

**FOUNDATION INVESTIGATION REPORT  
STRAWBERRY CREEK BRIDGE 1 REHABILITATION  
HIGHWAY 102  
THUNDER BAY DISTRICT, ONTARIO**

**G.W.P. 6073-09-00, SITE NO. 48W-1**

**Geocres Number: 52A-185**

**Report to:**

**MMM GROUP LIMITED**

Thurber Engineering Ltd.  
2010 Winston Park Drive, Suite 103  
Oakville, Ontario  
L6H 5R7  
Phone: (905) 829 8666  
Fax: (905) 829 1166

Date: October 22, 2014  
File: 19-1351-197

H:\19\1351\197 NWR 32 Rehabs\Reports & Memos\  
Strawberry Creek 1\Strawberry Creek Bridge 1 Final FIR.docx

## TABLE OF CONTENTS

|     |  |   |
|-----|--|---|
| 1   | INTRODUCTION .....                         | 1 |
| 2   | SITE DESCRIPTION .....                     | 1 |
| 3   | SITE INVESTIGATION AND FIELD TESTING ..... | 2 |
| 4   | LABORATORY TESTING .....                   | 3 |
| 5   | DESCRIPTION OF SUBSURFACE CONDITIONS ..... | 3 |
| 5.1 | Asphalt and Concrete.....                  | 3 |
| 5.2 | Sand and Gravel Fill .....                 | 4 |
| 5.3 | Sand and Gravel.....                       | 4 |
| 5.4 | Bedrock.....                               | 5 |
| 5.5 | Water Levels.....                          | 5 |
| 6   | MISCELLANEOUS .....                        | 6 |

## Appendices

|            |  |
|------------|--|
| Appendix A | Record of Borehole Sheets                  |
| Appendix B | Laboratory Test Results                    |
| Appendix C | Site Photographs                           |
| Appendix D | Borehole Locations and Soil Strata Drawing |

**FOUNDATION INVESTIGATION REPORT  
STRAWBERRY CREEK BRIDGE 1 REHABILITATION  
HIGHWAY 102  
THUNDER BAY DISTRICT, ONTARIO**

**G.W.P. 6073-09-00, SITE NO. 48W-1**

**Geocres Number: 52A-185**

**PART 1: FACTUAL INFORMATION**

**1 INTRODUCTION**

This report presents the factual findings obtained from a foundation investigation conducted at the existing Strawberry Creek Bridge 1 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 1 is located on Highway 102 in the community of Kaministiquia, approximately 7 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 reinforced concrete abutments. The bridge spans a length of approximately 27.4 m and is 11 m wide.

Strawberry Creek flows from northeast to southwest and crosses Highway 102 at three locations before draining into the Kaministiquia River. The creek channel is approximately 9 m wide and 1 m deep at the site. The surrounding lands are heavily wooded. Gravel quarrying has been carried out along the northwest side of the Creek, and a gravel pit and access road are located approximately 100 m west of the site.

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 intermediate mafic to felsic metavolcanic rocks.

### **3 SITE INVESTIGATION AND FIELD TESTING**

The site investigation and field testing for this project were carried out on July 10 and 11, 2013 and consisted of drilling and sampling four boreholes, identified as Boreholes SBC1-01 to SBC1-04, through the highway embankment in the area of the existing west and east abutments and approaches. Boreholes SBC1-02 and SBC1-03 were drilled near the abutments and Boreholes SCB1-01 and SBC1-04 were drilled through the approach embankments. The boreholes were terminated at depths of 9.2 to 13.7 m, including coring 3.2 to 3.3 m into bedrock in Boreholes SBC1-02 and SBC1-03.

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

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 a combination of NW casing/wash boring techniques, and NQ coring. 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 SBC1-02 and SBC1-03 on completion of drilling.

NQ coring techniques were used to recover 3.2 to 3.3 m long core samples of the bedrock in Boreholes SBC1-02 and SBC1-03. All rock cores were logged and the Total Core Recovery (TCR), Rock Quality Designation (RQD) and Fracture Indices (FI) were determined.

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 and rock 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**

| <b>Foundation Unit</b> | <b>Boreholes</b> | <b>Piezometer Tip Depth/<br/>Elevation (m)</b> | <b>Completion Details</b>  |
|------------------------|------------------|--|--|
| West Approach          | SBC1-01          | None installed                                 | Borehole backfilled with bentonite holeplug from 9.2 m to 0.15 m, then asphalt to surface.     |
| West Abutment          | SBC1-02          | 13.7/ 311.2                                    | Sand from 13.7 m to 10.2 m, bentonite holeplug from 10.2 m to 0.15 m, then asphalt to surface. |
| East Abutment          | SBC1-03          | 13.2/ 313.2                                    | Sand from 13.2 m to 9.4 m, bentonite holeplug from 9.4 m to 0.15 m, then asphalt to surface.   |
| East Approach          | SBC1-04          | None installed                                 | Borehole backfilled with bentonite holeplug from 9.7 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). 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.

Bedrock core samples were subjected to geological logging. Point load tests were carried out on selected samples of intact rock in the laboratory to evaluate the unconfined compressive strength (UCS) of the bedrock. The average UCS values of the intact rock assessed from the point load test data are reported on the borehole logs in Appendix A.

#### **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 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. It must be recognized that soil conditions may vary between and beyond the borehole locations.

The soil stratigraphy typically comprises a sand and gravel embankment fill, underlain by native sand and gravel over metavolcanic bedrock. 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 225 mm thick concrete slab was encountered below the asphalt in Borehole SBC1-02.

## 5.2 Sand and Gravel Fill

The existing highway embankment fill beneath the asphalt typically comprised a brown sand and gravel with trace to some silt and occasional cobbles. The lower portion of the embankment fill typically varied to gravelly sand with some silt and clay. A layer of concrete (180 mm thick) was encountered at the base of the fill in Borehole SBC1-02 at a depth of 8.2 m. The embankment fill has a total thickness of 4.5 to 8.0 m with a lower boundary at depths of 4.6 to 8.4 m (Elev. 322.1 to 316.5).

SPT 'N' values recorded in the fill typically ranged from 11 to 59 blows per 0.3 m penetration, indicating a compact to very dense relative density. An 'N' value of 4 blows per 0.3 m penetration (loose) was obtained at the base of the fill in Borehole SBC1-02. Measured moisture contents of the fill ranged from 3% to 21%.

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.

|          | Sand & Gravel | Lower Gravelly Sand |
|----------|---------------|---------------------|
| Gravel % | 49 to 55      | 13 to 28            |
| Sand %   | 43 to 45      | 46 to 49            |
| Silt %   | 2 to 6        | 11 to 17            |
| Clay %   | -             | 12 to 24            |

## 5.3 Sand and Gravel

A native deposit of brown sand and gravel containing trace to some silt and occasional cobbles and boulders was encountered below the embankment fill in all of the boreholes. In Boreholes SBC1-02 and SBC1-03, where fully penetrated, the sand and gravel deposit had a thickness of 2.0 and 3.9 m, with a lower boundary at depths of 10.4 and 10.0 m (Elev. 314.5 and 316.4). Boreholes SBC1-01 and SBC1-04 were terminated within the sand and gravel deposit at depths of 9.2 and 9.7 m respectively (Elevation 315.4 and 317.0).

SPT 'N' values obtained in the sand and gravel ranged from 11 blows for 0.3 m penetration to 50 blows for 0.025 m penetration, indicating a compact to very dense relative density. Measured moisture contents ranged from 2% to 12%.

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 %      | 34 to 43 |
| Sand %        | 44 to 55 |
| Silt & Clay % | 6 to 22  |

## 5.4 Bedrock

Bedrock was encountered below the sand and gravel deposit in Boreholes SBC1-02 and SBC1-03 at depths of 10.4 and 10.0 m respectively (Elevation 314.5 and 316.4). Bedrock was proven by recovery of 3.2 m to 3.3 m long rock core samples in the boreholes.

The recovered bedrock core samples were described as grey tuff with quartz veins. Total Core Recovery (TCR) in the bedrock was 97% to 100%, and the Rock Quality Designation (RQD) was between 79% and 97%, indicating good to excellent rock quality. The Fracture Index (FI) of the rock, expressed as fractures per 0.3 m core, was typically less than 3.

The unconfined compressive strength of the intact rock interpreted from point load tests conducted on selected cores ranged from 44 MPa to 165 MPa (average per core run), indicating a medium to very strong rock classification.

## 5.5 Water Levels

Where possible, water levels were monitored in the open boreholes during drilling operations. Wash boring and rock coring 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) |               |
| SBC1-02  | July 10, 2013  | 3.9         | 321.0     | Open borehole |
|          | August 1, 2013 | 5.2         | 319.7     | In piezometer |
|          | May 2, 2014    | 5.3         | 319.6     | In piezometer |
| SBC1-03  | July 11, 2013  | 4.2         | 322.2     | Open borehole |
|          | August 1, 2013 | 5.7         | 320.7     | In piezometer |
|          | May 2, 2014    | 5.3         | 321.1     | In piezometer |
| SBC1-04  | July 10, 2013  | 5.1         | 321.6     | Open borehole |

The preliminary GA drawings provided by MMM Group Limited indicates a water level at Elev. 319.7 in Strawberry Creek in March 2011. 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.

**Thurber Engineering Ltd.**

Mark Farrant, M.Eng., P.Eng.  
Geotechnical Engineer



Murray R. Anderson, M.Eng., P.Eng.  
Senior Foundations Engineer



Dr. P.K. Chatterji, P.Eng.  
Review Principal





**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 <sup>(1)</sup> '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<sub>pen</sub>

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

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

### DISCONTINUITY SPACING

| <b>Bedding</b>      | <b>Bedding Plane Spacing</b> |
|---------------------|------------------------------|
| 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

| <b>Rock Strength</b>  | <b>Approximate Uniaxial Compressive Strength</b> |                     | <b>Field Estimation of Hardness*</b>   |
|-----------------------|--|---------------------|--|
|                       | <b>(MPa)</b>                                     | <b>(psi)</b>        |  |
| 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<br>$W_L < 50\%$ | 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.<br>( $W_L < 30\%$ ). |
|                      |                                 | CI           | Inorganic clays of medium plasticity, silty clays.<br>( $30\% < W_L < 50\%$ ).  |
|                      |                                 | OL           | Organic silts and organic silty-clays of low plasticity.  |
|                      | SILTS AND CLAYS<br>$W_L > 50\%$ | 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                 |                                 |              |   |

# RECORD OF BOREHOLE No SBC1-01

1 OF 1

METRIC

WP# 6073-09-00 LOCATION Strawberry Creek Bridge 1 N 5 377 568.3 E 337 376.5 ORIGINATED BY ES  
HWY 102 BOREHOLE TYPE NW Casing COMPILED BY AN  
DATUM Geodetic DATE 2013.07.11 - 2013.07.11 CHECKED BY MC

| SOIL PROFILE  |   |            | SAMPLES |      |              | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT   |  |  |  |  | UNIT<br>WEIGHT<br>$\gamma$<br>kN/m <sup>3</sup>   | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%) |  |
|---------------|---|------------|---------|------|--------------|----------------------------|-----------------|---|--|--|--|--|---|---|--|
| ELEV<br>DEPTH | DESCRIPTION   | STRAT PLOT | NUMBER  | TYPE | "N" VALUES   |                            |                 | SHEAR STRENGTH kPa  |  |  |  |  |   |   |  |
| 324.6         | GROUND SURFACE  |            |         |      |              |                            |                 | <div><div>20406080100</div><div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL × LAB VANE</div></div> |  |  |  |  | <div><div>PLASTIC LIMIT</div><div>NATURAL MOISTURE CONTENT</div><div>LIQUID LIMIT</div><div>W<sub>P</sub> — W — W<sub>L</sub></div></div> |   |  |
| 0.0           | ASPHALT: (125mm)  |            |         |      |              |                            |                 | <div><div>20406080100</div><div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL × LAB VANE</div></div> |  |  |  |  | <div><div>204060</div><div>WATER CONTENT (%)</div></div>  |   |  |
| 0.1           | SAND and GRAVEL, trace to some silt, occasional cobbles<br>Very dense to Compact<br>Brown<br>(FILL)         |            | 1       | SS   | 51           |                            | 324             |   |  |  |  |  |   | 52 45 3<br>(SI+CL)                                |  |
|               |   |            | 2       | SS   | 15           |                            | 323             |   |  |  |  |  |   |   |  |
|               |   |            | 3       | SS   | 11           |                            | 322             |   |  |  |  |  |   |   |  |
|               | Some clay   |            | 4       | SS   | 27           |                            | 321             |   |  |  |  |  |   | 28 49 11 12                                       |  |
| 320.0         |   |            |         |      |              |                            | 320             |   |  |  |  |  |   |   |  |
| 4.6           | SAND and GRAVEL, trace to some silt, occasional cobbles<br>Compact to Very Dense<br>Brown<br>Wet            |            | 5       | SS   | 15           |                            | 319             |   |  |  |  |  |   |   |  |
|               |   |            | 6       | SS   | 50/<br>0.075 |                            | 318             |   |  |  |  |  |   |   |  |
|               | Boulder from 6.3m to 7.3m   |            | 7       | SS   | 50/<br>0.125 |                            | 317             |   |  |  |  |  |   | 34 44 22<br>(SI+CL)                               |  |
|               |   |            | 8       | SS   | 50/<br>0.025 |                            | 316             |   |  |  |  |  |   |   |  |
| 315.4         | END OF BOREHOLE AT 9.2m.<br>BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.15m<br>AND ASPHALT TO SURFACE. |            |         |      |              |                            |                 |   |  |  |  |  |   |   |  |
| 9.2           |   |            |         |      |              |                            |                 |   |  |  |  |  |   |   |  |

ONTMT4S 1197.GPJ 2012TEMPLATE(MTO).GDT 10/2/14

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No SBC1-02

1 OF 2

METRIC

WP# 6073-09-00 LOCATION Strawberry Creek Bridge 1 N 5 377 560.8 E 337 382.5 ORIGINATED BY ES  
HWY 102 BOREHOLE TYPE NW Casing/Dynamic Cone Penetration Test COMPILED BY AN  
DATUM Geodetic DATE 2013.07.10 - 2013.07.10 CHECKED BY MC

| SOIL PROFILE  |  |            | SAMPLES |      |            | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT |          | WATER CONTENT (%)               |                                     |                                | UNIT<br>WEIGHT<br>γ<br>kN/m <sup>3</sup> | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%) |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|----------|---------------------------------|-------------------------------------|--------------------------------|--|---|
| ELEV<br>DEPTH | DESCRIPTION  | STRAT PLOT | NUMBER  | TYPE | "N" VALUES |                            |                 | 20 40 60 80 100                             | 20 40 60 | PLASTIC LIMIT<br>W <sub>p</sub> | NATURAL<br>MOISTURE<br>CONTENT<br>W | LIQUID LIMIT<br>W <sub>L</sub> |  |   |
| 324.9         | GROUND SURFACE   |            |         |      |            |                            |                 |   |          |                                 |                                     |                                |  |   |
| 0.0           | ASPHALT: (125mm)   |            |         |      |            |                            |                 |   |          |                                 |                                     |                                |  |   |
| 0.1           | CONCRETE SLAB: (225mm)   |            |         |      |            |                            |                 |   |          |                                 |                                     |                                |  |   |
| 0.4           | SAND and GRAVEL, trace silt<br>Compact<br>Brown<br>(FILL)              |            | 1       | SS   | 21         |                            |                 |   |          |                                 |                                     |                                |  |   |
|               | Occasional cobbles   |            | 2       | SS   | 24         |                            |                 |   |          |                                 |                                     |                                |  |   |
|               |  |            | 3       | SS   | 21         |                            |                 |   |          |                                 |                                     |                                |  |   |
|               |  |            | 4       | SS   | 13         |                            |                 |   |          |                                 |                                     |                                |  |   |
|               |  |            | 5       | SS   | 17         |                            |                 |   |          |                                 |                                     |                                |  |   |
|               | Occasional cobbles   |            | 6       | SS   | 11         |                            |                 |   |          |                                 |                                     |                                |  |   |
| 317.3         | Gravelly SAND, some silt and clay<br>Loose<br>Brown<br>Moist<br>(FILL) |            | 7       | SS   | 4          |                            |                 |   |          |                                 |                                     |                                |  |   |
| 316.7         | CONCRETE: (180mm)  |            |         |      |            |                            |                 |   |          |                                 |                                     |                                |  |   |
| 316.8         | SAND and GRAVEL<br>Compact<br>Brown<br>Wet                             |            | 8       | SS   | 14         |                            |                 |   |          |                                 |                                     |                                |  |   |

Continued Next Page

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

# RECORD OF BOREHOLE No SBC1-02

2 OF 2

METRIC

WP# 6073-09-00 LOCATION Strawberry Creek Bridge 1 N 5 377 560.8 E 337 382.5 ORIGINATED BY ES  
HWY 102 BOREHOLE TYPE NW Casing/Dynamic Cone Penetration Test COMPILED BY AN  
DATUM Geodetic DATE 2013.07.10 - 2013.07.10 CHECKED BY MC

| SOIL PROFILE  |  |            | SAMPLES |      |            | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT                        |    |    |     | PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT |    |    | UNIT<br>WEIGHT<br><br>γ<br><br>kN/m <sup>3</sup> | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br><br>GR   SA   SI   CL |  |   |     |  |     |  |  |  |  |  |   |  |   |     |  |     |  |  |  |  |   |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|--|----|----|-----|---|----|----|--|--|--|---|-----|--|-----|--|--|--|--|--|---|--|---|-----|--|-----|--|--|--|--|---|
| ELEV<br>DEPTH | DESCRIPTION  | STRAT PLOT | NUMBER  | TYPE | "N" VALUES |                            |                 | SHEAR STRENGTH kPa   |    |    |     | WATER CONTENT (%)   |    |    |  |  |  |   |     |  |     |  |  |  |  |  |   |  |   |     |  |     |  |  |  |  |   |
|               |  |            |         |      |            |                            |                 | ○ UNCONFINED      + FIELD VANE<br>● QUICK TRIAXIAL      × LAB VANE |    |    |     | W P      W      W L   |    |    |  |  |  |   |     |  |     |  |  |  |  |  |   |  |   |     |  |     |  |  |  |  |   |
|               | Continued From Previous Page   |            |         |      |            |                            | 20              | 40   | 60 | 80 | 100 | 20  | 40 | 60 |  |  |  |   |     |  |     |  |  |  |  |  |   |  |   |     |  |     |  |  |  |  |   |
| 314.5         | Cobbles  |            |         |      |            |                            |                 |  |    |    |     |   |    |    | FI   | RUN #1<br>TCR=100%<br>SCR=88%<br>RQD=79%<br>UCS=86MPa<br>(Average)         |  |   |     |  |     |  |  |  |  |  |   |  |   |     |  |     |  |  |  |  |   |
| 10.4          | <b>BEDROCK:</b> TUFF, grey, with quartz veins<br>Rubble zone from 10.2m to 10.4m<br><br>Sub-vertical fractures at 10.42m to 10.50m<br>10.84m to 11.56m   |            | 1       | RUN  |            |                            | 314             |  |    |    |     |   |    |    | 0  |  | RUN #2<br>TCR=97%<br>SCR=97%<br>RQD=97%<br>UCS=165MPa<br>(Average) |   |     |  |     |  |  |  |  |  |   |  |   |     |  |     |  |  |  |  |   |
|               | Sub-vertical fractures from 11.73m to 11.86m<br>11.86m to 12.01m<br>12.27m to 12.42m   |            |         |      |            |                            |                 |  |    |    |     |   |    |    |  |  |  | 2 | RUN |  | 313 |  |  |  |  |  | 1 |  |   |     |  |     |  |  |  |  |   |
|               |  |            |         |      |            |                            |                 |  |    |    |     |   |    |    |  |  |  |   |     |  |     |  |  |  |  |  |   | Sub-vertical fractures at 13.26m to 13.70m | 3 | RUN |  | 312 |  |  |  |  | 0 |
|               |  |            |         |      |            |                            |                 |  |    |    |     |   |    |    |  |  |  |   |     |  |     |  |  |  |  |  |   |  |   |     |  |     |  |  |  |  |   |
| 311.2         |  |            |         |      |            |                            |                 |  |    |    |     |   |    |    | 0  | RUN #3<br>TCR=100%<br>SCR=100%<br>RQD=100%                                 |  |   |     |  |     |  |  |  |  |  |   |  |   |     |  |     |  |  |  |  |   |
| 13.7          | END OF BOREHOLE AT 13.7m.<br>WATER LEVEL AT 3.9m UPON COMPLETION.<br>Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen.<br><br>WATER LEVEL READINGS:<br>DATE      DEPTH (m)      ELEV. (m)<br>Aug 01/13      5.2      319.7<br>May 02/14      5.3      319.6 |            |         |      |            |                            |                 |  |    |    |     |   |    |    |  |  |  |   |     |  |     |  |  |  |  |  |   |  |   |     |  |     |  |  |  |  |   |

# RECORD OF BOREHOLE No SBC1-03

1 OF 2

METRIC

WP# 6073-09-00 LOCATION Strawberry Creek Bridge 1 N 5 377 551.8 E 337 418.7 ORIGINATED BY ES  
 HWY 102 BOREHOLE TYPE NW Casing/Dynamic Cone Penetration Test COMPILED BY AN  
 DATUM Geodetic DATE 2013.07.11 - 2013.07.11 CHECKED BY MC

| SOIL PROFILE  |   |            | SAMPLES |      |               | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT |                   | PLASTIC<br>LIMIT<br>W <sub>p</sub> | NATURAL<br>MOISTURE<br>CONTENT<br>W | LIQUID<br>LIMIT<br>W <sub>L</sub> | UNIT<br>WEIGHT<br>γ<br>kN/m <sup>3</sup> | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br>GR SA SI CL |
|---------------|---|------------|---------|------|---------------|----------------------------|-----------------|---|-------------------|------------------------------------|-------------------------------------|-----------------------------------|--|--|
| ELEV<br>DEPTH | DESCRIPTION   | STRAT PLOT | NUMBER  | TYPE | "N" VALUES    |                            |                 | SHEAR STRENGTH kPa                          | WATER CONTENT (%) |                                    |                                     |                                   |  |  |
| 326.4         | GROUND SURFACE  |            |         |      |               |                            |                 |   |                   |                                    |                                     |                                   |  |  |
| 0.0           | ASPHALT: (125mm)  |            |         |      |               |                            |                 |   |                   |                                    |                                     |                                   |  |  |
|               | SAND and GRAVEL, trace silt,<br>occasional cobbles<br>Compact to dense<br>Brown<br>(FILL) |            | 1       | SS   | 28            |                            |                 |   |                   |                                    |                                     |                                   |  |  |
|               |   |            | 2       | SS   | 28            |                            |                 |   |                   |                                    |                                     |                                   |  | 51 44 5<br>(SI+CL)   |
|               |   |            | 3       | SS   | 40            |                            |                 |   |                   |                                    |                                     |                                   |  |  |
|               |   |            | 4       | SS   | 26            |                            |                 |   |                   |                                    |                                     |                                   |  |  |
|               | No recovery   |            | 5       | SS   | 12            |                            |                 |   |                   |                                    |                                     |                                   |  |  |
| 320.3         |   |            |         |      |               |                            |                 |   |                   |                                    |                                     |                                   |  |  |
| 6.1           | SAND and GRAVEL, trace to some<br>silt<br>Compact to Very Dense<br>Brown<br>Wet           |            | 6       | SS   | 11            |                            |                 |   |                   |                                    |                                     |                                   |  |  |
|               |   |            | 7       | SS   | 25            |                            |                 |   |                   |                                    |                                     |                                   |  |  |
|               |   |            | 8       | SS   | 112/<br>0.250 |                            |                 |   |                   |                                    |                                     |                                   |  | 34 55 11<br>(SI+CL)  |
| 316.4         |   |            |         |      |               |                            |                 |   |                   |                                    |                                     |                                   |  |  |

Continued Next Page

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



# RECORD OF BOREHOLE No SBC1-03

2 OF 2

METRIC

WP# 6073-09-00 LOCATION Strawberry Creek Bridge 1 N 5 377 551.8 E 337 418.7 ORIGINATED BY ES  
 HWY 102 BOREHOLE TYPE NW Casing/Dynamic Cone Penetration Test COMPILED BY AN  
 DATUM Geodetic DATE 2013.07.11 - 2013.07.11 CHECKED BY MC

| SOIL PROFILE  |             |            | SAMPLES |      |            | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT  |  |  | PLASTIC<br>LIMIT<br><br>W <sub>P</sub> | NATURAL<br>MOISTURE<br>CONTENT<br><br>W | LIQUID<br>LIMIT<br><br>W <sub>L</sub> | UNIT<br>WEIGHT<br><br>γ<br><br>kN/m <sup>3</sup> | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br><br>GR SA SI CL |
|---------------|-------------|------------|---------|------|------------|----------------------------|-----------------|--|--|--|--|---|---------------------------------------|--|--|
| ELEV<br>DEPTH | DESCRIPTION | STRAT PLOT | NUMBER  | TYPE | "N" VALUES |                            |                 | SHEAR STRENGTH kPa<br>○ UNCONFINED      + FIELD VANE<br>● QUICK TRIAXIAL    × LAB VANE |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 | 20 40 60 80 100  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             |            |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |
|               |             | </         |         |      |            |                            |                 |  |  |  |  |   |                                       |  |  |

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No SBC1-04

1 OF 2

METRIC

WP# 6073-09-00 LOCATION Strawberry Creek Bridge 1 N 5 377 543.6 E 337 424.6 ORIGINATED BY ES  
 HWY 102 BOREHOLE TYPE NW Casing COMPILED BY AN  
 DATUM Geodetic DATE 2013.07.10 - 2013.07.10 CHECKED BY MC

| SOIL PROFILE  |  |            | SAMPLES |      |            | GROUND WATER<br>CONDITIONS | ELEVATION<br>SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT |    |    |    |     | PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT |  |   | UNIT<br>WEIGHT<br><br>γ<br><br>kN/m <sup>3</sup> | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br><br>GR   SA   SI   CL |  |                        |  |
|---------------|--|------------|---------|------|------------|----------------------------|--------------------|---|----|----|----|-----|---|--|---|--|--|--|------------------------|--|
| ELEV<br>DEPTH | DESCRIPTION  | STRAT PLOT | NUMBER  | TYPE | "N" VALUES |                            |                    | SHEAR STRENGTH kPa                          |    |    |    |     | WATER CONTENT (%)   |  |   |  |  |  |                        |  |
|               |  |            |         |      |            |                            |                    | ○ UNCONFINED      + FIELD VANE              |    |    |    |     | W P      W      W L   |  |   |  |  |  |                        |  |
|               |  |            |         |      |            |                            |                    | ● QUICK TRIAXIAL      × LAB VANE            |    |    |    |     |   |  |   |  |  |  |                        |  |
| 326.7         | GROUND SURFACE   |            |         |      |            |                            |                    | 20  | 40 | 60 | 80 | 100 |   |  |   |  |  |  |                        |  |
| 0.0           | ASPHALT: (125mm)   |            |         |      |            |                            |                    | 20  | 40 | 60 | 80 | 100 |   |  |   |  |  |  |                        |  |
| 0.1           | SAND and GRAVEL, trace to some silt, occasional cobbles<br>Very dense<br>Brown<br>(FILL) |            |         |      |            |                            | 326                |   |    |    |    |     |   |  | ○ |  |  |  |                        |  |
|               |  |            | 1       | SS   | 52         |                            |                    |   |    |    |    |     |   |  |   |  |  |  |                        |  |
|               |  |            |         |      |            |                            | 325                |   |    |    |    |     |   |  | ○ |  |  |  |                        |  |
|               |  |            | 2       | SS   | 59         |                            |                    |   |    |    |    |     |   |  |   |  |  |  |                        |  |
|               |  |            |         |      |            |                            |                    |   |    |    |    |     |   |  |   |  |  |  |                        |  |
|               |  |            | 3       | SS   | 48         |                            | 324                |   |    |    |    |     |   |  | ○ |  |  |  | 49   45   6<br>(SI+CL) |  |
|               |  |            |         |      |            |                            |                    |   |    |    |    |     |   |  |   |  |  |  |                        |  |
|               |  |            | 4       | SS   | 14         |                            |                    |   |    |    |    |     |   |  | ○ |  |  |  |                        |  |
| 323.1         |  |            |         |      |            |                            | 323                |   |    |    |    |     |   |  |   |  |  |  | 13   46   17   24      |  |
| 3.6           | Clayey SAND, some gravel and silt<br>Compact<br>Brown<br>(FILL)                          |            |         |      |            |                            |                    |   |    |    |    |     |   |  |   |  |  |  |                        |  |
| 322.1         |  |            |         |      |            |                            | 322                |   |    |    |    |     |   |  | ○ |  |  |  |                        |  |
| 4.6           | SAND and GRAVEL, trace silt, occasional cobbles<br>Compact to Very Dense<br>Brown<br>Wet |            | 5       | SS   | 19         |                            |                    |   |    |    |    |     |   |  |   |  |  |  |                        |  |
|               |  |            |         |      |            |                            | 321                |   |    |    |    |     |   |  |   |  |  |  |                        |  |
|               | No recovery  |            |         |      |            |                            |                    |   |    |    |    |     |   |  |   |  |  |  |                        |  |
|               |  |            | 6       | SS   | 22         |                            | 320                |   |    |    |    |     |   |  |   |  |  |  |                        |  |
|               |  |            |         |      |            |                            |                    |   |    |    |    |     |   |  |   |  |  |  |                        |  |
|               |  |            |         |      |            |                            | 319                |   |    |    |    |     |   |  | ○ |  |  |  | 43   51   6<br>(SI+CL) |  |
|               |  |            | 7       | SS   | 24         |                            |                    |   |    |    |    |     |   |  |   |  |  |  |                        |  |
|               |  |            |         |      |            |                            | 318                |   |    |    |    |     |   |  |   |  |  |  |                        |  |
|               |  |            |         |      |            |                            |                    |   |    |    |    |     |   |  | ○ |  |  |  |                        |  |
|               |  |            | 8       | SS   | 65         |                            |                    |   |    |    |    |     |   |  |   |  |  |  |                        |  |
| 317.0         |  |            |         |      |            |                            | 317                |   |    |    |    |     |   |  |   |  |  |  |                        |  |
| 9.7           | END OF BOREHOLE AT 9.7m.<br>WATER LEVEL AT 5.1m UPON                                     |            |         |      |            |                            |                    |   |    |    |    |     |   |  |   |  |  |  |                        |  |

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15 10 5 0  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No SBC1-04

2 OF 2

METRIC

WP# 6073-09-00 LOCATION Strawberry Creek Bridge 1 N 5 377 543.6 E 337 424.6 ORIGINATED BY ES  
 HWY 102 BOREHOLE TYPE NW Casing COMPILED BY AN  
 DATUM Geodetic DATE 2013.07.10 - 2013.07.10 CHECKED BY MC

| SOIL PROFILE  |   |            | SAMPLES |      |            | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT |                 | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT |          |  | UNIT<br>WEIGHT<br>$\gamma$<br>kN/m <sup>3</sup> | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br>GR SA SI CL |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|---|-----------------|---|----------|--|---|--|
| ELEV<br>DEPTH | DESCRIPTION   | STRAT PLOT | NUMBER  | TYPE | "N" VALUES |                            |                 | 20 40 60 80 100                             | 20 40 60 80 100 | W <sub>p</sub> W W <sub>L</sub>                     | 20 40 60 |  |   |  |
|               | Continued From Previous Page  |            |         |      |            |                            |                 |   |                 |   |          |  |   |  |
|               | COMPLETION.<br>BOREHOLE BACKFILLED WITH<br>BENTONITE HOLEPLUG TO 0.15m<br>THEN ASPHALT TO SURFACE |            |         |      |            |                            |                 |   |                 |   |          |  |   |  |

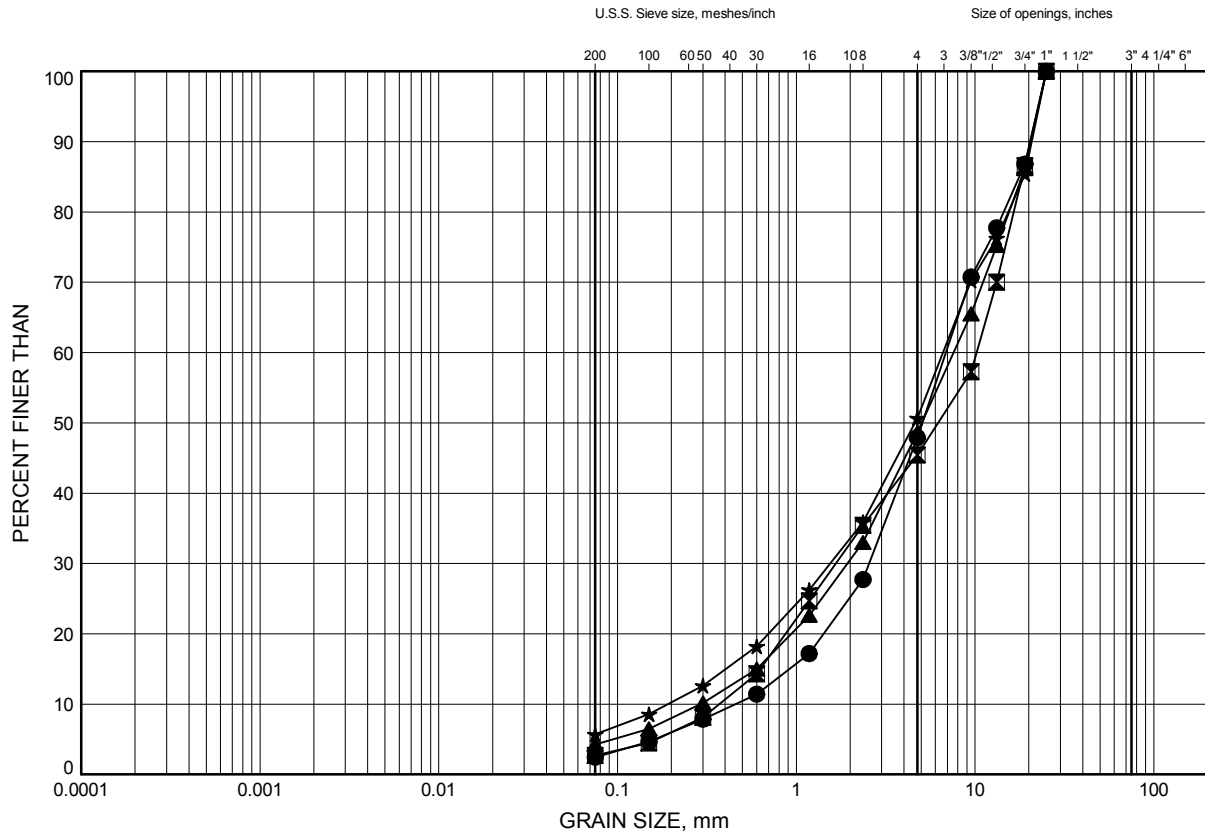
ONTMT4S 1197.GPJ 2012TEMPLATE(MTO).GDT 10/2/14

**Appendix B**  
**Laboratory Test Results**

# Strawberry Creek Bridge 1 GRAIN SIZE DISTRIBUTION

FIGURE B1

## SAND & GRAVEL FILL



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

### LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|--------|----------|-----------|-----------|
| ●      | SBC1-01  | 1.07      | 323.53    |
| ⊠      | SBC1-02  | 2.59      | 322.31    |
| ▲      | SBC1-03  | 1.83      | 324.57    |
| ★      | SBC1-04  | 2.59      | 324.11    |

Date September 2014  
WP# 6073-09-00



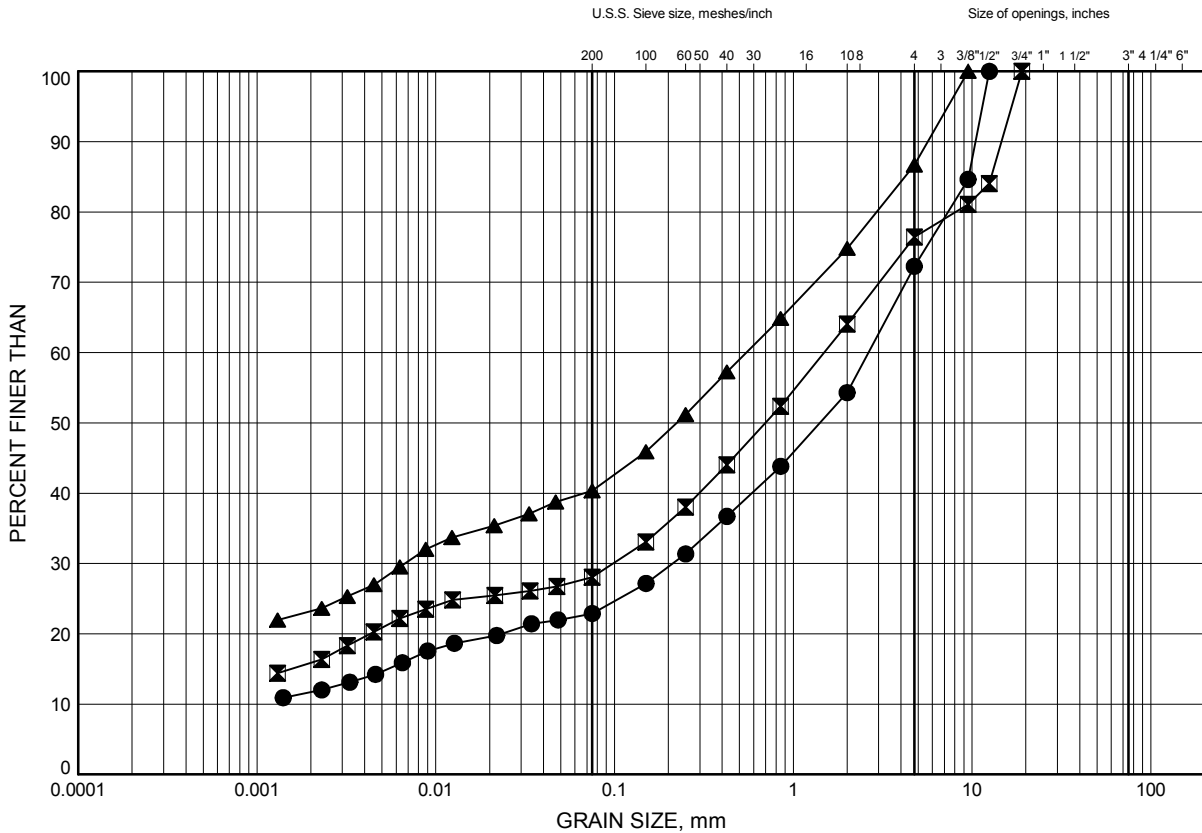
Prep'd AN  
Chkd. MEF

# Strawberry Creek Bridge 1

## GRAIN SIZE DISTRIBUTION

FIGURE B2

### GRAVELLY SAND FILL



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

### LEGEND

| SYMBOL | BOREHOLE | DEPTH (m) | ELEV. (m) |
|--------|----------|-----------|-----------|
| ●      | SBC1-01  | 3.35      | 321.25    |
| ⊠      | SBC1-02  | 7.92      | 316.98    |
| ▲      | SBC1-04  | 3.60      | 323.10    |

Date September 2014  
WP# 6073-09-00

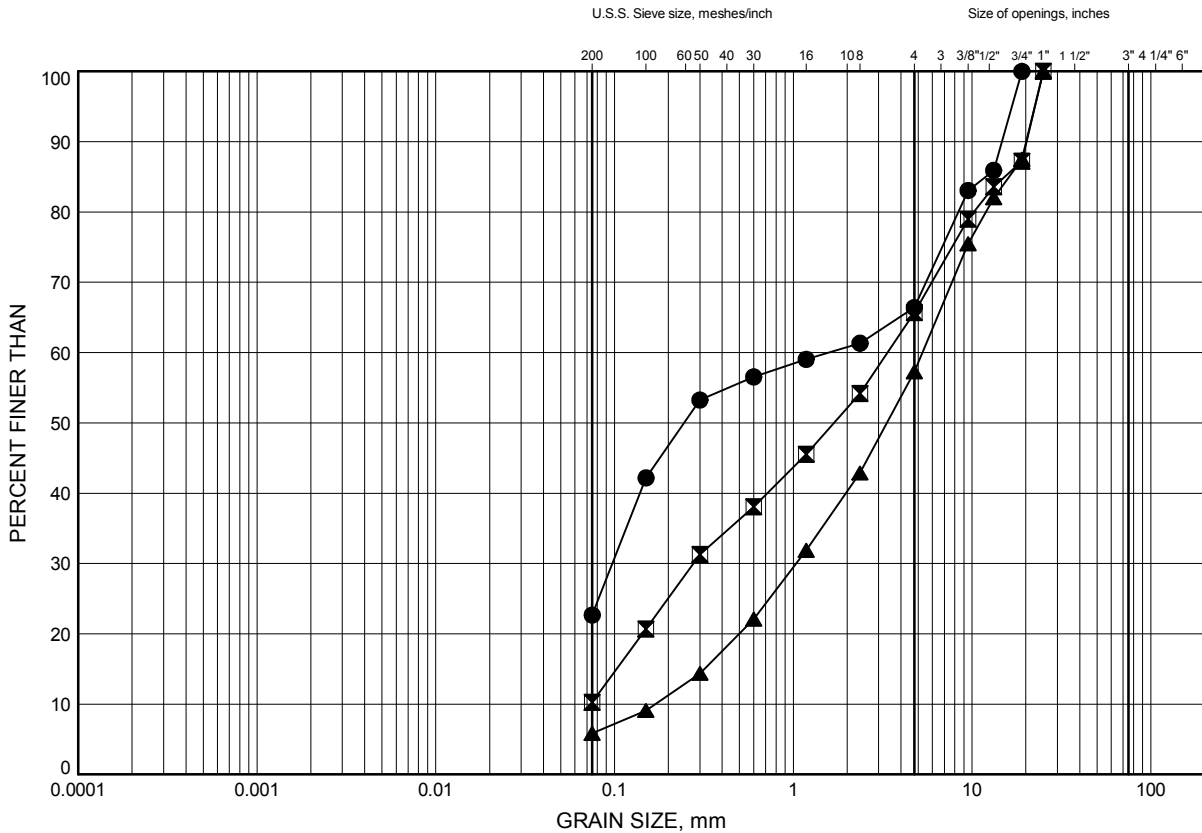


Prep'd AN  
Chkd. MEF

# Strawberry Creek Bridge 1 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) |
|--------|----------|-----------|-----------|
| ●      | SBC1-01  | 7.70      | 316.90    |
| ⊠      | SBC1-03  | 9.35      | 317.05    |
| ▲      | SBC1-04  | 7.92      | 318.78    |

Date September 2014  
WP# 6073-09-00



Prep'd AN  
Chkd. MEF

**Appendix C**  
**Site Photographs**





**Photograph 1 – East approach, looking west**



**Photograph 2 – East end of bridge, looking north**



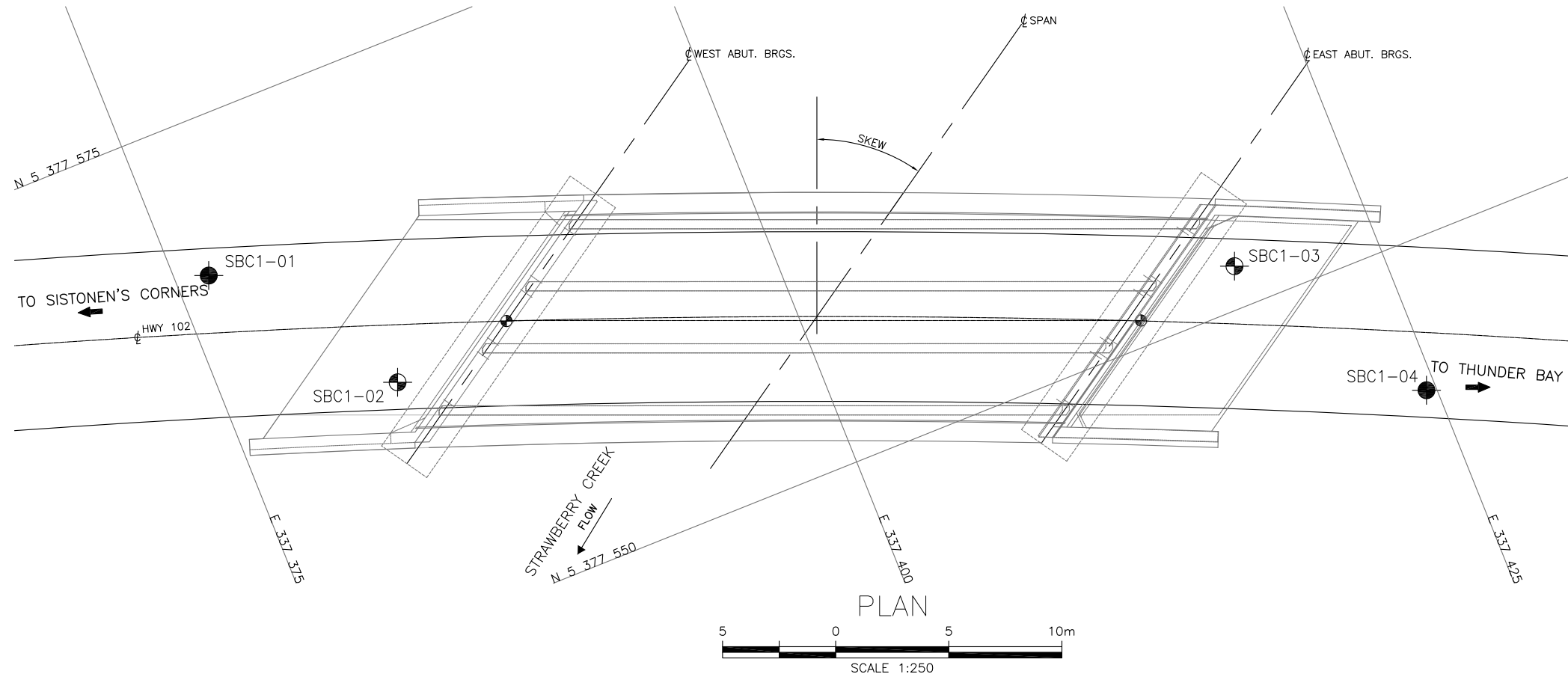


**Photograph 3 – East Abutment**



**Photograph 4 – North Elevation, looking west**

**Appendix D**  
**Borehole Locations and Soil Strata Drawing**

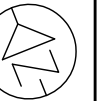


METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

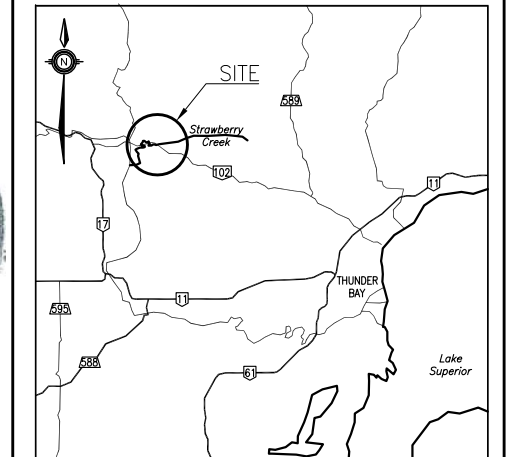


CONT No  
WP No 6073-09-00

HIGHWAY 102  
STRAWBERRY CREEK BRIDGE 1  
REHABILITATION  
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET  
66



KEYPLAN

LEGEND

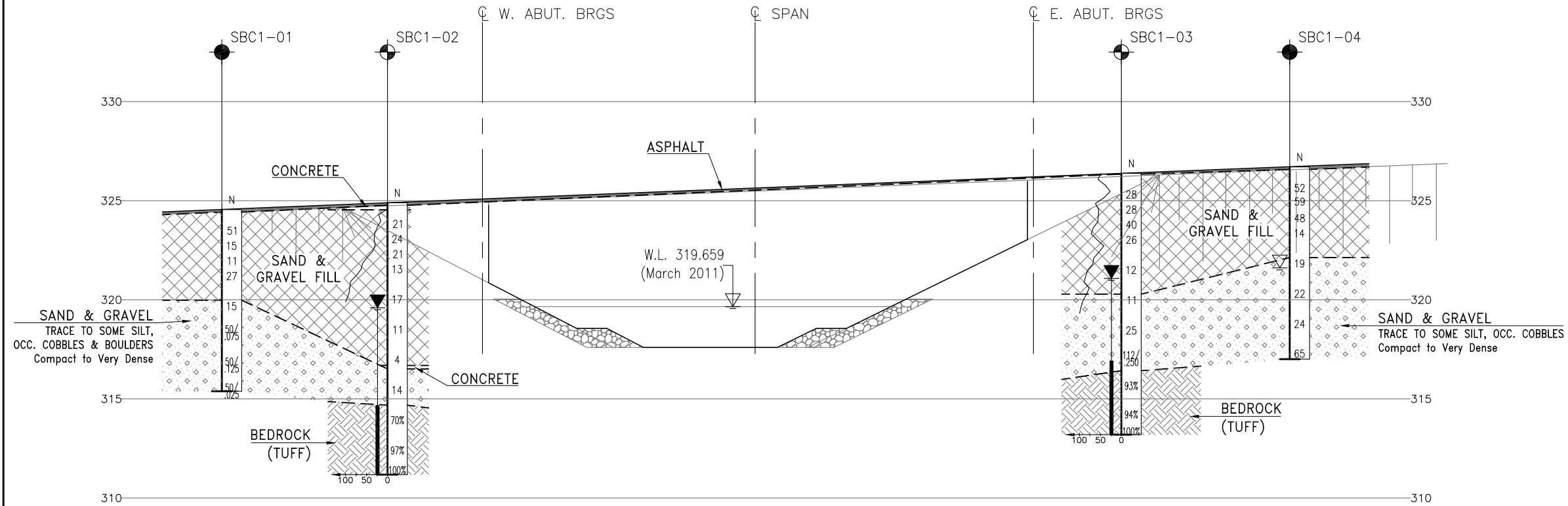
|      |                                       |
|------|---------------------------------------|
|      | Borehole                              |
|      | Borehole and Cone                     |
| N    | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE | Blows /0.3m (60" Cone, 475J/blow)     |
| PH  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

| NO      | ELEVATION | NORTHING    | EASTING   |
|---------|-----------|-------------|-----------|
| SBC1-01 | 324.6     | 5 377 568.3 | 337 376.5 |
| SBC1-02 | 324.9     | 5 377 560.8 | 337 382.5 |
| SBC1-03 | 326.4     | 5 377 551.8 | 337 418.7 |
| SBC1-04 | 326.7     | 5 377 543.6 | 337 424.6 |
|         |           |             |           |
|         |           |             |           |
|         |           |             |           |
|         |           |             |           |
|         |           |             |           |
|         |           |             |           |
|         |           |             |           |

-NOTES-

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

GEOCRES No. 52A-185



PROFILE ALONG CL HWY. 102

| REVISIONS | DATE  | BY     | DESCRIPTION |
|-----------|-------|--------|-------------|
| DESIGN    | MEF   | CHK    | PKC         |
| DRAWN     | MFA   | CHK    | MEF         |
| SITE      | 48W-1 | STRUCT | DWG 1       |