

**FOUNDATION INVESTIGATION REPORT
SOUTH TROUT CREEK BRIDGE WBL
HIGHWAY 11/17 RED ROCK TO NIPIGON
FROM 4.8 KM WEST OF HWY 628 TO 1.5KM WEST OF HWY 585
DISTRICT OF THUNDER BAY**

G.W.P. 647-89-00, SITE NO. 48C-10A

Geocres Number: 52A-177

Report to

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted at the proposed location of a bridge planned to carry the new Highway 11/17 westbound lanes (WBL) over the South Trout Creek in the Township of Red Rock, Ontario. The proposed bridge is part of the Highway 11/17 four-laning project, involving construction of a divided highway from 4.8 km west of Highway 628 to 1.5 km west of Highway 585 in the District of Thunder Bay.

The purpose of this 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 was developed from the data obtained in the course of the investigation.

Thurber carried out the investigation as a sub-consultant to Hatch Mott MacDonald (HMM), under the Ministry of Transportation Ontario (MTO) Agreement Number 6010-E-0006.

A previous foundation investigation report was prepared for replacement of the bridge on the current Highway 11/17 alignment with a temporary structure (Foundation Investigation and Design Report, South Trout Creek Bridge Replacement, Highway 11/17, 14 km west of the Town of Nipigon, January 22, 2010, by TBT Engineering; Geocres 52A-140). The existing bridge is located approximately 40 m southeast of the new WBL Bridge.

2 SITE DESCRIPTION

The site is located approximately 12 km southwest of Nipigon, Ontario and about 1.3 km southwest of the intersection of Highway 11/17 and Highway 628. At the bridge location, the new westbound lanes of Highway 11/17 will be approximately 40 m northwest of the existing highway.

South Trout Creek at the proposed crossing generally flows southerly and then easterly towards Lake Superior at Red Rock. The creek is situated at an approximate elevation of 212 m. The creek channel is approximately 9 m wide. The ground elevation surrounding the site drops from approximately 219.0 at the west approach to approximately 214.0 m on the east side. The surrounding lands are typically heavily treed with occasional vacant areas of grass and shrubs.

The site is located between local roads Red Rock Road No. 7 and Red Rock Road No. 6, which are approximately 60 m southwest and 200 m northeast of South Trout Creek respectively. Overhead hydro cables run parallel to the northwest side of the highway, in close proximity to the centreline of the new eastbound lanes of Highway 11/17. The existing bridge crossing South Trout Creek was replaced in the fall of 2012 with a temporary double-lane modular steel structure.

Photographs in Appendix C show the general nature of the site and the surrounding lands.

The site lies within the physiographic region known as the Quetico Subprovince of the Superior Province of the Canadian Shield. The bedrock consists of sedimentary rock of the Sibley Group, which is overlain by deposits of lacustrine clay and silt and glacial till.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this project were carried out during the period of April 24 to May 2, 2013 and consisted of drilling and sampling six boreholes (numbered STW-01 to STW-06) in the area of the proposed foundation units and approach embankments.

A summary of the borehole locations, designations, termination depths and termination elevations is provided in Table 3.1. The approximate borehole locations are shown on the attached Borehole Locations and Soil Strata Drawing in Appendix D.

Table 3.1 – Borehole Location, Termination Depth and Elevation

| Foundation Unit | Borehole Number | Borehole Termination Depth (m) | Borehole Termination Elevation (m) |
|-----------------|-----------------|--------------------------------|------------------------------------|
| West Approach | STW-01 | 12.8 | 206.3 |
| West Abutment | STW-02, STW-03 | 16.9 to 22.9 | 201.9 to 196.0 |
| East Abutment | STW-04, STW-05 | 12.3 to 13.9 | 201.7 to 199.8 |
| East Approach | STW-06 | 9.4 | 205.1 |

The borehole locations were marked in the field and utility clearances were obtained prior to drilling. It was necessary to relocate Boreholes STW-02 and STW-03 to the top of the valley slope due to the severity of slope at the west abutment location.

Drilling was carried out using a track-mounted CME55 drill rig and the boreholes were advanced with hollow stem augers. In general, samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT) in the native soils.

The drilling and sampling 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 samples for transport to Thurber's laboratory for further examination and testing.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. The boreholes were backfilled with bentonite holeplug in general accordance with O. Reg. 903 upon completion. Standpipe piezometers consisting of 19 mm PVC pipe with slotted screen enclosed in filter sand were installed in Boreholes STW-02 and STW-05 to permit longer term groundwater level monitoring. The piezometers were subsequently decommissioned in general accordance with MOE Regulation 903 following additional water level monitoring. The installation and completion details of the piezometers and boreholes are shown in Table 3.2.

Table 3.2 – Borehole Completion Details

| Borehole | Piezometer Tip Depth/ Elevation (m) | Completion Details |
|-----------------|--|---|
| STW-01 | None installed | Borehole backfilled with bentonite to surface. |
| STW-02 | 22.9/196.0 | Sand from 22.9 m to 18.9 m, bentonite from 18.9 m to surface. |
| STW-03 | None installed | Borehole backfilled with bentonite to surface. |
| STW-04 | None installed | Borehole backfilled with bentonite to surface. |
| STW-05 | 11.9/202.1 | Sand from 12.3 m to 5.9 m, bentonite to surface. |
| STW-06 | None installed | Borehole backfilled with bentonite to surface. |

4 LABORATORY TESTING

All recovered soil samples were subjected to Visual Identification (VI) and natural moisture content determination. Selected samples were also subjected to grain size distribution analyses (sieve and hydrometer) and Atterberg Limits testing where appropriate. The results of this testing program are summarized on the Record of Borehole sheets included in Appendix A and on the figures presented in Appendix B.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets included in Appendix A. Details of the encountered soil and rock stratigraphy are presented in these sheets and on the “Borehole Locations and Soil Strata” drawings included in Appendix D. An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole sheets governs any interpretation of the site conditions.

The subsurface stratigraphy at this site varies between the proposed west abutment and east abutment. At the west abutment, the stratigraphy typically consists of a topsoil layer over a thick deposit of typically firm to very soft silty clay, underlain by a loose to compact silt and sand layer, overlying typically very dense sandy silt to silt and sand till. At the east abutment, a topsoil/alluvium layer is underlain by layers of soft to firm sandy clayey silt and loose silt and sand, underlain by very dense sandy silt to silt and sand till. Very dense sand was encountered below the till in two boreholes. The boreholes for this investigation did not reach bedrock.

More detailed descriptions of the individual strata are presented below.

5.1 Topsoil / Alluvium

Topsoil and/or alluvial deposits were identified at the ground surface in all boreholes. The surficial layer ranged in thickness from 175 mm to 1.1 m and contained roots and rootlets, as well as wood fibres. The layer thickness may vary between and beyond the borehole locations and the data is not intended for the purpose of estimating quantities.

5.2 Sandy Clayey Silt

A layer of sandy clayey silt was encountered underlying the topsoil/alluvium in Boreholes STW-04 and STW-05 at the east abutment. The sandy clayey silt contained organic material including rootlets and wood fibres. The thickness of this layer was 1.1 and 1.7 m. The depth to the base of the layer was 1.9 m (Elev. 211.7 to 212.1 m) in both boreholes.

SPT N-values in the sandy clayey silt ranged from 2 to 8 blows per 0.3 m penetration, indicating a soft to firm consistency. The moisture content of the clayey silt samples ranged from 21% to 33%.

Grain size distribution curves for two samples of the clayey silt are presented on Figure B1 of Appendix B. The results are summarized on the Record of Borehole sheets and are as follows:

| | |
|----------|----------|
| Gravel % | 0 |
| Sand % | 20 to 24 |
| Silt % | 52 to 60 |
| Clay % | 20 to 24 |

5.3 Silty Clay

A thick deposit of native brown to grey silty clay with occasional silt seams and sand pockets was encountered below the topsoil in Boreholes STW-01, STW-02, and STW-03 drilled at the west approach and west abutment.

The silty clay deposit ranged in thickness from 8.8 to 10.4 m. The lower boundary of the silty clay layer was contacted at depths of 9.6 to 10.9 m (Elev. 208.1 to 209.1 m).

Standard Penetration Tests obtained in the silty clay deposit typically ranged from 0 to 2 blows per 0.3 m of penetration, indicating a very soft consistency. However, N-values ranging from 3 to 16 blows per 0.3 m of penetration were recorded within the upper 1.5 to 2.5 m of this layer, indicating the presence of a very stiff to firm crust.

In-situ vane shear tests carried out in the clay below the crust measured undrained shear strengths of 27 to 70 kPa, indicating a firm to stiff consistency. It is possible however that the measured strengths are affected by silt seams in the clay. The calculated sensitivity, a ratio of undisturbed strength to remoulded strength, ranged from 2 to 7, indicative of low to medium sensitivity.

The natural moisture content of the silty clay samples varied from 30 to 61%.

Selected samples of the silty clay underwent laboratory grain size analysis testing and Atterberg Limits tests. The grain size distribution curves for tested samples of silty clay are presented in Appendix B, Figures B2 and B3. The results of the Atterberg Limits tests are presented in Appendix B, Figures B8 and B9. The results are summarized on the Record of Borehole sheets included in Appendix A, and in the following tables:

| | |
|----------|----------|
| Gravel % | 0 |
| Sand % | 0 |
| Silt % | 30 to 49 |
| Clay % | 51 to 70 |

| | |
|---------------|----------|
| Liquid Limit | 40 to 61 |
| Plastic Limit | 19 to 22 |

The above results indicate that the silty clay is of intermediate to high plasticity with group symbols of CI to CH.

5.4 Silt and Sand

A layer of grey silt and sand was encountered below the silty clay at depths of 10.7 and 9.6 m (Elev. 208.1 and 209.1) in Boreholes STW-02 and STW-03 drilled on the west side of the creek, and below the topsoil/alluvium and sandy clayey silt at depths of 1.1 to 1.9 m (Elev.

211.7 to 213.3) in Boreholes STW-04 to STW-06 located on the east side. The thickness of this layer ranged from 1.1 to 2.1 m. The lower boundary was encountered at depths of 12.2 and 11.7 m (Elev. 206.7 and 207.1) on the west side of the creek, and at depths of 2.3 to 4.0 m (Elev. 210.0 to 212.2) on the east side.

SPT N-values recorded in the deposit ranged from 2 to 10 blows per 0.3 m of penetration, indicating a typically loose condition. The moisture content of the silt and sand samples ranged from 12 to 18%.

The grain size distribution curve for a sample of the silt and sand is presented on Figure B4 of Appendix B. The results are summarized on the Record of Borehole sheet and are as follows:

| | |
|----------|----|
| Gravel % | 1 |
| Sand % | 38 |
| Silt % | 59 |
| Clay % | 2 |

5.5 Sandy Silt to Silt and Sand Till

Grey glacial till ranging in composition from silt and sand to sandy silt was encountered in all boreholes at depths ranging from 10.9 to 12.2 m (Elev. 208.3 to 206.7) on the west side of the creek and from 2.3 to 4.0 m (Elev. 212.2 to 210.0) on the east side. The till contained trace to some gravel, trace clay, and occasional cobbles.

Boreholes STW-01, STW-03, STW-04 and STW-06 were terminated within the till deposit at depths ranging from 9.4 to 16.9 m (Elev. 199.8 to 206.3). In Boreholes STW-02 and STW-05, the layer was 2.7 and 5.6 m thick with a lower boundary a depths of 14.9 and 9.6 m (Elev. 203.9 and 204.4).

SPT N-values recorded in the till deposit typically ranged from 30 blows per 0.3 m of penetration to 100 blows for no penetration, indicating a dense to very dense relative density. N-values of 9 to 29 blows per 0.3 m of penetration were obtained near the upper boundary of this unit in Boreholes STW-01 to STW-03, indicating a locally loose to compact condition.

The moisture content of the till samples ranged from 5 to 22%.

Selected samples of the till underwent laboratory grain size analysis. The grain size distribution curves for tested samples are presented in Appendix B, Figures B5 and B6. The results are summarized on the Record of Borehole sheets included in Appendix A, and in the following table:

| | |
|----------|----------|
| Gravel % | 0 to 16 |
| Sand % | 20 to 42 |
| Silt % | 44 to 69 |
| Clay % | 3 to 10 |

Glacial till inherently contains cobbles and boulders and these should be anticipated during construction.

5.6 Sand

A sand deposit was encountered below the till in Boreholes STW-02 and STW-05. The sand was grey to dark grey in colour, and contained trace to some silt, trace gravel, and occasional cobbles and boulders. The upper boundary of the sand was encountered at depths of 14.9 and 9.6 m (Elev. 203.9 and 204.4 m). The boreholes were terminated within the sand at depths of 22.9 and 12.3 m (Elev. 196.0 and 201.7).

SPT N-values ranging from 85 blows per 0.3 m to 100 blows with no penetration were recorded in the sand, indicating a very dense relative density. The moisture content of samples ranged from 11 to 17%.

The results of grain size distribution analyses conducted on two samples of the sand are presented on the Record of Borehole sheets and on Figure B7 of Appendix B. The results are summarized as follows:

| | |
|--------------|----------|
| Gravel % | 6 to 8 |
| Sand % | 78 to 82 |
| Silt & Clay% | 12 to 14 |

5.7 Water Levels

Water levels were observed in the boreholes during and upon completion of drilling. Standpipe piezometers were installed in Boreholes STW-02 and STW-05 to monitor water levels after completion of drilling. The water levels observed upon completion of drilling and subsequently measured in the piezometers are summarized in Table 5.1.

Table 5.1 – Water Level Measurements

| Borehole | Date | Water Level | | Comment |
|----------|----------------|-------------|-----------|-----------------|
| | | Depth (m) | Elev. (m) | |
| STW-02 | May 9, 2013 | 4.2 | 214.7 | In piezometer |
| | June 23, 2013 | 5.8 | 213.1 | |
| STW-03 | May 2, 2013 | 6.2 | 212.6 | Upon completion |
| STW-04 | April 25, 2013 | 0.7 | 213.0 | Upon completion |
| STW-05 | May 9, 2013 | 0.6 | 213.4 | In piezometer |
| | June 23, 2013 | 0.7 | 213.3 | |
| STW-06 | April 24, 2013 | 0.9 | 213.6 | Upon completion |

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or periods of heavy rainfall.

The groundwater level is also expected to be influenced by the water level in South Trout Creek, which is shown on the preliminary GA drawing provided by HMM to be at Elev. 212.9 m (date not noted). The high water level is indicated at Elev. 213.6.

6 MISCELLANEOUS

Borehole locations were selected by Thurber Engineering Ltd. The borehole locations were staked in the field by TBT Engineering Limited surveyors. The co-ordinates and ground surface elevations at the boreholes were provided by the surveyors.

TBT Engineering Limited from Thunder Bay, Ontario supplied a track mounted CME 55 drill rig and conducted the drilling, sampling and in-situ testing operations.

Full time supervision of the field activities was carried out by Ms. Eekie Siu of Thurber. Overall supervision of the field program was conducted by Mr. Mark Farrant, P. Eng.

Interpretation of the data and preparation of the report were carried out by Mr. Mark Farrant, P.Eng. and Mr. Murray Anderson, P.Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd.

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Appendix A

Record of Borehole Sheets

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
 C_{pen} 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 | | | | |
| Very thinly bedded | 20 to 60mm | Strong | 50-100 | 7,500 to 15,000 | Requires more than one blow of geological hammer to break |
| Laminated | 6 to 20mm | | | | |
| Thinly Laminated | Less than 6mm | Medium Strong | 25.0 to 50.0 | 3,500 to 7,500 | Breaks under single blow of geological hammer. |
| <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 |
| 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 | Can be peeled by a pocket knife, crumbles under firm blows of geological pick. |
| 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 | Indented by thumbnail |
| 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 STW-01

1 OF 2

METRIC

WP# 647-89-00 LOCATION N 5 424 487.4 E 205 859.9 ORIGINATED BY ES
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.04.29 - 2013.04.30 CHECKED BY MEF

| 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 | | | | | |
| 219.1 0.0 | TOPSOIL , some roots Dark Brown Wet | | | | | | | | | | | | | | |
| 218.6 0.5 | Silty CLAY , trace sand Very Stiff Brown (CH to Cl) Varved, with silt seams Firm to Very Soft Grey | | 1 | SS | 16 | | | | | | | ○ | | | |
| | | | 2 | SS | 4 | | | | | | | ○ | 0 0 38 62 | | |
| | | | 3 | SS | 2 | | | | | | | ○ | | | |
| | | | 4 | SS | 0 | | | | | | | ○ | | | |
| | | | 5 | SS | 0 | | | | 7.0 | | | ○ | | | |
| | | | 6 | SS | 0 | | | | | | | ○ | 0 0 41 59 | | |
| | | | 7 | SS | 1 | | | | | | | ○ | | | |
| | | | 8 | SS | 1 | | | | | | | ○ | | | |

ONTMT4S_05117.GPJ_2012TEMPLATE(MTO).GDT_3/28/14

Continued Next Page

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

RECORD OF BOREHOLE No STW-01

2 OF 2

METRIC

WP# 647-89-00 LOCATION N 5 424 487.4 E 205 859.9 ORIGINATED BY ES
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.04.29 - 2013.04.30 CHECKED BY MEF

| 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 | | | | | | | |
| | Continued From Previous Page | | | | | | | | | | | | | | |
| 208.3 | Silty CLAY Firm to Very Soft Grey | | | | | | 209 | | 3.0 | | | | | | |
| 10.9 | Sandy SILT , some gravel, trace clay Compact Grey Wet to Moist (TILL) | | 9 | SS | 17 | | 208 | | | | | | | 16 30 50 4 | |
| 206.3 | | | | | | | 207 | | | | | | | | |
| 12.8 | END OF BOREHOLE AT 12.8m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE. | | 10 | SS | 29 | | | | | | | | | | |

ONTMT4S_05117.GPJ_2012TEMPLATE(MTO).GDT_3/28/14

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

RECORD OF BOREHOLE No STW-02

2 OF 3

METRIC

WP# 647-89-00 LOCATION N 5 424 500.7 E 205 868.6 ORIGINATED BY ES
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.01 - 2013.05.01 CHECKED BY MEF

| 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 | | | | | |
| 208.1 | Silty CLAY , trace sand Firm to Very Soft Grey | | | | | | | | | | | | | | |
| 10.7 | SILT and SAND , trace gravel, trace clay Loose to Compact Grey Wet | | 9 | SS | 2 | | | | | | | | | | |
| 206.7 | Sandy SILT , trace clay, trace to some gravel Loose to Dense Grey Wet (TILL) | | 10 | SS | 9 | | | | | | | | | 16 | 35 44 5 |
| 12.2 | | | 11 | SS | 30 | | | | | | | | | 4 | 29 58 9 |
| 203.9 | SAND , trace to some silt, trace gravel, occasional cobbles Very Dense Grey to Dark Grey Moist to Wet | | 12 | SS | 100/ 0.125 | | | | | | | | | | |
| | | | 13 | SS | 100/ 0.075 | | | | | | | | | | |
| | | | 14 | SS | 85 | | | | | | | | | 8 | 79 13 (SI+CL) |
| | | | 15 | SS | 100/ | | | | | | | | | | |

ONTMT4S_05117.GPJ_2012TEMPLATE(MTO).GDT 3/28/14

Continued Next Page

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

RECORD OF BOREHOLE No STW-02

3 OF 3

METRIC

WP# 647-89-00 LOCATION N 5 424 500.7 E 205 868.6 ORIGINATED BY ES
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.01 - 2013.05.01 CHECKED BY MEF

| 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 | | | | | | | |
| | | | | | | 20 | 40 | 60 | 80 | 100 | 20 | 40 | 60 | | |
| | Continued From Previous Page | | | | 0.075 | | | | | | | | | | |
| | SAND, trace to some silt, trace gravel, occasional cobbles Very Dense Grey to Dark Grey Moist to Wet | | | | | | | | | | | | | | |
| | Probable cobbles | | 16 | SS | 100/0.025 | | | | | | | | | | |
| 196.0 | | | | | | | | | | | | | | | |
| 22.9 | END OF BOREHOLE AT 22.9m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) May 09/13 4.2 214.7 Jun. 23/13 5.8 213.1 | | 17 | SS | 100/0.0 | | | | | | | | | | |

ONTMT4S_05117.GPJ_2012TEMPLATE(MTO).GDT 3/28/14

RECORD OF BOREHOLE No STW-03

1 OF 2

METRIC

WP# 647-89-00 LOCATION N 5 424 495.0 E 205 881.2 ORIGINATED BY ES
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.02 - 2013.05.02 CHECKED BY MEF

| 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 | | | | | | | |
| | | | | | | | 20 40 60 80 100 | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 218.8 0.0 | TOPSOIL, some roots and rootlets, occasional wood fibres Dark Brown Wet | | | | | | | | | | | | | | |
| 218.0 0.8 | Silty CLAY, trace sand Firm to Soft Brown (Cl to CH) Varved, occasional silt seams Becoming Very Soft Occasional sand pockets Grey | | 1 | SS | 7 | | | | | | | | | | |
| | | | 2 | SS | 5 | | | | | | | | | 0 0 49 51 | |
| | | | 3 | SS | 3 | | | | | | | | | | |
| | | | 4 | SS | 0 | | | | | | | | | 0 0 39 61 | |
| | | | | | | | 2.0 | | | | | | | | |
| | | | 5 | SS | 0 | | | | | | | | | | |
| | | | | | | | 4.0 | | | | | | | | |
| | | | 6 | SS | 0 | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | 7 | SS | 0 | | 3.0 | | | | | | | 0 0 30 70 | |
| | | | | | | | | | | | | | | | |
| | | | | | | | 6.0 | | | | | | | | |
| 209.1 9.6 | SILT and SAND, trace gravel Compact | | 8 | SS | 1 | | | | | | | | | | |
| | | | | | | | | | | | | | | | |

ONTMT4S_05117.GPJ_2012TEMPLATE(MTO).GDT_3/28/14

Continued Next Page

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

RECORD OF BOREHOLE No STW-03

2 OF 2

METRIC

WP# 647-89-00 LOCATION N 5 424 495.0 E 205 881.2 ORIGINATED BY ES
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.05.02 - 2013.05.02 CHECKED BY MEF

| 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 | | | | | | |
| | Continued From Previous Page | | | | | | 20 40 60 80 100 | | | | | | | |
| | | | | | | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W _p W W _L WATER CONTENT (%) 20 40 60 | | | | | | | |
| | | | | | | | SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE | | | | | | | |
| 207.1 | SILT and SAND, trace gravel Compact Grey Moist | | 9 | SS | 10 | | | | | | | | | |
| 11.7 | Sandy SILT, trace clay, trace gravel Compact to Very Dense Grey Moist (TILL) | | 10 | SS | 27 | | | | | | | | 0 27 68 5 | |
| | Occasional cobbles | | 11 | SS | 100/ 0.175 | | | | | | | | | |
| | | | 12 | SS | 100/ 0.125 | | | | | | | | | |
| 201.9 | | | 13 | SS | 100/ 0.150 | | | | | | | | | |
| 16.9 | END OF BOREHOLE AT 16.9m. WATER LEVEL AT 6.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE. | | | | | | | | | | | | | |

ONTMT4S_05117.GPJ_2012TEMPLATE(MTO).GDT_3/28/14

+³, ×³: Numbers refer to Sensitivity 20
15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No STW-04

2 OF 2

METRIC

WP# 647-89-00 LOCATION N 5 424 525.3 E 205 900.1 ORIGINATED BY ES
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.04.25 - 2013.04.25 CHECKED BY MEF

| 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 | | | | | | |
| | Continued From Previous Page | | | | | | 20 40 60 80 100 | | | | | | | |
| | | | | | | | 20 40 60 80 100 | | | | | | | |
| | Sandy SILT, trace clay, trace gravel, occasional cobbles Very Dense Grey Moist (TILL) | | 9 | SS | 100/ 0.0 | | | | | | | | | |
| | | | 10 | SS | 106/ 0.150 | | | | | | | | | |
| 199.8 | | | 11 | SS | 100/ 0.050 | | | | | | | | | |
| 13.9 | END OF BOREHOLE AT 13.9m UPON AUGER REFUSAL. WATER LEVEL AT 0.7m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE. | | | | | | | | | | | | | |

ONTMT4S_05117.GPJ_2012TEMPLATE(MTO).GDT 3/28/14

RECORD OF BOREHOLE No STW-05

1 OF 2

METRIC

WP# 647-89-00 LOCATION N 5 424 516.7 E 205 909.1 ORIGINATED BY ES
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.04.25 - 2013.04.27 CHECKED BY MEF

| 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 | NUMBER | TYPE | "N" VALUES | | | 20 | 40 | 60 | 80 | 100 | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | GR |
| 214.0 | TOPSOIL: (175mm) | | | | | | | | | | | | | | | | |
| 0.0 | | | | | | | | | | | | | | | | | |
| 0.2 | Clayey SILT , sandy, trace rootlets, occasional wood fibres Soft to Firm Brown | 1 | SS | 3 | | | | | | | | | | 0 | 24 | 53 | 23 |
| 212.1 | | 2 | SS | 5 | | | | | | | | | | | | | |
| 1.9 | SILT and SAND , trace clay, trace gravel Loose Grey Wet | 3 | SS | 4 | | | | | | | | | | | | | |
| | | 4 | SS | 8 | | | | | | | | | | | | | |
| 210.0 | | | | | | | | | | | | | | | | | |
| 4.0 | Sandy SILT to SILT and SAND , trace clay, trace gravel, occasional coarse sand seams, occasional cobbles/boulders Very Dense to Dense Grey Moist (TILL) Sand layer at 4.6m | 5 | SS | 100/ 0.125 | | | | | | | | | | | | | |
| | | 6 | SS | 51 | | | | | | | | | | 4 | 33 | 54 | 9 |
| | | 7 | SS | 37 | | | | | | | | | | | | | |
| | Occasional sand pockets | | | | | | | | | | | | | | | | |
| | | 8 | SS | 100/ 0.175 | | | | | | | | | | | | | |
| 204.4 | | | | | | | | | | | | | | | | | |
| 9.6 | SAND , coarse grained, some silt, trace gravel | | | | | | | | | | | | | | | | |

ONTMT4S_05117.GPJ_2012TEMPLATE(MTO).GDT 3/28/14

Continued Next Page

+ 3, x 3. Numbers refer to Sensitivity
 20
 15 10 5 0
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No STW-05

2 OF 2

METRIC

WP# 647-89-00 LOCATION N 5 424 516.7 E 205 909.1 ORIGINATED BY ES
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.04.25 - 2013.04.27 CHECKED BY MEF

| 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 | | | | | | | | |
| | | | | | | 20 40 60 80 100 | 20 40 60 80 100 | 20 40 60 | | | | | | | | |
| | | | | | | | ○ UNCONFINED | + FIELD VANE | | | | | | | | |
| | | | | | | | ● QUICK TRIAXIAL | × LAB VANE | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| 201.7 | Continued From Previous Page SAND , coarse grained, some silt, trace gravel Very Dense Dark Grey Wet | | 9 | SS | 100/ 0.125 | | | | | | | | | | | 6 82 12 (SI+CL) |
| 12.3 | END OF BOREHOLE AT 12.3m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) May 09/13 0.6 213.4 Jun. 23/13 0.7 213.3 | | 10 | SS | 100/ 0.100 | | | | | | | | | | | |

ONTMT4S_05117.GPJ_2012TEMPLATE(MTO).GDT_3/28/14

RECORD OF BOREHOLE No STW-06

1 OF 2

METRIC

WP# 647-89-00 LOCATION N 5 424 535.5 E 205 922.4 ORIGINATED BY ES
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.04.24 - 2013.04.24 CHECKED BY MEF

| 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 | | | | | | | | |
| 214.5 | | | | | | 20 40 60 80 100 | | | | | | | | | | |
| 0.0 | TOPSOIL/ALLUVIUM , trace roots, with wood fibres Dark Brown Wet | | | | | | | | | | | | | | | |
| 213.3 | | | 1 | SS | 3 | | | | | | | | | | | |
| 1.1 | SILT and SAND , trace clay, trace gravel Loose Brown to Grey Wet | | 2 | SS | 8 | | | | | | | | | | 1 38 59 2 | |
| 212.2 | | | 3 | SS | 79/ 0.275 | | | | | | | | | | | |
| 2.3 | SILT and SAND , trace clay, trace gravel, occasional cobbles Very Dense Grey Moist (TILL) | | 4 | SS | 86 | | | | | | | | | | | |
| | | | 5 | SS | 99/ 0.225 | | | | | | | | | | | |
| | Possible cobbles/boulders at 6.1m | | 6 | SS | 100/ 0.025 | | | | | | | | | | | |
| | | | 7 | SS | 110/ 0.250 | | | | | | | | | | 9 42 46 3 | |
| | Occasional sand seam | | 8 | SS | 109/ 0.250 | | | | | | | | | | | |
| 205.1 | END OF BOREHOLE AT 9.4m. WATER LEVEL AT 0.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH | | | | | | | | | | | | | | | |

ONTMT4S_05117.GPJ_2012TEMPLATE(MTO).GDT_3/28/14

Continued Next Page

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

RECORD OF BOREHOLE No STW-06

2 OF 2

METRIC

WP# 647-89-00 LOCATION N 5 424 535.5 E 205 922.4 ORIGINATED BY ES
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.04.24 - 2013.04.24 CHECKED BY MEF

| 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 | | | | | |
| | Continued From Previous Page BENTONITE HOLEPLUG TO SURFACE. | | | | | | | | | | | | | | | | | |

ONTMT4S_05117.GPJ_2012TEMPLATE(MTO).GDT_3/28/14

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

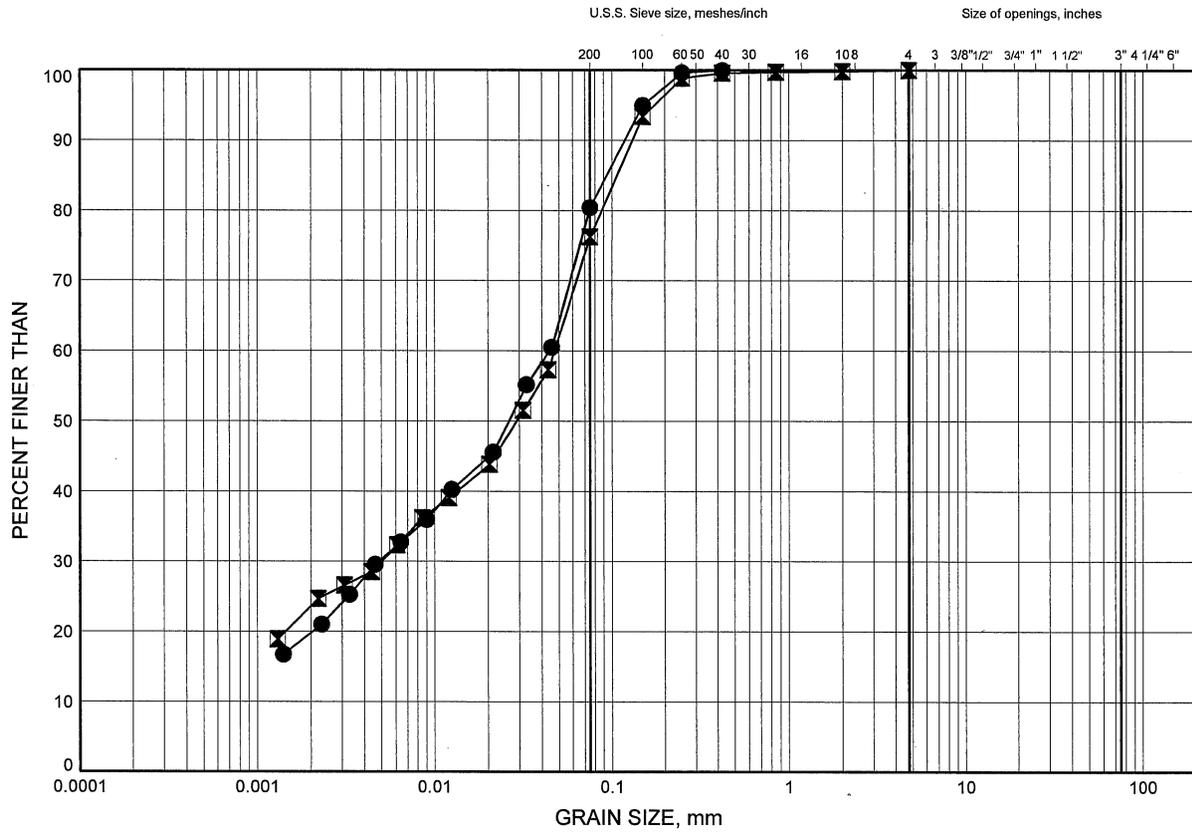
Appendix B

Laboratory Test Results

South Trout Creek - WBL
GRAIN SIZE DISTRIBUTION

FIGURE B1

CLAYEY SILT



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

LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|--------|----------|-----------|-----------|
| ● | STW-04 | 1.07 | 212.58 |
| ⊠ | STW-05 | 1.07 | 212.92 |

GRAIN SIZE DISTRIBUTION - THURBER 05117.GPJ 9/20/13

Date September 2013
 GWP# 647-89-00

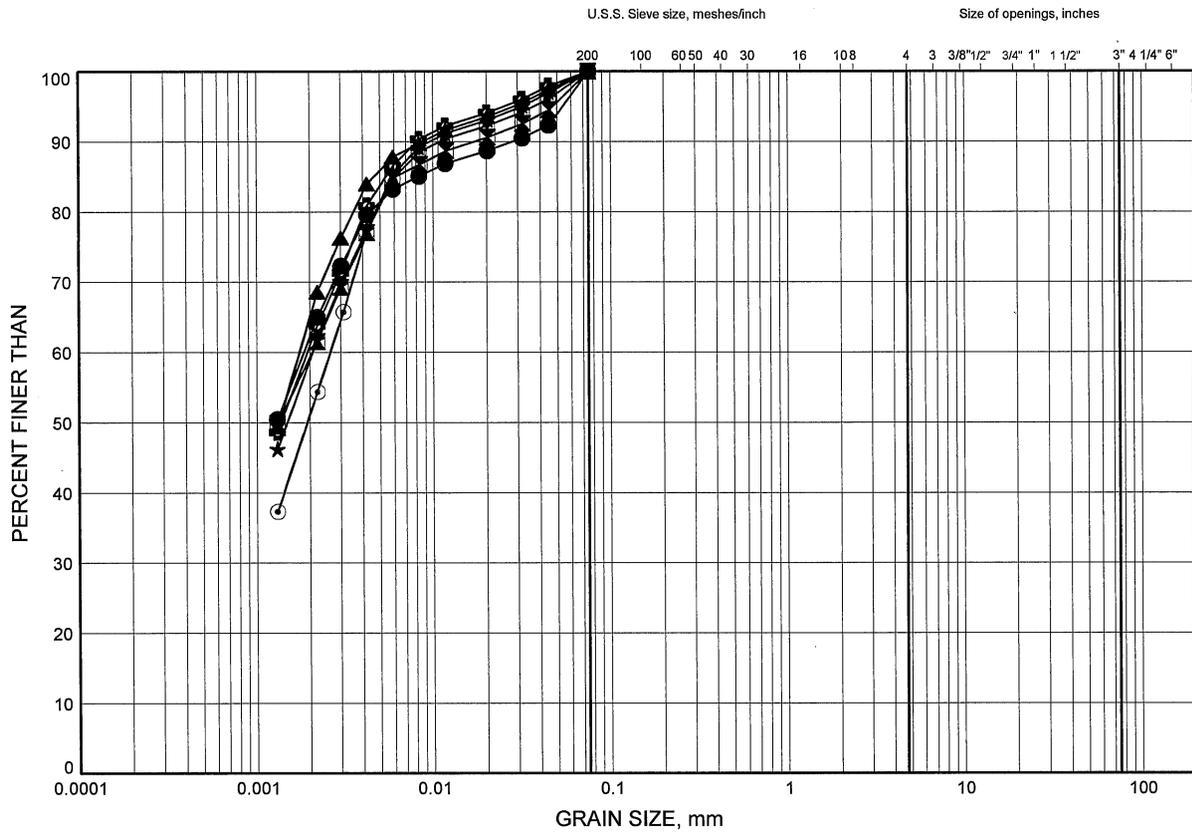


Prep'd AN
 Chkd. MRA

South Trout Creek - WBL
GRAIN SIZE DISTRIBUTION

FIGURE B2

SILTY CLAY



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

LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|--------|----------|-----------|-----------|
| ● | STW-01 | 1.83 | 217.31 |
| ⊠ | STW-01 | 6.40 | 212.73 |
| ▲ | STW-02 | 1.07 | 217.81 |
| ★ | STW-02 | 4.88 | 214.00 |
| ⊙ | STW-03 | 1.83 | 216.94 |
| ⊕ | STW-03 | 3.35 | 215.42 |

GRAIN SIZE DISTRIBUTION - THURBER 05117.GPJ 9/20/13

Date September 2013
 GWP# 647-89-00

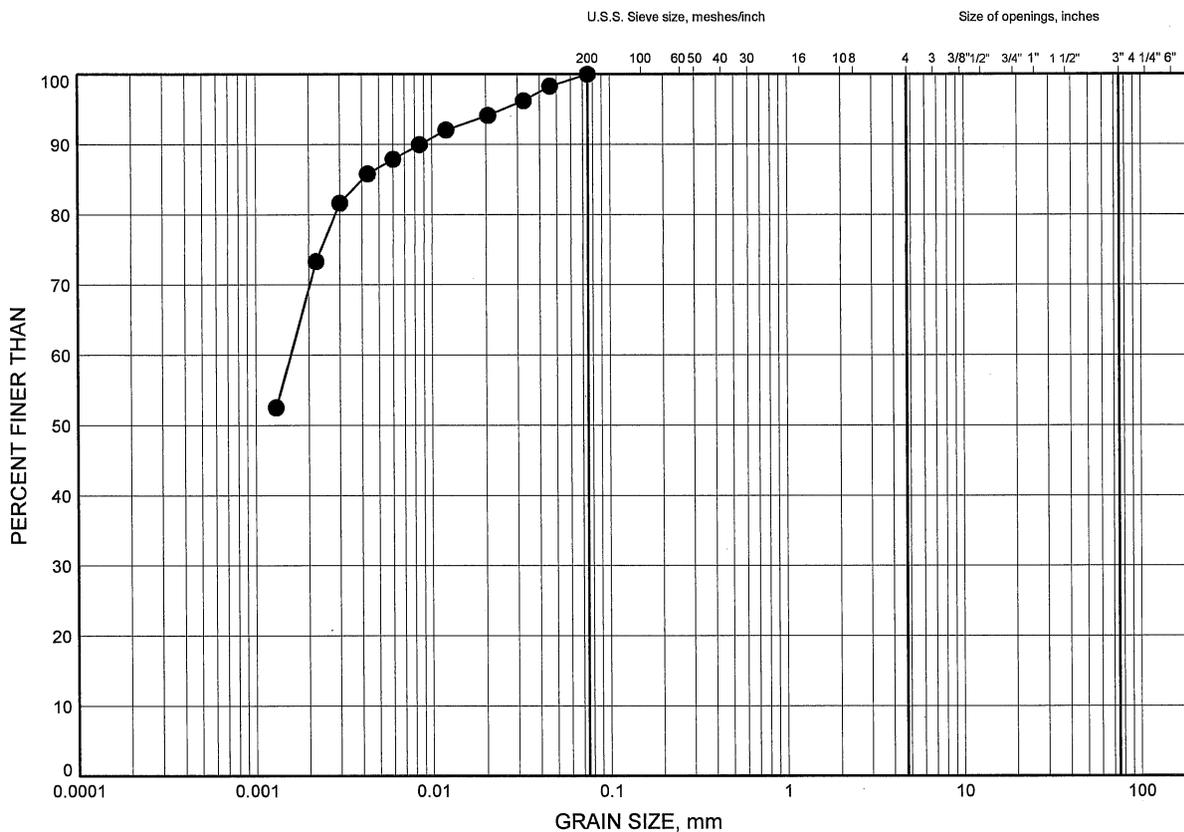


Prep'd AN
 Chkd. MRA

South Trout Creek - WBL
GRAIN SIZE DISTRIBUTION

FIGURE B3

SILTY CLAY



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

LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|--------|----------|-----------|-----------|
| ● | STW-03 | 7.92 | 210.84 |

GRAIN SIZE DISTRIBUTION - THURBER_05117.GPJ 9/20/13

Date September 2013
 GWP# 647-89-00

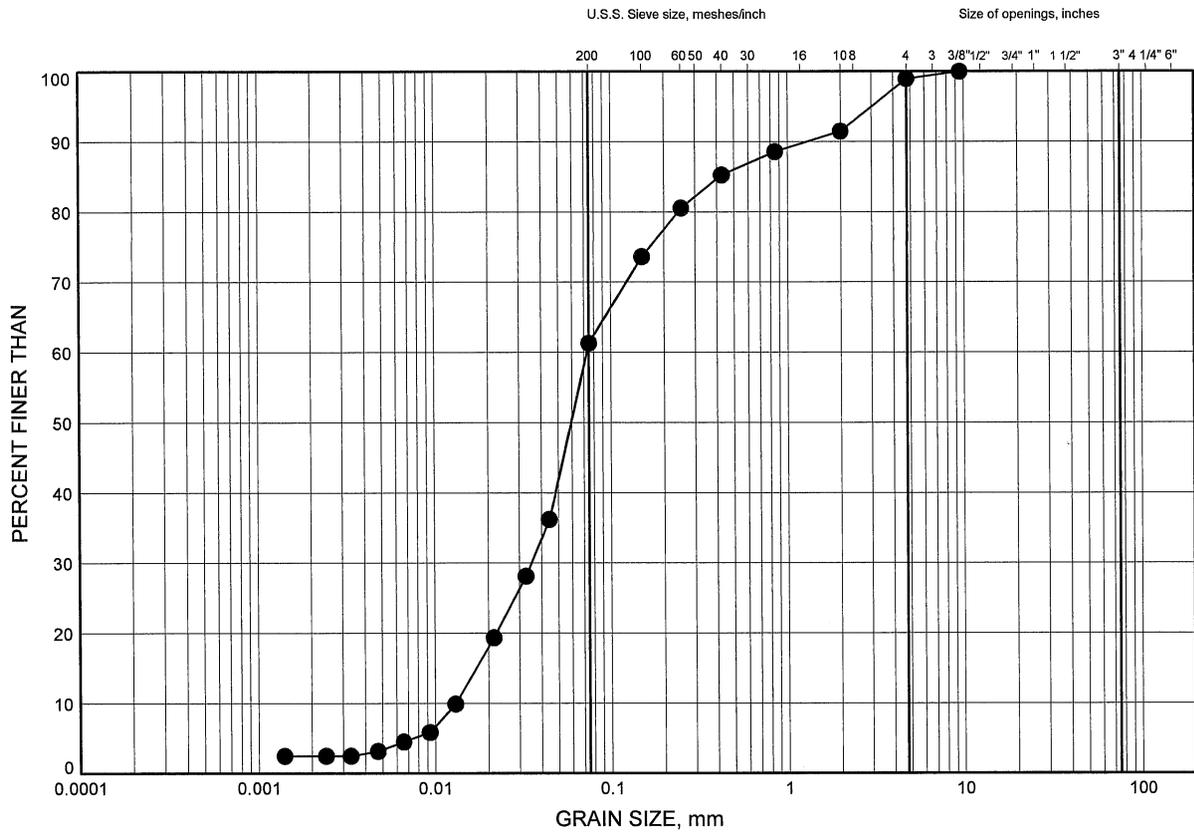


Prep'd AN
 Chkd. MRA

South Trout Creek - WBL
GRAIN SIZE DISTRIBUTION

FIGURE B4

SILT & SAND



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

LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|--------|----------|-----------|-----------|
| ● | STW-06 | 1.83 | 212.64 |

GRAIN SIZE DISTRIBUTION - THURBER 05117.GPJ 9/20/13

Date ..September 2013.....
 GWP# ..647-89-00.....

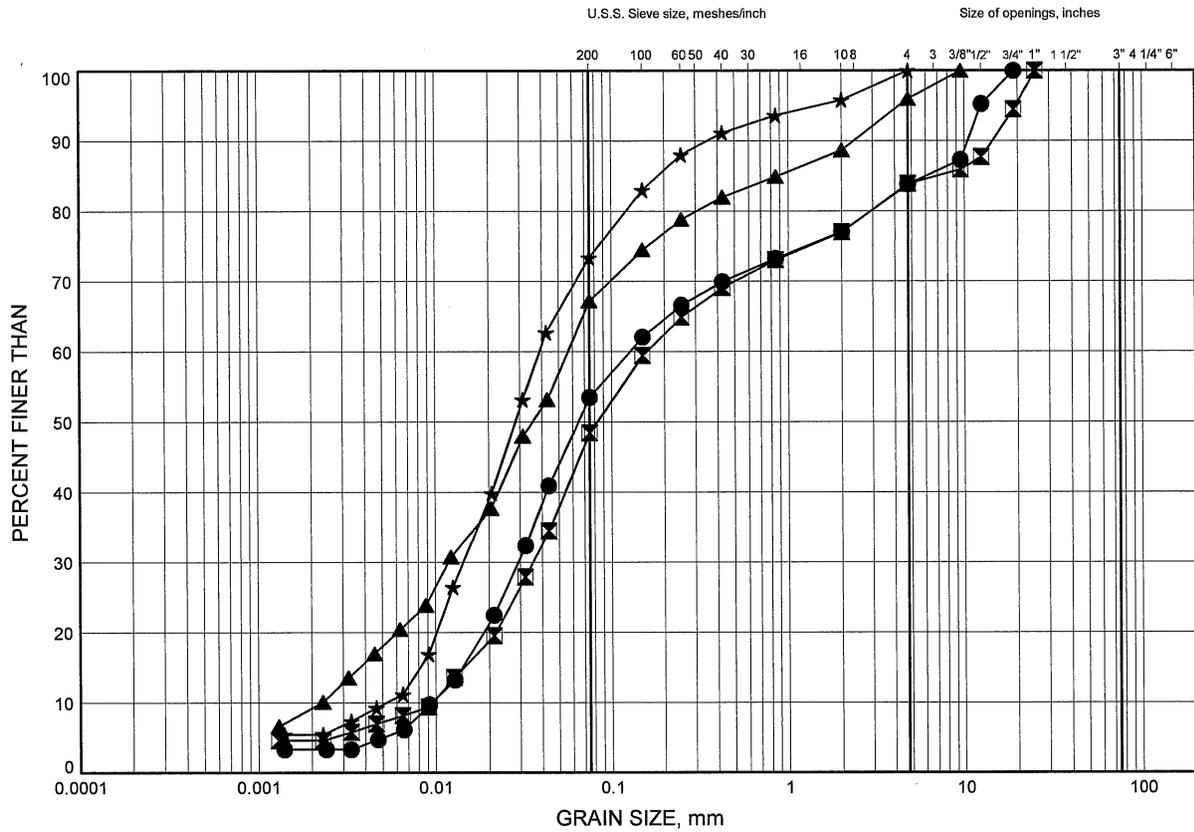


Prep'd ..AN.....
 Chkd.MRA.....

South Trout Creek - WBL
GRAIN SIZE DISTRIBUTION

FIGURE B5

SANDY SILT to SILT & SAND TILL



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

LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|--------|----------|-----------|-----------|
| ● | STW-01 | 10.97 | 208.16 |
| ■ | STW-02 | 12.50 | 206.38 |
| ▲ | STW-02 | 14.02 | 204.86 |
| ★ | STW-03 | 12.50 | 206.27 |

GRAIN SIZE DISTRIBUTION - THURBER 05117.GPJ 9/20/13

Date September 2013
 GWP# 647-89-00

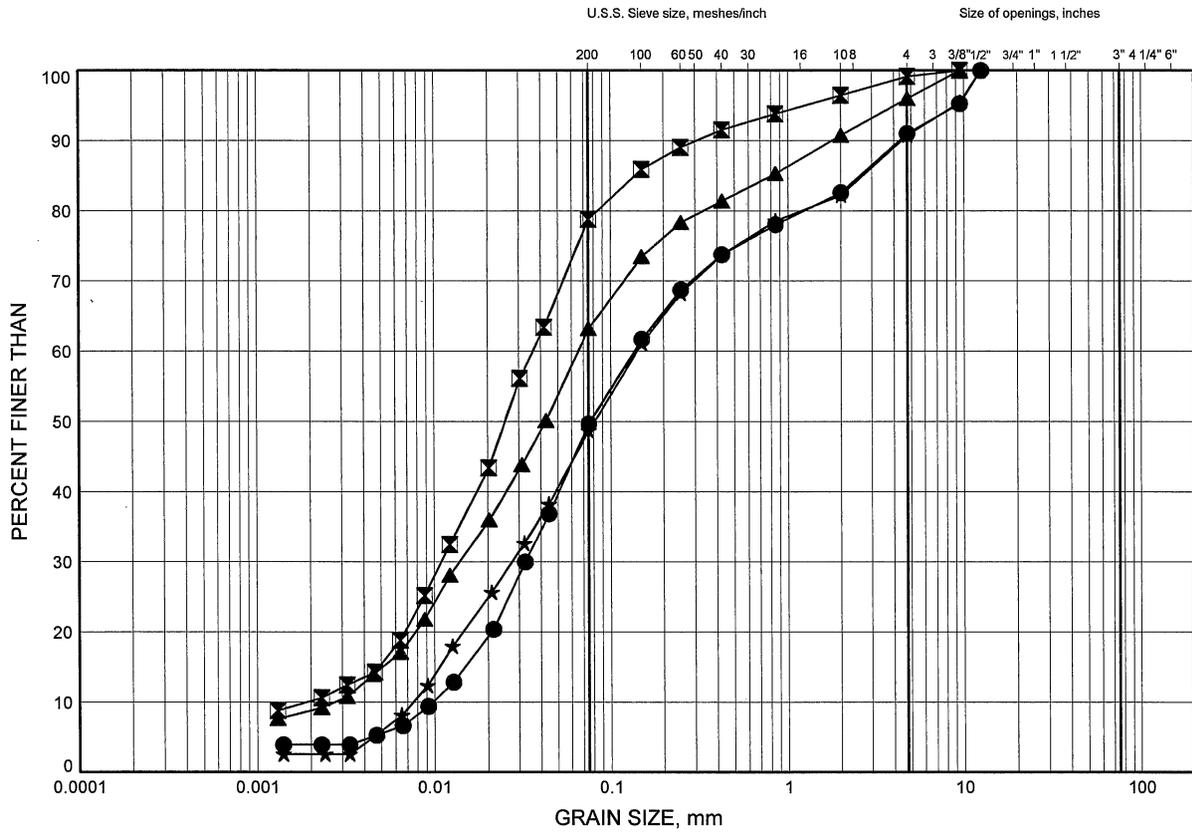


Prep'd AN
 Chkd. MRA

South Trout Creek - WBL
GRAIN SIZE DISTRIBUTION

FIGURE B6

SANDY SILT to SILT & SAND TILL



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

LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|--------|----------|-----------|-----------|
| ● | STW-04 | 3.24 | 210.41 |
| ⊠ | STW-04 | 7.92 | 205.73 |
| ▲ | STW-05 | 6.40 | 207.59 |
| ★ | STW-06 | 7.75 | 206.72 |

GRAIN SIZE DISTRIBUTION - THURBER 05117.GPJ 9/20/13

Date September 2013
 GWP# 647-89-00

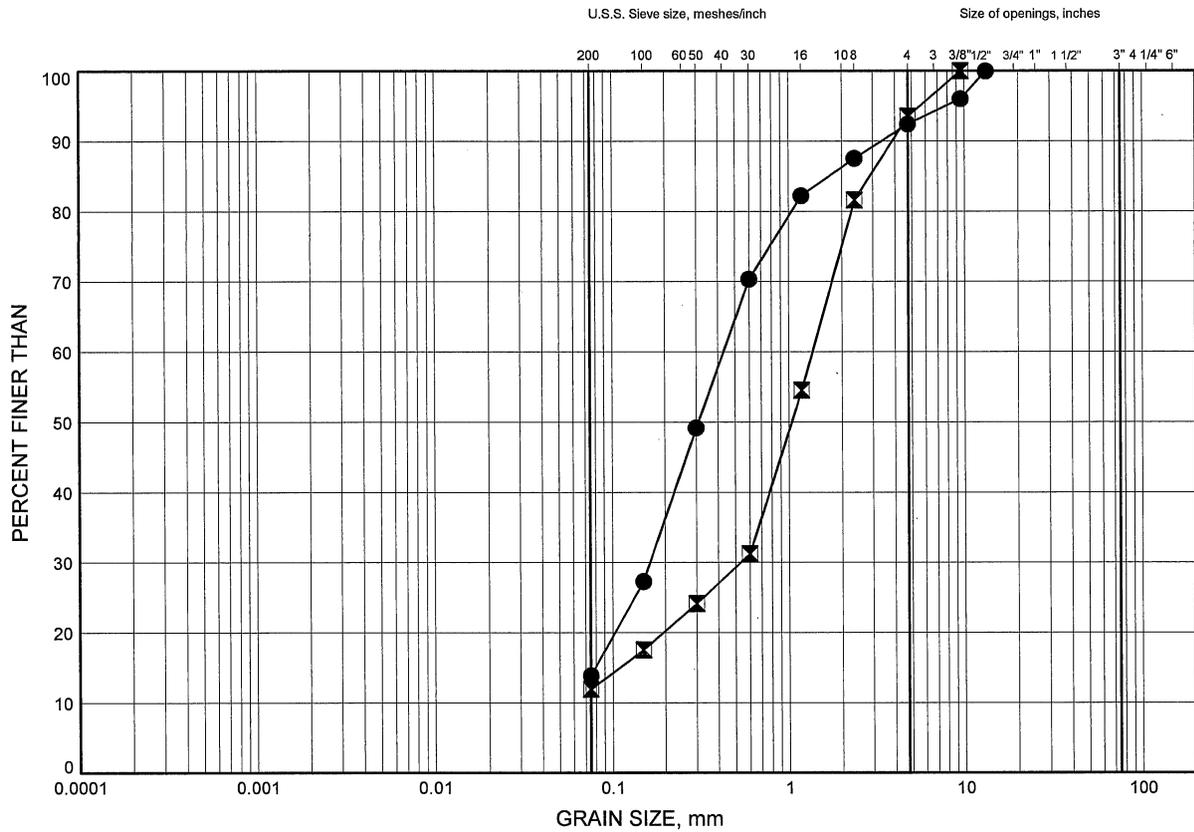


Prep'd AN
 Chkd. MRA

South Trout Creek - WBL
GRAIN SIZE DISTRIBUTION

FIGURE B7

SAND



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

LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|--------|----------|-----------|-----------|
| ● | STW-02 | 18.59 | 200.29 |
| ⊠ | STW-05 | 10.73 | 203.25 |

GRAIN SIZE DISTRIBUTION - THURBER 05117.GPJ 9/20/13

Date September 2013
 GWP# 647-89-00

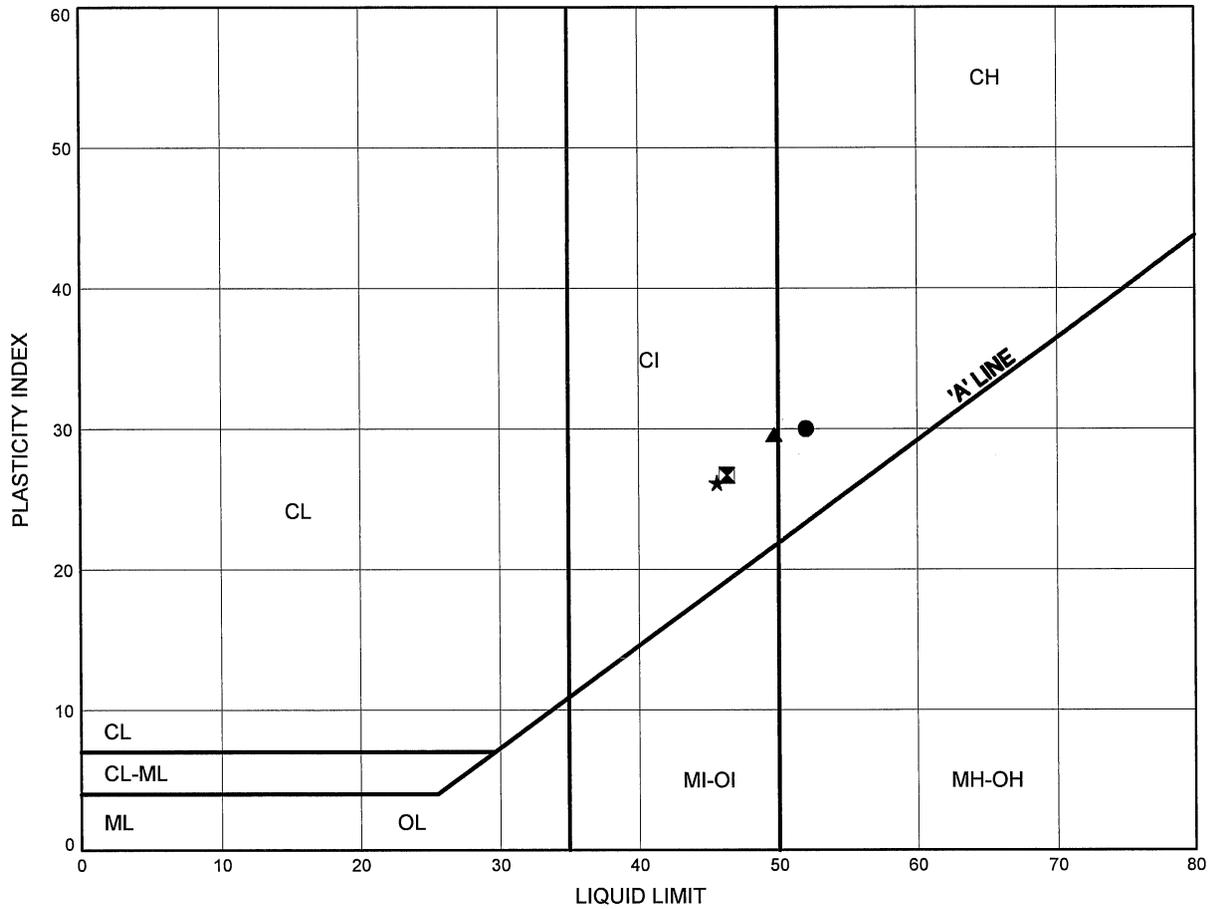


Prep'd AN
 Chkd. MRA

South Trout Creek - WBL
ATTERBERG LIMITS TEST RESULTS

FIGURE B8

SILTY CLAY



LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|--------|----------|-----------|-----------|
| ● | STW-01 | 1.83 | 217.31 |
| ⊠ | STW-01 | 6.40 | 212.73 |
| ▲ | STW-02 | 1.07 | 217.81 |
| ★ | STW-02 | 4.88 | 214.00 |

THURBALT 05117.GPJ 9/20/13

Date .. September 2013 ..
 GWP# .. 647-89-00 ..

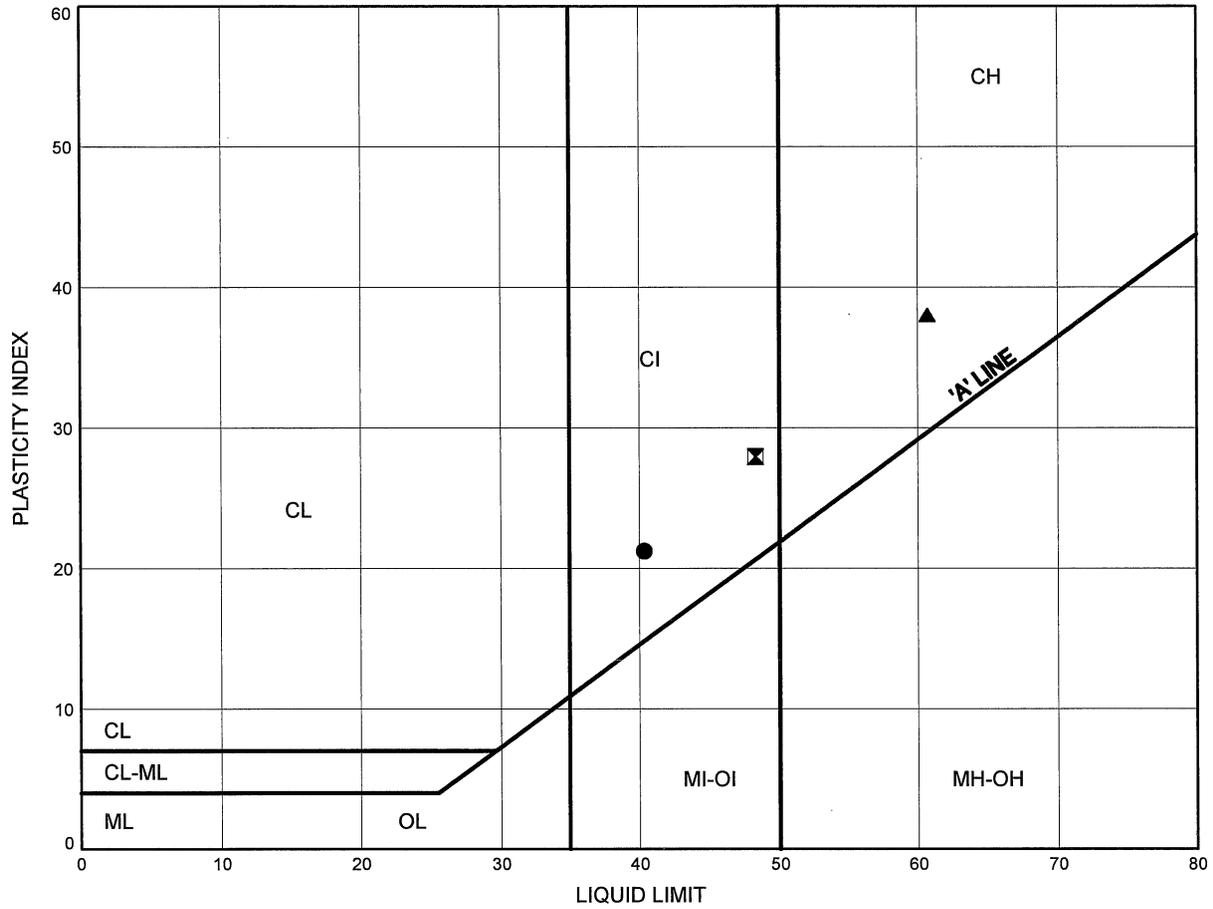


Prep'd .. AN ..
 Chkd. .. MRA ..

South Trout Creek - WBL
ATTERBERG LIMITS TEST RESULTS

FIGURE B9

SILTY CLAY



LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|--------|----------|-----------|-----------|
| ● | STW-03 | 1.83 | 216.94 |
| ⊠ | STW-03 | 3.35 | 215.42 |
| ▲ | STW-03 | 7.92 | 210.84 |

THURBALT_05117.GPJ 9/20/13

Date September 2013
 GWP# 647-89-00



Prep'd AN
 Chkd. MRA

Appendix C

Site Photographs



Photograph 1 – Existing conditions at South Trout Creek, looking northeast at southwest bank.



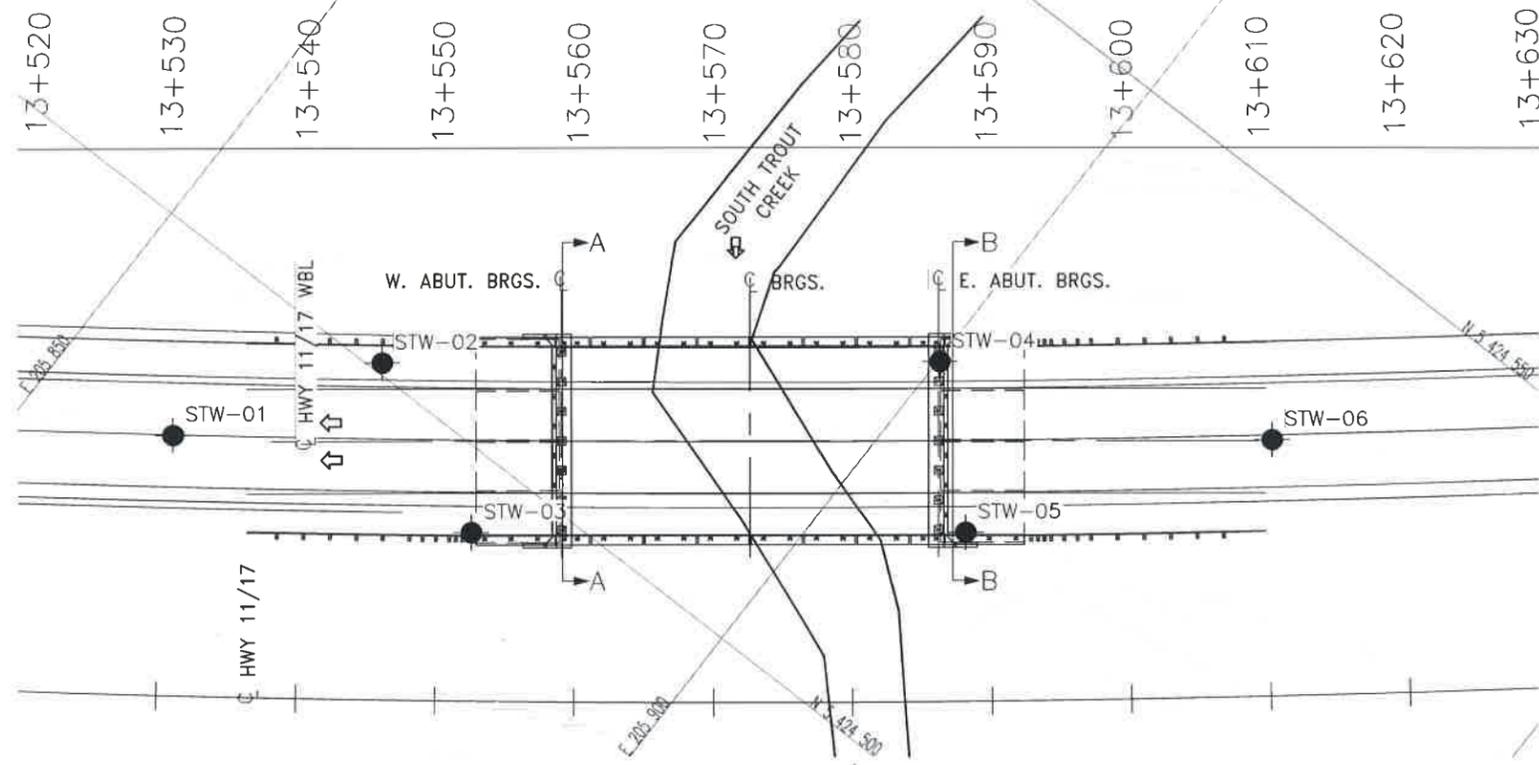
Photograph 2 – Existing conditions at South Trout Creek, looking north at northeast bank.



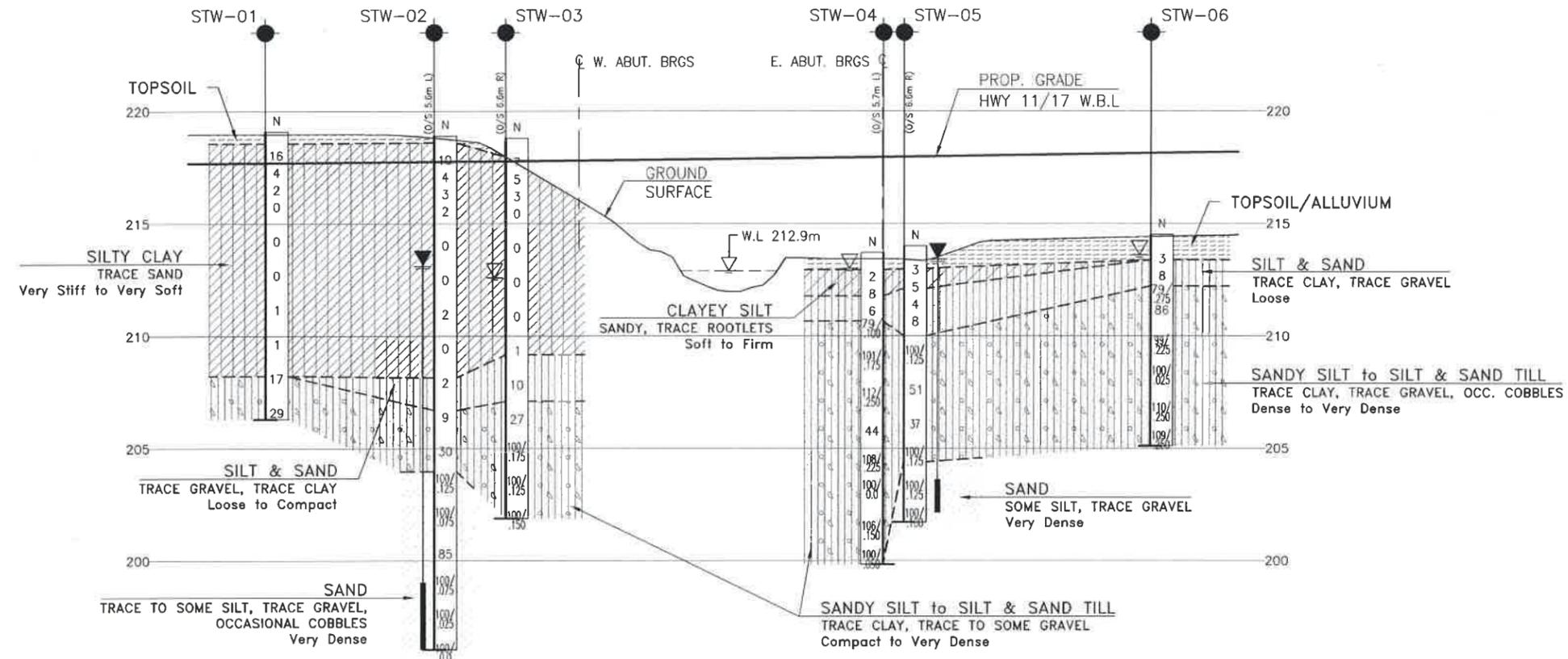
Photograph 3 – Existing conditions of the South Trout Creek

Appendix D

Borehole Locations and Soil Strata Drawings



PLAN
SCALE 1:500

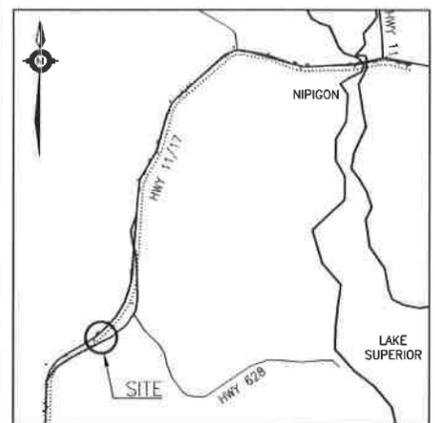


PROFILE ALONG \bar{C} HWY 11/17 WBL
H 1:500
V 1:250

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



CONT No
GWP No 647-89-00
HIGHWAY 11/17 FOUR LANING
SOUTH TROUT CREEK
WESTBOUND LANE
BOREHOLE LOCATIONS AND SOIL STRATA



KEYPLAN

LEGEND

- ◆ Borehole (Current Investigation)
- ◊ Borehole (Previous Investigation)
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60' Cone, 475J/blow)
- PH Pressure, Hydraulic
- ▽ Water Level During Drilling
- ↑ Water Level In Piezometer
- 90% Rock Quality Designation (ROD)
- A/R Auger Refusal

| NO | ELEVATION | NORTHING | EASTING |
|--------|-----------|-------------|-----------|
| STW-01 | 219.1 | 5 424 487.4 | 205 859.9 |
| STW-02 | 218.9 | 5 424 500.7 | 205 868.6 |
| STW-03 | 218.8 | 5 424 495.0 | 205 881.2 |
| STW-04 | 213.7 | 5 424 525.3 | 205 900.1 |
| STW-05 | 214.0 | 5 424 516.7 | 205 909.1 |
| STW-06 | 214.5 | 5 424 535.5 | 205 922.4 |

-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEORES No. 52A-177

| REVISIONS | DATE | BY | DESCRIPTION |
|-----------|------|----|-------------|
| | | | |
| | | | |

| DESIGN | MEF | CHK | MRA | CODE | LOAD | DATE |
|--------|-----|-----|-----|------|------|------|
| | | | | | | |

