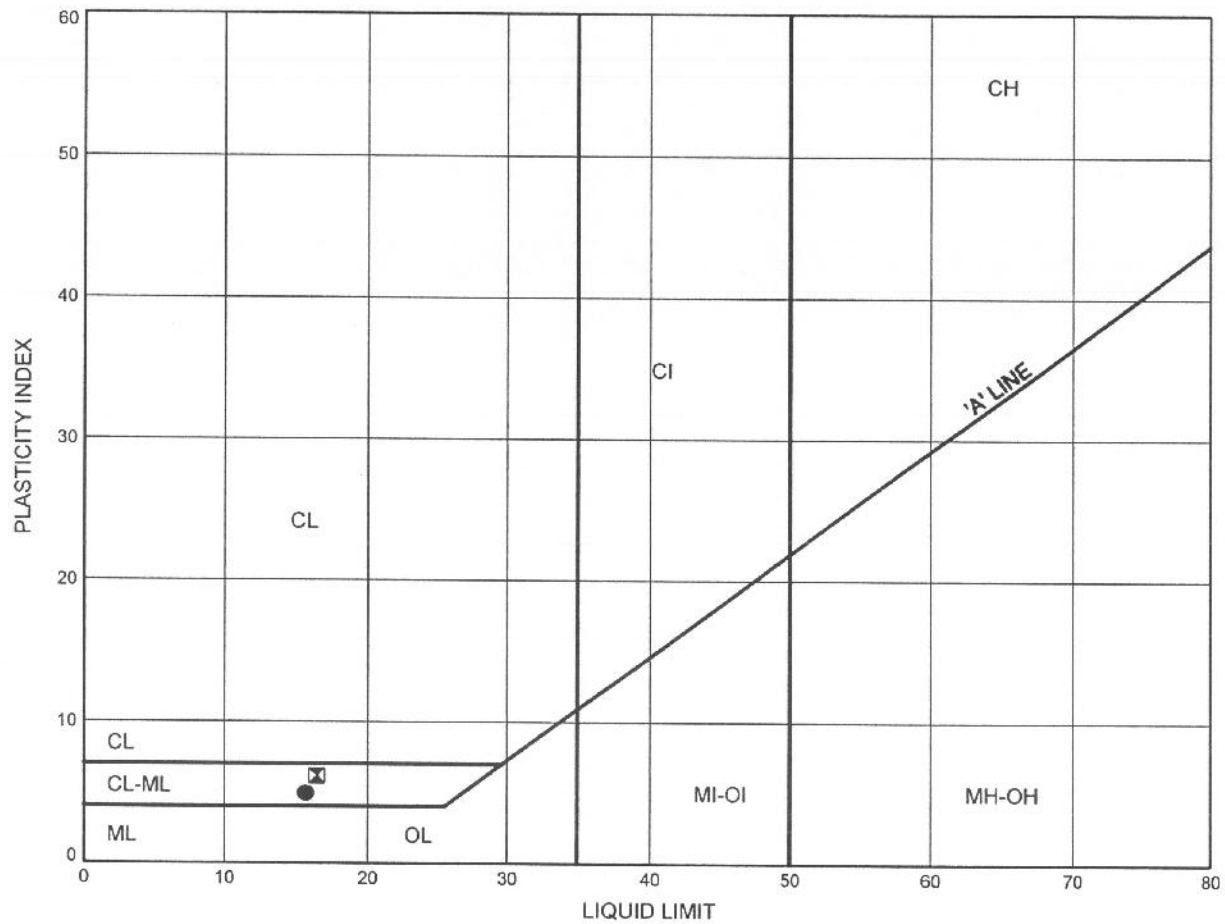


| SYMBOL | BH | DEPTH (m) | ELEV. (m) |
|--------|--------|-----------|-----------|
| ● | 08-157 | 14.02 | 315.58 |
| ⊠ | 08-158 | 10.97 | 319.03 |

Highway 7 - New ATTERBERG LIMITS TEST RESULTS

FIGURE B9

Sandy Silt Till

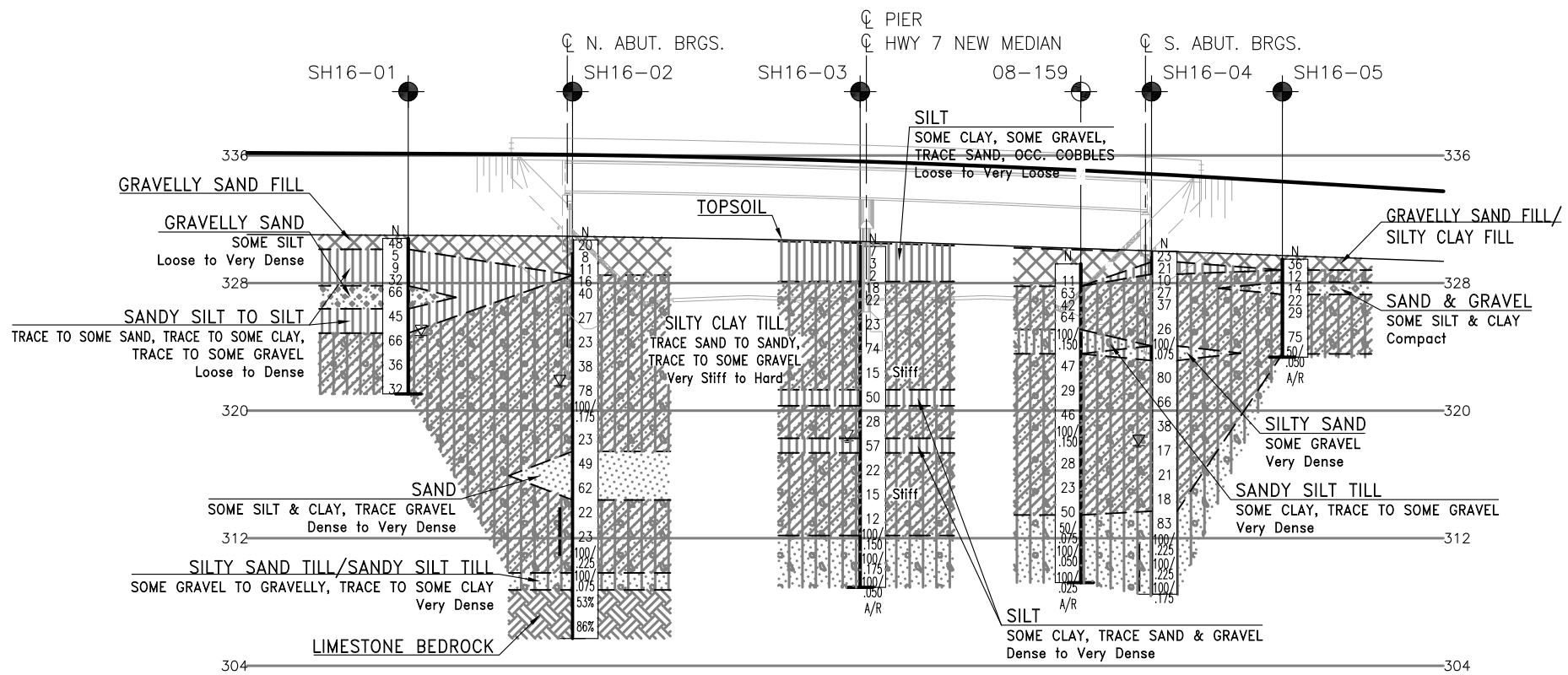
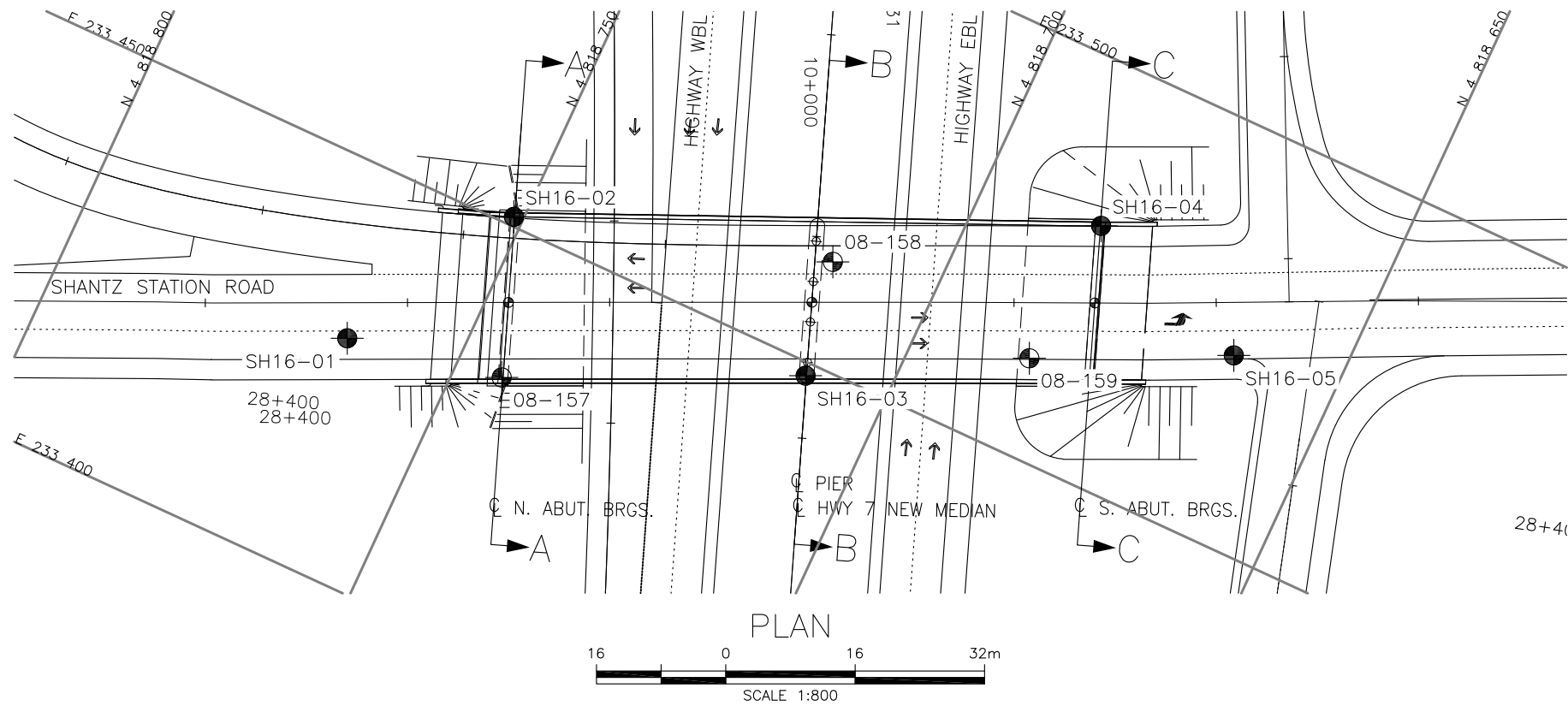


| SYMBOL | BH | DEPTH (m) | ELEV. (m) |
|--------|--------|-----------|-----------|
| ● | 08-157 | 20.04 | 309.56 |
| ⊠ | 08-158 | 18.44 | 311.56 |

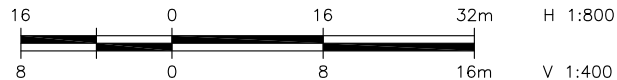


Appendix C

Borehole Locations and Soil Strata Drawing



PROFILE ALONG SHANTZ STATION ROAD



METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

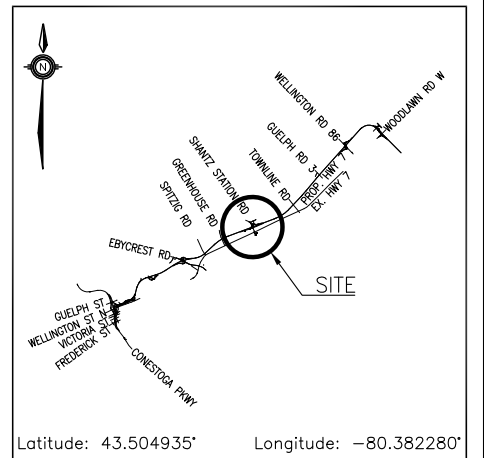


CONT No
GWP No 408-88-00

HIGHWAY 7
SHANTZ STATION ROAD
PROPOSED UNDERPASS
BOREHOLE LOCATIONS AND SOIL STRATA



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

| | |
|------|---------------------------------------|
| ● | Borehole (Current Investigation) |
| ⊙ | Borehole (2008 Investigation) |
| N | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE | Blows /0.3m (60° Cone, 475J/blow) |
| PH | Pressure, Hydraulic |
| ▽ | Water Level |
| ⌵ | Head Artesian Water |
| ⌵ | Piezometer |
| 90% | Rock Quality Designation (RQD) |
| A/R | Auger Refusal |

| NO | ELEVATION | NORTHING | EASTING |
|---------|-----------|-------------|-----------|
| SH16-01 | 330.8 | 4 818 763.6 | 233 428.9 |
| SH16-02 | 330.7 | 4 818 751.2 | 233 451.1 |
| SH16-03 | 330.3 | 4 818 710.2 | 233 448.4 |
| SH16-04 | 330.0 | 4 818 684.8 | 233 480.5 |
| SH16-05 | 329.5 | 4 818 663.2 | 233 472.9 |
| 08-157 | 329.6 | 4 818 744.2 | 233 432.5 |
| 08-158 | 330.0 | 4 818 713.0 | 233 462.6 |
| 08-159 | 329.2 | 4 818 686.0 | 233 462.0 |
| | | | |
| | | | |
| | | | |

NOTES

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- Coordinate system is MTM NAD 83 Zone 10.

GEOCRES No. 40P9-61

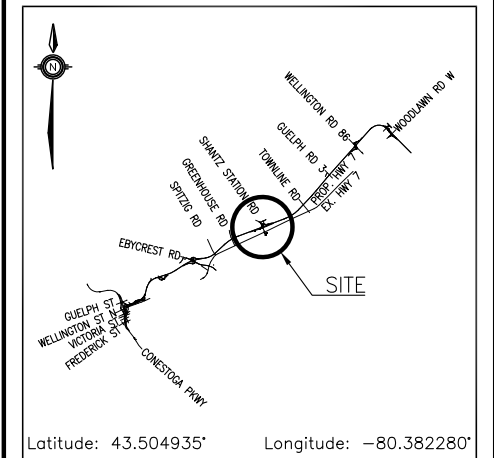
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METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
GWP No 408-88-00

HIGHWAY 7
SHANTZ STATION ROAD
PROPOSED UNDERPASS
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



KEYPLAN

LEGEND

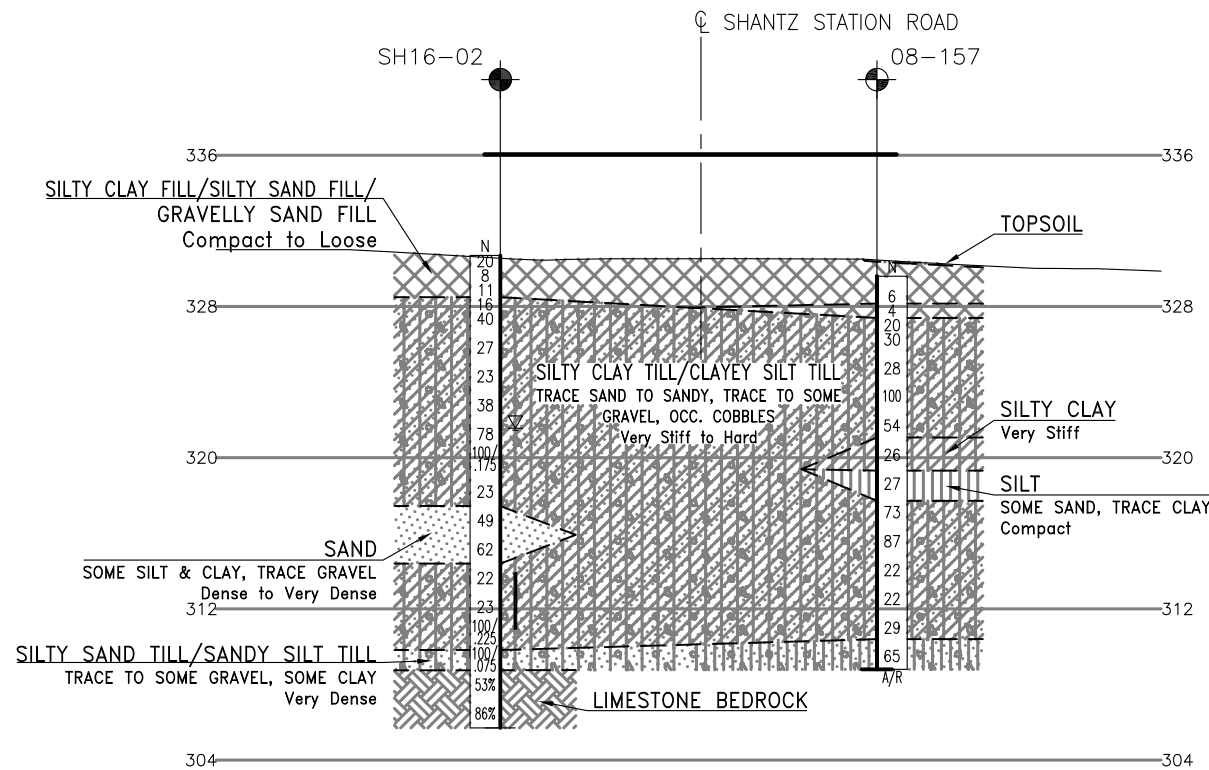
- Borehole (Current Investigation)
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- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- ☼ Water Level
- ☼ Head Artesian Water
- ☼ Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

| NO | ELEVATION | NORTHING | EASTING |
|---------|-----------|-------------|-----------|
| SH16-01 | 330.8 | 4 818 763.6 | 233 428.9 |
| SH16-02 | 330.7 | 4 818 751.2 | 233 451.1 |
| SH16-03 | 330.3 | 4 818 710.2 | 233 448.4 |
| SH16-04 | 330.0 | 4 818 684.8 | 233 480.5 |
| SH16-05 | 329.5 | 4 818 663.2 | 233 472.9 |
| 08-157 | 329.6 | 4 818 744.2 | 233 432.5 |
| 08-158 | 330.0 | 4 818 713.0 | 233 462.6 |
| 08-159 | 329.2 | 4 818 686.0 | 233 462.0 |
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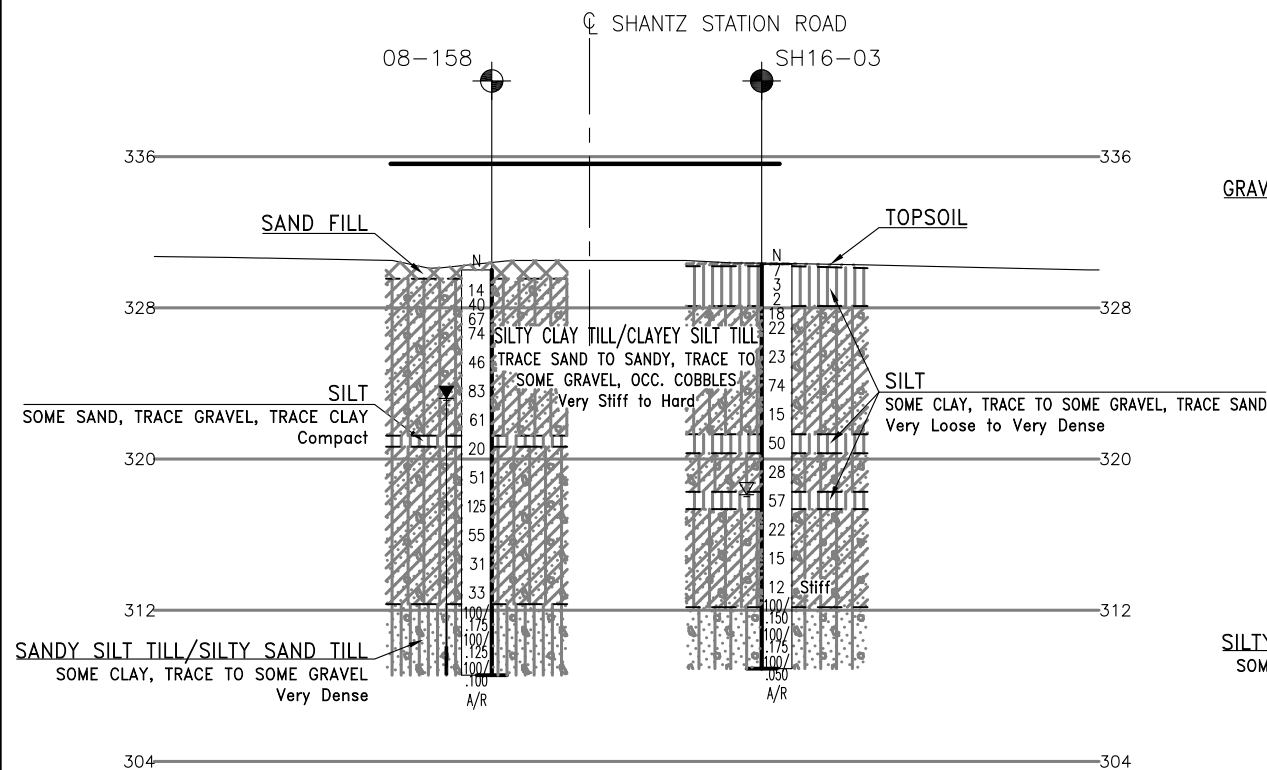
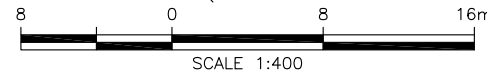
-NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- Coordinate system is MTM NAD 83 Zone 10.

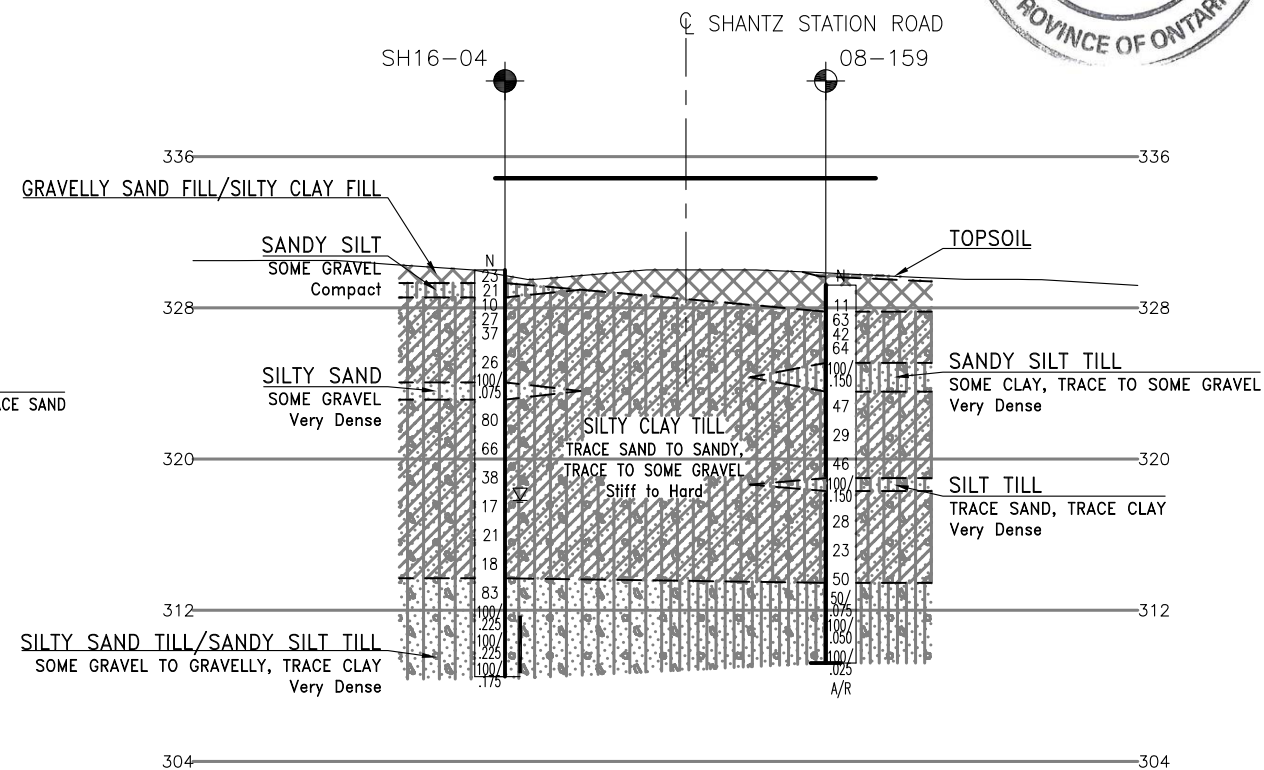
GEOCRES No. 40P9-61



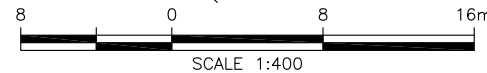
SECTION A-A (NORTH ABUTMENT)



SECTION B-B (PIER)



SECTION C-C (SOUTH ABUTMENT)



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