



## **FOUNDATION INVESTIGATION REPORT**

**for**

**DESJARDINS CANAL BRIDGE EASTBOUND REPLACEMENT  
HIGHWAY 403, SITE No. 36-36/1  
WP 2357-09-01  
CENTRAL REGION, ONTARIO**

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PML Ref.: 13TF017A-EB  
Index No.: 116FIR  
Geocres No.: 30M5-320  
January 21, 2016



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**FOUNDATION INVESTIGATION REPORT**

for

Desjardins Canal Bridge Eastbound Replacement  
Highway 403, Site No. 36-36/1  
WP 2357-09-01  
Central Region, Ontario

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**1. INTRODUCTION**

This report summarises the results of a foundation investigation carried out for a replacement of existing eastbound bridge over the Desjardins Canal located on Highway 403 near Hamilton, Ontario. The investigation was conducted for Morrison Hershfield Limited on behalf of the Ministry of Transportation of Ontario (MTO).

Highway 403 passes over the Desjardins Canal at approximate Station 25+586, Highway 403 chainage (ref. General Arrangement Drawing 'Desjardins Canal Bridge EBL Structure Replacement' prepared by Morrison Hershfield Limited in November 2015). The existing bridge is a three span structure having a total length of about 51.8 m and supported on stepped spread footings founded in sandy soils at elevation 76.8 to 78.3 at the south abutment and elevation 77.4 to 79.2 at the north abutment. It is intended to replace the existing bridge on a new alignment 17 to 19 m east of the existing EBL centreline.

The existing road grade on Highway 403 at the bridge location is at approximate elevation 86.0. The existing approach embankments are up to about 8 m high. The water level in the canal is at elevation 75.0.

The report provides subsurface information pertaining to the proposed structure and approaches within about 20 m of the abutments.

All elevations in this report are expressed in meters.



## **2. SITE DESCRIPTION AND GEOLOGY**

The structure to be replaced carries Highway 403 eastbound traffic over the Desjardins Canal connecting Hamilton Harbour and Lake Cootes Paradise near Hamilton. At the location of the bridge, Highway 403 runs approximately in the south-north direction.

The Desjardins Canal is about 30 m wide and 3 m deep. The trail running under the bridge along its south abutment is at approximate elevation 77.5.

The project site is located just west of Lake Ontario. The land surface adjacent to the canal is flat to gently undulating.

The site forms part of the Lake Iroquois offshore deposits consisting mainly of fine grained sands becoming silty with depth and resting on early Lake Iroquois clays. The deposits are generally stratified.

Bedrock in the vicinity of the site is at depths exceeding 35 m.

## **3. INVESTIGATION PROCEDURES**

The field work for this study was carried out during the period of April 28 to July 9, 2015 and comprised six boreholes advanced to depths of 10.4 to 35.3 m. The borehole locations are indicated on Drawing EB-1, attached.

The locations of the boreholes were established in the field by Peto MacCallum Ltd. The ground surface elevations at the boreholes were provided by Callon-Dietz Inc.

The boreholes were advanced using continuous flight hollow and solid stem augers, powered by track-mounted drill rigs, supplied and operated by specialist drilling contractors, working under the full-time supervision of a member of our engineering staff. A mud rotary technique was used to extend boreholes EB-2 to EB-5.



Representative soil samples were recovered at frequent depth intervals using a conventional split spoon sampler during drilling. Standard penetration tests (SPT) were conducted simultaneously with the sampling operation to assess the strength characteristics of the substrata. Dynamic cone penetration tests were performed from the bottom of boreholes EB-2 and EB-5 to supplement the test data. The cone tests were terminated by practical refusal with blow counts of 410 and 796 per 200 and 100 mm of penetration in boreholes EB-2 and EB-5 respectively.

Groundwater conditions at the borehole locations were assessed during drilling by visual examination of soil, the sampler and drill rods as the samples were retrieved and, when appropriate, by measurement of the water level in the open boreholes. Piezometers were installed in boreholes EB-3 and EB-4, with readings taken over 2 months. The boreholes were backfilled with bentonite/cement grout where required in accordance with the MTO guidelines and MOE Regulation 903 for borehole abandonment procedures.

Soils were identified in the field in accordance with the MTO Soil Classification procedures. Recovered soil samples were returned to our laboratory for detailed visual examination, classification and routine moisture content determination. Atterberg limits testing (1) and grain size distribution analyses (27) were conducted on selected soil samples. The laboratory test results are presented in Figures EB-GS-1 to EB-GS-5, EB-PC-1 and on the corresponding logs.

#### **4. SUMMARISED SUBSURFACE CONDITIONS**

Reference is made to the appended Record of Borehole sheets for details of the subsurface conditions including soil classifications, inferred stratigraphy, boundary elevations, standard and dynamic cone penetration test data and groundwater observations. The results of laboratory Atterberg limits testing, grain size distribution analyses and natural moisture content determinations are also shown on the Record of Borehole sheets.

The borehole locations and stratigraphic profile prepared from the borehole data are shown on Drawing EB-1. The boundaries between soil strata have been established at the borehole locations only. Between and beyond the boreholes, the boundaries are assumed and may vary.



The subsurface stratigraphy revealed in the boreholes drilled at the site generally comprised topsoil over fill overlying sandy soils containing seams of clayey silt / silty clay and underlain by silt / sandy silt. Cobbles and boulders were encountered in boreholes EB-2, EB-3 and EB-5. The groundwater was at elevation 74.9 to 75.7. The water level in the Desjardins Canal was at elevation 75.0 on August 30, 2015.

The strata encountered are summarised below.

#### **4.1 Topsoil**

Surficial topsoil was present in boreholes EB-1 to EB-3 and EB-5. The silty topsoil was 250 to 750 mm thick and penetrated at elevation 84.1 to 85.5.

#### **4.2 Fill**

Asphalt 150 mm in thickness and crusher run material from the existing highway pavement was present surficially in borehole EB-6 put down on the shoulder at the north approach. The granular fill overlay sand and gravel fill that was compact in relative density, about 3% in moisture content and extended to 1.8 m depth (elevation 84.3).

Silty sand and/or sand fill was present surficially in borehole EB-4 and below the topsoil at a depth of 0.3 m (elevation 84.4) in borehole EB-2. The fill was loose to compact in relative density (SPT-'N' values of 4 to 22) and had a moisture content of 3 to 11%. The fill was penetrated at 5.2 m depth (elevation 79.5) in borehole EB-2 and a depth of 4.0 m (elevation 81.4) in borehole EB-4.

#### **4.3 Sand / Silty Sand**

Directly beneath the topsoil or fill at depths of 0.3 to 5.2 m (elevation 79.5 to 85.5) in all the boreholes was sand / silty sand. This stratum was very loose to compact becoming dense to very dense (SPT-'N' values of 1 to over 99), with a moisture content of 3 to 24%. Containing seams of clayey silt / silty clay, the sand / silty sand was 6.7 to 24.3 m thick and penetrated at depths of 8.5 to 24.6 m



(elevation 60.1 to 77.6). The cohesive soils were present at depths of 19.6 to 21.6 m (elevation 63.1 to 65.4) on the south side of the canal and at depths of 7.1 to 12.8 m (elevation 72.6 to 79.0) on the north side. Borehole EB-1 was terminated in the stratum at 10.4 m depth (elevation 74.5). It is noteworthy that cobbles were encountered in the sand in borehole EB-3.

The results of grain size distribution analyses performed on 17 samples of the sand / silty sand are presented in Figure EB-GS-1.

The results of Atterberg limits testing and grain size distribution analysis conducted on a cohesive sample revealed within the sandy soil stratum in borehole EB-3 are presented in respective Figures EB-PC-1 and EB-GS-2. The liquid and plastic limits of the clayey silt were 20 and 15 respectively, thus giving the plasticity index of 5.

#### **4.4 Sand and Silt**

Overlain by the sand at 19.2 m depth (elevation 66.2) in borehole EB-4 and at a depth of 16.2 m (elevation 69.6) in borehole EB-5 was cohesionless sand and silt. This unit was very dense (SPT-'N' values of 50 blows per 15 cm penetration to 106 blows per 23 cm penetration) and 15 to 21% in moisture content. The sand and silt was 5.3 m in thickness and penetrated at 24.5 m depth (elevation 60.9) in borehole EB-4 and a depth of 21.5 m (elevation 64.3) in borehole EB-5.

The results of grain size distribution analyses performed on 2 samples of the sand and silt are presented in Figure EB-GS-3.

#### **4.5 Sandy Silt / Silt**

Underlying the sand or sand and silt at 8.5 m depth (elevation 77.6) in borehole EB-6 and depths of 21.5 to 24.6 m (elevation 60.1 to 64.3) in boreholes EB-2 to EB-5 was sandy silt / silt. This stratum was compact to very dense (SPT-'N' values of 26 to over 103) and had a moisture content ranging from 15 to 24%. The sandy silt / silt was not penetrated upon termination of drilling at 11.3 m depth (elevation 74.8) in borehole EB-6 and a depth of 30.9 m (elevation 53.8 to 54.9) in boreholes EB-2 to



EB-5. It is worth noting that dynamic cone penetration tests performed in boreholes EB-2 and EB-5 were terminated by refusal on probable boulders.

The results of grain size distribution analyses performed on 2 samples of the sandy silt and 5 samples of the silt are presented in respective Figures EB-GS-4 and EB-GS-5.

#### **4.6 Groundwater**

In the process of augering, water was detected at depths of 4.3 to 10.2 m (elevation 74.5 to 80.6) in all the boreholes. Upon completion of drilling, groundwater was measured in boreholes EB-3 and EB-6 to be at 10.4 m depth (elevation 74.9 and 75.7).

Two piezometers were installed in boreholes EB-3 and EB-4. The piezometer readings subsequently taken showed water levels to be at the following depths / elevations:

| <b>Borehole No.</b> | <b>June 10, 2015</b> |                  | <b>July 9, 2015</b> |                  | <b>August 30, 2015</b> |                  |
|---------------------|----------------------|------------------|---------------------|------------------|------------------------|------------------|
|                     | <b>Depth, m</b>      | <b>Elevation</b> | <b>Depth, m</b>     | <b>Elevation</b> | <b>Depth, m</b>        | <b>Elevation</b> |
| EB-3                | 10.4                 | 74.9             | 10.1                | 75.2             | 10.2                   | 75.1             |
| EB-4                | -                    | -                | 10.1                | 75.3             | 10.3                   | 75.1             |

The water level in the Desjardins Canal was at elevation 75.0 on August 30, 2015. The groundwater levels at the site are subject to seasonal fluctuations and precipitation patterns, generally reflecting the water level of the adjacent Desjardins Canal.





## 5. CLOSURE

The field work was carried out under the supervision of Mr. F. Portela, Senior Technician, under the coordination of Mr. K. Daly, BEng, and direction of Mr. C.M.P. Nascimento, P.Eng., Senior Project Engineer. The equipment was supplied by Elite Drilling Services and Altech Drilling & Investigative Services Ltd.

This report was prepared by Mr. G.O. Degil, PhD, P.Eng., Senior Foundation Engineer, and reviewed by Mr. C.M.P. Nascimento, P.Eng., Project Manager and MTO Designated Principal Contact.

Yours very truly,

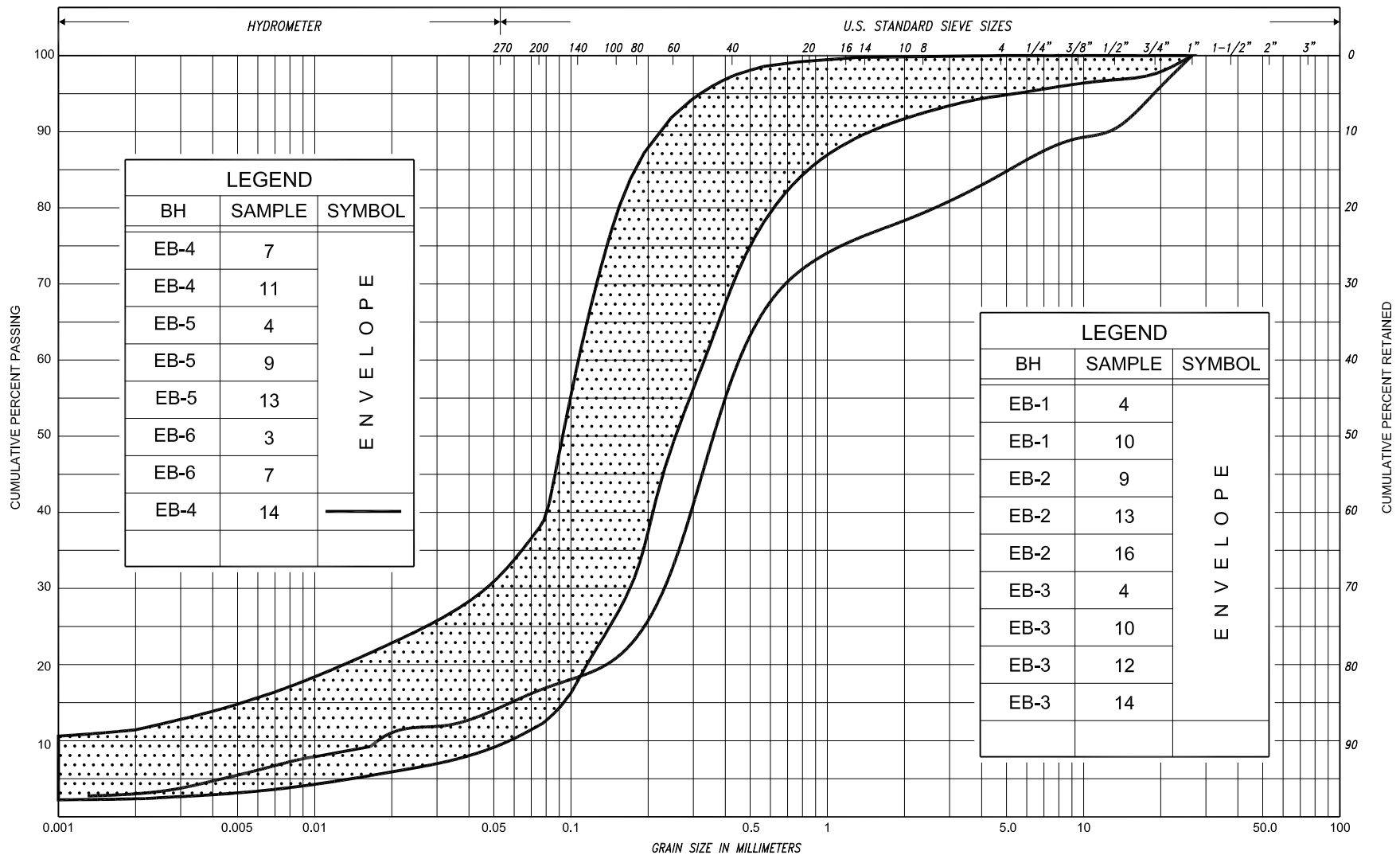
Peto MacCallum Ltd.



Grigory O. Degil, PhD, P.Eng.  
Senior Foundation Engineer



Carlos M.P. Nascimento, P.Eng.  
Project Manager and  
MTO Designated Principal Contact



|             |      |      |        |        |      |         |        |      |        |        |        |  |          |         |  |
|-------------|------|------|--------|--------|------|---------|--------|------|--------|--------|--------|--|----------|---------|--|
| SILT & CLAY |      |      |        |        | FINE |         | MEDIUM |      | COARSE | GRAVEL |        |  | COB BLES | UNIFIED |  |
| CLAY        | FINE |      | MEDIUM | COARSE | SAND |         |        |      |        |        |        |  |          |         |  |
|             |      |      |        |        | FINE |         | MEDIUM |      | COARSE |        | GRAVEL |  |          | COBBLES |  |
| CLAY        |      | SILT |        |        |      | V. FINE |        | FINE | MED.   | COARSE | GRAVEL |  |          |         |  |
|             |      |      |        |        | SAND |         |        |      |        |        |        |  |          |         |  |



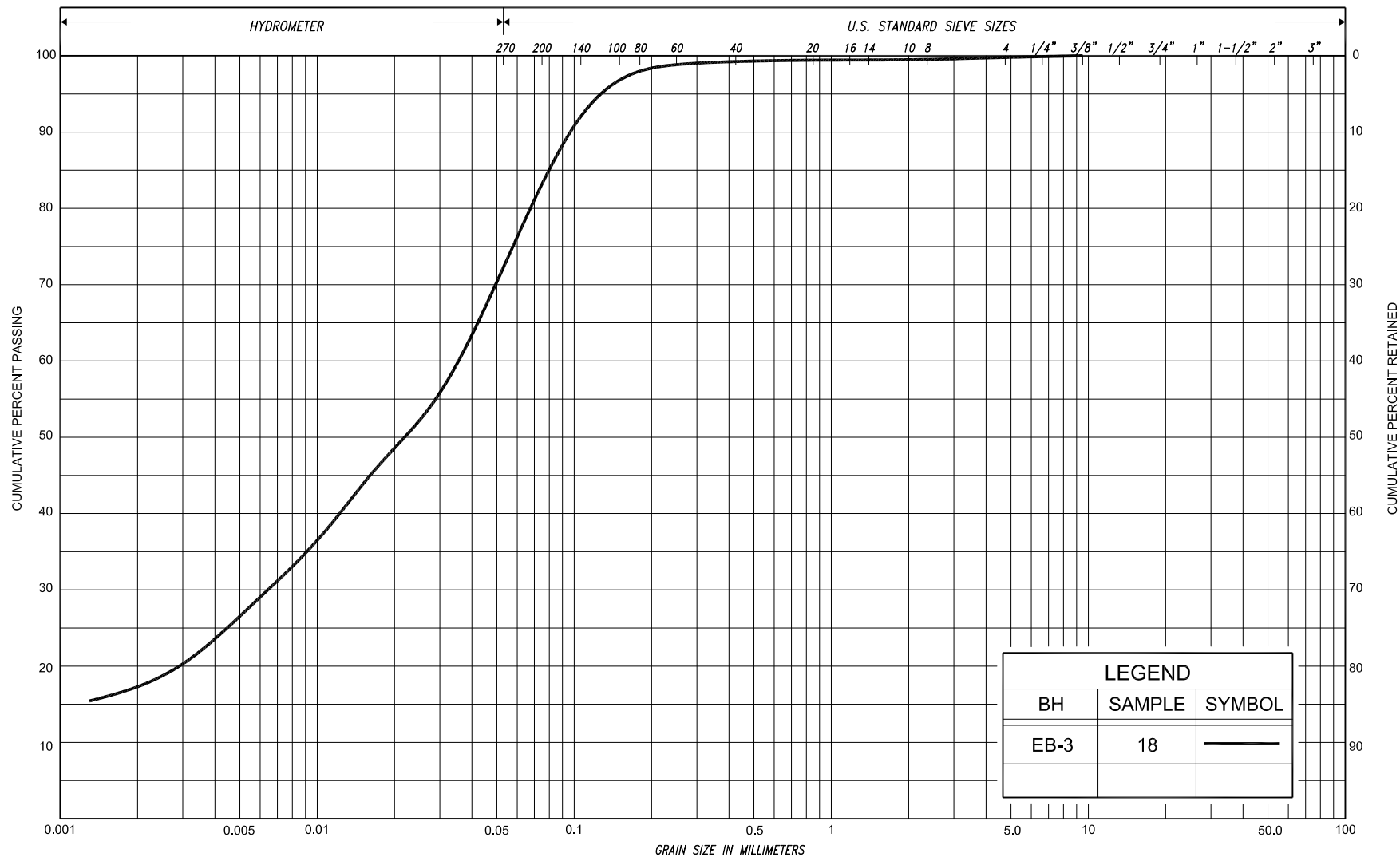
## GRAIN SIZE DISTRIBUTION

SAND, some silt to silty, trace to some clay, trace to some gravel

FIG No. EB-GS-1

HWY: 403

W.P. No. 2357-09-01



|             |      |      |        |         |      |      |        |  |        |        |        |  |         |         |             |  |  |
|-------------|------|------|--------|---------|------|------|--------|--|--------|--------|--------|--|---------|---------|-------------|--|--|
| SILT & CLAY |      |      |        |         | FINE |      | MEDIUM |  | COARSE | GRAVEL |        |  | COBBLES | UNIFIED |             |  |  |
|             |      |      |        |         | SAND |      |        |  |        |        |        |  |         |         |             |  |  |
| CLAY        | FINE |      | MEDIUM | COARSE  | FINE |      | MEDIUM |  | COARSE |        | GRAVEL |  |         | COBBLES | M.I.T.      |  |  |
|             | SILT |      |        |         |      |      |        |  |        |        | GRAVEL |  |         | COBBLES | U.S. BUREAU |  |  |
| CLAY        |      | SILT |        | V. FINE | FINE | MED. | COARSE |  |        |        |        |  |         |         |             |  |  |
|             |      |      |        | SAND    |      |      |        |  |        |        |        |  |         |         |             |  |  |

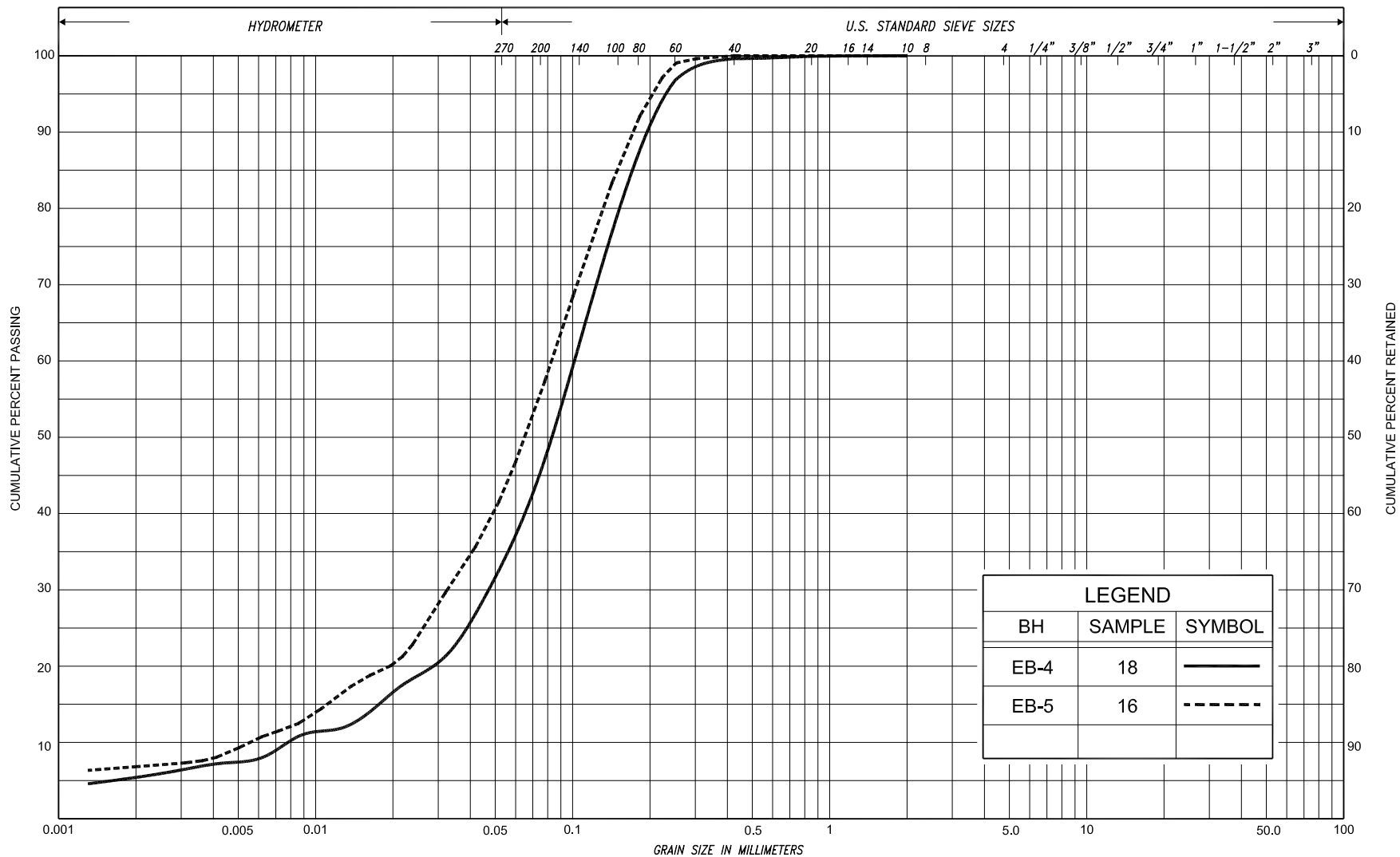


# GRAIN SIZE DISTRIBUTION CLAYEY SILT, some sand (CL-ML)

FIG No. EB-GS-2

HWY: 403

W.P. No. 2357-09-01



|             |      |      |        |        |         |      |        |        |        |        |        |  |         |         |        |             |
|-------------|------|------|--------|--------|---------|------|--------|--------|--------|--------|--------|--|---------|---------|--------|-------------|
| SILT & CLAY |      |      |        |        | FINE    |      | MEDIUM |        | COARSE | GRAVEL |        |  | COBBLES | UNIFIED |        |             |
|             |      |      |        |        | SAND    |      |        |        |        |        |        |  |         |         |        |             |
| CLAY        | FINE |      | MEDIUM | COARSE | FINE    |      | MEDIUM |        | COARSE |        | GRAVEL |  |         | COBBLES | M.I.T. |             |
|             | SILT |      |        |        |         |      |        |        |        |        |        |  |         |         |        |             |
| CLAY        |      | SILT |        |        | V. FINE | FINE | MED.   | COARSE | GRAVEL |        |        |  |         |         |        | U.S. BUREAU |
|             |      |      |        |        | SAND    |      |        |        |        |        |        |  |         |         |        |             |



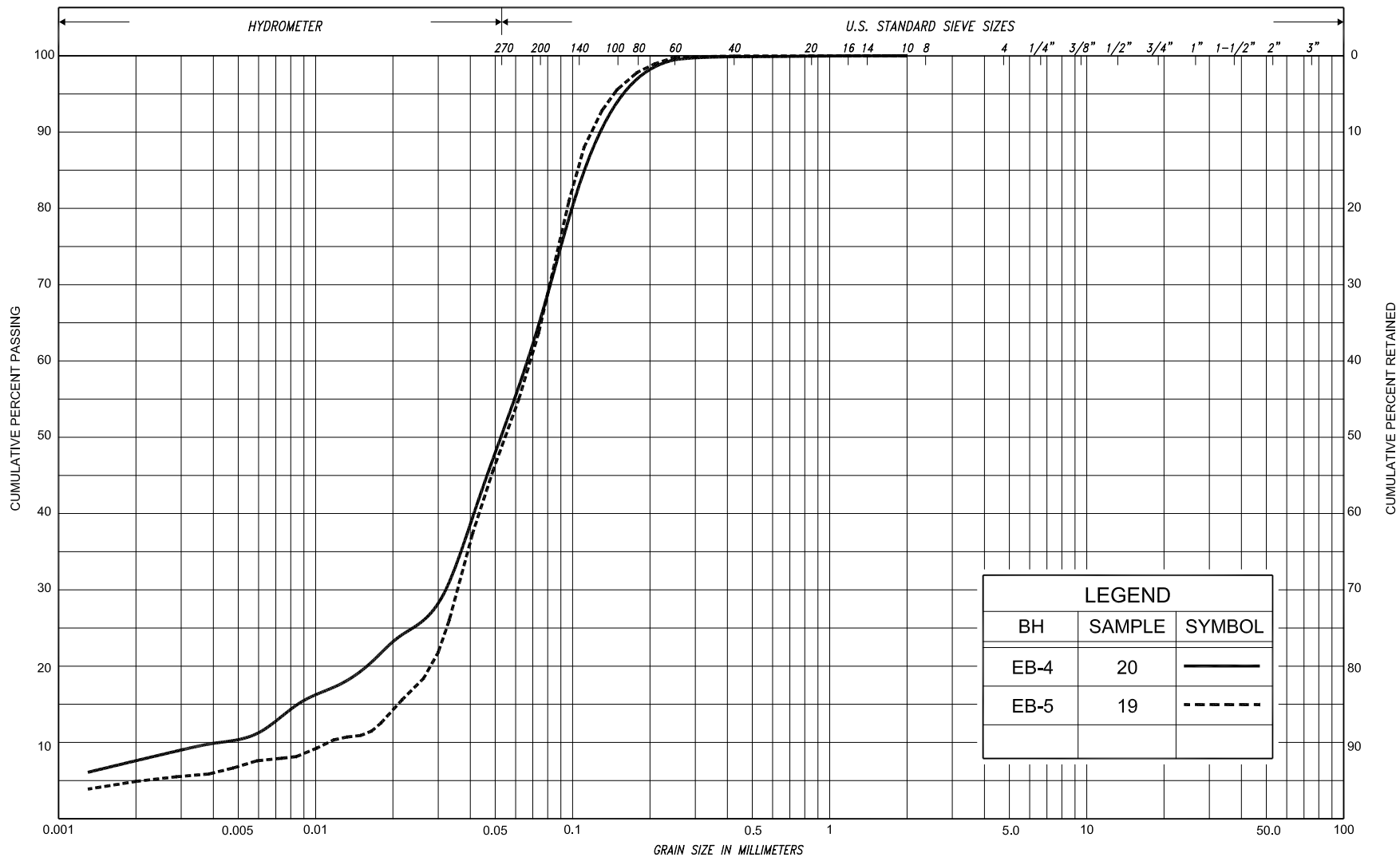
## GRAIN SIZE DISTRIBUTION

SAND AND SILT, trace clay

FIG No. EB-GS-3

HWY: 403

W.P. No. 2357-09-01



|             |      |      |        |        |         |      |        |        |        |        |        |  |         |         |        |             |
|-------------|------|------|--------|--------|---------|------|--------|--------|--------|--------|--------|--|---------|---------|--------|-------------|
| SILT & CLAY |      |      |        |        | FINE    |      | MEDIUM |        | COARSE | GRAVEL |        |  | COBBLES | UNIFIED |        |             |
|             |      |      |        |        | SAND    |      |        |        |        |        |        |  |         |         |        |             |
| CLAY        | FINE |      | MEDIUM | COARSE | FINE    |      | MEDIUM |        | COARSE |        | GRAVEL |  |         | COBBLES | M.I.T. |             |
|             | SILT |      |        |        |         |      |        |        |        |        |        |  |         |         |        |             |
| CLAY        |      | SILT |        |        | V. FINE | FINE | MED.   | COARSE | GRAVEL |        |        |  |         |         |        | U.S. BUREAU |
|             |      |      |        |        | SAND    |      |        |        |        |        |        |  |         |         |        |             |



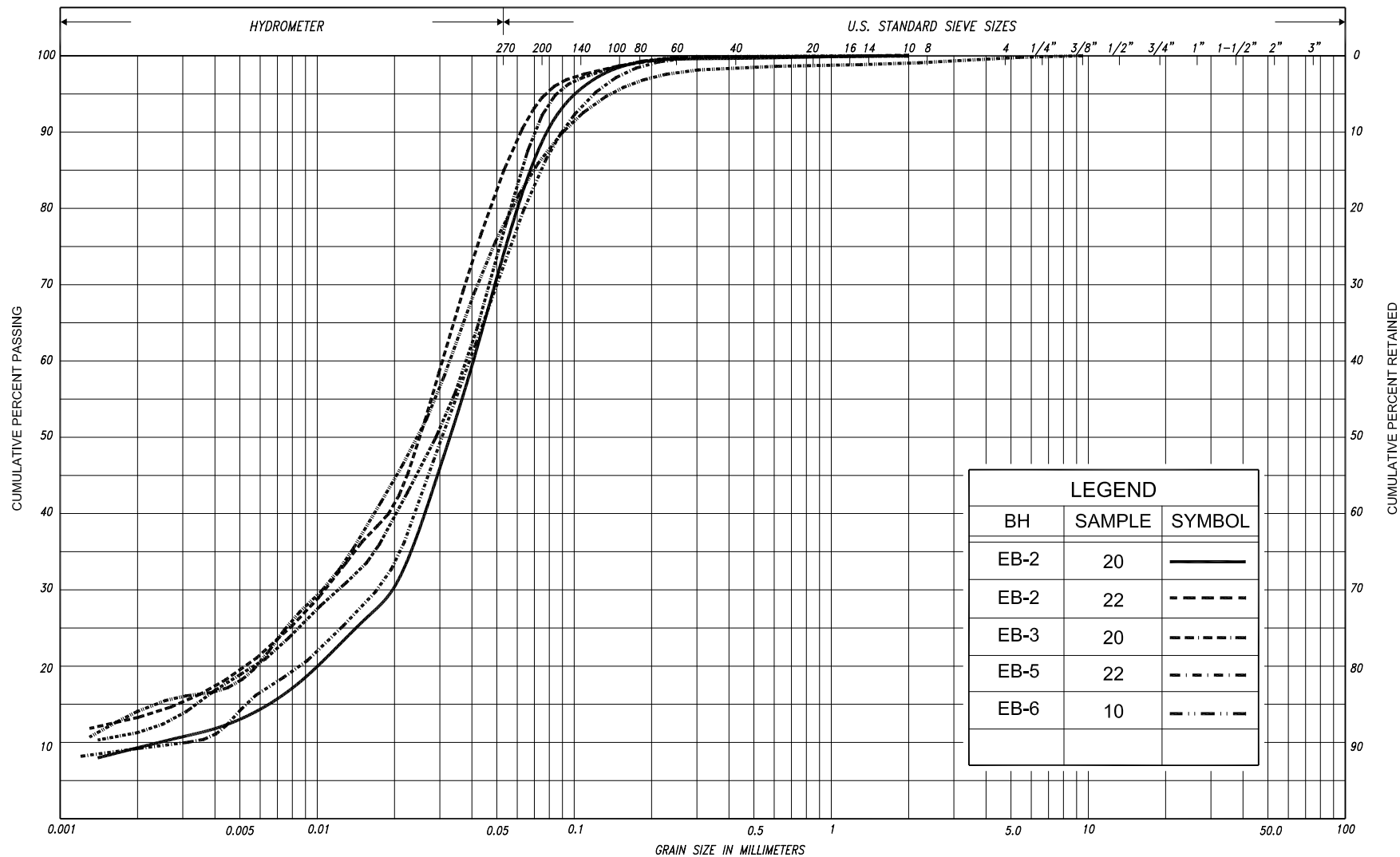
## GRAIN SIZE DISTRIBUTION

SANDY SILT, trace clay

FIG No. EB-GS-4

HWY: 403

W.P. No. 2357-09-01



|             |      |      |        |        |         |      |        |        |        |        |        |  |         |         |        |             |
|-------------|------|------|--------|--------|---------|------|--------|--------|--------|--------|--------|--|---------|---------|--------|-------------|
| SILT & CLAY |      |      |        |        | FINE    |      | MEDIUM |        | COARSE | GRAVEL |        |  | COBBLES | UNIFIED |        |             |
|             |      |      |        |        | SAND    |      |        |        |        |        |        |  |         |         |        |             |
| CLAY        | FINE |      | MEDIUM | COARSE | FINE    |      | MEDIUM |        | COARSE |        | GRAVEL |  |         | COBBLES | M.I.T. |             |
|             | SILT |      |        |        |         |      |        |        |        |        |        |  |         |         |        |             |
| CLAY        |      | SILT |        |        | V. FINE | FINE | MED.   | COARSE | GRAVEL |        |        |  |         |         |        | U.S. BUREAU |
|             |      |      |        |        | SAND    |      |        |        |        |        |        |  |         |         |        |             |

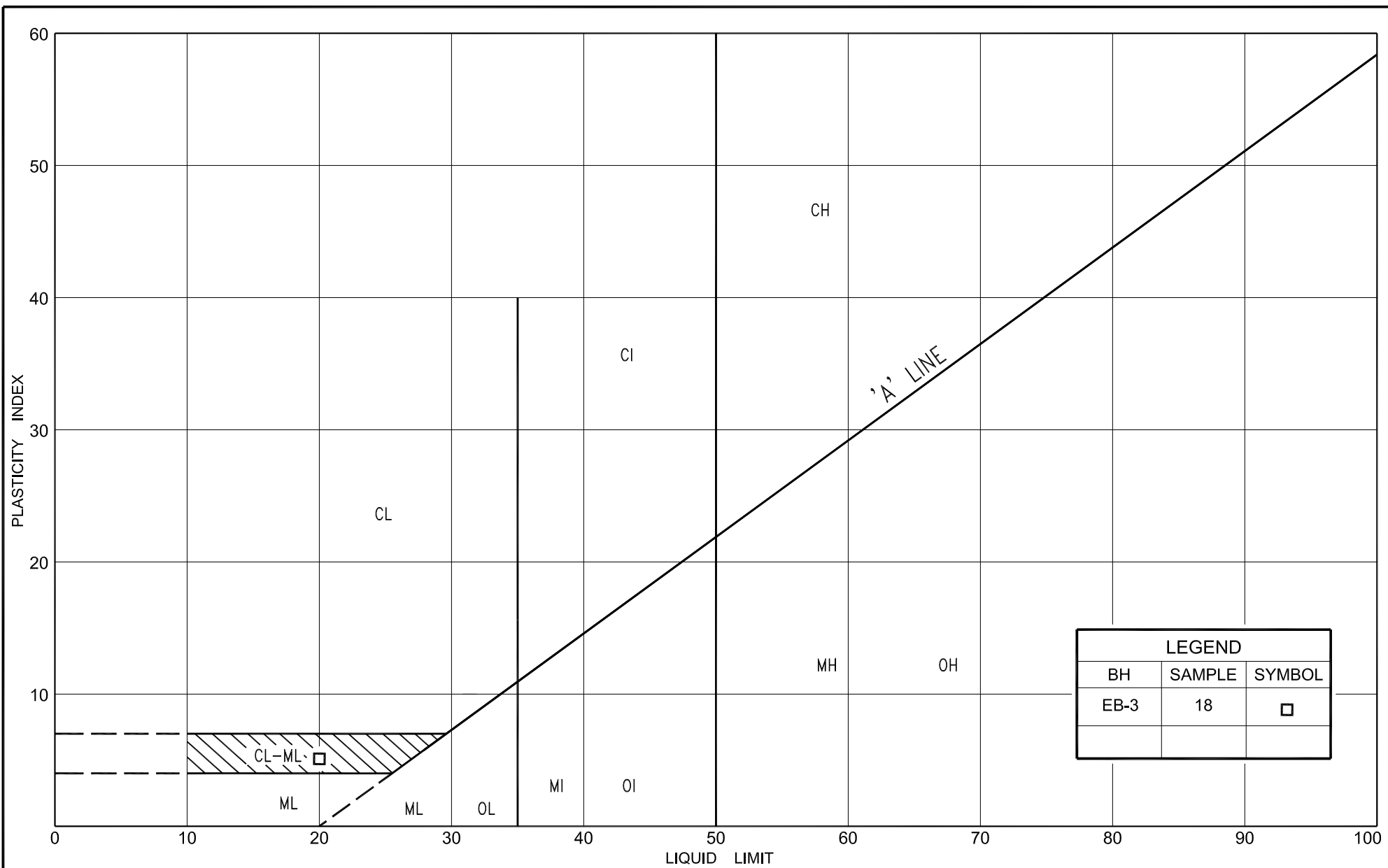


# GRAIN SIZE DISTRIBUTION SILT, trace to some sand, trace to some clay

FIG No. EB-GS-5

HWY: 403

W.P. No. 2357-09-01



**PLASTICITY CHART**  
CLAYEY SILT, some sand (CL-ML)

|          |            |
|----------|------------|
| FIG No.  | EB-PC-1    |
| HWY:     | 403        |
| W.P. No. | 2357-09-01 |

## EXPLANATION OF TERMS USED IN REPORT

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

**COMPOSITION:** SECONDARY SOIL COMPONENTS ARE DESCRIBED ON THE BASIS OF PERCENTAGE BY MASS OF THE WHOLE SAMPLE AS FOLLOWS:

| PERCENT BY MASS | 0 - 10 | 10 - 20 | 20 - 30 | 30 - 40           | > 40           |
|-----------------|--------|---------|---------|-------------------|----------------|
|                 | TRACE  | SOME    | WITH    | ADJECTIVE (SILTY) | AND (AND SILT) |

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

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

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

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

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

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

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

| R Q D (%) | 0 - 25    | 25 - 50 | 50 - 75 | 75 - 90 | 90 - 100  |
|-----------|-----------|---------|---------|---------|-----------|
|           | VERY POOR | POOR    | FAIR    | GOOD    | EXCELLENT |

**JOINTING AND BEDDING:**

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

## ABBREVIATIONS AND SYMBOLS

### FIELD SAMPLING

|     |                     |     |                            |
|-----|---------------------|-----|----------------------------|
| S S | SPLIT SPOON         | T P | THINWALL PISTON            |
| W S | WASH SAMPLE         | O S | OSTERBERG SAMPLE           |
| S T | SLOTTED TUBE SAMPLE | R C | ROCK CORE                  |
| B S | BLOCK SAMPLE        | P H | T W ADVANCED HYDRAULICALLY |
| C S | CHUNK SAMPLE        | P M | T W ADVANCED MANUALLY      |
| T W | THINWALL OPEN       | F S | FOIL SAMPLE                |
| F V | FIELD VANE          |     |                            |

### STRESS AND STRAIN

|                                      |     |                               |
|--------------------------------------|-----|-------------------------------|
| $u_w$                                | kPa | PORE WATER PRESSURE           |
| $u$                                  | 1   | PORE PRESSURE RATIO           |
| $\sigma$                             | kPa | TOTAL NORMAL STRESS           |
| $\sigma'$                            | kPa | EFFECTIVE NORMAL STRESS       |
| $\tau$                               | kPa | SHEAR STRESS                  |
| $\sigma_1, \sigma_2, \sigma_3$       | kPa | PRINCIPAL STRESSES            |
| $\epsilon$                           | %   | LINEAR STRAIN                 |
| $\epsilon_1, \epsilon_2, \epsilon_3$ | %   | PRINCIPAL STRAINS             |
| E                                    | kPa | MODULUS OF LINEAR DEFORMATION |
| G                                    | kPa | MODULUS OF SHEAR DEFORMATION  |
| $\mu$                                | 1   | COEFFICIENT OF FRICTION       |

### MECHANICAL PROPERTIES OF SOIL

|                |                   |                                      |
|----------------|-------------------|--------------------------------------|
| $m_v$          | kPa <sup>-1</sup> | COEFFICIENT OF VOLUME CHANGE         |
| $C_c$          | 1                 | COMPRESSION INDEX                    |
| $C_s$          | 1                 | SWELLING INDEX                       |
| $C_\alpha$     | 1                 | RATE OF SECONDARY CONSOLIDATION      |
| $c_v$          | m <sup>2</sup> /s | COEFFICIENT OF CONSOLIDATION         |
| H              | m                 | DRAINAGE PATH                        |
| $T_v$          | 1                 | TIME FACTOR                          |
| U              | %                 | DEGREE OF CONSOLIDATION              |
| $\sigma'_{vo}$ | kPa               | EFFECTIVE OVERBURDEN PRESSURE        |
| $\sigma'_p$    | kPa               | PRECONSOLIDATION PRESSURE            |
| $\tau_f$       | kPa               | SHEAR STRENGTH                       |
| $c'$           | kPa               | EFFECTIVE COHESION INTERCEPT         |
| $\phi'$        | -°                | EFFECTIVE ANGLE OF INTERNAL FRICTION |
| $c_u$          | kPa               | APPARENT COHESION INTERCEPT          |
| $\phi_u$       | -°                | APPARENT ANGLE OF INTERNAL FRICTION  |
| $\tau_R$       | kPa               | RESIDUAL SHEAR STRENGTH              |
| $\tau_r$       | kPa               | REMOULDED SHEAR STRENGTH             |
| $S_i$          | 1                 | SENSITIVITY = $\frac{c_u}{\tau_r}$   |

### PHYSICAL PROPERTIES OF SOIL

|                |                   |                                |       |      |   |           |                   |   |
|----------------|-------------------|--------------------------------|-------|------|---|-----------|-------------------|---|
| $\rho_s$       | kg/m <sup>3</sup> | DENSITY OF SOLID PARTICLES     | n     | 1, % | POROSITY                                  | $e_{max}$ | 1, %              | VOID RATIO IN LOOSEST STATE                             |
| $\gamma_s$     | kN/m <sup>3</sup> | UNIT WEIGHT OF SOLID PARTICLES | w     | 1, % | WATER CONTENT                             | $e_{min}$ | 1, %              | VOID RATIO IN DENSEST STATE                             |
| $\rho_w$       | kg/m <sup>3</sup> | DENSITY OF WATER               | $S_r$ | %    | DEGREE OF SATURATION                      | $I_D$     | 1                 | DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$ |
| $\gamma_w$     | kN/m <sup>3</sup> | UNIT WEIGHT OF WATER           | $w_L$ | %    | LIQUID LIMIT                              | D         | mm                | GRAIN DIAMETER  |
| $\rho$         | kg/m <sup>3</sup> | DENSITY OF SOIL                | $w_p$ | %    | PLASTIC LIMIT                             | $D_n$     | mm                | n PERCENT - DIAMETER                                    |
| $\gamma$       | kN/m <sup>3</sup> | UNIT WEIGHT OF SOIL            | $w_s$ | %    | SHRINKAGE LIMIT                           | $C_u$     | 1                 | UNIFORMITY COEFFICIENT                                  |
| $\rho_d$       | kg/m <sup>3</sup> | DENSITY OF DRY SOIL            | $I_p$ | %    | PLASTICITY INDEX = $w_L - w_p$            | h         | m                 | HYDRAULIC HEAD OR POTENTIAL                             |
| $\gamma_d$     | kN/m <sup>3</sup> | UNIT WEIGHT OF DRY SOIL        | $I_L$ | 1    | LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$   | q         | m <sup>3</sup> /s | RATE OF DISCHARGE                                       |
| $\rho_{sat}$   | kg/m <sup>3</sup> | DENSITY OF SATURATED SOIL      | $I_C$ | 1    | CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$ | v         | m/s               | DISCHARGE VELOCITY                                      |
| $\gamma_{sat}$ | kN/m <sup>3</sup> | UNIT WEIGHT OF SATURATED SOIL  | DTPL  |      | DRIER THAN PLASTIC LIMIT                  | i         | 1                 | HYDRAULIC GRADIENT                                      |
| $\rho'$        | kg/m <sup>3</sup> | DENSITY OF SUBMERGED SOIL      | APL   |      | ABOUT PLASTIC LIMIT                       | k         | m/s               | HYDRAULIC CONDUCTIVITY                                  |
| $\gamma'$      | kN/m <sup>3</sup> | UNIT WEIGHT OF SUBMERGED SOIL  | WTP   |      | WETTER THAN PLASTIC LIMIT                 | j         | kN/m <sup>3</sup> | SEEPAGE FORCE   |
| e              | 1, %              | VOID RATIO                     |       |      |   |           |                   |   |



# RECORD OF BOREHOLE No EB-1

1 of 1

**METRIC**

|        |            |          |                                     |               |                                     |             |      |
|--------|------------|----------|-------------------------------------|---------------|-------------------------------------|-------------|------|
| G.W.P. | 2357-09-01 | LOCATION | Coords: 4 793 308.3 N ; 272 992.1 E | ORIGINATED BY | S.A.                                |             |      |
| DIST   | Niagara    | HWY      | 403                                 | BOREHOLE TYPE | Continuous Flight Solid Stem Augers | COMPILED BY | K.D. |
| DATUM  | Geodetic   | DATE     | April 28, 2015                      | CHECKED BY    | G.D.                                |             |      |

| SOIL PROFILE  |  |            | SAMPLES |      |            | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT |  |  |  |  | PLASTIC LIMIT  |   |                | NATURAL<br>MOISTURE<br>CONTENT |  |  | LIQUID LIMIT |  |  | UNIT<br>WEIGHT<br><br>γ<br><br>kN/m³ | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  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| 84.9<br>0.0   | Ground Surface<br>Topsoil<br>sand and gravel pockets<br>(FILL) |            | 1       | SS   | 7          |                            |                 |   |  |  |  |  |                |   |                |                                |  |  |              |  |  |                                      |   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

**RECORD OF BOREHOLE No EB-2**

1 of 3

**METRIC**

**G.W.P.** 2357-09-01      **LOCATION** Coords: 4 793 333.9 N ; 272 988.2 E      **ORIGINATED BY** F.P.  
**DIST** Niagara      **HWY** 403      **BOREHOLE TYPE** C.F.H.S.A. + Mud Rotary and Dynamic Cone Penetration Test      **COMPILED BY** G.D.  
**DATUM** Geodetic      **DATE** June 12, 15 and 16, 2015      **CHECKED BY** G.D.

| SOIL PROFILE  |  |            | SAMPLES |      |            | GROUND WATER<br>CONDITIONS  | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT |  |  |  |                | PLASTIC 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><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                          |  |  |  |                |                                 |                                     |                                   |  |  |
|               |  |            |         |      |            |                             | ○ UNCONFINED      + FIELD VANE              |  |  |  |                |                                 |                                     |                                   |  |  |
|               |  |            |         |      |            |                             | ● QUICK TRIAXIAL      × LAB VANE            |  |  |  |                |                                 |                                     |                                   |  |  |
|               |  |            |         |      |            | WATER CONTENT (%)           |   |  |  |  |                |                                 |                                     |                                   |  |  |
|               |  |            |         |      |            | 20    40    60    80    100 |   |  |  |  | 20    40    60 |                                 |                                     |                                   |  |  |
| 84.7          | Ground Surface                                 |            |         |      |            |                             |   |  |  |  |                |                                 |                                     |                                   |  |  |
| 0.0           | Topsoil  |            | 1       | SS   | 6          |                             |   |  |  |  |                | ○                               |                                     |                                   |  |  |
|               | Sand, trace silt<br>topsoil inclusions to 0.8m |            |         |      |            |                             |   |  |  |  |                |                                 |                                     |                                   |  |  |
|               | Loose to Brown Moist<br>compact                |            | 2       | SS   | 7          |                             |   |  |  |  |                | ○                               |                                     |                                   |  |  |
|               |  |            |         |      |            |                             |   |  |  |  |                |                                 |                                     |                                   |  |  |
|               |  |            | 3       | SS   | 12         |                             |   |  |  |  |                |                                 |                                     |                                   |  |  |
|               |  |            |         |      |            |                             |   |  |  |  |                |                                 |                                     |                                   |  |  |
|               | trace gravel                                   |            | 4       | SS   | 4          |                             |   |  |  |  |                | ○                               |                                     |                                   |  |  |
|               |  |            |         |      |            |                             |   |  |  |  |                |                                 |                                     |                                   |  |  |
|               | (FILL)   |            | 5       | SS   | 9          |                             |   |  |  |  |                | ○                               |                                     |                                   |  |  |
|               |  |            |         |      |            |                             |   |  |  |  |                |                                 |                                     |                                   |  |  |
|               |  |            | 6       | SS   | 7          |                             |   |  |  |  |                | ○                               |                                     |                                   |  |  |
|               |  |            |         |      |            |                             |   |  |  |  |                |                                 |                                     |                                   |  |  |
|               |  |            | 7       | SS   | 19         |                             |   |  |  |  |                |                                 |                                     |                                   |  |  |
| 79.5          |  |            |         |      |            |                             |   |  |  |  |                |                                 |                                     |                                   |  |  |
| 5.2           | Sand   |            | 8       | SS   | 7          |                             |   |  |  |  |                | ○                               |                                     |                                   |  |  |
|               | some to with silt<br>trace to some clay        |            |         |      |            |                             |   |  |  |  |                |                                 |                                     |                                   |  |  |
|               | Loose to Brown Moist<br>compact                |            | 9       | SS   | 9          |                             |   |  |  |  |                | ○                               |                                     |                                   |  | 0 62 26 12   |
|               |  |            |         |      |            |                             |   |  |  |  |                |                                 |                                     |                                   |  |  |
|               |  |            |         |      |            |                             |   |  |  |  |                |                                 |                                     |                                   |  |  |
|               |  |            | 10      | SS   | 1          |                             |   |  |  |  |                | ○                               |                                     |                                   |  |  |
|               |  |            |         |      |            |                             |   |  |  |  |                |                                 |                                     |                                   |  |  |
|               |  |            |         |      |            |                             |   |  |  |  |                |                                 |                                     |                                   |  |  |
|               |  |            | 11      | SS   | 23         |                             |   |  |  |  |                | ○                               |                                     |                                   |  |  |
|               |  |            |         |      |            |                             |   |  |  |  |                |                                 |                                     |                                   |  |  |
|               | trace gravel                                   |            |         |      |            |                             |   |  |  |  |                |                                 |                                     |                                   |  |  |
|               | Dense to very dense                            |            | 12      | SS   | 41         |                             |   |  |  |  |                | ○                               |                                     |                                   |  |  |
|               | Wet  |            |         |      |            |                             |   |  |  |  |                |                                 |                                     |                                   |  |  |
|               |  |            |         |      |            |                             |   |  |  |  |                |                                 |                                     |                                   |  |  |
|               |  |            |         |      |            |                             |   |  |  |  |                |                                 |                                     |                                   |  |  |
|               |  |            | 13      | SS   | 80         |                             |   |  |  |  |                | ○                               |                                     |                                   |  | 1 78 17 4  |
|               |  |            |         |      |            |                             |   |  |  |  |                |                                 |                                     |                                   |  |  |
|               |  |            |         |      |            |                             |   |  |  |  |                |                                 |                                     |                                   |  |  |
|               |  |            | 14      | SS   | 34         |                             |   |  |  |  |                | ○                               |                                     |                                   |  |  |
|               |  |            |         |      |            |                             |   |  |  |  |                |                                 |                                     |                                   |  |  |
| 69.7          |  |            |         |      |            |                             |   |  |  |  |                |                                 |                                     |                                   |  |  |

## RECORD OF BOREHOLE No EB-2

2 of 3

METRIC

|                          |                 |                                     |                           |
|--------------------------|-----------------|-------------------------------------|---------------------------|
| <b>G.W.P.</b> 2357-09-00 | <b>LOCATION</b> | Coords: 4 793 333.9 N ; 272 988.2 E | <b>ORIGINATED BY</b> F.P. |
|--------------------------|-----------------|-------------------------------------|---------------------------|

|             |         |            |     |                      |   |                    |      |
|-------------|---------|------------|-----|----------------------|---|--------------------|------|
| <b>DIST</b> | Niagara | <b>HWY</b> | 403 | <b>BOREHOLE TYPE</b> | C.F.H.S.A. + Mud Rotary and Dynamic Cone Penetration Test | <b>COMPILED BY</b> | G.D. |
|-------------|---------|------------|-----|----------------------|---|--------------------|------|

**DATUM** Geodetic **DATE** June 12, 15 and 16, 2015 **CHECKED BY** G.D.

[illegible]

## RECORD OF BOREHOLE No EB-2

3 of 3

METRIC

|               |            |                 |                                     |                      |      |
|---------------|------------|-----------------|-------------------------------------|----------------------|------|
| <b>G.W.P.</b> | 2357-09-00 | <b>LOCATION</b> | Coords: 4 793 333.9 N ; 272 988.2 E | <b>ORIGINATED BY</b> | F.P. |
|---------------|------------|-----------------|-------------------------------------|----------------------|------|

|             |         |            |     |                      |   |                    |      |
|-------------|---------|------------|-----|----------------------|---|--------------------|------|
| <b>DIST</b> | Niagara | <b>HWY</b> | 403 | <b>BOREHOLE TYPE</b> | C.F.H.S.A. + Mud Rotary and Dynamic Cone Penetration Test | <b>COMPILED BY</b> | G.D. |
|-------------|---------|------------|-----|----------------------|---|--------------------|------|

**DATUM** Geodetic **DATE** June 12, 15 and 16, 2015 **CHECKED BY** G.D.

[illegible]

# RECORD OF BOREHOLE No EB-3

1 of 3

METRIC

G.W.P. 2357-09-01 LOCATION Coords: 4 793 328.5 N ; 273 002.8 E ORIGINATED BY F.P.

DIST Niagara HWY 403 BOREHOLE TYPE Continuous Flight Hollow Stem Augers + Mud Rotary COMPILED BY G.D.

DATUM Geodetic DATE April 30, May 01 and June 10 to 12, 2015 CHECKED BY G.D.

| SOIL PROFILE  |  |            | SAMPLES |      |            | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT  |    |    |    | PLASTIC LIMIT<br>W <sub>p</sub> | NATURAL<br>MOISTURE<br>CONTENT<br>W | LIQUID LIMIT<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 |    |    |    |                                 |                                     |                                |  |  |
| 85.3          | Ground Surface                                 |            |         |      |            |                            |                 | 20   | 40 | 60 | 80 | 100                             |                                     |                                |  |  |
| 0.0           | Topsoil  | ~~~~~      | 1       | SS   | 3          |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
| 85.0          | Sand, trace silt<br>topsoil seams to 1.2m      | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
| 0.3           | Very loose Brown      Moist<br>to loose        | •••••      | 2       | SS   | 4          |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               | some silt to silty<br>trace clay, trace gravel | •••••      | 3       | SS   | 3          |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      | 4       | SS   | 3          |                            |                 |  |    |    |    |                                 |                                     |                                |  | 2 61 31 6  |
|               |  | •••••      | 5       | SS   | 3          |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      | 6       | SS   | 7          |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      | 7       | SS   | 8          |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      | 8       | SS   | 8          |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               | cobbles to 6.7m                                | •••••      | 9       | SS   | 15         |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               | Compact<br>to dense                            | •••••      | 10      | SS   | 35         |                            |                 |  |    |    |    |                                 |                                     |                                |  | 5 82 (13)  |
|               |  | •••••      | 11      | SS   | 30         |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      | 12      | SS   | 23         |                            |                 |  |    |    |    |                                 |                                     |                                |  | 3 79 14 4  |
|               |  | •••••      | 13      | SS   | 25         |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      | 14      | SS   | 32         |                            |                 |  |    |    |    |                                 |                                     |                                |  | 0 87 (13)  |
| 70.3          |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      |         |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |
|               |  | •••••      | </      |      |            |                            |                 |  |    |    |    |                                 |                                     |                                |  |  |

**RECORD OF BOREHOLE No EB-3**

2 of 3

**METRIC**

**G.W.P.** 2357-09-01      **LOCATION** Coords: 4 793 328.5 N ; 273 002.8 E      **ORIGINATED BY** F.P.  
**DIST** Niagara      **HWY** 403      **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers + Mud Rotary      **COMPILED BY** G.D.  
**DATUM** Geodetic      **DATE** April 30, May 01 and June 10 to 12, 2015      **CHECKED BY** G.D.

| SOIL PROFILE  |   |            | SAMPLES |      | GROUND WATER<br>CONDITIONS | 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>(%) |
|---------------|---|------------|---------|------|----------------------------|---|----|----|----|-----|---|---|----------------|---|---|
| ELEV<br>DEPTH | DESCRIPTION   | STRAT PLOT | NUMBER  | TYPE |                            | SHEAR STRENGTH kPa                          |    |    |    |     | W <sub>p</sub>                                      | W | W <sub>L</sub> |   |   |
| 70.3          |   |            |         |      |                            | 20  | 40 | 60 | 80 | 100 |   |   |                |   |   |
| 15.0          | Sand<br>some silt, trace clay<br>Compact to Brown Wet<br>very dense (Cont'd.) |            | 15      | SS   | 28                         |   |    |    |    |     |   |   |                |   |   |
|               |   |            |         |      |                            |   |    |    |    |     |   |   |                |   |   |
|               |   |            | 16      | SS   | 33                         |   |    |    |    |     |   |   |                |   |   |
|               |   |            |         |      |                            |   |    |    |    |     |   |   |                |   |   |
|               |   |            | 17      | SS   | 36                         |   |    |    |    |     |   |   |                |   |   |
|               |   |            |         |      |                            |   |    |    |    |     |   |   |                |   |   |
|               | clayey silt layers<br>Moist   |            | 18      | SS   | 53                         |   |    |    |    |     |   |   |                |   |   |
|               |   |            |         |      |                            |   |    |    |    |     |   |   |                |   |   |
|               | with silt<br>Dense Wet  |            |         |      |                            |   |    |    |    |     |   |   |                |   |   |
|               |   |            | 19      | SS   | 40                         |   |    |    |    |     |   |   |                |   |   |
|               |   |            |         |      |                            |   |    |    |    |     |   |   |                |   |   |
| 60.7          |   |            |         |      |                            |   |    |    |    |     |   |   |                |   |   |
| 24.6          | Silt<br>some clay, trace sand<br>Compact Grey Moist<br>to dense               |            |         |      |                            |   |    |    |    |     |   |   |                |   |   |
|               |   |            | 20      | SS   | 26                         |   |    |    |    |     |   |   |                |   |   |
|               |   |            |         |      |                            |   |    |    |    |     |   |   |                |   |   |
|               |   |            |         |      |                            |   |    |    |    |     |   |   |                |   |   |
|               | some to with sand<br>Very dense Grey Moist                                    |            | 21      | SS   | 81                         |   |    |    |    |     |   |   |                |   |   |
|               |   |            |         |      |                            |   |    |    |    |     |   |   |                |   |   |
| 55.3          | Cont'd  |            |         |      |                            |   |    |    |    |     |   |   |                |   |   |

**RECORD OF BOREHOLE No EB-3**

3 of 3

**METRIC**

G.W.P. 2357-09-01 LOCATION Coords: 4 793 328.5 N ; 273 002.8 E ORIGINATED BY F.P.  
DIST Niagara HWY 403 BOREHOLE TYPE Continuous Flight Hollow Stem Augers + Mud Rotary COMPILED BY G.D.  
DATUM Geodetic DATE April 30, May 01 and June 10 to 12, 2015 CHECKED BY G.D.

| 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 | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%) |  |  |
|--|------------------------------------|------------|--------|---------|------------|--|----------------------------|-----------------|---|--|-------------------|--|---|------------------------------------|-------------------------------------|-----------------------------------|---------------------|---|--|--|
| ELEV<br>DEPTH                          | DESCRIPTION                        | STRAT PLOT | NUMBER | TYPE    | "N" VALUES | SHEAR STRENGTH kPa                                       |                            |                 |   |  | WATER CONTENT (%) |  |   |                                    |                                     |                                   |                     |   |  |  |
|  |                                    |            |        |         |            | 20 40 60 80 100  |                            |                 |   |  | 20 40 60          |  |   |                                    |                                     |                                   |                     |   |  |  |
|  |                                    |            |        |         |            | ○ UNCONFINED + FIELD VANE<br>● QUICK TRIAXIAL × LAB VANE |                            |                 |   |  |                   |  |   |                                    |                                     |                                   |                     |   |  |  |
| 55.3                                   |                                    |            |        |         |            |  |                            |                 |   |  |                   |  |   |                                    |                                     |                                   |                     |   |  |  |
| 30.0                                   | Silt<br>with sand, trace clay      |            |        |         |            |  | 55                         |                 |   |  |                   |  |   |                                    |                                     |                                   |                     |   |  |  |
| 54.4                                   | Very dense Grey Moist<br>(Cont'd.) |            | 22     | SS      | 57         |  |                            |                 |   |  |                   |  | 0 |                                    |                                     |                                   |                     |   |  |  |
| 30.9                                   | End of borehole                    |            |        |         |            |  |                            |                 |   |  |                   |  |   |                                    |                                     |                                   |                     |   |  |  |
|  |                                    |            |        |         |            |  |                            |                 |   |  |                   |  |   |                                    |                                     |                                   |                     |   |  |  |
| * 2015 04 30 / 05 01                   |                                    |            |        |         |            |  |                            |                 |   |  |                   |  |   |                                    |                                     |                                   |                     |   |  |  |
| ▽ Water level observed during drilling |                                    |            |        |         |            |  |                            |                 |   |  |                   |  |   |                                    |                                     |                                   |                     |   |  |  |
| ▼ Water level measured after drilling  |                                    |            |        |         |            |  |                            |                 |   |  |                   |  |   |                                    |                                     |                                   |                     |   |  |  |
|  |                                    |            |        |         |            |  |                            |                 |   |  |                   |  |   |                                    |                                     |                                   |                     |   |  |  |
| Water Level Readings:                  |                                    |            |        |         |            |  |                            |                 |   |  |                   |  |   |                                    |                                     |                                   |                     |   |  |  |
| Date Depth (m) Elev.                   |                                    |            |        |         |            |  |                            |                 |   |  |                   |  |   |                                    |                                     |                                   |                     |   |  |  |
| 06/10/'15 10.4 74.9                    |                                    |            |        |         |            |  |                            |                 |   |  |                   |  |   |                                    |                                     |                                   |                     |   |  |  |
| 07/09/'15 10.1 75.2                    |                                    |            |        |         |            |  |                            |                 |   |  |                   |  |   |                                    |                                     |                                   |                     |   |  |  |
| 08/30/'15 10.2 75.1                    |                                    |            |        |         |            |  |                            |                 |   |  |                   |  |   |                                    |                                     |                                   |                     |   |  |  |
|  |                                    |            |        |         |            |  |                            |                 |   |  |                   |  |   |                                    |                                     |                                   |                     |   |  |  |
| Piezometer Legend:                     |                                    |            |        |         |            |  |                            |                 |   |  |                   |  |   |                                    |                                     |                                   |                     |   |  |  |
| ■ Bentonite Seal                       |                                    |            |        |         |            |  |                            |                 |   |  |                   |  |   |                                    |                                     |                                   |                     |   |  |  |
| ▨ Bentonite Grout                      |                                    |            |        |         |            |  |                            |                 |   |  |                   |  |   |                                    |                                     |                                   |                     |   |  |  |
| ⦿ Filter Sand                          |                                    |            |        |         |            |  |                            |                 |   |  |                   |  |   |                                    |                                     |                                   |                     |   |  |  |
| ⦿ Screen                               |                                    |            |        |         |            |  |                            |                 |   |  |                   |  |   |                                    |                                     |                                   |                     |   |  |  |
|  |                                    |            |        |         |            |  |                            |                 |   |  |                   |  |   |                                    |                                     |                                   |                     |   |  |  |

## RECORD OF BOREHOLE No EB-4

1 of 3

**METRIC**

**G.W.P.** 2357-09-01

LOCATION

Coords: 4 793 410.5 N ; 272 993.4 E

ORIGINATED BY F.P.

DIST Niagara HWY 403

**BOREHOLE TYPE** Continuous Flight Hollow Stem Augers + Mud Rotary

COMPILED BY G.D.

**DATUM** Geodetic

DATE \_\_\_\_\_

July 02 & 03, 2015

**CHECKED BY** G.D.

[illegible]



## RECORD OF BOREHOLE No EB-4

2 of 3

METRIC

|                   |          |                                     |                    |
|-------------------|----------|-------------------------------------|--------------------|
| G.W.P. 2357-09-01 | LOCATION | Coords: 4 793 410.5 N ; 272 993.4 E | ORIGINATED BY F.P. |
|-------------------|----------|-------------------------------------|--------------------|

DIST Niagara HWY 403 BOREHOLE TYPE Continuous Flight Hollow Stem Augers + Mud Rotary COMPILED BY G.D.

DATUM Geodetic DATE July 02 & 03, 2015 CHECKED BY G.D.

| SOIL PROFILE                                      |   |            | SAMPLES |         |            |
|---|---|------------|---------|---------|------------|
| ELEV<br>DEPTH                                     | DESCRIPTION   | STRAT PLOT | NUMBER  | TYPE    | "N" VALUES |
| 70.4  |   |            |         |         |            |
| 66.2<br>19.2                                      | Sand, with silt<br>trace clay, trace gravel<br><br>Very dense Brown      Wet to<br>moist<br>(Cont'd.) |            | 15      | SS      | 54         |
|   |   |            |         |         |            |
|   | 16  |            | SS      | 88      |            |
|   |   |            |         |         |            |
|   | 17  |            | SS      | 99/25cm |            |
|   |   |            |         |         |            |
| 60.9<br>24.5                                      | Sand and silt, trace clay<br><br>Very dense Grey      Moist   |            | 18      | SS      | 50/15cm    |
|   |   |            |         |         |            |
|   |   |            |         |         |            |
|   | 19  |            | SS      | 50/8cm  |            |
|   |   |            |         |         |            |
|   |   |            |         |         |            |
|   | Sandy silt, trace clay<br><br>Very dense Grey      Moist  |            | 20      | SS      | 82         |
|   |   |            |         |         |            |
|   |   |            |         |         |            |
|   |   |            |         |         |            |
|   | 21  |            | SS      | 62      |            |
|   |   |            |         |         |            |
| Ground Water<br>Conditions                        |   |            |         |         |            |
| ELEVATION SCALE                                   |   |            |         |         |            |
| DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT       |   |            |         |         |            |
| 20    40    60    80    100                       |   |            |         |         |            |
| SHEAR STRENGTH kPa                                |   |            |         |         |            |
| ○ UNCONFINED    + FIELD VANE                      |   |            |         |         |            |
| ● QUICK TRIAXIAL    × LAB VANE                    |   |            |         |         |            |
| WATER CONTENT (%)                                 |   |            |         |         |            |
| 20    40    60                                    |   |            |         |         |            |
| UNIT<br>WEIGHT                                    |   |            |         |         |            |
| γ   |   |            |         |         |            |
| kN/m³   |   |            |         |         |            |
| REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%) |   |            |         |         |            |
| GR   SA   SI   CL                                 |   |            |         |         |            |

## RECORD OF BOREHOLE No EB-4

3 of 3

METRIC

|                   |          |                                     |                    |
|-------------------|----------|-------------------------------------|--------------------|
| G.W.P. 2357-09-01 | LOCATION | Coords: 4 793 410.5 N ; 272 993.4 E | ORIGINATED BY F.P. |
|-------------------|----------|-------------------------------------|--------------------|

DIST Niagara HWY 403 BOREHOLE TYPE Continuous Flight Hollow Stem Augers + Mud Rotary COMPILED BY G.D.

DATUM Geodetic DATE July 02 & 03, 2015 CHECKED BY G.D.

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## RECORD OF BOREHOLE No EB-5

1 of 3

**METRIC**

|        |            |          |                                     |               |   |
|--------|------------|----------|-------------------------------------|---------------|---|
| G.W.P. | 2357-09-01 | LOCATION | Coords: 4 793 409.4 N ; 273 008.7 E | ORIGINATED BY | F.P.  |
| DIST   | Niagara    | HWY      | 403                                 | BOREHOLE TYPE | C.F.H.S.A. + Mud Rotary and Dynamic Cone Penetration Test |
| DATUM  | Geodetic   | DATE     | June 26, 29 & 30, 2015              | COMPILED BY   | G.D.  |
|        |            |          |                                     | CHECKED BY    | G.D.  |

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## RECORD OF BOREHOLE No EB-5

2 of 3

METRIC

|                   |          |                                     |                    |
|-------------------|----------|-------------------------------------|--------------------|
| G.W.P. 2357-09-01 | LOCATION | Coords: 4 793 409.4 N ; 273 008.7 E | ORIGINATED BY F.P. |
|-------------------|----------|-------------------------------------|--------------------|

DIST Niagara HWY 403 BOREHOLE TYPE C.F.H.S.A. + Mud Rotary and Dynamic Cone Penetration Test COMPILED BY G.D.

DATUM Geodetic DATE June 26, 29 & 30, 2015 CHECKED BY G.D.

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## RECORD OF BOREHOLE No EB-5

3 of 3

METRIC

|                          |                 |                                     |                           |
|--------------------------|-----------------|-------------------------------------|---------------------------|
| <b>G.W.P.</b> 2357-09-00 | <b>LOCATION</b> | Coords: 4 793 409.4 N ; 273 008.7 E | <b>ORIGINATED BY</b> F.P. |
|--------------------------|-----------------|-------------------------------------|---------------------------|

|             |         |            |     |                      |   |                    |      |
|-------------|---------|------------|-----|----------------------|---|--------------------|------|
| <b>DIST</b> | Niagara | <b>HWY</b> | 403 | <b>BOREHOLE TYPE</b> | C.F.H.S.A. + Mud Rotary and Dynamic Cone Penetration Test | <b>COMPILED BY</b> | G.D. |
|-------------|---------|------------|-----|----------------------|---|--------------------|------|

**DATUM** Geodetic **DATE** June 26, 29 & 30, 2015 **CHECKED BY** G.D.

[illegible]

**RECORD OF BOREHOLE No EB-6**


1 of 1


**METRIC**

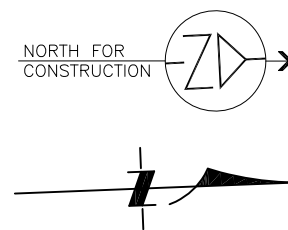
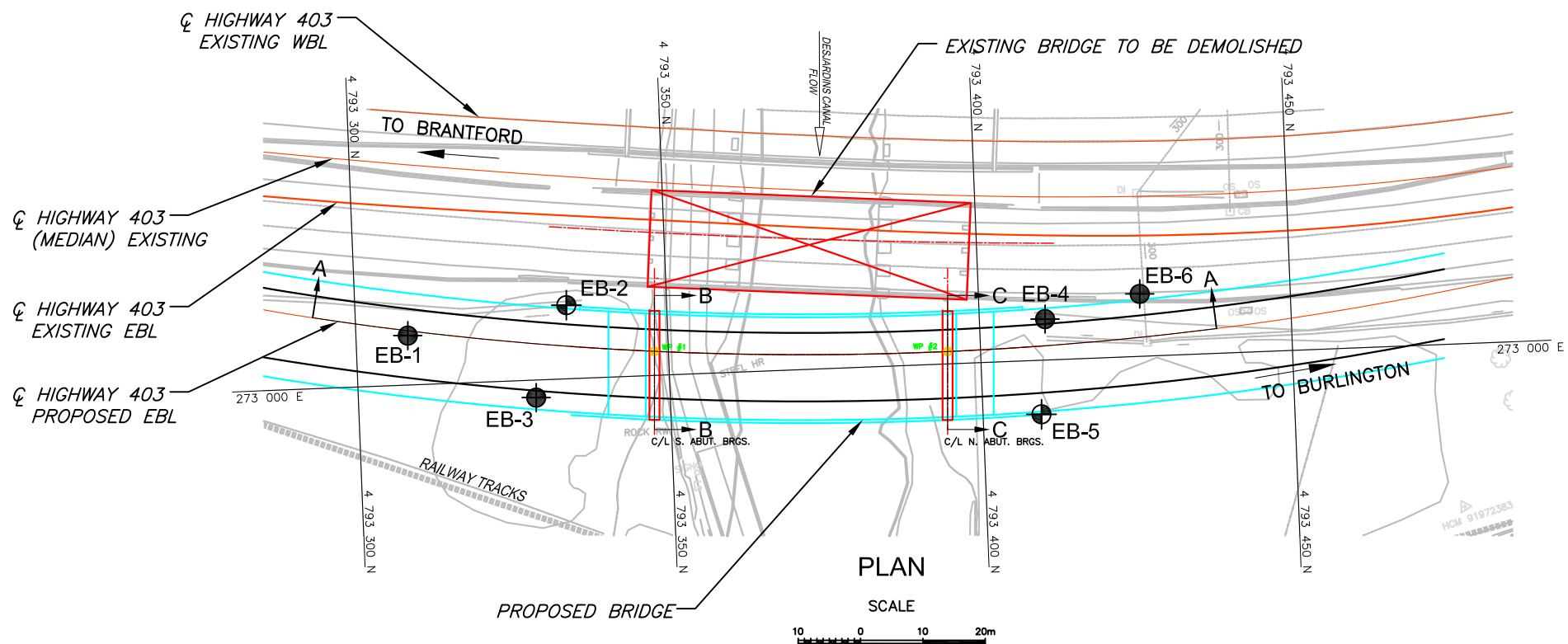
**G.W.P.** 2357-09-01      **LOCATION** Coords: 4 793 425.9 N ; 272 990.0 E      **ORIGINATED BY** F.P.  
**DIST** Niagara      **HWY** 403      **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers      **COMPILED BY** G.D.  
**DATUM** Geodetic      **DATE** July 08 & 09, 2015      **CHECKED BY** G.D.

| 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><br>γ<br><br>kN/m³ | 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                          |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 | ○ UNCONFINED      + FIELD VANE              |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 | ● QUICK TRIAXIAL      × LAB VANE            |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      | WATER CONTENT (%) |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
| 86.1          | Ground Surface                        |            |         |      |                   |                            | 20              | 40  | 60 | 80 | 100 |  |                                    |                                     |                                   |                                      |  |
| 0.0           | 150mm asphalt over<br>sand and gravel |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               | Compact      Brown      Moist         |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               | (FILL)                                |            | 1       | SS   | 24                |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
| 84.3          |                                       |            | 2       | SS   | 17                |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
| 1.8           | Sand<br>some silt, trace clay         |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               | Loose to Brown      Moist             |            | 3       | SS   | 9                 |                            |                 |   |    |    |     |  |                                    |                                     |                                   | 0 81 16 3                            |  |
|               | very dense                            |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            | 4       | SS   | 29                |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            | 5       | SS   | 31                |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            | 6       | SS   | 37                |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            | 7       | SS   | 34                |                            |                 |   |    |    |     |  |                                    |                                     |                                   | 0 84 14 2                            |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            | 8       | SS   | 54                |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               | silty clay seams                      |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            | 9       | SS   | 32                |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
| 77.6          |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
| 8.5           | Silt<br>some sand, some clay          |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               | Dense      Brown      Moist<br>to wet |            | 10      | SS   | 39                |                            |                 |   |    |    |     |  |                                    |                                     |                                   | 0 13 73 14                           |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |
|               |                                       |            |         |      |                   |                            |                 |   |    |    |     |  |                                    |                                     |                                   |                                      |  |

\* 2015 07 09

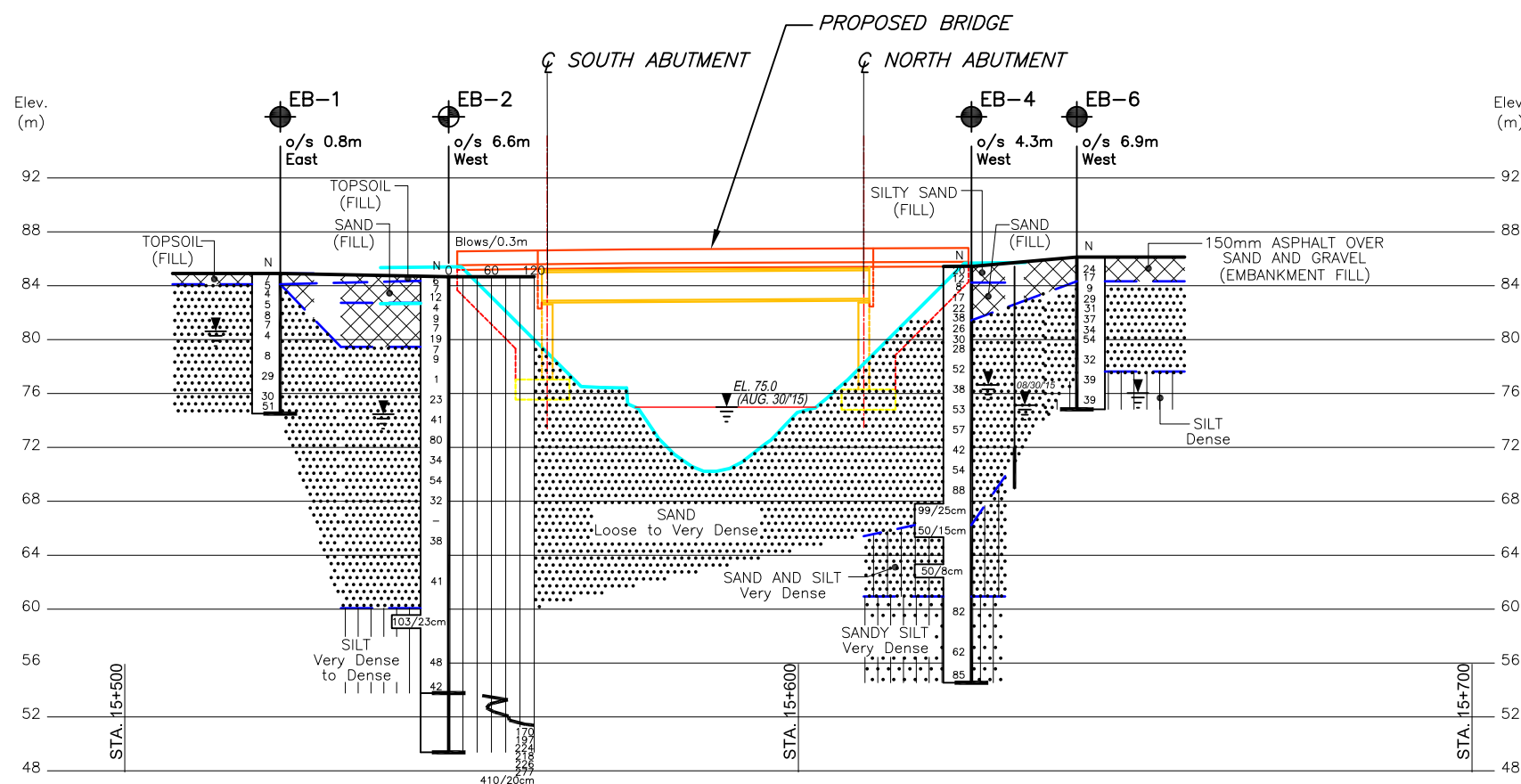
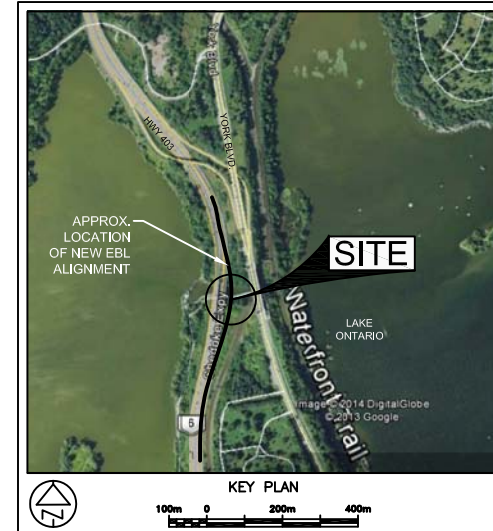
 Water level observed during drilling

 Water level measured after drilling

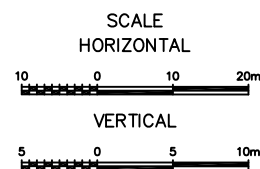


|   |                  |       |
|---|------------------|-------|
| CONT No   | WP No 2357-09-01 | SHEET |
| DESJARDINS CANAL BRIDGE<br>EASTBOUND REPLACEMENT<br>HIGHWAY 403<br>BOREHOLE LOCATIONS AND SOIL STRATA |                  |       |
|   |                  |       |

**PML Peto MacCallum Ltd.**  
CONSULTING ENGINEERS



PROFILE A-A



NOTES:

- THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
- REFER TO DRAWING EB-2 FOR SECTIONS B-B AND C-C.
- THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
- DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

| LEGEND |  |  |  |
|--------|--|--|--|
|        | Borehole   |  |  |
|        | Borehole and Cone                                |  |  |
|        | Auger probe (AP)                                 |  |  |
| N      | Blows/0.3m (Std. Pen Test, 475 J/blow)           |  |  |
| CONE   | Blows/0.3m (60 Cone, 475 J/blow)                 |  |  |
|        | WL at time of investigation April to August 2015 |  |  |
| WH     | Penetration due to weight of hammer              |  |  |
| *      | Water level not established                      |  |  |
|        | Head   |  |  |
|        | ARTESIAN WATER                                   |  |  |
|        | Encountered                                      |  |  |
|        | PIEZOMETER                                       |  |  |

| BH No | ELEVATION | NORTHINGS   | EASTINGS  |
|-------|-----------|-------------|-----------|
| EB-1  | 84.9      | 4 793 308.3 | 272 992.1 |
| EB-2  | 84.7      | 4 793 333.9 | 272 988.2 |
| EB-3  | 85.3      | 4 793 328.5 | 273 002.8 |
| EB-4  | 85.4      | 4 793 410.5 | 272 993.4 |
| EB-5  | 85.8      | 4 793 409.4 | 273 008.7 |
| EB-6  | 86.1      | 4 793 425.9 | 272 990.0 |

NOTE

The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

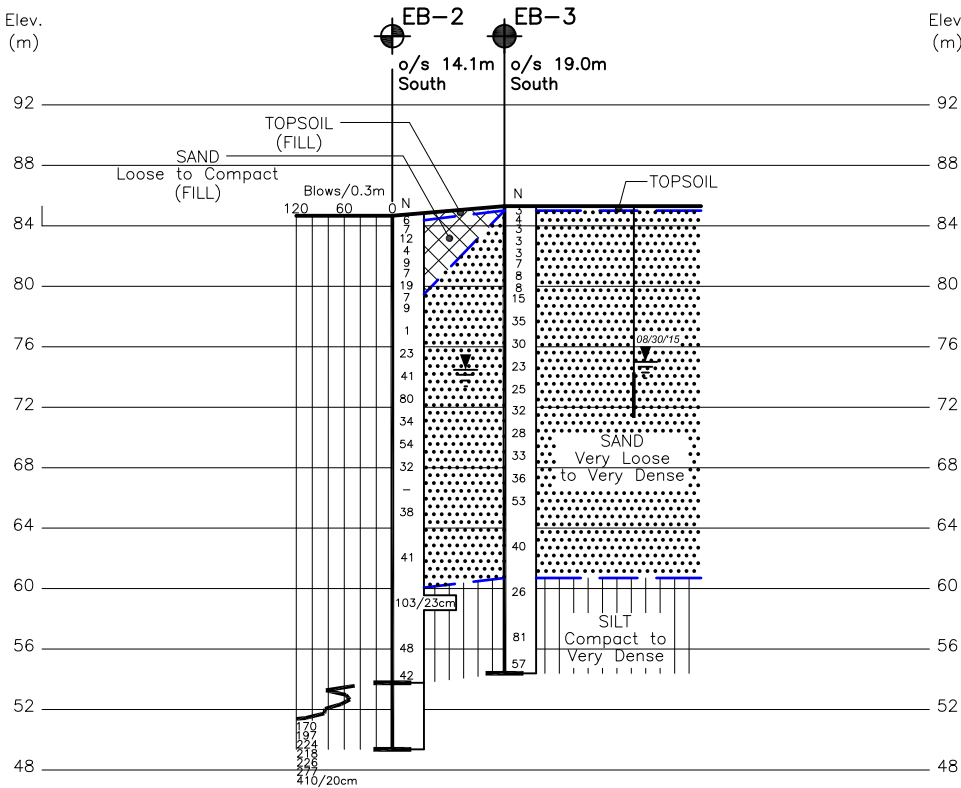
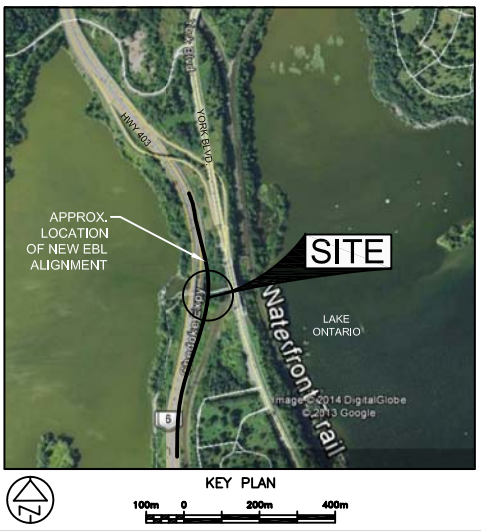
| REVISIONS | DATE | BY | DESCRIPTION  |
|-----------|------|----|--|
| 01/18/16  | CN   |    | DRAWING No. REVISED AS MHL EMAIL DT. JAN. 18, 2016 |

Geocres No. 30M5-320

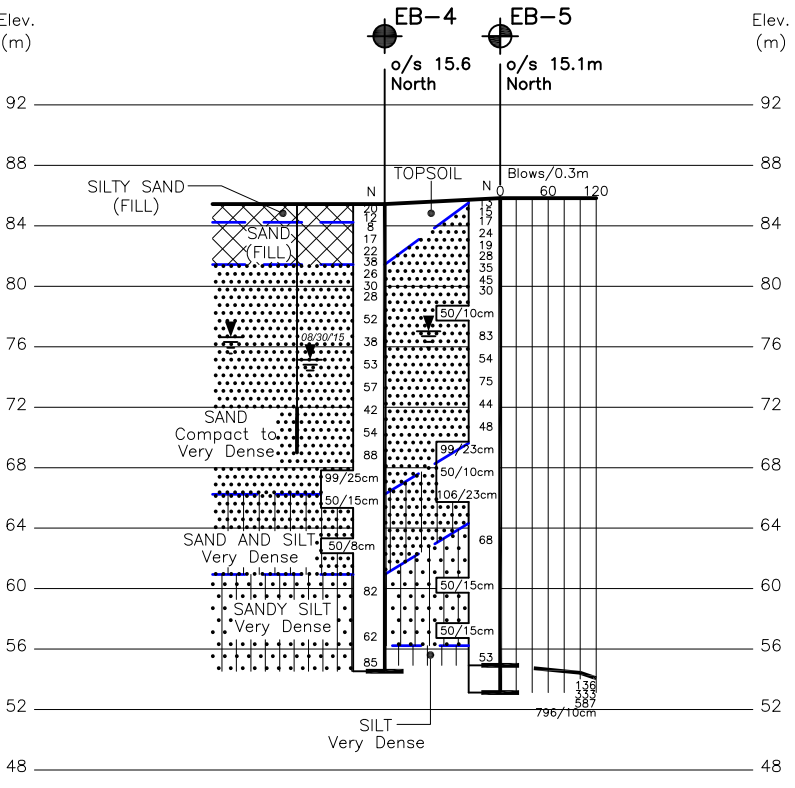
| HWY No | 403           | DIST         |
|--------|---------------|--------------|
| SUBM'D | NA            | CHECKED GD   |
| DATE   | JAN. 18, 2016 | SITE 36-36/1 |
| DRAWN  | NA            | CHECKED DD   |
|        | APPROVED CN   | DWG 2A       |



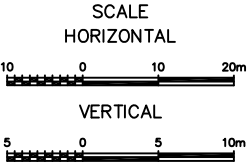
Reference Morrison Hershfield Limited Drawing: 36-36-1\_01.dwg dated June 2015



SECTION B-B



SECTION C-C



| LEGEND |  |  |  |
|--------|--|--|--|
|        | Borehole   |  |  |
|        | Borehole and Cone                                |  |  |
|        | Auger probe (AP)                                 |  |  |
|        | N Blows/0.3m (Std. Pen Test, 475 J/blow)         |  |  |
|        | CONE Blows/0.3m (60 Cone, 475 J/blow)            |  |  |
|        | WL at time of investigation April to August 2015 |  |  |
|        | WH Penetration due to weight of hammer           |  |  |
|        | * Water level not established                    |  |  |
|        | Head   |  |  |
|        | ARTESIAN WATER                                   |  |  |
|        | Encountered                                      |  |  |
|        | PIEZOMETER                                       |  |  |

| BH No                         | ELEVATION | NORTHINGS | EASTINGS |
|-------------------------------|-----------|-----------|----------|
| REFER TO DWG EB-1 FOR DETAILS |           |           |          |

- NOTES:
- THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
  - REFER TO DRAWING EB-1 FOR BOREHOLE LOCATION PLAN AND PROFILE A-A.
  - THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
  - DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.



— NOTE —  
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

| REVISIONS            |               |  |               |
|----------------------|---------------|--|---------------|
| DATE                 | BY            | DESCRIPTION  |               |
| 01/18/16             | CN            | DRAWING No. REVISED AS MHL EMAIL DT. JAN. 18, 2016 |               |
| Geocres No. 30M5-320 |               |  |               |
| HWY No               | 403           | DIST   |               |
| SUBM'D               | NA            | CHECKED  | GD            |
| DATE                 | JAN. 18, 2016 | DATE   | JAN. 18, 2016 |
| DRAWN                | NA            | CHECKED  | DD            |
| APPROVED             | CN            | APPROVED   | CN            |
| SITE                 | 36-36/1       | DWG  | 2B            |