DRAFT

FOUNDATION INVESTIGATION AND DESIGN REPORT
STRAWBERRY CREEK BRIDGE 2 REHABILITATION
HIGHWAY 102
THUNDER BAY DISTRICT, ONTARIO

G.W.P. 6073-09-00, SITE NO. 48W-2

Geocres Number:

Report to:

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TABLE OF CONTENTS

Appendices

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted at the existing Strawberry Creek Bridge 2 along Highway 102, in the District of Thunder Bay, Ontario.

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, stratigraphic profile and 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 MMM Group Limited, under the Ministry of Transportation Ontario (MTO) Agreement Number 6010-E-0011.

2 SITE DESCRIPTION

The existing Strawberry Creek Bridge 2 is located on Highway 102 in the community of Kaministiquia, approximately 6 km east of the intersection of Highways 102 and 11/17, and 25 km northwest of Thunder Bay. The existing bridge is a single-span structure with a concrete deck and steel girders supported on concrete abutments and steel H-piles. The bridge spans a length of approximately 21.3 m and is 11 m wide.

Strawberry Creek flows from south to north at this bridge site, but flows in an overall northeast to southwest direction in the area crossing Highway 102 at three locations before draining into the Kaministiquia River. The creek channel is approximately 10 m wide and 1.5 m deep at the site. The

surrounding lands are heavily wooded with occasional clearings for some residential and commercial usage along the highway. An active gravel pit is located approximately 500 m to the east.

Photographs in Appendix C show the general nature of the site and the existing bridge.

The site lies within the physiographic region known as the Wawa Subprovince of the Superior Province of the Canadian Shield. The soil deposits in the area comprise glaciofluvial outwash gravel. Bedrock at depth is formed of mafic to metavolcanic rocks.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this project were carried out between July 16 and 21, 2013 and consisted of drilling and sampling four boreholes, identified as Boreholes SBC2-01 to SBC4-04, through the highway embankment in the area of the existing west and east abutments and approaches. Boreholes SBC2-02 and SBC2-03 were drilled near the abutments to depths of 27.6 to 29.4 m, and Boreholes SCB2-01 and SBC2-04 were drilled through the approach embankments to depths of 9.8 m.

The approximate locations of the boreholes are shown on the attached Borehole Locations and Soil Strata Drawing in Appendix E.

The borehole locations were marked in the field and utility clearances were obtained prior to drilling. The coordinates and ground surface elevations for the boreholes were derived from topographic plans provided to Thurber by MMM Group Limited.

A truck-mounted CME 75 drill rig was used to advance the boreholes using NW casing/wash boring techniques. Soil samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). Dynamic Cone Penetration Tests (DCPTs) were conducted adjacent to Boreholes SBC2-02 and SBC2-03 on completion of drilling.

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 transporting to Thurber's laboratory for further examination and testing.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Groundwater conditions observed after completion of drilling were not representative of site conditions as water was used during wash boring and coring operations. Standpipe piezometers were installed in two boreholes to monitor the groundwater level after drilling. The piezometers were subsequently decommissioned and the boreholes without piezometers were backfilled in general accordance with MOE Regulation 903. Completion details of the piezometers and boreholes are summarized in Table 3.1.

Table 3.1 – Borehole Completion Details

Foundation Unit	Boreholes	Piezometer Tip Depth/ Elevation (m)	Completion Details
West Approach	SBC2-01	None installed	Borehole backfilled with bentonite holeplug from 9.8 m to 0.15 m, then asphalt to surface.
West Abutment	SBC2-02	27.3/ 291.5	Sand from 27.6 m to 23.2 m, bentonite holeplug from 23.2 m to 0.5 m, sand from 0.5 m to 0.15 m, then asphalt to surface.
East Abutment	SBC2-03	28.5/ 290.2	Sand from 29.4 m to 24.4 m, bentonite holeplug from 24.4 m to 0.15 m, then asphalt to surface.
East Approach	SBC2-04	None installed	Borehole backfilled with bentonite holeplug from 9.8 m to 0.15 m, then asphalt to surface.

4 LABORATORY TESTING

All recovered soil samples were subjected to visual identification and natural moisture content determination. Selected samples were also subjected to grain size distribution analyses (sieve and hydrometer) and Atterberg Limits tests. 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 stratigraphy are presented in these sheets and on the "Borehole Locations and Soil Strata" drawing included in Appendix E. 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. It must be recognized that soil conditions may vary between and beyond the borehole locations.

The soil stratigraphy typically comprises a gravelly sand to sand and gravel embankment fill, underlain by native sand and gravel over sand. More detailed descriptions of the individual strata are presented below.

5.1 Asphalt and Concrete

Asphalt was encountered in all the boreholes, which were drilled from the existing Highway 102 roadway. The asphalt layer was 125 mm thick at the four borehole locations. A concrete slab (125 to 250 mm thick) with steel rebar was encountered below the asphalt in Boreholes SBC2-02 and SBC2-03 near the bridge abutments.

5.2 Embankment Fill

The existing highway embankment fill beneath the asphalt typically comprised a brown sand and gravel ranging to sandy gravel and containing trace silt and occasional cobbles. The lower

portion of the embankment fill at the bridge approaches (below 2.3 to 2.6 m depth at Boreholes SBC2-01 and SBC2-04) transitioned to clayey sand with some silt and trace gravel. The embankment fill has a total thickness of 3.9 to 4.3 m with a lower boundary at depths of 4.0 to 4.6 m (Elev. 314.7 to 314.1).

SPT 'N' values recorded in the sand and gravel fill typically ranged from 14 to 53 blows per 0.3 m penetration, indicating a compact to very dense relative density. The clayey sand fill was loose to compact, based on SPT 'N' values of 4 to 13 blows per 0.3 m penetration.

Measured moisture contents of the fill ranged from 1% to 12% in the sand and gravel and from 20% to 50% in the clayey sand.

The results of grain size analysis tests conducted on the embankment fill are summarized below. These results are also presented on the Record of Borehole sheets included in Appendix A. The grain size distribution curves for these samples are shown on Figures B1 and B2 of Appendix B.

Sandy Gravel to Sand and Gravel Fill:

Gravel %	54 to 78
Sand %	21 to 42
Silt & Clay %	1 to 5

Clayey Sand Fill:

Gravel %	0 to 1
Sand %	50 to 53
Silt %	14 to 17
Clay %	32 to 35

Atterberg Limits testing conducted on one sample of the clayey sand indicate that the fill has intermediate plasticity, with a group symbol of CI. The results are plotted on Figure B5 of Appendix B.

5.3 Sand and Gravel

A native deposit of brown to grey sand and gravel containing occasional cobbles and boulders and trace to some silt was encountered below the embankment fill in Boreholes SBC2-01, SBC2-02 and SBC2-03. Where fully penetrated, the sand and gravel deposit had a thickness of 13.7 and 7.6 m, with lower boundary at depths of 18.3 and 12.2 m (Elev. 300.5 and 306.5). Borehole SBC2-01 was terminated within the sand and gravel deposit at a depth of 9.8 m (Elev. 309.0).

SPT 'N' values obtained in the sand and gravel ranged from 14 blows for 0.3 m penetration to 50 blows for 0.05 m penetration, indicating a compact to very dense relative density. Measured moisture contents ranged from 8% to 16%.

Selected samples of sand and gravel underwent laboratory grain size analysis testing, the results of which are summarized below. These results are also presented on the Record of Borehole sheets included in Appendix A. The grain size distribution curves for these samples are shown on Figure B3 of Appendix B.

Gravel %	44 to 56
Sand %	38 to 50
Silt & Clay %	3 to 14

5.4 Sand

A native deposit of brown sand with trace to some gravel, trace silt to silty and occasional cobbles and boulders was encountered below the sand and gravel in Boreholes SBC2-02 and SBC2-03, and below the embankment fill in Borehole SBC2-04. The boreholes were each terminated within the sand deposit at depths of 9.8 to 29.4 m (Elev. 308.8 to 289.3).

SPT 'N' values obtained in the sand typically ranged from 17 blows for 0.3 m penetration to 100 blows for 0.025 m penetration, indicating a compact to very dense relative density. A loose zone with 'N' values of 8 and 6 blows for 0.3 m penetration was encountered between 13.0 and 16.0 m depths in Borehole SBC2-03. Measured moisture contents ranged from 14% to 35%.

Selected samples of the sand underwent laboratory grain size analysis testing, the results of which are summarized below. These results are also presented on the Record of Borehole sheets included in Appendix A. The grain size distribution curves for these samples are shown on Figure B4 of Appendix B.

Gravel %	0 to 19
Sand %	70 to 94
Silt & Clay %	4 to 30

5.5 Water Levels

Where possible, water levels were monitored in the open boreholes during drilling operations. Wash boring methods were used to advance the boreholes and therefore water levels recorded during or upon completion of drilling may not reflect natural groundwater levels. Standpipe piezometers were installed in two boreholes to monitor the groundwater level after completion. The water levels observed in the open boreholes upon completion and 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)	
SBC2-02	July 21, 2013	4.7	314.1	Open Borehole
	August 1, 2013	5.3	313.5	In piezometer
	May 2, 2014	3.6	315.2	In piezometer
SBC2-03	July 19, 2013	4.6	314.1	Open borehole
	August 1, 2013	5.0	313.7	In piezometer
	May 2, 2014	3.7	315.0	In piezometer

The preliminary General Arrangement drawings provided by MMM Group Limited indicates a water level at approximate Elev. 314.5 in Strawberry Creek in February 1972. In general, the groundwater level is expected to be at or slightly above the water level in the creek.

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

6 MISCELLANEOUS

Borehole locations were selected and established in the field by Thurber Engineering Ltd. The coordinates and the ground surface elevations for the boreholes were established based on topographic survey information provided by MMM Group Limited.

Thurber obtained utility clearances for the borehole locations prior to drilling.

Eastern Ontario Diamond Drilling of Hawkesbury, Ontario supplied a truck-mounted CME-75 drill rig and conducted the drilling, sampling and in-situ testing operations for the boreholes. The drilling operations were supervised by Ms. Eckie Siu of Thurber.

Overall supervision of the field program, interpretation of the data, and preparation of the report were carried out by Mr. Mark Farrant P.Eng.

The report was reviewed by Mr. Murray Anderson, P.Eng. and Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

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PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

7 GENERAL

This report presents interpretation of the geotechnical data in the factual report and provides geotechnical recommendations for the proposed rehabilitation of the existing Strawberry Creek Bridge 2 on Highway 102, in the District of Thunder Bay, Ontario.

At present, the bridge carries Highway 102 over Strawberry Creek on a single-span structure with a span length of 21.3 m and a deck width of 11 m. Archive drawings dated May 1973 indicate that the existing bridge abutments are supported on two rows of battered steel HP310x79 piles driven to a design load of 70 tons (700 kN) per pile based on the Hiley Formula. The existing approach fill heights above the surrounding ground are approximately 3 m at both abutments.

Based on the GA drawing dated August 2014, rehabilitation of the bridge will consist of replacement of the existing deck slab with a new precast concrete deck. The rehabilitation will include modification of the tops of the abutments and wingwalls, and replacement of the approach slabs. Grade raises of 120 mm and 170 mm are proposed at the west and east approaches, respectively. Widening of the bridge deck is not proposed.

The discussion and recommendations presented in this report are based on the information provided by MMM Group Limited and on the factual data obtained in the course of the investigation.

8 ASSESSMENT OF EXISTING ABUTMENT FOUNDATIONS

The subsurface stratigraphy encountered at this site generally consists of sand and gravel fill to clayey sand fill underlain by a layer of compact to very dense native sand and gravel overlying loose

to very dense sand. The fill and native deposits contain occasional cobbles and boulders. Bedrock was not encountered within the drilling depths of 27.6 and 29.4 m (Elev. 291.2 and 289.3) at the abutments.

The archive drawings for the existing bridge indicate that each abutment is supported on ten HP310x79 piles battered at inclinations varying from 1H: 4V to 1H: 6V. Pile lengths of 25.3 and 27.4 m are indicated for the west and east abutment, respectively. The pile caps are 760 mm thick with a top at elevation 314.9 m, and the top of pile is embedded 300 mm into the bottom of the pile cap.

Assuming installation of the full length of supplied pile, the design pile tip levels would be at approximate elevation 289.4 to 289.9 at the west abutment and elevation 287.3 to 287.8 m at the east abutment. Pile driving records were not available to confirm the actual pile tip elevations as driven. Based on the borehole data, it is likely that the piles were driven into very dense sand encountered below approximate elevations 295 and 292 m at the west and east abutments, respectively.

As the depth of pile penetration cannot be confirmed and the design allowable pile capacity for pile driving was 700 kN per pile, it is recommended that resistances of 1,000 kN per pile at factored ULS and 800 kN per pile at SLS be employed to assess the capability of the existing piles to support the rehabilitated bridge loads.

It is understood from MMM that due to the deck replacement there will be a slight increase in load on the foundation but that it should be less than 10% of the existing load. Supporting the new deck on the existing pile foundations is therefore considered to be acceptable from a geotechnical viewpoint. The Structural Designer must verify that the strength and integrity of the existing foundations is adequate to carry the foundation loads.

Resistance to lateral loads will be provided by the horizontal component of the batter piles.

In view of the cohesionless soil conditions at this site, downdrag on the piles due to the slight grade raise is not an issue.

The design depth of frost penetration at this site is 2.2 m. Existing pile caps constructed over the native sand and gravel are not considered to be susceptible to frost action.

9 ABUTMENT BACKFILL AND LATERAL EARTH PRESSURES

Any new backfill behind the modified abutment and wing walls should be placed in accordance with OPSS 902. All backfill material should consist of Granular A, Granular B Type II or Granular B Type III material meeting the specifications of OPSS.PROV 1010. Compaction equipment to be used adjacent to the walls should be restricted in accordance with OPSS 501.

Lateral earth pressures acting on the abutment walls may be assumed to be distributed triangularly and to be governed by the characteristics of the wall backfill. For a fully drained condition, the pressures should be computed in accordance with the CHBDC but generally are given by the expression:

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

Where: p_h = horizontal pressure on the wall at depth h (kPa)

K = earth pressure coefficient (see Table 9.1)

γ = unit weight of retained soil (see Table 9.1)

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

q = value of any surcharge (kPa)

Earth pressure coefficients for backfill to the abutment wall are dependent on the material used as backfill and the existing material adjacent to the wall. Typical values are given in Table 9.1.

Table 9.1 – Earth Pressure Coefficients (K)

Condition	OPSS Granular A or Granular B Type II $\phi = 35°, \gamma = 22.8$ kN/m^3		OPSS Granular B Type I, Granular B Type III or Existing Granular Fill $\phi = 32°, \gamma = 21.2$ kN/m^3	
	Horizontal Surface Behind Wall	Sloping Backfill (2H:1V)	Horizontal Surface Behind Wall	Sloping Backfill (2H:1V)
Active (Unrestrained Wall)	0.27	0.38*	0.31	0.46*
At Rest (Restrained Wall)	0.43	-	0.47	-
Passive	3.7	-	3.3	-

* For wing walls.

The use of a material with a high friction angle and low active pressure coefficient (Granular A, Granular B Type II) is preferred as it results in lower earth pressures acting on the wall.

The earth pressure coefficients in Table 9.1 are "ultimate" values and require certain movements for the respective conditions to be mobilized. The values to use in design may be estimated from Figure C6.16 in the Commentary to the Canadian Highway Bridge Design Code.

In accordance with Clause 6.9.3 of the CHBDC, a compaction surcharge should be added. The magnitude should be 12 kPa at the top of fill and decreasing to 0 kPa at a depth of 2.0 m for Granular B Type I or III, or at a depth of 1.7 m for Granular A or Granular B Type II.

10 SEISMIC CONSIDERATIONS

The following seismic parameters should be used for design:

- Velocity Related Seismic Zone 0
- Zonal Velocity Ratio 0.0
- Acceleration Related Seismic Zone 0
- Zonal Acceleration Ratio 0.0
- Peak Horizontal Acceleration 0.036

The soil profile type at this site has been classified as Type I. Therefore, according to Table 4.4 of the CHBDC, a Site Coefficient "S" (ground motion amplification factor) of 1.0 should be used in seismic design.

In accordance with Clause 4.6.4 of the CHBDC, retaining structures should be designed using active (K_{AE}) and passive (K_{PE}) earth pressure coefficients that incorporate the effects of earthquake loading. The coefficients of horizontal earth pressure for seismic loading presented in Table 10.1 may be used.

Based on review of the SPT data, the foundation soils at this site are assessed as not being prone to liquefaction.

Table 10.1 – Earth Pressure Coefficients for Earthquake Loading (K_E)

Conditions	OPSS Granular A or Granular B Type II $\phi = 35°; \gamma = 22.8$ kN/m^3		OPSS Granular B Type I or Existing Granular Fill $\phi = 32°, \gamma = 21.2$ kN/m^3	
	Horizontal Surface Behind Wall	Sloping Backfill (2H:1V)	Horizontal Surface Behind Wall	Sloping Backfill (2H:1V)
Active (K_{AE})*	0.28	0.42	0.32	0.51
Passive (K_{PE})	3.6	-	3.2	-
At Rest (K_{OE})**	0.47	-	0.52	-

* After Mononobe and Okabe, passive case assumes a horizontal surface in front of the wall.
** After Woods

11 SCOUR AND EROSION CONTROL

Erosion protection must be provided along any soil surfaces that may be in contact with the river flow. In particular, erosion should be provided along the toe of the embankment slopes where not protected by wingwalls.

A vegetation cover should be established on all other exposed earth surfaces to protect against surficial erosion, in general accordance with OPSS 804.

12 EXCAVATION AND GROUNDWATER CONTROL

Excavation to carry out modifications to the existing abutments is expected to be limited to the existing granular embankment fill above the river and groundwater levels.

All excavations must be carried out in accordance with OPSS 902 and the requirements of the Occupational Health and Safety Act (OHSA). For the purposes of the OHSA, the approach fill within the depth of excavation may be classed as Type 3 soil above the water table.

The selection of the method of excavation is the responsibility of the Contractor and must be based on his equipment, experience and interpretation of the site conditions. It is anticipated that a hydraulic excavator will be suitable. Provision must be made for the handling of pavement materials, potential obstructions in the fill, and cobbles and boulders.

Bridge rehabilitation will be carried out in stages to maintain one traffic lane operational at all times. Roadway protection will be required to facilitate staging. Roadway protection should be provided in accordance with OPSS 539 and designed for Performance Level 2.

The design of any road protection or dewatering system that may be required is the responsibility of the Contractor. All shoring systems should be designed by a Professional Engineer experienced in such designs.

13 APPROACH EMBANKMENTS

Grade raises of 120 mm and 170 mm are planned at the west and east abutment, respectively. In view of the soil conditions at this site, settlement or stability issues are not anticipated for the existing approach embankments.

14 CONSTRUCTION CONCERNS

Potential construction concerns include, but are not necessarily limited to:

- The existing embankment fill contains occasional cobbles which may interfere with excavation or installation of temporary roadway protection systems.
- Water levels in the creek may fluctuate during construction.

15 CLOSURE

Engineering analysis and preparation of the report were carried out by Mr. Keli Shi, P.Eng. The report was reviewed by Mr. Murray Anderson, P.Eng. and Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

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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.

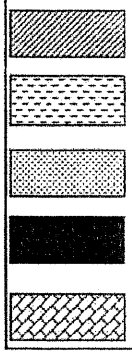
(2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

EXPLANATION OF ROCK LOGGING TERMS

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

DISCONTINUITY SPACING	
Bedding	**Bedding Plane Spacing**
Very thickly bedded	Greater than 2m
Thickly bedded	0.6 to 2m
Medium bedded	0.2 to 0.6m
Thinly bedded	60mm to 0.2m
Very thinly bedded	20 to 60mm
Laminated	6 to 20mm
Thinly Laminated	Less than 6mm

SYMBOLS



CLAYSTONE

SILTSTONE

SANDSTONE

COAL

BEDROCK

STRENGTH CLASSIFICATION			
Rock Strength	**Approximate Uniaxial Compressive Strength**		**Field Estimation of Hardness***
	(MPa)	**(psi)**	
Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

TERMS	
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length
Solid Core Recovery:(SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run
Rock Quality Designation:(RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a % of total core run length.
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen
Fracture Index:(FI)	Frequency of natural fractures per 0.3m of core run.

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			

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No SBC2-01 1 OF 2 METRIC

WP# 6073-09-00 LOCATION Strawberry Creek Bridge 2 N 5 377 446.0 E 336 480.3 ORIGINATED BY ES

HWY 102 BOREHOLE TYPE NW Casing COMPILED BY AN

DATUM Geodetic DATE 2013.07.19 - 2013.07.19 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
318.8	GROUND SURFACE										
0.0	**ASPHALT:** (125mm)										
0.1	**SAND** and **GRAVEL**, trace silt Compact to Very Dense Brown Moist (FILL)		1	SS	19		318		○		54 42 4 (SI+CL)
	Wet		2	SS	51		317		○		
316.2			3	SS	50				○		0 53 15 32
2.6	Clayey **SAND**, some silt, trace gravel Loose Brown Wet (FILL)		4	SS	4		316		○		1 50 14 35
314.7							315				
4.1	**SAND** and **GRAVEL**, trace silt, occasional cobbles Very Dense to Dense Brown Wet		5	SS	50/ 0.125		314				
			6	SS	30		313		○		
	Cobbles						312				
			7	SS	32		311		○		
	Cobbles (150mm)						310				
309.0			8	SS	38				○		
9.8	END OF BOREHOLE AT 9.8m.										

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
10

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No SBC2-01 2 OF 2 METRIC

WP# 6073-09-00 LOCATION Strawberry Creek Bridge 2 N 5 377 446.0 E 336 480.3 ORIGINATED BY ES

HWY 102 BOREHOLE TYPE NW Casing COMPILED BY AN

DATUM Geodetic DATE 2013.07.19 - 2013.07.19 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.15m, THEN ASPHALT TO SURFACE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No SBC2-02 1 OF 3 METRIC

WP# 6073-09-00 LOCATION Strawberry Creek Bridge 2 N 5 377 455.0 E 336 492.1 ORIGINATED BY ES

HWY 102 BOREHOLE TYPE NW Casing/Dynamic Cone Penetration Test COMPILED BY AN

DATUM Geodetic DATE 2013.07.19 - 2013.07.21 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (UNCONFINED, FIELD VANE, QUICK TRIAXIAL, LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
318.8	GROUND SURFACE										
0.0	**ASPHALT:** (125mm)										
318.5 / 0.3	**CONCRETE:** (125mm)										
0.3	Sandy **GRAVEL** to **SAND** and **GRAVEL**, trace silt, occasional cobbles Very Dense to Compact Brown (FILL)		1	SS	50/0.125		318				
			2	SS	18		317				73 25 2 (SI+CL)
			3	SS	14		316				
			4	SS	19	▼	315				
314.2											
4.6	**SAND** and **GRAVEL**, trace silt, occasional cobbles Very Dense to Compact Brown Wet		5	SS	50/0.050		314				
			6	SS	17		313				47 50 3 (SI+CL)
	Becoming grey		7	SS	14		312				
			8	SS	21		311				
							310				
							309				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No SBC2-02 2 OF 3 METRIC

WP# 6073-09-00 LOCATION Strawberry Creek Bridge 2 N 5 377 455.0 E 336 492.1 ORIGINATED BY ES
HWY 102 BOREHOLE TYPE NW Casing/Dynamic Cone Penetration Test COMPILED BY AN
DATUM Geodetic DATE 2013.07.19 - 2013.07.21 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	SAND and **GRAVEL**, trace silt, occasional cobbles Dense to Compact Grey Wet										
			9	SS	47		308		○		
							307				
			10	SS	25				○		
							306				
			11	SS	32		305		○		56 38 6 (SI+CL)
							304				
			12	SS	47				○		
							303				
			13	SS	45		302		○		
300.5											
18.3	**SAND**, trace gravel, trace silt, occasional cobbles Compact to Very Dense Grey Wet		14	SS	24		301		○		1 94 5 (SI+CL)
							300				
	Cobbles (125mm)						299				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE

ONTMT4S 1197.GPJ 2012TEMPLATE(MTO).GDT 10/6/14

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No SBC2-02 3 OF 3 METRIC

WP# 6073-09-00 LOCATION Strawberry Creek Bridge 2 N 5 377 455.0 E 336 492.1 ORIGINATED BY ES

HWY 102 BOREHOLE TYPE NW Casing/Dynamic Cone Penetration Test COMPILED BY AN

DATUM Geodetic DATE 2013.07.19 - 2013.07.21 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	SAND, trace gravel, trace silt, occasional cobbles and boulders Very Dense Grey Wet						298				
			15	SS	89/ 0.250		297		○		
							296				
							295				
	boulder (200mm)		16	SS	100/ 0.100		294		○		
			17	SS	100/ 0.025		293				
	Boulder (330mm)						292				
291.2			18	SS	100/				○		
27.6	END OF BOREHOLE AT 27.6m. WATER LEVEL AT 4.7m UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Aug. 01/13 5.3 313.5 May 02/14 3.6 315.2				0.125						

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
10

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No SBC2-03 1 OF 4 METRIC

WP# 6073-09-00 LOCATION Strawberry Creek Bridge 2 N 5 377 457.6 E 336 517.9 ORIGINATED BY ES

HWY 102 BOREHOLE TYPE NW Casing/Dynamic Cone Penetration Test COMPILED BY AN

DATUM Geodetic DATE 2013.07.16 - 2013.07.19 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
318.7	GROUND SURFACE						
0.0	**ASPHALT:** (125mm)						
0.1 / 318.3	**CONCRETE SLAB**, steel rebar:						
0.4	(250mm)						
	Sandy **GRAVEL** to **SAND** and **GRAVEL**, trace silt, occasional cobbles Very Dense to Compact Brown Moist (FILL)		1	SS	53		
			2	SS	17		
			3	SS	17		
			4	SS	20		
314.1							
4.6	**SAND** and **GRAVEL**, some silt Very Dense to Compact Brown Wet		5	SS	53		
	Boulder (350mm) at 5.6m		6	SS	24		
	Occasional cobbles		7	SS	28		
			8	SS	16		

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100
SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
20 40 60

UNIT WEIGHT γ kN/m^3

REMARKS & GRAIN SIZE DISTRIBUTION (%)

	GR	SA	SI	CL
1	64	31	5	(SI+CL)
5	44	42	14	(SI+CL)

ELEVATION SCALE: 318, 317, 316, 315, 314, 313, 312, 311, 310, 309

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No SBC2-03 2 OF 4 METRIC

WP# 6073-09-00 LOCATION Strawberry Creek Bridge 2 N 5 377 457.6 E 336 517.9 ORIGINATED BY ES

HWY 102 BOREHOLE TYPE NW Casing/Dynamic Cone Penetration Test COMPILED BY AN

DATUM Geodetic DATE 2013.07.16 - 2013.07.19 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	SAND and **GRAVEL**, some silt Compact Brown Wet										
	Occasional cobbles		9	SS	28		308		○		
306.5							307				
12.2	**SAND**, trace to some gravel, trace silt, trace clay Loose to Very Dense Brown Wet		10	SS	32		306		○		19 73 8 (SI+CL)
			11	SS	8		305		○		
			12	SS	6		304		○		
			13	SS	17		303		○		12 84 4 (SI+CL)
			14	SS	23		302		○		
							301				
							300		○		
							299				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \cdot 5}$ (%) STRAIN AT FAILURE

ONTMT4S 1197.GPJ 2012TEMPLATE(MTO).GDT 10/6/14

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No SBC2-03 3 OF 4 METRIC

WP# 6073-09-00 LOCATION Strawberry Creek Bridge 2 N 5 377 457.6 E 336 517.9 ORIGINATED BY ES

HWY 102 BOREHOLE TYPE NW Casing/Dynamic Cone Penetration Test COMPILED BY AN

DATUM Geodetic DATE 2013.07.16 - 2013.07.19 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	SAND, trace to some gravel, trace silt, trace clay Loose to Very Dense Brown Wet						298				
			15	SS	24		297		○		
							296				
							295				
	Becoming silty		16	SS	78		294		○		0 70 27 3
	Boulders (485mm)						293				
							292				
			17	SS	100/ 0.025		291				
289.3							290				
29.4	END OF BOREHOLE UPON REFUSAL TO DCPT AT 29.4m. WATER LEVEL AT 4.6m UPON COMPLETION.										

Continued Next Page

+ ³, × ³: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No SBC2-03 4 OF 4 METRIC

WP# 6073-09-00 LOCATION Strawberry Creek Bridge 2 N 5 377 457.6 E 336 517.9 ORIGINATED BY ES

HWY 102 BOREHOLE TYPE NW Casing/Dynamic Cone Penetration Test COMPILED BY AN

DATUM Geodetic DATE 2013.07.16 - 2013.07.19 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Aug. 01/13 5.0 313.7 May 02/14 3.7 315.0										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \cdot 10 \cdot 5}$ (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No SBC2-04 1 OF 2 METRIC

WP# 6073-09-00 LOCATION Strawberry Creek Bridge 2 N 5 377 466.5 E 336 529.7 ORIGINATED BY ES

HWY 102 BOREHOLE TYPE NW Casing COMPILED BY AN

DATUM Geodetic DATE 2013.07.21 - 2013.07.21 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
318.6	GROUND SURFACE										
0.0	**ASPHALT:** (125mm)										
0.1	Sandy **GRAVEL** to **SAND** and **GRAVEL**, trace silt, occasional cobbles Compact to Dense Brown Wet (FILL)		1	SS	16		318				78 21 1 (SI+CL)
			2	SS	36		317				
316.3											
2.3	Clayey **SAND**, some silt, trace gravel Compact to Loose Brown (FILL)(CI)		3	SS	13		316				
			4	SS	6		315				1 50 17 32
314.6											
4.0	**SAND**, some gravel, trace silt, occasional cobbles Dense to Compact Brown Moist		5	SS	39		314				17 74 9 (SI+CL)
			6	SS	32		313				
			7	SS	23		312				
			8	SS	31		311				
308.8							310				
9.8	END OF BOREHOLE AT 9.8m.						309				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No SBC2-04 2 OF 2 METRIC

WP# 6073-09-00 LOCATION Strawberry Creek Bridge 2 N 5 377 466.5 E 336 529.7 ORIGINATED BY ES

HWY 102 BOREHOLE TYPE NW Casing COMPILED BY AN

DATUM Geodetic DATE 2013.07.21 - 2013.07.21 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.15m, THEN ASPHALT TO SURFACE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

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Appendix B

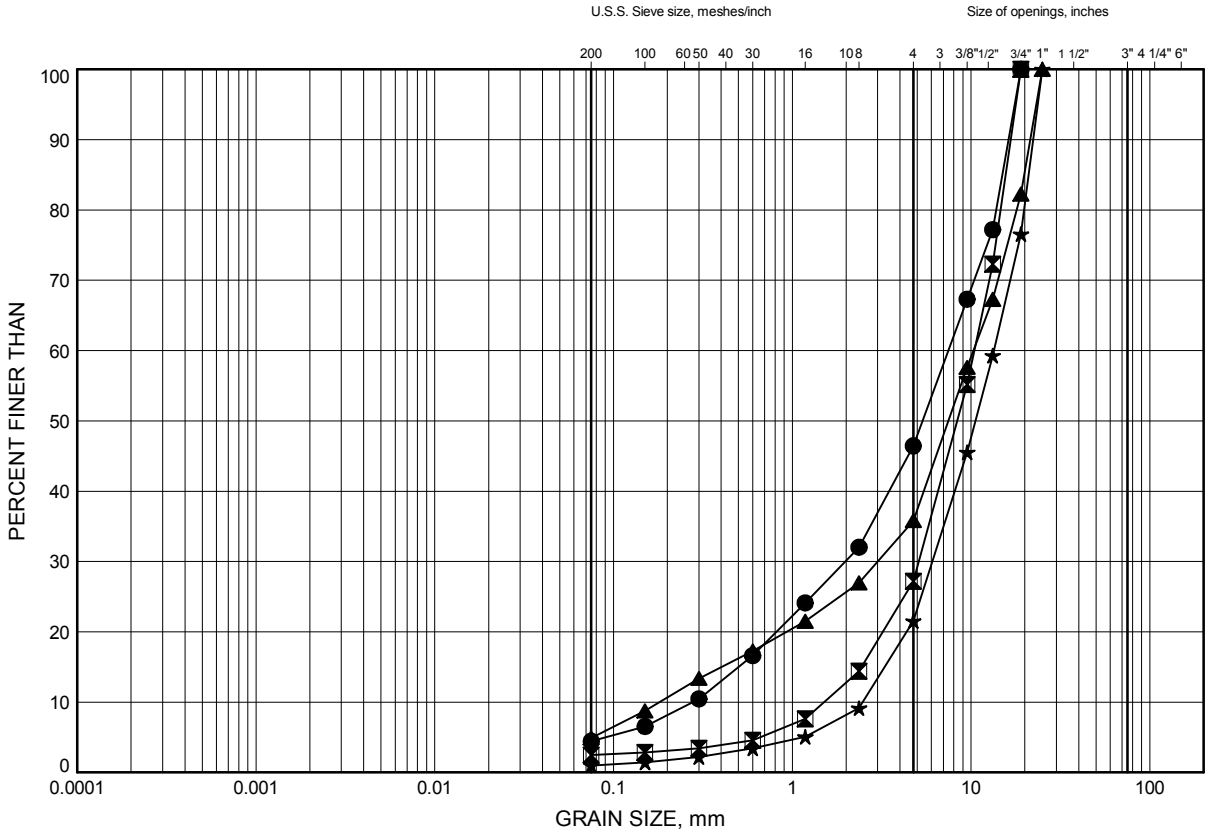
Laboratory Test Results

Strawberry Creek Bridge 2

GRAIN SIZE DISTRIBUTION

FIGURE B1

SANDY GRAVEL TO SAND & GRAVEL FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	SBC2-01	1.07	317.73
⊠	SBC2-02	1.83	316.97
▲	SBC2-03	1.07	317.63
★	SBC2-04	1.07	317.53

Date September 2014

WP# 6073-09-00

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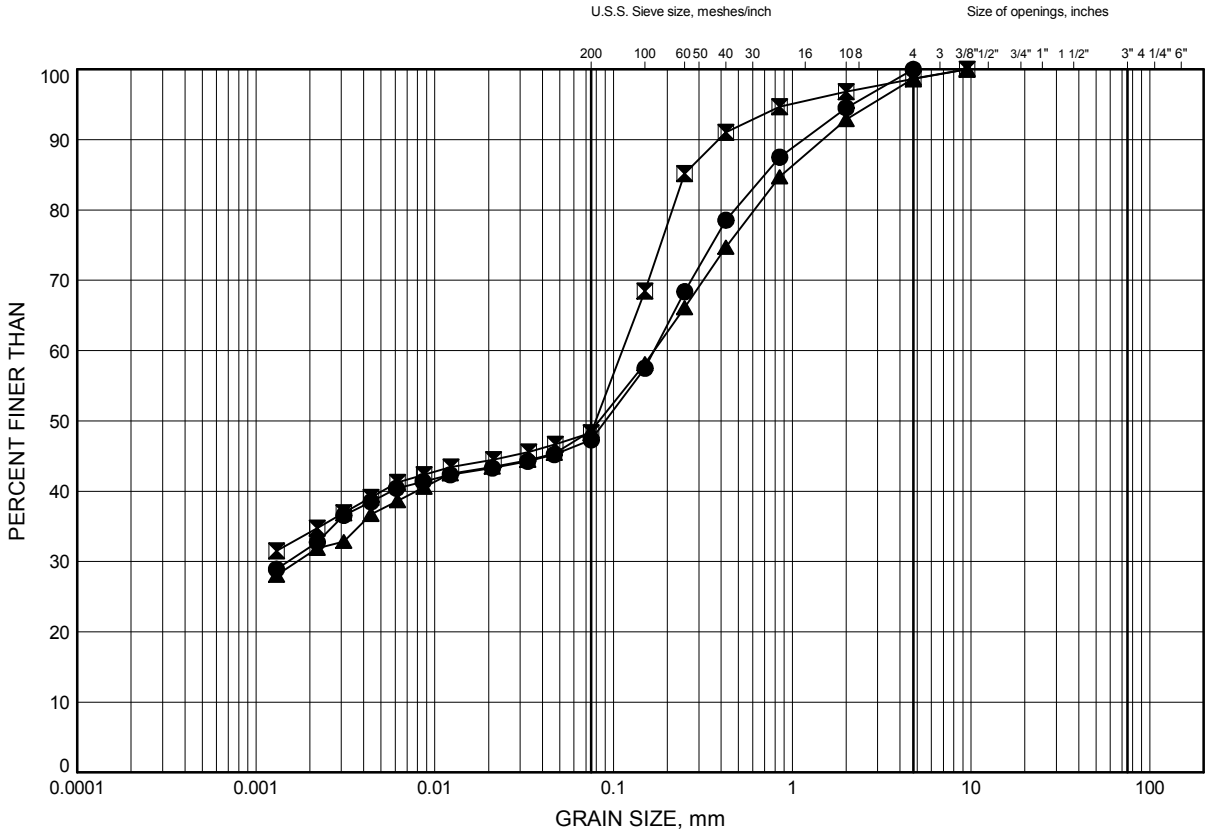
GRAIN SIZE DISTRIBUTION - THURBER 1197.GPJ 9/26/14

Strawberry Creek Bridge 2

GRAIN SIZE DISTRIBUTION

FIGURE B2

CLAYEY SAND FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	SBC2-01	2.59	316.21
⊠	SBC2-01	3.35	315.45
▲	SBC2-04	3.35	315.25

Date September 2014

WP# 6073-09-00

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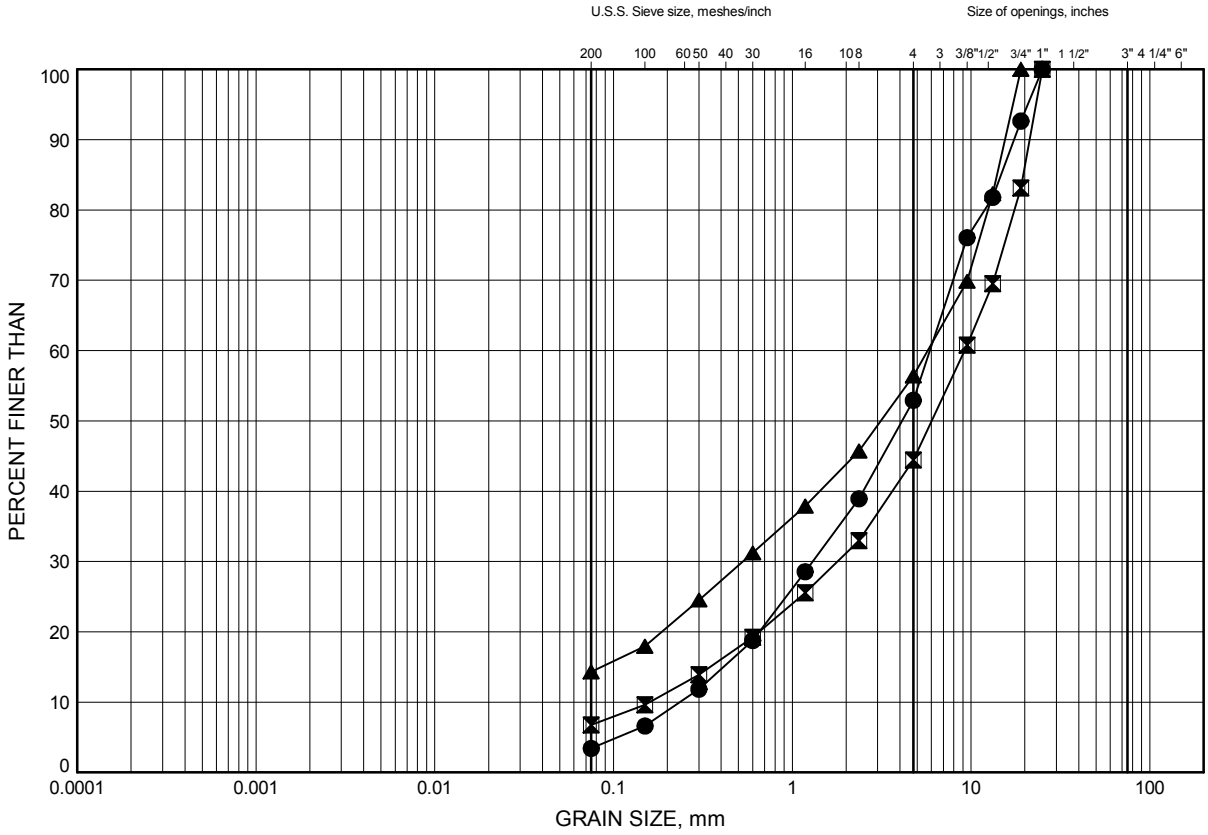
GRAIN SIZE DISTRIBUTION - THURBER 1197.GPJ 9/26/14

Strawberry Creek Bridge 2

GRAIN SIZE DISTRIBUTION

FIGURE B3

SAND & GRAVEL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	SBC2-02	6.40	312.40
⊠	SBC2-02	14.02	304.78
▲	SBC2-03	4.80	313.90

Date September 2014

WP# 6073-09-00

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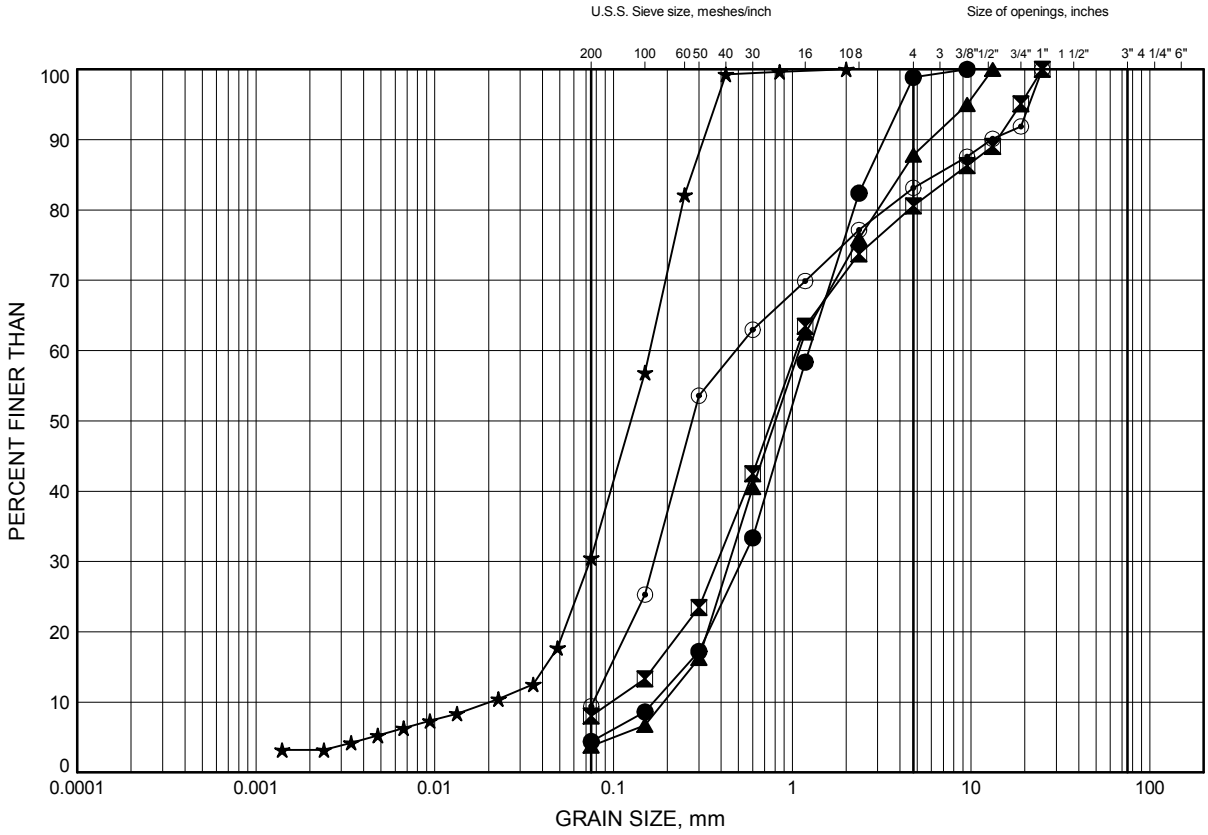
GRAIN SIZE DISTRIBUTION - THURBER 1197.GPJ 9/26/14

Strawberry Creek Bridge 2

GRAIN SIZE DISTRIBUTION

FIGURE B4

SAND



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	SBC2-02	18.59	300.21
⊠	SBC2-03	12.50	306.20
▲	SBC2-03	17.07	301.63
★	SBC2-03	24.65	294.05
⊙	SBC2-04	4.88	313.72

Date September 2014

WP# 6073-09-00

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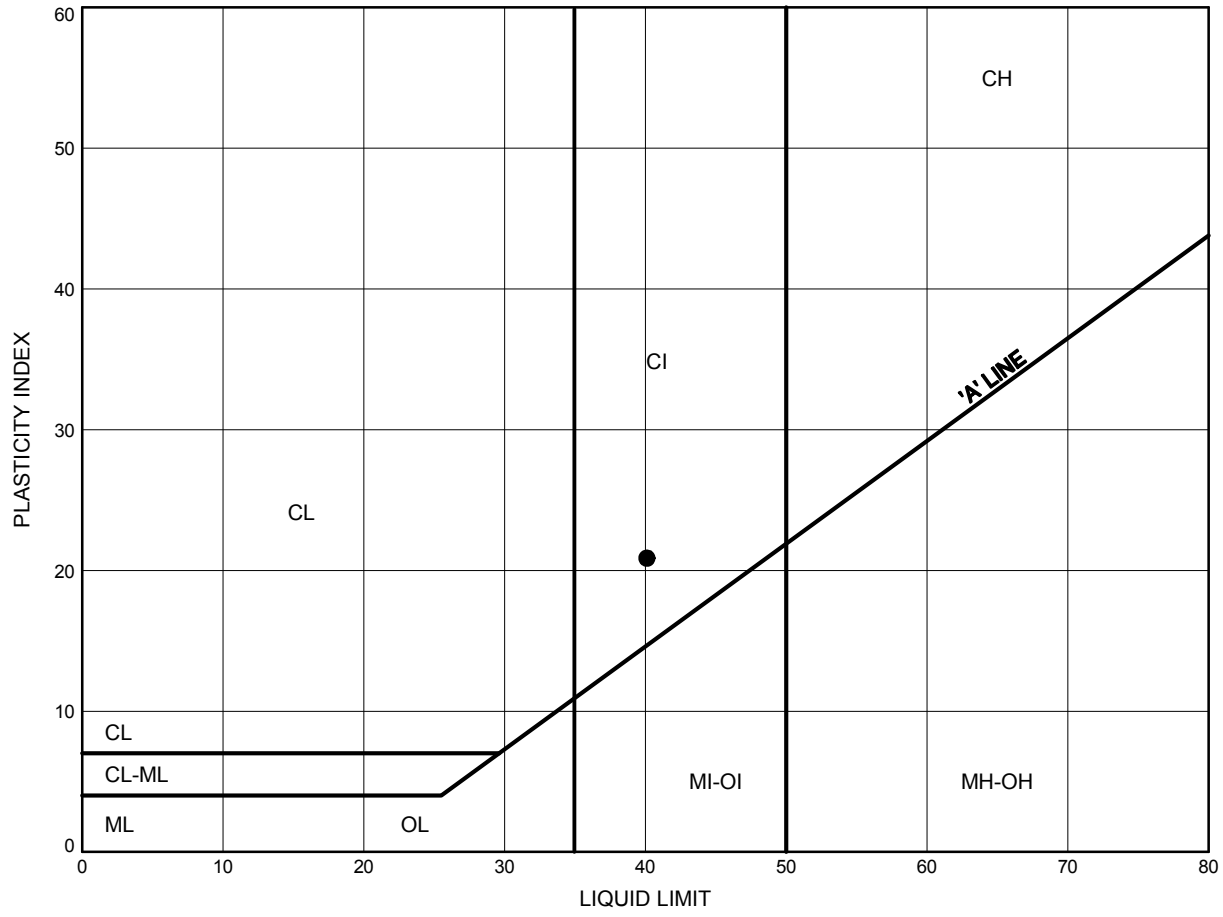
GRAIN SIZE DISTRIBUTION - THURBER 1197.GPJ 9/26/14

Strawberry Creek Bridge 2

ATTERBERG LIMITS TEST RESULTS

FIGURE B5

CLAYEY SAND FILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	SBC2-04	3.35	315.25

Date September 2014

WP# 6073-09-00

THURBER

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THURBALT 1197.GPJ 9/26/14

Appendix C

Site Photographs

Photograph 1 – East approach, looking west

Photograph 2 – West approach, looking east

Appendix D

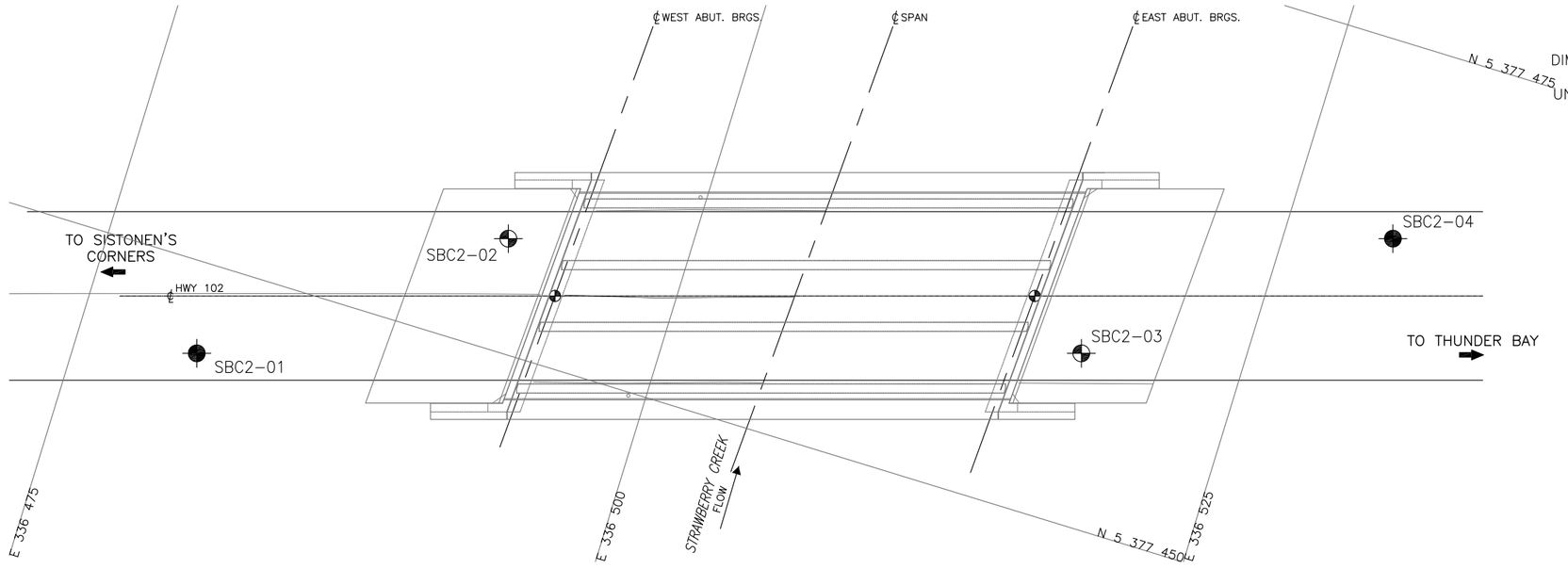
List of SPs and OPSS, and Suggested Text for Selected NSSP

1. List of Special Provisions and OPSS Documents Referenced in this Report

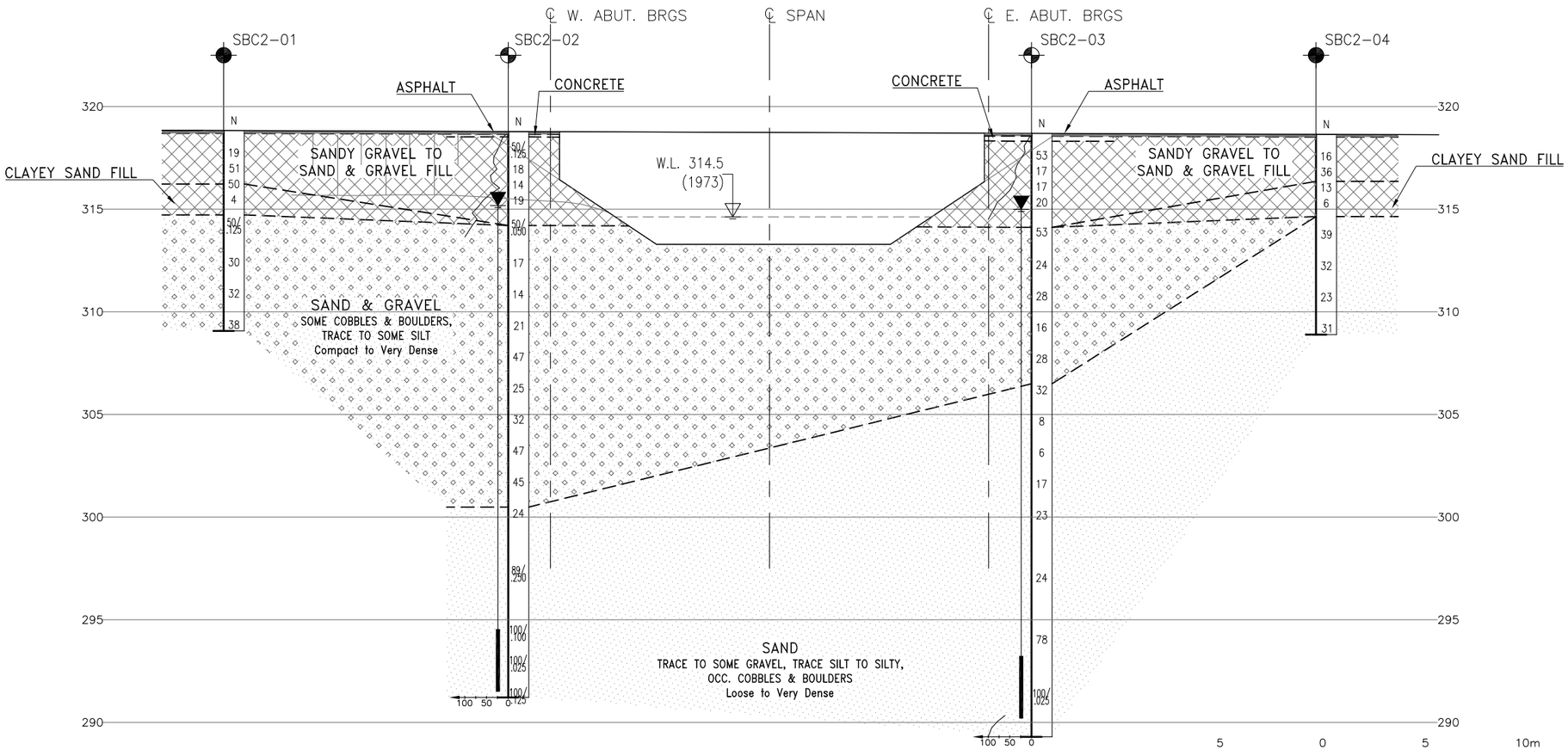
- OPSS 501
- OPSS 539
- OPSS 804
- OPSS 902
- OPSS.PROV 1010

Appendix E

Borehole Locations and Soil Strata Drawing



PLAN



PROFILE ALONG ℄ HWY. 102

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

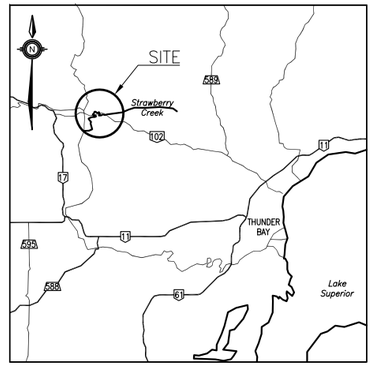
CONT No
WP No 6073-09-00

HIGHWAY 102
STRAWBERRY CREEK BRIDGE 2 REHABILITATION
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET S20

MMM GROUP

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

⊕	Borehole
⊕	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
▽	Water Level In Open Borehole
▼	Water Level In Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
SBC2-01	318.8	5 377 446.0	336 480.3
SBC2-02	318.8	5 377 455.0	336 492.1
SBC2-03	318.7	5 377 457.6	336 517.9
SBC2-04	318.6	5 377 466.5	336 529.7

-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.

GEOCRES No.

REVISIONS			
DATE	BY	DESCRIPTION	
DESIGN MEF	CHK PKC	CODE	LOAD — DATE OCT 2014
DRAWN MFA	CHK MEF	SITE 48W-2	STRUCT — DWG 1

FILENAME: H:\Drafting\19\35\\197\Strawberry Creek\ted1197-StrawberryCreek2.dwg
PLOTDATE: 10/6/2014 2:04 PM