Peto MacCallum Ltd.
CONSULTING ENGINEERS

# FOUNDATION INVESTIGATION AND DESIGN REPORT

**for**

**HIGH FILL AREAS**
**HIGHWAY 11 IMPROVEMENTS AND**
**NEW INTERCHANGE AT SOUTH**
**ENTRANCE TO POWASSAN**
**TOWNSHIP OF SOUTH HIMSWORTH**
**NORTH BAY AREA, ONTARIO**
**G.W.P. 323-00-00**

***HIGHWAY 11 NBL (AREA 1): STA 20+025 TO 20+200***
***E/W-S RAMP (AREA 6A): STA. 21+075 TO 21+125***
***N-E/W RAMP (AREA 6B): STA. 20+890 TO 21+000***
***N-E/W RAMP (AREA C): STA. 21+060 TO 21+100***
***PROUDFOOT ROAD EXTENSION (AREA 11): STA. 8+620 TO 8+710***
***WEST SERVICE ROAD (AREA E): STA. 9+400 TO 9+685***

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PML Ref.: 10TF013A-H1
Index No.: 422FIR and 423FDR
Geocres No.: 31L-184
February 25, 2015

Peto MacCallum Ltd.
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# FOUNDATION INVESTIGATION REPORT

**for**

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**HIGHWAY 11 IMPROVEMENTS AND**
**NEW INTERCHANGE AT SOUTH**
**ENTRANCE TO POWASSAN**
**TOWNSHIP OF SOUTH HIMSWORTH**
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# TABLE OF CONTENTS

Peto MacCallum Ltd.
CONSULTING ENGINEERS

# FOUNDATION INVESTIGATION REPORT
for
High Fill Areas
Highway 11 Improvements and New Interchange at South Entrance to Powassan
Township of South Himsworth
North Bay Area, Ontario
GWP 323-00-00

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## 1. INTRODUCTION

This report summarizes the results of the foundation investigation carried out for the proposed high fill areas as part of a new interchange at the south entrance to Powassan, from 5.7 km south of the Highway 534 northerly 5.0 km. The study was carried out by Peto MacCallum Ltd. (PML) for AECOM Canada Ltd. (AECOM) on behalf of the Ministry of Transportation of Ontario (MTO).

The proposed high fill areas are located along the Highway 11 Northbound lane (NBL), the East/West to South interchange ramp (E/W-S ramp), the North to East/West interchange ramp (N-E/W ramp), West Service Road and the Proudfoot Road Extension. A total of 4 high fill areas were identified in the initial Scope Change Request F-1 (Areas 1, 6A, 6B and 11) and 2 more (Areas C and E) were identified in the subsequent Scope Change Request F-2 for the foundation investigation. For ease of reference, the high fill areas have been assigned identification numbers. The identification number and location of each high fill area are provided below and presented on the appended Drawing 1.

| PML AREA NO. | LOCATION/STATION RANGE |
|---|---|
| 1 | Highway 11 NBL, Sta. 20+025 to 20+200 (*) |
| 6A | Proposed E/W-S ramp, Sta. 21+075 to 21+125 |
| 6B | Proposed N-E/W ramp, Sta. 20+890 to 21+000 |
| C | Proposed N-E/W ramp, Sta. 21+060 to 21+100 |
| 11 | Proudfoot Road Extension, Sta. 8+620 to 8+710 |
| E | Proposed West Service Road, Sta. 9+400 to 9+685 |

Note: (*) Excluding Sta. 20+106 to 20+178 (proposed NBL Bridge section – refer to PML Foundation Investigation Report Ref No.: 10TF013A-S1)

Figures, Records of Borehole and Cone Penetration Test Sheets and Drawings are appended as listed in the Table of Contents.

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This report summarises the results of the field investigation conducted at the high fill areas for this project. The subsurface conditions along the remaining sections of the alignment identified in the RFP for the geotechnical investigation are provided in the Pavement Design Report under the separate cover, PML Reference No.: 10TF013B.

## 2. SITE DESCRIPTION

### 2.1 General

The project site is located within the Physiographic Region known as the Number 11 Strip. The typical soil cover at the project site is from sandy glaciolacustrine deposits and a local kame formation which overlies Precambrian age monzonitic (granitic) rock formation.

### 2.2 Area 1 (Highway 11 NBL, Sta. 20+025 to 20+200)

Area 1 is located directly north of the existing Loxton Line intersection. Land use in the vicinity of the site includes the existing Highway 11 NBL corridor, undeveloped land to the east and west and the existing McGillvray Creek at the right toe of the NBL slope. The McGillvray Creek runs from the south limit of the area, north to approximately Sta. 20+140. At Sta. 20+140, the creek meanders west through a culvert under the NBL of the highway and switches from a north/south to an east/west alignment.

The local topography of site is generally sloping from east to west with localized areas of steeply sloping ground near the McGillvray Creek. The existing Highway 11 NBL embankment is about 6 to 8 m high. Ground cover typically comprises grasses with localized areas of bushes and stands of trees.

### 2.3 Area 6A, 6B and C (New E/W-S Ramp, Sta. 21+075 to 21+125 and New N-E/W Ramp, Sta. 20+890 to 21+000 / Sta. 21+060 to 21+100)

Area 6A, Area 6B and C are located approximately 150 m west of the existing Highway 11 SBL and approximately 1.1 km south of Purdon Line in the Municipality of Powassan. Land use in the vicinity of the site includes the Highway 11 SBL corridor to the east and an existing gravel pit to the west.

The local topography of site is extremely variable, sloping both in the east/west and north/south directions. The ground cover in these areas includes pockets of dense, heavily-wooded coniferous/deciduous trees/forest.

### 2.4 Area 11 (Proudfoot Road Extension, Sta. 8+620 to 8+710)

Area 11 is located approximately 300 m south of existing Loxton Line and approximately 60 m east of the existing Highway 11 NBL in the Municipality of Powassan. Land use in the vicinity includes Highway 11 to the west and a largely undeveloped area with heavily treed pockets to the east. In addition, a small stream runs east/west through the site at approximately Sta. 8+655 on the proposed Proudfoot Road Extension alignment.

Area 11 is located within a valley with the lowest point at approximately Sta. 8+670. Ground cover within Area 11 typically comprises grass or shrubs, with isolated stand of mature coniferous/deciduous trees at the south and north limits.

### 2.5 Area E (West Service Road, Sta. 9+400 to 9+685)

Area E is located on the proposed West Service Road about 320 m north of the existing English Line and about 350 m west of the existing Highway 11 Southbound Lanes. The high fill area is separated by McGillvray Creek which runs east to west direction. Ground cover within the area includes grasses and bushes near the creek area and stands of trees elsewhere.

## 3. INVESTIGATION PROCEDURES

The field work for Scope Change F-1 (Areas 1, 6A, 6B and 11) involved a total of 26 boreholes and 4 dynamic cone penetration tests (including one cone test performed adjacent to borehole PR-2 in Area 11) carried out during the period of December 8, 2011 to January 31, 2012. The field work for Scope Change F-2 (areas C and E) involved a total of 16 boreholes and 2 dynamic cone penetration tests carried out during the period of June 20 to July 12, 2013. The test locations and drawings for each crossing are identified by a prefix identical to the crossing number. The test holes have been numbered sequentially from left to right in the direction of increasing chainage and are shown on corresponding Drawings. The Records of the Borehole sheets are appended.

The test holes were advanced to depths ranging from 0.7 to 15.8 m below existing grade with termination in most cases due to refusal on probable bedrock or boulders.

The proposed scopes of fieldwork for scope changes F-1 and F-2 were discussed with the MTO on September 27, 2011 and November 8, 2012. PML optimized the borehole depths and locations based on the data from previous Pavement boreholes and some of the Pavement boreholes were also used for the foundations investigations. The test hole locations were established in general accordance with in the MTO Northeastern Region Pavement Design Practices and Guidelines.

During the initial field investigation, thick cohesive soils were contacted within the proposed high fills Areas 6A and 6B. On October 23, 2012, additional field work was undertaken in these areas and three (3) shelby tube samples were taken from boreholes 6A-5 and 6B-7 for consolidation and unconfined compression tests.

exp Geomatics Ltd. laid out the new roadway alignments in the field and these lines were used to locate the programmed test holes. Geodetic elevations were measured in the field by PML.

The test holes were advanced using track-mounted drill rigs. The equipment was supplied and operated by soil drilling contractors working under the full-time supervision of members of our engineering staff.

Representative samples of the soils were recovered at frequent (semi-continuous) depth intervals using a conventional split spoon sampler during drilling. Standard penetration tests were conducted simultaneously with the sampling operation to assess the strength characteristics of the substrata. In situ vane shear tests were carried out using the MTO 'N' vane according to the procedure described in the Northeastern Region Pavement Design Practices and Guidelines. Penetrometer testing was also performed to further assess the shear strength of the cohesive soils encountered. The results of the field tests and observations are reported on the Record of Borehole sheets.

The groundwater conditions at the borehole locations were assessed during drilling by visual examination of the soil, the sampler and drill rods as the samples were retrieved and, when appropriate, by measurement of the water level in the open borehole. Upon completion of drilling, the boreholes were backfilled with a bentonite/cement mixture in accordance with the MTO guidelines for borehole abandonment procedures.

Soils were identified in the field in accordance with the MTO Soil Classification procedures and testing. The soil samples were returned to our laboratory for detailed visual examination, classification. The laboratory testing program included the following tests:

- Natural water content (354)
- Atterberg limit testing (44)
- Grain size distribution analyses (92)
- Organic Content Test (5)
- Unconfined compression tests (3)
- Consolidation tests (3)

The results of the Atterberg Limit testing, grain size distribution analyses, unconfined compression tests and consolidation tests are presented in appended figures. The results of all the laboratory tests are also summarized on the Record of Borehole sheets.

## 4. SUMMARISED SUBSURFACE CONDITIONS

Reference is made to the appended Record of Borehole and Record of Penetration Test sheets for details of the subsurface conditions including soil classifications, inferred stratigraphy, standard and dynamic cone penetration test data, in situ vane/penetrometer shear strength tests and groundwater observations. The results of laboratory Atterberg limits, grain size distribution analyses and natural moisture content determinations are also shown on the Record of Borehole sheets. The results of the Atterberg limits testing are listed in the attached Table 1.

A general description of the subsurface conditions encountered at the high fill areas is provided in Table 2. The shear strength/consistency of the cohesive soils noted on the Record of Borehole sheets and in the subsequent sections of the report is primarily based on the in situ vane shear testing and supplemented by penetrometer tests on recovered SPT samples. Less consideration was given to Standard Penetration Test (SPT) 'N' values since the shear strength indicated by this technique is less reliable in soft to very soft clayey soils. It is also noted that penetrometer tests typically provide lower shear strength values due to disturbance during sampling. The findings are described below.

### 4.1 Area 1 (Highway 11 NBL, Sta. 20+025 to 20+200, excluding Sta. 20+106 to 20+178)

A total of 8 boreholes were advanced in Area 1 (boreholes 1-1 to 1-3, 1-5, 1-7, 1-10 to 1-12). Additionally, four boreholes that were completed within Area 1 for the concurrent pavement design report at the proposed NBL's right toe of slope were reused for this report. For ease of reference these boreholes have been renumber and their format has been converted into MTO style foundation borehole logs. The converted logs include boreholes at 20+050 24.3 Rt (renamed 1-4), 20+075 25.2 Rt (renamed 1-6), 20+100 42.1 Rt (renamed 1-8), and 20+175 38.1 Rt (renamed 1-9).

The subsurface stratigraphy revealed in the boreholes at the site generally comprised surficial topsoil/organic material or fill overlying a non cohesive silty/sandy soil underlain locally by a cohesive layer of clayey silt and a lower cohesionless sand deposit, which extended locally to refusal (8 boreholes terminated on probable bedrock and 2 on probable boulders) and bedrock cores were obtained in these boreholes. Details are provided in section 4.1.6. Cobbles and

boulders were encountered at depth in 6 boreholes. Groundwater was noted surficially to 8.8 m (elevation 254.3 to 257.1.2) upon completion of drilling.

It is noted that the summary of subsurface conditions below includes only minimal information between Sta. 20+106 and 20+178. For a comprehensive summary of subsurface conditions in this area refer to the concurrent PML geotechnical investigation for the proposed McGillvray Creek Bridge (PML ref.: 10TF013A-S1). For completeness the borehole logs at the proposed McGillvray Creek Bridge are attached. The subsurface conditions encountered within these boreholes are consistent with the stratigraphic conditions encountered in Area 1.

4.1.1 Peat/Topsoil

A 700 and 800 mm thick amorphous peat layer was encountered surficially in boreholes 1-4 and 1-6, respectively. The peat extended to elevations 256.3 in borehole 1-4 and elevation 256.3 in borehole 1-6.

A 200 to 600 mm thick surficial topsoil layer was present in 8 boreholes and was penetrated at elevation 257.0 to 264.9.

4.1.2 Asphalt

Locally, a 130 and 150 mm thick layer of surficial asphalt was encountered in boreholes 1-7 and 1-11, respectively. The asphalt was penetrated at elevations 263.0 in borehole 1-7 and elevation 266.2 in borehole 1-11.

4.1.2 Fill

A 1.5 to 7.4 m thick fill deposit was encountered locally beneath the asphalt at 130 and 150 mm (elevations 263.0 and 266.4) in boreholes 1-7 and 1-11, respectively and beneath the topsoil at 300 mm in borehole 1-10. The fill deposit was penetrated at 1.8 to 7.5 m (elevation 255.6 to 262.3). The fill comprised silty/sandy soils of various granulometric compositions (sand and gravel, silt, sand) and was loose to dense (SPT-'N' values 5 to 55). It is noted that clayey silt

pockets, woodchips and organic pockets were revealed within the fill in borehole 1-7. The fill was moist to wet with moisture contents typically ranging between 3 and 20% with higher values up to 38% where organics were encountered.

The results of Atterberg limits testing and grain size distribution analyses conducted on 2 clayey slit samples of the fill are presented in respective Figures 1-PC-1 and 1-GS-1. The results of the Atterberg Limit testing showed the fill to be slightly plastic, with liquid limits of 17 and 18, plastic limits of 13 and 15 and plasticity indexes of 3 and 4.

### 4.1.3 Upper Silty/Sandy Soils

A loose to very dense (typically compact), 0.9 to 11.6 m thick silty/sandy soil stratum of various granulometric compositions (silt, sand and silt, silty sand, sand, gravelly sand) was encountered beneath the topsoil/peat at 0.2 to 0.8 m (elevation 256.3 to 264.9) and beneath the fill at 1.8 to 7.5 m (elevation 255.6 to 262.3). The silty/sandy soils extended to the 5.3 to 13.1 m (elevations 249.8 to 256.9) sampling exploration depth in all boreholes except boreholes 1-4, 1-6 and 1-8. In boreholes 1-4, 1-6 and 1-8 the silty/sandy soils were penetrated at 1.5 to 3.1 m (elevation 254.0 to 256.1). The silty/sandy soils had typical moisture contents of 3 to 27% (locally a moisture content of 34% was recorded in borehole 1-5) and SPT-'N' values typically ranging between 4 and 59 (locally 50 blows for 3 cm was recorded directly above the probable bedrock in boreholes 1-1 and 1-3). It is noted that cobbles and boulders were encountered in within the sandy/silty soils in the lower portions of 6 boreholes and that organics were recorded in 4 boreholes.

The results of 12 grain size distribution analyses performed on the silty/sandy soils samples are presented in Figures 6B-GS-2 to 6B-GS-6. In addition the result from Atterberg Limit testing for a sample of cohesionless silt from borehole 1-11 is presented on Figure 1-PC-2. The silt had a liquid limit of 21, plastic limit of 18 and a plasticity index of 3.

### 4.1.4 Clayey Silt

A 1.1 to 1.4 m thick, firm cohesive clayey silt deposit was encountered beneath the upper silty/sandy soils at 1.5 to 3.1 m (elevation 254.0 to 256.1) in boreholes 1-4, 1-6 and 1-8. The unit was penetrated at 2.8 to 4.5 m (elevation 252.6 to 254.8). The clayey silt was wet and an N value of 5 was recorded in borehole 1-8.

### 4.1.5 Lower Sand

A 1.2 to 3.7 m thick, compact to very dense sand deposit was encountered underlying the clayey silt at 2.8 to 4.5 m (elevation 252.6 to 254.8) in boreholes 1-4, 1-6 and 1-8. The deposit extended to the 5.5 to 6.5 m termination depth (elevation 251.1 to 251.5). The strata contained some gravel, was wet and SPT-'N' values of 12 and 60 were recorded in borehole 1-8.

### 4.1.6 Probable Bedrock / Boulders

Refusal upon probable bedrock or boulders was met in 10 boreholes (1-1, 1-3, 1-7, 1-10, 1-11, 1-12, MN-1, MN-2, MN-4, MN-AP9) at depths ranging from 4.0 m to 13.1 m (elevations 249.8 to 256.9).

Granite bedrock was encountered and confirmed (through coring) at elevations 250.2 to 252.7 in boreholes MN-1A, MN-3 and MN-3A of the McGillvray Creek Bridge Foundation Investigation.

### 4.1.7 Groundwater

In the course of the field work, groundwater was observed in 10 boreholes. In the process of augering, water was detected in boreholes 1-3, 1-4, 1-6 at ground surface to 0.8 m (elevations 256.9 to 259.8) and at 3.0 to 7.6 m (elevation 258.5 to 261.2) in the remaining boreholes. Upon completion of drilling, groundwater was measured in boreholes 1-4 and 1-6 at 0.1 m and ground surface (elevation 256.9 and 257.1), respectively and measured to be at 7.6 and 8.8 m (elevation 255.4 and 254.3) in boreholes 1-5 and 1-7, respectively. No water was

observed in the remaining boreholes upon completion of augering. The groundwater levels at the site are subject to seasonal fluctuations and precipitation patterns.

## 4.2 Area 6A (New E/W-S ramp, Sta. 21+075 to 21+125)

A total of 5 boreholes were advanced in Area 6A along the E/W-S ramp. Additionally, 2 boreholes (6B-6 and 6B-8) were completed along the N-EW ramp in Area 6B and coincide with the right toe of slope of the proposed E/W-S ramp. These boreholes have been used to supplement the information in Area 6A and are in included in the soil descriptions below.

The subsurface stratigraphy revealed in the boreholes generally comprised surficial topsoil overlying a non cohesive silty/sandy layer, overlying a cohesive deposit of clayey silt/silty clay underlain by a lower cohesionless silty/sandy soil typically extending to refusal on probable bedrock/boulder. Cobbles and boulders were encountered at depth in 3 boreholes. Upon completion of drilling groundwater was at depths of 7.6 to 8.8 m (elevation 260.7 to 263.7).

### 4.2.1 Topsoil

A 300 mm thick topsoil layer was present surficially in all 7 boreholes that extended to elevation 269.2 to 273.8.

### 4.2.2 Upper Silty/Sandy Soils

A very loose to compact, 1.1 to 2.8 m thick silty/sandy soil deposit of various granulometric composition (silt, sand and silt, silty sand, sand) was encountered directly beneath the topsoil at 0.3 m (elevation 269.2 to 273.8) in all 7 boreholes. The silty/sandy soils extended to 1.4 to 3.1 m (elevation 267.8 to 271.9), terminating at the silty clay/clayey silt layer. The deposit had moisture contents of 17 to 35% and SPT-'N' values ranging between 2 and 17.

The results of 4 grain size distribution analyses performed on the upper cohesionless samples are presented in Figures 6A-GS-1.

### 4.2.3 Silty Clay/Clayey Silt

A 4.9 to 8.2 m thick cohesive silty clay/clayey silt deposit was encountered beneath the silty/sandy soils at 1.4 to 3.1 m (elevation 267.8 to 271.9) in all 7 boreholes. The deposit was penetrated at 7.0 to 10.4 m (elevation 261.9 to 266.2). This deposit was soft to very stiff in consistency with SPT-'N' values ranging between 2 and 10. The results of in situ vane and pocket penetrometer testing carried out in the clayey silt and silty clay yielded undisturbed shear strength values in a range of 24 to greater than 100 kPa (soil sensitivity of 6 to 10). Unconfined compression testing on the TW8 sample of silty clay from borehole 6A-5 taken at elevation 265.2 resulted in a shear strength of 26 kPa and strain at failure of 4.5%. A photograph of the sample is presented in the appended Photograph 1.

The results of Atterberg limits testing and grain size distribution analyses conducted on 12 samples of the silty clay/clayey silt are presented in Figures 6A-PC-1, 6A-PC-2, 6A-GS-2 and 6A-GS-3. The liquid and plastic limits of the silty clay ranged from 35 to 43 and from 19 to 23 respectively, thus giving the plasticity index of 12 to 22. The clayey silt had a liquid limit of 25 to 34, plastic limit of 16 to 22, with the plasticity index of 9 to 13. The clayey silt and silty clay typically had natural moisture content varying from 32 to 45% and 30 to 51%, respectively. Locally a moisture content of 64% was recorded within the silty clay in borehole 6A-3.

The results of consolidation testing carried out on the relatively undisturbed sample TW8 of silty clay taken from 5.2 to 5.8 m depths in borehole 6A-5 are presented on Figure 6A-C-1. The consolidation testing results were as follows:

| **Parameter** | **TW8 Sample 5.2 to 5.8 m** |
|---|---|
| Preconsolidation Pressure ($P_c$') | 610 kPa |
| Initial Void Ratio ($e_o$) | 1.37 |
| Compression Index ($C_c$) | 0.76 |
| Recompression Index ($C_r$) | 0.04 |

### 4.2.4 Lower Silty/Sandy Soils

A lower 1.3 to 5.9 m thick cohesionless silty/sandy soil of various granulometric composition (silt, sand and silt, silty sand, sand) was encountered below the cohesive clayey silt/silty clay at 7.0 to 10.4 m (elevation of 261.9 to 266.2) in all 7 boreholes. The silty/sandy soils extended to the probable bedrock/boulders at 9.3 to 14.6 m (elevations 257.7 to 261.1) in all boreholes. This deposit was typically compact to dense, however locally loose in the upper portions of the layer in borehole 6A-1. It is noted that cobble and boulders were encountered in the lower portions of boreholes 6A-4 and 6B-8. SPT-'N' values typically varied from 5 to 56, local SPT-'N' values of 50 blows for 10 and 13 cm of penetration and 20 blows for 6 cm of penetration were recorded directly above the probable bedrock in boreholes 6A-1 and 6B-6 and within the cobbles and boulders in 6A-5.

The results of grain size distribution analyses performed on 5 samples of the lower silty/sandy soils are presented on Figures 6A-GS-4 and 6A-GS-5. Additionally the results of Atterberg testing on a sample of slightly cohesive silt from borehole 6A-2 is presented on Figure 6A-PC-3. The silt had a liquid limit of 22, plastic limit of 16, plasticity index of 6 and natural moisture contents varying from 4 to 33%.

### 4.2.5 Probable Bedrock

Refusal upon probable bedrock was met in all seven boreholes at 9.3 to 14.6 m (elevations 257.7 to 261.1).

### 4.2.6 Groundwater

In the process of augering, water was detected in boreholes 6A-2 to 6A-5 and 6B-6 at 0.3 to 8.2 m (elevation 262.7 to 270.2). Upon completion of drilling, groundwater was measured in boreholes 6A-2 to 6A-4 and 6B-6 at 7.6 to 8.8 m (elevation 260.7 to 263.7). No water was observed in the remaining boreholes. The groundwater levels at the site are subject to seasonal fluctuations and precipitation patterns.

## 4.3 Area 6B (New N-E/W ramp, Sta. 20+890 to 21+000)

A total of 10 test holes comprising 8 boreholes and 2 dynamic cone penetration tests were advanced in Area 6B (along the N-E/W ramp). Additionally 3 boreholes (6A-1, 6A-3 and 6A-5), were advanced in Area 6A (along the E/W-S ramp) and coincide with the left toe of slope of the proposed N-E/W ramp. These boreholes have been used to supplement the information in Area 6B and are in included in the soil descriptions below.

The subsurface stratigraphy revealed in the boreholes generally comprised surficial topsoil overlying a non cohesive silty/sandy soil overlying a cohesive layer of clayey silt underlain by a lower cohesionless silty/sandy soils typically extending to refusal on probable bedrock/boulder (2 test holes terminated prior to refusal). Cobbles and boulders were encountered within the lower silty/sandy soil in 3 boreholes. Groundwater was at depths of 7.3 to 8.8 m (elevation 260.7 to 267.5) upon completion of drilling.

### 4.3.1 Topsoil

A 200 to 300 mm thick topsoil layer was present surficially in all 10 boreholes. The topsoil extended to elevations 268.9 to 274.5.

### 4.3.2 Upper Silty/Sandy Soils

A 1.1 to 5.7 m thick silty/sandy deposit of various granulometric compositions (silt, sand and silt, silty sand, sand) was encountered directly beneath the topsoil at 0.2 to 0.3 m (elevation 268.9 to 274.5) in all 11 boreholes. The stratum extended to the silty clay/clayey silt layer and was penetrated at a 1.4 to 6.0 m (elevation 267.6 to 271.9). The silty/sandy soils were very loose to dense, with SPT-'N' values of 2 to 17 and moisture contents of 11 to 36%.

The results of 5 grain size distribution analyses performed on the upper cohesionless samples are presented in Figures 6B-GS-1 and 6B-GS-2.

### 4.3.3 Clayey Silt/Silty Clay

A cohesive 2.8 to 10.6 m thick, soft to very stiff (typically firm to stiff) clayey silt/silty clay deposit was revealed beneath the upper silty/sandy deposit at 1.4 to 6.0 m (elevation 267.6 to 271.9). The deposit extended to 4.3 to 12.0 m, corresponding to elevation 258.9 to 267.2. The results of in situ vane and pocket penetrometer testing carried out in the clayey silt/silty clay yielded undisturbed shear strength values in a range of 24 kPa to greater than 100 kPa. The soil sensitivity was 3 to 10 from the in situ vane test results. Unconfined compression testing on TW8 sample of clayey silt from borehole 6B-7 taken at elevation 263.0 resulted in a shear strength of 19 kPa and a strain at failure of 4.0%.

The results of Atterberg limits testing and grain size distribution analyses conducted on 13 samples of the silty clay/clayey silt presented on Figures 6B-PC-1 to 6B-PC-3, 6B-GS-3 and 6B-GS-4. The liquid and plastic limits of the silty clay ranged from 35 to 40 and from 19 to 23 respectively, the plasticity index of the silty clay ranged from 12 to 21. The clayey silt had a liquid limit of 25 to 34, plastic limit of 16 to 22, with the plasticity index of 8 to 13. Locally, at the location of a silt some clay layer, an Atterberg Limit test indicated a plastic limit of 21, Liquid limit of 25 and plasticity index of 4. The moisture content of the clayey silt/silty clay typically varied between 23 and 50% however was locally as high as 64% in borehole 6A-3.

The results of consolidation testing carried out on two relatively undisturbed samples of clayey silt from borehole 6B-7, TW5 taken from 3.1 to 3.7 m and TW8 from 7.6 to 8.2 m, are presented on Figure 6B-C-1 and 6B-C-2, respectively. The consolidation testing results were as follows:

| **Parameter** | **TW5 Sample** | **TW8 Sample** |
|---|---|---|
| | **3.1 to 3.7 m** | **7.6 to 8.2 m** |
| Preconsolidation Pressure ($P_c$') | 1,000 kPa | 570 kPa |
| Initial Void Ratio ($e_o$) | 0.83 | 1.27 |
| Compression Index ($C_c$) | 0.44 | 0.68 |
| Recompression Index ($C_r$) | 0.03 | 0.05 |

It is noted that the TW5 sample from borehole 6B-7 was not from a varved soil and is shown in the appended Photograph 2. The clayey silt in the lower TW8 sample was varved and consisted of approximately 25 mm thick silt layers interbedded with approximately 20 mm thick clayey silt layers, as shown in the attached Photograph 3.

4.3.4 Lower Silty/Sandy Soils

A 0.9 to 5.9 m thick layers of silty/sandy soils of various granulometric composition (silt, sand and silt, silty sand, sand, sandy gravel) was encountered underlying the clayey silt/silty clay at 4.3 to 12.0 m (elevation 258.9 to 267.2), in all boreholes. The stratum was loose to very dense (typically compact to dense) having SPT-'N' values of 5 to 50 blows for 8 cm and moisture content of 4 to 38%. The deposit extended to the probable boulders/bedrock encountered at 5.2 to 14.6 m (elevation 257.6 to 264.7) in all boreholes except borehole 6B-10, where the deposit terminated at the 15.8 m exploration depth (elevations 258.3). It is noted that cobbles and boulders were encountered within the silty/sandy soils in boreholes 6B-7, 6B-8, 6B-10 and 6A-5.

The results of 5 grain size distribution analyses performed on the lower silty/sandy soils are presented in Figures 6B-GS-5 to 6B-GS-8.

4.3.5 Probable Bedrock

Refusal upon probable bedrock was met in all thirteen test holes except boreholes 6B-8 and 6B-10 and penetration test 6B-5 at depths ranging from 5.2 to 14.6 m (elevations 257.6 to 264.7).

4.3.6 Groundwater

In the process of augering, water was detected at 2.1 to 8.2 m (elevation 262.7 to 270.3) in 6 boreholes. Upon completion of drilling, groundwater was measured in boreholes 6B-1, 6B-4, 6B-6, and 6A-3 at 7.3 to 8.8 m (elevation 260.7 to 267.5). No water was observed in the remaining boreholes. The groundwater levels at the site are subject to seasonal fluctuations and precipitation patterns.

## 4.4 Area C (New N-E/W ramp, Sta. 21+060 to 21+100)

A total of 5 boreholes were advanced in Area C. The subsurface stratigraphy revealed in the boreholes generally comprised surficial topsoil overlying a non cohesive silty/sandy soil overlying a cohesive layer of clayey silt / silty clay underlain by a lower cohesionless silty/sandy soils that locally extended to refusal on probable boulders. Cobbles and boulders were encountered within the lower silty/sandy soil in 4 boreholes. Groundwater was at depths of 2.6 to 3.7 m (elevation 270.7 to 273.0) upon completion of drilling.

### 4.4.1 Topsoil/Peat

A 200 to 600 mm thick surficial topsoil layer was present in all boreholes and was penetrated at elevation 271.8 to 277.1.

### 4.4.2 Upper Silty/Sandy Soils

A 1.6 to 3.5 m thick silty/sandy deposit of various granulometric compositions (silt, sandy silt, silty sand, sand) was encountered directly beneath the topsoil at 0.2 to 0.6 m (elevation 271.8 to 277.1) in all the boreholes. The stratum extended to the silty clay/clayey silt layer at 2.2 to 3.7 m (elevation 270.2 to 273.6) in the remaining boreholes. Organics were noted in the upper portions of the deposit in borehole C-5. The silty/sandy soils were very loose to compact (although typically loose), with SPT-'N' values of 2 to 16 and moisture contents of 6 to 32%.

The results of 5 grain size distribution analyses performed on the upper cohesionless samples are presented in Figures C-GS-1 and C-GS-3.

### 4.4.3 Clayey Silt/Silty Clay

A cohesive 2.0 to 3.0 m thick (locally 5.5 m in borehole C-1), soft to very stiff (typically firm to stiff) clayey silt/silty clay deposit was revealed beneath the upper silty/sandy deposit at 2.2 to 3.7 m (elevation 270.2 to 273.6) in all boreholes. The deposit extended to 4.5 to 9.2 m, corresponding to elevation 265.2 to 271.6. The results of in situ vane and pocket penetrometer testing carried out

in the clayey silt/silty clay yielded undisturbed shear strength values in a range of 20 to greater than 100 kPa. Soil sensitivity of 2 to 12 was obtained in the in situ vane tests.

The results of Atterberg limits testing and grain size distribution analyses conducted on 5 samples of the silty clay/clayey silt presented on Figures C-PC-1, C-PC-2, C-GS-4 and C-GS-5. The liquid and plastic limits of the silty clay ranged from 35 to 42 and from 18 to 21 respectively, the plasticity index of the silty clay ranged from 17 to 21. The clayey silt had liquid limits of 25 and 34, plastic limits of 19 and plasticity indices of 6 and 15. The moisture content of the clayey silt/silty clay typically varied between 28 and 54%.

### 4.4.4 Lower Silty/Sandy/Gravelly Soils

A 0.2 to 2.3 m thick layer of silty/sandy soils of various granulometric composition (gravelly sand, sand, silty sand, silty sand) was encountered underlying the clayey silt/silty clay at 4.5 to 9.2 m (elevation 265.2 to 271.6), in all boreholes. The stratum extended to the 4.7 to 9.6 m (elevation 264.8 to 270.9) termination depth in the boreholes. The material was typically dense to very dense (locally loose in the borehole C-2) having SPT-'N' values of 7 to 50 blows for 10 cm and moisture content of 4 to 38%. It is noted that cobbles and boulders were encountered within the gravelly sand in boreholes C-1, C-3, C-4 and C-5.

The result of a grain size distribution analysis performed on a sample of the lower silt is presented on Figure C-GS-2.

### 4.4.5 Probable Boulders

Refusal upon probable boulders was met in boreholes C-1, C-3, C-4 and C-5 at depths ranging from 4.7 to 9.6 m (elevations 264.8 to 270.9).

### 4.4.6 Groundwater

In the process of augering, water was detected at 0.8 to 3.7 m (elevation 271.6 to 273.6) in all 5 boreholes. Upon completion of drilling, groundwater was measured in boreholes C-1, C-2 and C-5 at 2.6 to 3.7 m (elevation 270.7 to 273.0). The groundwater levels at the site are subject to seasonal fluctuations and precipitation patterns.

## 4.5 Area 11 (Proudfoot Road Extension, Sta. 8+620 to 8+710)

A total of 6 test holes, including 5 boreholes and 1 dynamic cone penetration tests were advanced in Area 11 located on the proposed Proudfoot Road Extension. A supplemental dynamic cone penetration test was also conducted adjacent to borehole PR-2. In addition, several boreholes were completed between Sta. 8+620 and 8+710 for the concurrent pavement design report, of particular importance are the boreholes completed at the low point of the valley, Sta. 8+670. For ease of reference in this report, the pavement boreholes completed at Sta. 8+670 have been relabelled PR-A, PR-B and PR-C. The borehole logs at Sta. 8+670 are attached and summarized in the soil descriptions below.

The subsurface stratigraphy revealed in the boreholes drilled at the site generally comprised surficial topsoil (locally fill) overlying silty clay/clayey silt and/or silty/sandy soils extending to the 9.8 to 10.7 m investigation depths. Upon completion of drilling groundwater levels were measured at 3.7 to 5.2 m (elevation 255.2 to 256.4). It is noted that numerous organic seams were encountered in the upper 2.5 to 5.5 m of the pavement boreholes at Sta. 8+670. The organic seams typically comprised approximately 25 mm thick layers of sand, with organic material and decaying wood pieces throughout.

### 4.5.1 Topsoil

A 200 to 300 mm thick surficial topsoil layer was present surficially in all boreholes except borehole PR-3 and extended to elevations 259.5 to 261.1.

A 600 to 700 mm thick topsoil layer was also noted surficially in the 3 boreholes PR-A, PR-B, PR-C completed at Sta. 8+670.

### 4.5.2 Fill

Locally a 600 mm thick surficial sandy silt fill layer was noted in boreholes PR-3. The fill had a moisture content of 50%, an SPT-'N' value of 8 and was penetrated at elevation 259.8.

### 4.5.3 Upper Silt

A 1.0 to 1.1 m thick, compact silt to sandy silt deposit was contacted beneath the topsoil/fill at 0.2 to 0.3 m (elevation 259.5 to 261.1) in boreholes PR-1, PR-2 and PR-6. The silt to sandy silt had moisture contents of 17 to 29% and SPT-'N' values ranging between 8 and 18. The deposit extended to the silty clay/clayey silt layer and was penetrated at 1.2 to 1.4 m (elevation 258.4 to 260.1).

An upper sandy silt to silt was also encountered below the surficial topsoil at 600 to 700 mm within the pavement boreholes PR-A and PR-C. The silt extended to the 10.1 m investigation depth in borehole PR-A and was penetrated at 3.0 m in PR-C. The material was very loose to compact (SPT-'N' values ranging between 2 and 11) and numerous organic seams were noted. The organic seams typically consisted of approximately 25 mm thick, sand seams with organic material and decaying vegetation throughout. Organic content tests were conducted on a sample of silt from borehole PR-A and two samples from PR-C, showing organic contents of 2.9 to 4.1 % by weight.

### 4.5.4 Silty Clay/Clayey Silt

Cohesive silty clay/clayey silt deposits was encountered beneath the topsoil/fill or silty soils at depths of 0.3 to 1.4 m (elevation 258.4 to 260.1) in all 5 boreholes. These deposits were 1.6 to 3.3 m thick and extended to 2.2 to 4.5 m (elevations 256.6 to 257.3). The silty clay/clayey silt were typically firm to stiff (locally soft in borehole PR-2) with SPT-'N' values ranging between 3 and 12. The results of pocket penetrometer testing carried out in the clayey silt/silty clay yielded shear strength values in a range of 36 to 84 kPa.

A 1.4 and 3.4 m thick, cohesive deposit clayey silt was also encountered beneath the upper silt or topsoil within the boreholes PR-B and PR-C pavement boreholes at Sta. 8+670. The silty clay and clayey silt extended to 4.0 and 4.4 m and were soft to stiff with SPT-'N' values of 3 to 11. The results of an in situ vane test carried out in the clayey silt yielded a shear strength value of 74 kPa. It is also noted that numerous organic seams were encountered within the cohesive deposit in borehole PR-B and occasional organic seams were encountered in borehole PR-C. The organic seams were noted within the entire layer and comprised approximately 25 mm thick sand seams containing organic material and decaying vegetation. An organic content test was carried on a sample of the clayey silt from borehole PR-B and showed an organic content of 2.7 % by weight.

The results of Atterberg limits testing and grain size distribution analyses conducted on 3 clayey silt samples are presented in respective Figures PR-PC-1 and PR-GS-1 and the results on 2 samples of silty clay are presented in respective Figures PR-PC-2 and PR-GS-2. The liquid and plastic limits of the clayey silt ranged from 23 to 34 and from 16 to 21 respectively, with the plasticity index of 7 to 13. The liquid limits of the silty clay were 35 and 41 and the plastic limits were 21 and 22, thus giving plasticity indexes of 14 and 19. The silty clay and clayey silt had natural moisture contents varying from 26 to 42% and 20 to 39%, respectively.

### 4.5.5 Lower Silty/Sandy Soils

Silty/sandy cohesionless soils of various granulometric compositions (silt, sandy silt, sand and silt, and silty sand) were revealed beneath the clayey silt/silty clay at 2.2 to 4.5 m (elevation 256.6 to 257.3) in all 5 boreholes. The deposits were 5.3 to 7.6 m thick and extended to their 9.8 m

sampling exploration depth (elevation 249.7 to 251.5). These strata were loose to compact (SPT-'N' values varying from 5 to 12) and had moisture content ranging from 18 to 31%. Low SPT-'N' values of 1 to 4 were recorded but probably reflect hydraulic disturbance during sampling.

A lower 6.0 and 10.1 m thick silty/sandy soil layer was also encountered within boreholes PR-B and PR-C. The silty/sandy soil extended to their 10.0 and 14.5 m termination depths and had a variable compaction of very loose to very dense (typically loose to compact) with SPT-'N' values between 1 and 100 blows for 225 mm (typically ranging from 5 to 10). Numerous organic seams were noted to 5.6 m in borehole PR-C. The organic seams were similar to those found within the upper silts and clayey silt/silty soils, comprising approximately 25 mm thick sand seams containing organic material and decaying vegetation. An organic content test was carried on a sample of the silt from borehole PR-C and showed an organic content of 3.9 %.

The results of grain size distribution analyses conducted on 8 samples are presented in Figures PR-GS-3 and PR-GS-4.

#### 4.5.6 Groundwater

In the process of augering, water was detected in all 5 boreholes at 3.0 to 4.6 m (elevation 255.2 to 257.1). Upon completion of drilling, groundwater was measured in boreholes PR-2, PR-5 and PR-6 to be at 3.7 to 5.2 m (elevation 255.2 to 256.4). The groundwater levels at the site are subject to seasonal fluctuations and precipitation patterns.

### 4.6 Area E (West Service Road, Sta. 9+400 to 9+685)

Area E extends from Sta. 9+400 to Sta. 9+685 and spans the McGillvray Creek between Sta. 9+470 and Sta. 9+525. A total of 20 test holes comprising 17 boreholes and 3 dynamic cone penetration tests were advanced in Area E (including 6 boreholes carried out for pavement design purposes). Additionally, 6 boreholes (CWM-1 to CWM-6) from the McGillvray Creek structure investigation have been included in the below summary.

The subsurface stratigraphy revealed in the boreholes varied within Area E. At south end of the high fill area, between Stations 9+400 to 9+430, a thin topsoil cover over shallow bedrock was encountered.

The boreholes in the remainder of the high fill area generally revealed surficial peat / topsoil, over organic soils (non-cohesive and cohesive) typically extending to 0.9 m to 2.7 m (locally organic material was encountered at 3.8 and 4.0 m in boreholes E-15 and E-17, which extended to 7.0 and 6.3 m, respectively). North of McGillvray Creek, a cohesive silty clay / clayey silt layer was contacted beneath the organic material / topsoil, which extended to 2.6 to 4.0 m.

A non-cohesive silty / sandy deposit was encountered underlying the organic material / silty clay / clayey silt / topsoil throughout the area which extended to the 2.8 to 15.6 m termination / refusal depth in the boreholes. Cobbles and boulders were encountered within the lower silty/sandy soil in boreholes E-8 to E-10, E-17, and CWM -1 to CWM-6. Upon completion of drilling, groundwater was present surficially or measured at depths up to 7.0 m (elevations 249.7 to 259.5) in boreholes E-6, E-8 to E-16, E-18 and CWM-1 to CWM-6.

### 4.6.1 Topsoil/Peat

A 300 mm thick fine fibrous peat layer was encountered surficially in boreholes E-6 and E-8 that extended to elevations 256.4 and 256.2.

A 100 to 300 mm thick surficial topsoil layer was present in all boreholes, except boreholes E-4, E-6, E-8, CWM-1, CWM-3 and CWM-4, and was penetrated at elevations 256.2 to 262.1.

### 4.6.2 Organic Silty Sand Fill

Locally a 0.9 m thick organic silty sand fill unit was contacted beneath the peat at 0.3 m (elevation 256.4) in borehole E-6 that extended to the 1.2 m borehole termination depth (elevation 255.5). The material was very loose (SPT-'N' value of 3) and moist (based on visual and tactile evidence).

### 4.6.3 Organic Soils

A 0.7 to 3.2 m thick non-cohesive silt / sandy silt alluvial deposit was typically encountered surficially or at 0.2 to 0.3 m (locally at 3.8 in borehole E-15) beneath the topsoil, peat, cohesive material or upper non-cohesive material in boreholes E-8, E-9, CWM-3 to CWM-6 and E-11. The deposit typically extended to 0.9 to 2.7 m (elevations 253.7 to 255.9), except in borehole E-15 where it extended to 7.0 m (elevation 251.4). The material was very loose to compact (SPT-N' values ranging from weight of hammer to 10 blows) and moist to wet (moisture contents of 19 to 105%). The results of a grain size analysis conducted on a sample of the layer are presented in Figure E-GS-1.

A 1.4 to 4.3 m thick cohesive clayey silt / silty clay / clay alluvial deposit was typically encountered beneath the topsoil, peat and non-cohesive organic material at 0.1 to 0.9 m (elevations 255.9 to 257.0) in boreholes E-10, E-12, CWM-1, CMW-2 and CMW-6. The material extended to 1.8 to 4.4 m, corresponding to elevations 252.3 to 255.6. Locally a 2.3 m thick organic clayey silt layer was contacted at 4.0 m in borehole E-17 that extended to 6.3 m (elevation 255.9). The deposit was very soft to very stiff, with SPT-'N' values of 1 to 22 and undisturbed shear strengths of 62 to 138 kPa indicated in penetrometer testing. The material was moist to wet with moisture contents of 17 to 126%.

The results of Atterberg limits testing and grain size distribution analyses conducted on 3 clayey silt samples are presented in respective Figures E-PC-2 and E-GS-2 and the results of 2 sample of silty clay is presented in respective Figures E-PC-2 and E-GS-3. The liquid and plastic limits of the clayey silt ranged from 32 to 35 and from 23 to 27 respectively, with the plasticity index of 8 to 11. The organic silty clay had liquid limits of 41 and 68 and plastic limits of 24 and 50, respectively, corresponding to plasticity indices of 17 and 18.

### 4.6.4 Upper Silt

A 0.5 to 2.0 m thick silt layer was contacted below topsoil at 0.2 and 0.3 m (elevation 256.6 to 259.0) in boreholes E-13, E-15 and E-17 that extended to 0.8 to 2.2 m (elevation 255.4 to 258.5). The silt contained organics and clay seams in borehole E-15. The material was loose to compact

(SPT-'N' values of 7 to 12) and moist to wet (moisture contents of 21 to 29%). The results of a grain size distribution analysis and Atterberg Limit Test conducted on a sample of this layer are present on Figures E-GS-4 and E-PC-3, respectively.

4.6.5 Silty Clay/Clayey Silt

A 1.5 to 4.3 m thick silty clay / clayey silt deposit was encountered beneath the topsoil, organic soils, and upper silt, at 0.2 to 2.2 m (elevations 255.4 to 258.5) in boreholes E-8, E-13, E-14, E-15 and E-17. The layer was penetrated at 2.6 to 4.5 m, corresponding to elevations 252.5 to 255.3. The material was firm to very stiff, with SPT-'N' values of 4 to 24 and an undisturbed shear strength of 32 to 150 kPa recorded by in-situ vane and penetrometer testing. Peat seams and organic material were encountered within the unit in boreholes E-8, E-12 and E-14. Cobbles and boulders were also noted in borehole E-8. The material was moist to wet with moisture contents typically between 22 and 38%.

The results of Atterberg limits testing and grain size distribution analyses conducted on 4 clayey silt samples are presented in respective Figures E-PC-4 and E-GS-5 and the results on 2 samples of silty clay are presented in respective Figures E-PC-5 and E-GS-6. The liquid and plastic limits of the clayey silt ranged from 25 to 34 and from 17 to 23 respectively, with the plasticity index of 8 to 14. The liquid limits of the silty clay were 36 and 38 and the plastic limits were 23 and 24, with plasticity indexes of 12 and 15. The moisture contents of 24 to 38% in the clayey silt were at the plastic limit to wetter than the liquid limit. The moisture contents of 22 to 29% of the silty clay were above the plastic limit but drier than the liquid limit.

4.6.6 Lower Silty / Sandy Soils

A 0.2 to 13.4 m thick layer of silty/sandy soils of various granulometric composition (sand, silty sand, sandy silt, silt) was encountered underlying the topsoil, silty clay / clayey silt, organic soils at 0.2 to 7.0 m (elevation 251.4 to 260.8) in boreholes E-8 to E-15, E-17 to E-19 and CWM-1 to CWM-6. The stratum extended to the 2.8 to 15.6 m (elevation 241.2 to 257.2) termination / refusal depth in all the boreholes, except boreholes CWM-2 and CWM-3 where the boreholes were

advanced into the bedrock. The material was loose to very dense (SPT-'N' values of 4 blows to 55 blows for 15 cm) and moist to wet (moisture contents of 6 to 27%).

The results of 22 grain size distribution analyses performed on samples of the lower silty / sandy material are presented on Figures E-GS-7 to E-GS-13.

4.6.7 Probable Boulders

Refusal upon probable boulders was met in boreholes E-6 to E-10, CWM-1, CWM-3, CWM-4, CWM-6 and E-15 at depths ranging from 1.1 to 11.6 m (elevations 245.2 to 255.5).

4.6.8 Bedrock

Granite bedrock was contacted beneath the topsoil at 0.1 m and surficially in boreholes E-1 to E-5 at elevations 257.5 to 262.1. Granite bedrock was also contacted beneath the lower silty / sandy soils in boreholes CWM-2 and CWM-5 at 10.2 and 15.6 m (elevations 246.7 and 241.2), respectively. The bedrock was cored 3.0 and 3.2 m in boreholes CWM-2 and CWM-5 to 13.2 and 18.8 m (elevations 243.7 and 238.0).

4.6.9 Groundwater

In the process of augering, water was detected surficially and to depths up to 4.3 m (elevation 252.5 to 258.9) in boreholes E-6, E-8 to E-11, E-13, E-15, E-18, CWM-3 and CWM-6. Upon completion of drilling, groundwater present surficially or measured at depths up to 7.0 m (elevations 249.7 to 259.5) in boreholes E-6, E-8 to E-16, E-18 and CWM-1 to CWM-6. The groundwater levels at the site are subject to seasonal fluctuations and precipitation patterns.

## 5. CLOSURE

Messrs F. Portela and A. Djirdeh carried out the field investigation for this study under the supervision of Mrs. N .S. Balakumaran, P. Eng., and Mr. C. M. P. Nascimento, P. Eng. The equipment was supplied by Walker Drilling Ltd. and the laboratory testing of selected soil samples was carried out at the PML laboratory in Toronto.

This report was prepared by Mr. A. DeSira, MEng, P.Eng and reviewed by Mr. B.R. Gray, MEng, P.Eng., MTO Designated Principal Contact. Mr. C.M.P. Nascimento, P.Eng., Project Manager, conducted an independent review of the report.

Yours very truly,

Peto MacCallum Ltd.

REGISTERED PROFESSIONAL ENGINEER
C M P Nascimento
Feb 25, 2015
PROVINCE OF ONTARIO

Carlos M.P. Nascimento, P.Eng.
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AD/CN/BRG:ad-mi-jk

# TABLE 1
## LIST OF ATTERBERG LIMITS TEST RESULTS

| PML HIGH FILL AREA DESIGNATION | SOIL TYPE | BOREHOLE NO. | SAMPLE NO. | DEPTH / ELEVATION (m) | LIQUID LIMIT (LL) | PLASTIC LIMIT (PL) | PLASTICITY INDEX (PI) |
|---|---|---|---|---|---|---|---|
| 1 | FILL (ML) | 1-10 | 2 | 1.0 / 263.1 | 17 | 13 | 4 |
| | | 1.-11 | 3 | 3.4 / 263.2 | 18 | 15 | 3 |
| | SILT (ML) | 1-11 | 8 | 7.9 / 258.7 | 21 | 18 | 3 |
| 6A | SILTY CLAY (CI) | 6A-2 | 4 | 2.6 / 267.9 | 40 | 21 | 19 |
| | | 6A-2 | 8 | 6.4 / 265.0 | 35 | 19 | 16 |
| | | 6A-4 | 5 | 3.4 / 267.9 | 43 | 21 | 22 |
| | | 6A-5 | 7 | 4.8 / 266.1 | 37 | 22 | 15 |
| | | 6A-5 | 8* | 5.5 / 265.4 | 40 | 23 | 17 |
| | | 6B-6 | 4** | 2.6 / 266.9 | 35 | 23 | 12 |
| | | 6B-8 | 7** | 5.6 / 266.7 | 38 | 22 | 16 |
| | CLAYEY SILT (CL) | 6A-1 | 6 | 4.1 / 270.0 | 34 | 22 | 12 |
| | | 6A-1 | 10 | 7.0 / 267.1 | 27 | 19 | 8 |
| | | 6A-2 | 5 | 3.4 / 267.1 | 30 | 21 | 9 |
| | | 6A-5 | 11 | 7.9 / 263.0 | 28 | 18 | 10 |
| | | 6B-6 | 6** | 4.9 / 264.6 | 33 | 20 | 13 |
| | | 6B-8 | 4** | 2.6 / 269.7 | 25 | 16 | 9 |
| | SILT (CL-ML) | 6A-2 | 9 | 7.9 / 263.5 | 22 | 16 | 6 |

# TABLE 1
## LIST OF ATTERBERG LIMITS TEST RESULTS

| PML HIGH FILL AREA DESIGNATION | SOIL TYPE | BOREHOLE NO. | SAMPLE NO. | DEPTH / ELEVATION (m) | LIQUID LIMIT (LL) | PLASTIC LIMIT (PL) | PLASTICITY INDEX (PI) |
|---|---|---|---|---|---|---|---|
| 6B | SILTY CLAY (CI) | 6B-2 | 4 | 2.6 / 266.5 | 37 | 21 | 16 |
| | | 6B-4 | 6 | 4.0 / 266.8 | 38 | 21 | 17 |
| | | 6B-6 | 4 | 2.6 / 266.9 | 35 | 23 | 12 |
| | | 6B-8 | 7 | 5.6 / 266.7 | 38 | 22 | 16 |
| | | 6B-10 | 10 | 7.2 / 266.9 | 40 | 19 | 21 |
| | | 6A-5 | 7** | 4.8 / 266.1 | 37 | 22 | 15 |
| | | 6A-5 | 8** | 5.5 / 265.4 | 40 | 23 | 17 |
| | CLAYEY SILT (CL) | 6B-6 | 6 | 4.9 / 264.6 | 33 | 20 | 13 |
| | | 6B-7 | 5 | 3.4 / 267.5 | 34 | 22 | 12 |
| | | 6B-7 | 7 | 6.4 / 264.5 | 28 | 19 | 9 |
| | | 6B-7 | 8* | 7.9 / 263.0 | 28 | 19 | 9 |
| | | 6B-8 | 4 | 2.6 / 269.7 | 25 | 16 | 9 |
| | | 6B-10 | 13 | 11.0 / 263.1 | 28 | 20 | 8 |
| | | 6A-1 | 6** | 4.1 / 270.0 | 34 | 22 | 12 |
| | | 6A-1 | 10** | 7.0 / 267.1 | 27 | 19 | 8 |
| | | 6A-5 | 11** | 7.9 / 263.0 | 28 | 18 | 10 |
| | SILT (CL-ML) | 6B-7 | 5* | 3.4 / 267.5 | 25 | 21 | 4 |

# TABLE 1

## LIST OF ATTERBERG LIMITS TEST RESULTS

| PML HIGH FILL AREA DESIGNATION | SOIL TYPE | BOREHOLE NO. | SAMPLE NO. | DEPTH / ELEVATION (m) | LIQUID LIMIT (LL) | PLASTIC LIMIT (PL) | PLASTICITY INDEX (PI) |
|---|---|---|---|---|---|---|---|
| C | CLAYEY SILT (CL) | C1 | 6 | 4.1 / 270.3 | 25 | 19 | 6 |
| | | C3 | 5 | 3.4 / 269.0 | 34 | 19 | 15 |
| | SILTY CLAY (CI) | C2 | 5 | 3.4 / 270.4 | 35 | 18 | 17 |
| | | C4 | 7 | 4.9 / 272.4 | 38 | 20 | 18 |
| | | C5 | 6 | 4.1 / 271.5 | 42 | 21 | 21 |
| 11 | CLAYEY SILT (CL) | PR-1 | 3 | 1.8 / 258.0 | 23 | 16 | 7 |
| | | PR-3 | 3 | 1.8 / 257.7 | 28 | 19 | 9 |
| | | PR-6 | 3 | 1.8 / 258.2 | 34 | 21 | 13 |
| | SILTY CLAY (CI) | PR-2 | 3 | 1.8 / 259.5 | 41 | 22 | 19 |
| | | PR-5 | 2 | 1.1 / 259.0 | 35 | 21 | 14 |
| E | ORGANIC CLAYEY SILT (CL-OL) | E-10 | 2 | 1.1 / 256.1 | 32 | 23 | 9 |
| | | CWM-1 | 2 | 1.4 / 255.5 | 35 | 27 | 8 |
| | | CWM-2 | 2 | 1.3 / 255.6 | 34 | 23 | 11 |
| | ORGANIC SILTY CLAY (OH) | E-12 | 5 | 3.4 / 253.3 | 68 | 50 | 18 |
| | | CWM-6 | 3 | 1.8 / 255.0 | 41 | 24 | 17 |
| | SILT (CL-ML) | E-15 | 2 | 1.1 / 257.3 | 26 | 20 | 6 |
| | | E-18 | 3 | 1.8 / 259.2 | 24 | 19 | 5 |

# TABLE 1

## LIST OF ATTERBERG LIMITS TEST RESULTS

| PML HIGH FILL AREA DESIGNATION | SOIL TYPE | BOREHOLE NO. | SAMPLE NO. | DEPTH / ELEVATION (m) | LIQUID LIMIT (LL) | PLASTIC LIMIT (PL) | PLASTICITY INDEX (PI) |
|---|---|---|---|---|---|---|---|
| E | CLAYEY SILT (CL) | E-8 | 3 | 1.8 / 254.7 | 33 | 19 | 14 |
| | | E-14 | 3 | 1.8 / 255.4 | 34 | 22 | 12 |
| | | E-15 | 5 | 3.1 / 255.1 | 33 | 23 | 10 |
| | | E-17 | 3 | 3.1 / 256.2 | 25 | 17 | 8 |
| | SILTY CLAY (CI) | E-13 | 3 | 1.7 / 255.1 | 36 | 24 | 12 |
| | | E-13 | 5 | 3.4 / 253.4 | 38 | 23 | 15 |

Notes: (*) Atterberg Limits test from thin walled sample obtained on October 23, 2012.
(**) Atterberg Limits repeated in Areas 6A and 6B for completeness and discussion purposes in this report.

# TABLE 2

## SUMMARY OF SUBSOIL CONDITIONS

| PML HIGH FILL DESIGNATION | ALIGNMENT SECTION (STA. TO STA.) | NO. OF TEST HOLES | DEPTH TO BOTTOM OF ORGANICS (m) | DEPTH TO BOTTOM OF FILL (m) | DEPTH TO BOTTOM OF CLAYEY SILT / SILTY CLAY (m) | DEPTH TO BOTTOM OF SILT, SAND, GRAVEL (m) | DEPTH TO PROBABLE BEDROCK / BOULDER (m) | NOTES AND/OR SOIL STRATIGRAPHY |
|---|---|---|---|---|---|---|---|---|
| **Highway 11 Mainline** | | | | | | | | |
| Area 1 | NBL Station 20+025 to 20+200 (excluding Station 20+106 to 20+178) | 8 + 4 PVMT Logs (for reference) | 0.2 - 0.8 | 1.8 – 7.5 (3 boreholes) | 2.8 – 4.5 (3 boreholes) | 5.5 – 13.1 | 7.2 – 13.1. (6 boreholes) (El. 249.8 - 256.9) | Topsoil/organic material/fill, over silty/sandy soils, locally over clayey silt (3 boreholes), locally over probable bedrock (6 boreholes). Cobbles and boulders were noted in 6 boreholes. Organic inclusions were noted in 4 boreholes. Ground water was revealed at 0.0 to 8.8 m upon completion of augering. |
| **New E/W-S Ramp** | | | | | | | | |
| Area 6A | Station 21+075 to 21+125 | 5 + 2 boreholes from Area 6B (for reference) | 0.3 | Not Encountered | 7.0 – 10.4 | 9.3 – 14.6 | 9.3-14.6 (El. 257.7 – 261.1) | Topsoil overlying silty/sandy soil overlying a clayey silt overlying silty/sandy soils typically overlying probable bedrock/boulders. Cobbles and boulders were noted in 3 boreholes. Groundwater was encountered at 0.3 to 8.8 m during and upon completion of augering. |

# TABLE 2

## SUMMARY OF SUBSOIL CONDITIONS

| PML HIGH FILL DESIGNATION | ALIGNMENT SECTION (STA. TO STA.) | NO. OF TEST HOLES | DEPTH TO BOTTOM OF ORGANICS (m) | DEPTH TO BOTTOM OF FILL (m) | DEPTH TO BOTTOM OF CLAYEY SILT / SILTY CLAY (m) | DEPTH TO BOTTOM OF SILT, SAND, GRAVEL (m) | DEPTH TO PROBABLE BEDROCK / BOULDER (m) | NOTES AND/OR SOIL STRATIGRAPHY |
|---|---|---|---|---|---|---|---|---|
| **New N-E/W Ramp** | | | | | | | | |
| Area 6B | Station 20+890 to 21+000 | 8+2 Cones + 3 boreholes from Area 6A (for reference) | 0.2 – 0.3 | Not Encountered | 4.3 – 12.0 | 5.2 – 15.8 | 5.2 – >15.8 (El. 257.6 – 264.7) | Topsoil overlaying a non cohesive silty/sandy soil overlying a clayey silt, underlain by silty/sandy soil, typically extending to refusal on probable bedrock/boulders. Cobbles and boulders noted in 3 holes. Groundwater at 2.1 to 8.8 m during and upon completion of augering. |
| Area C | Station 21+060 to 21+000 | 5 | 0.2 – 0.6 | Not Encountered | 4.5 – 9.2 | 4.7 – 9.6 | 4.7 – 9.6 (El. 264.8 – 270.9) | Topsoil overlying a cohesionless silty/sandy layer, overlying a cohesive deposit of clayey silt/silty clay underlain by a lower cohesionless silty/sandy soil typically extending to refusal on probable bedrock/boulder Groundwater at 0.8 to 3.7 m during and upon completion of augering. |

# TABLE 2

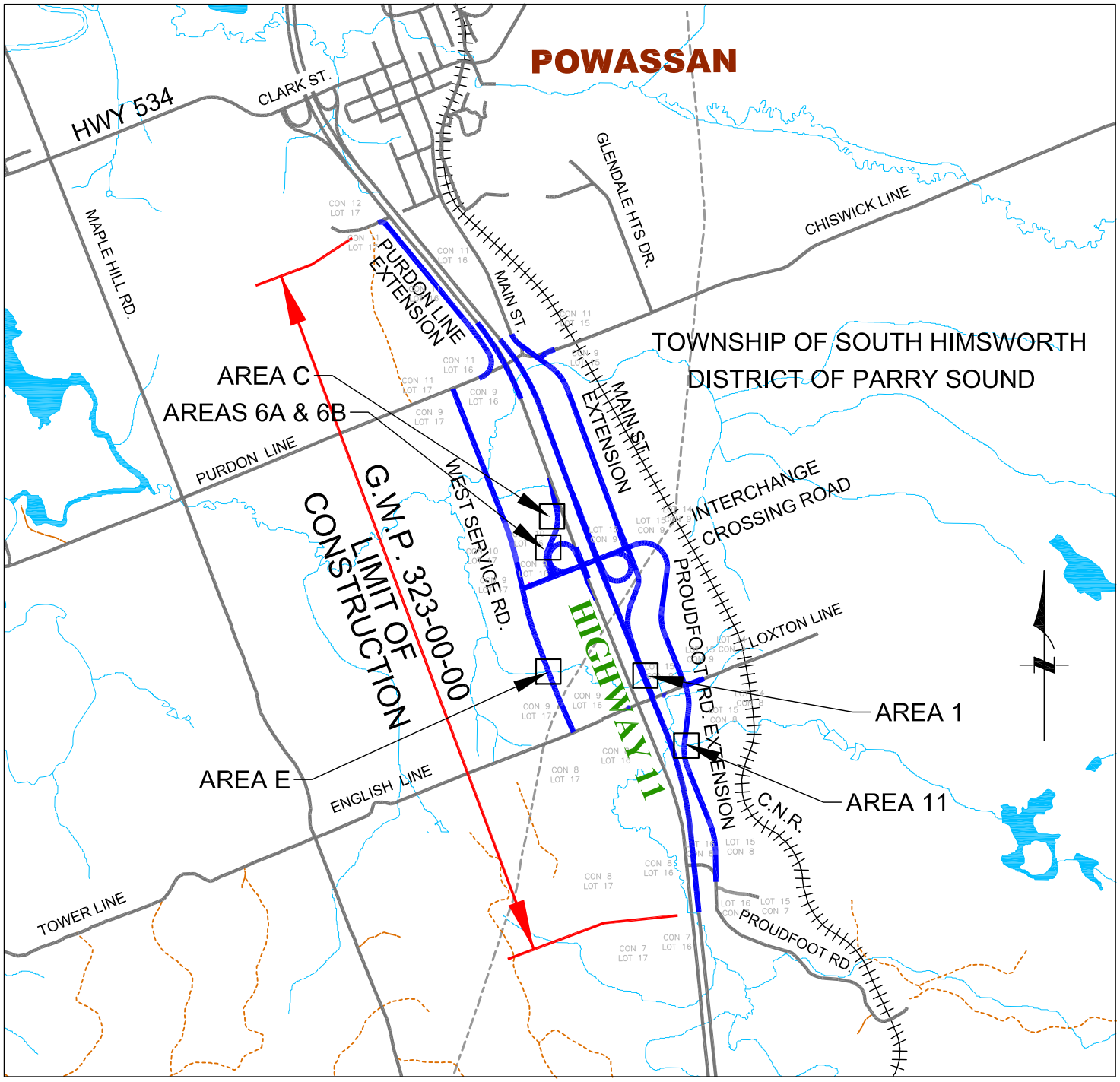
## SUMMARY OF SUBSOIL CONDITIONS

| PML HIGH FILL DESIGNATION | ALIGNMENT SECTION (STA. TO STA.) | NO. OF TEST HOLES | DEPTH TO BOTTOM OF ORGANICS (m) | DEPTH TO BOTTOM OF FILL (m) | DEPTH TO BOTTOM OF CLAYEY SILT / SILTY CLAY (m) | DEPTH TO BOTTOM OF SILT, SAND, GRAVEL (m) | DEPTH TO PROBABLE BEDROCK / BOULDER (m) | NOTES AND/OR SOIL STRATIGRAPHY |
|---|---|---|---|---|---|---|---|---|
| **Proudfoot Road Extension** | | | | | | | | |
| Area 11 | Station 8+620 to 8+710 | 5 + 1 Cone | 0.3 | 0.6 | 2.2 – 4.5 | 9.8 | Not Encountered | Note: Pavement boreholes at station 8+670 revealed numerous organic seams within upper 2.5 to 5.5 m of boreholes. Organic seams comprised small (approximately 25 mm thick) sand seams containing organic material and decaying vegetation. Foundation boreholes revealed topsoil/fill locally overlying silt, over silty clay/clayey silt and/or silty/sandy soils. Groundwater was measured at 3.0 to 5.2 m during and upon completion of augering. |

# TABLE 2

## SUMMARY OF SUBSOIL CONDITIONS

| PML HIGH FILL DESIGNATION | ALIGNMENT SECTION (STA. TO STA.) | NO. OF TEST HOLES | DEPTH TO BOTTOM OF ORGANICS (m) | DEPTH TO BOTTOM OF FILL (m) | DEPTH TO BOTTOM OF CLAYEY SILT / SILTY CLAY (m) | DEPTH TO BOTTOM OF SILT, SAND, GRAVEL (m) | DEPTH TO PROBABLE BEDROCK / BOULDER (m) | NOTES AND/OR SOIL STRATIGRAPHY |
|---|---|---|---|---|---|---|---|---|
| Area E | Station 9+400 to 9+685 | 17 + 3 Cone | 0.2 – 4.4 | 0 – 1.2 | 2.6 – 6.3 | 2.8 - 15.6 | 0.1 – 15.6 (El. 241.2 – 262.1) | South of McGillvray Creek comprised surficial topsoil / peat generally over alluvial soils, typically over cohesionless soils. North of McGillvray Creek stratigraphy comprised surficial topsoil overlying a cohesionless silty/sandy layer, overlying a cohesive deposit of clayey silt/silty clay underlain by a lower cohesionless silty/sandy soil. Locally a 1.3 and 2.0 m thick organic silt / clayey silt layer was contacted beneath the cohesive deposit in boreholes E-17 and E-15 at 4.0 and 3.8 m. Groundwater was measured surficially to depths up to 7.0 m during and upon completion of augering. |




0.5 km 0 0.5 1 1.5 km

SCALE

KEY PLAN LEGEND:

EXISTING ROADS/HIGHWAY

PROPOSED HIGHWAY

# KEY PLAN

HIGH FILL AREAS

HIGHWAY 11 IMPROVEMENTS AND NEW INTERCHANGE

at South Entrance to Powassan

Township of South Himsworth, North Bay Area, Ontario

METRIC

Ontario AECOM

PML Peto MacCallum Ltd. CONSULTING ENGINEERS

DRAWING 1

# 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:

| RQD (%) | 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 |
| $r_u$ | 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

| | | |
|---|---|---|
| $m_v$ | $kPa^{-1}$ | COEFFICIENT OF VOLUME CHANGE |
| $C_c$ | 1 | COMPRESSION INDEX |
| $C_s$ | 1 | SWELLING INDEX |
| $C_\alpha$ | 1 | RATE OF SECONDARY CONSOLIDATION |
| $c_v$ | $m^2/s$ | 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 |
| $S_t$ | 1 | SENSITIVITY = $\frac{c_u}{\tau_r}$ |

### PHYSICAL PROPERTIES OF SOIL

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

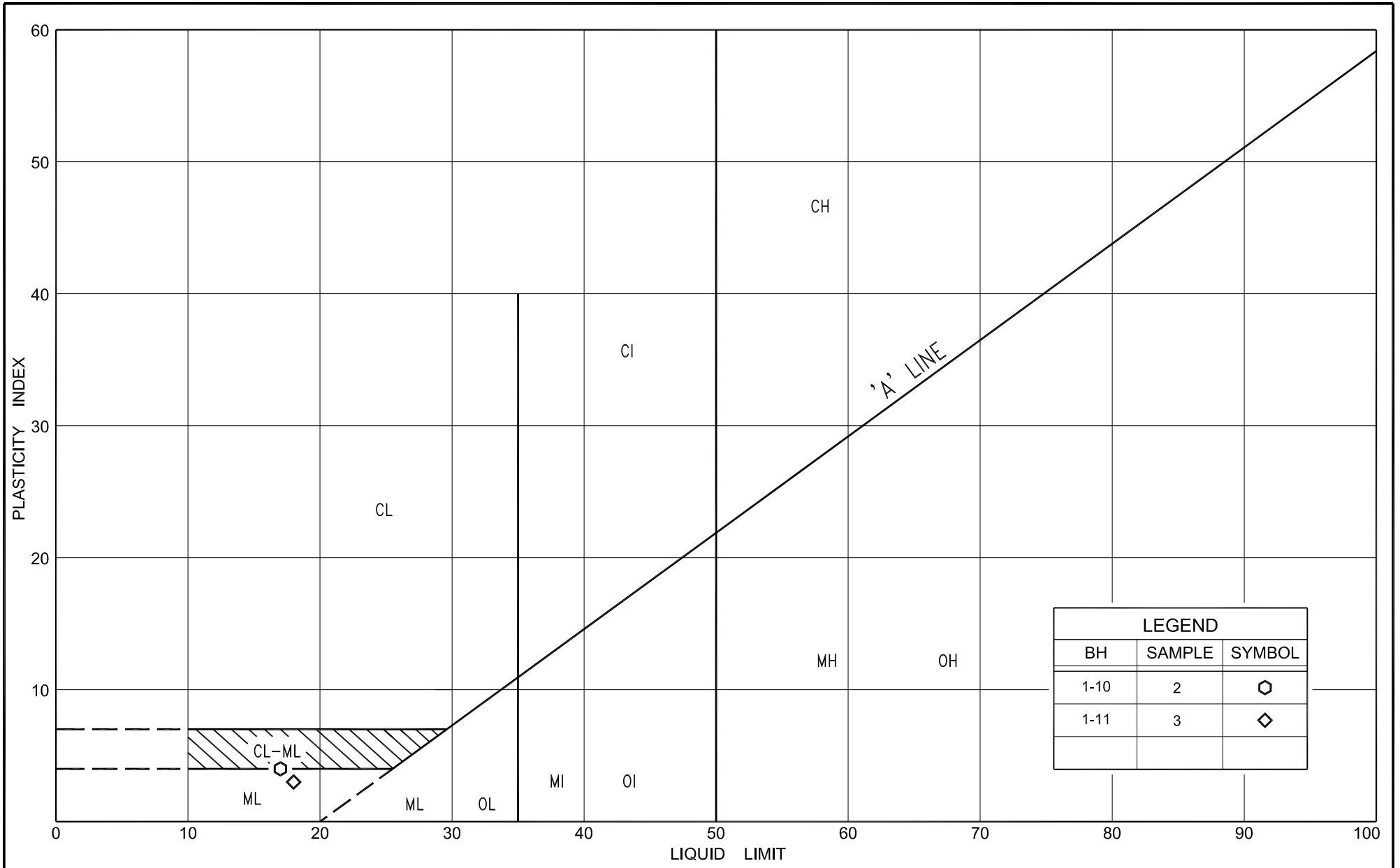
# Area 1 – Hwy 11 NBL, Sta. 20+025 to 20+200, Excluding Sta. 20+106 to 20+178

Figures 1-PC-1 to 1-PC-2 – Plasticity Charts

Figures 1-GS-1 to 1-GS-6 – Grain Size Distribution Analyses

Record of Borehole Sheets – 1-1 to 1-12, MN-1 to MN-4, MN-1A, MN-3A and MN-AP-1

Drawing 1-1 – Borehole Locations and Soil Strata

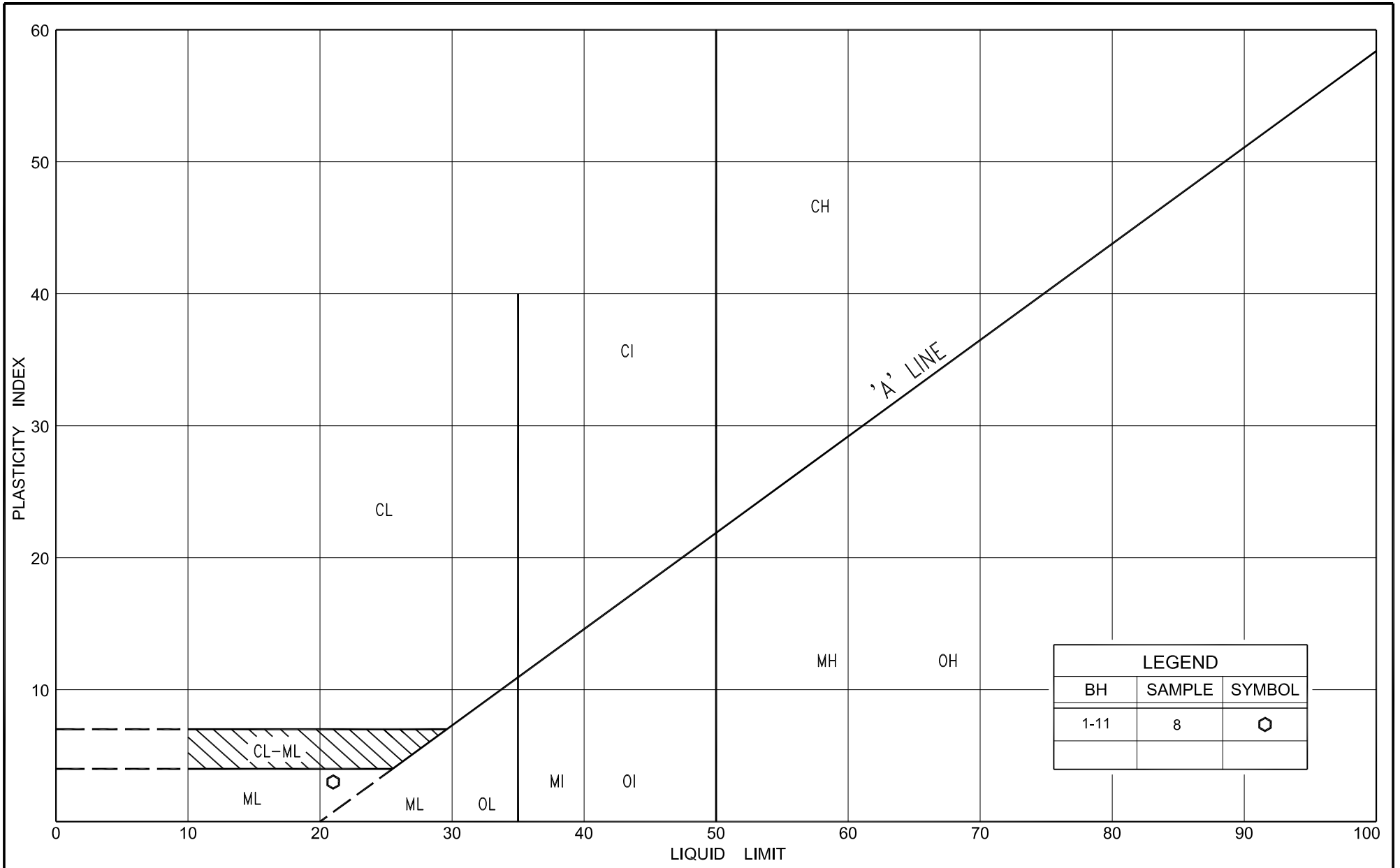



Ontario

# PLASTICITY CHART

SILTY SAND, some clay, trace gravel (ML)
(FILL)

| | |
|---|---|
| FIG No. | 1-PC-1 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

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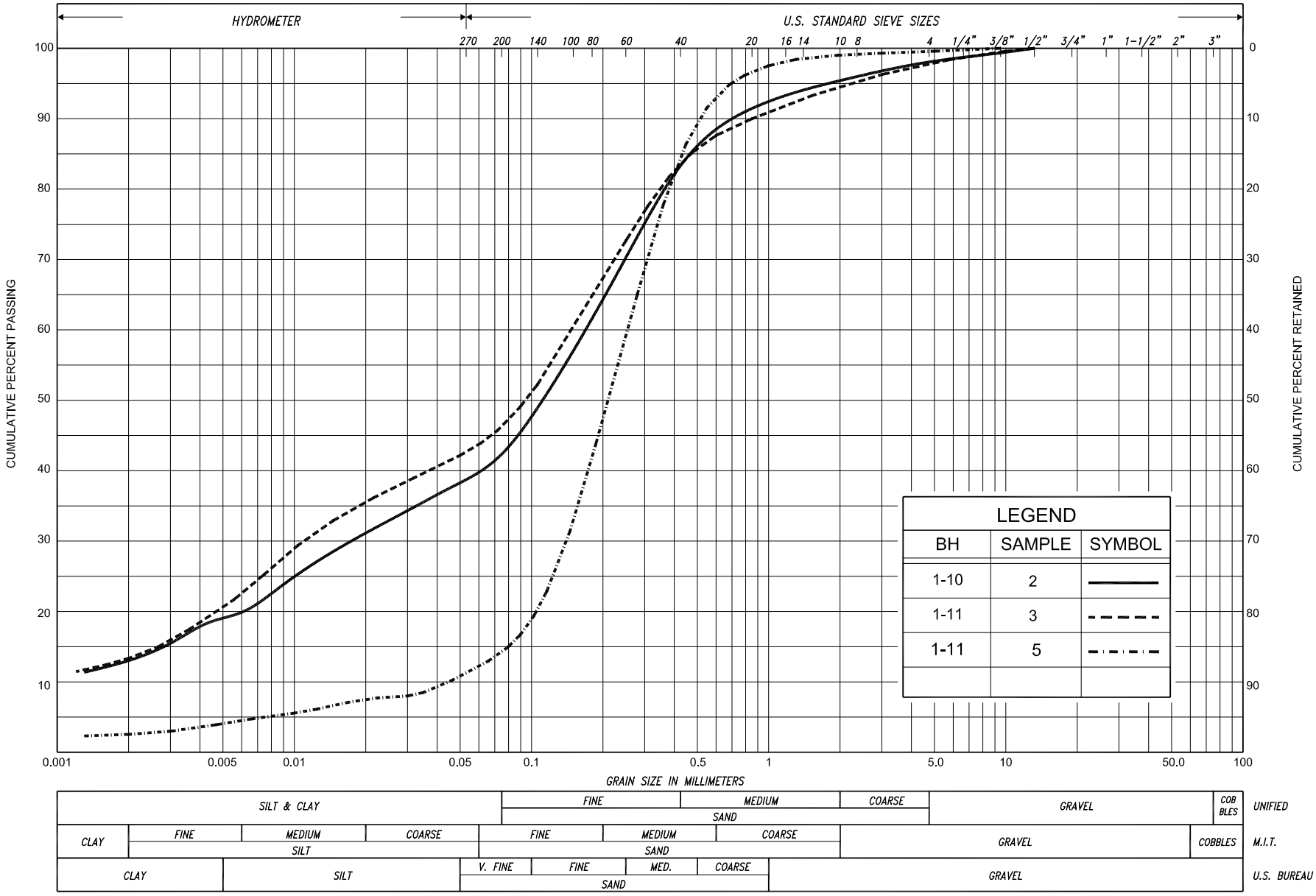
# PLASTICITY CHART

SILT, some to with sand, some clay (ML)

| | |
|---|---|
| FIG No. | 1-PC-2 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

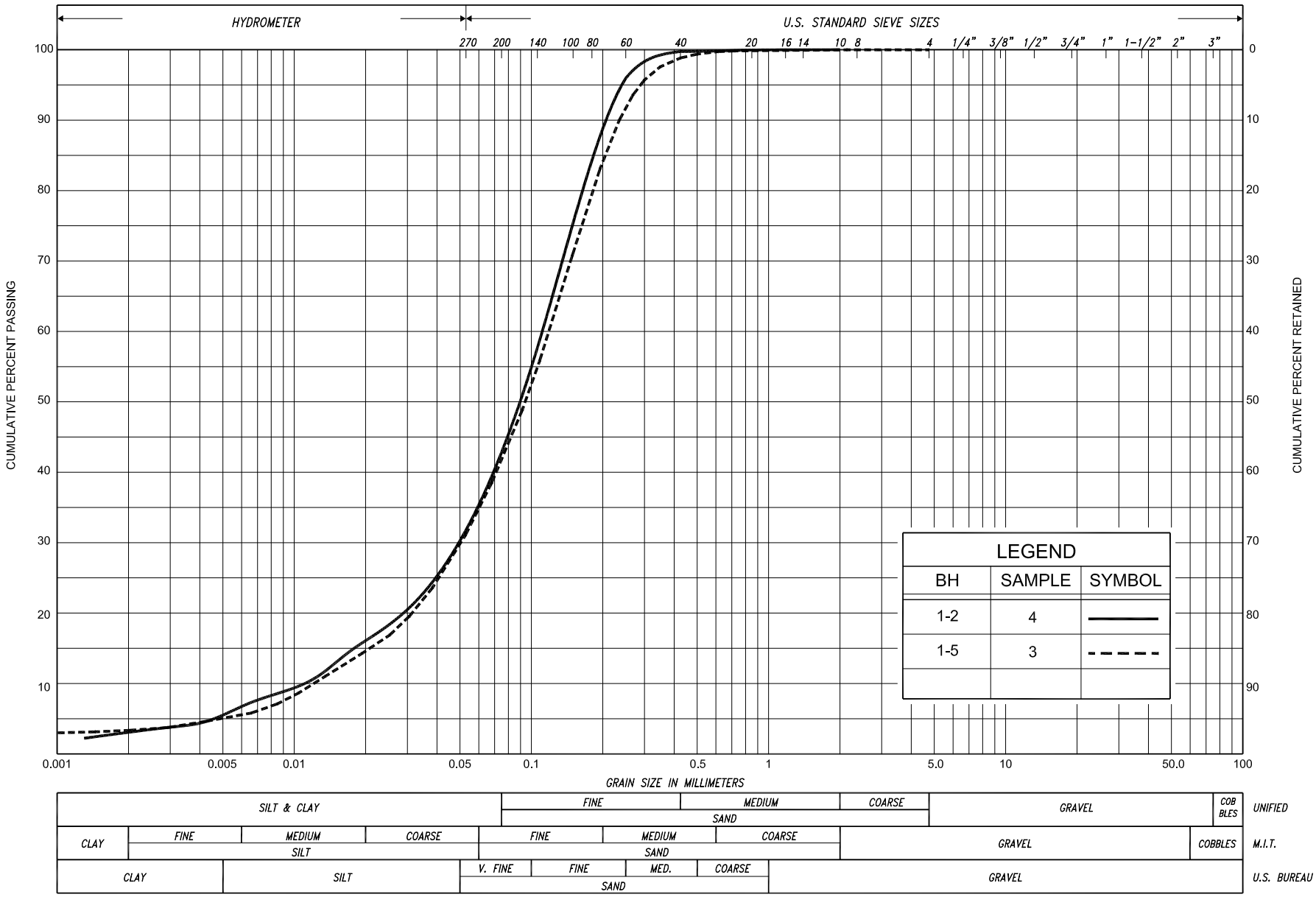



Ontario

# GRAIN SIZE DISTRIBUTION

SILTY SAND, some clay, trace gravel (ML)
or Sand, some silt, trace clay
(FILL)

| | |
|---|---|
| FIG No. | 1-GS-1 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

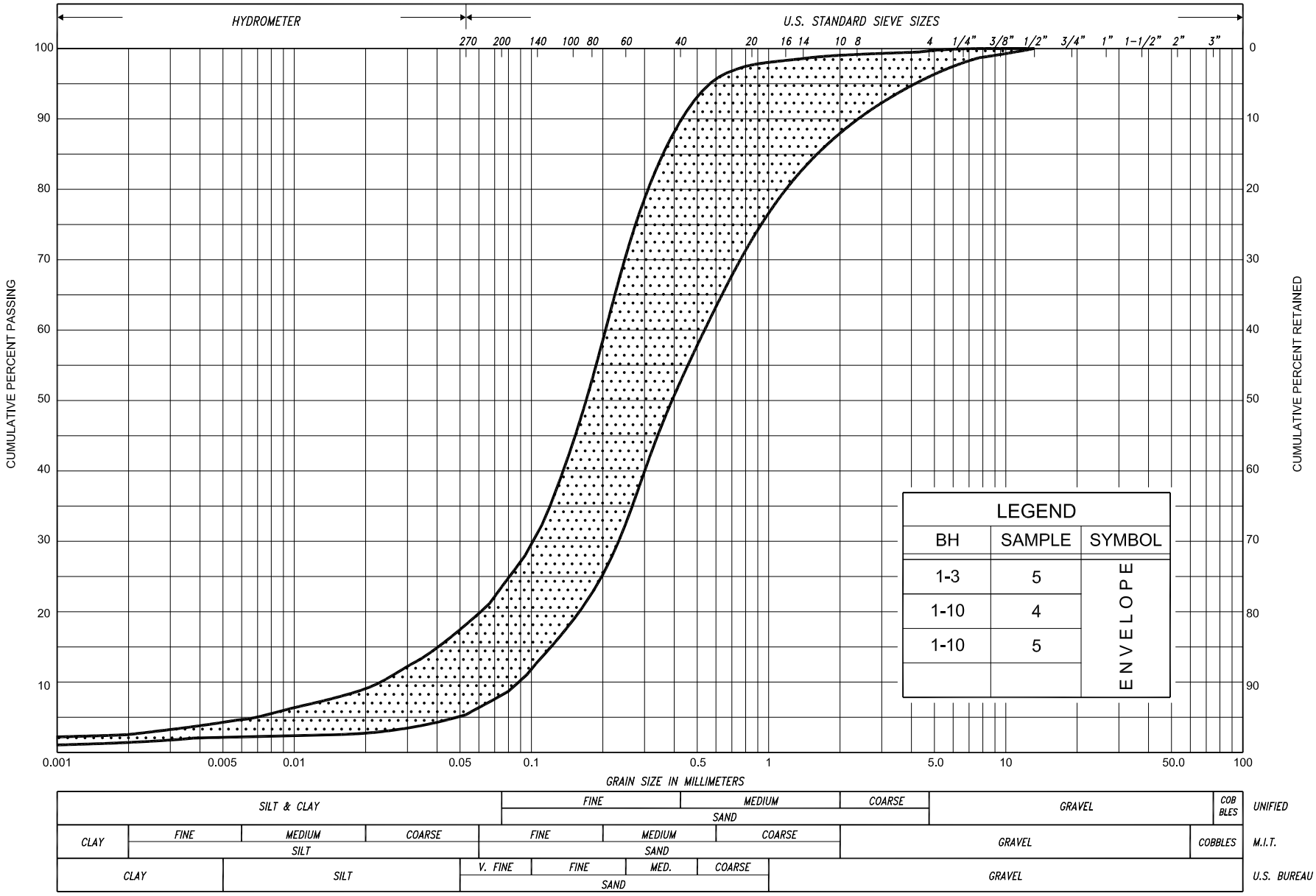



Ontario

# GRAIN SIZE DISTRIBUTION

SILTY SAND, trace clay

| | |
|---|---|
| FIG No. | 1-GS-2 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

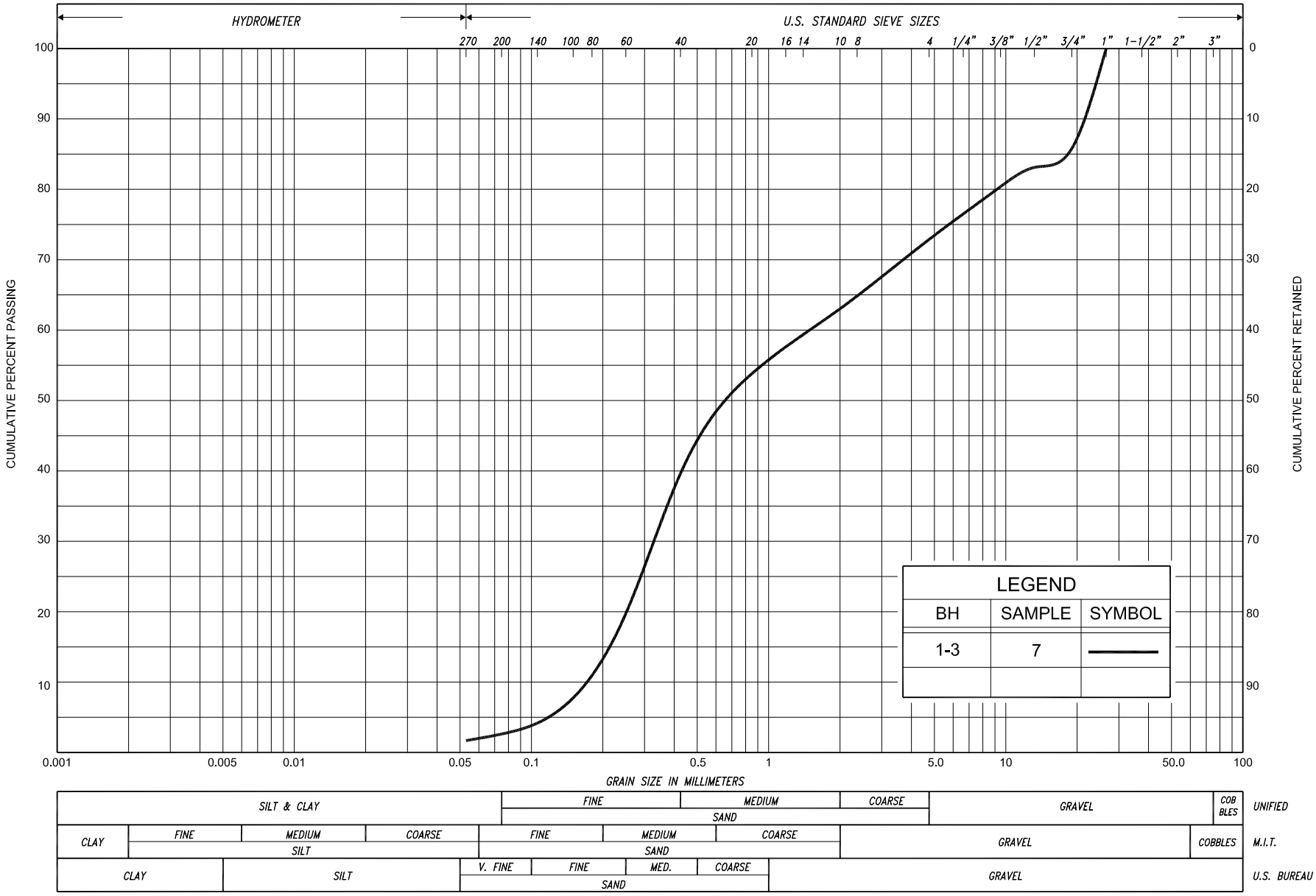



Ontario

# GRAIN SIZE DISTRIBUTION

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

| | |
|---|---|
| FIG No. | 1-GS-3 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

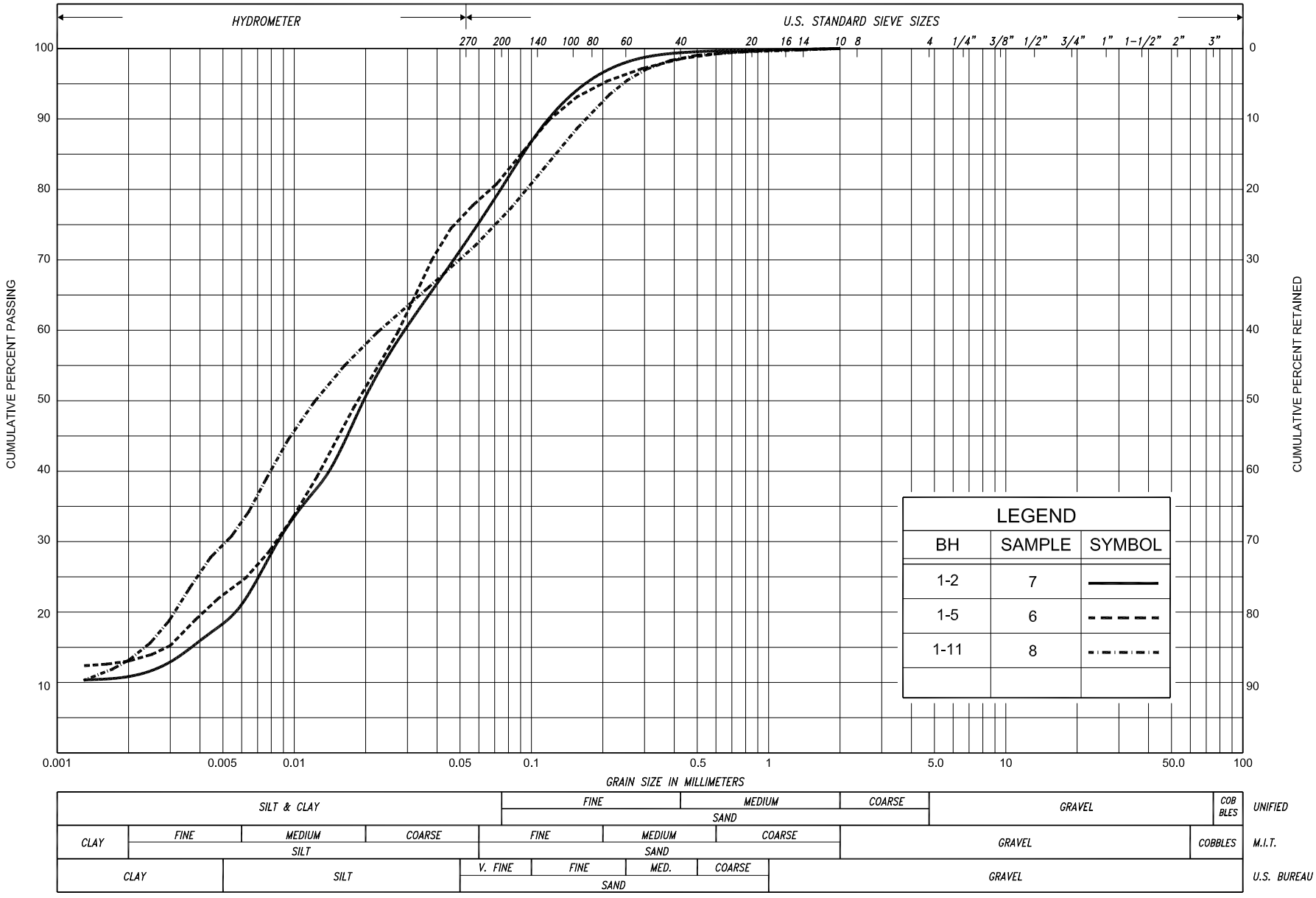



Ontario

# GRAIN SIZE DISTRIBUTION

SAND, with gravel, trace silt

| | |
|---|---|
| FIG No. | 1-GS-4 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

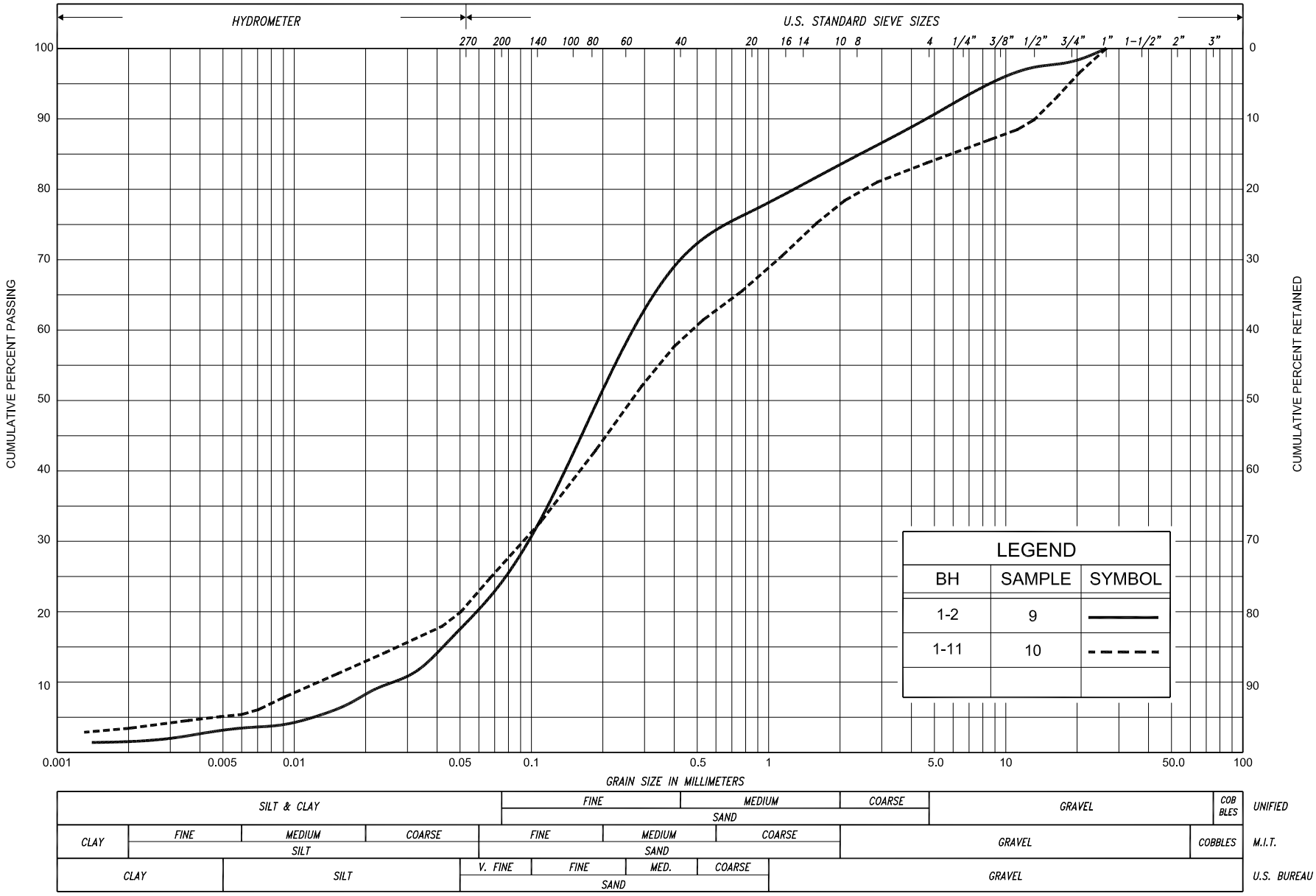



Ontario

# GRAIN SIZE DISTRIBUTION

SILT, some to with sand, some clay

| | |
|---|---|
| FIG No. | 1-GS-5 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

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# GRAIN SIZE DISTRIBUTION

SAND, with silt, some gravel, trace clay

| | |
|---|---|
| FIG No. | 1-GS-6 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. 1-1 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** Hwy 11, Sta. 20+025, o/s 13.0m Lt. NBL **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** December 12, 2011 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 261.1 | Ground Surface | | | | | | | | | | |
| 0.0 / 260.8 | Topsoil | | 1 | SS | 2 | | 261 | | ○ | | |
| 0.3 | Sand<br>trace to some silt<br>trace gravel<br>Loose to compact — Dark brown — Damp | | 2 | SS | 7 | | 260 | | ○ | | |
| | | | 3 | SS | 12 | | 259 | | ○ | | |
| | | | 4 | SS | 12 | | | | ○ | | |
| | Wet | | 5 | SS | 16 | ▽* | 258 | | ○ | | |
| | | | 6 | SS | 26 | | 257 | | ○ | | |
| | | | 7 | SS | 24 | | 256 | | ○ | | |
| | cobbles and boulders | | 8 | SS | 42 | | 255 | | ○ | | |
| | | | 9 | SS | 28 | | 254 | | ○ | | |
| 250.4 | | | 10 | SS | 50/3cm | | 253 | | | | |
| 10.7 | End of borehole<br>Refusal on probable bedrock | | | | | | 252 | | | | |
| | | | | | | | 251 | | | | |

* 2011 12 12

▽ Water level observed during drilling

NOTE: Auger grinding between 7.8 and 8.8m depth



+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. 1-2 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** Hwy 11, Sta. 20+037.5, o/s 19.0m Lt. NBL **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** December 14, 2011 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 265.2 | Ground Surface | | | | | | | | | | |
| 0.0 / 264.9 | Topsoil | | 1 | SS | 3 | | 265 | | ○ | | |
| 0.3 | Silty sand<br>trace clay, trace gravel<br>Loose to compact Brown Damp | | 2 | SS | 5 | | | | ○ | | |
| | | | 3 | SS | 9 | | 264 | | ○ | | |
| | Moist | | 4 | SS | 9 | | 263 | | ○ | | 0 57 40 3 |
| | | | 5 | SS | 10 | | 262 | | ○ | | |
| | Wet | | | | | ▽* | | | | | |
| | | | 6 | SS | 12 | | 261 | | ○ | | |
| 259.4 | | | | | | | 260 | | | | |
| 5.8 | Silt, with sand<br>trace to some clay<br>Compact Brown Wet | | 7 | SS | 10 | | 259 | | ○ | | 0 20 69 11 |
| | | | 8 | SS | 12 | | 258 | | ○ | | |
| 257.0 | | | | | | | 257 | | | | |
| 8.2 | Sand, with silt<br>trace to some gravel<br>trace clay<br>cobbles and boulders<br>Compact to very dense Brown Wet | | 9 | SS | 19 | | 256 | | ○ | | 10 66 21 3 |
| | | | 10 | SS | 23 | | 255 | | ○ | | |
| 253.3 | | | 11 | SS | 52 | | 254 | | | | |
| 11.9 | End of borehole | | | | | | | | | | |

* 2011 12 14

▽ Water level observed during drilling

NOTE: Auger grinding between 8.2 and 9.2m depth



$+^{7}$, $\times^{5}$: Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. 1-3 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** Hwy 11, Sta. 20+050, o/s 13.0m Lt. NBL **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** December 12, 2011 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|
| 260.6 | Ground Surface | | | | | | | | |
| 0.0 / 260.3 | Topsoil | | 1 | SS | 4 | ▽* | 260 | | |
| 0.3 | Silty sand<br>Loose Brown Moist to wet | | 2 | SS | 4 | | | | |
| 259.2 / 1.4 | Sand, trace silt<br>Loose to compact Brown Wet to damp | | 3 | SS | 7 | | 259 | | |
| | | | 4 | SS | 13 | | 258 | | |
| | Loose Wet | | 5 | SS | 6 | | 257 | | 1 91 (8) |
| | cobbles and boulders | | 6 | SS | 59 | | 256 | | |
| | with gravel<br>Compact | | 7 | SS | 11 | | 255 | | 27 70 (3) |
| | | | 8 | SS | 30 | | 254 | | |
| | | | 9 | SS | 18 | | 253 | | |
| 249.8 | Very dense | | 10 | SS | 50/3cm | | 252 | | |
| 10.8 | End of borehole<br>Refusal on probable bedrock | | | | | | 251 | | |
| | * 2011 12 14<br>▽ Water level observed during drilling<br>Auger grinding at 4.6m | | | | | | 250 | | |

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100

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

+7 , ×5 : Numbers refer to Sensitivity

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

Ontario

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# RECORD OF BOREHOLE No. 1-4 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** Highway 11, Sta. 20+050, o/s 24.3 m Rt. **ORIGINATED BY** J.H.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Auger Probe **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** November 08, 2010 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ / WATER CONTENT (%) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 257.0 | Ground Surface | | | | | | | | | | |
| 0.0 | Peat, amorphous<br>Dark brown | | | | | | | | | | |
| 256.3 | | | | | | | 256 | | | | |
| 0.7 | Sandy silt, organics<br>Loose Brown/ grey Wet | | | | | | 255 | | | | |
| 254.1 | | | | | | | 254 | | | | |
| 2.9 | Clayey silt, some sand<br>Firm Grey Wet | | | | | | 253 | | | | |
| 253.0 | | | | | | | 252 | | | | |
| 4.0 | Sand<br>some gravel, trace silt<br>Compact Brown Wet | | | | | | | | | | |
| 251.5 | | | | | | | | | | | |
| 5.5 | End of borehole | | | | | | | | | | |

* 2010 11 08

▼ Water level measured after drilling



+7, ×5 : Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

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# RECORD OF BOREHOLE No. 1-5 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** Hwy 11, Sta. 20+062.5, o/s 18.5m Lt. NBL **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** December 14, 2011 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 263.0 | Ground Surface | | | | | | | | | | |
| 262.8 | Topsoil | | | | | | | | | | |
| 0.2 | Silty sand, trace clay<br>Compact Brown Damp to loose | | 1 | SS | 4 | | | | ○ | | |
| | | | 2 | SS | 10 | | 262 | | ○ | | |
| | | | 3 | SS | 4 | ▽* | 261 | | ○ | | 0 57 39 4 |
| 260.8 | | | | | | | | | | | |
| 2.2 | Sand, trace silt<br>Compact Brown Wet | | 4 | SS | 10 | | 260 | | ○ | | |
| 260.0 | | | | | | | | | | | |
| 3.0 | Silt, some sand trace to some clay<br>Loose Brown Wet | | 5 | SS | 6 | | 259 | | ○ | | |
| | | | 6 | SS | 5 | | 258 | | ○ | | 0 18 69 13 |
| 257.0 | | | | | | | | | | | |
| 6.0 | Sand trace silt, trace gravel<br>Compact Brown Wet | | 7 | SS | 12 | | 257 | | ○ | | |
| | cobbles and boulders | | | | | ▼* | 256 | | | | |
| | | | 8 | SS | 11 | | 255 | | ○ | | |
| | | | | | | | 254 | | | | |
| 253.4 | | | 9 | SS | 27 | | | | ○ | | |
| 9.6 | End of borehole | | | | | | | | | | |

* 2011 12 14

▽ Water level observed during drilling

▼ Water level measured after drilling

Auger grinding between 7.0 to 7.6m depth



+7, ×5 : Numbers refer to Sensitivity

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

Ontario

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# RECORD OF BOREHOLE No. 1-6 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** Highway 11, Sta. 20+075, o/s 25.2 m Rt. **ORIGINATED BY** J.H.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Auger Probe **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** November 08, 2010 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ / WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 257.1 | Ground Surface | | | | | | | | | | |
| 0.0 / 256.3 | Peat, amorphous<br>Dark brown/ grey Wet | | | | | | 257 | | | | |
| 0.8 / 254.0 | Sandy silt, organics<br>Loose Brown/ grey Wet | | | | | | 256 | | | | |
| | | | | | | | 255 | | | | |
| 3.1 / 252.6 | Clayey silt, some sand<br>Firm Grey Wet | | | | | | 254 | | | | |
| | | | | | | | 253 | | | | |
| 4.5 / 251.4 | Sand<br>some gravel, trace silt<br>Compact Brown Wet | | | | | | 252 | | | | |
| 5.7 | End of borehole | | | | | | | | | | |

* 2010 11 08

▼ Water level measured after drilling



+7, ×5 : Numbers refer to Sensitivity

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

Ontario

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# RECORD OF BOREHOLE No. 1-7 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** Hwy 11, Sta. 20+100, o/s 5.0m Rt. **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** December 21, 2011 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ WATER CONTENT (%) 20 40 60 | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 263.1 | Ground Surface | | | | | | | | | | |
| 0.0 | 130mm asphalt over sand and gravel<br>Compact Brown Moist<br>(FILL)<br>clayey silt pockets | | 1 | SS | 55 | | 263 | | ○ | | |
| | | | 2 | SS | 20 | | 262 | | ○ | | |
| | | | 3 | SS | 16 | | 261 | | ○ | | |
| | Loose Wet | | 4 | SS | 5 | ▽* | 260 | | | | |
| | woodchips and organic pockets<br>Grey | | 5 | SS | 5 | | 259 | | ○ | | |
| | Compact | | 6 | SS | 10 | | 258 | | ○ | | |
| 255.6 | | | 7 | SS | 13 | | 257 | | ○ | | |
| 7.5 | Sand, trace gravel<br>Dense to compact Reddish brown Moist | | 8 | SS | 36 | | 256 | | ○ | | |
| | gravelly sand layer trace silt<br>Wet | | 9 | SS | 22 | ▼* | 255 | | ○ | | |
| | | | 10 | SS | 11 | | 254 | | ○ | | |
| | medium to coarse sand<br>Compact Brown Wet | | 11 | SS | 26 | | 253 | | ○ | | |
| 250.4 | | | | | | | 252 | | | | |
| 12.7 | End of borehole<br>Refusal on probable bedrock | | | | | | 251 | | | | |

* 2011 12 21

▽ Water level observed during drilling

▼ Water level measured after drilling



$+^{7}$, $\times^{5}$ : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. 1-8 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** Highway 11, Sta. 20+100, o/s 42.1 m Rt. **ORIGINATED BY** J.H.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Auger Probe **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** November 08, 2010 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 257.6 | Ground Surface | | | | | | | | | | |
| 0.0 / 257.0 | Topsoil | | | | | | | | | | |
| 0.6 / 256.5 | Sandy silt<br>Loose Brown/ grey Moist | | | | | ▼* | 257 | | | | |
| 1.1 / 256.1 | Silt and sand<br>Loose Grey Wet | | 1 | SS | 5 | | 256 | | | | |
| 1.5 | Clayey silt<br>some sand, trace gravel<br>Firm Grey Wet | | | | | | 255 | | | | |
| 254.8 / 2.8 | Silt<br>trace sand, trace clay<br>Compact Light brown Wet | | 2 | SS | 19 | | 254 | | | | |
| 253.6 / 4.0 | Sand<br>some gravel, trace silt<br>Compact to Brown Wet<br>very dense | | 3 | SS | 12 | | 253 | | | | |
| | | | | | | | 252 | | | | |
| 251.1 / 6.5 | End of borehole | | 4 | SS | 60 | | | | | | |

* 2010 11 08

▼ Water level measured after drilling



+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

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# RECORD OF BOREHOLE No. 1-9 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** Highway 11, Sta. 20+175, o/s 38.1 m Rt. **ORIGINATED BY** J.H.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Auger Probe **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** November 08, 2010 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ / WATER CONTENT (%) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 260.7 | Ground Surface | | | | | | | | | | |
| 0.0 / 260.4 | Topsoil | | | | | | | | | | |
| 0.3 | Sandy silt<br>Loose Brown/grey Moist<br>Brown Wet | | 1 | SS | 4 | | 260<br>259 | | | | |
| 258.2 | | | | | | | | | | | |
| 2.5 | Silt and sand, organics<br>Loose Grey Wet | | 2 | SS | 8 | | 258<br>257 | | | | |
| 256.7 | | | | | | | | | | | |
| 4.0 | Sand<br>some gravel, trace silt<br>Very dense Brown Wet | | 3 | SS | 52 | | 256 | | | | |
| 255.4 | | | | | | | | | | | |
| 5.3 | End of borehole | | | | | | | | | | |

* 2010 11 08

▼ Water level measured after drilling



+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. 1-10 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** Hwy 11, Sta. 20+187.5, o/s 19.0m Lt. NBL **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** December 16, 2011 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 264.1 | Ground Surface | | | | | | | | | | |
| 0.0 / 263.8 | Topsoil | | 1 | SS | 18 | | 264 | | ○ | | |
| 0.3 | Silt with gravel, trace clay organic inclusions | | | | | | | | | | |
| | Silty sand some clay, trace gravel | | 2 | SS | 50 | | 263 | | ○ H | | 3 54 30 13 |
| 262.3 | Grey (FILL) | | 3 | SS | 22 | | | | ○ | | |
| 1.8 | Sand, some to with silt trace garvel | | | | | | 262 | | | | |
| | Compact to loose Reddish brown Moist to damp | | 4 | SS | 15 | | | | ○ | | 3 84 11 2 |
| | | | 5 | SS | 8 | | 261 | | ○ | | 4 73 20 3 |
| | Wet | | | | | ▽* | 260 | | | | |
| | | | 6 | SS | 6 | | | | ○ | | |
| | silt layers | | | | | | 259 | | | | |
| | Compact | | 7 | SS | 13 | | 258 | | ○ | | |
| 256.9 | cobbles and boulders | | | | | | 257 | | | | |
| 7.2 | End of borehole | | | | | | | | | | |
| | Refusal on probable bedrock | | | | | | | | | | |

* 2011 12 16

▽ Water level observed during drilling

NOTE: Auger grinding at 6.9m



+7 , ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. 1-11 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** Hwy 11, Sta. 20+187.5, o/s 5.0m Rt. NBL **ORIGINATED BY** A.K.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** December 21, 2011 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 266.6 | Ground Surface | | | | | | | | | | |
| 0.0 | 150mm asphalt over Sand and gravel<br>Compact Brown Moist | | 1 | SS | 29 | | 266 | ○ 175 | | | |
| | Sand, some gravel trace silt and clay | | 2 | SS | 13 | | 265 | | | | |
| | Silty sand some clay, trace gravel organics<br>Grey | | 3 | SS | 23 | | 264 | | | | 2 52 33 13 |
| | sand seams<br>Loose to dense<br>(FILL) | | 4 | SS | 7 | | 263 | | | | |
| | | | 5 | SS | 13 | | 262 | | | | 0 86 12 2 |
| 259.8 | | | 6 | SS | 31 | | 261 | | | | |
| 6.8 | Silty sand trace clay, trace gravel<br>Loose Brown Moist | | 7 | SS | 6 | ▽* | 260 | | | | |
| 259.1 | | | | | | | | | | | |
| 7.5 | Silt with sand, trace clay<br>Compact Grey Wet | | 8 | SS | 13 | | 259 | | | | 0 25 62 13 |
| | trace clay<br>Brown Moist | | 9 | SS | 20 | | 258 | | | | |
| 256.2 | | | | | | | 257 | | | | |
| 10.4 | Sand, with silt some gravel, trace clay<br>Compact Reddish Moist brown | | 10 | SS | 22 | | 256 | | | | 16 58 23 3 |
| | sand layers, organics cobbles and boulders | | 11 | SS | 20 | | 255 | | | | |
| 253.5 | | | | | | | 254 | | | | |
| 13.1 | End of borehole<br>Refusal on probable bedrock | | | | | | | | | | |

* 2011 12 08

▽ Water level observed during drilling

ON MTO_VER3 NEW LOGO 10TF013A FINAL.GPJ ON_MOT.GDT 8/7/2014 2:44:55 PM

+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

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# RECORD OF BOREHOLE No. 1-12 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** Hwy 11, Sta. 20+200, o/s 16.0m Lt. NBL **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** December 08, 2011 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 264.4 | Ground Surface | | | | | | | | | | |
| 0.0 / 264.1 | Topsoil | | 1 | SS | 16 | | 264 | ○ | ○ | | |
| 0.3 / 263.8 | Silt, trace sand | | | | | | | | | | |
| 0.6 | Compact Brown Moist | | | | | | | | | | |
| | Sand, trace gravel | | | | | | | | | | |
| | Compact Brown Moist to loose | | | | | | | | | | |
| | silty sand layers | | 2 | SS | 13 | | 263 | | ○ | | |
| | | | | | | | 262 | | | | |
| | oxidized partings | | 3 | SS | 12 | | 261 | | ⊖ | | |
| | Wet | | | | | ▽* | | | | | |
| | | | 4 | SS | 12 | | 260 | | ○ | | |
| | | | 5 | SS | 8 | | 259 | | | | |
| | | | 6 | SS | 4 | | 258 | | ○ | | |
| 257.1 | | | 7 | SS | 12 | | | | ○ | | |
| 7.3 | Gravelly sand cobbles and boulders | | | | | | 257 | | | | |
| | Dense to compact Brown Wet | | 8 | SS | 35 | | | | ⊖ | | |
| | | | | | | | 256 | | | | |
| | | | 9 | SS | 22 | | 255 | | | | |
| 254.3 | | | | | | | | | | | |
| 10.1 | End of borehole | | | | | | | | | | |
| | Refusal on probable bedrock | | | | | | | | | | |

* 2011 12 21

▽ Water level observed during drilling

ON MTO_VER3 NEW LOGO 10TF013A FINAL.GPJ ON_MOT.GDT 8/7/2014 2:45:19 PM

+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No MN-1 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** Co-ords: 5 101 274.6 N; 316 834.8 E **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.S.

**DATUM** Geodetic **DATE** December 09, 2011 **CHECKED BY** C.N.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 263.5 | Ground Surface | | | | | | | | | | |
| 0.0 | Sand and gravel<br>Loose to compact Brown Moist<br>cobbles and boulders | | 1 | SS | 7 | | 263 | | ○ | | |
| | | | 2 | SS | 21 | | 262 | | | | |
| | | | | | | | 261 | | | | |
| | Sand, some silt<br>trace clay, trace gravel<br>organic inclusions<br>Wet | | 3 | SS | 6 | | 260 | | ○ | | 3 74 19 4 |
| | | | 4 | SS | 18 | ▽* | 259 | | | | |
| | oxidized layers<br>(FILL) | | 5 | SS | 4 | | | | ○ | | |
| 257.6 | | | 6 | SS | 8/8cm | | 258 | | | | |
| 5.9 | Topsoil | | | | | | | | | | |
| 257.1 | | | 7 | SS | 21 | | 257 | | ○ | | |
| 6.4 | Sandy silt<br>some clay, trace gravel<br>organics<br>Compact to Grey Wet<br>loose | | 8 | SS | 7 | | | | ○ | | 1 29 59 11 |
| 255.9 | | | | | | | 256 | | | | |
| 7.6 | End of borehole<br>Refusal on probable bedrock<br>Sample 6: Sampler bouncing<br>* 2011 12 09<br>▽ Water level observed during drilling | | | | | | | | | | |

ON MTO_VER3 NEW LOGO 10TF013A FINAL.GPJ ON_MOT.GDT 5/11/2012 8:19:33 AM

Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS
Foundation Design

# RECORD OF BOREHOLE No MN-1A 1 of 2 METRIC

**G.W.P.** 323-00-00 **LOCATION** Co-ords: 5 101 293.2 N; 316 827.3 E **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** C.F.H.S.A. and NQ Diamond Coring **COMPILED BY** A.S.

**DATUM** Geodetic **DATE** December 15, 2011 **CHECKED BY** C.N.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES "N" VALUES | GROUND WATER CONDITIONS * | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT w / LIQUID LIMIT $w_L$ WATER CONTENT (%) 20 40 60 | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 263.8 | Ground Surface | | | | | | | | | | |
| 0.0 | Sand and gravel<br>Loose brown<br>(FILL) | | 1 | SS | 8 | | 263 | | | | |
| | gravelly sand, trace silt | | 2 | SS | 23 | | 262 | | ○ | | 35 59 (6) |
| | | | 3 | SS | 8 | | 261 | | | | |
| | | | 4 | SS | 3 | | 260 | | | | |
| | | | 5 | SS | 4 | | 259 | | | | |
| | | | 6 | SS | 6 | | 258 | | | | |
| 257.0 | | | | | | | 257 | | | | |
| 6.8 | Silt and sand<br>trace clay, organics<br>Loose Dark grey Moist | | 7 | SS | 3 | | 256 | | | | 0 43 49 8 |
| | | | 8 | SS | 6 | | | | | | |
| 255.3 | | | 9 | SS | 50/5cm | | | | | | |
| 8.5 | Sand, trace gravel<br>cobbles and boulders<br>Dense Brown Moist<br>(TILL) | | 10 | RC | | | 255 | | | | |
| | Boulder | | 11 | RC | | | 254 | | | | |
| | Boulder | | 12 | RC | | | 253 | | | | |
| | Boulder | | 13 | RC | | | 252 | | | | |
| 250.2 | | | | | | | 251 | | | | |
| 13.6 | Granite bedrock<br>Slightly weathered<br>High strength<br>Fair to good quality<br>Cont'd | | 14 | RC NQ | REC 100% | | 250 | | | | RQD 66% |
| | | | | | | | 249 | | | | |

ON MTO_VER3 NEW LOGO 10TF013A FINAL.GPJ ON_MOT.GDT 6/18/2012 8:52:11 AM

Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No MN-1A 2 of 2 METRIC

**G.W.P.** 323-00-00 **LOCATION** Co-ords: 5 101 293.2 N; 316 827.3 E **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** C.F.H.S.A. and NQ Diamond Coring **COMPILED BY** A.S.

**DATUM** Geodetic **DATE** December 15, 2011 **CHECKED BY** C.N.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ WATER CONTENT (%) 20 40 60 | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | | | GR SA SI CL |
| 248.8 | | | | | | | | | | | |
| | | | 15 | RC NQ | REC 100% | | 248 | | | | RQD 69% |
| | | | 16 | RC NQ | REC 95% | | 247 | | | | RQD 81% |
| 246.8 17.0 | End of borehole | | | | | | | | | | |

* Borehole charged with drilling water



Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No MN-2 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** Co-ords: 5 101 297.4 N ; 316 837.9 E **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers and 'N' Casing **COMPILED BY** A.S.

**DATUM** Geodetic **DATE** December 20, 2011 **CHECKED BY** C.N.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 263.9 | Ground Surface | | | | | | | | | | |
| 0.0 | 80mm asphalt over sand and gravel<br>Compact Brown Moist to loose<br>(FILL)<br>clayey silt inclusions<br>Sand trace to some silt trace gravel, organics | | 1 | SS | 45 | | 263 | ○ | ○ | | |
| | | | 2 | SS | 15 | | 262 | | | | |
| | | | 3 | SS | 10 | | 261 | | ○ | | |
| | | | 4 | SS | 17 | | 260 | | ○ | | |
| | | | 5 | SS | 4 | | 259 | | ○ | | 5 85 (10) |
| 257.9 | | | 6 | SS | 5 | | 258 | | | | |
| 6.0 | Organic silt<br>Loose to Compact Dark grey Wet | | 7 | SS | 4 | | | | ○ | | |
| | | | 8 | SS | 8 | | 257 | | H | | 0 32 60 8 |
| 255.7 | | | 9 | SS | 12 | | 256 | | | | |
| 8.2 | Silt, trace sand, organics | | | | | | | | | | |
| 255.4 | | | | | | | | | | | |
| 8.5 | Compact Grey to brown Wet | | 10 | SS | 53 | | | | ○ | | |
| | Sand, with gravel some silt, trace clay<br>Very dense Reddish brown Moist<br>(TILL) | | 11 | SS | 57 | | 255 | | ○ | | 28 58 12 2 |
| 252.8 | | | 12 | SS | 50/10cm | | 254 | | | | |
| 11.1 | End of borehole<br>Refusal on probable boulder<br>* Borehole dry | | | | | | 253 | | ○ | | |

ON MTO_VER3 NEW LOGO 10TF013A FINAL.GPJ ON_MOT.GDT 5/11/2012 8:19:36 AM

Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No MN-3 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** Co-ords: 5 101 315.9 N; 316 798.1 E **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers and 'N' Casing **COMPILED BY** A.S.

**DATUM** Geodetic **DATE** December 08 and 13, 2011 **CHECKED BY** C.N.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 260.1 | Ground Surface | | | | | | | | | | |
| 0.0 | Topsoil | | 1 | SS | 3 | | 260 | | | | |
| | Silt, trace sand topsoil inclusions<br>Loose Brown Moist | | 2 | SS | 5 | ▽* | 259 | | ○ | | |
| | Sand, some silt trace clay, trace gravel<br>Loose Brown Wet | | 3 | SS | 3 | | 258 | | ○ | | 3 74 17 6 |
| | Compact Dark brown | | 4 | SS | 14 | | 257 | | ○ | | |
| | wood chips<br>Loose (FILL) | | 5 | SS | 8 | | | | ○ | | |
| 256.4 | | | | | | | | | | | |
| 3.7 | Sand trace silt, trace gravel organics<br>Loose Brown Wet<br>(TILL) | | 6 | SS | 6 | | 256 | | ○ | | |
| | cobbles and boulders<br>Compact | | | | | | 255 | | | | |
| | | | | | | | 254 | | | | |
| | | | | | | | 253 | | | | |
| 252.7 | | | | | | | | | | | |
| 7.4 | Granite bedrock<br>Slightly weathered<br>High strength | | 7 | RC NQ | REC 100% | | 252 | | | | RQD 59% |
| | Very poor to fair, becoming excellent quality | | 8 | RC NQ | REC 90% | | | | | | RQD 20% |
| | | | 9 | RC NQ | REC 98% | | 251 | | | | RQD 95% |
| | | | | | | | 250 | | | | |
| 249.7 | | | | | | | | | | | |
| 10.4 | End of borehole | | | | | | | | | | |

* 2011 12 08

▽ Water level observed during drilling

NOTE: Borehole advanced on December 13, 2011, using casing from 5.8m depth



Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No MN-3A 1 of 2 METRIC

**G.W.P.** 323-00-00 **LOCATION** Co-ords: 5 101 327.1 N ; 316 826.0 E **ORIGINATED BY** A.K.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** C.F.H.S.A. and NQ Diamond Coring **COMPILED BY** A.S.

**DATUM** Geodetic **DATE** December 20, 2011 **CHECKED BY** C.N.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 265.2 | Ground Surface | | | | | * | 265 | | | | |
| 0.0 | 150mm asphalt over sand and gravel<br>Compact Brown Moist | | 1 | SS | 22 | | | | ○ | | |
| | Silty sand<br>trace clay, trace gravel | | 2 | SS | 17 | | 264 | | ○ | | |
| | sand seams<br>(FILL) | | 3 | SS | 16 | | 263 | | ○ | | |
| | Sand, with silt<br>trace clay, trace gravel<br>Grey Wet | | 4 | SS | 20 | | 262 | | ○ | | 3 71 20 6 |
| | | | 5 | SS | 10 | | 261 | | ○ | | |
| | | | 6 | SS | 10 | | 260 | | ○ | | |
| 258.4 | | | 7 | SS | 10 | | 259 | | ○ | | |
| 6.8 | Sandy silt, some clay<br>Compact Grey Wet<br>to loose | | 8 | SS | 14 | | 258 | ■ | ‖○ | | 0 38 49 13 |
| 256.4 | | | 9 | SS | 9 | | 257 | | ○ | | |
| 8.8 | Silty sand, trace clay<br>Loose Grey Wet | | 10 | SS | 8 | | 256 | | ○ | | 0 62 30 8 |
| 254.7 | | | | | | | 255 | | | | |
| 10.5 | Sand, with gravel<br>some silt, trace clay<br>Compact Brown Moist<br>(TILL) | | 11 | SS | 28 | | 254 | | ○ | | 26 54 18 2 |
| | | | 12 | SS | 15 | | 253 | | ○ | | |
| 251.8 | | | | | | | 252 | | | | |
| 13.4 | Granite bedrock<br>Slightly weathered<br>High strength<br>Good to excellent quality<br>Cont'd | | 13 | RC NQ | REC 100% | | 251 | | | | RQD 80% |

ON MTO_VER3 NEW LOGO 10TF013A FINAL.GPJ ON_MOT.GDT 5/11/2012 8:59:13 AM

Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No MN-3A 2 of 2 METRIC

**G.W.P.** 323-00-00 **LOCATION** Co-ords: 5 101 327.1 N ; 316 826.0 E **ORIGINATED BY** A.K.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** C.F.H.S.A. and NQ Diamond Coring **COMPILED BY** A.S.

**DATUM** Geodetic **DATE** December 20, 2011 **CHECKED BY** C.N.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ NATURAL MOISTURE CONTENT $w$ LIQUID LIMIT $w_L$ WATER CONTENT (%) 20 40 60 | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | * | | | | | |
| 250.2 | | | | | | | | | | | |
| | | | 14 | RC NQ | REC 97% | | 250 | | | | RQD 95% |
| 248.7 | | | | | | | 249 | | | | |
| 16.5 | End of borehole | | | | | | | | | | |

* Borehole charged with drilling water

C.F.H.S.A. denotes continuous flight hollow stem augers



Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF AUGER PROBE No MN-4 1 of 1 METRIC

Co-ords: 5 101 335.2 N; 316 792.5 E

**G.W.P.** 323-00-00 **LOCATION** Hwy 11, Sta. 20+179, o/s 23m Lt. NBL **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.S.

**DATUM** Geodetic **DATE** December 08, 2011 **CHECKED BY** C.N.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 263.4 | Ground Surface | | | | | | | | | | |
| 0.0 | Topsoil | | 1 | SS | 3 | | 263 | ○ | ○ | | |
| | Silty sand topsoil inclusions | | | | | | | | | | |
| | Loose Brown Moist | | 2 | SS | 6 | | | | ○ | | |
| | organics clayey silt pockets | | 3 | SS | 7 | | 262 | | ○ | | |
| | Grey | | | | | | | | | | |
| | Clayey silt, trace sand | | | | | | 261 | | | | |
| | Stiff Brown Moist | | 4 | SS | 12 | | | | | | |
| | Sand trace silt, trace gravel | | 5 | SS | 19 | | 260 | | | | 4 94 (2) |
| | Compact to loose Reddish brown Moist | | | | | | | | | | |
| | (FILL) | | 6 | SS | 6 | | 259 | | ○ | | |
| 258.9 | | | | | | | | | | | |
| 4.5 | Topsoil | | | | | | | | | | |
| 258.4 | | | 7 | SS | 2 | ▽* | | | ○ | | |
| 5.0 | Sand, some silt trace clay, trace gravel | | | | | | 258 | | | | |
| | Loose Brown Wet | | 8 | SS | 6 | | | | ○ | | |
| 257.4 | | | | | | | | | | | |
| 6.0 | Sand, with silt some gravel, trace clay cobbles and boulders | | 9 | SS | 21 | | 257 | | ○ | | |
| | Loose to compact Brown Wet | | | | | | | | | | |
| | (TILL) | | 10 | SS | 22 | ▼* | 256 | | ○ | | 12 59 24 5 |
| 255.9 | | | | | | | | | | | |
| 7.5 | End of borehole | | | | | | | | | | |
| | Refusal on probable bedrock | | | | | | | | | | |

* 2011 12 08

▽ Water level observed during drilling

▼ Water level measured after drilling



+7, ×5 : Numbers refer to Sensitivity

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

# RECORD OF AUGER PROBE No MN-AP-1 1 of 1

**METRIC**

Co-ords: 5 101 287.3 N; 316 812.2 E

**G.W.P.** 323-00-00 **LOCATION** Hwy 11, Sta. 20+127, o/s 22m Lt. NBL **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.S.

**DATUM** Geodetic **DATE** December 13, 2011 **CHECKED BY** C.N.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ WATER CONTENT (%) 20 40 60 | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 257.8 | Ground Surface | | | | | | | | | | |
| 0.0 / 257.5 | Topsoil | | 1 | SS | 2 | | | | | | |
| 0.3 | Silty sand<br>trace gravel, organics<br>Loose Brown Moist | | | | | | 257 | | | | |
| 256.6 / 1.2 | Silt<br>some clay, trace sand<br>Loose Grey Moist | | 2 | SS | 7 | ▽* | 256 | | | | |
| | | | | | | | 255 | | | | |
| | | | 3 | SS | 25 | | | | | | |
| 253.8 | | | | | | | 254 | | | | |
| 4.0 | End of auger probe<br>Refusal on probable boulder | | | | | | | | | | |

* 2011 12 13

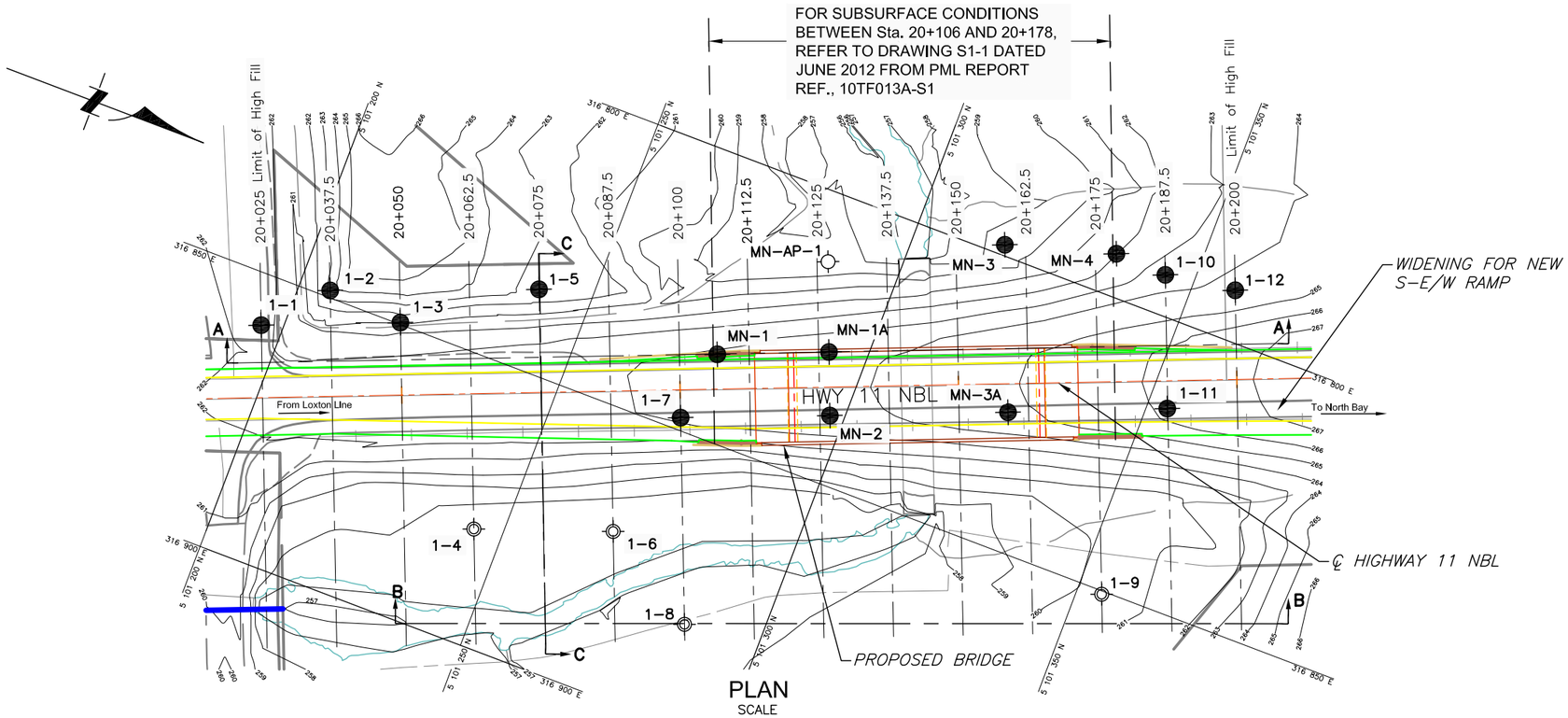
▽ Water level observed during drilling



+7 , ×5 : Numbers refer to Sensitivity

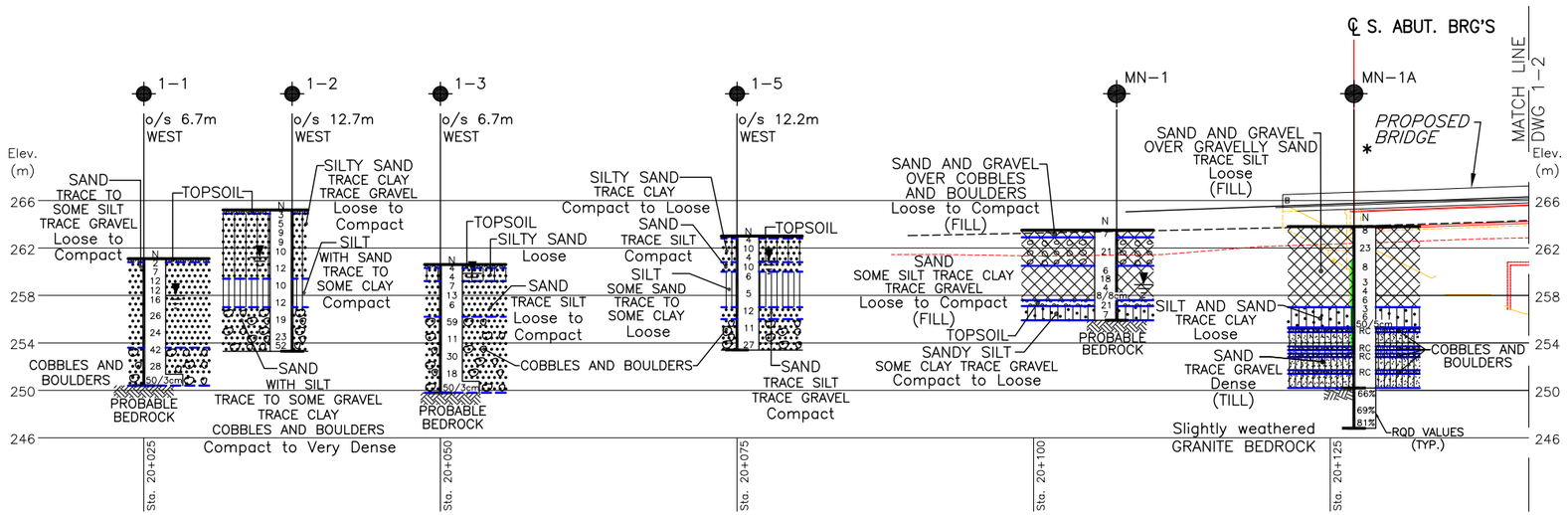
20 / 15 — 5 / 10 (%) STRAIN AT FAILURE

FOR SUBSURFACE CONDITIONS BETWEEN Sta. 20+106 AND 20+178, REFER TO DRAWING S1-1 DATED JUNE 2012 FROM PML REPORT REF., 10TF013A-S1




PLAN

SCALE 10 0 10 20m




PROFILE A-A

SCALE 5 0 5 10m

NOTES:

1. DRAWINGS 1–1 AND 1–2 SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
2. SEE DRAWING 1–2 FOR PROFILE B–B AND SECTION C–C.
3. THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
4. DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

(Legend Continued)

| BH No | ELEVATION | NORTHINGS | EASTINGS |
|---|---|---|---|
| MN–1 | 263.5 | 5 101 274.6 | 316 834.8 |
| MN–1A | 263.8 | 5 101 293.2 | 316 827.3 |
| MN–2 | 263.9 | 5 101 297.4 | 316 837.9 |
| MN–3 | 260.1 | 5 101 315.9 | 316 798.1 |
| MN–3A | 265.2 | 5 101 327.1 | 316 826.0 |
| MN–4 | 263.4 | 5 101 336.4 | 316 795.4 |
| MN–AP–1 | 257.8 | 5 101 287.3 | 316 812.2 |

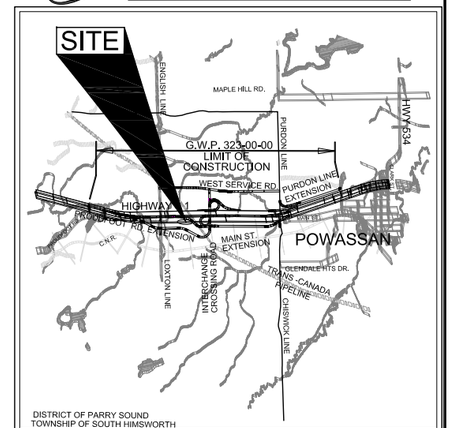
REF AECOM Drawings: Hwy11-Design.dwg; X-60157537-C-Hwy11-Base.dwg dated September 2010

CONT No
GWP No 323-00-00
WP No

AREA 1 Sta. 20+025 to 20+200
HIGHWAY 11 – NORTHBOUND LANE
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET 1

Peto MacCallum Ltd.
CONSULTING ENGINEERS




LEGEND

- Borehole
- Pavement Borehole
- Auger Probe
- N Blows/0.3m (Std. Pen Test, 475 J/blow)
- CONE Blows/0.3m (60 Cone, 475 J/blow)
- WL at time of investigation Dec. 2011
- Head
- ARTESIAN WATER Encountered
- PIEZOMETER

| BH No | ELEVATION | STA. | o/s NBL |
|---|---|---|---|
| 1–1 | 261.1 | 20+025 | 13.0m Lt. |
| 1–2 | 265.2 | 20+037.5 | 19.0m Lt. |
| 1–3 | 260.6 | 20+050 | 13.0m Lt. |
| 1–4 | 257.0 | 20+050 | 24.3m Rt. |
| 1–5 | 263.0 | 20+062.5 | 18.5m Lt. |
| 1–6 | 257.1 | 20+075 | 25.2m Rt. |
| 1–7 | 263.1 | 20+100 | 5.0m Rt. |
| 1–8 | 257.6 | 20+100 | 42.1m Rt. |
| 1–9 | 260.7 | 20+175 | 38.1m Rt. |
| 1–10 | 264.1 | 20+187.5 | 19.0m Lt. |
| 1–11 | 266.6 | 20+187.5 | 5.0m Rt. |
| 1–12 | 264.4 | 20+200 | 16.0m Lt. |

(Legend Continues)

– 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 |
|---|---|---|
| | | |

REGISTERED PROFESSIONAL ENGINEER C M P Nascimento Province of Ontario Feb. 20, 2015

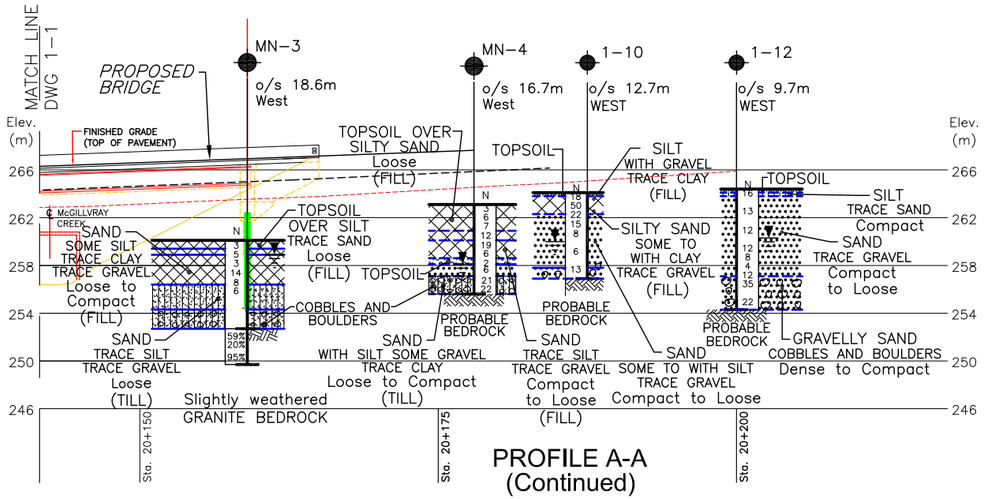
REGISTERED PROFESSIONAL ENGINEER B. R. GRAY Feb. 20, 2015 Province of Ontario

Geocres No. 31L–184

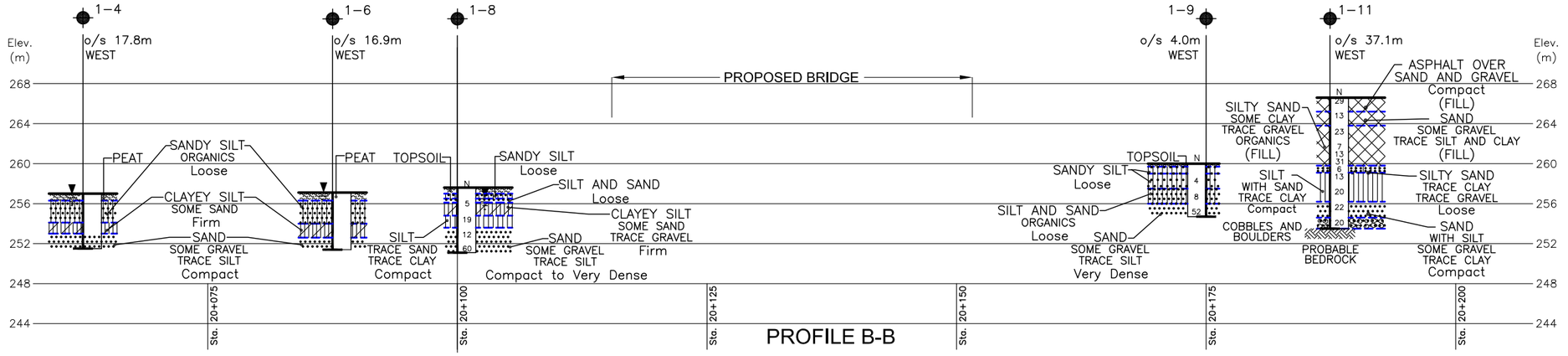
| | | | | | |
|---|---|---|---|---|---|
| HWY No | 11 | | | DIST | North Bay |
| SUBM'D | NA | CHECKED | AD | DATE | FEB. 20, 2015 |
| DRAWN | NA | CHECKED | BRG | APPROVED | CN |
| SITE | | | | | |
| DWG | 1–1 | | | | |

| | |
|---|---|
| CONT No<br>GWP No 323-00-00 | |
| AREA 1 – Sta. 20+025 to 20+200<br>HIGHWAY 11 – NORTHBOUND LANE<br>SOIL STRATA | SHEET<br>2 |

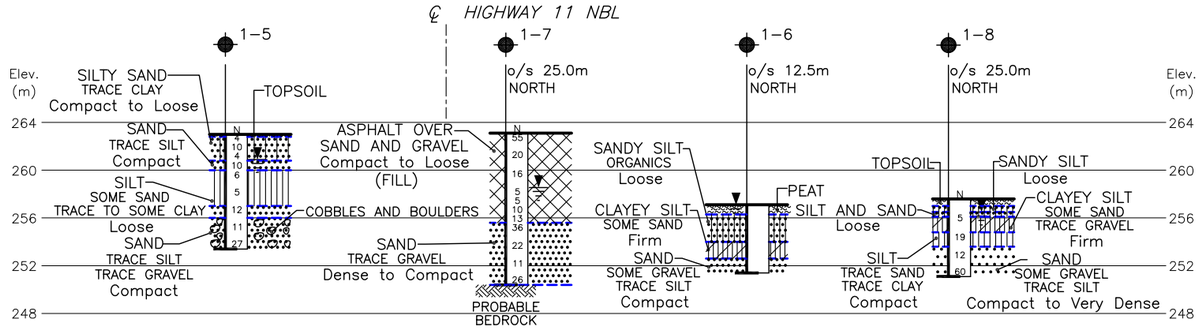
Peto MacCallum Ltd.
CONSULTING ENGINEERS




## PROFILE A-A (Continued)

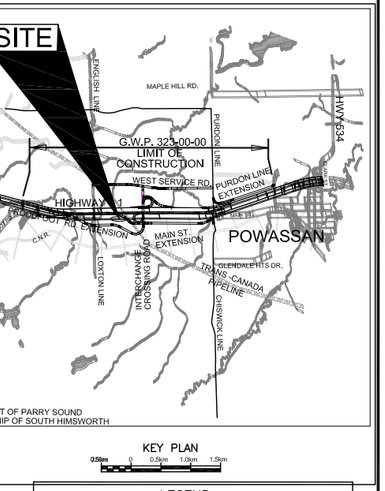



## PROFILE B-B




## SECTION C-C

SCALE
5 0 5 10m




### LEGEND

- Borehole
- Borehole and Cone
- Pavement Borehole
- N Blows/0.3m (Std. Pen Test, 475 J/blow)
- CONE Blows/0.3m (60 Cone, 475 J/blow)
- WL at time of investigation Dec. 2011
- Head ARTESIAN WATER Encountered
- PIEZOMETER

| BH No | ELEVATION | STA. | o/s NBL |
|---|---|---|---|
| SEE DWG. 1–1 FOR DETAILS | | | |

**– NOTE –**

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

NOTES:

1. DRAWINGS 1–1 AND 1–2 SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
2. SEE DRAWING 1–1 FOR PLAN, PROFILE A–A (CONTINUED) AND LOCATIONS OF B–B AND SECTION C–C.
3. THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
4. DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

REGISTERED PROFESSIONAL ENGINEER C M P Nascimento Feb. 20, 20 PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER B. R. GRAY Feb. 20, 2015 PROVINCE OF ONTARIO

REF AECOM Drawings:
Hwy11-Design.dwg; X-60157537-C-Hwy11-Base.dwg
dated September 2010

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

**Geocres No. 31L–184**

| | | | | | |
|---|---|---|---|---|---|
| HWY No | 11 | | | DIST | North Bay |
| SUBM'D | NA | CHECKED AD | DATE FEB. 20, 2015 | SITE | |
| DRAWN | NA | CHECKED BRG | APPROVED CN | DWG | 1–2 |

# Area 6A – New E/W-S Ramp, Sta. 21+075 to 21+125

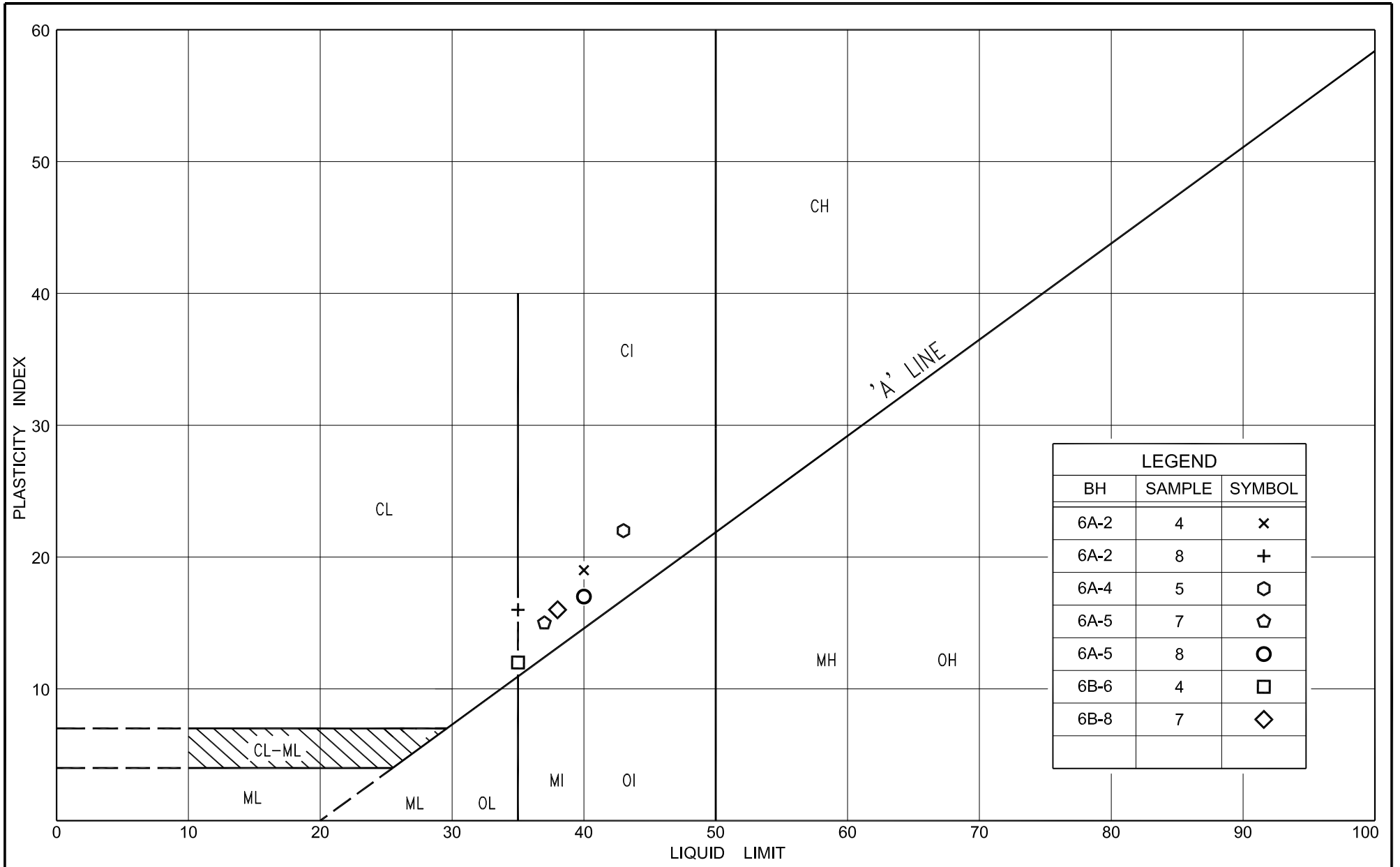
Figures 6A-PC-1 to 6A-PC-3 – Plasticity Charts

Figures 6A-GS-1 to 6A-GS-5 – Grain Size Distribution Analyses

Figures 6A-C-1 – Consolidation Test Results

Record of Borehole Sheets – 6A-1 to 6A-5, 6B-6 and 6B-8

Drawing 6A-1 – Borehole Locations and Soil Strata

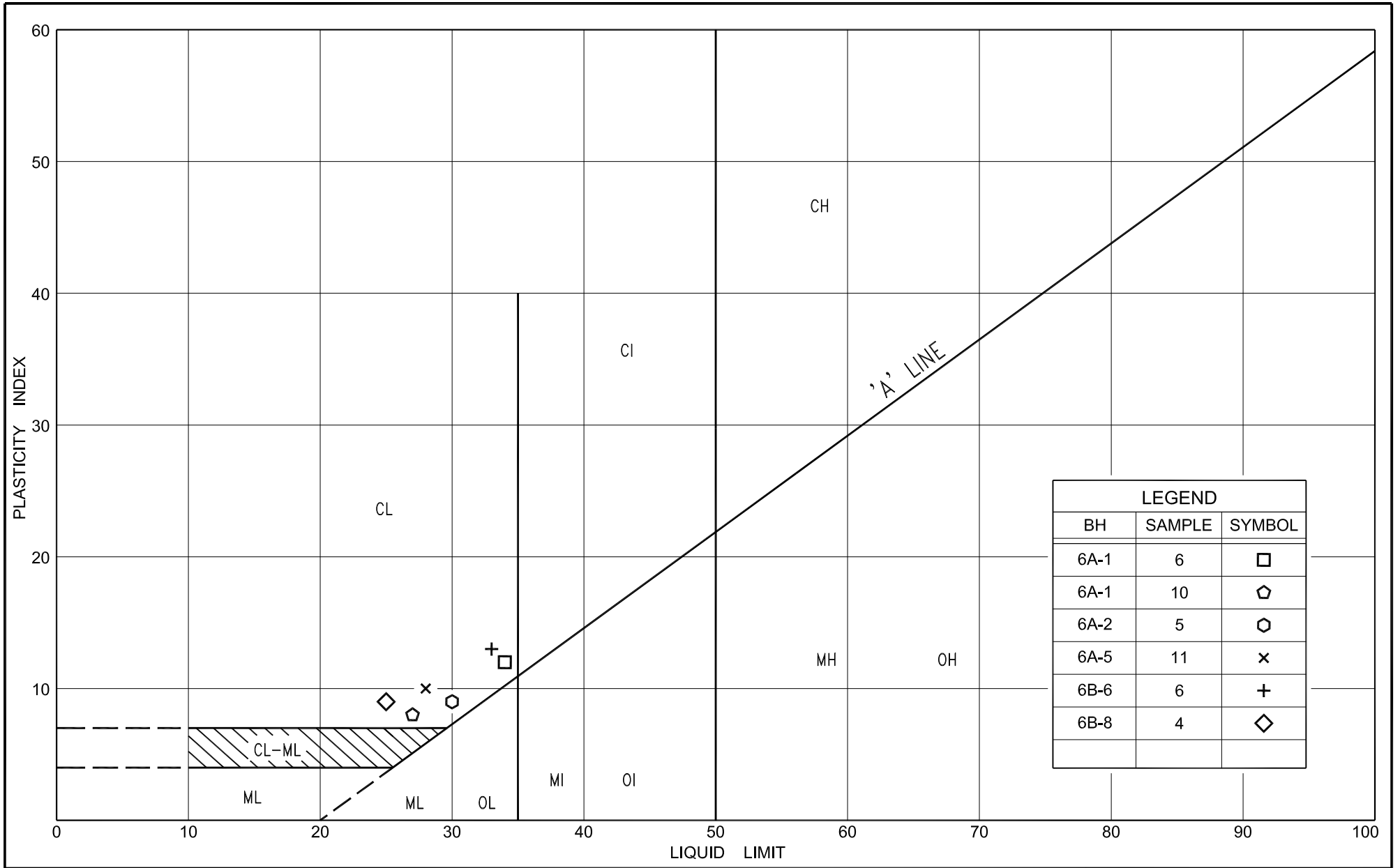



Ontario

# PLASTICITY CHART

SILTY CLAY, trace sand (CI)

| | |
|---|---|
| FIG No. | 6A-PC-1 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

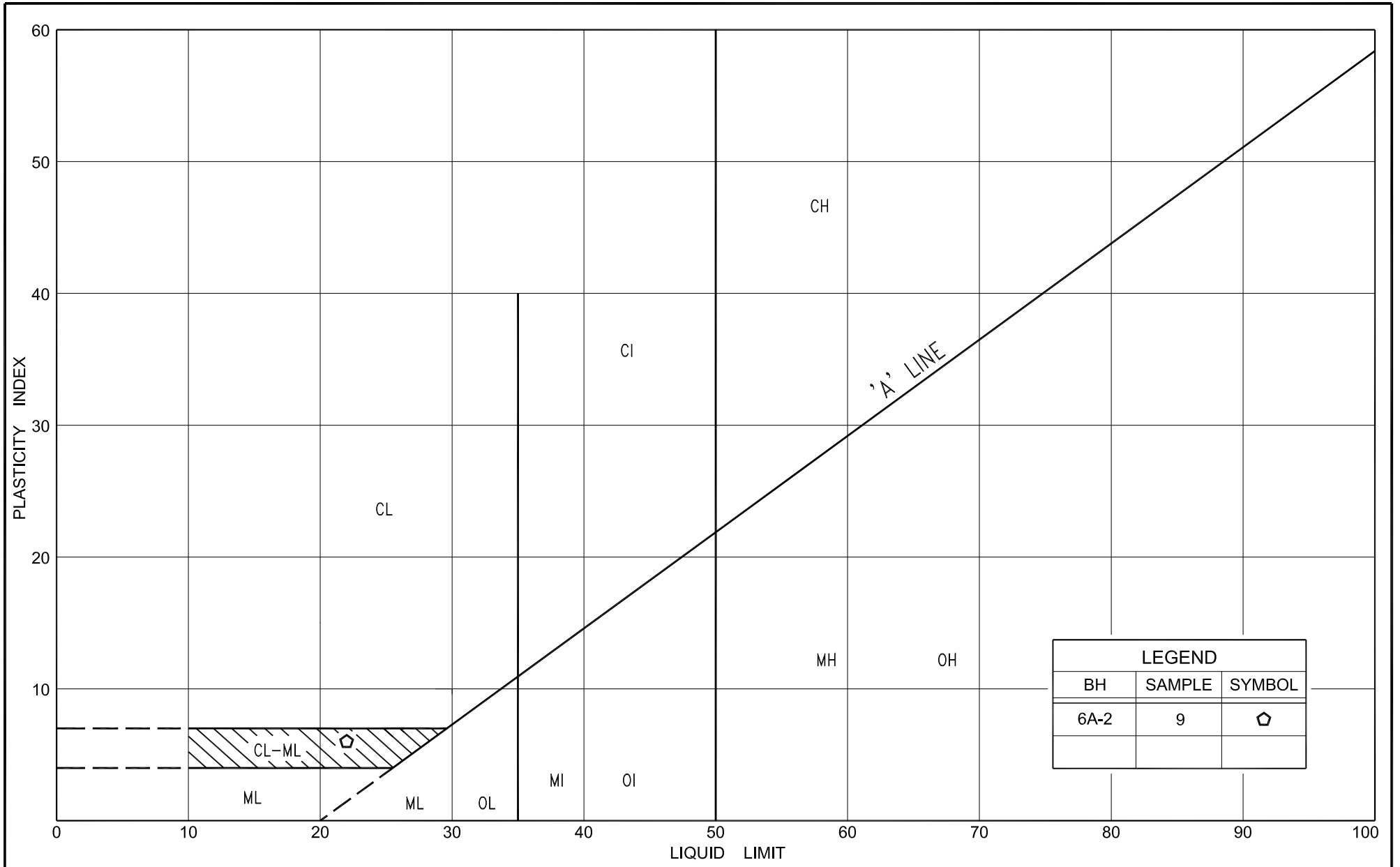



Ontario

# PLASTICITY CHART

CLAYEY SILT, trace to with sand (CL)

| | |
|---|---|
| FIG No. | 6A-PC-2 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

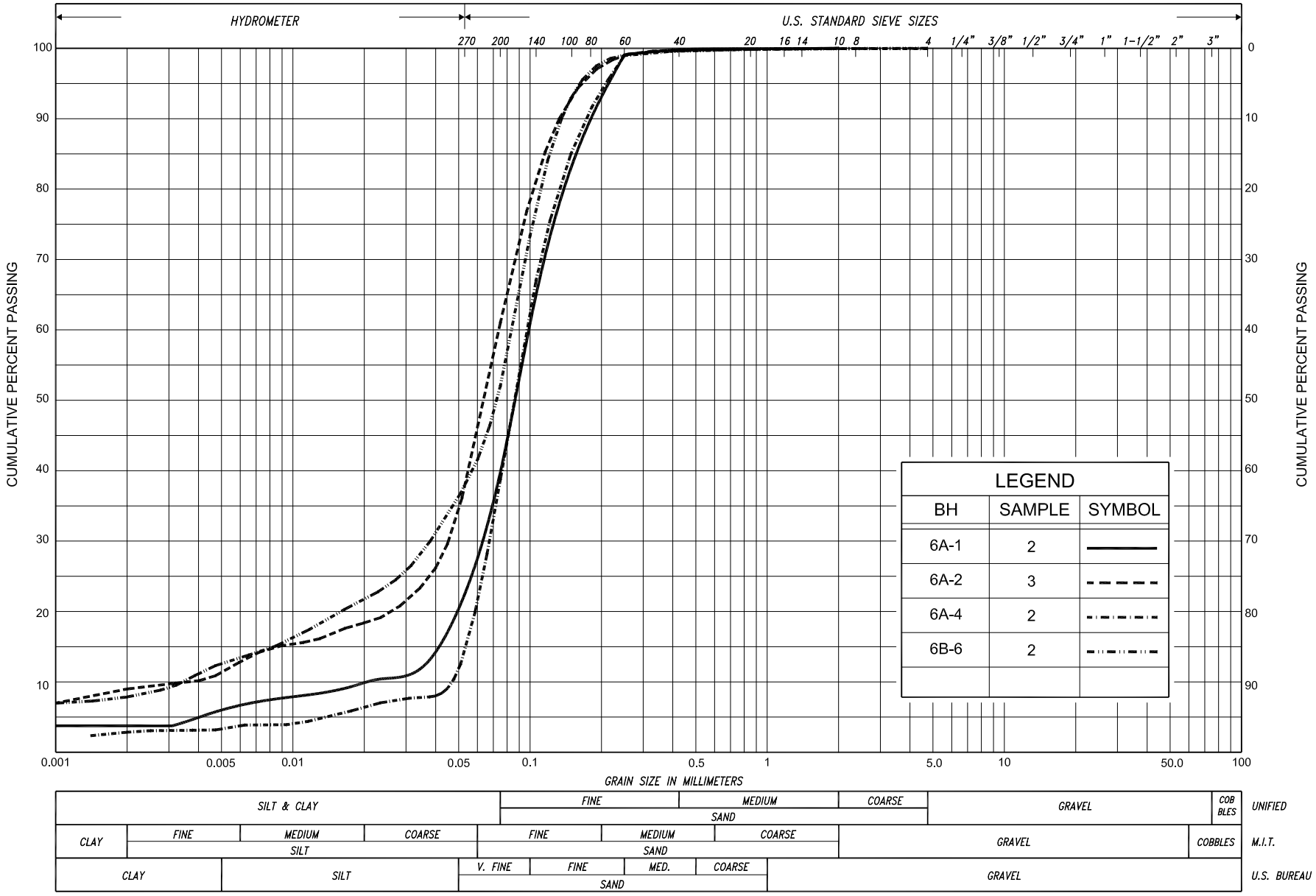



Ontario

# PLASTICITY CHART

SILT, trace to some sand, trace to some clay (CL-ML)

| | |
|---|---|
| FIG No. | 6A-PC-3 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

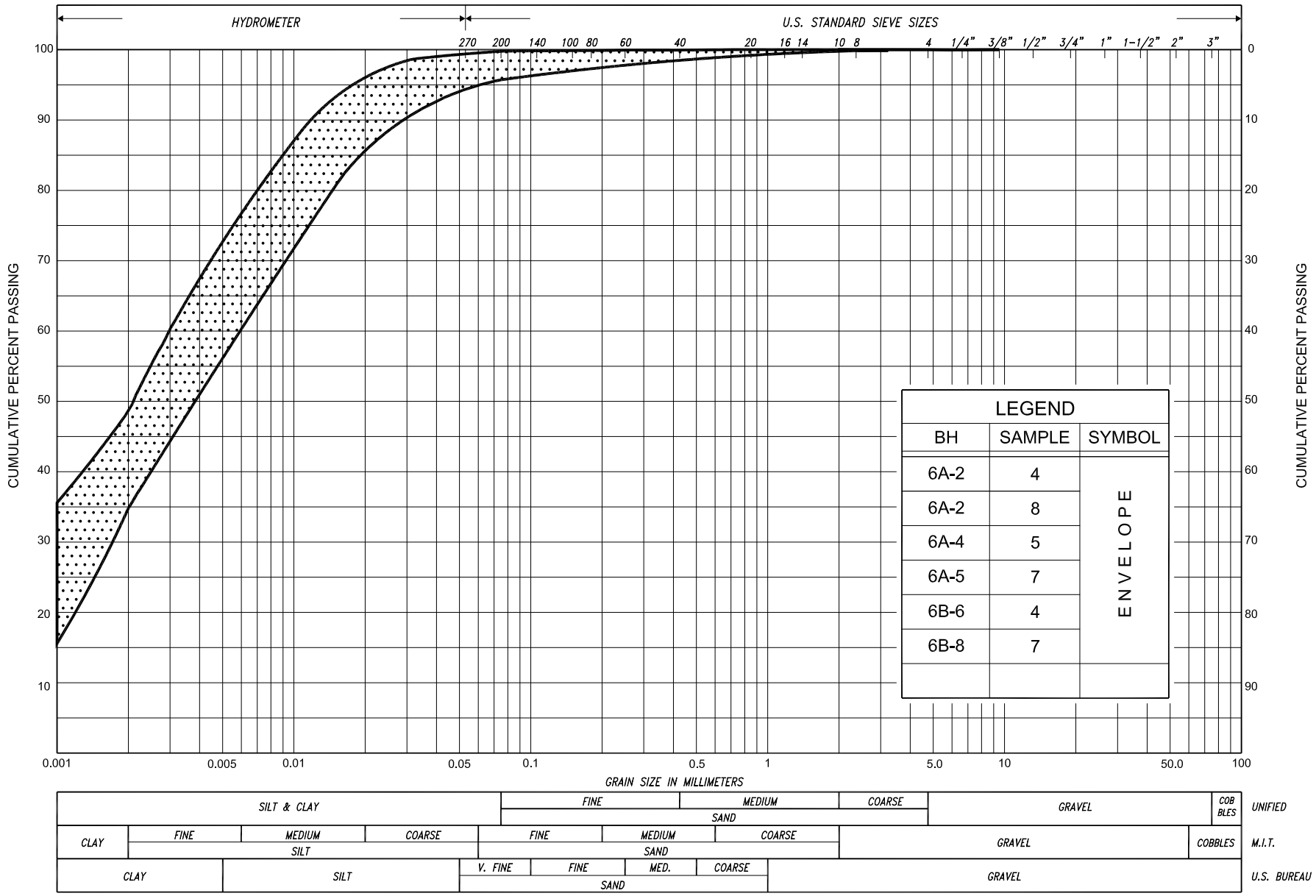



Ontario

# GRAIN SIZE DISTRIBUTION

SILTY SAND TO SANDY SILT, trace clay

| | |
|---|---|
| FIG No. | 6A-GS-1 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

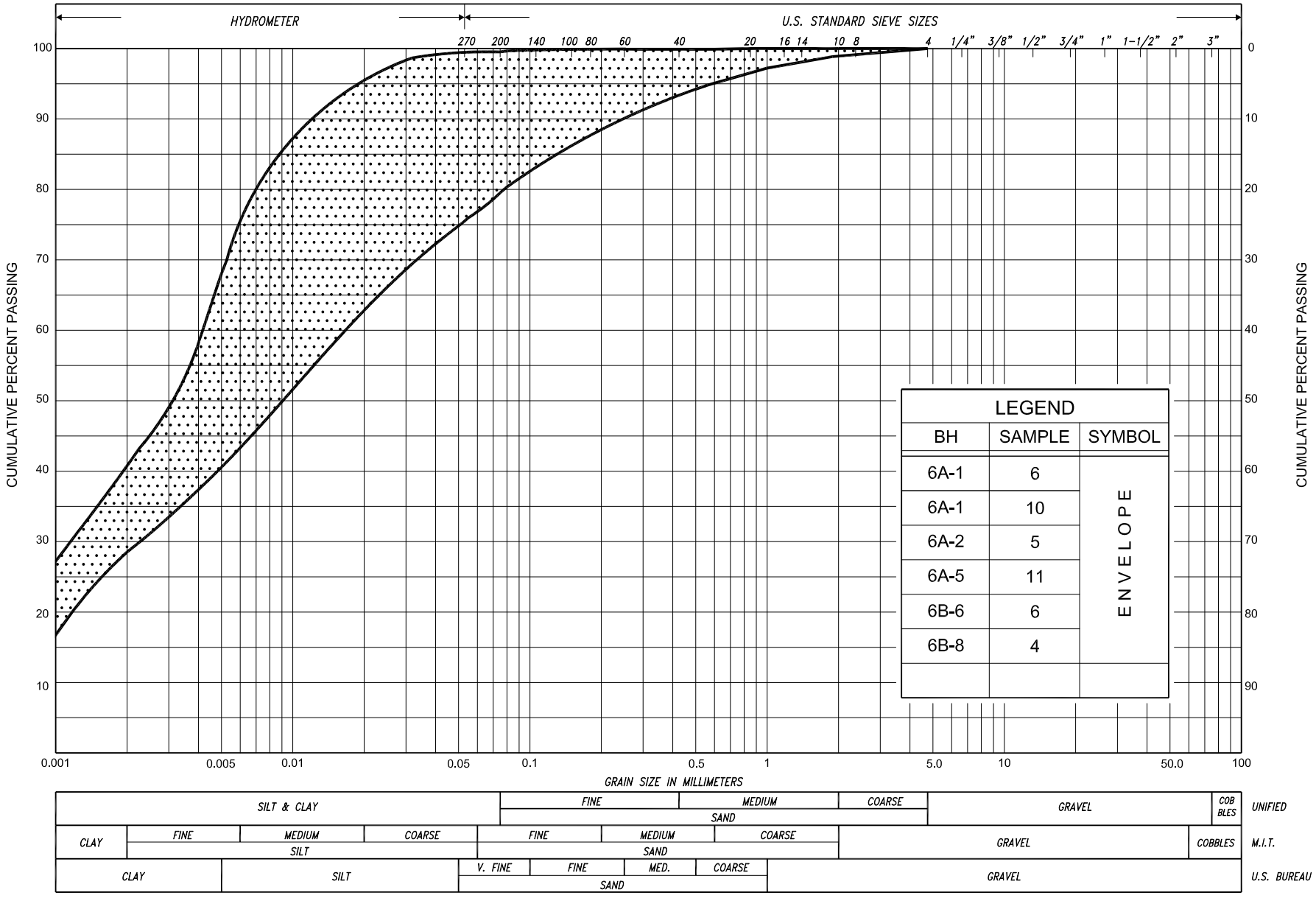



Ontario

# GRAIN SIZE DISTRIBUTION

SILTY CLAY, trace sand (CI)

| | |
|---|---|
| FIG No. | 6A-GS-2 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

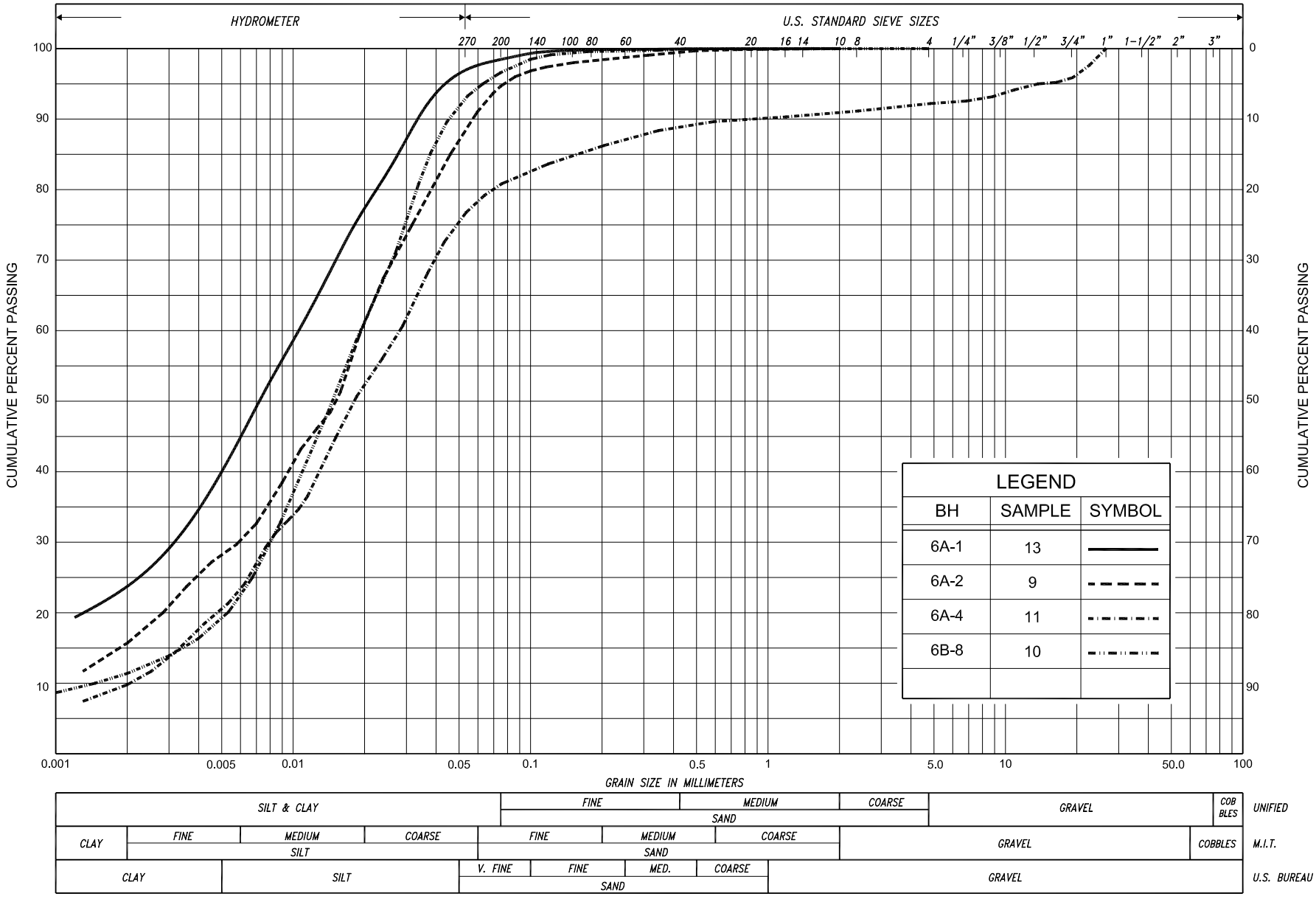



Ontario

# GRAIN SIZE DISTRIBUTION

CLAYEY SILT, trace to with sand (CL)

| | |
|---|---|
| FIG No. | 6A-GS-3 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

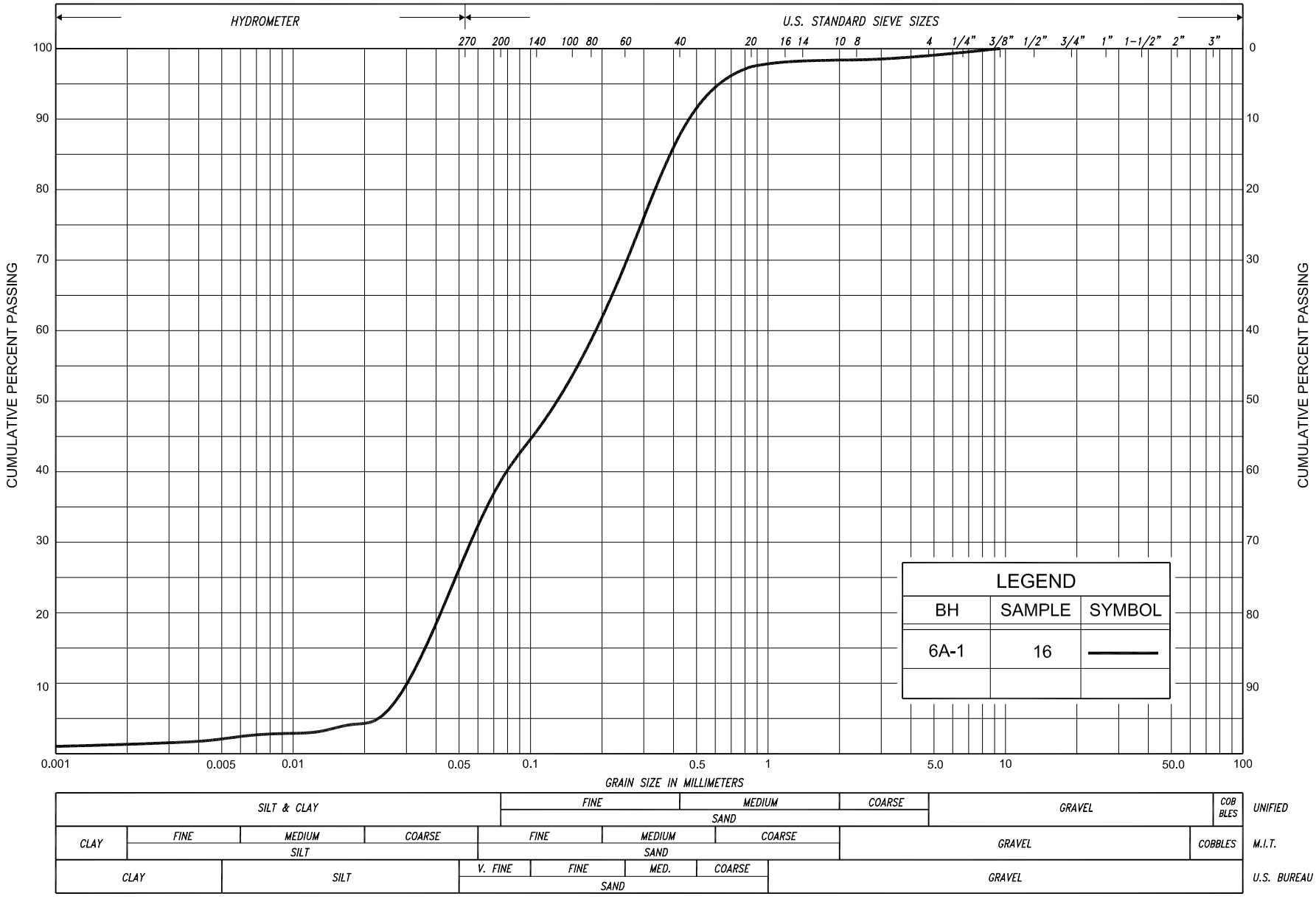



Ontario

# GRAIN SIZE DISTRIBUTION

SILT, trace to some sand, trace to some clay (CL-ML)

| | |
|---|---|
| FIG No. | 6A-GS-4 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |




Ontario

# GRAIN SIZE DISTRIBUTION

SILTY SAND, trace clay, trace gravel

| | |
|---|---|
| FIG No. | 6A-GS-5 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

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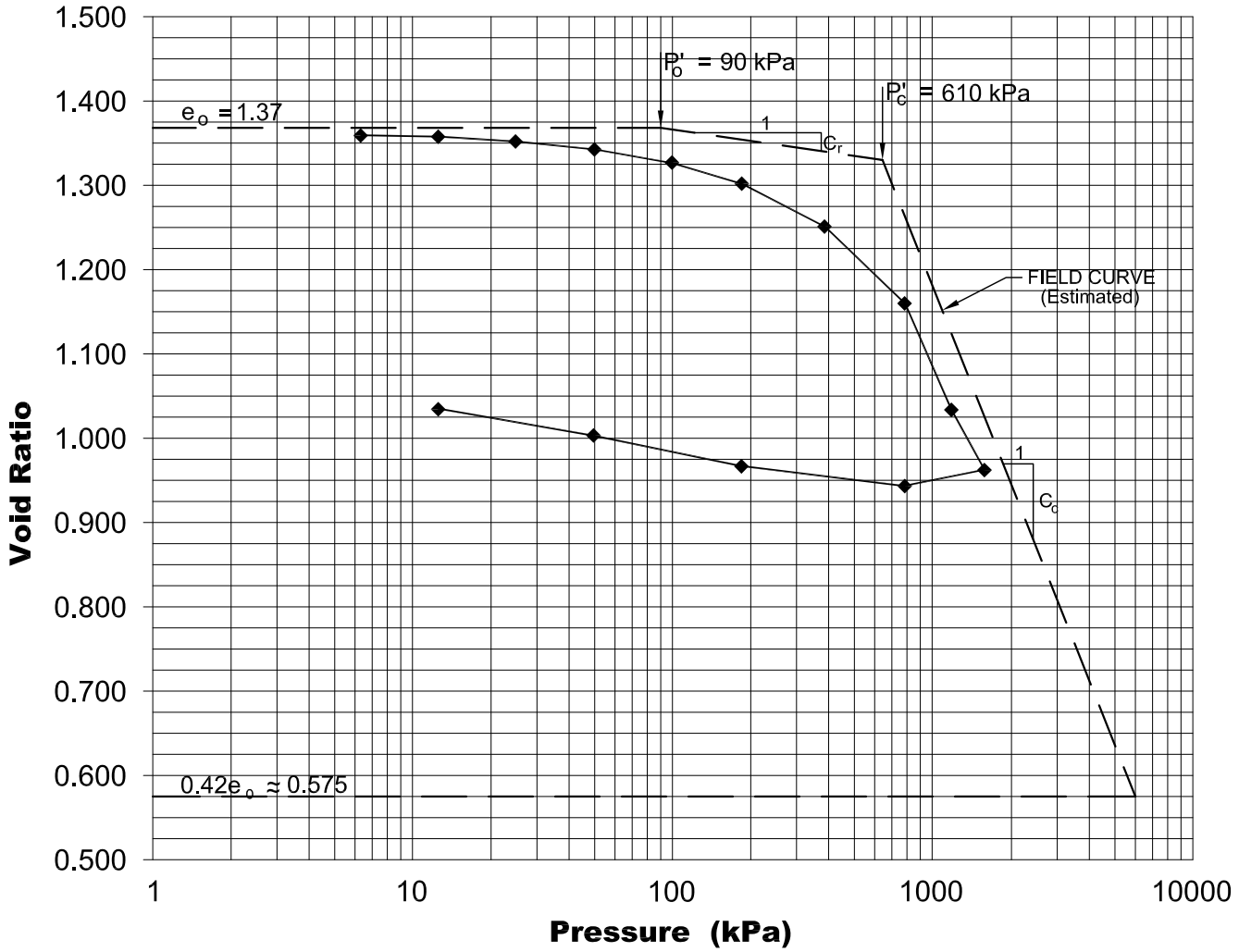
Laboratory Consolidation Test Results

Area 6A, Borehole 6A-5, Sample TW-8
Location Sta. 21+125, 2.4 m Rt. of Lt. EP, Depth 5.2 - 5.8 m

## Void Ratio versus Log of Pressure




| SOIL TYPE: SILTY CLAY | | | |
|---|---|---|---|
| $e_o$ = 1.37 | $P'_o$ = 90 kPa | $W_L$ = 40 | FIGURE No: 6A-C-1 |
| $W_o$ = 50% | $P'_c$ = 610 kPa | $W_P$ = 23 | HIGHWAY: 11 |
| $\gamma$ = 17.4 kN/m$^3$ | $C_c$ = 0.76 | PI = 17 | TOWNSHIP: POWASSAN |
| | $C_r$ = 0.04 | | G.W.P. 323-00-00 |

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. 6A-1 1 of 1 METRIC

Hwy 11/Interchange Crossing Road, E/W-S Ramp

**G.W.P.** 323-00-00 **LOCATION** Sta. 21+075, o/s 2.4m Rt of Lt. EP **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 19, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ / WATER CONTENT (%) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 274.1 | Ground Surface | | | | | * | 274 | | | | |
| 0.0 / 273.8 | Topsoil | | 1 | SS | 4 | | | | | | |
| 0.3 | Silty sand, trace clay<br>Very loose Brown Wet<br>to compact | | | | | | | | | | |
| | sandy silt seams | | 2 | SS | 2 | | 273 | | | | 0 60 36 4 |
| | clayey silt layers | | 3 | SS | 11 | | | | | | |
| 271.9 | | | | | | | 272 | | | | |
| 2.2 | Clayey silt, trace sand<br>silt seams<br>Firm to Reddish Wet<br>very stiff brown | | 4 | SS | 7 | | | | | | |
| | | | 5 | SS | 4 | | 271 | | | | |
| | Brown | | 6 | SS | 2 | | 270 | | | | 0 1 59 40 |
| | | | | FV | | | | 10 | | | |
| | | | 7 | SS | 2 | | 269 | | | | |
| | Grey | | | FV | | | | > | | | |
| | | | 8 | SS | 2 | | | 6 | | | |
| | | | | FV | | | 268 | | | | |
| | | | 9 | SS | 2 | | | 6 | | | |
| | | | | FV | | | | | | | |
| | silt layers | | 10 | SS | 2 | | 267 | | | | 0 1 68 31 |
| 266.2 | | | | | | | | | | | |
| 7.9 | Silt<br>trace clay, trace sand<br>clayey silt layers<br>Loose to Brown Wet<br>compact | | 11 | SS | 4 | | 266 | | | | |
| | | | 12 | SS | 7 | | | | | | |
| | | | 13 | SS | 5 | | 265 | | | | 0 3 73 24 |
| | some clay | | 14 | SS | 10 | | 264 | | | | |
| | sandy silt seams<br>Moist | | 15 | SS | 9 | | | | | | |
| 263.0 | | | | | | | 263 | | | | |
| 11.1 | Silty sand<br>trace clay, trace gravel<br>Dense to Brown Moist<br>very dense | | | | | | | | | | |
| | | | 16 | SS | 39 | | 262 | | | | 2 60 36 2 |
| 260.3 | | | 17 | SS | 50/10cm | | 261 | | | | |
| 13.8 | End of borehole<br>Refusal on probable bedrock<br>Sample 17: Sampler bouncing<br>* Borehole dry | | | | | | | | | | |

ON MTO_VER3 NEW LOGO 10TF013A-AREA 6.GPJ ON_MOT.GDT 8/7/2014 3:19:34 PM

+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. 6A-2 1 of 1 METRIC

Hwy 11/Interchange Crossing Road, E/W-S Ramp

**G.W.P.** 323-00-00 **LOCATION** Sta. 21+092, o/s 16.6m Lt. of Lt. EP **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 18, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ WATER CONTENT (%) 20 40 60 | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 270.5 | Ground Surface | | | | | | | | | | |
| 0.0 / 270.2 | Topsoil | | 1 | SS | 7 | ▽* | 270 | | | | |
| 0.3 | Sandy silt, trace clay<br>Compact Brown Wet<br>Grey<br>silt layers | | 2 | SS | 11 | | | | | | |
| | | | 3 | SS | 13 | | 269 | | | | 0 39 52 9 |
| 268.4 | | | | | | | | | | | |
| 2.1 | Silty clay, trace sand<br>silt layers<br>Soft to firm Grey Moist<br>clayey silt layers | | 4 | SS | 3 | | 268 | | | | 0 4 50 46 |
| | | | 5 | SS | 4 | | 267 | | | | 0 2 61 37 |
| | | | 6 | SS | 4 | | | | | | |
| | silt seams/partings | | 7 | SS | 6 | | 266 | | | | |
| | | | | | | | 265 | | | | |
| | | | 8 | SS | 4 | | 264 | | | | 0 1 61 38 |
| 263.5 | | | | | | | | | | | |
| 7.0 | Silt<br>some clay, trace sand<br>clayey silt layers<br>Loose Grey Wet<br>Brown | | 9 | SS | 9 | ▼* | 263 | | | | 0 5 79 16 |
| | | | | | | | 262 | | | | |
| 261.1 | | | 10 | SS | 17 | | 261 | | | | |
| 9.4 | Sand, trace silt<br>Compact Brown Wet | | | | | | | | | | |
| 260.3 | | | | | | | | | | | |
| 10.2 | End of borehole<br>Refusal on probable bedrock | | | | | | | | | | |

* 2012 01 18

▽ Water level observed during drilling

▼ Water level measured after driling

■ Penetrometer test

+7, ×5 : Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. 6A-3 1 of 1 METRIC

Hwy 11/Interchange Crossing Road, E/W-S Ramp

**G.W.P.** 323-00-00 **LOCATION** Sta. 21+100, o/s 2.4m Rt. of Lt. EP **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 17, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 270.9 | Ground Surface | | | | | | | | | | |
| 0.0 / 270.6 | Topsoil | | 1 | SS | 2 | | | | ○ | | |
| 0.3 | Silty sand<br>Loose to compact Brown Wet | | 2 | SS | 17 | | 270 | | ○ | | |
| 268.8 | | | 3 | SS | 7 | | 269 | | ○ | | |
| 2.1 | Silty clay, trace sand<br>Stiff to firm Brown Wet | | 4 | SS | 4 | | 268 | ■ | ○ | | |
| | | | 5 | SS | 4 | | | ■ | ○ | | |
| | | | 6 | SS | 4 | | 267 | ■ | ○ | | |
| | silt seams/partings | | | | | ▽* | | | | | |
| | | | 7 | SS | 5 | | 266 | ■ | ○ | | |
| | | | 8 | SS | 2 | | 265 | | ○ | | |
| | | | 9 | SS | 5 | | | | ○ | | |
| 263.4 | | | 10 | SS | 7 | | 264 | | ○ | | |
| 7.5 | Silt, trace sand clay seams<br>Compact Brown Wet | | 11 | SS | 14 | ▼* | 263 | | ○ | | |
| 262.1 | | | | | | | | | | | |
| 8.8 | Sand, trace gravel<br>Compact Reddish brown Moist | | 12 | SS | 19 | | 262 | | ○ | | |
| 260.8 | | | | | | | 261 | | | | |
| 10.1 | End of borehole<br>Refusal on probable bedrock | | | | | | | | | | |

* 2012 01 17

▽ Water level observed during drilling

▼ Water level measured after driling

■ Penetrometer test



+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. 6A-4 1 of 1 METRIC

Hwy 11/Interchange Crossing Road, E/W-S Ramp

**G.W.P.** 323-00-00 **LOCATION** Sta. 21+112.5, o/s 16.1m Lt. of Lt. EP **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 09, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ / WATER CONTENT (%) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 271.3 | Ground Surface | | | | | | | | | | |
| 0.0 / 271.0 | Topsoil | | 1 | SS | 3 | | 271 | | | | |
| 0.3 | Silty sand, organics<br>Loose to compact Brown Moist | | 2 | SS | 9 | | | | | | 0 61 36 3 |
| | | | 3 | SS | 16 | | 270 | | | | |
| 269.0 | silt layers | | | | | | | | | | |
| 2.3 | Silty clay, trace sand<br>Firm to stiff Brown Wet | | 4 | SS | 9 | | 269 | | | | |
| | | | 5 | SS | 4 | | 268 | | | | 0 1 50 49 |
| | Grey | | 6 | SS | 3 | | | | | | |
| | | | | FV | | | 267 | 9 | | | |
| | | | 7 | SS | 4 | | | | | | |
| | | | 8 | SS | 4 | | 266 | | | | |
| | | | | FV | | | | 8 | | | |
| | | | 9 | SS | 4 | | 265 | | | | |
| | clayey silt layers | | | | | ▼* | 264 | | | | |
| | | | 10 | SS | 7 | ▽* | | | | | |
| 262.8 | | | | | | | 263 | | | | |
| 8.5 | Silt<br>some sand, trace clay<br>silty sand layers<br>Compact Grey Moist | | 11 | SS | 10 | | 262 | | | | 8 11 71 10 |
| | trace gravel<br>silty sand layers<br>cobbles and boulders | | | | | | | | | | |
| 260.8 | | | | | | | 261 | | | | |
| 10.5 | End of borehole<br>Refusal on probable bedrock | | | | | | | | | | |

* 2012 01 09

▽ Water level observed during drilling

▼ Water level measured after drilling

+7, ×5 : Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. 6A-5 1 of 1 METRIC

Hwy 11/Interchange Crossing Road, E/W-S Ramp

**G.W.P.** 323-00-00 **LOCATION** Sta. 21+125, o/s 2.4m Rt. of Lt. EP **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 10, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT w / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 270.9 | Ground Surface | | | | | | | | | | |
| 0.0 / 270.6 | Topsoil | | 1 | SS | 3 | | 270 | | | | |
| 0.3 | Silty sand<br>Very loose Brown Wet<br>to loose | | 2 | SS | 3 | | | | | | |
| 268.8 | | | 3 | SS | 9 | | 269 | | | | |
| 2.1 | Silt<br>trace clay, trace sand<br>Compact Brown Wet | | 4 | SS | 11 | | 268 | | | | |
| 267.8 | | | | | | | | | | | |
| 3.1 | Silty clay, trace sand<br>silt layers<br>Firm to Reddish Wet<br>very stiff brown | | 5 | SS | 7 | | 267 | | | | |
| | | | | FV | | | | | | | |
| | | | 6 | SS | 10 | | | | | | |
| | Grey | | 7 | SS | 4 | | 266 | | | | 0 1 63 36 |
| | | | | FV | | | | 9 | | | |
| | | | 8 | SS TW | 5 ** | | 265 | | | 17.4 | |
| | | | 9 | SS | 4 | | | | | | |
| | clayey silt layers | | | FV | | | | 10 | | | |
| | | | 10 | SS | 4 | | 264 | | | | |
| | | | 11 | SS | 7 | ▽* | 263 | 5 | | | 0 2 61 27 |
| 262.4 | | | | FV | | | | | | | |
| 8.5 | Silt<br>trace sand, trace clay<br>layers of wet silty sand | | 12 | SS | 33 | | 262 | | | | |
| 261.8 | | | | | | | | | | | |
| 9.1 | Dense Grey Wet<br>Sand with gravel<br>cobbles and boulders | | 13 | SS | 50/13cm | | | | | | |
| 261.1 | | | | | | | | | | | |
| 9.8 | Very Dense Reddish Wet<br>brown | | | | | | | | | | |
| | End of borehole | | | | | | | | | | |
| | Refusal on probable bedrock | | | | | | | | | | |
| | Sample 13: Sampler bouncing | | | | | | | | | | |

* 2012 01 10

** TW sample obtained on October 23, 2012 in new borehole at approximately the same SS sample depth and location

■ Penetrometer test

▽ Water level observed during drilling



+7, ×5: Numbers refer to Sensitivity

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

Ontario

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# RECORD OF BOREHOLE No. 6B-6 1 of 1 METRIC

Hwy 11/Interchange Crossing Road, N-E/W Ramp

**G.W.P.** 323-00-00 **LOCATION** Sta. 20+940, o/s 2.4m Lt. of Rt. EP **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 20, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | REMARKS & GRAIN SIZE DISTRIBUTION (%): GR SA SI CL |
|---|---|---|---|---|---|---|---|---|
| 269.5 | Ground Surface | | | | | | | |
| 0.0 / 269.2 | Topsoil | | 1 | SS | 3 | | 269 | |
| 0.3 | Sand and silt, trace clay<br>Very loose Grey Wet | | 2 | SS | 3 | | | 0 48 44 8 |
| 268.1 | | | | | | | 268 | |
| 1.4 | Silty clay, trace sand<br>Stiff to firm Mottled greyish brown Wet | | 3 | SS | 5 | | | |
| | | | 4 | SS | 5 | | 267 | 0 1 64 35 |
| | Brown | | 5 | SS | 4 | | 266 | |
| | clayey silt layers | | 6 | SS | 3 | ▽* | 265 | 0 1 58 41 |
| | silt layers | | 7 | SS | 7 | | 264 | |
| 262.2 | | | | | | | 263 | |
| 7.3 / 261.6 | Silt<br>trace clay, trace sand<br>some clay seams | | 8 | SS | 31 | | 262 | |
| 7.9 | Dense Brown Moist | | | | | | | |
| | Sand<br>Dense Reddish brown Moist | | | | | ▼* | 261 | |
| 260.2 | | | 9 | SS | 20/6cm | | | |
| 9.3 | End of borehole<br>Refusal on probable bedrock<br>Sample 9: Sampler bouncing | | | | | | | |

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE; ● QUICK TRIAXIAL × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT $w_P$ NATURAL MOISTURE CONTENT w LIQUID LIMIT $w_L$

WATER CONTENT (%): 20 40 60

UNIT WEIGHT γ kN/m³

* 2012 01 20

▽ Water level observed during drilling

▼ Water level measured after driling

■ Penetrometer test

+7, ×5 : Numbers refer to Sensitivity

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

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# RECORD OF BOREHOLE No. 6B-8 1 of 1 METRIC

Hwy 11/Interchange Crossing Road, N-E/W Ramp

**G.W.P.** 323-00-00 **LOCATION** Sta. 20+975, o/s 2.4m Lt. of Rt. EP **ORIGINATED BY** A.K.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 24, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 272.3 | Ground Surface | | | | | * | | | | | |
| 0.0 / 272.0 | Topsoil | | 1 | SS | 2 | | 272 | | 85 | | |
| 0.3 | Sand, trace silt<br>Loose to compact Brown Wet | | 2 | SS | 6 | | | | | | |
| | | | 3 | SS | 12 | | 271 | | | | |
| 270.1 | | | | | | | | | | | |
| 2.2 | Clayey silt, with sand<br>Firm Brown to grey Wet | | 4 | SS | 5 | | 270 | | | | 0 21 51 29 |
| | | | 5 | SS | 6 | | 269 | | | | |
| 268.6 | | | | | | | | | | | |
| 3.7 | Silty clay, trace sand silt layers<br>Firm Grey Wet | | 6 | SS | 4 | | 268 | | | | |
| | | | 7 | SS | 3 | | 267 | | | | 0 0 60 40 |
| | | | 8 | SS | 3 | | 266 | | | | |
| | | | 9 | SS | 4 | | 265 | | | | |
| 261.9 | | | | | | | 264 | | | | |
| 10.4 | Silt some clay, trace sand<br>Compact Grey Wet | | 10 | SS | 10 | | 263 | | | | 0 3 85 12 |
| 260.3 | | | | | | | 262 | | | | |
| 12.0 | Silty sand, trace clay<br>Compact to very dense Grey Moist | | 11 | SS | 19 | | 261 | | | | |
| | cobbles and boulders | | 12 | SS | 56 | | 260 | | | | |
| 257.7 | | | | | | | 259 | | | | |
| 14.6 | End of borehole<br>Refusal on probable boulder | | | | | | 258 | | | | * Borehole dry |

ON MTO_VER3 NEW LOGO 10TF013A-AREA 6.GPJ ON_MOT.GDT 8/7/2014 4:00:28 PM

+7, ×5 : Numbers refer to Sensitivity

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

| | |
|---|---|
| CONT No<br>GWP No 323-00-00<br>WP No | |
| AREA 6A – E/W–S RAMP<br>Sta. 20+075 to 20+125<br>HIGHWAY 11 POWASSAN<br>BOREHOLE LOCATIONS AND SOIL STRATA | SHEET<br>1 |

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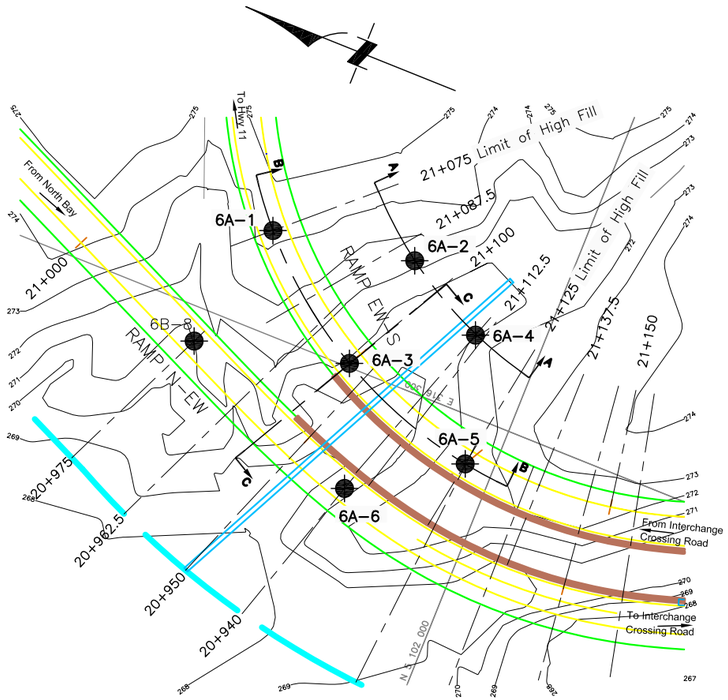
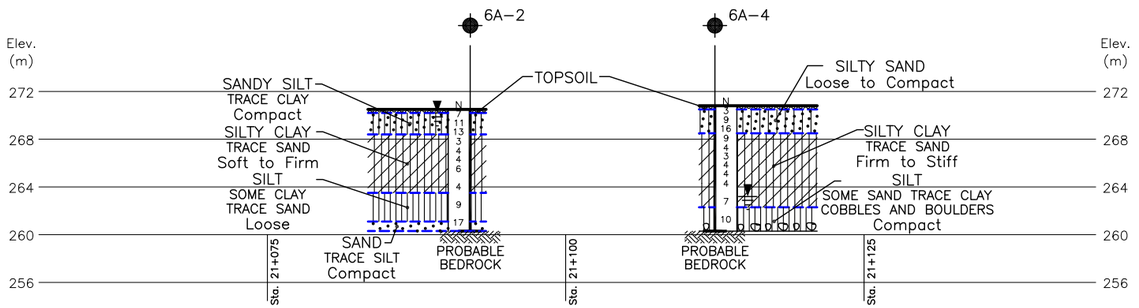


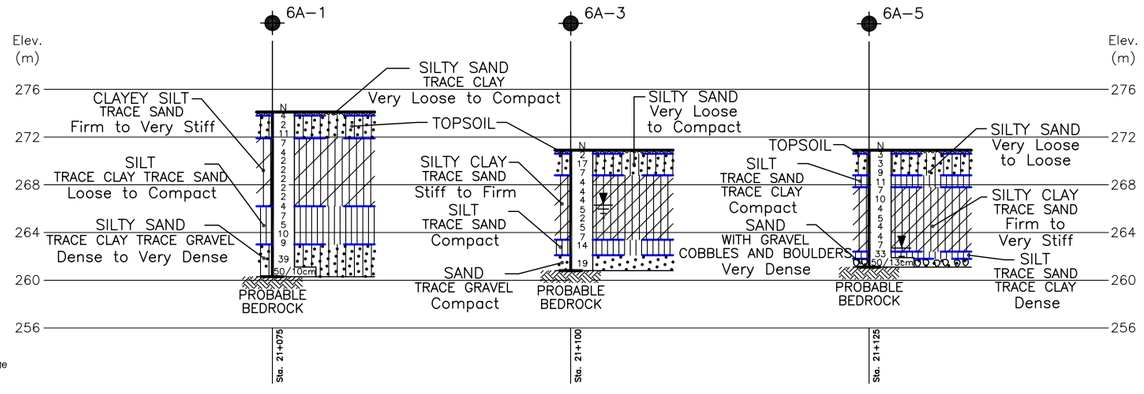

PLAN

SCALE

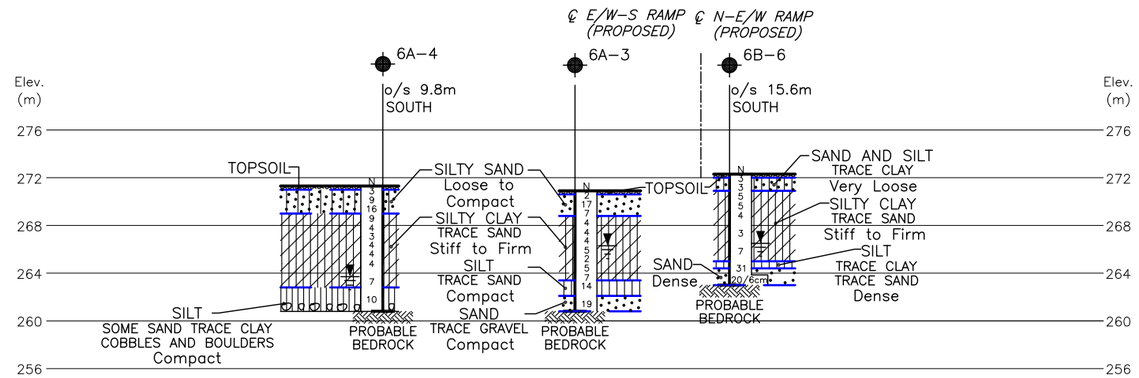
10 0 10 20m




PROFILE A-A




PROFILE B-B




SECTION C-C

SCALE

5 0 5 10m


LEGEND

- Borehole
- Borehole and Cone
- N Blows/0.3m (Std. Pen Test, 475 J/blow)
- CONE Blows/0.3m (60 Cone, 475 J/blow)
- WL at time of investigation Dec. 2011
- Head ARTESIAN WATER Encountered
- PIEZOMETER

| BH No | ELEVATION | STA. E/W–S Ramp | o/s Lt. E.P. |
|---|---|---|---|
| 6A–1 | 274.1 | 21+075 | 2.4m Rt. |
| 6A–2 | 270.5 | 21+092 | 16.6m Lt. |
| 6A–3 | 270.9 | 21+100 | 2.4m Rt. |
| 6A–4 | 271.3 | 21+112.5 | 16.1m Lt. |
| 6A–5 | 270.9 | 21+125 | 2.4m Rt. |
| BH No | ELEVATION | STA. N–E/W Ramp | o/s Rt. E.P. |
| 6B–6 | 269.5 | 20+940 | 2.4m Lt. |
| 6B–8 | 272.3 | 20+975 | 2.4m Lt. |

NOTES:

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

REGISTERED PROFESSIONAL ENGINEER C M P Nascimento Feb. 20, 2015 PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER B. R. GRAY Feb. 20, 2015 PROVINCE OF ONTARIO

REF AECOM Drawings:
Hwy11-Design.dwg: X-60157537-C-Hwy11-Base.dwg
dated September 2010

– 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 |

**Geocres No. 31L–184**

| | | | | | |
|---|---|---|---|---|---|
| HWY No | 11 | | | DIST | North Bay |
| SUBM'D | NA | CHECKED | AD | DATE | FEB. 20, 2015 |
| DRAWN | NA | CHECKED | BRG | APPROVED | CN |
| | | | | SITE | |
| | | | | DWG | 6A–1 |

# Area 6B – New N-E/W Ramp, Sta. 20+890 to 21+000

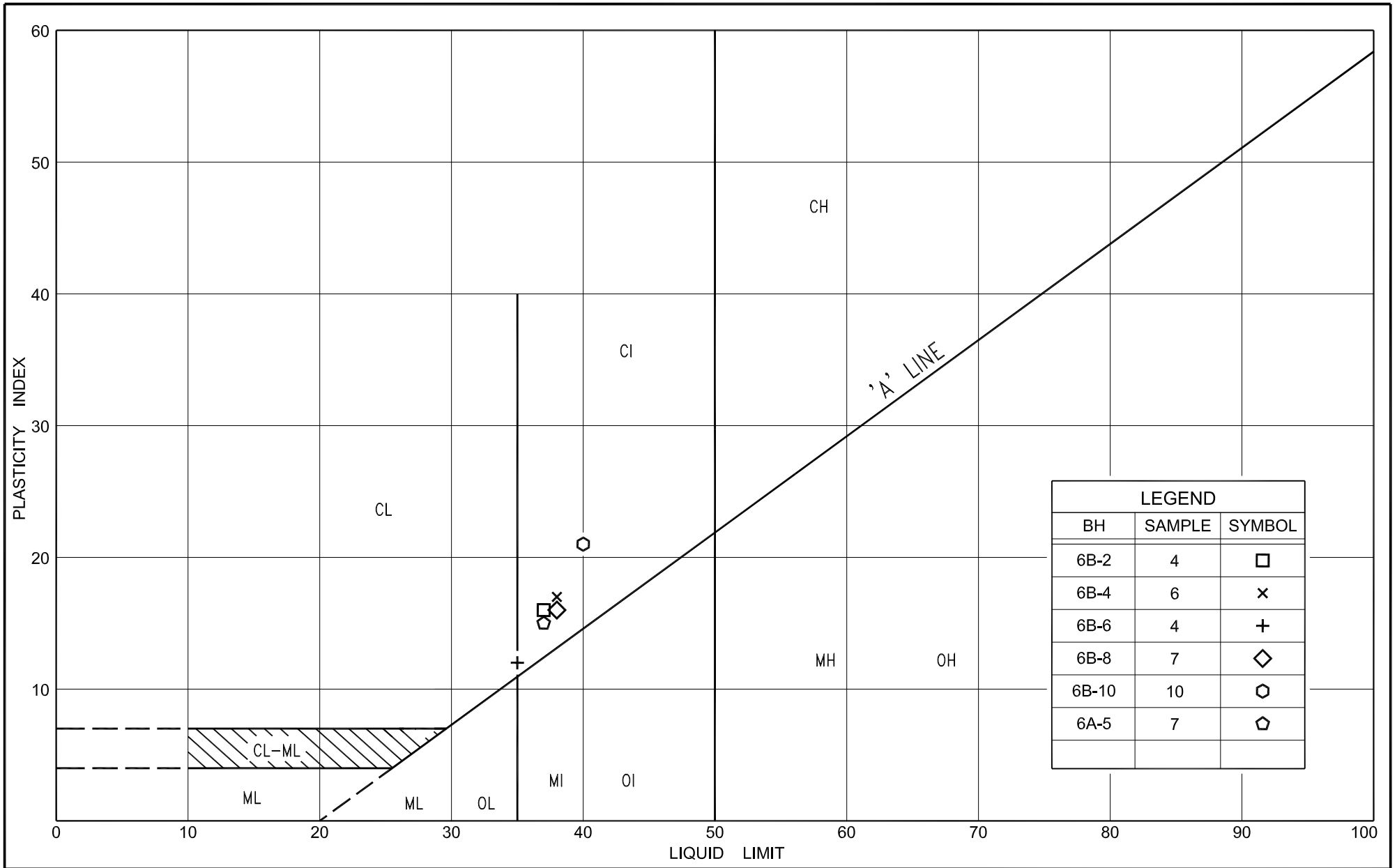
Figures 6B-PC-1 to 6B-PC-2 – Plasticity Charts

Figures 6B-GS-1 to 6B-GS-8 – Grain Size Distribution Analyses

Figures 6B-C-1 and 6B-C-2 – Consolidation Test Results

Record of Borehole Sheets – 6B-1 to 6B-10, 6A-1, 6A-3 and 6A-5

Drawing 6B-1 – Borehole Locations and Soil Strata

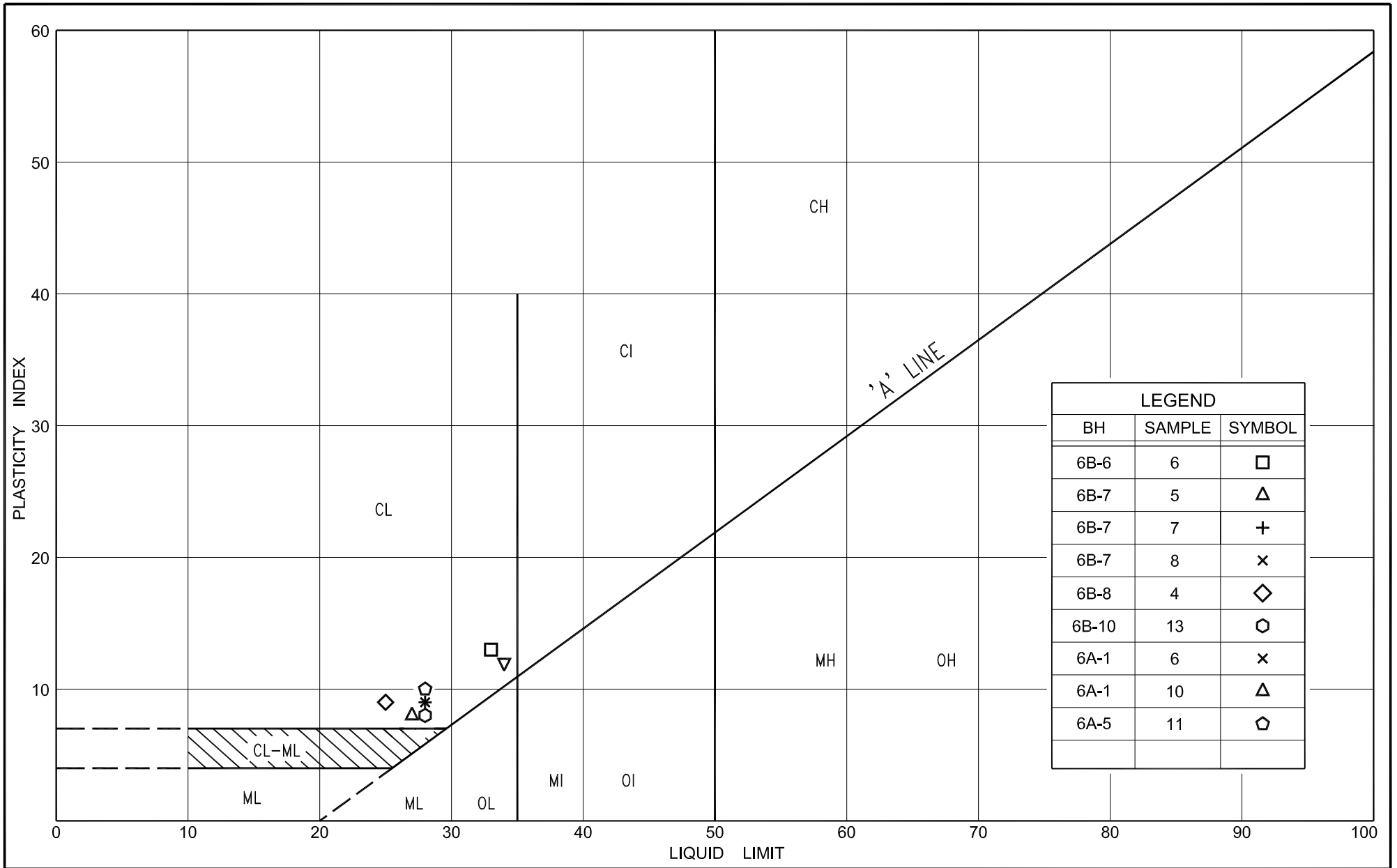



Ontario

# PLASTICITY CHART

SILTY CLAY, trace sand (CI)

| | |
|---|---|
| FIG No. | 6B-PC-1 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

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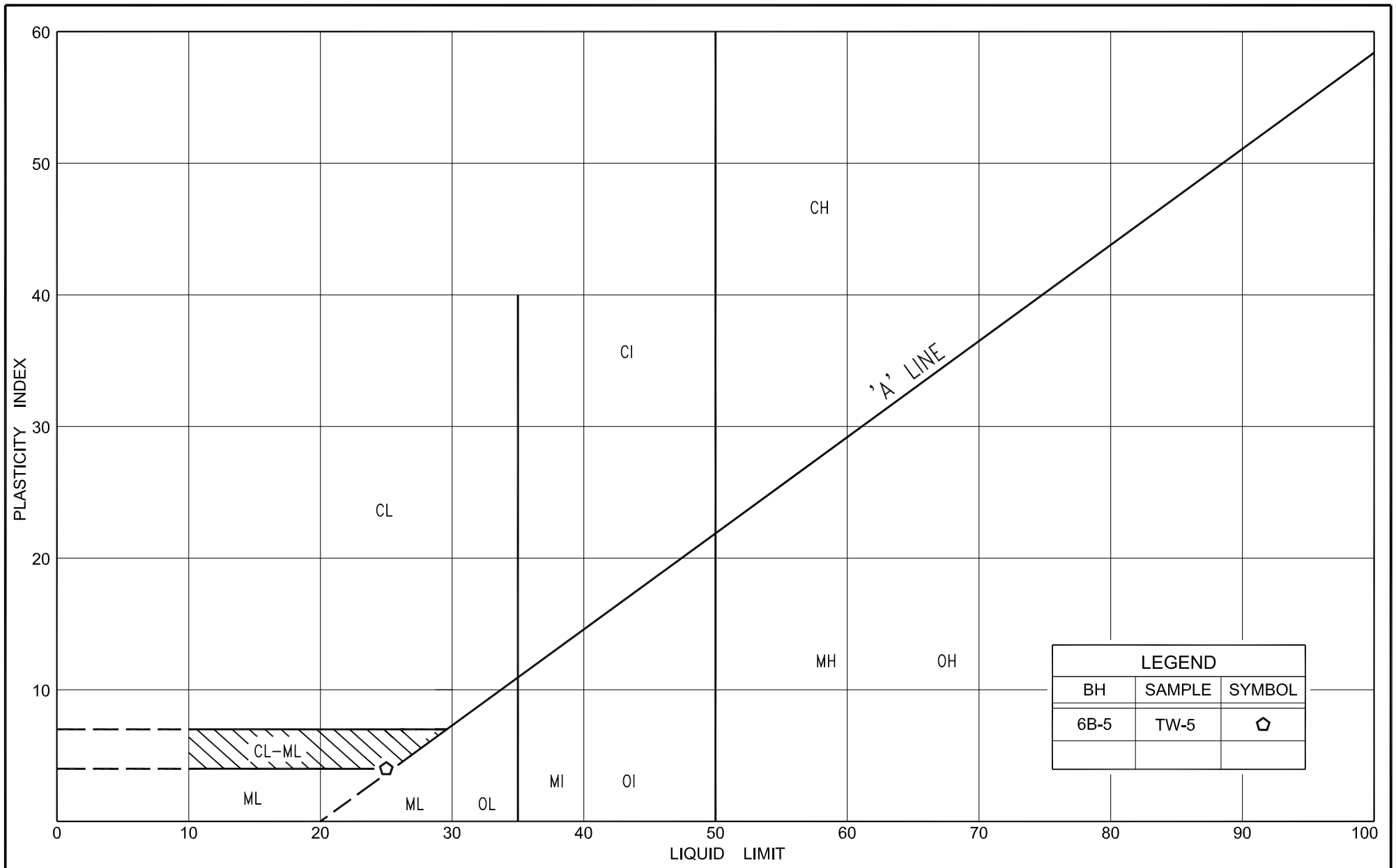
# PLASTICITY CHART

CLAYEY SILT, trace to with sand (CL)

| | |
|---|---|
| FIG No. | 6B-PC-2 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

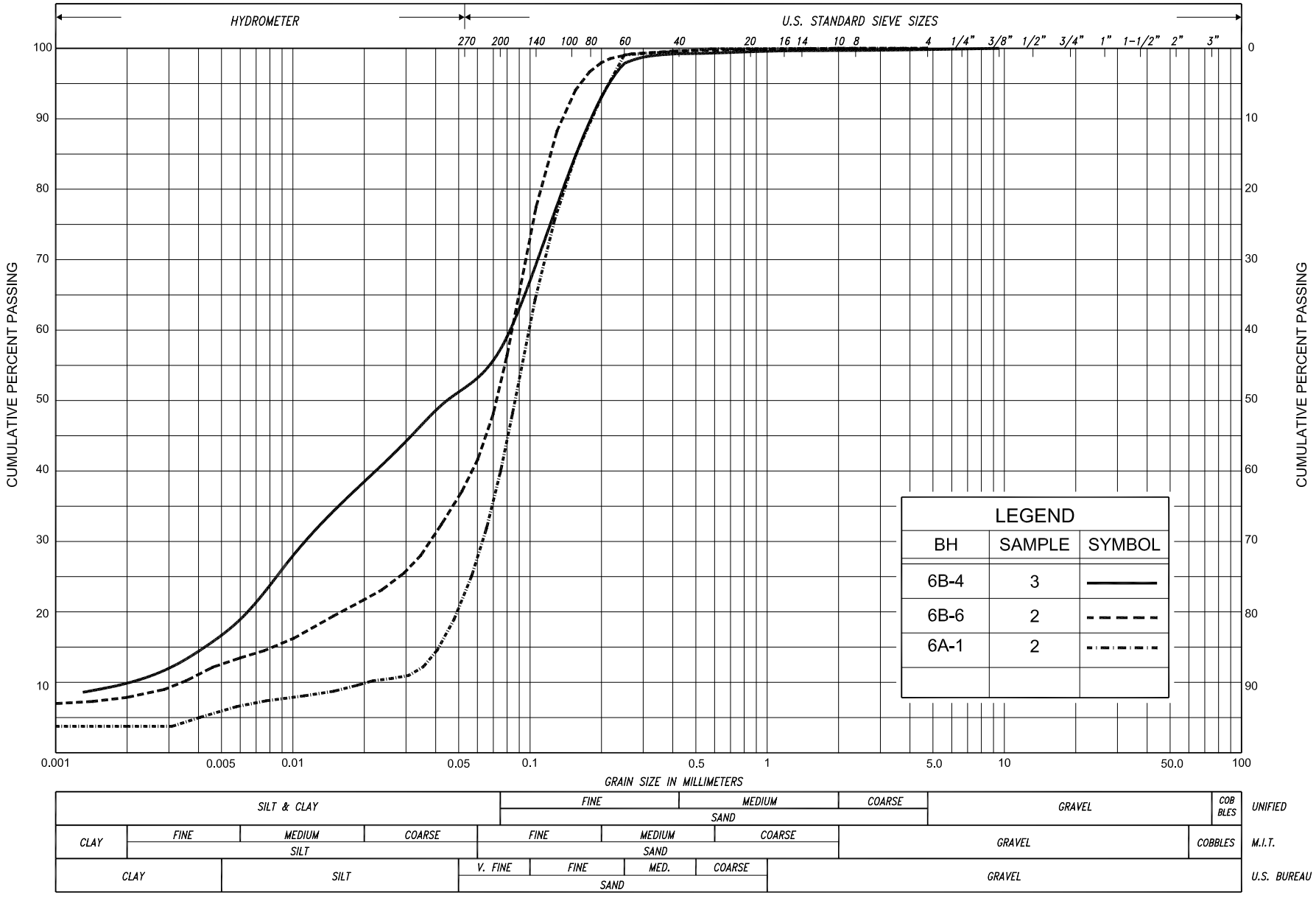



Ontario

# PLASTICITY CHART

SILT, some clay (ML)

| | |
|---|---|
| FIG No. | 6B-PC-3 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

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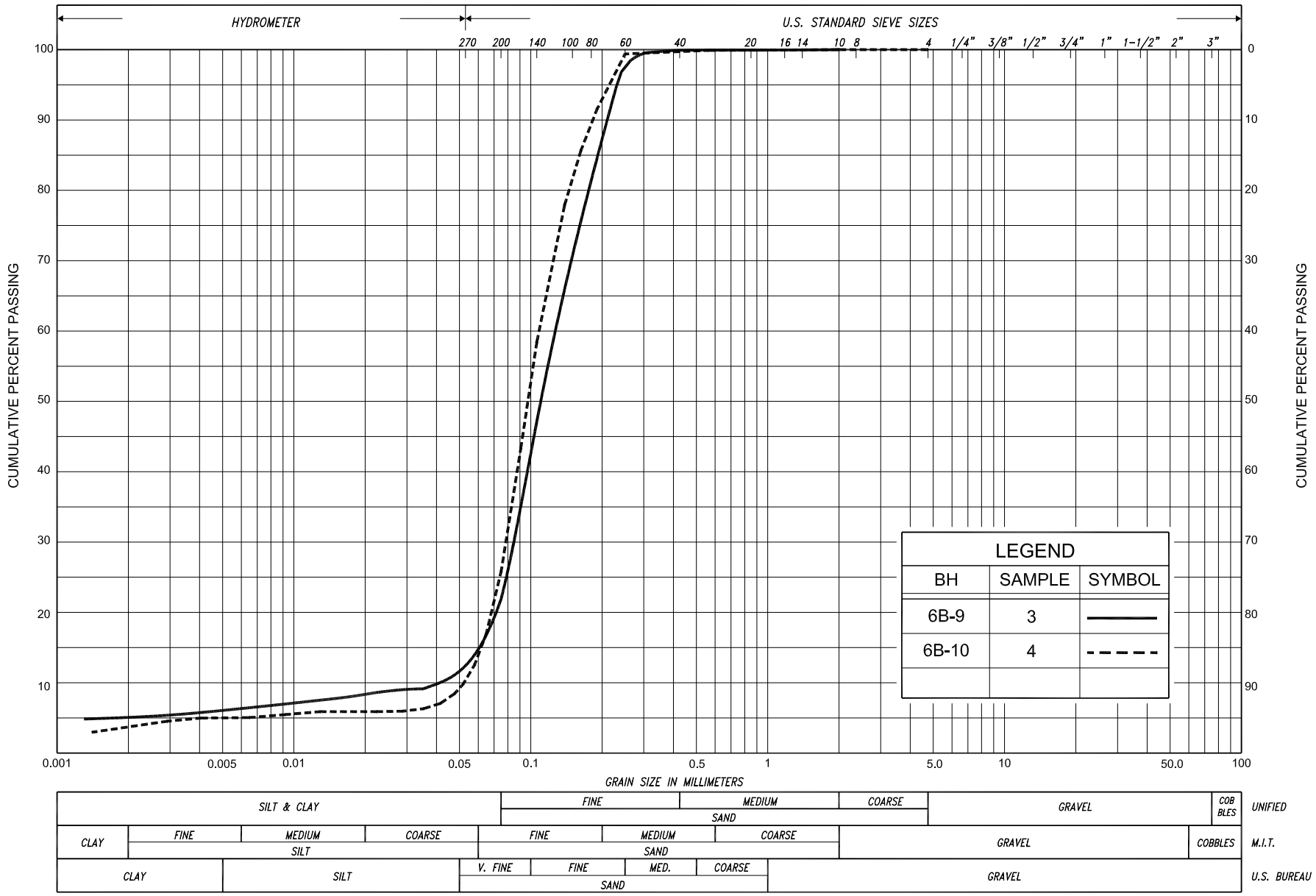
# GRAIN SIZE DISTRIBUTION

SAND AND SILT to SILTY SAND, trace clay

| | |
|---|---|
| FIG No. | 6B-GS-1 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

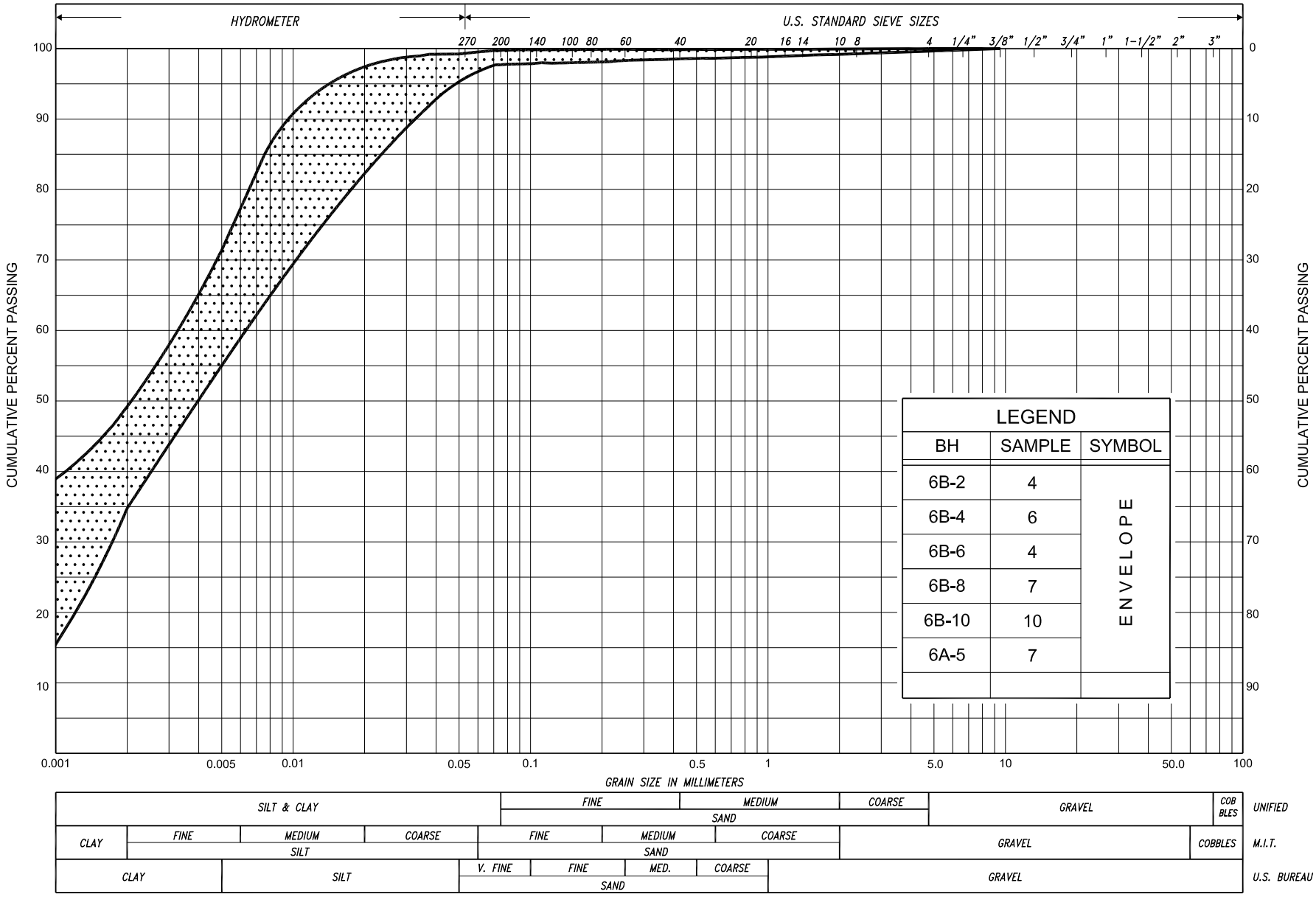



Ontario

# GRAIN SIZE DISTRIBUTION

SAND, some to with silt, trace clay

| | |
|---|---|
| FIG No. | 6B-GS-2 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

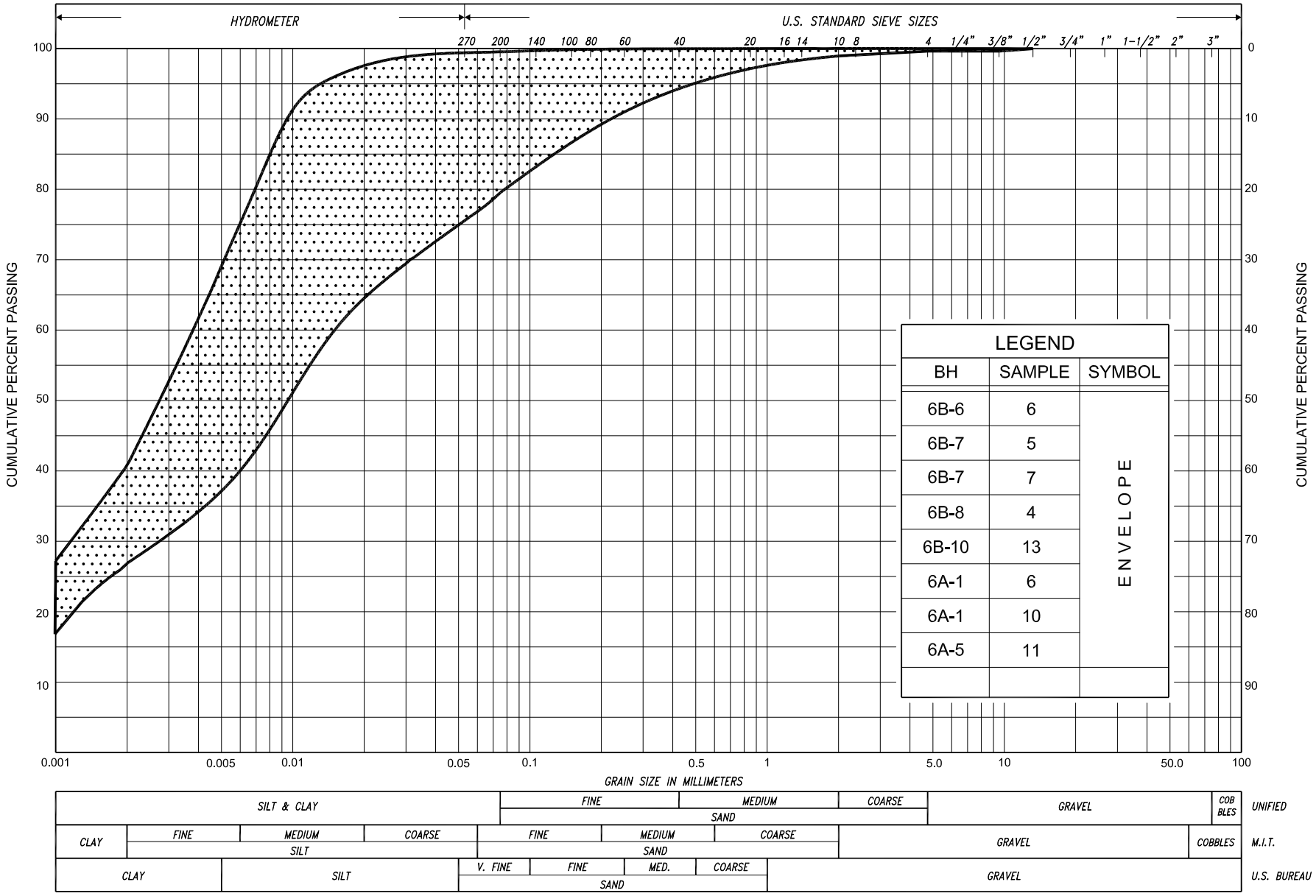



Ontario

# GRAIN SIZE DISTRIBUTION

SILTY CLAY, trace sand (CI)

| | |
|---|---|
| FIG No. | 6B-GS-3 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

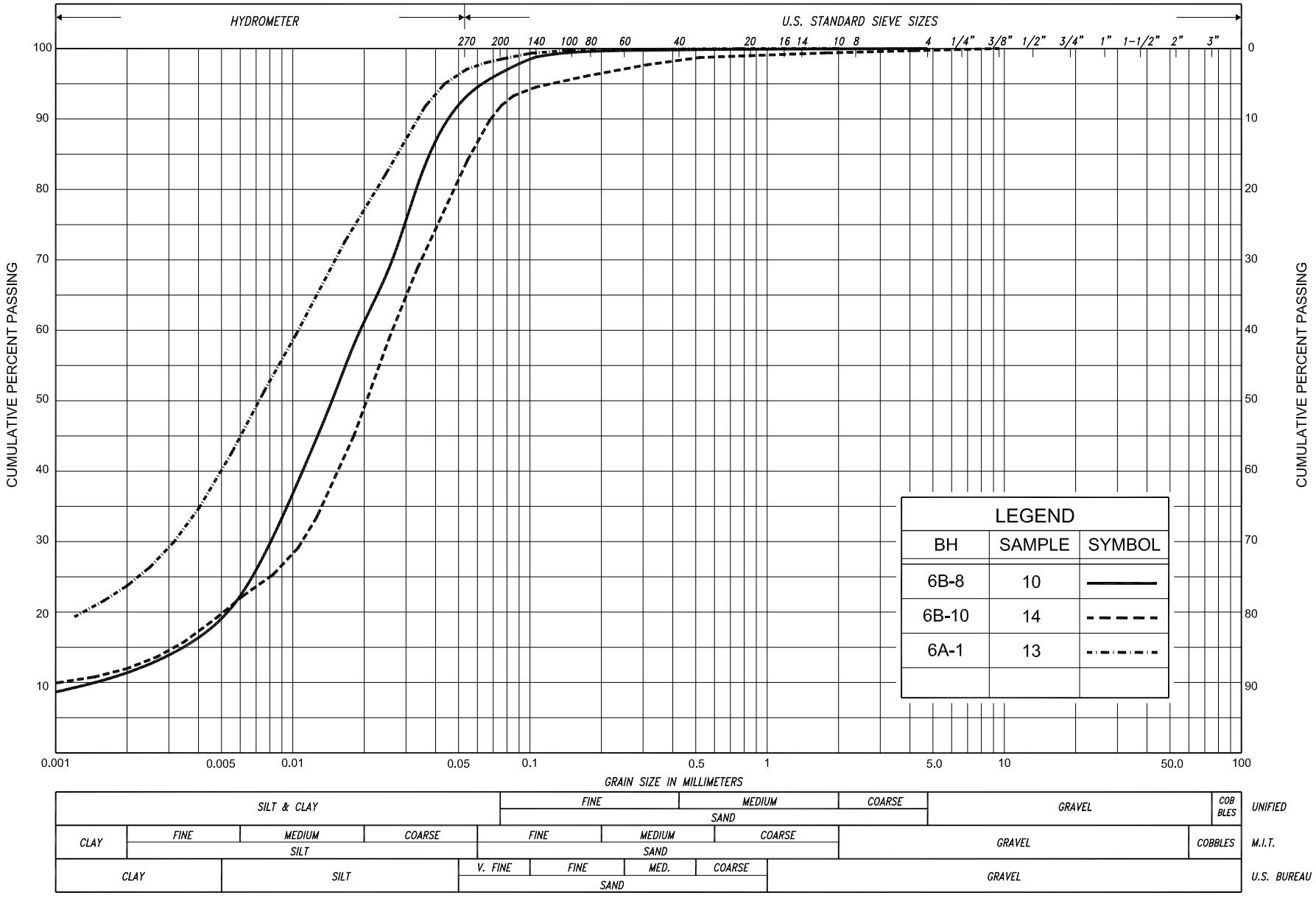



Ontario

# GRAIN SIZE DISTRIBUTION

CLAYEY SILT, trace to with sand (CL)

| | |
|---|---|
| FIG No. | 6B-GS-4 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

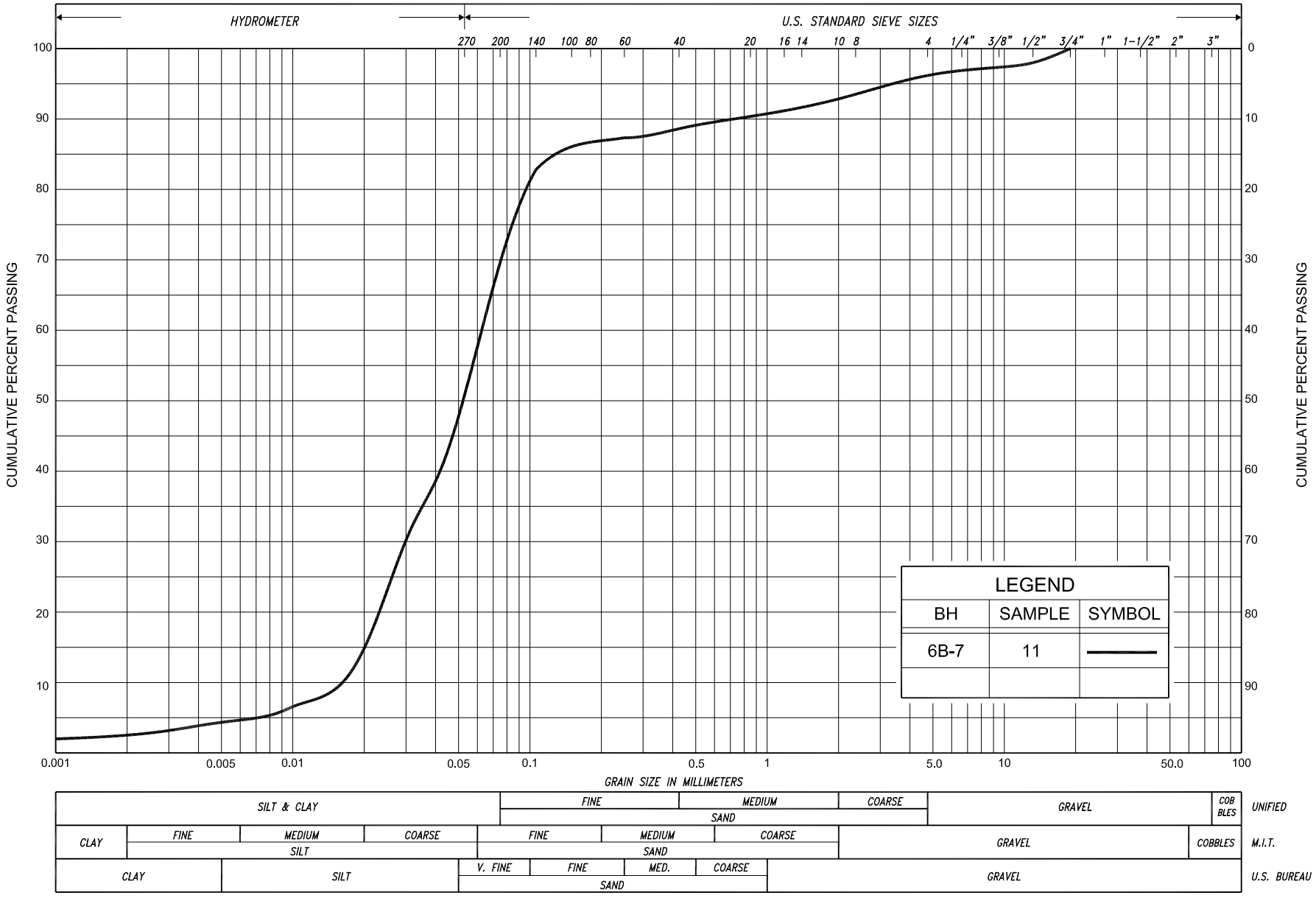



Ontario

# GRAIN SIZE DISTRIBUTION

SILT, some clay, trace sand

| | |
|---|---|
| FIG No. | 6B-GS-5 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

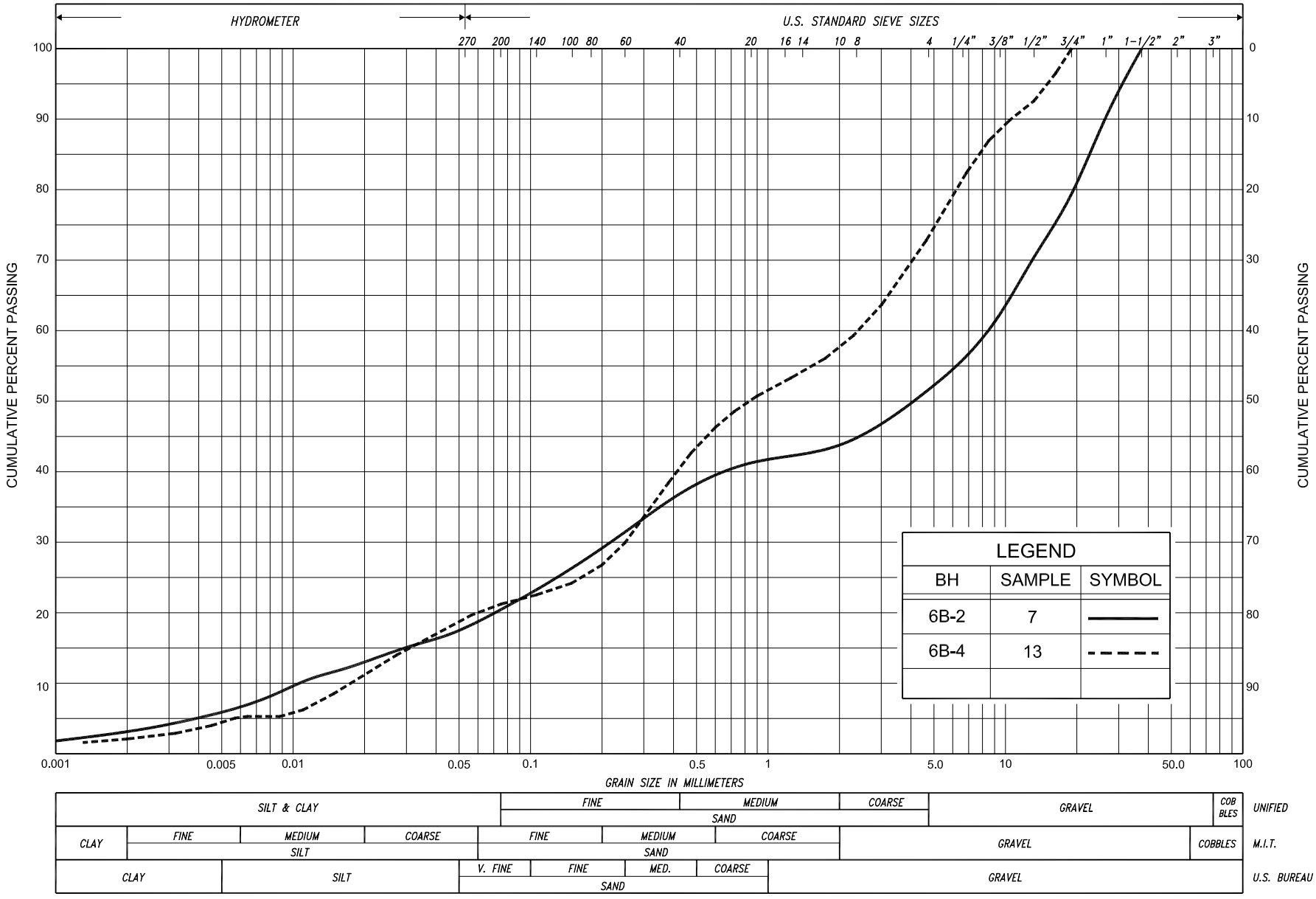



Ontario

# GRAIN SIZE DISTRIBUTION

SILT, with sand, trace clay, trace gravel

| | |
|---|---|
| FIG No. | 6B-GS-6 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

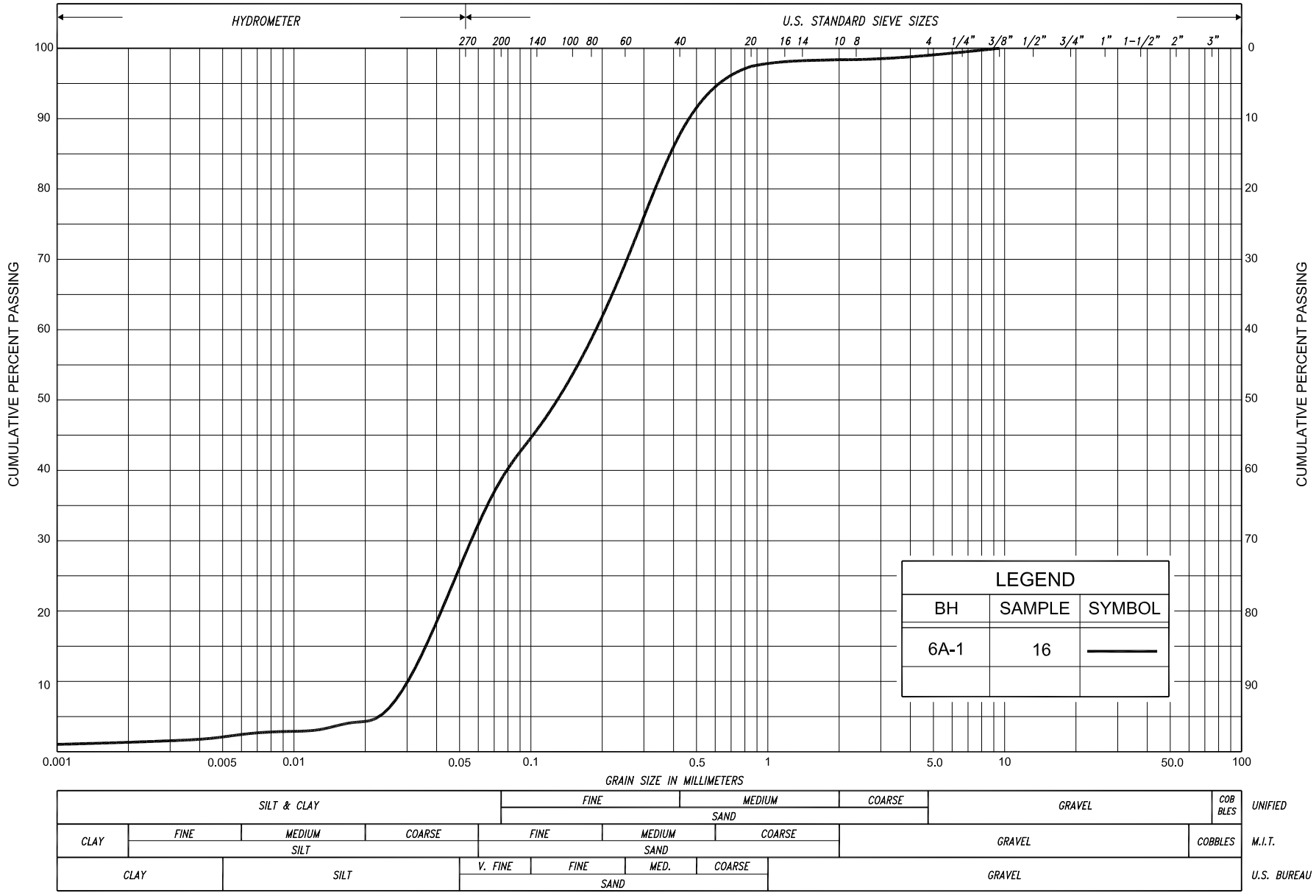



Ontario

# GRAIN SIZE DISTRIBUTION

SAND, with gravel, some silt, trace clay to
SANDY GRAVEL, some silt, trace clay

| | |
|---|---|
| FIG No. | 6B-GS-7 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |




Ontario

# GRAIN SIZE DISTRIBUTION

SILTY SAND, trace clay, trace gravel

| | |
|---|---|
| FIG No. | 6B-GS-8 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

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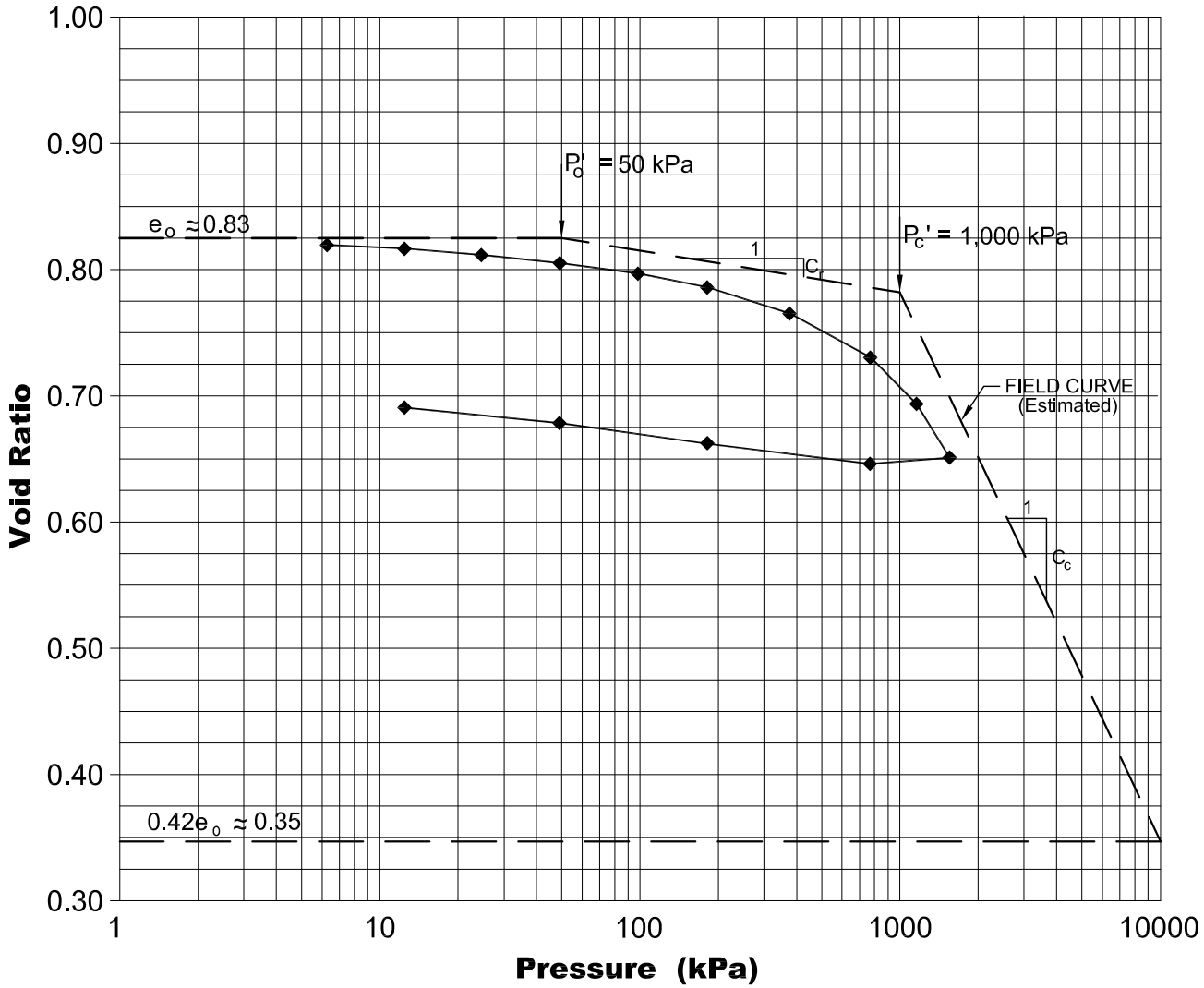
Laboratory Consolidation Test Results

Area 6B, Borehole 6B-7, Sample TW-5
Location Sta. 20+962.5, 7.4 m Lt. of Rt. EL, Depth 3.1 - 3.7 m

## Void Ratio versus Log of Pressure




| SOIL TYPE: SILT, some clay | | | |
|---|---|---|---|
| $e_o$ = 0.83 | $P'_o$ = 50 kPa | $W_L$ = 25 | FIGURE No: 6B-C-1 |
| $W_o$ = 29% | $P'_c$ = 1,000 kPa | $W_P$ = 21 | HIGHWAY: 11 |
| $\gamma$ = 19.1 kN/m$^3$ | $C_c$ = 0.44 | PI = 4 | TOWNSHIP: POWASSAN |
| | $C_r$ = 0.03 | | G.W.P. 323-00-00 |

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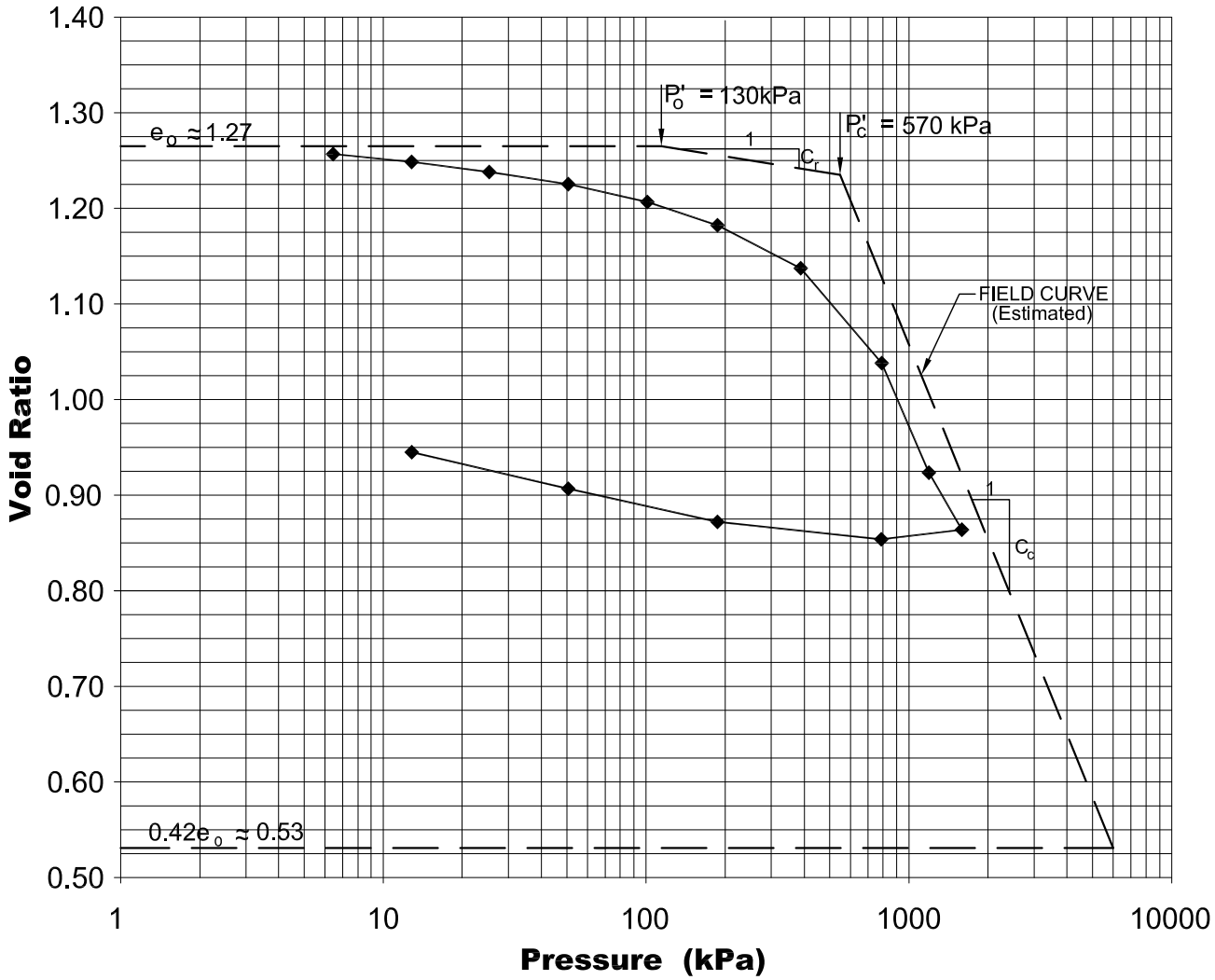
CONSULTING ENGINEERS

Laboratory Consolidation Test Results

Area 6B, Borehole 6B-7, Sample TW-8
Location Sta. 20+962.5, 7.4 m Lt. of Rt. EP, Depth 7.6 - 8.2 m

## Void Ratio versus Log of Pressure




| SOIL TYPE: CLAYEY SILT | | | |
|---|---|---|---|
| $e_o$ = 1.27 | $P'_o$ = 130 kPa | $W_L$ = 28 | FIGURE No: 6B-C-2 |
| $W_o$ = 47% | $P'_c$ = 570 kPa | $W_P$ = 19 | HIGHWAY: 11 |
| $\gamma$ = 17.5 kN/m$^3$ | $C_c$ = 0.68 | PI = 9 | TOWNSHIP: POWASSAN |
| | $C_r$ = 0.05 | | G.W.P. 323-00-00 |

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. 6B-1 1 of 1 METRIC

Hwy 11/Interchange Crossing Road, N-E/W Ramp

**G.W.P.** 323-00-00 **LOCATION** Sta. 20+890, o/s 35.9m Rt. of Rt. EP **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 17, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 274.8 | Ground Surface | | | | | | | | | | |
| 0.0 / 274.5 | Topsoil | | 1 | SS | 4 | | 274 | | ○ | | |
| 0.3 | Silty sand<br>Very loose Brown Moist<br>to compact | | 2 | SS | 2 | | | | ○ | | |
| 272.4 | | | 3 | SS | 13 | | 273 | | ○ | | |
| 2.4 | Silt<br>trace clay, trace sand | | 4 | SS | 10 | | 272 | | ○ | | |
| 271.8 | Compact Brown Wet | | | | | | | | | | |
| 3.0 | Clayey silt, trace sand<br>silty clay seams<br>Stiff Brown Wet | | 5 | SS | 9 | | | | ○ | | |
| | | | 6 | SS | 3 | | 271 | ■ | ○ | | |
| | | | 7 | SS | 5 | | 270 | | ○ | | |
| | | | | FV | | ▽* | | 6 + | | | |
| | silt layers<br>Grey | | 8 | SS | 5 | | 269 | | ○ | | |
| | | | | FV | | | 268 | 6 + | | | |
| 267.2 | | | | | | ▼* | | | | | |
| 7.6 | Silt<br>trace sand, trace clay<br>clayey silt layers | | 9 | SS | 11 | | 267 | | ○ | | |
| | Compact Brown Wet | | | | | | | | | | |
| 266.0 | | | | | | | 266 | | | | |
| 8.8 | Sand<br>trace silt, trace gravel | | | | | | | | | | |
| | Compact Brown Moist | | 10 | SS | 29 | | | | ○ | | |
| 264.7 | | | | | | | 265 | | | | |
| 10.1 | End of borehole<br>Refusal on probable bedrock | | | | | | | | | | |

* 2012 01 17

▽ Water level observed during drilling

▼ Water level measured after driling

■ Penetrometer test

ON MTO_VER3 NEW LOGO 10TF013A-AREA 6.GPJ ON_MOT.GDT 8/7/2014 3:36:51 PM

+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. 6B-2 1 of 1 METRIC

Hwy 11/Interchange Crossing Road, N-E/W Ramp

**G.W.P.** 323-00-00 **LOCATION** Sta. 20+900, o/s 2.4m Lt. of Rt. EP **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 23, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ WATER CONTENT (%) 20 40 60 | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 269.1 | Ground Surface | | | | | | | | | | |
| 268.9 | Topsoil | | | | | | 269 | | | | |
| 0.2 | Silt<br>trace sand, trace clay<br>Loose Mottled Moist<br>grey/brown<br>clayey silt seams | | 1 | SS | 6 | | | | ○ | | |
| | | | 2 | SS | 4 | | 268 | | ○ | | |
| 267.6 | Grey | | | | | | | | | | |
| 1.5 | Silty clay, trace sand<br>silt seams<br>Firm Brown Wet | | 3 | SS | 8 | | 267 | | ○ | | |
| | | | 4 | SS | 4 | | | | ○ | | 0 1 49 50 |
| | | | 5 | SS | 6 | | 266 | ■ | ○ | | |
| | sandy silt seams | | 6 | SS | 8 | | 265 | | ○ | | |
| 264.8 | | | | | | | | | | | |
| 4.3 | Sandy gravel<br>with silt, trace clay<br>Very dense Brown Moist | | 7 | SS | 37/18cm | | 264 | | ○ | | 49 31 17 3 |
| 263.9 | | | | | | | | | | | |
| 5.2 | End of borehole<br>Refusal on probable bedrock<br>Sample 7: Sampler bouncing | | | | | | | | | | |

* Borehole dry

■ Penetrometer test

ON MTO_VER3 NEW LOGO 10TF013A-AREA 6.GPJ ON_MOT.GDT 8/7/2014 3:36:52 PM

+7, ×5 : Numbers refer to Sensitivity

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

# RECORD OF PENETRATION TEST No 6B-3

1 of 1

**METRIC**

**G.W.P.** 323-00-00 **LOCATION** Hwy 11/Interchange Crossing Road, N-E/W Ramp Sta. 20+912.5, o/s 19.6m Rt. of Rt. EP **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Dynamic Cone Penetration Test **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 10, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ / WATER CONTENT (%) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 272.5 | Ground Surface | | | | | | | | | | |
| 0.0 | Topsoil | | | | | | 272 | | | | |
| | Probable sand and silt<br>Loose | | | | | | 271 | | | | |
| | Probable silty clay<br>Stiff to very stiff | | | | | | 270<br>269<br>268<br>267 | | | | |
| | Probable sand<br>Compact | | | | | | 266<br>265<br>264 | | | | |
| 263.1 | | | | | | | | | | | |
| 9.4 | End of dynamic cone penetration test<br>Refusal on probable bedrock | | | | | | | | | | |

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT $w_P$ — NATURAL MOISTURE CONTENT $w$ — LIQUID LIMIT $w_L$

WATER CONTENT (%): 20 40 60

150

MOT_DCPT R2012 10TF013A-AREA 6.GPJ ON_MOT.GDT 8/7/2014 3:39:39 PM

+7 , ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. 6B-4 1 of 1 METRIC

Hwy 11/Interchange Crossing Road, N-E/W Ramp

**G.W.P.** 323-00-00 **LOCATION** Sta. 20+925, o/s 2.4m Lt. of Rt. EP **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 11, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ / WATER CONTENT (%) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 270.8 | Ground Surface | | | | | | | | | | |
| 0.0 / 270.5 | Topsoil | | 1 | SS | 9 | | 270 | | | | |
| 0.3 | Sand and silt<br>trace clay<br>Loose Brown Wet<br>silt layers | | 2 | SS | 7 | | | | | | |
| | | | 3 | SS | 9 | ▽* | 269 | | | | 0 43 47 10 |
| 268.1 | | | 4 | SS | 2 | | | | | | |
| 2.7 | Silty clay, trace sand<br>silt layers<br>Firm Brown Wet | | 5 | SS | WH** | | 268 | | | | |
| | | | 6 | SS | 4 | | 267 | | | | 0 2 59 39 |
| | | | | FV | | | | > | | | |
| | | | 7 | SS | 5 | | 266 | | | | |
| | silt layers | | | FV | | | | > | | | |
| | | | 8 | SS | 5 | | 265 | | | | |
| | | | 9 | SS | 6 | | | | | | |
| | Grey | | | FV | | | 264 | 4 | | | |
| 263.2 | | | 10 | SS | 4 | ▼* | | | | | |
| 7.6 | Silt<br>trace clay, trace sand<br>clayey silt layers<br>Loose Grey Wet | | 11 | SS | 5 | | 263 | | | | |
| 262.3 | | | | | | | | | | | |
| 8.5 | Sand, with gravel<br>some silt, trace clay<br>sandy silt layers<br>Loose to dense Brown Wet<br>Reddish Brown Moist | | 12 | SS | 8 | | 262 | | | | |
| | | | 13 | SS | 28 | | 261 | | | | 27 52 19 2 |
| | | | 14 | SS | 43 | | 260 | | | | |
| 259.2 | | | | | | | | | | | |
| 11.6 | End of borehole<br>Refusal on probable bedrock | | | | | | | | | | |

* 2012 01 11

▽ Water level observed during drilling

▼ Water level measured after drilling

WH** denotes penetration due to weight of rods and hammer

+7, ×5 : Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

# RECORD OF PENETRATION TEST No 6B-5

1 of 1

**METRIC**

**G.W.P.** 323-00-00 **LOCATION** Hwy 11/Interchange Crossing Road, N-E/W Ramp Sta. 20+937.5, o/s 17.5m Lt. of Rt. EP **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Dynamic Cone Penetration Test **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 11, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ / WATER CONTENT (%) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 270.1 | Ground Surface | | | | | | | | | | |
| 0.0 | Topsoil | | | | | | 270 | | | | |
| | Probable sand and silt<br>Very loose | | | | | | 269 | | | | |
| | | | | | | | 268 | | | | |
| | Probable silty clay<br>Firm to stiff | | | | | | 267 | | | | |
| | | | | | | | 266 | | | | |
| | | | | | | | 265 | | | | |
| | | | | | | | 264 | | | | |
| | | | | | | | 263 | | | | |
| | Probable sand<br>Compact to dense | | | | | | 262 | | | | |
| | | | | | | | 261 | | | | |
| 260.0 | | | | | | | 260 | | | | |
| 10.1 | End of dynamic cone penetration test | | | | | | | | | | |



+7, ×5 : Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ontario

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# RECORD OF BOREHOLE No. 6B-6 1 of 1 METRIC

Hwy 11/Interchange Crossing Road, N-E/W Ramp

**G.W.P.** 323-00-00 **LOCATION** Sta. 20+940, o/s 2.4m Lt. of Rt. EP **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 20, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | REMARKS & GRAIN SIZE DISTRIBUTION (%): GR SA SI CL |
|---|---|---|---|---|---|---|---|---|
| 269.5 | Ground Surface | | | | | | | |
| 0.0 / 269.2 | Topsoil | | 1 | SS | 3 | | 269 | |
| 0.3 | Sand and silt, trace clay<br>Very loose Grey Wet | | 2 | SS | 3 | | | 0 48 44 8 |
| 268.1 | | | | | | | 268 | |
| 1.4 | Silty clay, trace sand<br>Stiff to firm Mottled greyish brown Wet | | 3 | SS | 5 | | | |
| | | | 4 | SS | 5 | | 267 | 0 1 64 35 |
| | Brown | | 5 | SS | 4 | | 266 | |
| | clayey silt layers | | 6 | SS | 3 | ▽* | 265 | 0 1 58 41 |
| | silt layers | | 7 | SS | 7 | | 264 | |
| 262.2 | | | | | | | 263 | |
| 7.3 / 261.6 | Silt<br>trace clay, trace sand<br>some clay seams | | 8 | SS | 31 | | 262 | |
| 7.9 | Dense Brown Moist | | | | | | | |
| | Sand<br>Dense Reddish brown Moist | | | | | ▼* | 261 | |
| 260.2 | | | 9 | SS | 20/6cm | | | |
| 9.3 | End of borehole<br>Refusal on probable bedrock<br>Sample 9: Sampler bouncing | | | | | | | |

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT $w_P$ | NATURAL MOISTURE CONTENT w | LIQUID LIMIT $w_L$

WATER CONTENT (%): 20 40 60

UNIT WEIGHT γ kN/m³

* 2012 01 20

▽ Water level observed during drilling

▼ Water level measured after driling

■ Penetrometer test

+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. 6B-7 1 of 1 METRIC

Hwy 11/Interchange Crossing Road, N-E/W Ramp

**G.W.P.** 323-00-00 **LOCATION** Sta. 20+962.5, o/s 7.4m Lt. of Rt. EP **ORIGINATED BY** A.K.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 25, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|
| 270.9 | Ground Surface | | | | | | | | |
| 0.0 / 270.6 | Topsoil | | 1 | SS | 3 | | 270 | | |
| 0.3 | Sand<br>Loose Brown Wet | | 2 | SS | 9 | | | | |
| 269.5 | | | | | | | 269 | | |
| 1.4 | Clayey silt, trace sand<br>Stiff to firm Grey to brown Wet | | 3 | SS | 8 | | | | |
| | | | 4 | SS | 8 | | 268 | | |
| | Silt, some clay layers<br>Grey | | 5 | SS<br>TW | 7<br>** | | | 19.1 | 0 1 63 36 |
| | | | | FV | | | 267 | | |
| | Silty clay layers, varved | | 6 | SS | 6 | | 266 | | |
| | | | | FV | | | | | |
| | | | 7 | SS | 3 | | 265 | | 0 3 70 27 |
| | | | | FV | | | 264 | | |
| | | | 8 | SS<br>TW | 6<br>** | | 263 | 17.5 | |
| | | | | FV | | | | | |
| | | | 9 | SS | 6 | | 262 | | |
| | | | | FV | | | 261 | | |
| 258.9 | | | | | | | 260 | | |
| 12.0 | Silt, with sand<br>trace clay, trace gravel<br>cobbles and boulders<br>Compact Grey Wet | | 10 | SS | 11 | | 259 | | 4 26 67 3 |
| 257.6 | | | | | | | 258 | | |
| 13.3 | End of borehole<br>Refusal on probable bedrock<br>Sample 11: Sampler bouncing<br>* Borehole dry<br>■ Penetrometer test | | 11 | SS | 50/8cm | | | | |

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100

PLASTIC LIMIT $w_P$ NATURAL MOISTURE CONTENT w LIQUID LIMIT $w_L$

WATER CONTENT (%) 20 40 60

** TW sample obtained on October 23, 2012 in new borehole at approximately the same SS sample depth and location



+7, ×5 : Numbers refer to Sensitivity

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

Ontario

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# RECORD OF BOREHOLE No. 6B-8 1 of 1 METRIC

Hwy 11/Interchange Crossing Road, N-E/W Ramp

**G.W.P.** 323-00-00 **LOCATION** Sta. 20+975, o/s 2.4m Lt. of Rt. EP **ORIGINATED BY** A.K.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 24, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ / WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 272.3 | Ground Surface | | | | | * | | | | | |
| 0.0 / 272.0 | Topsoil | | 1 | SS | 2 | | 272 | | 85 | | |
| 0.3 | Sand, trace silt<br>Loose to compact Brown Wet | | 2 | SS | 6 | | 271 | | | | |
| 270.1 | | | 3 | SS | 12 | | | | | | |
| 2.2 | Clayey silt, with sand<br>Firm Brown to grey Wet | | 4 | SS | 5 | | 270 | | | | 0 21 51 29 |
| 268.6 | | | 5 | SS | 6 | | 269 | | | | |
| 3.7 | Silty clay, trace sand silt layers<br>Firm Grey Wet | | 6 | SS | 4 | | 268 | | | | |
| | | | 7 | SS | 3 | | 267 | | | | 0 0 60 40 |
| | | | 8 | SS | 3 | | 266 | | | | |
| 261.9 | | | 9 | SS | 4 | | 265 | | | | |
| 10.4 | Silt some clay, trace sand<br>Compact Grey Wet | | 10 | SS | 10 | | 264 | | | | 0 3 85 12 |
| 260.3 | | | | | | | 263 | | | | |
| 12.0 | Silty sand, trace clay<br>Compact to very dense Grey Moist | | 11 | SS | 19 | | 262 | | | | |
| | cobbles and boulders | | 12 | SS | 56 | | 261 | | | | |
| 257.7 | | | | | | | 260 | | | | |
| 14.6 | End of borehole<br>Refusal on probable boulder | | | | | | 259 | | | | * Borehole dry |
| | | | | | | | 258 | | | | |

ON MTO_VER3 NEW LOGO 10TF013A-AREA 6.GPJ ON_MOT.GDT 8/7/2014 4:00:28 PM

+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. 6B-9 1 of 1 METRIC

Hwy 11/Interchange Crossing Road, N-E/W Ramp

**G.W.P.** 323-00-00 **LOCATION** Sta. 20+987.5, o/s 12.5m Lt. of Rt. EP **ORIGINATED BY** A.K.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 23, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT w / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 271.4 | Ground Surface | | | | | | | | | | |
| 0.0 / 271.1 | Topsoil | | 1 | SS | 3 | | 271 | | ○ | | |
| 0.3 | Sand<br>some silt, trace clay<br>Loose to Brown Wet<br>compact | | 2 | SS | 9 | | | | ○ | | |
| 269.2 | | | 3 | SS | 10 | | 270 | | ○ | | 0 78 17 5 |
| 2.2 | Sandy silt, trace clay<br>Loose to Brown Wet<br>very loose | | 4 | SS | 6 | | 269 | | ○ | | |
| 268.5 | | | 5 | SS | 3 | | 268 | ■ | ○ | | |
| 2.9 | Clayey silt, trace sand<br>Firm Brown Wet | | | FV | | | | 2 | | | |
| 266.9 | | | 6 | SS | 2 | | 267 | | ○ | | |
| 4.5 | Silty clay, trace sand<br>Very soft Grey Wet<br>to firm | | 7 | SS | 4 | | 266 | | ○ | | |
| | | | | FV | | | 265 | 4 | | | |
| 262.6 | | | 8 | SS | 4 | | 264 | | ○ | | |
| 8.8 | Silty sand, trace clay<br>Compact Grey Wet | | | FV | | | | 3 | | | |
| | | | 9 | SS | 10 | | 262 | | ○ | | |
| | sand seams | | 10 | SS | 14 | | 261 | | ○ | | |
| 258.7 | | | 11 | SS | 74/23cm | | 259 | | ○ | | |
| 12.7 | End of borehole<br>Refusal on probable bedock<br>Sample 11: Sampler bouncing<br>* Borehole dry<br>■ Penetrometer test | | | | | | | | | | |

ON MTO_VER3 NEW LOGO 10TF013A-AREA 6.GPJ ON_MOT.GDT 8/7/2014 4:00:29 PM

+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

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# RECORD OF BOREHOLE No. 6B-10 1 of 2 METRIC

Hwy 11/Interchange Crossing Road, N-E/W Ramp

**G.W.P.** 323-00-00 **LOCATION** Sta. 21+000, o/s 2.4m Rt. of Lt. EP **ORIGINATED BY** A.K.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 18 and 19, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 274.1 | Ground Surface | | | | | | 274 | | | | |
| 0.0 / 273.8 | Topsoil | | 1 | SS | 5 | | | | ○ | | |
| 0.3 | Sand, trace silt<br>Compact to loose Brown Moist to wet | | 2 | SS | 10 | | 273 | | ○ | | |
| | | | 3 | SS | 8 | | | | ○ | | |
| | with silt, trace clay | | 4 | SS | 8 | | 272 | | ○ | | 0 75 22 3 |
| 270.4 | | | 5 | SS | 6 | ▽* | 271 | | ○ | | |
| 3.7 | Silty sand, trace clay<br>Loose Brown Wet | | 6 | SS | 6 | | 270 | | ○ | | |
| 268.8 | | | 7 | SS | 4 | | 269 | | ○ | | |
| 5.3 | Sandy silt, trace clay<br>Loose Brown Wet | | 8 | SS | 6 | | | | ○ | | |
| 268.1 | | | | | | | 268 | | | | |
| 6.0 | Clayey silt, trace sand<br>Firm Grey Wet | | 9 | SS | 7 | | | ■ | ○ | | |
| 267.3 | | | | | | | | | | | |
| 6.8 | Silty clay, trace sand<br>Firm to stiff Grey Wet | | 10 | SS | 2 | | 267 | | ⊢○ | | 0 3 50 47 |
| | | | | FV | | | | +5 | | | |
| | | | 11 | SS | 4 | | 266 | | ○ | | |
| | | | | FV | | | 265 | +4 | | | |
| | clayey silt layers | | 12 | SS | 8 | | 264 | | ○ | | |
| | | | 13 | SS | 8 | | 263 | | ⊢○ | | 1 2 69 28 |
| 262.1 | | | | | | | | | | | |
| 12.0 | Silt<br>some clay, trace sand<br>Compact Grey Wet | | 14 | SS | 12 | | 262 | | ○ | | 0 7 81 12 |
| 260.6 | | | | | | | 261 | | | | |
| 13.5 | Silty sand, trace clay<br>cobbles and boulders<br>Very dense Brown Moist | | 15 | SS | 54 | | 260 | | ○ | | |
| | Cont'd | | | | | | | | | | |

ON MTO_VER3 NEW LOGO 10TF013A-AREA 6.GPJ ON_MOT.GDT 8/7/2014 4:03:13 PM

+7, ×5 : Numbers refer to Sensitivity

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

# RECORD OF BOREHOLE No. 6B-10 2 of 2 METRIC

Hwy 11/Interchange Crossing Road, N-E/W Ramp

**G.W.P.** 323-00-00 **LOCATION** Sta. 21+000, o/s 2.4m Rt. of Lt. EP **ORIGINATED BY** A.K.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 18 and 19, 2012 **CHECKED BY** B.R.G.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ WATER CONTENT (%) 20 40 60 | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | | | |
| 259.1 | | | | | | | 259 | | | | |
| 258.3 | | | 16 | SS | 70 | | | | ○ | | |
| 15.8 | End of borehole | | | | | | | | | | |

* 2012 01 18

▽ Water level observed during drilling



+7 ,×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. 6A-1 1 of 1 METRIC

Hwy 11/Interchange Crossing Road, E/W-S Ramp

**G.W.P.** 323-00-00 **LOCATION** Sta. 21+075, o/s 2.4m Rt of Lt. EP **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 19, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|
| 274.1 | Ground Surface | | | | | | 274 | |
| 0.0 / 273.8 | Topsoil | | 1 | SS | 4 | | | |
| 0.3 | Silty sand, trace clay<br>Very loose Brown Wet<br>to compact | | 2 | SS | 2 | | 273 | 0 60 36 4 |
| | sandy silt seams | | 3 | SS | 11 | | | |
| 271.9 | clayey silt layers | | | | | | 272 | |
| 2.2 | Clayey silt, trace sand<br>silt seams<br>Firm to Reddish Wet<br>very stiff brown | | 4 | SS | 7 | | | |
| | | | 5 | SS | 4 | | 271 | |
| | Brown | | 6 | SS | 2 | | 270 | 0 1 59 40 |
| | | | | FV | | | | |
| | | | 7 | SS | 2 | | 269 | |
| | Grey | | | FV | | | | |
| | | | 8 | SS | 2 | | | |
| | | | | FV | | | 268 | |
| | | | 9 | SS | 2 | | | |
| | | | | FV | | | | |
| | silt layers | | 10 | SS | 2 | | 267 | 0 1 68 31 |
| 266.2 | | | | | | | | |
| 7.9 | Silt<br>trace clay, trace sand<br>clayey silt layers<br>Loose to Brown Wet<br>compact | | 11 | SS | 4 | | 266 | |
| | | | 12 | SS | 7 | | | |
| | | | 13 | SS | 5 | | 265 | 0 3 73 24 |
| | some clay | | 14 | SS | 10 | | 264 | |
| | sandy silt seams<br>Moist | | 15 | SS | 9 | | | |
| 263.0 | | | | | | | 263 | |
| 11.1 | Silty sand<br>trace clay, trace gravel<br>Dense to Brown Moist<br>very dense | | 16 | SS | 39 | | 262 | 2 60 36 2 |
| 260.3 | | | 17 | SS | 50/10cm | | 261 | |
| 13.8 | End of borehole<br>Refusal on probable bedrock<br>Sample 17: Sampler bouncing<br>* Borehole dry | | | | | | | |

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT $w_P$ NATURAL MOISTURE CONTENT $w$ LIQUID LIMIT $w_L$

WATER CONTENT (%): 20 40 60

UNIT WEIGHT $\gamma$ kN/m³

+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. 6A-3 1 of 1 METRIC

Hwy 11/Interchange Crossing Road, E/W-S Ramp

**G.W.P.** 323-00-00 **LOCATION** Sta. 21+100, o/s 2.4m Rt. of Lt. EP **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 17, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 270.9 | Ground Surface | | | | | | | | | | |
| 0.0 / 270.6 | Topsoil | | 1 | SS | 2 | | | | ○ | | |
| 0.3 | Silty sand<br>Loose to compact Brown Wet | | 2 | SS | 17 | | 270 | | ○ | | |
| 268.8 | | | 3 | SS | 7 | | 269 | | ○ | | |
| 2.1 | Silty clay, trace sand<br>Stiff to firm Brown Wet | | 4 | SS | 4 | | 268 | ■ | ○ | | |
| | | | 5 | SS | 4 | | | ■ | ○ | | |
| | | | 6 | SS | 4 | | 267 | ■ | ○ | | |
| | silt seams/partings | | | | | ▽* | | | | | |
| | | | 7 | SS | 5 | | 266 | ■ | ○ | | |
| 263.4 | | | 8 | SS | 2 | | | | ○ | | |
| 7.5 | Silt, trace sand clay seams<br>Compact Brown Wet | | 9 | SS | 5 | | 265 | | ○ | | |
| | | | 10 | SS | 7 | | 264 | | ○ | | |
| 262.1 | | | | | | ▼* | | | | | |
| 8.8 | Sand, trace gravel<br>Compact Reddish brown Moist | | 11 | SS | 14 | | 263 | | ○ | | |
| | | | 12 | SS | 19 | | 262 | | ○ | | |
| 260.8 | | | | | | | 261 | | | | |
| 10.1 | End of borehole<br>Refusal on probable bedrock | | | | | | | | | | |

* 2012 01 17

▽ Water level observed during drilling

▼ Water level measured after driling

■ Penetrometer test

ON MTO_VER3 NEW LOGO 10TF013A-AREA 6.GPJ ON_MOT.GDT 8/7/2014 3:23:07 PM

+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. 6A-5 1 of 1 METRIC

Hwy 11/Interchange Crossing Road, E/W-S Ramp

**G.W.P.** 323-00-00 **LOCATION** Sta. 21+125, o/s 2.4m Rt. of Lt. EP **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 10, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ WATER CONTENT (%) 20 40 60 | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 270.9 | Ground Surface | | | | | | | | | | |
| 0.0 / 270.6 | Topsoil | | 1 | SS | 3 | | 270 | | | | |
| 0.3 | Silty sand<br>Very loose Brown Wet<br>to loose | | 2 | SS | 3 | | | | | | |
| 268.8 | | | 3 | SS | 9 | | 269 | | | | |
| 2.1 | Silt<br>trace clay, trace sand<br>Compact Brown Wet | | 4 | SS | 11 | | 268 | | | | |
| 267.8 | | | | | | | | | | | |
| 3.1 | Silty clay, trace sand<br>silt layers<br>Firm to Reddish Wet<br>very stiff brown | | 5 | SS | 7 | | 267 | | | | |
| | | | | FV | | | | | | | |
| | | | 6 | SS | 10 | | | | | | |
| | Grey | | 7 | SS | 4 | | 266 | | | | 0 1 63 36 |
| | | | | FV | | | | 9 | | | |
| | | | 8 | SS TW | 5 ** | | 265 | | | | |
| | clayey silt layers | | 9 | SS | 4 | | | 10 | | | |
| | | | | FV | | | 264 | | | | |
| | | | 10 | SS | 4 | | | | | | |
| | | | 11 | SS | 7 | ▽* | 263 | 5 | | | 0 2 61 27 |
| 262.4 | | | | FV | | | | | | | |
| 8.5 | Silt<br>trace sand, trace clay<br>layers of wet silty sand | | 12 | SS | 33 | | 262 | | | | |
| 261.8 | | | | | | | | | | | |
| 9.1 | Dense Grey Wet<br>Sand with gravel<br>cobbles and boulders | | 13 | SS | 50/13cm | | | | | | |
| 261.1 | | | | | | | | | | | |
| 9.8 | Very Dense Reddish Wet<br>brown | | | | | | | | | | |
| | End of borehole<br>Refusal on probable bedrock<br>Sample 13: Sampler bouncing | | | | | | | | | | |

* 2012 01 10

** TW sample obtained on October 23, 2012 in new borehole at approximately the same SS sample depth and location

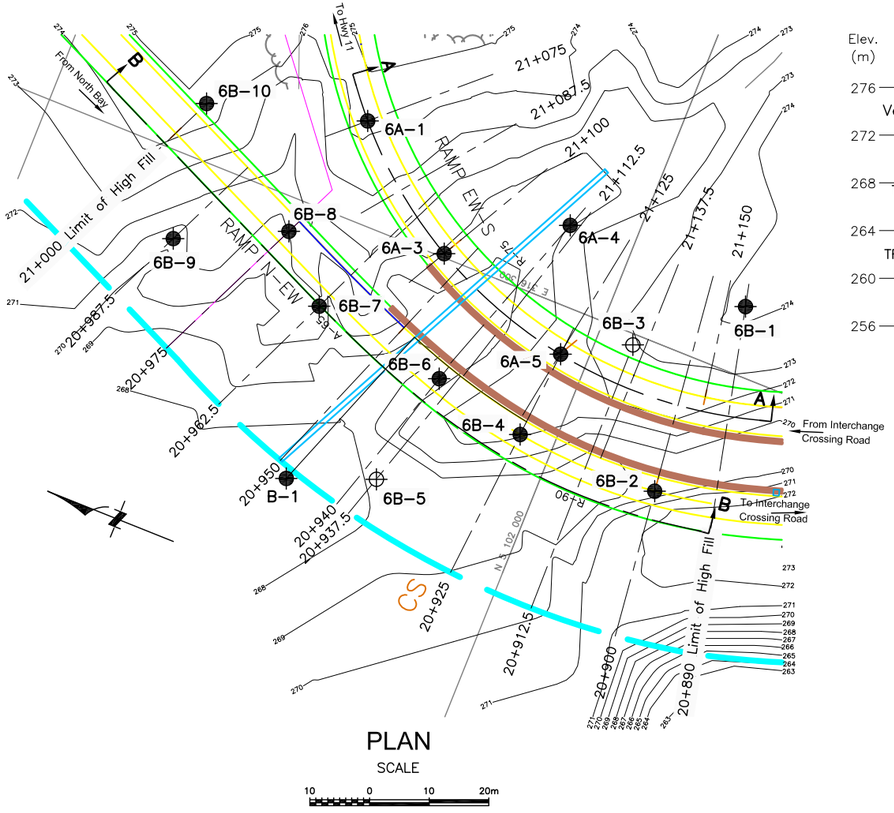
■ Penetrometer test

▽ Water level observed during drilling



+7, ×5 : Numbers refer to Sensitivity

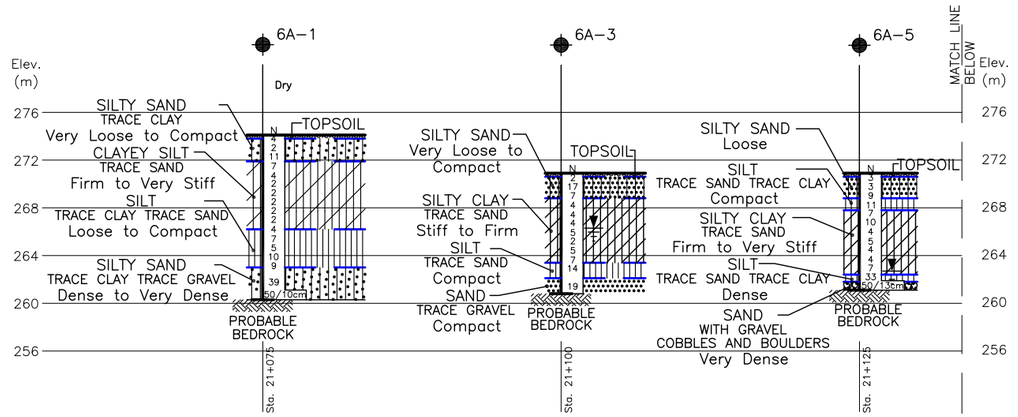
20 / 15—○—5 / 10 (%) STRAIN AT FAILURE



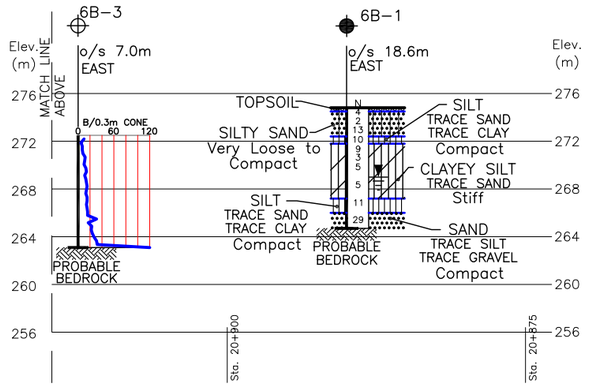

PLAN

SCALE

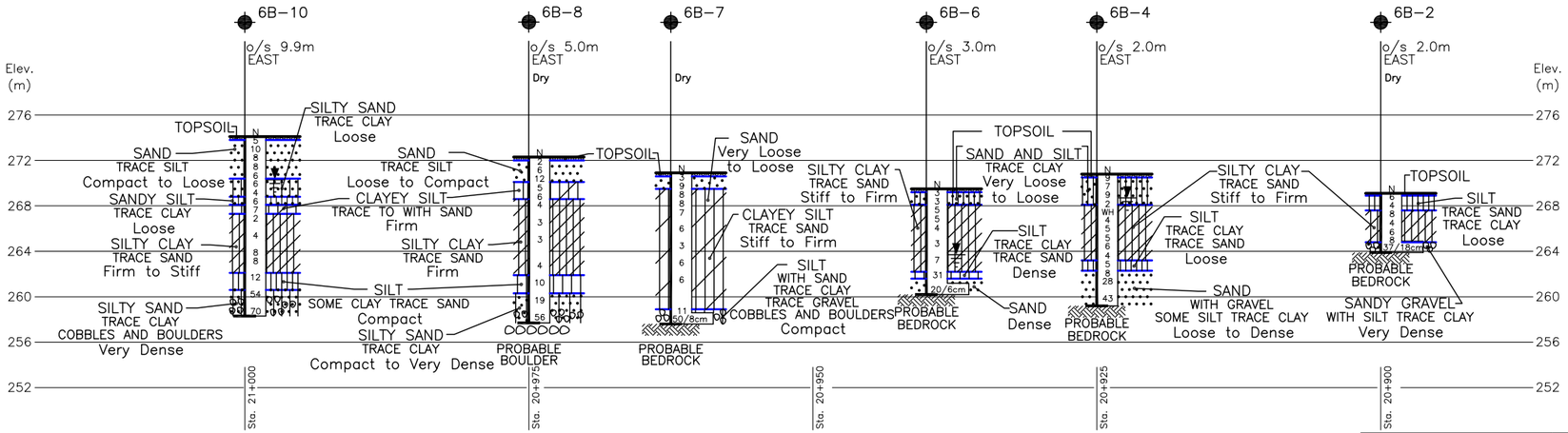
10 0 10 20m




PROFILE A-A




PROFILE A-A (Continued)




PROFILE B-B

SCALE

5 0 5 10m

NOTES:

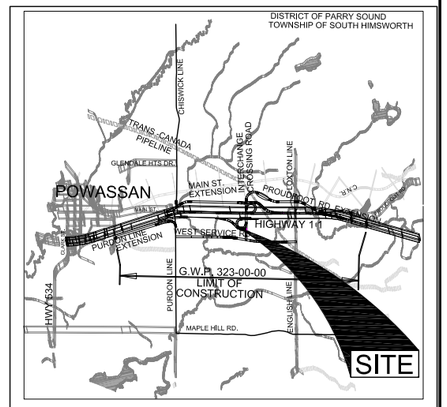
1. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
2. THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
3. DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES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

CONT No
GWP No 323-00-00
WP No

AREA 6B – N-E/W RAMP
Sta. 20+890 to 21+000
HIGHWAY 11 POWASSAN
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET 1

Peto MacCallum Ltd.
CONSULTING ENGINEERS




LEGEND

- Borehole
- Cone
- N Blows/0.3m (Std. Pen Test, 475 J/blow)
- CONE Blows/0.3m (60 Cone, 475 J/blow)
- WH Penetration due to weight of hammer and rods
- WL at time of investigation Dec. 2011
- Head ARTESIAN WATER Encountered
- PIEZOMETER

| BH No | ELEVATION | STA. N–E/W Ramp | o/s Rt. E.P. |
|---|---|---|---|
| 6B–1 | 274.8 | 20+890 | 35.9m Rt. |
| 6B–2 | 269.1 | 20+900 | 2.4m Lt. |
| 6B–3 | 272.5 | 20+912.5 | 19.6m Rt. |
| 6B–4 | 270.8 | 20+925 | 2.4m Lt. |
| 6B–5 | 270.1 | 20+937.5 | 17.5m Lt. |
| 6B–6 | 269.5 | 20+940 | 2.4m Lt. |
| 6B–7 | 270.9 | 20+962.5 | 7.4m Lt. |
| 6B–8 | 272.3 | 20+975 | 2.4m Lt. |
| 6B–9 | 271.4 | 20+987.5 | 12.5m Lt. |
| 6B–10 | 274.1 | 21+000 | 2.4m Rt. |

| BH No | ELEVATION | STA. E/W–S Ramp | o/s Lt. E.P. |
|---|---|---|---|
| 6A–1 | 274.1 | 21+075 | 2.4m Rt. |
| 6A–3 | 270.9 | 21+100 | 2.4m Rt. |
| 6A–5 | 270.9 | 21+125 | 2.4m Rt. |

REF AECOM Drawings: Hwy11-Design.dwg; X-60157537-C-Hwy11-Base.dwg dated September 2010

REGISTERED PROFESSIONAL ENGINEER C M P Nascimento Province of Ontario

REGISTERED PROFESSIONAL ENGINEER B. R. GRAY Province of Ontario

– 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 |

Geocres No. 31L–184

| | | | | | |
|---|---|---|---|---|---|
| HWY No | 11 | | | DIST | North Bay |
| SUBM'D | NA | CHECKED | AD | DATE | FEB. 20, 2015 |
| DRAWN | NA | CHECKED | BRG | APPROVED | CN |
| SITE | | | | DWG | 6B–1 |

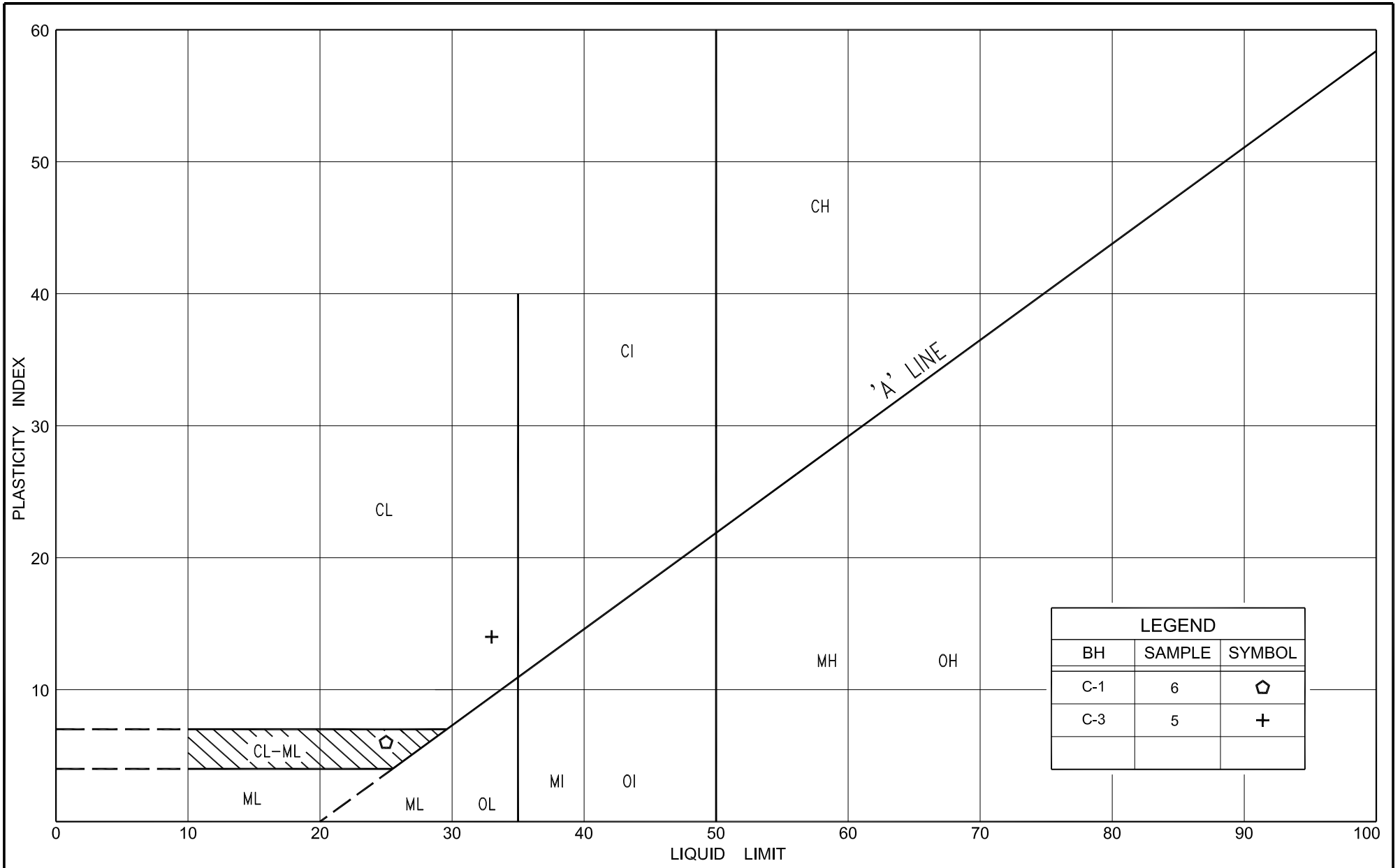
# Area C – New N-E/W Ramp, Sta 21+060 to 21+100

Figures C-PC-1 to C-PC-2 – Plasticity Charts

Figures C-GS-1 to C-GS-6 – Grain Size Distribution Analyses

Record of Borehole Sheets – C-1 to C-5

Drawing C-1 – Borehole Locations and Soil Strata

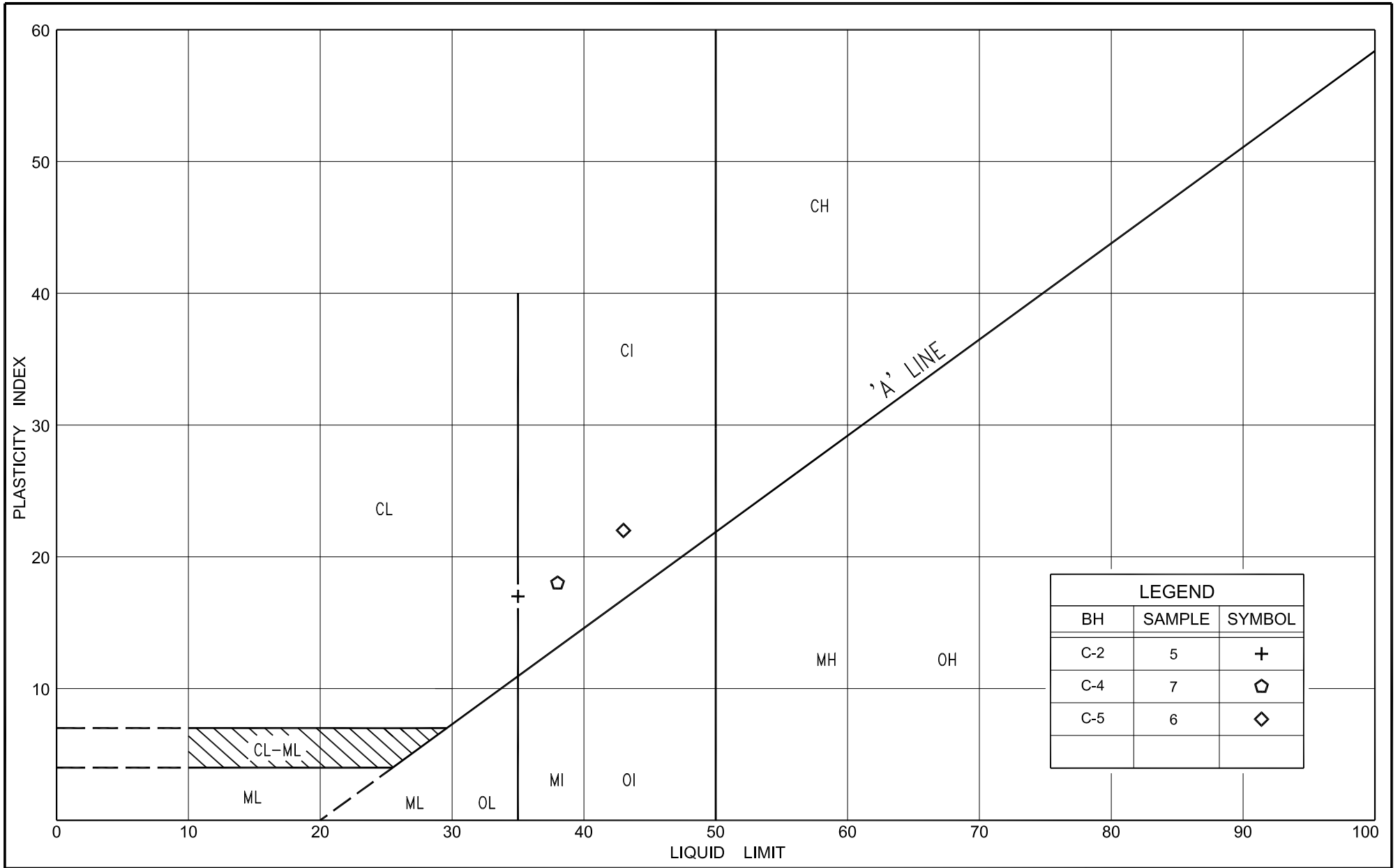



Ontario

# PLASTICITY CHART

CLAYEY SILT, trace sand (CL)

| | |
|---|---|
| FIG No. | C-PC-1 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

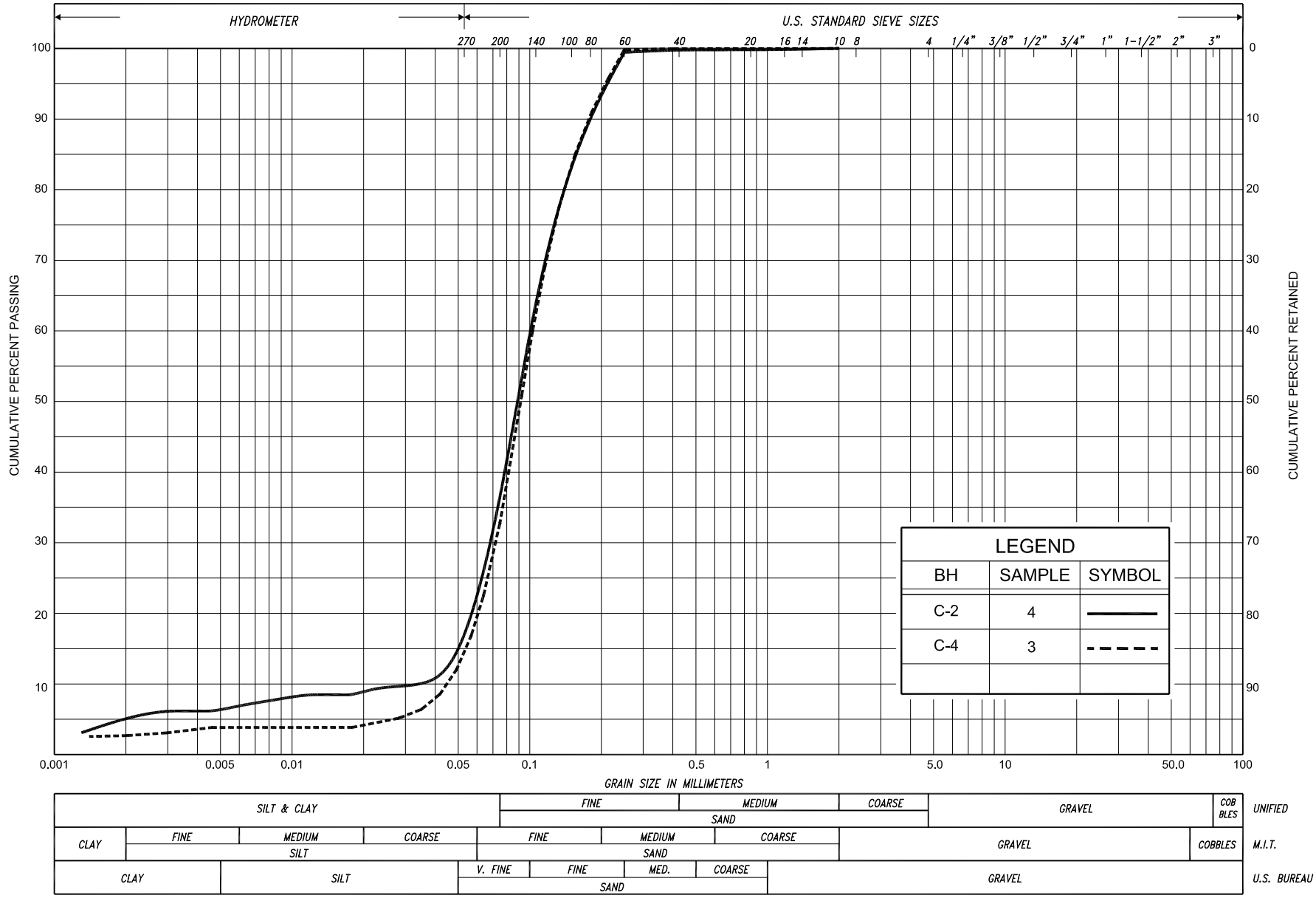



Ontario

# PLASTICITY CHART

SILTY CLAY, trace sand (CI)

| | |
|---|---|
| FIG No. | C-PC-2 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

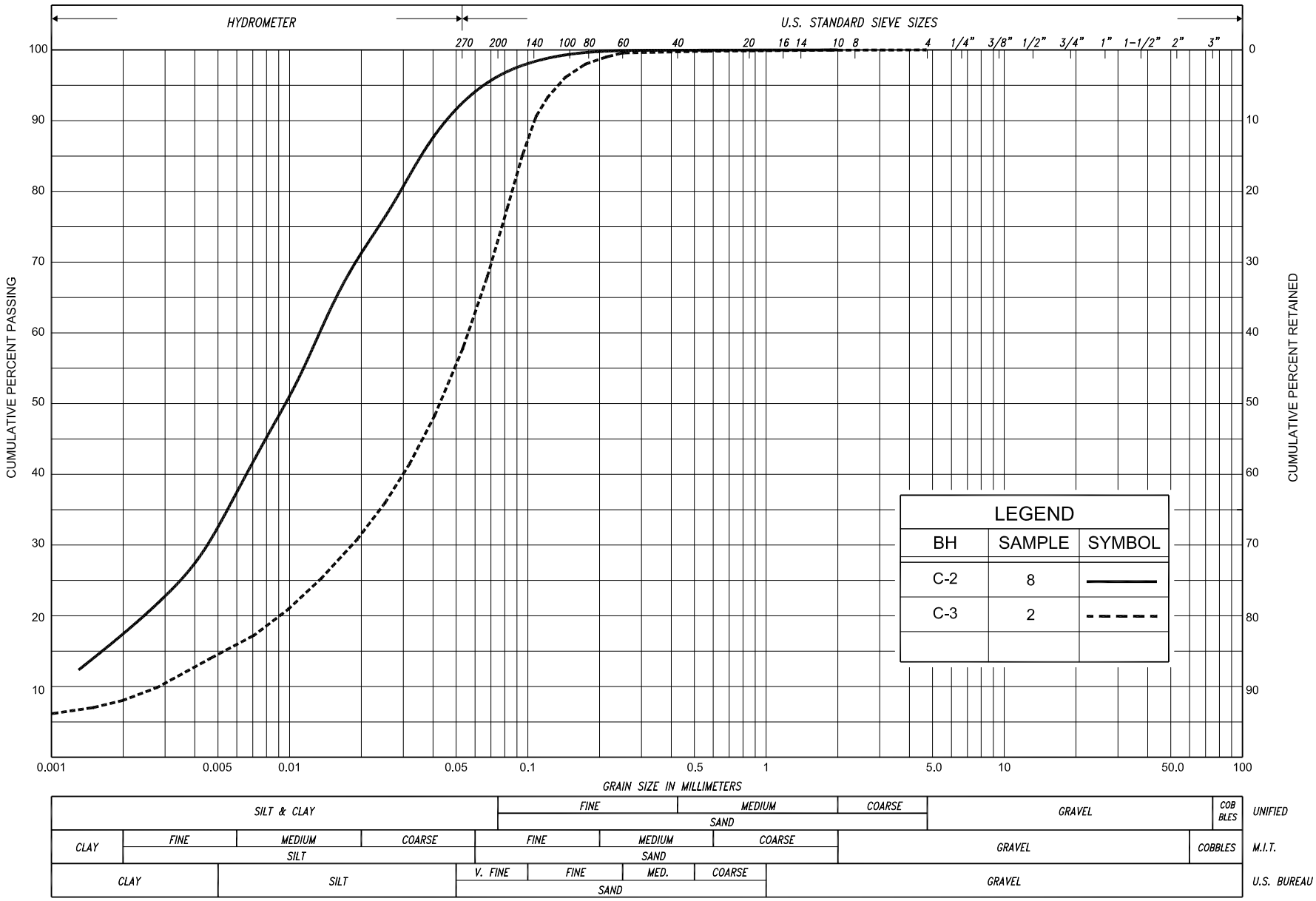



Ontario

# GRAIN SIZE DISTRIBUTION

SILTY SAND, trace clay

| | |
|---|---|
| FIG No. | C-GS-1 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

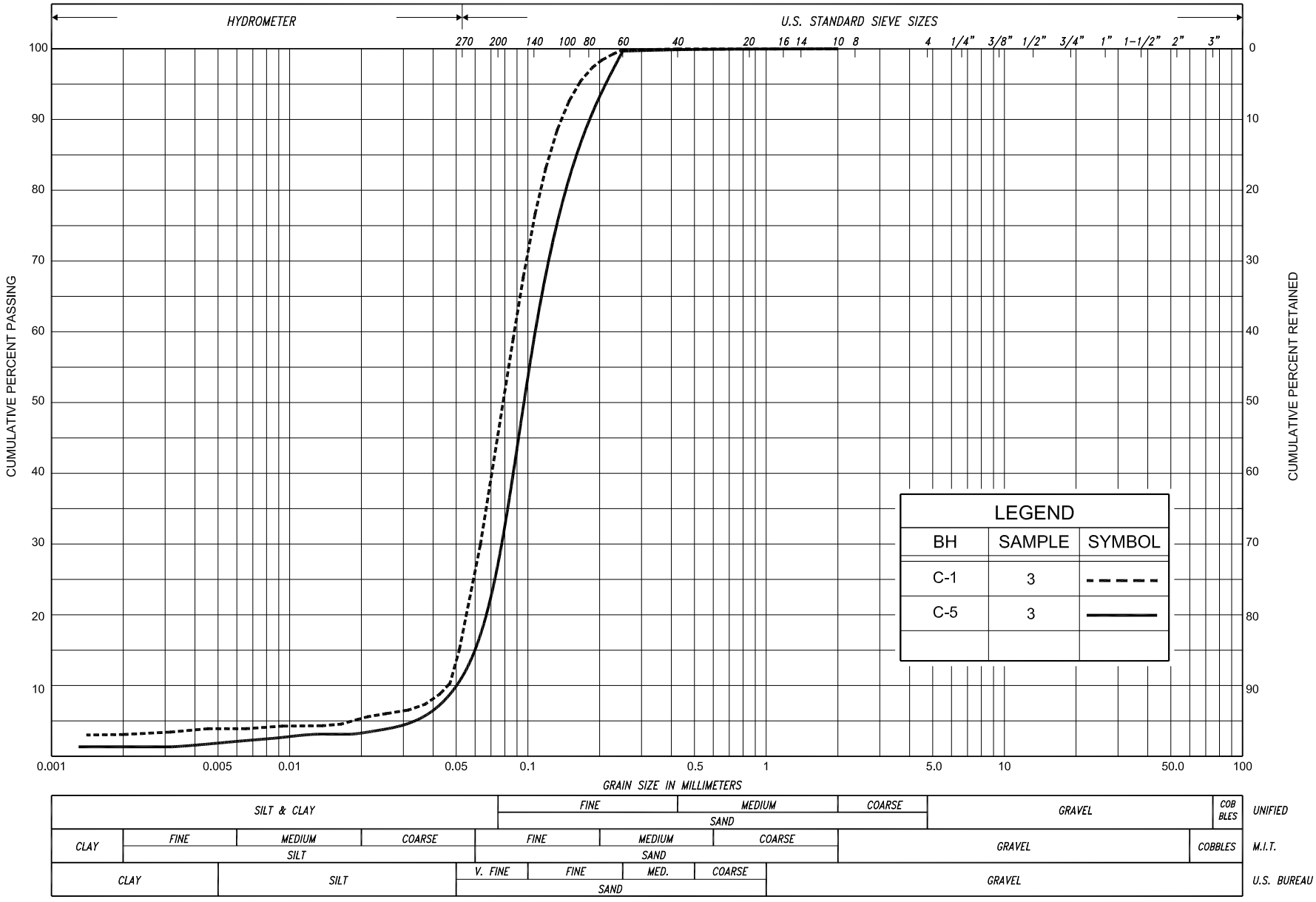



Ontario

# GRAIN SIZE DISTRIBUTION

SILT, trace to with sand, trace to some clay

| | |
|---|---|
| FIG No. | C-GS-2 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

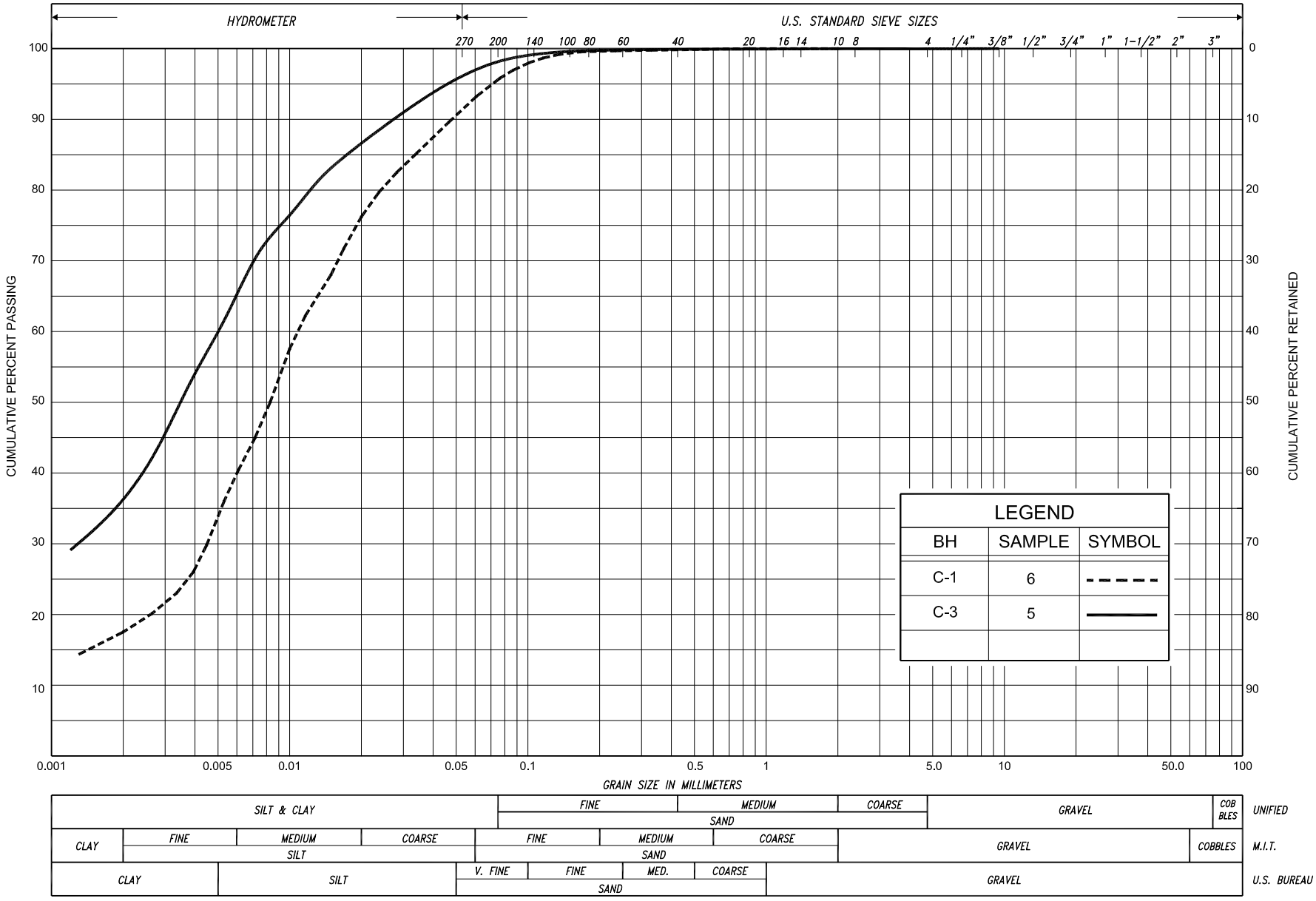



Ontario

# GRAIN SIZE DISTRIBUTION

SAND AND SILT TO SAND, with silt, trace clay

| | |
|---|---|
| FIG No. | C-GS-3 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

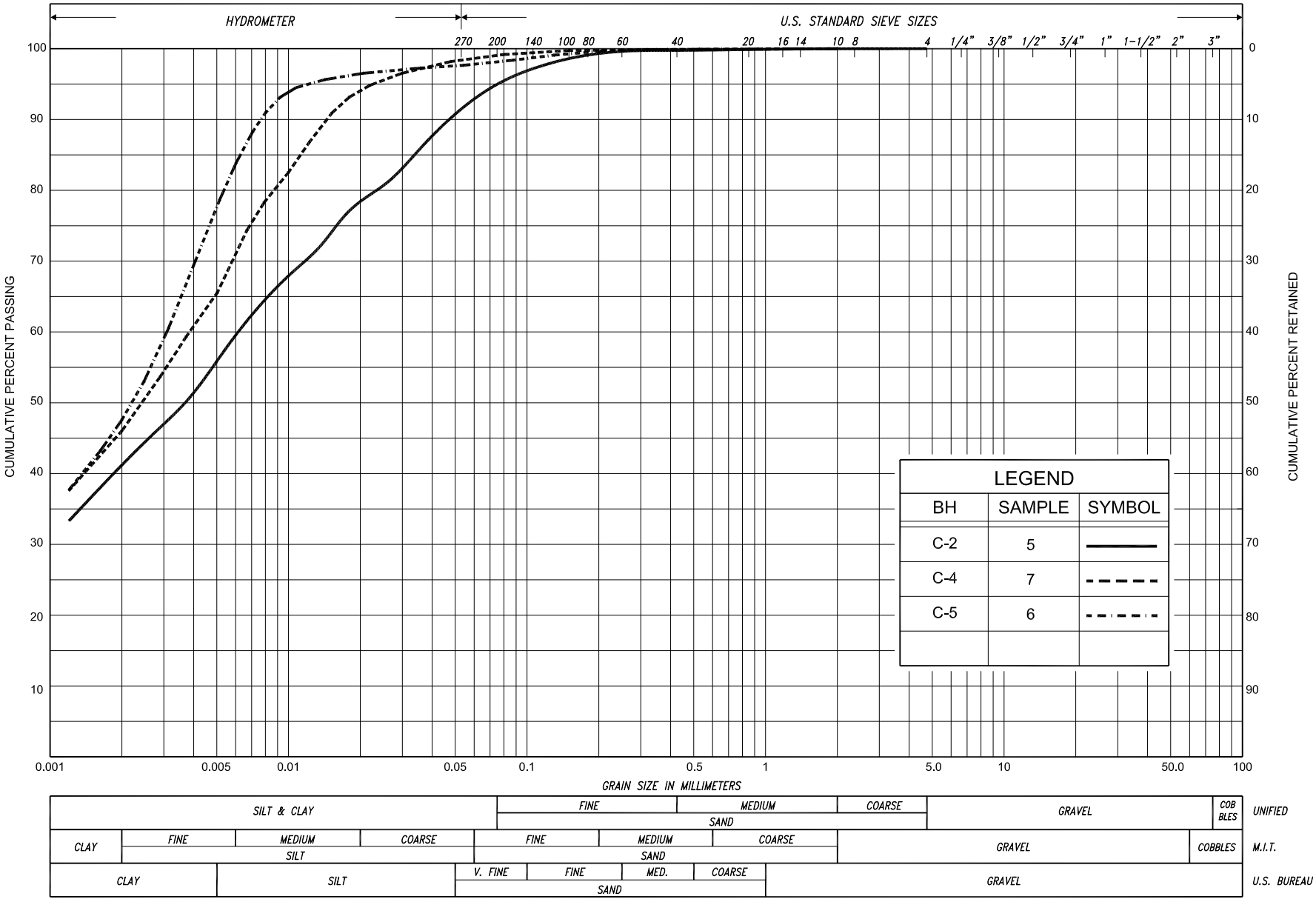



Ontario

# GRAIN SIZE DISTRIBUTION

CLAYEY SILT, trace sand (CL)

| | |
|---|---|
| FIG No. | C-GS-4 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |




Ontario

# GRAIN SIZE DISTRIBUTION

SILTY CLAY, trace sand (CI)

| | |
|---|---|
| FIG No. | C-GS-5 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

Ontario

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# RECORD OF BOREHOLE No. C-1 1 of 1 METRIC

Hwy 11/Interchange Crossing Road

**G.W.P.** 323-00-00 **LOCATION** N-E/W Ramp, Sta. 21+060, o/s 2.4 Lt. **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** July 11 and 12, 2013 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 274.4 | Ground Surface | | | | | | | | | | |
| 274.2 | Topsoil | | | | | | | | | | |
| 0.2 | Sand and silt, trace clay<br>Loose Brown Moist | | 1 | SS | 4 | | 274 | | ○ | | |
| | | | 2 | SS | 9 | | | | ○ | | |
| | | | 3 | SS | 9 | | 273 | | ○ | | 0 55 42 3 |
| | Wet | | 4 | SS | 6 | ▽* | 272 | | | | |
| | | | 5 | SS | 9 | | 271 | | ○ | | |
| 270.7 | | | | | | ▼* | | | | | |
| 3.7 | Clayey silt, trace sand<br>silt seams<br>Stiff to soft Grey Moist | | 6 | SS | 4 | | 270 | 2 | H○ | | 0 4 79 17 |
| | | | | FV | | | | | | | |
| | | | 7 | SS | 6 | | 269 | 4 | ○ | | |
| | silty clay layers | | | FV | | | | | | | |
| | Reddish brown | | 8 | SS | 2 | | 268 | 2 | ○ | | |
| | silt seams | | | FV | | | | | | | |
| | | | 9 | SS | 2 | | 267 | 6 | ○ | | |
| | | | | FV | | | | | | | |
| 265.2 | | | 10 | SS | 4 | | 266 | | ○ | | |
| 9.2 | Silty sand, trace gravel<br>cobbles and boulders | | 11 | SS | 41/23cm | | 265 | | | | |
| 264.8 | | | | | | | | | | | |
| 9.6 | Very dense Grey Moist<br>End of borehole<br>Refusal on probable boulder<br>Sample 11: Sampler bouncing | | | | | | | | | | |

* 2013 07 11 & 12

▽ Water level observed during drilling



+7, ×5: Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. C-2 1 of 1 METRIC

Hwy 11/Interchange Crossing Road

**G.W.P.** 323-00-00 **LOCATION** N-E/W Ramp, Sta. 21+085, o/s 22.7 Lt. **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** July 12, 2013 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT w / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 273.8 | Ground Surface | | | | | | | | | | |
| 273.6 | Topsoil | | | | | | | | | | |
| 0.2 | Silty sand, trace clay<br>Loose Brown Moist | | 1 | SS | 7 | | 273 | | | | |
| | | | 2 | SS | 7 | | | | ○ | | |
| | | | | | | ▽* | | | | | |
| | | | 3 | SS | 10 | | 272 | | ○ | | |
| | | | 4 | SS | 7 | | | | ○ | | 0 62 33 5 |
| 270.8 | | | | | | ▼* | 271 | | | | |
| 3.0 | Silty clay, trace sand<br>Stiff to very stiff Brown Moist | | 5 | SS | 5 | | | | ⊖ | | 0 5 54 41 |
| | | | | FV | | | | > – | | | |
| | | | 6 | SS | 5 | | 270 | | ○ | | |
| | sand layers | | | | | | | | | | |
| | Wet | | 7 | SS | 5 | | 269 | 5 | ○ | | |
| | | | | FV | | | | + | | | |
| 268.0 | | | | | | | 268 | | | | |
| 5.8 | Silt, trace sand<br>trace to some clay<br>clayey silt seams<br>Loose Grey Wet | | 8 | SS | 7 | | | | ○ | | 0 4 79 17 |
| 266.5 | | | | | | | 267 | | | | |
| 7.3 | Sand, some gravel<br>Very dense Reddish brown Moist | | 9 | SS | 55 | | 266 | | | | |
| 265.7 | | | | | | | | | | | |
| 8.1 | End of borehole | | | | | | | | | | |

* 2013 07 12

▽ Water level observed during drilling

▼ Water level measured after drilling

■ Penetrometer test

+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. C-3 1 of 1 METRIC

Hwy 11/Interchange Crossing Road

**G.W.P.** 323-00-00 **LOCATION** N-E/W Ramp, Sta. 21+080, o/s 2.4 Lt. **ORIGINATED BY** A.D.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 11, 2011 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ / WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 272.4 | Ground Surface | | | | | | | | | | |
| 0.0 / 271.8 | Topsoil | | 1 | SS | 3 | | 272 | | ○ | | |
| 0.6 | Silt, with sand trace clay<br>Very loose Grey Wet to compact | | 2 | SS | 2 | ▽* | | | ○ | | 0 27 65 8 |
| | | | 3 | SS | 16 | | 271 | | ○ | | |
| 270.2 | | | | | | | | | | | |
| 2.2 | Clayey silt, trace sand<br>Firm to stiff Grey Wet | | 4 | SS | 7 | | 270 | ■ | ○ | | |
| | | | 5 | SS | 2 | | 269 | | ○ | | 0 2 62 36 |
| | | | | FV | | | | 3 | | | |
| 267.9 | | | | | | | 268 | | | | |
| 4.5 | Sandy silt trace clay, trace gravel cobbles and boulders<br>Very dense Grey Moist | | 6 | SS | 50/10cm | | | | | | |
| 267.7 / 4.7 | End of borehole<br>Refusal on probable boulder | | | | | | | | | | |

* 2011 01 11

▽ Water level observed during drilling

■ Penetrometer test



+7, ×5: Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. C-4 1 of 1 METRIC

Hwy 11/Interchange Crossing Road

**G.W.P.** 323-00-00 **LOCATION** N-E/W Ramp, Sta. 21+087, o/s 25.7 Rt. **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** July 11, 2013 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 277.3 | Ground Surface | | | | | | | | | | |
| 277.1 / 0.2 | Topsoil | | | | | | | | | | |
| | Sandy silt, trace clay<br>Very loose Brown Moist | | 1 | SS | 4 | | 277 | | ○ | | |
| | | | 2 | SS | 4 | | | | ○ | | |
| 276.1 / 1.2 | Silty sand, trace clay<br>Loose Brown Moist | | 3 | SS | 7 | | 276 | | ○ | | 0 67 30 3 |
| | | | 4 | SS | 9 | | 275 | | ○ | | |
| | | | 5 | SS | 9 | ▽* | 274 | | ○ | | |
| 273.6 / 3.7 | Silty clay, trace sand<br>silt seams<br>Stiff to very stiff Grey Wet | | 6 | SS | 6 | | | ■ | ○ | | |
| | Brown | | | FV | | | 273 | > | | | |
| | | | 7 | SS | 6 | | | ■ 5 + | ○ | | 0 2 52 46 |
| | sandy silt seams | | | FV | | | | | | | |
| 271.6 / 5.7 | Gravelly sand, trace silt<br>cobbles and boulders | | 8 | SS | 6 | | 272 | | ○ | | |
| 270.9 / 6.4 | Very dense Reddish brown Moist | | 9 | SS | 50/10cm | | 271 | | ○ | | |
| | End of borehole<br>Refusal on probable boulder | | | | | | | | | | |

Sample 9: Sampler bouncing

* 2013 07 11

▽ Water level observed during drilling

■ Penetrometer test

+7, ×5: Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. C-5 1 of 1 METRIC

Hwy 11/Interchange Crossing Road

**G.W.P.** 323-00-00 **LOCATION** N-E/W Ramp, Sta. 21+100, o/s 2.4 Lt. **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** July 12 and 15, 2013 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ WATER CONTENT (%) 20 40 60 | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 275.6 | Ground Surface | | | | | | | | | | |
| 275.4 | Topsoil | | | | | | | | | | |
| 0.2 | Silt, trace sand organics<br>Loose Brown Moist | | 1 | SS | 4 | | 275 | | | | |
| | | | 2 | SS | 5 | | | | | | |
| 274.2 | | | | | | | | | | | |
| 1.4 | Sand, with silt<br>Compact to loose Brown Moist | | 3 | SS | 14 | ▽* | 274 | | ○ | | 0 73 26 1 |
| | Wet | | 4 | SS | 5 | ▼* | 273 | | | | |
| 272.3 | | | | | | | | | | | |
| 3.3 | Silty clay, trace sand<br>Stiff to firm Brown Wet | | 5 | SS | 7 | | 272 | | | | |
| | | | 6 | SS | 2 | | | | ● | | 0 2 51 47 |
| | clayey silt seams | | | FV | | | | + 12 | | | |
| | | | 7 | SS | 5 | | 271 | | | | |
| | | | | FV | | | | + 10 | | | |
| | silt seams | | 8 | SS | 6 | | 270 | | | ○ | |
| 269.3 | | | | | | | | | | | |
| 6.3 | Gravelly sand cobbles and boulders<br>Dense Brown Moist | | 9 | SS | 37 | | 269 | | | ○ | |
| 268.6 | | | | | | | | | | | |
| 7.0 | End of borehole<br>Refusal on probable boulder | | | | | | | | | | |

* 2013 07 12 & 15

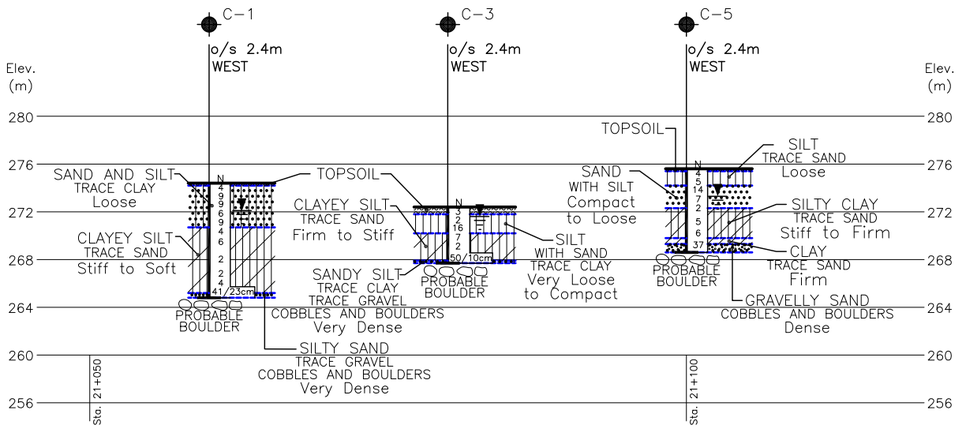
▽ Water level observed during drilling

▼ Water level measured after drilling

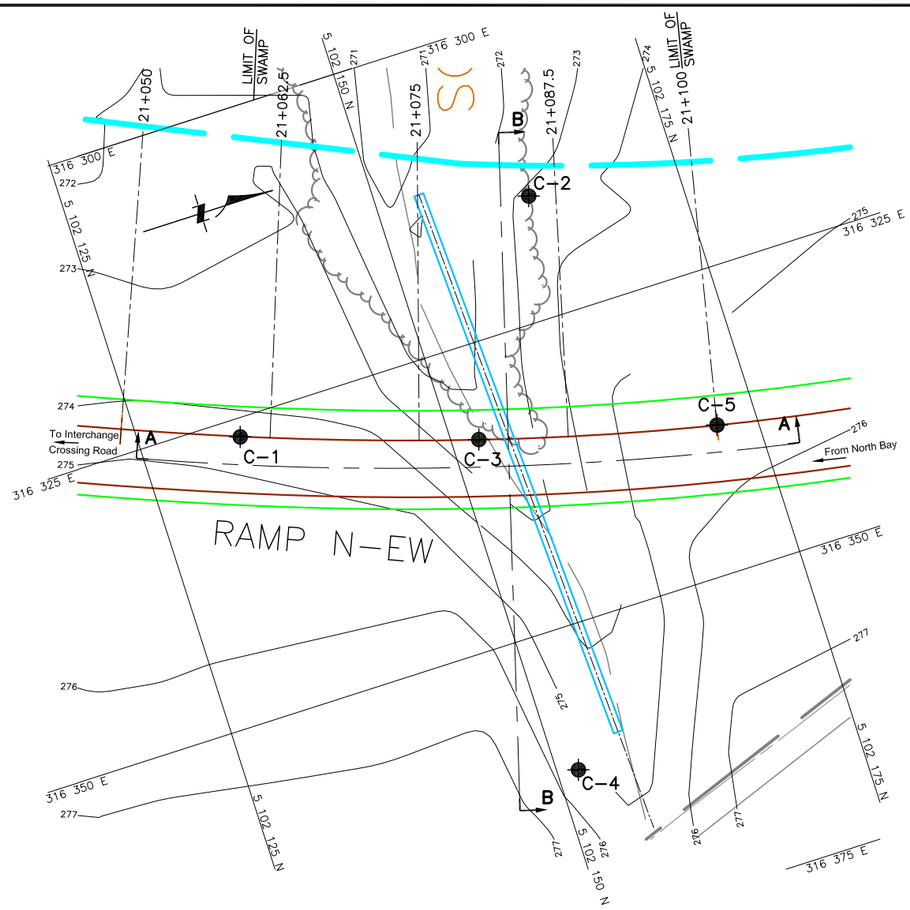
NOTE: Borehole caved-in at 2.5m

+7, ×5: Numbers refer to Sensitivity

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



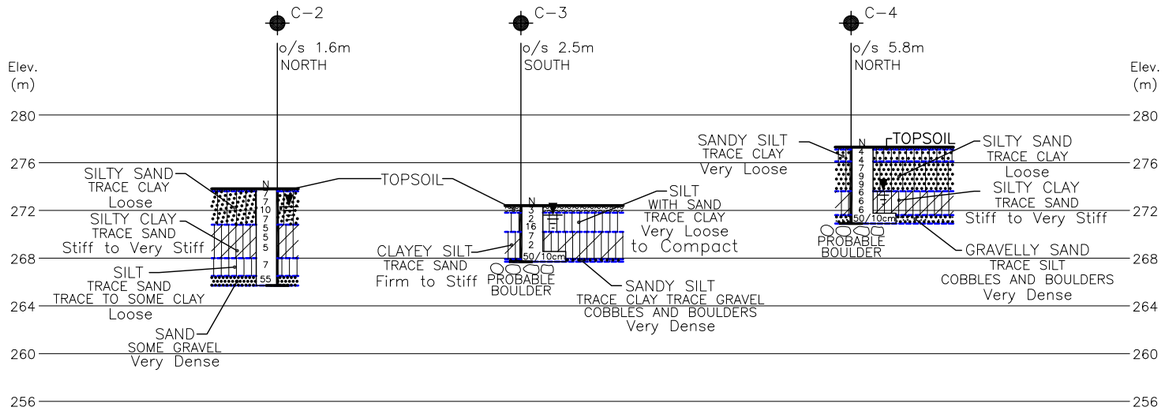

PROFILE A-A ALONG Ç RAMP N-E/W




PLAN

SCALE

5 0 5 10m




SECTION B-B

SCALE

5 0 5 10m

NOTES:

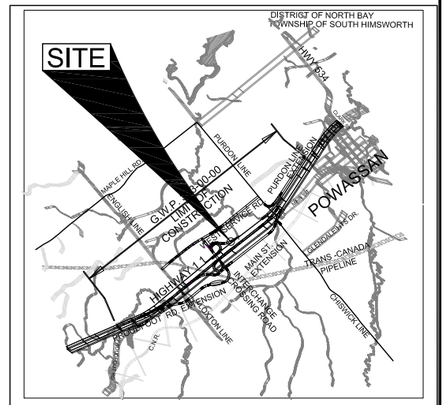
1. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
2. THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
3. DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES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

CONT No
GWP No 323-00-00
WP No

SHEET 1

AREA 'C' – RAMP N-E/W
Sta. 21+060 TO 21+100
HIGHWAY 11 POWASSAN
BOREHOLE LOCATIONS AND SOIL STRATA

Peto MacCallum Ltd.
CONSULTING ENGINEERS




LEGEND

- Borehole
- Cone
- N Blows/0.3m (Std. Pen Test, 475 J/blow)
- CONE Blows/0.3m (60 Cone, 475 J/blow)
- WH Penetration due to weight of hammer and rods
- WL at time of investigation July 2013
- Head
- ARTESIAN WATER Encountered
- PIEZOMETER

| BH No | ELEVATION | STA. N-E/W Ramp | o/s CL |
|---|---|---|---|
| C-1 | 274.4 | 21+060 | 2.4m Lt. |
| C-2 | 273.8 | 21+085 | 22.7m Lt. |
| C-3 | 272.4 | 21+080 | 2.4m Lt. |
| C-4 | 277.3 | 21+087 | 25.7m Rt. |
| C-5 | 275.6 | 21+100 | 2.4m Lt. |

– 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 |
|---|---|---|
| | | |

REGISTERED PROFESSIONAL ENGINEER
C M P Nascimento
Feb. 20, 2015
PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER
B. R. GRAY
Feb. 20, 2015
PROVINCE OF ONTARIO

REF AECOM Drawings: Hwy11-Design.dwg: X-60157537-C-Hwy11-Base.dwg dated September 2010

Geocres No. 31L-184

| | | | | | |
|---|---|---|---|---|---|
| HWY No | 11 | | | DIST | North Bay |
| SUBM'D | NA | CHECKED | AD | DATE | FEB. 20, 2015 |
| DRAWN | NA | CHECKED | BRG | APPROVED | CN |
| SITE | | | | DWG | C-1 |

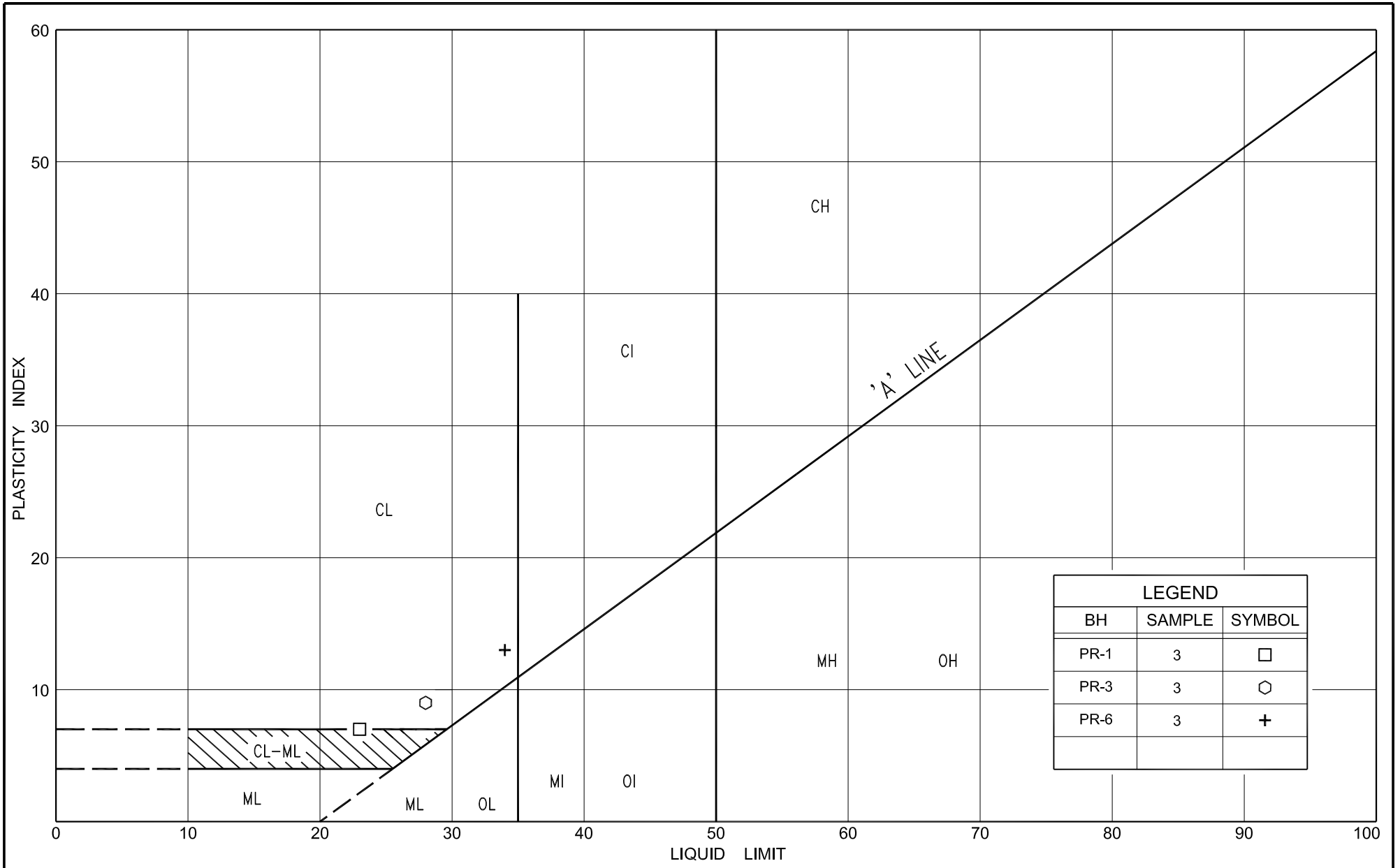
# Area 11 – Proudfoot Road Extension, Sta. 8+620 to 8+710

Figures PR-PC-1 to PR-PC-2 – Plasticity Charts

Figures PR-GS-1 to PR-GS-4 – Grain Size Distribution Analyses

Record of Borehole Sheets – PR-1 to PR-6, PR-A, PR-B and PR-C

Drawing 11-1 – Borehole Locations and Soil Strata

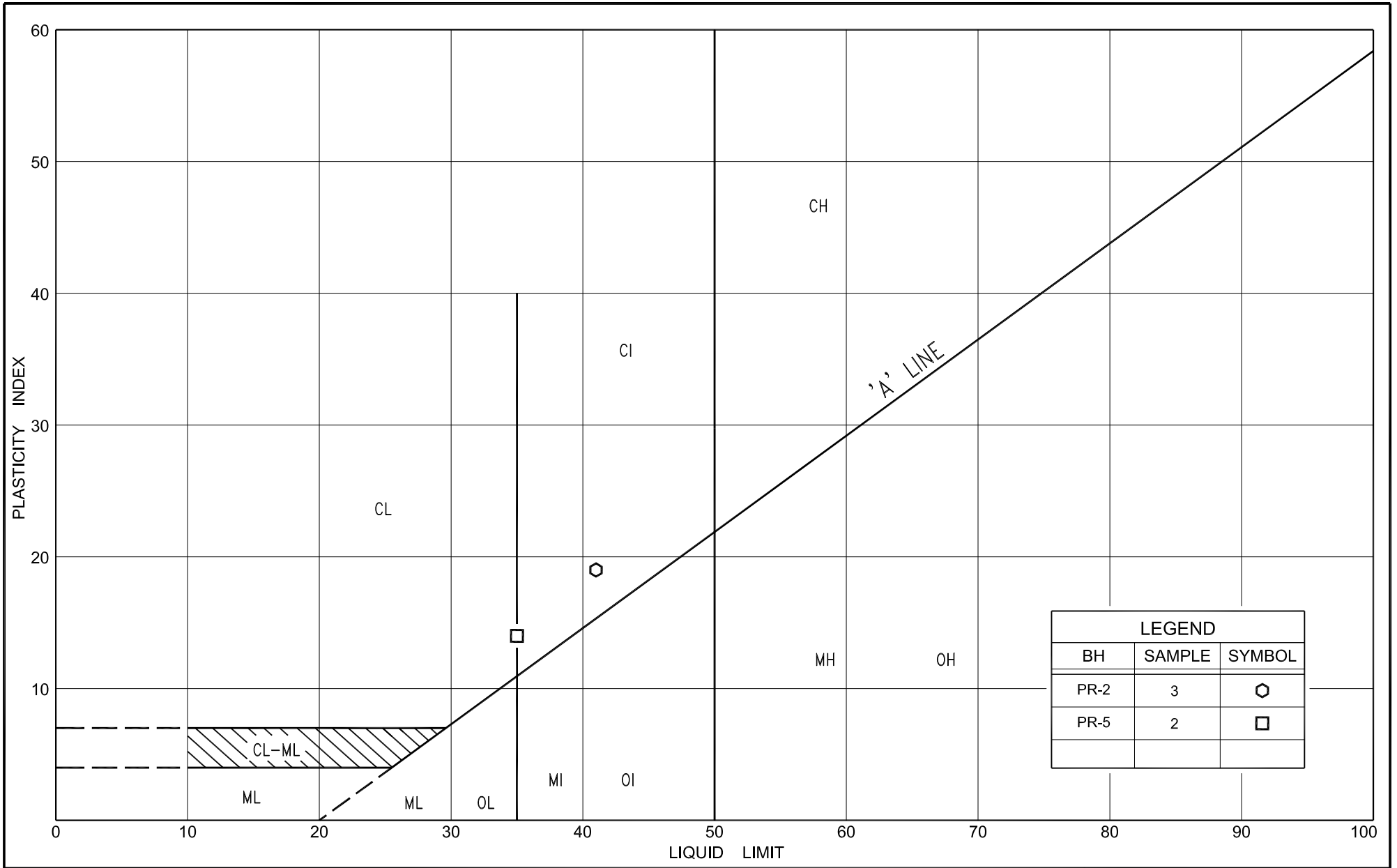



Ontario

# PLASTICITY CHART

CLAYEY SILT, trace to some sand (CL)

| | |
|---|---|
| FIG No. | PR-PC-1 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

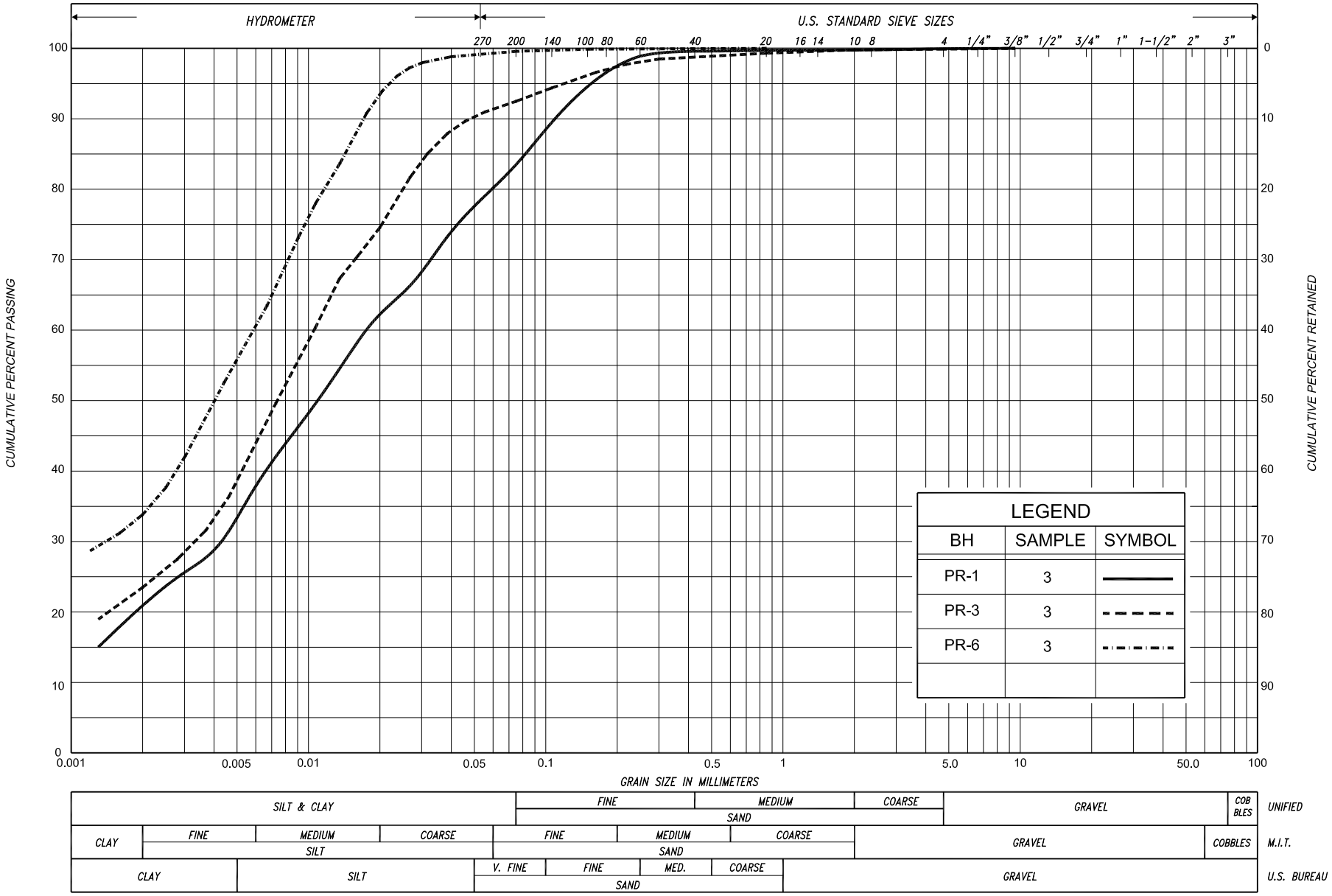



Ontario

# PLASTICITY CHART

SILTY CLAY, trace sand (CI)

| | |
|---|---|
| FIG No. | PR-PC-2 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

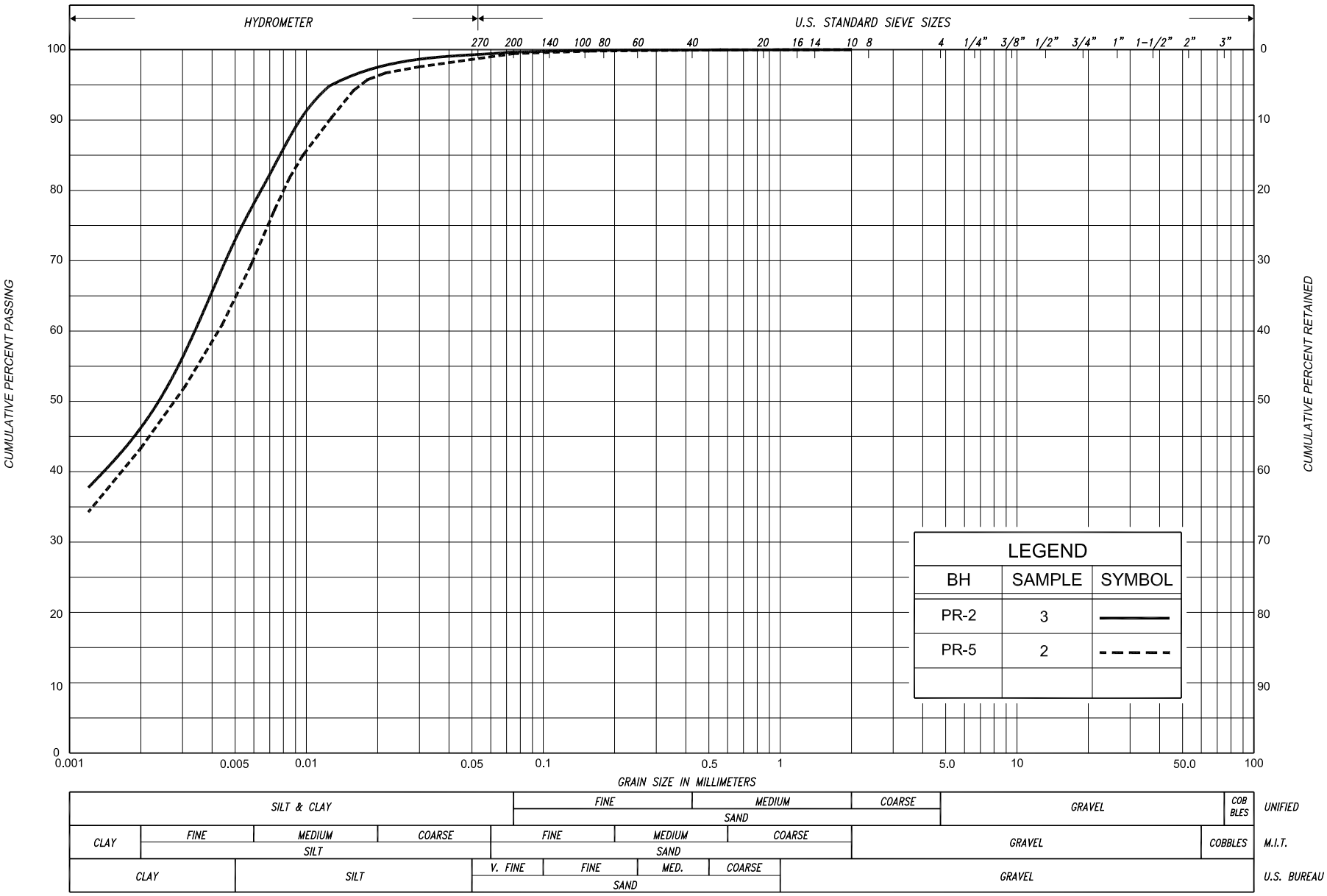



Ontario

# GRAIN SIZE DISTRIBUTION

CLAYEY SILT, trace to some sand (CL)

| | |
|---|---|
| FIG No. | PR-GS-1 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

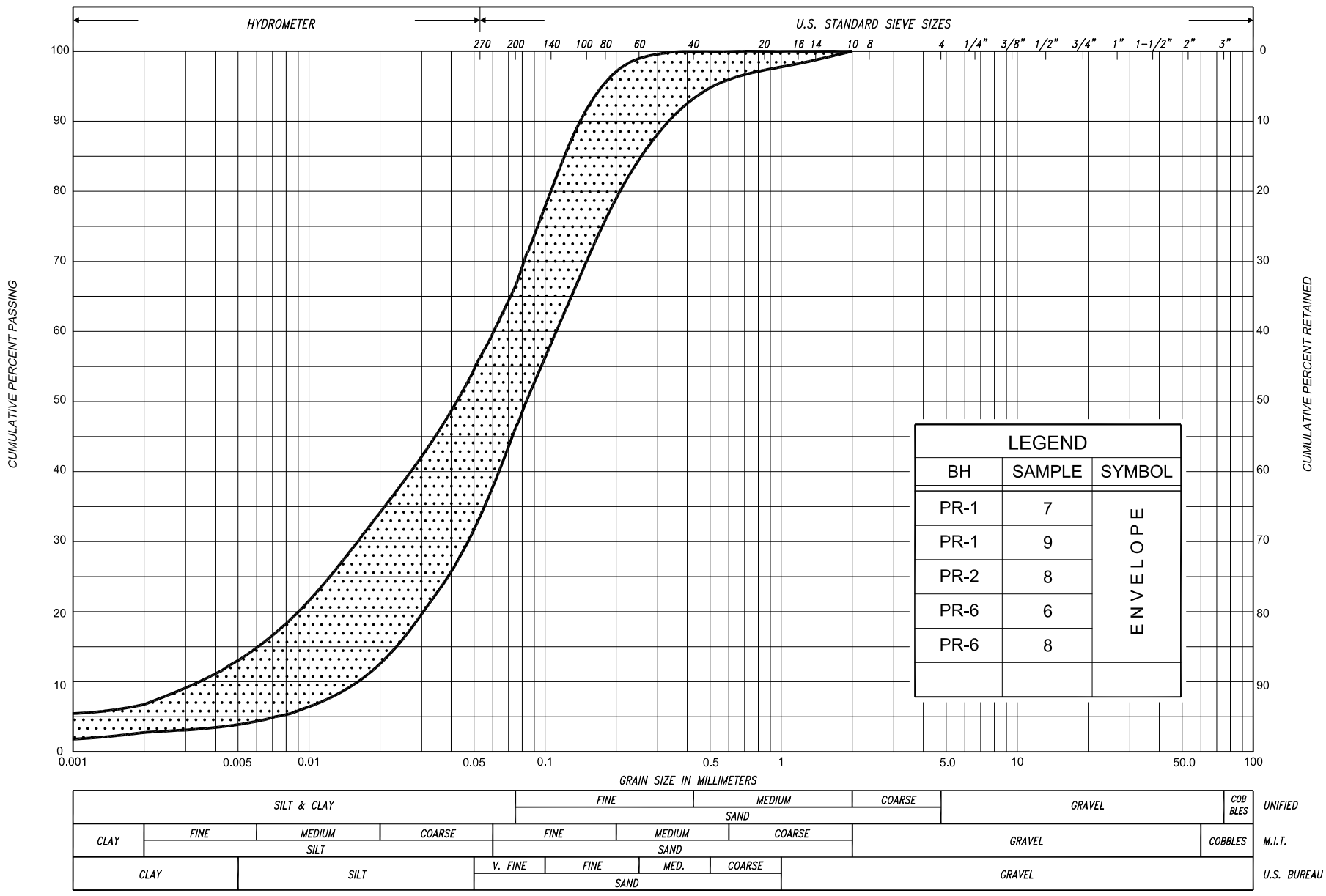



Ontario

# GRAIN SIZE DISTRIBUTION

SILTY CLAY, trace sand (CI)

| | |
|---|---|
| FIG No. | PR-GS-2 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

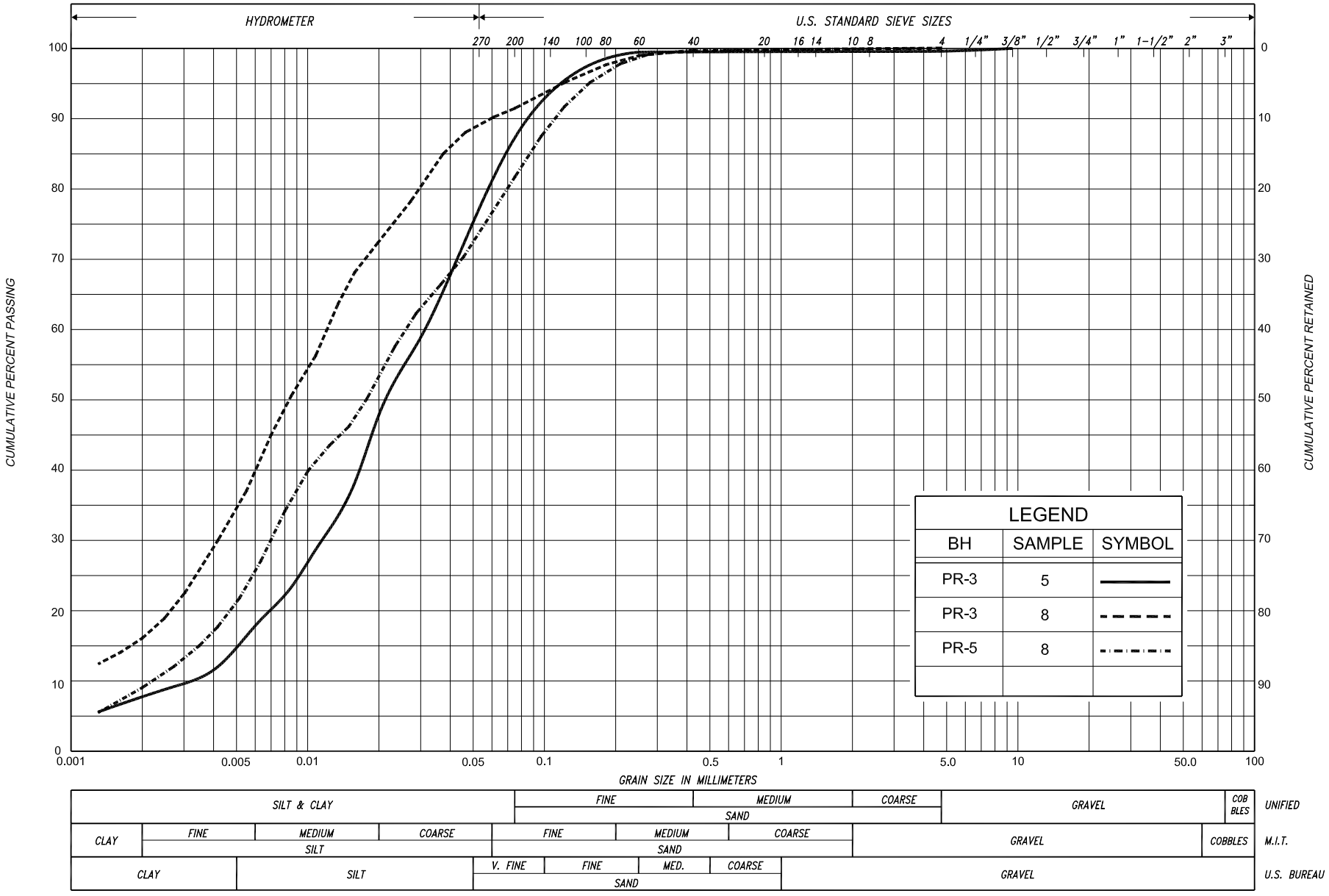



Ontario

# GRAIN SIZE DISTRIBUTION

SANDY SILT TO SAND AND SILT, trace clay

| | |
|---|---|
| FIG No. | PR-GS-3 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |




Ontario

# GRAIN SIZE DISTRIBUTION

SILT, trace to some sand, trace to some clay

| | |
|---|---|
| FIG No. | PR-GS-4 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

Ontario

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# RECORD OF BOREHOLE No. PR-1 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** Proudfoot Road Ext. Sta. 8+637.5 o/s 20.5m Lt **ORIGINATED BY** A.K.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 26, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT w / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 259.8 | Ground Surface | | | | | | | | | | |
| 0.0 / 259.5 | Topsoil | | 1 | SS | 18 | | | | ○ | | |
| 0.3 | Sandy silt, trace clay<br>Compact Brown Wet | | 2 | SS | 16 | | 259 | | ○ | | |
| 258.4 | | | | | | | | | | | |
| 1.4 | Clayey silt, trace sand<br>Stiff to firm Brown Wet | | 3 | SS | 6 | | 258 | ■ | ○ | | 0 17 62 21 |
| 256.8 | | | 4 | SS | 9 | | 257 | ■ | ○ | | |
| 3.0 | Sand and silt, trace clay<br>Compact to loose Brown Wet | | 5 | SS | 10 | | | | | | |
| | | | 6 | SS | 8 | ▽* | 256 | | ○ | | |
| | | | 7 | SS | 3 | | 255 | | ○ | | 0 54 43 3 |
| | | | | | | | 254 | | | | |
| | | | 8 | SS | 8 | | | | ○ | | |
| | | | | | | | 253 | | | | |
| | | | 9 | SS | 8 | | 252 | | ○ | | 0 44 51 5 |
| | | | | | | | 251 | | | | |
| 250.0 | | | 10 | SS | 8 | | 250 | | ○ | | |
| 9.8 | End of borehole | | | | | | | | | | |

* 2012 01 26

▽ Water level observed during drilling

■ Penetrometer test



+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. PR-2 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** Proudfoot Road Ext. Sta. 8+637.5, o/s 20.5m Rt. **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** C.F.H.S.A. and Dynamic Cone Penetration Test **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 30, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 261.3 | Ground Surface | | | | | | | | | | |
| 261.1 | Topsoil | | | | | | | | | | |
| 0.2 | Silt, trace fine sand<br>trace clay<br>Compact Brown Wet | | 1 | SS | 11 | | 261 | | | | |
| 260.1 | | | 2 | SS | 11 | | | | | | |
| 1.2 | Silty clay<br>silt partings<br>Soft Brown Moist | | 3 | SS | 3 | | 260 | | | | 0 1 53 46 |
| | | | 4 | SS | 3 | | 259 | | | | |
| | Grey<br>silt layers | | 5 | SS | 3 | | 258 | | | | |
| | | | 6 | SS | 7 | ▽* | 257 | | | | |
| 256.8 | | | | | | | | | | | |
| 4.5 | Sandy silt, trace clay<br>Loose Grey Wet<br>silty sand seams | | 7 | SS | 8 | ▼* | 256 | | | | |
| | | | 8 | SS | 6 | | 255 | | | | 0 36 58 6 |
| 254.0 | | | | | | | | | | | |
| 7.3 | Silty sand<br>sandy silt seams<br>Loose Dark grey Wet | | 9 | SS | 7 | | 254 | | | | |
| | | | 10 | SS | 4 | | 253 | | | | |
| 251.5 | | | | | | | 252 | | | | |
| 9.8 | End of borehole<br>Probable silty sand<br>Compact | | | | | | 251 | | | | |
| 250.6 | | | | | | | | | | | |
| 10.7 | End of dynamic cone penetration test | | | | | | | | | | |

* 2012 01 30

▽ Water level observed during drilling

▼ Water level measured after drilling

C.F.H.S.A. denotes Continuous Flight Hollow Stem Augers



+7, ×5 : Numbers refer to Sensitivity

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

Ontario

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Foundation Design

# RECORD OF BOREHOLE No. PR-3 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** Proudfoot Road Ext. Sta. 8+650 CL **ORIGINATED BY** A.K.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 26, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ / WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 259.5 | Ground Surface | | | | | | | | | | |
| 0.0 / 258.9 | Sandy silt<br>Loose Brown Wet (FILL) | | 1 | SS | 8 | | 259 | | ○ | | |
| 0.6 / 257.3 | Clayey silt, trace sand<br>Stiff Brown Wet | | 2 | SS | 10 | | | | ○ | | |
| | | | 3 | SS | 12 | | 258 | | ⊢● | | 0 7 69 24 |
| 2.2 | Silt, trace sand<br>trace clay, trace gravel<br>Loose Brown Wet | | 4 | SS | 9 | | 257 | | ○ | | |
| | | | 5 | SS | 9 | ▽* | 256 | | ○ | | 1 11 80 8 |
| | | | 6 | SS | 2 | | | | | | |
| | | | 7 | SS | 6 | | 255 | | ○ | | |
| | some clay | | | | | | 254 | | | | |
| | | | 8 | SS | 6 | | 253 | | ○ | | 0 9 75 16 |
| | | | 9 | SS | 7 | | 252 | | ○ | | |
| | | | | | | | 251 | | | | |
| 9.8 / 249.7 | End of borehole | | 10 | SS | 7 | | 250 | | ○ | | |

* 2012 01 26

▽ Water level observed during drilling



+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF PENETRATION TEST No PR-4 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** Proudfoot Road Ext. Sta. 8+687.5, o/s 20.5m Rt. **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Dynamic Cone Penetration Test **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 31, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ / WATER CONTENT (%) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 259.4 | Ground Surface | | | | | | | | | | |
| 0.0 | Topsoil | | | | | | 259 | | | | |
| | Probable clayey silt | | | | | | | | | | |
| | Stiff | | | | | | 258 | | | | |
| | | | | | | | 257 | | | | |
| | Probable silt | | | | | | | | | | |
| | Compact | | | | | | 256 | | | | |
| | | | | | | | 255 | | | | |
| | Probable sandy silt | | | | | | | | | | |
| | Compact | | | | | | 254 | | | | |
| | | | | | | | 253 | | | | |
| | | | | | | | 252 | | | | |
| | | | | | | | 251 | | | | |
| | | | | | | | 250 | | | | |
| | | | | | | | 249 | | | | |
| 248.7 | | | | | | | | | | | |
| 10.7 | End of dynamic cone test | | | | | | | | | | |

MOT_DCPT R2012 10TF013A FINAL.GPJ ON_MOT.GDT 8/7/2014 4:32:38 PM

+7, ×5 : Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. PR-5 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** Proudfoot Road Ext. Sta. 8+690, o/s 20.2m Lt. **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 31, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 260.1 | Ground Surface | | | | | | | | | | |
| 0.0 / 259.8 | Topsoil | | 1 | SS | 7 | | 260 | | | | |
| 0.3 | Silty clay, trace sand silt layers<br>Firm to stiff Brown Wet | | 2 | SS | 7 | | 259 | | | | 0 1 56 43 |
| | | | 3 | SS | 8 | | 258 | | | | |
| 257.1 | | | 4 | SS | 11 | ▽* | | | | | |
| 3.0 | Silt, trace to some sand, trace clay<br>Loose Brown Wet to grey | | 5 | SS | 8 | ▼* | 257 | | | | |
| | | | 6 | SS | 1 | | 256 | | | | |
| | silt layers | | 7 | SS | 5 | | 255 | | | | |
| | | | 8 | SS | 8 | | 254 | | | | 0 18 73 9 |
| | | | 9 | SS | 7 | | 253 | | | | |
| | | | | | | | 252 | | | | |
| | | | | | | | 251 | | | | |
| 250.3 | | | 10 | SS | 9 | | | | | | |
| 9.8 | End of borehole | | | | | | | | | | |

* 2012 01 31

▽ Water level observed during drilling

▼ Water level measured after drilling

■ Penetrometer test

+7, ×5 : Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. PR-6 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** Proudfoot Road Ext. Sta. 8+700, o/s 20.5m Rt **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** January 31, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|
| 259.8 | Ground Surface | | | | | | | |
| 0.0 / 259.5 | Topsoil | | 1 | SS | 8 | | 259 | |
| 0.3 | Silt<br>trace sand, trace clay<br>Compact Brown Moist | | 2 | SS | 10 | | | |
| 258.4 | | | | | | | 258 | |
| 1.4 | Silty clay, trace sand<br>Firm Brown Wet | | 3 | SS | 6 | | | 0 1 65 34 |
| 257.5 | | | | | | | 257 | |
| 2.3 | Clayey silt<br>silt seams<br>Firm Brown Wet | | 4 | SS | 7 | | | |
| 256.6 | | | | | | ▽* | | |
| 3.2 | Silt<br>trace sand, trace clay<br>silt seams<br>Compact Brown Wet<br>to loose<br>sandy silt layers | | 5 | SS | 12 | | 256 | |
| | | | 6 | SS | 9 | | | 0 34 62 4 |
| | | | 7 | SS | 1 | ▼* | 255 | |
| 254.3 | | | | | | | | |
| 5.5 | Sandy silt, trace clay<br>Loose to compact Grey Wet | | | | | | 254 | |
| | | | 8 | SS | 8 | | | 0 35 58 7 |
| | | | | | | | 253 | |
| | | | 9 | SS | 8 | | 252 | |
| | | | | | | | 251 | |
| 250.4 | | | | | | | | |
| 9.4 / 250.0 | Sand, trace silt<br>Compact Brown Wet | | 10 | SS | 12 | | 250 | |
| 9.8 | End of borehole | | | | | | | |

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

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

UNIT WEIGHT γ kN/m³

* 2012 01 31

▽ Water level observed during drilling

▼ Water level measured after drilling

■ Penetrometer test



+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. PR-A 1 of 1 METRIC

Proudfoot Road Extension, Sta. 8+670, o/s 26.0m Lt.

**G.W.P.** 323-00-00 **LOCATION** Coords: 5 100 945.2 N; 317 023.5 E **ORIGINATED BY** J.H.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** November 03, 2010 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ WATER CONTENT (%) 20 40 60 | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 259.2 | Ground Surface | | | | | | | | | | |
| 0.0 / 258.6 | Topsoil | | | | | | 259 | | | | |
| 0.6 | Organic silt<br>Loose Grey/brown Wet | | 1 | SS | 5 | ▼* | 258 | | | | |
| 256.7 | | | 2 | SS | 11 | | 257 | | | | |
| 2.5 | Silt and sand, trace gravel silty clay layers<br>Compact to Grey Wet very loose | | | | | | 256 | | | | |
| | | | 3 | SS | 4 | | 255 | | | | |
| | | | | | | | 254 | | | | |
| | | | 4 | SS | 5 | | 253 | | | | |
| | Brown/grey | | | | | | 252 | | | | |
| | | | 5 | SS | 8 | | 251 | | | | |
| | | | 6 | SS | 4 | | 250 | | ○ | | 0 37 58 5 |
| 249.1 | | | | | | | | | | | |
| 10.1 | End of borehole | | | | | | | | | | |

* 2010 11 03

▼ Water level measured after drilling

NOTE: Borehole PR-A was carried out for pavement design purposes and reused.



+7, ×5 : Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. PR-B 1 of 1 METRIC

Proudfoot Road Extension, Sta. 8+670 CL

**G.W.P.** 323-00-00 **LOCATION** Coords: 5 100 942.9 N; 317 049.4 E **ORIGINATED BY** J.H.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** November 03, 2010 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ / WATER CONTENT (%) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 259.1 | Ground Surface | | | | | | | | | | |
| 0.0 / 258.5 | Topsoil | | | | | ▼* | 259 | | | | |
| 0.6 | Organic clayey silt<br>silt seams, varved<br>Soft to stiff Grey Moist to wet | | 1 | SS | 3 | | 258 | | | | |
| | | | 2 | SS | 11 | | 257 | | | | |
| 255.1 | | | | | | | 256 | | | | |
| 4.0 | Silt, some sand<br>sand and silty clay seams<br>Loose Grey Wet | | 3 | SS | 5 | | 255 | | | | |
| | | | 4 | SS | 6 | | 254 | | | | |
| 251.6 | | | | | | | 253 | | | | |
| 7.5 | Silty sand<br>Loose Grey Wet | | 5 | SS | 5 | | 252 | | | | |
| | | | 6 | SS | 5 | | 251 | | | | |
| 249.1 | | | | | | | 250 | | | | |
| 10.0 | End of borehole | | | | | | | | | | |

* 2010 11 03

▼ Water level measured after drilling

NOTE: Borehole PR-B was carried out for pavement design purposes and reused.



+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. PR-C 1 of 2 METRIC

Proudfoot Road Extension, Sta. 8+670, o/s 26.0m Rt.

**G.W.P.** 323-00-00 **LOCATION** Coords: 5 100 940.7 N; 317 075.3 E **ORIGINATED BY** J.H.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** November 03, 2010 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 259.2 | Ground Surface | | | | | | | | | | |
| 0.0 / 258.5 | Topsoil | | 1 | SS | 4 | | 259 | | ○ | | |
| 0.7 | Silt and sand, trace clay organic seams<br>Very loose Brown/ grey Moist to wet | | 2 | SS | 4 | ▼* | 258 | | ○ | | |
| | | | 3 | SS | 3 | | 257 | | ○ | | |
| 256.2 | | | 4 | SS | 2 | | | | ○ | | 0 44 53 3 |
| 3.0 | Silty clay, trace sand sand layers organics<br>Firm to stiff Grey Wet | | 5 | SS | 4 | | 256 | | ⊖ | | 0 7 77 16 |
| | | | | FV | | | | + 3 | | | |
| 254.8 | | | | | | | 255 | | | | |
| 4.4 | Silty sand, organics silty clay seams<br>Very loose Grey Wet | | 6 | SS | 1 | | | | ○ | | |
| | Loose | | 7 | SS | 5 | | 253 | | ○ | | |
| 252.0 | | | | | | | 252 | | | | |
| 7.2 | Sandy silt silty clay seams<br>Very loose Grey Wet to loose | | 8 | SS | 4 | | | | ○ | | |
| | | | 9 | SS | 4 | | 250 | | ○ | | 0 32 59 9 |
| | | | 10 | SS | 8 | | 248 | | ○ | | |
| | some gravel, cobbles<br>Dense | | 11 | SS | 48 | | 247 | | ○ | | |
| 245.9 | | | | | | | 246 | | | | |
| 13.3 | Sand some gravel, trace silt<br>Dense to very dense Brown Wet | | 12 | SS | 100/23cm | | 245 | | | | |
| 244.7 | | | | | | | | | | | |
| 14.5 | End of borehole<br>Refusal on probable boulder<br>Cont'd | | | | | | | | | | |

ON MTO_VER3 NEW LOGO 10TF013A- AREA A N E.GPJ ON_MOT.GDT 8/7/2014 4:48:41 PM

+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. PR-C 2 of 2 METRIC

Proudfoot Road Extension, Sta. 8+670, o/s 26.0m Rt.

**G.W.P.** 323-00-00 **LOCATION** Coords: 5 100 940.7 N; 317 075.3 E **ORIGINATED BY** J.H.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** November 03, 2010 **CHECKED BY** B.R.G.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ NATURAL MOISTURE CONTENT $w$ LIQUID LIMIT $w_L$ WATER CONTENT (%) 20 40 60 | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEV / DEPTH 244.2 | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | | | GR SA SI CL |
| | Sample 12: Sampler bouncing | | | | | | | | | | |
| | * 2010 11 03 | | | | | | | | | | |
| | ▼ Water level measured after drilling | | | | | | | | | | |
| | NOTE: Borehole PR-A was carried out for pavement design purposes and reused. | | | | | | | | | | |

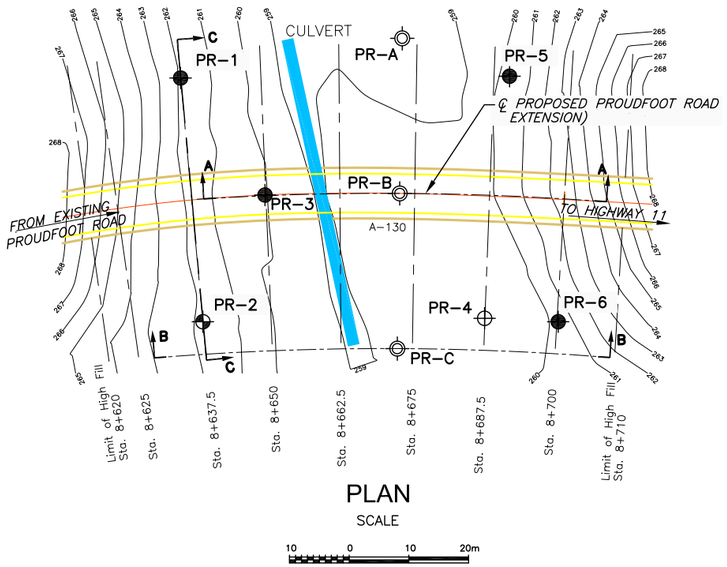


+ , × : Numbers refer to Sensitivity

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

| | |
|---|---|
| CONT No<br>GWP No 323-00-00 | Z |
| AREA 11 –PROUDFOOT ROAD EXTENSION<br>Sta. 8+620 to 8+710<br>HIGHWAY 11 POWASSAN<br>BOREHOLE LOCATIONS AND SOIL STRATA | SHEET<br>1 |

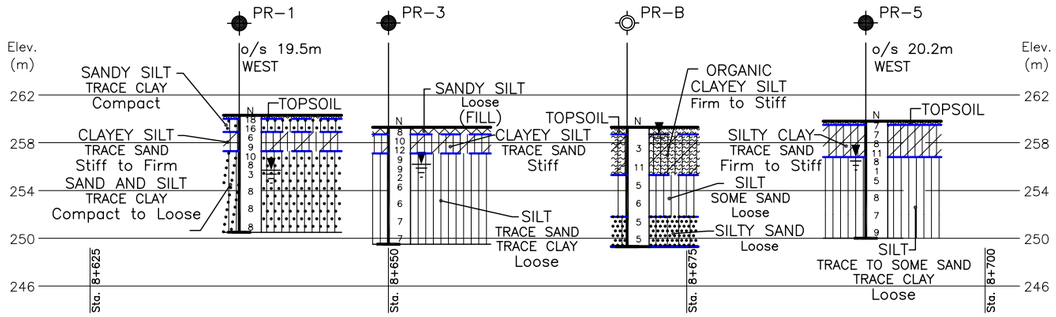
Peto MacCallum Ltd.
CONSULTING ENGINEERS



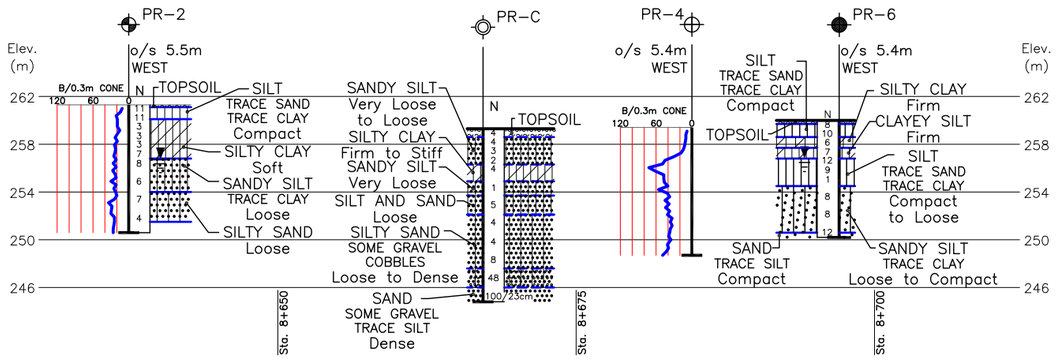

PLAN

SCALE

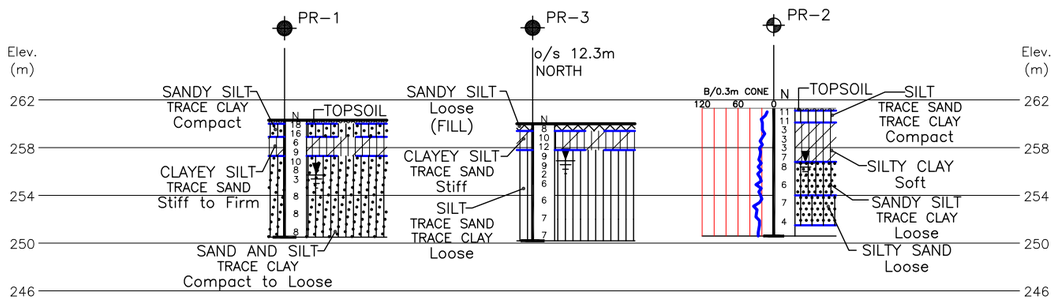
10 0 10 20m




PROFILE A-A



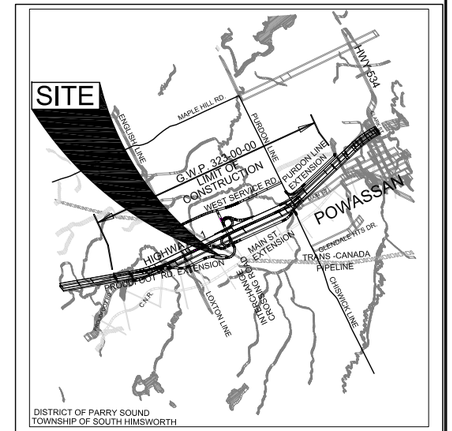

PROFILE B-B




SECTION C-C

SCALE

5 0 5 10m




KEY PLAN

0.5km 0 0.5km 1.0km 1.5km

LEGEND

- Borehole
- Borehole and Cone
- Dynamic Cone Penetration Test (Cone)
- Pavement Borehole (See Appendix 'B')
- N Blows/0.3m (Std. Pen Test, 475 J/blow)
- CONE Blows/0.3m (60 Cone, 475 J/blow)
- WL at time of investigation Dec. 2011
- Head ARTESIAN WATER Encountered
- PIEZOMETER

| BH No | ELEVATION | STA. | o/s |
|---|---|---|---|
| PR–1 | 259.8 | 8+637.5 | 20.5m Lt. |
| PR–2 | 261.3 | 8+637.5 | 20.5m Rt. |
| PR–3 | 259.5 | 8+650 | CL |
| PR–4 | 259.4 | 8+687.5 | 20.5m Rt. |
| PR–5 | 260.1 | 8+690 | 20.2m Lt. |
| PR–6 | 259.8 | 8+700 | 20.5m Rt. |

(Legend Continues)

(Legend Continues)

| BH No | ELEVATION | STA. | o/s |
|---|---|---|---|
| PR–A | 259.2 | 8+670 | 26.0m Lt. |
| PR–B | 259.3 | 8+670 | CL |
| PR–C | 259.3 | 8+670 | 26.0m Rt. |

NOTES:

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

REGISTERED PROFESSIONAL ENGINEER C M P Nascimento FEB. 20, 2015 PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER B. R. GRAY Feb. 20, 2015 PROVINCE OF ONTARIO

REF AECOM Drawings:
Hwy11-Design.dwg; and X-60157537-C-Hwy11-Base.dwg dated September 2010

– 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 | |

**Geocres No. 31L–184**

| | | | | | |
|---|---|---|---|---|---|
| HWY No | 11 | | | DIST | North Bay |
| SUBM'D | NA | CHECKED | AD | DATE | FEB. 20, 2015 |
| DRAWN | NA | CHECKED | BRG | APPROVED | CN |
| SITE | | | | | |
| DWG | 11–1 | | | | |

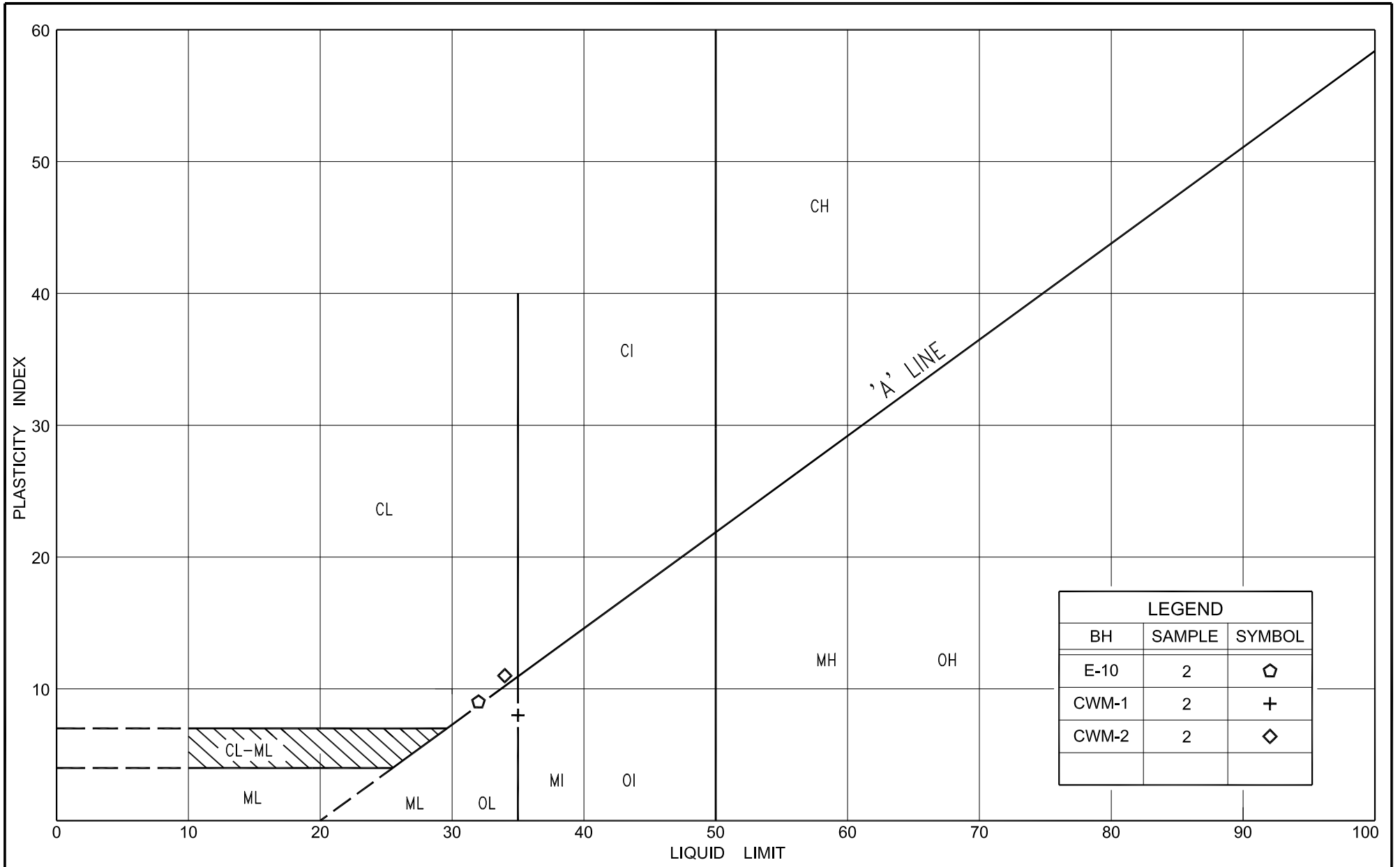
# Area E – West Service Road, Sta. 9+400 to 9+685

Figures E-PC-1 to E-PC-5 – Plasticity Charts

Figures E-GS-1 to E-GS-13 – Grain Size Distribution Analyses

Record of Borehole Sheets – E-1 to E-19, CWM-1 to CWM-6, CWM-AP-1 and CWM-AP-2

Drawing E-1 to E-3 – Borehole Locations and Soil Strata

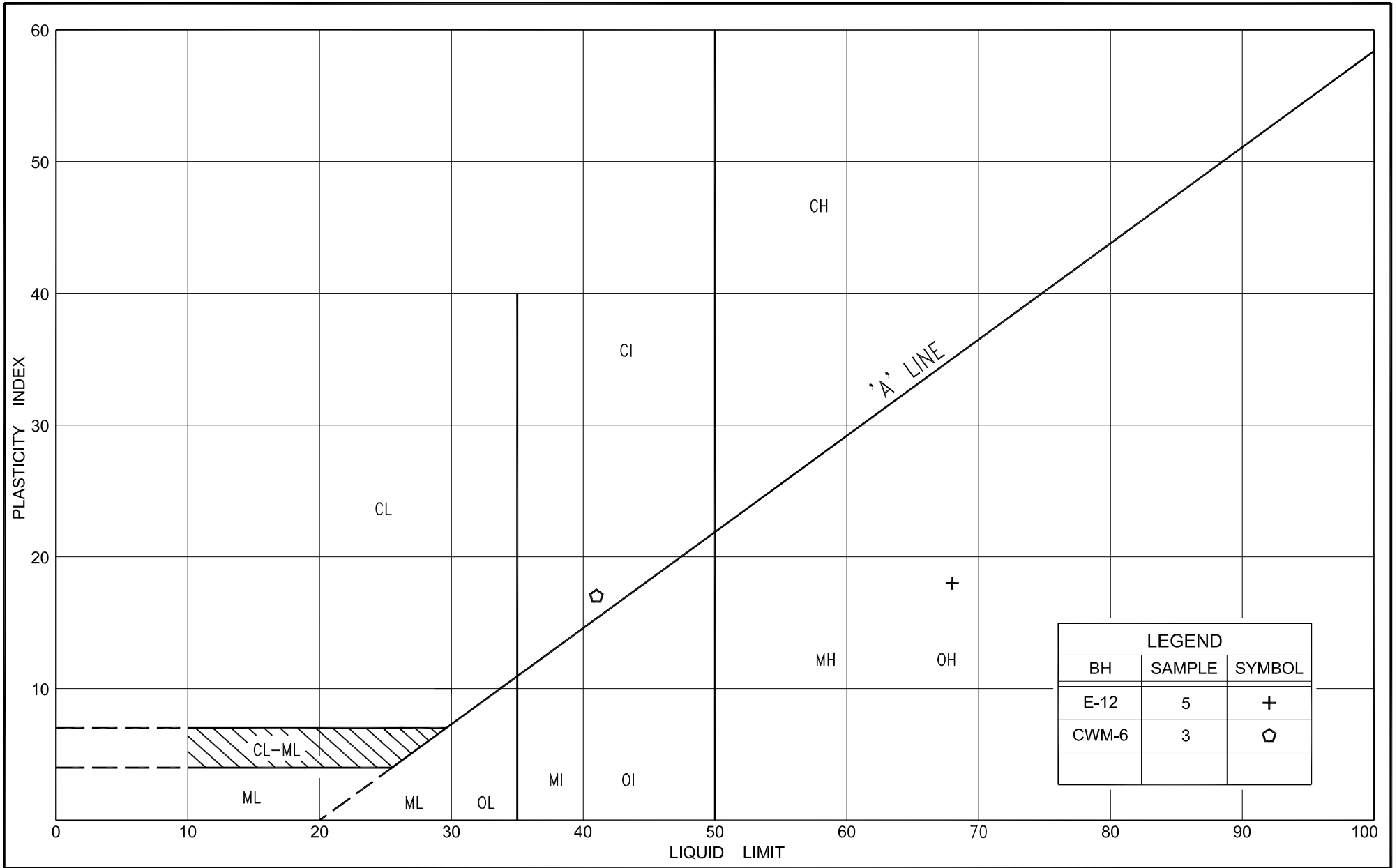



Ontario

# PLASTICITY CHART

ORGANIC CLAYEY SILT, trace sand (CL-OL)
(ALLUVIUM)

| | |
|---|---|
| FIG No. | E-PC-1 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

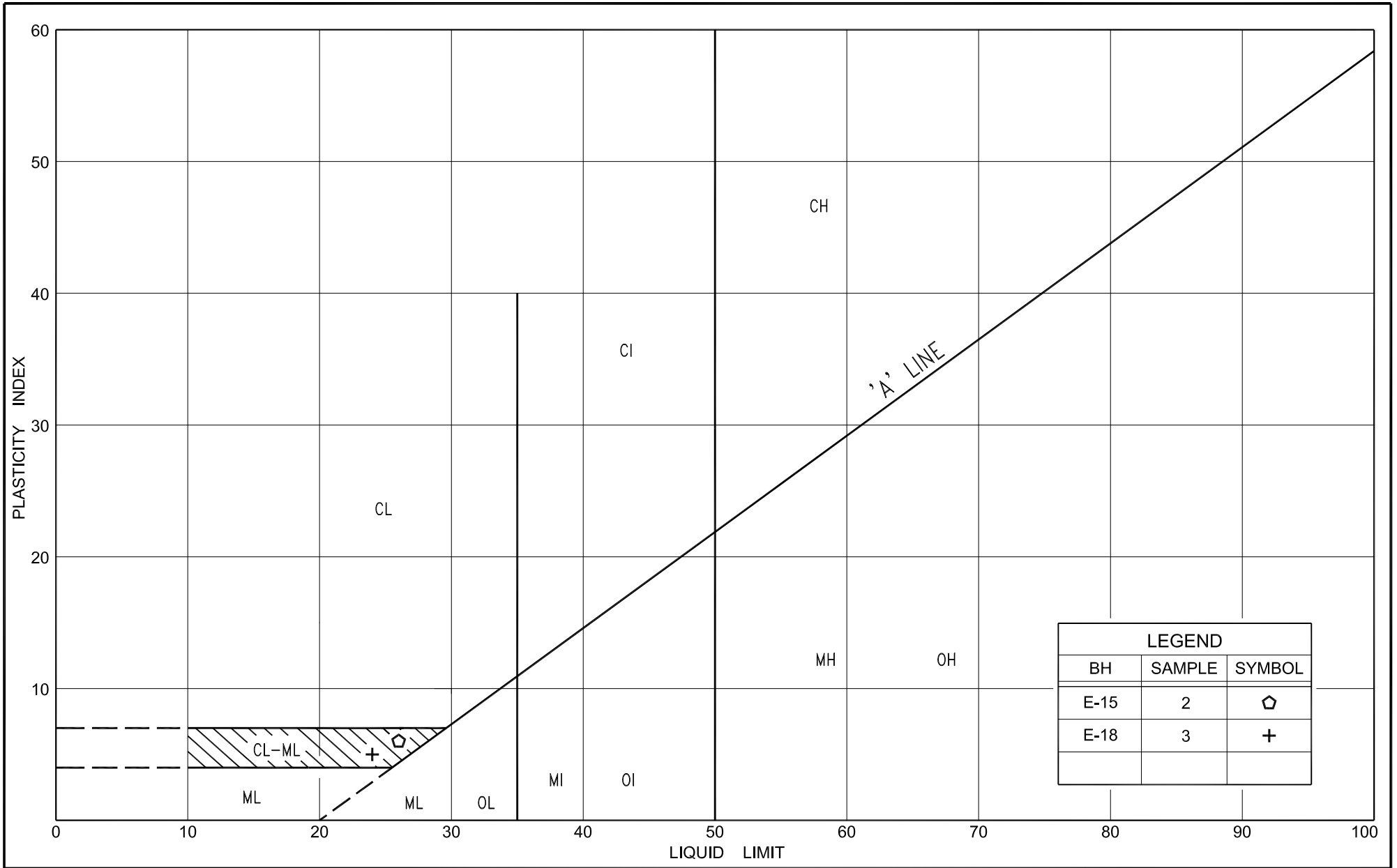



Ontario

# PLASTICITY CHART

ORGANIC SILTY CLAY, trace sand (CL-OH)
(ALLUVIUM)

| | |
|---|---|
| FIG No. | E-PC-2 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

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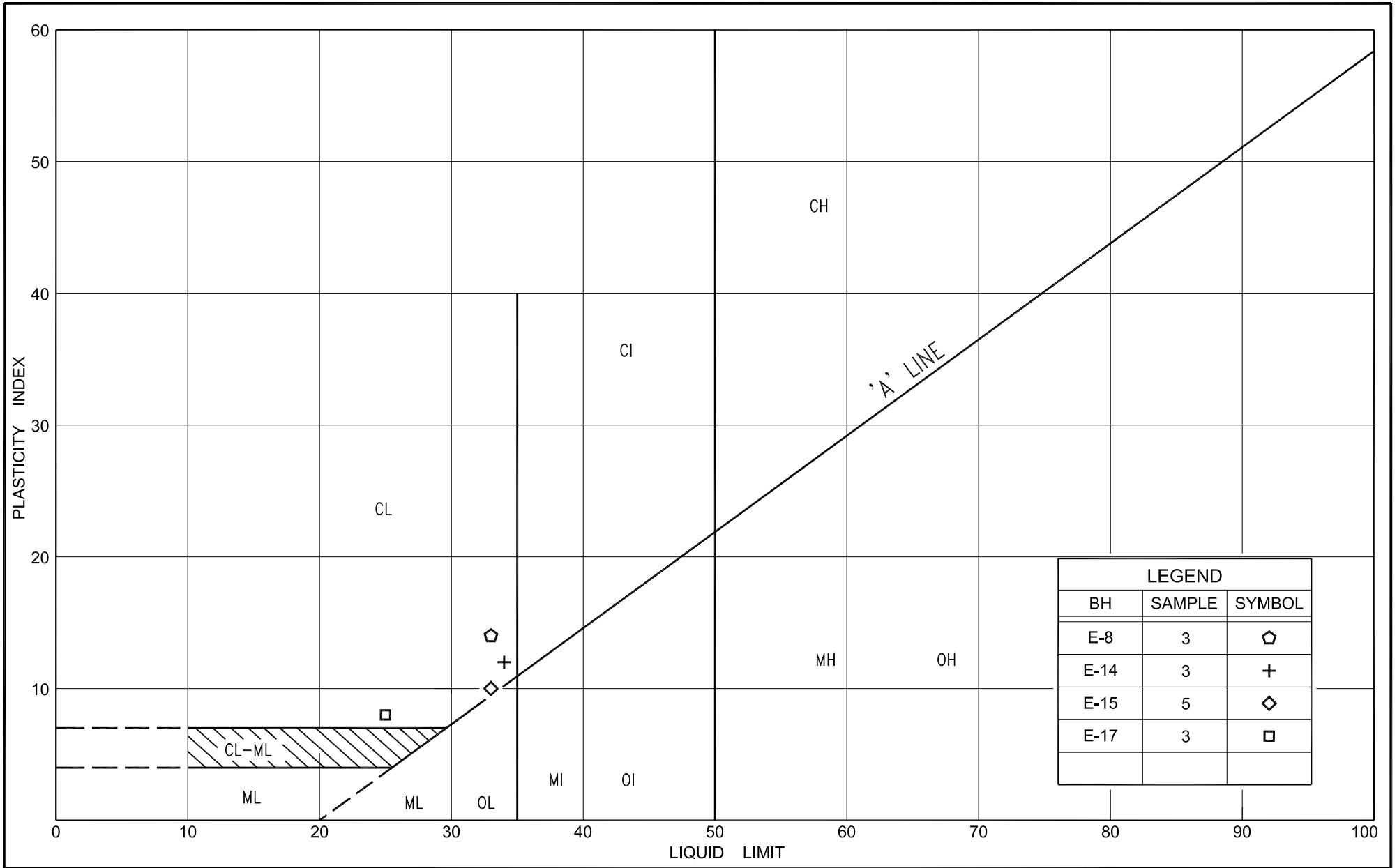
# PLASTICITY CHART

SILT, some clay, trace sand (CL-ML)

| | |
|---|---|
| FIG No. | E-PC-3 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

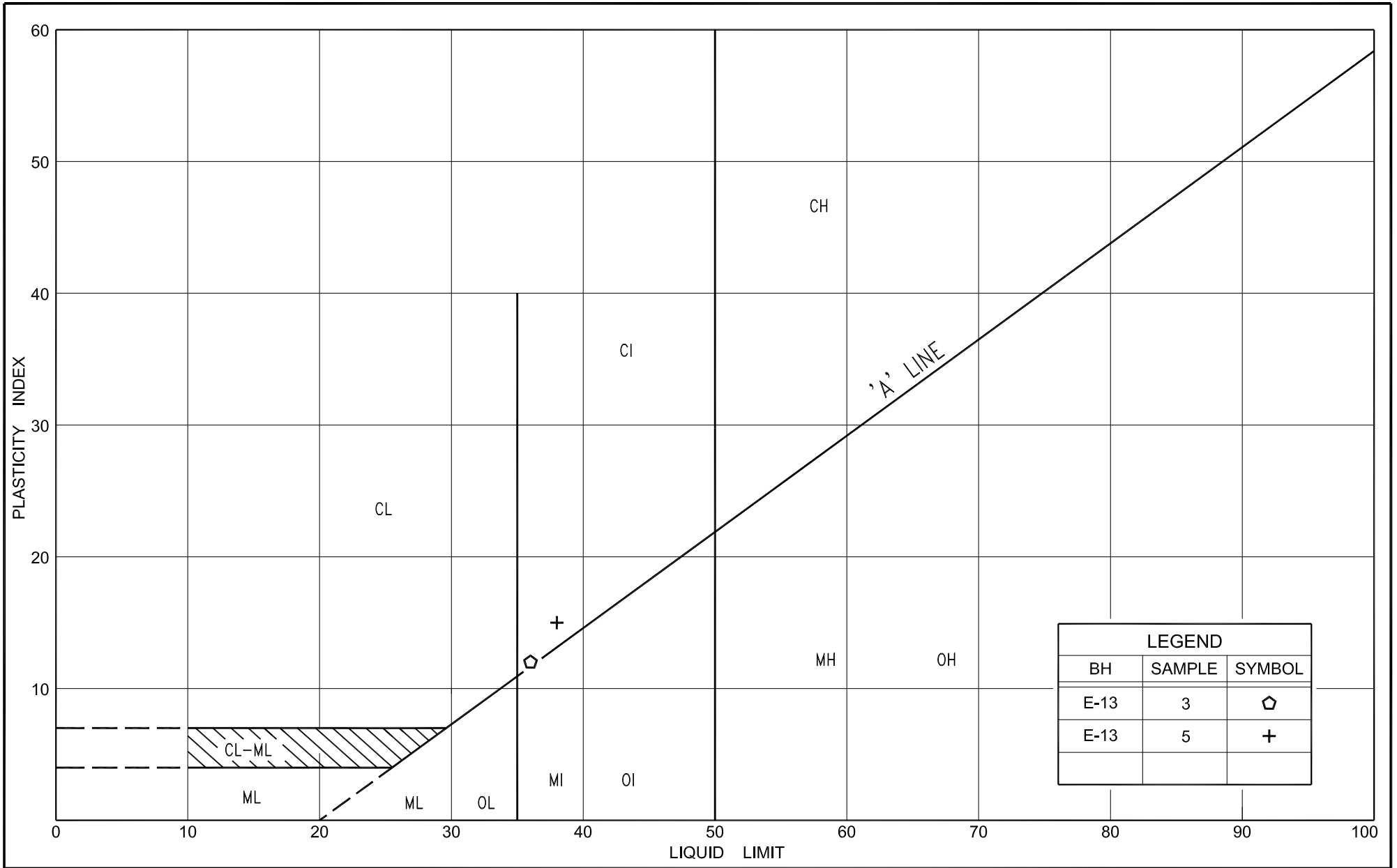



Ontario

# PLASTICITY CHART

CLAYEY SILT, trace to with sand, trace gravel (CL)

| | |
|---|---|
| FIG No. | E-PC-4 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

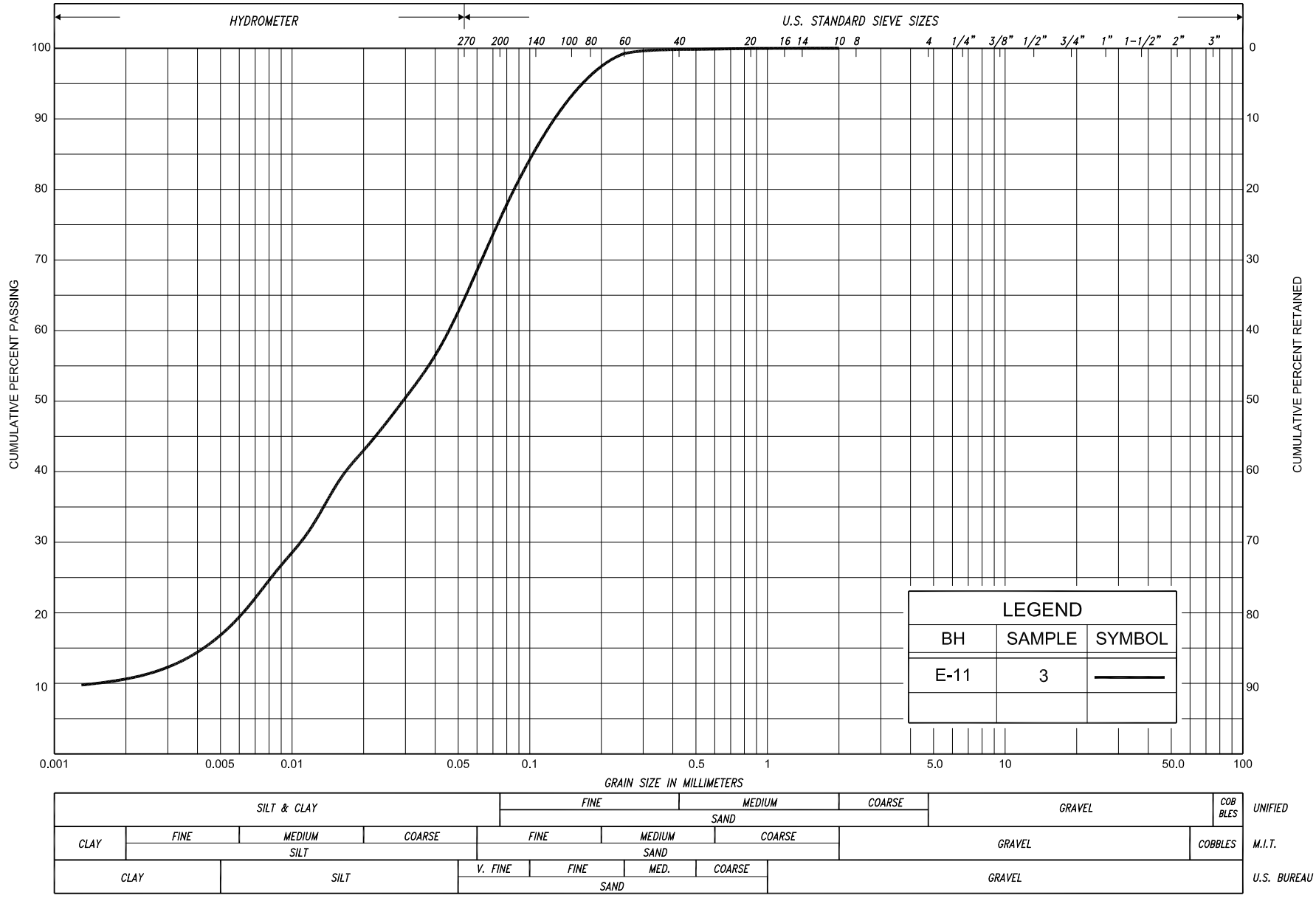



Ontario

# PLASTICITY CHART

SILTY CLAY, trace sand (CI)

| | |
|---|---|
| FIG No. | E-PC-5 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

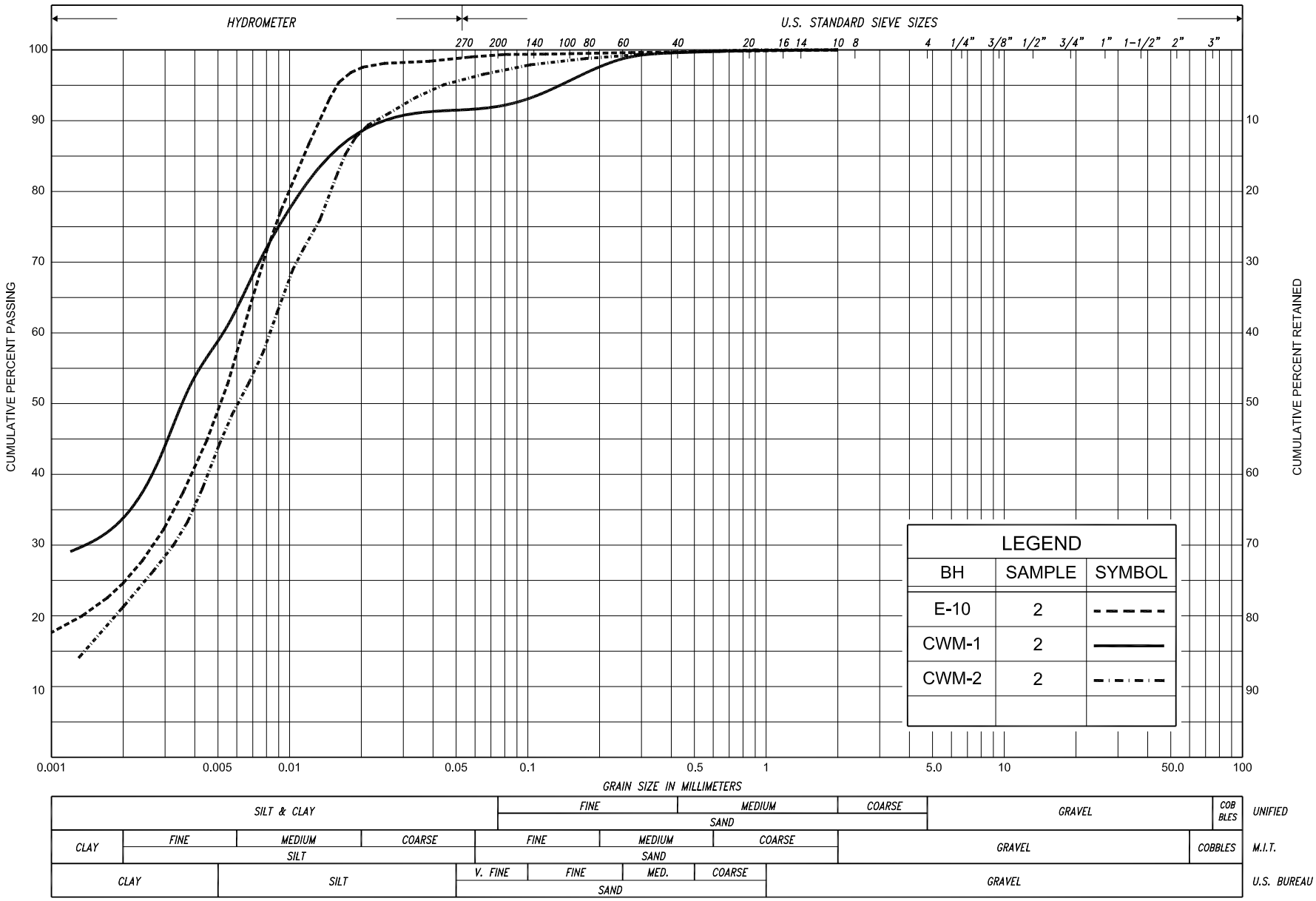



Ontario

# GRAIN SIZE DISTRIBUTION

ORGANIC SILT, with sand, some clay
(ALLUVIUM)

| | |
|---|---|
| FIG No. | E-GS-1 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

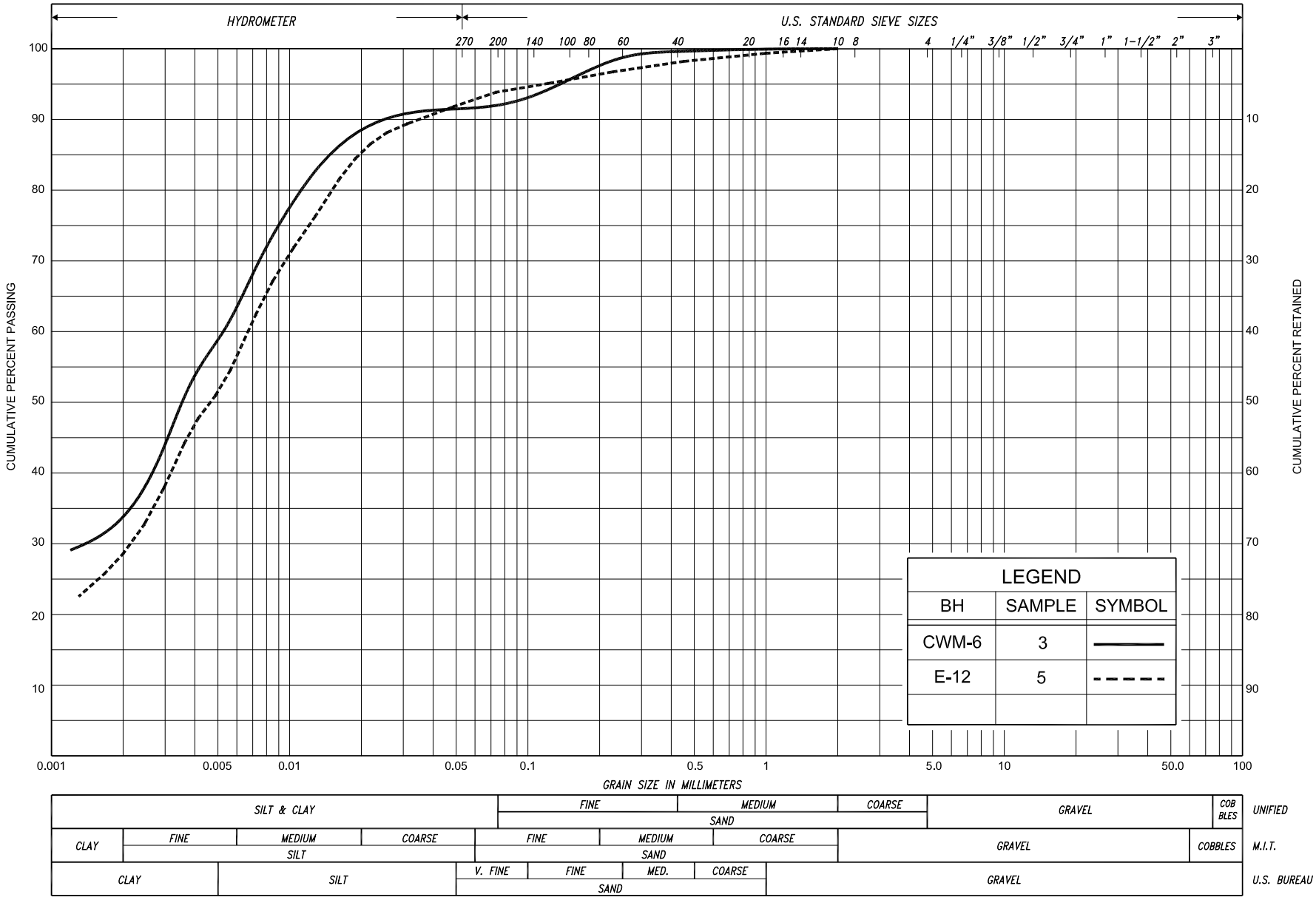



Ontario

# GRAIN SIZE DISTRIBUTION

ORGANIC CLAYEY SILT, trace sand (CL-OL)
(ALLUVIUM)

| | |
|---|---|
| FIG No. | E-GS-2 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

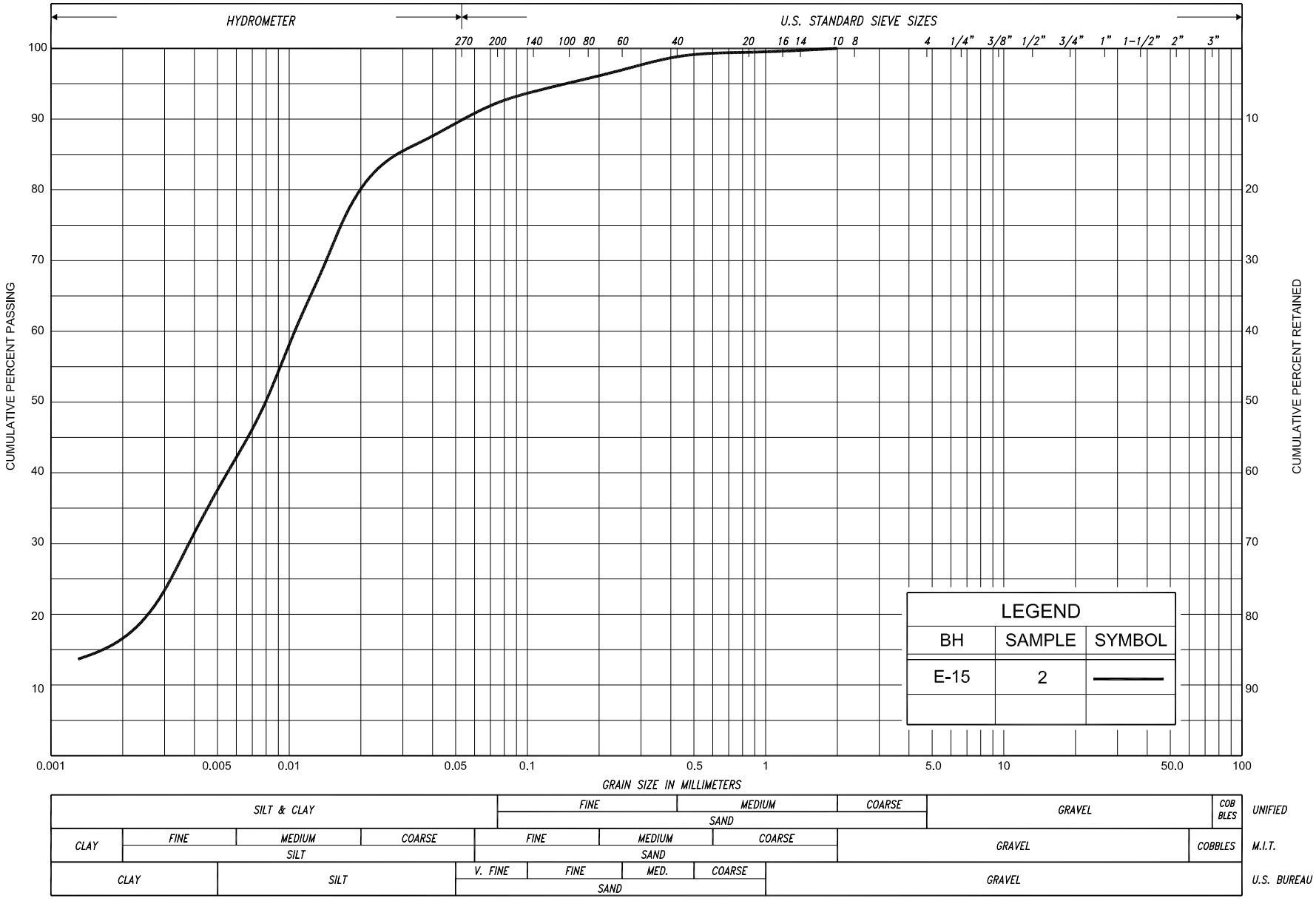



Ontario

# GRAIN SIZE DISTRIBUTION

ORGANIC SILTY CLAY, trace sand (CL-OH)
(ALLUVIUM)

| | |
|---|---|
| FIG No. | E-GS-3 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

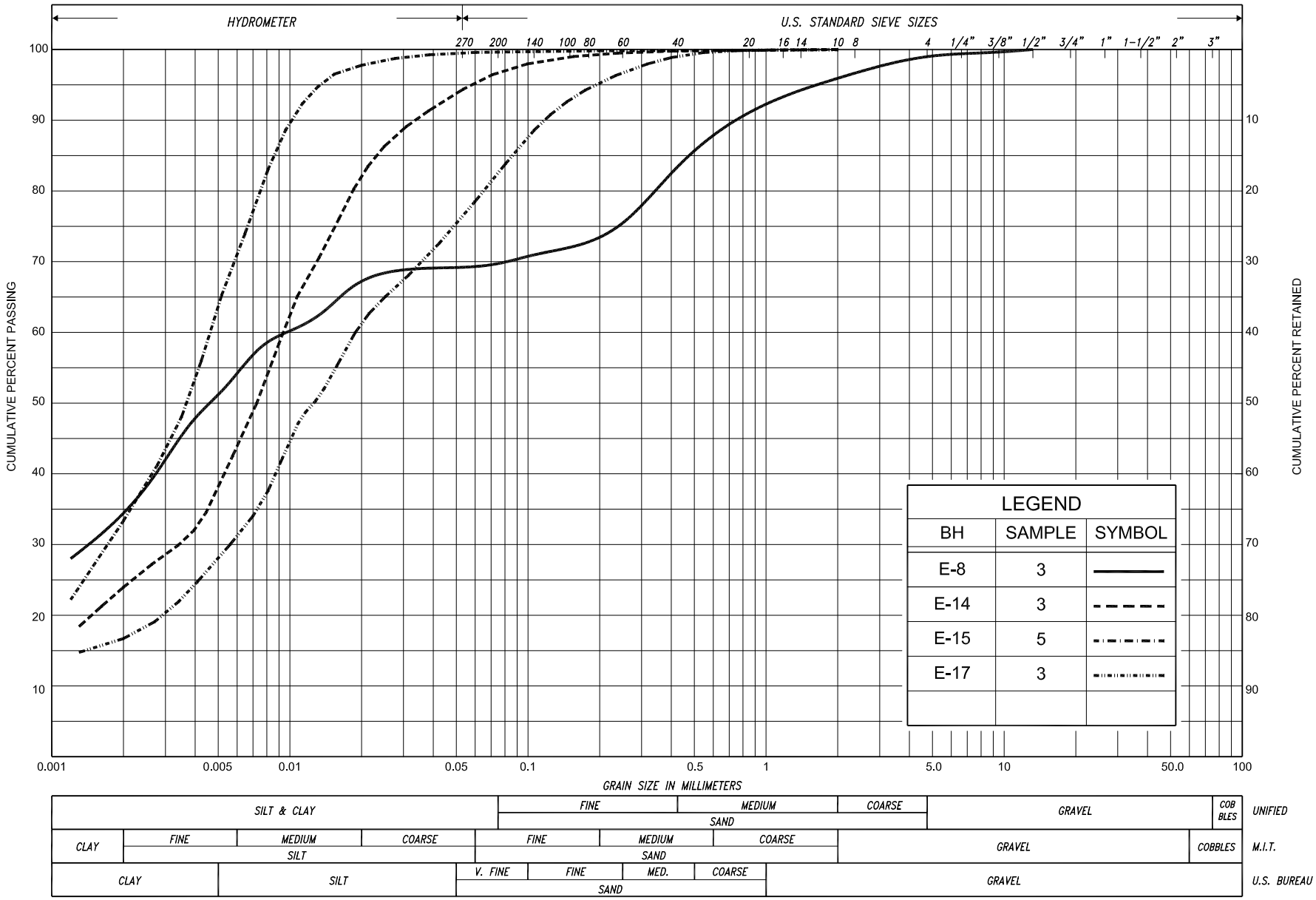



Ontario

# GRAIN SIZE DISTRIBUTION

SILT, some clay, trace sand

| | |
|---|---|
| FIG No. | E-GS-4 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

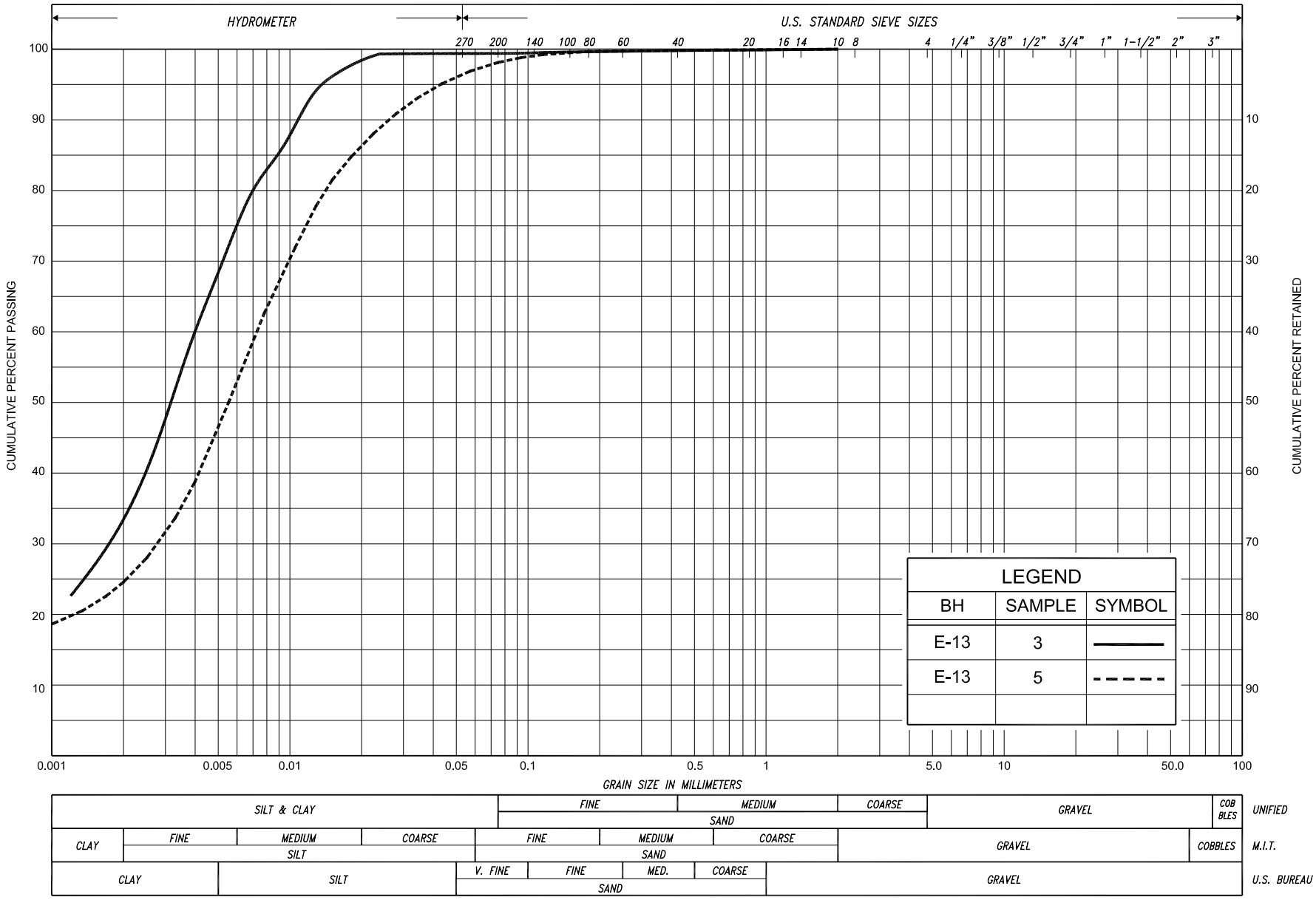



Ontario

# GRAIN SIZE DISTRIBUTION

CLAYEY SILT, trace to with sand, trace gravel (CL)

| | |
|---|---|
| FIG No. | E-GS-5 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

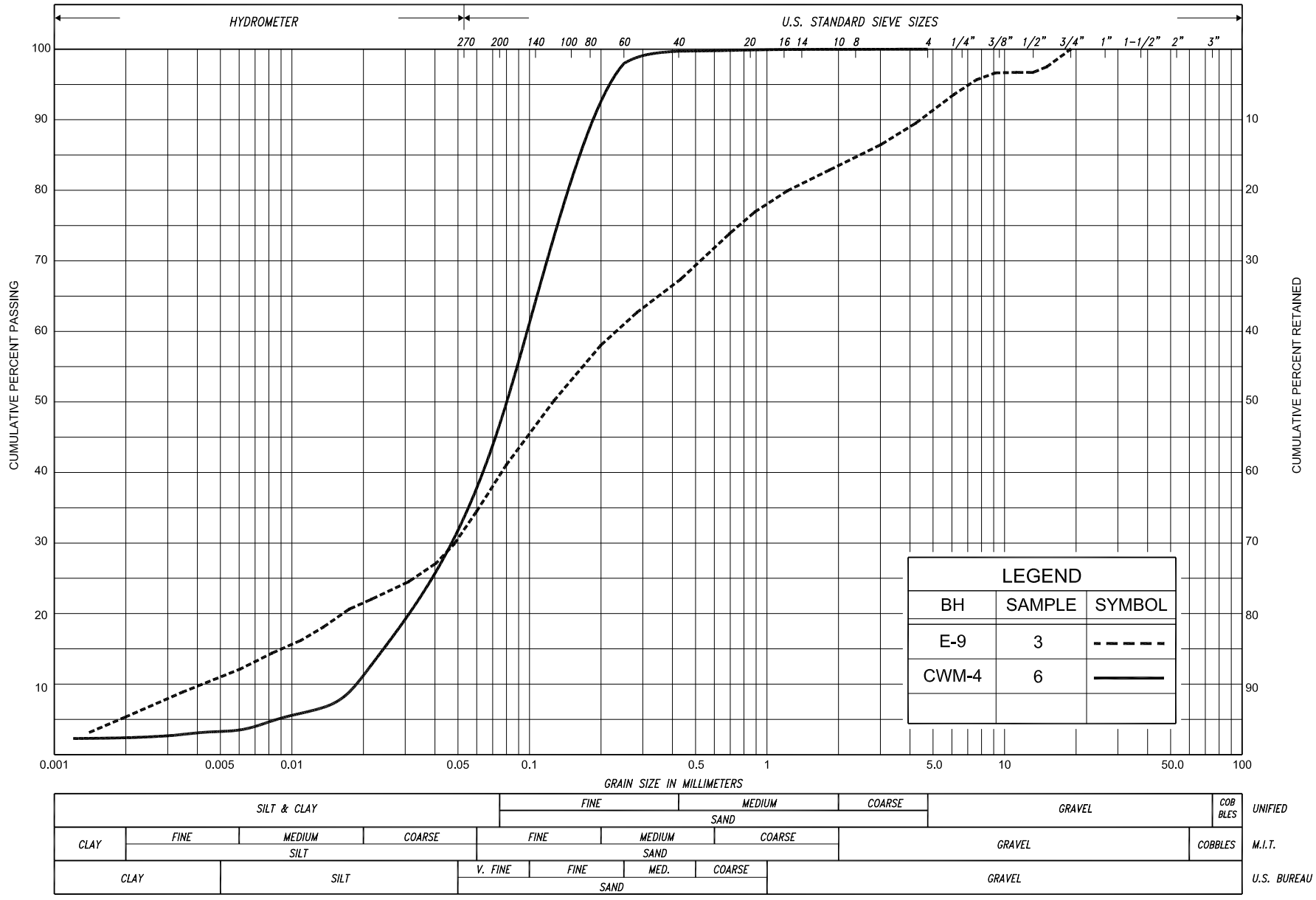



Ontario

# GRAIN SIZE DISTRIBUTION

SILTY CLAY, trace sand (CI)

| | |
|---|---|
| FIG No. | E-GS-6 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

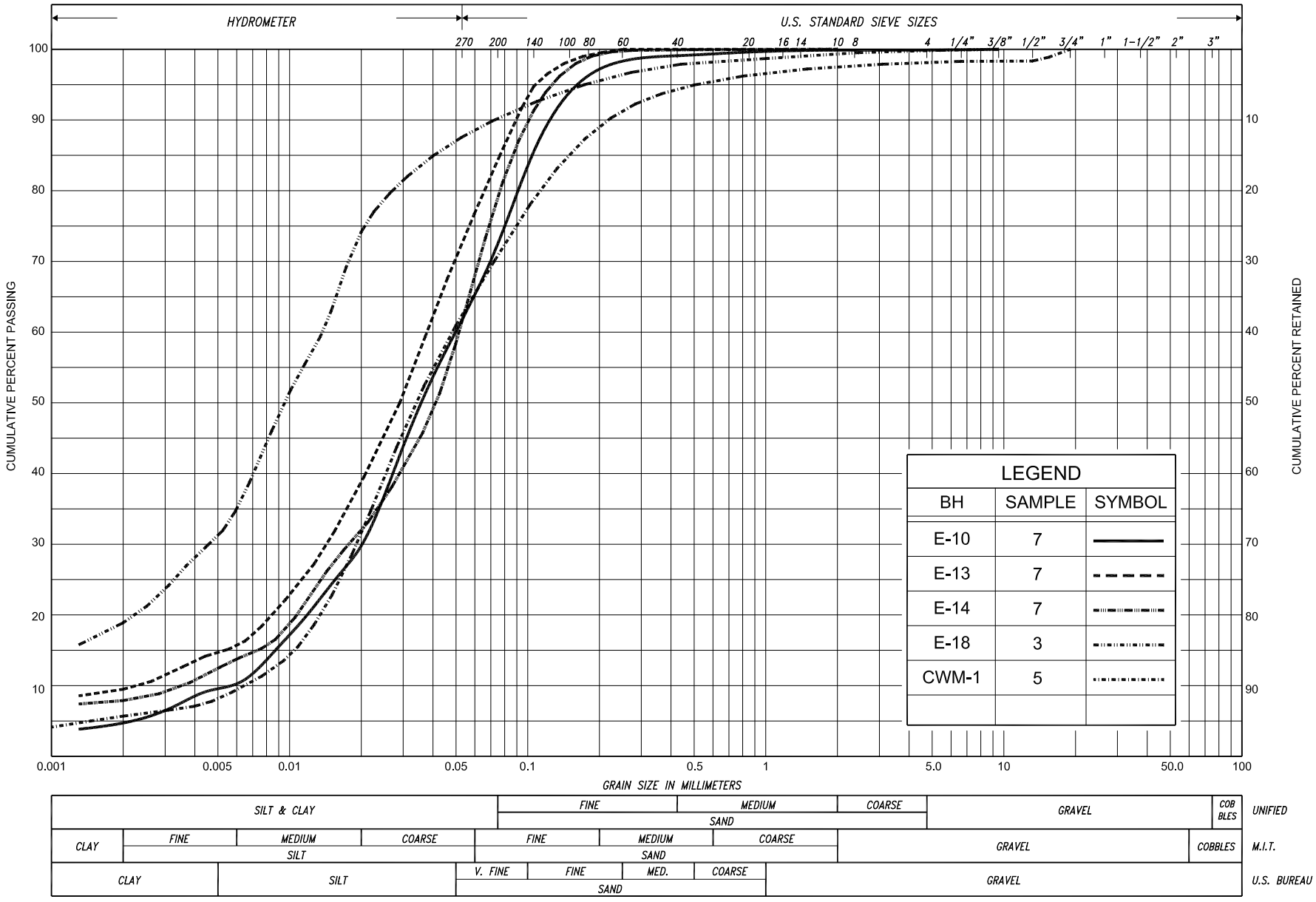



Ontario

# GRAIN SIZE DISTRIBUTION

SILTY SAND, trace clay, trace gravel

| | |
|---|---|
| FIG No. | E-GS-7 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

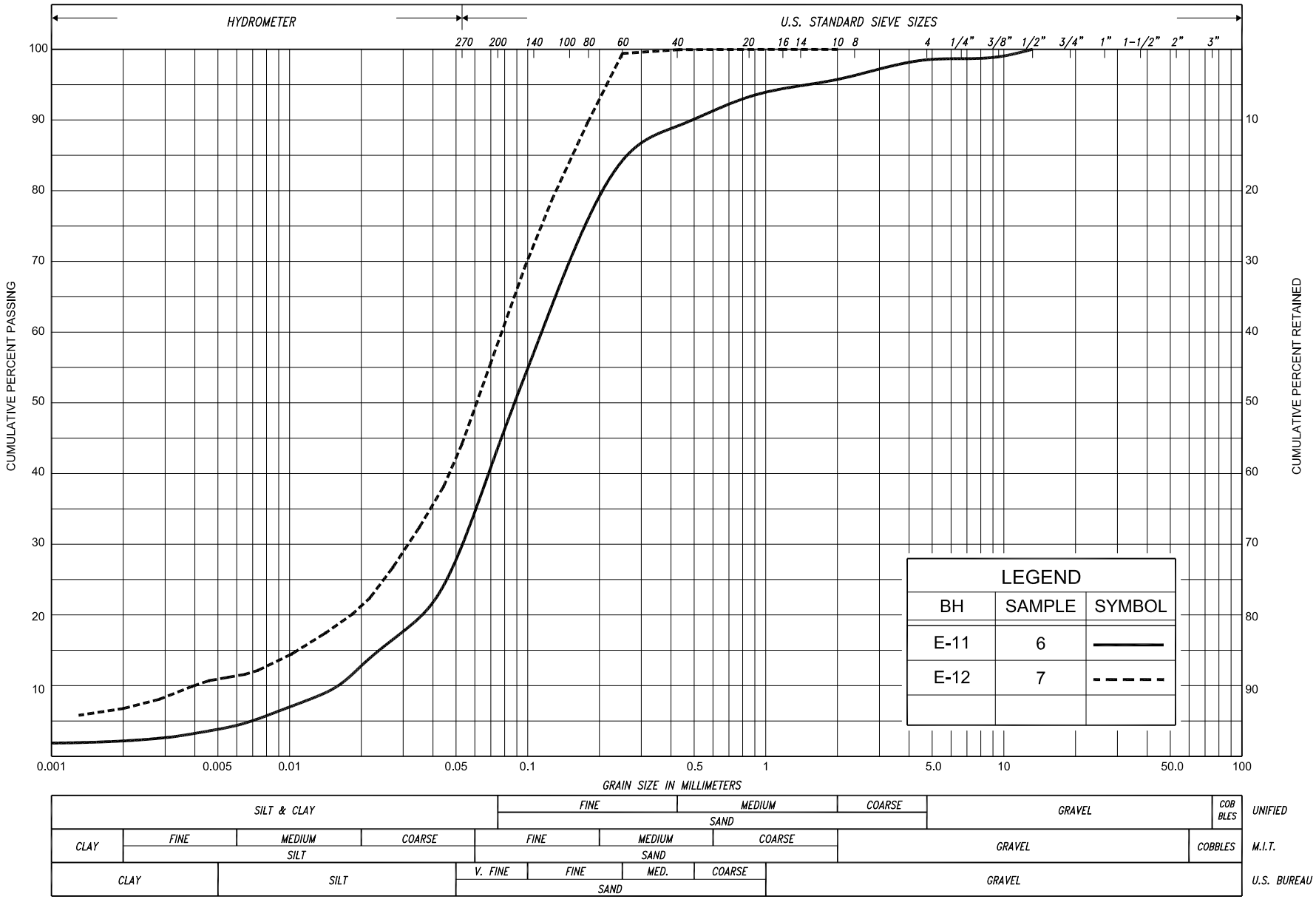



Ontario

# GRAIN SIZE DISTRIBUTION

SILT, some to with sand, trace to some clay, trace gravel

| | |
|---|---|
| FIG No. | E-GS-8 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

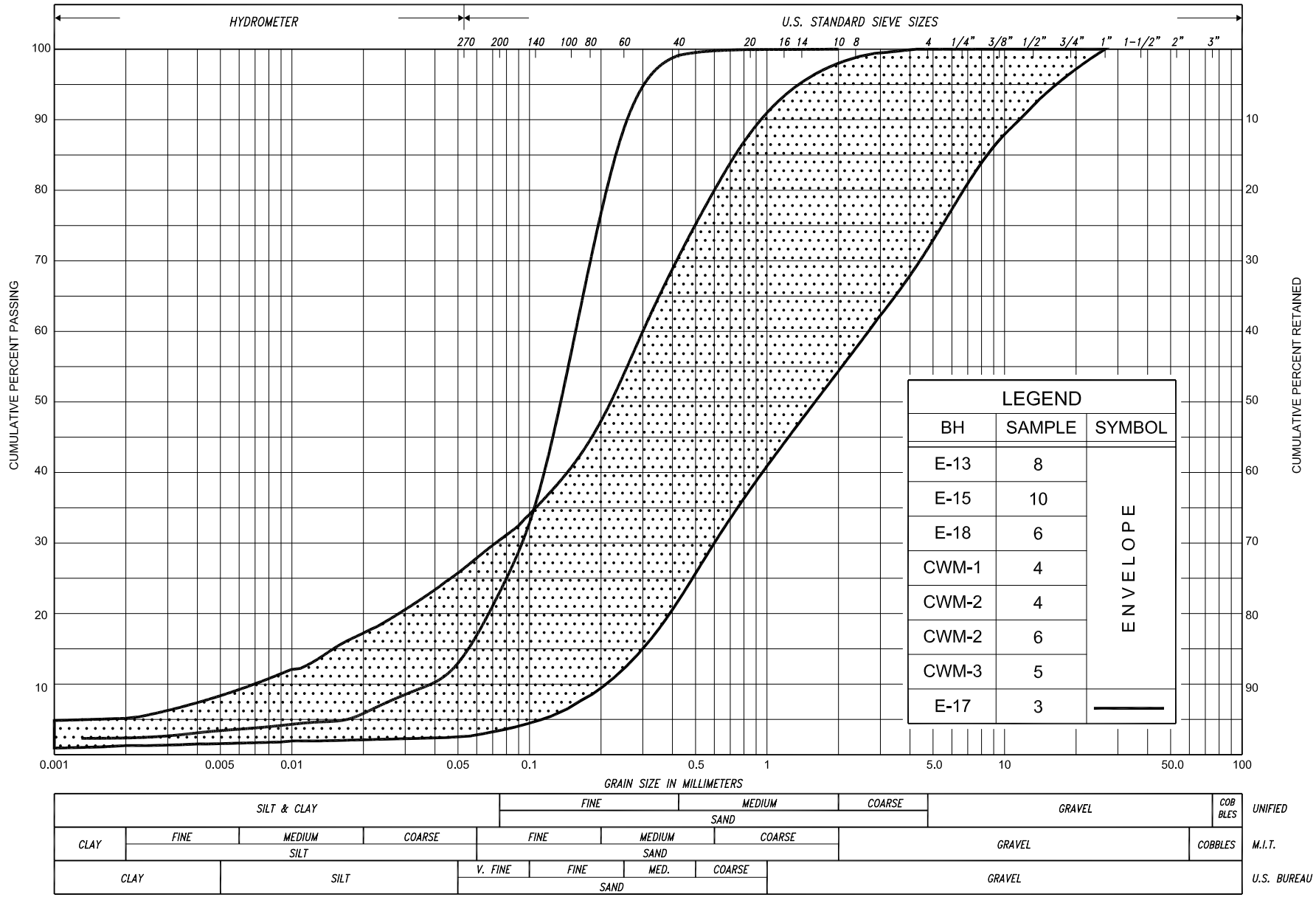



Ontario

# GRAIN SIZE DISTRIBUTION

SAND AND SILT, trace clay, trace gravel

| | |
|---|---|
| FIG No. | E-GS-9 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

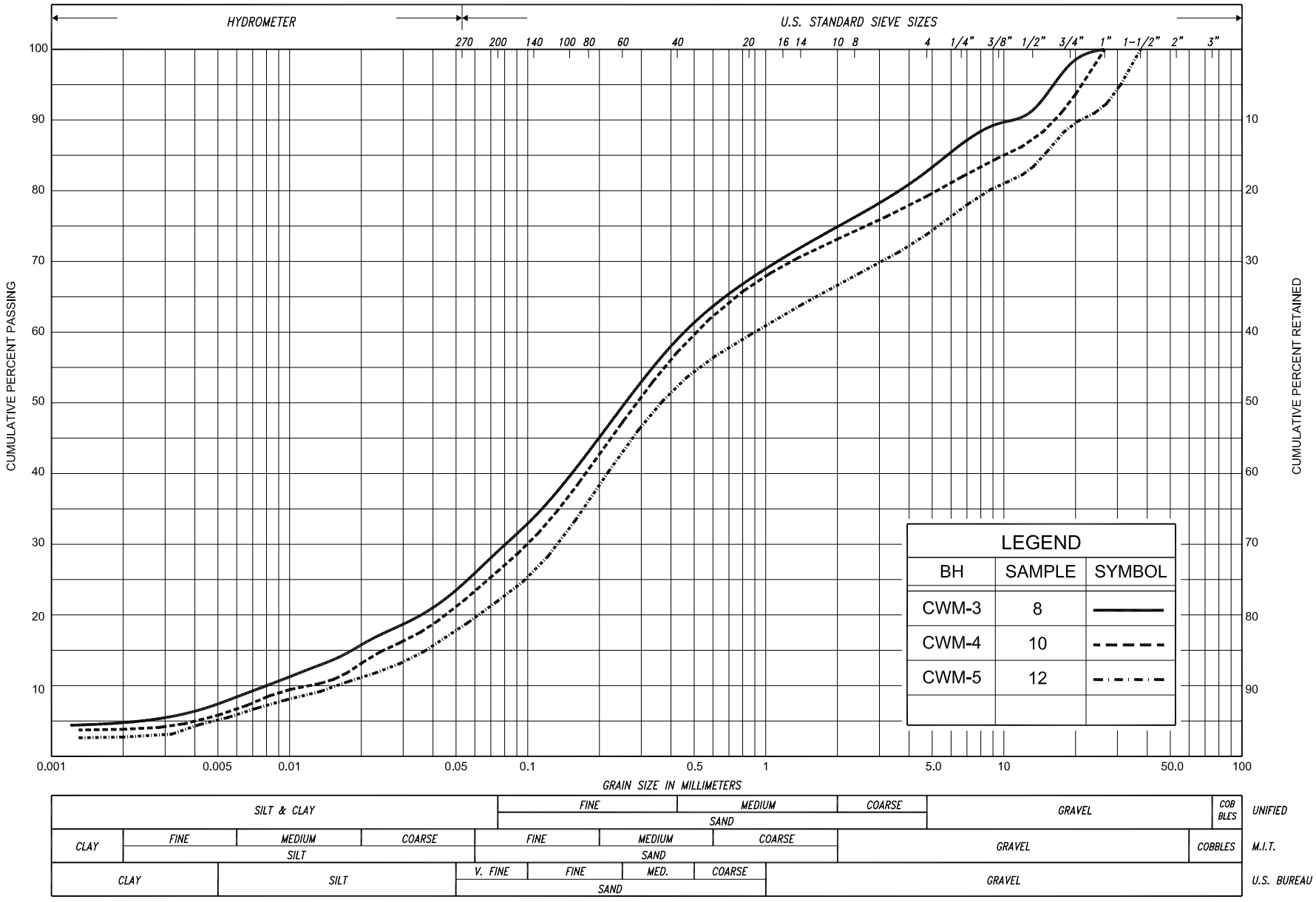



Ontario

# GRAIN SIZE DISTRIBUTION

SAND, trace to with silt, trace to with gravel, trace clay

| | |
|---|---|
| FIG No. | E-GS-10 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

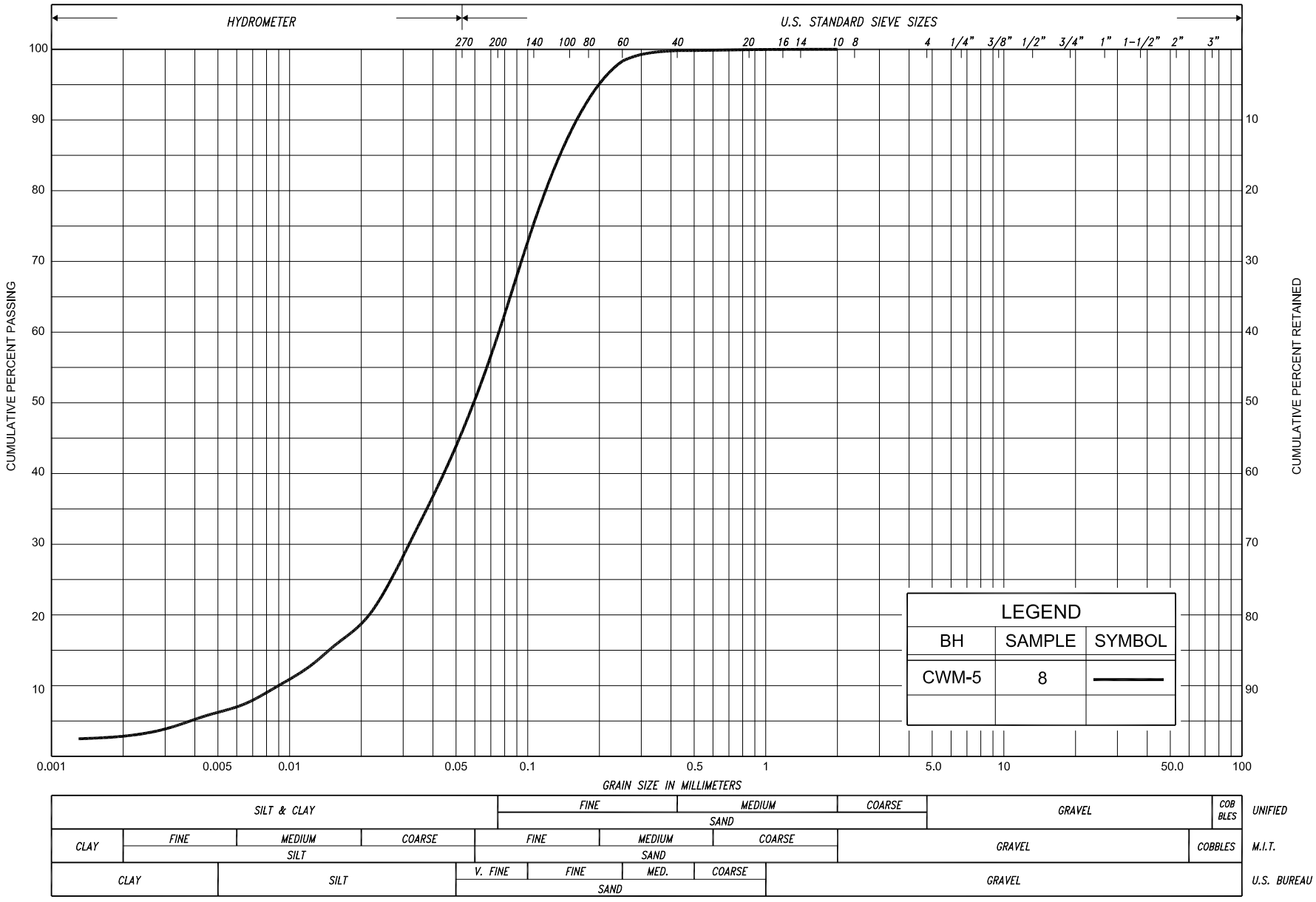



Ontario

# GRAIN SIZE DISTRIBUTION

SAND, some to with silt, some to with gravel, trace clay
(TILL)

| | |
|---|---|
| FIG No. | E-GS-11 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

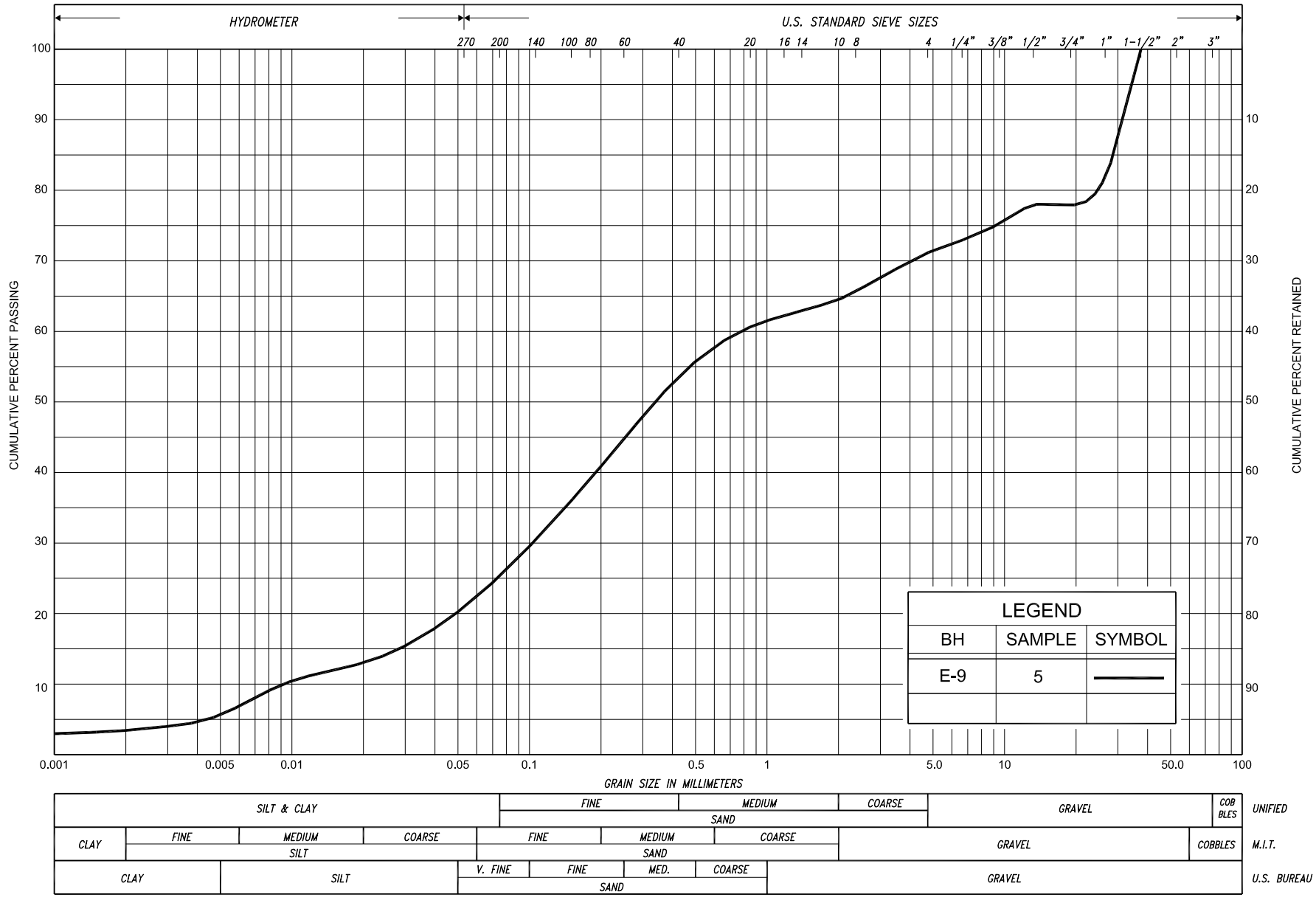



Ontario

# GRAIN SIZE DISTRIBUTION

SANDY SILT, trace clay

| | |
|---|---|
| FIG No. | E-GS-12 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |




Ontario

# GRAIN SIZE DISTRIBUTION

SAND, with silt, with gravel, trace clay

| | |
|---|---|
| FIG No. | E-GS-13 |
| HWY: | 11 |
| G.W.P. No. | 323-00-00 |

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

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# RECORD OF BOREHOLE No. E-1 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** West Service Road, Sta. 9+400, o/s 12.0m Lt. **ORIGINATED BY** K.D.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Manual Probing **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** May 16, 2012 **CHECKED BY** B.R.G.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) 20 40 60 | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | | | GR SA SI CL |
| 262.2 | Ground Surface | | | | | * | | | | | |
| 0.0 | Topsoil | | | | | | | | | | |
| 262.1 | End of borehole | | | | | | | | | | |
| 0.1 | Refusal on probable bedrock | | | | | | | | | | |
| | * Borehole dry | | | | | | | | | | |



+ , × : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

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# RECORD OF BOREHOLE No. E-2 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** West Service Road, Sta. 9+400 CL **ORIGINATED BY** K.D.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Manual Probing **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** May 16, 2012 **CHECKED BY** B.R.G.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ — NATURAL MOISTURE CONTENT $w$ — LIQUID LIMIT $w_L$ / WATER CONTENT (%) 20 40 60 | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | | | GR SA SI CL |
| 261.3 | Ground Surface | | | | | * | | | | | |
| 0.0 | Bedrock outcrop | | | | | | | | | | |
| | * Borehole dry | | | | | | | | | | |

ON MTO_VER3 NEW LOGO 10TF013A- AREA A N E.GPJ ON_MOT.GDT 8/7/2014 8:50:09 AM

+7, ×5: Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. E-3 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** West Service Road, Sta. 9+400, o/s 12.0m Rt. **ORIGINATED BY** K.D.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Manual Probing **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** May 16, 2012 **CHECKED BY** B.R.G.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT w / LIQUID LIMIT $w_L$ / WATER CONTENT (%) 20 40 60 | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | | | |
| 259.0 | Ground Surface | | | | | * | | | | | |
| 0.0 | Topsoil | | | | | | | | | | |
| 258.9 | End of borehole | | | | | | | | | | |
| 0.1 | Refusal on probable bedrock | | | | | | | | | | |
| | * Borehole dry | | | | | | | | | | |



+ , × : Numbers refer to Sensitivity

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

Ontario

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# RECORD OF BOREHOLE No. E-4 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** West Service Road, Sta. 9+429, o/s 15.0m Lt. **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Manual Probing **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** July 08, 2013 **CHECKED BY** B.R.G.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ — NATURAL MOISTURE CONTENT $w$ — LIQUID LIMIT $w_L$ / WATER CONTENT (%) 20 40 60 | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | | | GR SA SI CL |
| 259.3 | Ground Surface | | | | | * | | | | | |
| 0.0 | Bedrock outcrop | | | | | | | | | | |
| | * Borehole dry | | | | | | | | | | |

ON MTO_VER3 NEW LOGO 10TF013A- AREA A N E.GPJ ON_MOT.GDT 8/7/2014 8:50:12 AM

+7, ×5: Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

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# RECORD OF BOREHOLE No. E-5 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** West Service Road, Sta. 9+429 CL **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Manual Probing **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** July 08, 2013 **CHECKED BY** B.R.G.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT w / LIQUID LIMIT $w_L$ — WATER CONTENT (%) 20 40 60 | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | | | |
| 257.6 | Ground Surface | | | | | * | | | | | |
| 0.0 | Topsoil | | | | | | | | | | |
| 257.5 | End of borehole | | | | | | | | | | |
| 0.1 | Refusal on probable bedrock | | | | | | | | | | |
| | * Borehole dry | | | | | | | | | | |



+ , × : Numbers refer to Sensitivity

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

Ontario

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# RECORD OF BOREHOLE No. E-6 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** West Service Road, Sta. 9+442, o/s 17.0m Rt. **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Tripod **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** June 20, 2013 **CHECKED BY** B.R.G.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ NATURAL MOISTURE CONTENT w LIQUID LIMIT $w_L$ WATER CONTENT (%) 20 40 60 | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | | | |
| 256.7 | Ground Surface | | | | | | | | | | |
| 0.0 / 256.4 | Peat, coarse fibrous | | | | | | | | | | |
| 0.3 | Dark brown | | 1 | SS | 3 | ▽* | | | | | |
| | Organic silty sand with gravel cobbles and boulders | | | | | | 256 | | | | |
| 255.5 / 1.2 | Very loose Dark brown Moist (FILL) | | | | | | | | | | |
| | End of borehole | | | | | | | | | | |
| | Refusal on probable boulder | | | | | | | | | | |

* 2013 06 20

▽ Water level observed during drilling

▼ Water level measured after drilling

NOTE: Additional boreholes were carried out at 1.5m and 3.0m north of borehole E-6, refusal at 0.8 and 1.2m respectively



+7, ×5: Numbers refer to Sensitivity

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

Ontario

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Foundation Design

# RECORD OF PENETRATION TEST No E-7 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** West Service Road, Sta. 9+450, o/s 18.0m Lt. **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Dynamic Cone Penetration Test **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** June 21, 2013 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ / WATER CONTENT (%) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 256.3 | Ground Surface | | | | | | | 20 40 60 80 100 | 20 40 60 | | |
| 0.0 | Topsoil<br>Probable silt | | | | | | 256 | | | | |
| | Very loose to loose<br>Probable sand | | | | | | | | | | |
| 255.2 | Very dense | | | | | | | 120/20cm | | | |
| 1.1 | End of dynamic cone penetration test<br>Refusal on probable boulder | | | | | | | | | | |
| | Additional dynamic cone penetration test was carried out, refusal at 1.1m | | | | | | | | | | |



+7, ×5 : Numbers refer to Sensitivity

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

Ontario

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# RECORD OF BOREHOLE No. E-8 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** West Service Road, Sta. 9+450 CL **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Tripod + 'N' Casing **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** June 21, 2013 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 256.5 | Ground Surface | | | | | | | | | | |
| 0.0 / 256.2 | Peat, coarse fibrous Dark brown | | 1 | SS | 2 | | 256 | | 88 | | |
| 0.3 | Organic silt, some sand peat layers | | | | | | | | | | |
| | Very loose to loose | | 2 | SS | 6 | | | 138 | 105 | | |
| 255.4 / 1.1 | (ALLUVIUM) | | | FV | | | | > | | | |
| | Clayey silt, with sand trace gravel cobbles and boulders organics, sand layers | | 3 | SS | 11 | | 255 | | | | 1 29 36 34 |
| | Very stiff Brown Moist | | | FV | | | | > | | | |
| 253.9 / 2.6 | | | 4 | SS | 73 | | 254 | | | | |
| 253.7 / 2.8 | Sand, some gravel cobbles and boulders Very dense Grey Wet | | | | | | | | | | |
| | End of borehole | | | | | | | | | | |
| | Refusal on probable boulder | | | | | | | | | | |

* 2013 06 21

▽ Water level observed during drilling

▼ Water level measured after drilling

■ Penetrometer test

NOTE: Boulders are at surface in the vicinity of borehole E-8



+7, ×5: Numbers refer to Sensitivity

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

Ontario

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Foundation Design

# RECORD OF BOREHOLE No. E-9 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** West Service Road, Sta. 9+462, o/s 3.0m Lt. **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** July 08, 2013 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ WATER CONTENT (%) 20 40 60 | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 256.5 | Ground Surface | | | | | | | | | | |
| 256.3 | Topsoil | | | | | | | | | | |
| 0.2 | Organic silt some clay, trace sand<br>Loose Dark Moist brown<br>(ALLUVIUM) | | 1 | SS | 5 | | 256 | | ○ | | |
| | | | 2 | SS | 3 | | | | ○ | | |
| 255.1 | | | | | | | | | | | |
| 1.4 | Silty sand trace clay, trace gravel cobbles and boulders<br>Compact to Brown Wet very dense to grey | | 3 | SS | 11 | ▽* ▼* | 255 | | ○ | | 9 51 34 6 |
| | | | 4 | SS | 25/18cm | | 254 | | ○ | | |
| 253.7 | | | | | | | | | | | |
| 2.8 | Sand, with silt with gravel, trace clay cobbles and boulders<br>Dense to Grey Wet compact | | 5 | SS | 31 | | 253 | | ○ | | 28 46 23 3 |
| | | | 6 | SS | 17 | | 252 | | | | |
| 250.9 | | | | | | | 251 | | | | |
| 5.6 | End of borehole<br>Refusal on probable boulder<br>Sample 4: Sampler bouncing<br>* 2013 07 08<br>▽ Water level observed during drilling<br>▼ Water level measured after drilling | | | | | | | | | | |



+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. E-10 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** West Service Road, Sta. 9+475, o/s 19.0m Rt. **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** July 08, 2013 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 257.2 | Ground Surface | | | | | | | | | | |
| 257.0 | Topsoil | | | | | | | | | | |
| 0.2 | Organic clayey silt<br>trace sand<br>Firm Grey Wet<br>(ALLUVIUM) | | 1 | SS | 5 | | 257 | | ○ | | |
| | | | 2 | SS | 8 | ▼* | 256 | | ⊖ | | 0 0 75 25 |
| 255.4 | | | 3 | SS | 4 | ▽* | | | | 89 ○ | |
| 1.8 | Sand, trace silt<br>Loose Brown Wet | | | | | | | | | | |
| 254.7 | | | 4 | SS | 8 | | 255 | | ○ | | |
| 2.5 | Silt, with sand<br>trace clay, trace garvel<br>Compact Brown Wet<br>to loose | | 5 | SS | 10 | | 254 | | ○ | | |
| | | | 6 | SS | 5 | | 253 | | ○ | | |
| | | | 7 | SS | 7 | | | | ○ | | 0 28 67 5 |
| 251.4 | | | 8 | SS | 18 | | 252 | | | | |
| 5.8 | Sand<br>some gravel, trace silt<br>Compact Brown Wet | | 9 | SS | 16 | | 251 | | ○ | | |
| | cobbles and boulders<br>Grey | | 10 | SS | 20 | | 250 | | ○ | | |
| 248.7 | | | | | | | 249 | | | | |
| 8.5 | End of borehole<br>Refusal on probable boulder | | | | | | | | | | |

* 2013 07 08

▽ Water level observed during drilling

▼ Water level measured after drilling

Auger grinding from 7.0m

NOTE: Field vane test was carried out 1.0m west of borehole E-10 from 1.4 to 1.7m depth, Undistrubed 38 kPa, Sensitivy 4 was obtained



+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. E-11 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** West Service Road, Sta. 9+530, o/s 15.0m Lt. **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** July 09, 2013 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 256.4 | Ground Surface | | | | | | | | | | |
| 256.2 | Topsoil | | | | | | | | | | |
| 0.2 | Organic silt with sand, some clay<br>Very loose Dark Wet brown<br>(ALLUVIUM) | | 1 | SS | 5 | | 256 | | ○ | | |
| | | | 2 | SS | 7 | ▽* ▼* | 255 | | ○ | | |
| | | | 3 | SS | 1 | | | | ○ | | 0 24 65 11 |
| | | | | FV | | | | | | | |
| 253.7 | | | 4 | SS | 10 | | 254 | | ○ | | |
| 2.7 | Sand and silt trace clay, trace gravel<br>Compact to loose Dark Wet brown | | 5 | SS | 18 | | 253 | | ○ | | |
| | | | 6 | SS | 9 | | 252 | | ○ | | 2 54 42 2 |
| | | | 7 | SS | 4 | | 251 | | ○ | | |
| | | | 8 | SS | 27 | | 250 | | ○ | | |
| | | | 9 | SS | 37 | | 249 | | ○ | | |
| 246.8 | | | | | | | 248 | | | | |
| 9.6 | End of borehole | | | | | | 247 | | ○ | | |

* 2013 07 09

▽ Water level observed during drilling

▼ Water level measured after drilling



+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. E-12 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** West Service Road, Sta. 9+555 CL **ORIGINATED BY** K.D.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** May 17, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT w / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 256.7 | Ground Surface | | | | | | | | | | |
| 256.6 / 0.1 | Topsoil | | | | | | | | | | |
| | Organic silty clay trace sand | | 1 | SS | 18 | | 256 | | | | |
| | Very stiff Mottled Wet to firm brown/grey | | 2 | SS | 22 | | | | | | |
| | (ALLUVIUM) | | | | | | | | | | |
| | peat layers, wood pieces | | 3 | SS | 6 | | 255 | | 126 | | |
| | | | 4 | SS | 6 | | 254 | | | | |
| | | | 5 | SS | 7 | | 253 | | | | 0 6 66 28 |
| 252.3 | | | 6 | SS | 19 | | | | | | |
| 4.4 | Sand and silt, trace clay | | | | | | 252 | | | | |
| | Compact Grey Wet | | 7 | SS | 10 | | | | | | 0 41 52 7 |
| | | | 8 | SS | 10 | | 251 | | | | |
| 250.0 | | | | | | | 250 | | | | |
| 6.7 | Sand some gravel, trace silt | | | | | ▼* | | | | | |
| | Compact Grey/brown Wet | | 9 | SS | 11 | | 249 | | | | |
| 248.5 | | | | | | | | | | | |
| 8.2 | End of borehole | | | | | | | | | | |

* 2012 05 17

▼ Water level measured after drilling

■ Penetrometer test

NOTE: Borehole E-12 was carried out for pavement design purposes and reused

ON MTO_VER3 NEW LOGO 10TF013A- AREA A N E.GPJ ON_MOT.GDT 8/7/2014 9:05:51 AM

+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. E-13 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** West Service Road, Sta. 9+580, o/s 14.0m Rt. **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** C.F.H.S.A. and Dynamic Cone Penetration Test **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** July 09 and 10, 2013 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 256.8 | Ground Surface | | | | | | | | | | |
| 256.6 | Topsoil | | | | | | | | | | |
| 0.2 | Silt, trace sand<br>trace clay, trace gravel<br>Compact Brown Moist | | 1 | SS | 11 | | | | ○ | | |
| | | | 2 | SS | 12 | | 256 | | ○ | | |
| 255.4 | | | | | | | | | | | |
| 1.4 | Silty clay, trace sand<br>Stiff Brown Moist<br>to firm | | 3 | SS | 14 | | 255 | 150 ■ | ○ | | 0 1 65 34 |
| | Grey | | 4 | SS | 8 | | 254 | | ○ | | |
| | | | 5 | SS | 4 | | | ■ | ○ | | 0 2 73 25 |
| | | | | FV | | | | + 3 | | | |
| 252.5 | | | 6 | TW | PH | ▼* | 253 | | | | |
| 4.3 | Silt<br>some sand, trace clay<br>organics<br>Very loose Grey Moist | | 7 | SS | 2 | ▽* | 252 | | ○ | | 0 16 75 9 |
| 250.0 | | | | | | | 251 | | | | |
| 6.8 | Sand, with silt<br>some gravel, trace clay<br>Compact Reddish Wet<br>to loose brown | | 8 | SS | 15 | | 250 | | | | |
| | | | | | | | 249 | | ○ | | 18 52 27 3 |
| 247.0 | | | 9 | SS | 7 | | 248 | | | | |
| 9.8 | End of borehole | | | | | | 247 | | | | |

* 2013 07 09

▽ Water level observed during drilling

▼ Water level measured after drilling

■ Penetrometer test

WH** denotes penetration due to weight of rods and hammer

DCPT was carried out 1.5m north of borehole E-13

C.F.H.S.A. denotes continuous flight hollow stem augers



+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. E-14 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** West Service Road , Sta. 9+605 CL **ORIGINATED BY** K.D.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** May 17, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ / WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 257.2 | Ground Surface | | | | | | | | | | |
| 257.0 | Topsoil | | | | | | 257 | | | | |
| 0.2 | Clayey silt, trace sand<br>Stiff to very stiff Mottled brown/grey Moist to wet | | 1 | SS | 9 | | | | | | |
| | | | 2 | SS | 24 | | 256 | ■ | ○ | | |
| | | | 3 | SS | 16 | | | 163 ■ | ⊢○⊣ | | 0 4 72 24 |
| | | | 4 | SS | 9 | | 255 | ■ | ○ | | |
| | topsoil and peat inclusions | | 5 | SS | 4 | | 254 | | | ○ | |
| | | | 6 | SS | 5 | ▼* | 253 | | | 127 ○ | |
| 252.7 | | | | | | | | | | | |
| 4.5 | Silt<br>with sand, trace clay<br>Loose Grey Wet | | | | | | 252 | | | | |
| | | | 7 | SS | 7 | | 251 | | ○ | | 0 21 71 8 |
| 250.5 | | | | | | | | | | | |
| 6.7 | End of borehole | | | | | | | | | | |

* 2012 05 17

▼ Water level measured after drilling

■ Penetrometer test

NOTE: Field vane tests were conducted between 3.7 and 4.0m on October 25, 2012; Undisturbed shear strength 60 kPa with Sensitivity of 3 was measured



+7, ×5 : Numbers refer to Sensitivity

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

Ontario

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# RECORD OF BOREHOLE No. E-15 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** West Service Road, Sta. 9+630, o/s 13.0m Lt. **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** July 10, 2013 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 258.4 | Ground Surface | | | | | | | | | | |
| 258.2 | Topsoil | | | | | | | | | | |
| 0.2 | Silt some clay, trace sand organics<br>Compact to loose Brown Moist | | 1 | SS | 7 | | 258 | | ○ | | |
| | | | 2 | SS | 11 | ▽* | | | ⊖ | | 0 8 75 17 |
| | sand partings | | | | | | 257 | | | | |
| | Wet | | 3 | SS | 9 | | | | ○ | | |
| 256.2 | | | | | | | | | | | |
| 2.2 | Clayey silt, trace sand<br>Firm to very stiff Grey Moist | | 4 | SS | 9 | | 256 | | ○ | | |
| | | | | FV | | ▼* | | 3 + | | | |
| | | | 5 | TW | PM | | 255 | | ⊖ | | 0 0 66 34 |
| 254.6 | | | | FV | | | | | | | |
| 3.8 | Organic silt, trace sand<br>Very loose to loose Dark brown Wet | | 6 | SS | 2 | | | | ○ | | |
| | | | | FV | | | 254 | 6 + | | | |
| | | | 7 | SS | 2 | | | | ○ | | |
| | | | 8 | SS | 2 | | 253 | | | ○ | |
| | trace gravel | | 9 | SS | 6 | | 252 | | ○ | | |
| 251.4 | | | | | | | | | | | |
| 7.0 | Sand, with gravel trace silt, trace clay<br>Compact Reddish brown Wet | | 10 | SS | 20 | | 251 | | ○ | | 28 61 9 2 |
| 249.9 | | | | | | | 250 | | | | |
| 8.5 | End of borehole<br>Refusal on probable boulders | | | | | | | | | | |

* 2013 07 10

▽ Water level observed during drilling

▼ Water level measured after drilling

+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF PENETRATION TEST No E-16 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** West Service Road, Sta. 9+630, o/s 13.0m Rt. **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Dynamic Cone Penetration Test **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** July 10, 2013 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ / WATER CONTENT (%) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 258.7 | Ground Surface | | | | | | | 20 40 60 80 100 | 20 40 60 | | |
| 0.0 | Topsoil<br>Probable silt<br>Loose to compact | | | | | | 258<br>257<br>256<br>255 | | | | |
| | Probable sand<br>Compact | | | | | | 254<br>253<br>252 | | | | |
| 251.1<br>7.6 | End of penetrometer test | | | | | | | | | | |

MOT_DCPT R2012 10TF013A- AREA A N E.GPJ ON_MOT.GDT 8/7/2014 9:12:01 AM

+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

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# RECORD OF BOREHOLE No. E-17 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** West Service Road, Sta. 9+655 CL **ORIGINATED BY** K.D./F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** May 18, 2012 and July 10-12, 2013 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ WATER CONTENT (%) 20 40 60 | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 259.3 | Ground Surface | | | | | | | | | | |
| 0.0 / 259.0 | Topsoil | | | | | | 259 | | | | |
| 0.3 / 258.5 | Silt, trace clay<br>Brown Moist | | 1 | SS | 21 | | | | | | |
| 0.8 | Clayey silt, trace sand<br>Very stiff Mottled Moist<br>brown/grey | | | FV | | | 258 | | | | |
| | | | 2 | SS | 10 | | | | | | |
| | | | | FV | | | | | | | |
| | Grey/<br>brown | | | FV | | | 257 | | | | |
| | | | 3 | SS | 11 | | | | | | 0 18 65 17 |
| | Mottled<br>brown/grey | | | FV | | ▽* ▼* | 256 | | | | |
| 255.3 | | | | TW | PM | | | | | | |
| 4.0 | Organic clayey silt<br>trace sand<br>silt seams | | | TW | PM | | 255 | | | | |
| | Stiff Moist | | 4 | FV | | | | | | | |
| | sand layers | | | | | | | | | | |
| | Wet | | 5 | AS | - | | 254 | | | | |
| 253.0 | | | | | | | | | | | |
| 6.3 / 252.6 | Sand<br>some silt, trace clay | | 6 | AS | - | | 253 | | | | 0 77 21 2 |
| 6.7 | Very loose Brown Wet<br>to grey | | | | | | | | | | |
| | End of borehole | | | | | | | | | | |

* 2012 05 18

▽ Water level observed during drilling

▼ Water level measured after drilling

NOTE: Borehole E-17 was carried out for pavement design purposes and augmented by additional testing conducted 1.5m east on July 10 & 12, 2013



+7, ×5: Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

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# RECORD OF BOREHOLE No. E-18 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** West Service Road, Sta. 9+685, o/s 6.0m Lt. **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** July 11, 2013 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 261.0 | Ground Surface | | | | | | | | | | |
| 260.8 | Topsoil | | | | | | | | | | |
| 0.2 | Silt<br>trace to some clay<br>trace sand<br>organics to 0.7m<br>Compact Brown Moist | | 1 | SS | 9 | | | | | | |
| | | | 2 | SS | 20 | | 260 | | | | |
| | clayey silt layers | | 3 | SS | 17 | ▼* | | 150 ■ | H | | 0 10 71 19 |
| | | | | | | ▽* | 259 | | | | |
| | sand seams and<br>silty sand seams | | 4 | SS | 9 | | | | | | |
| 258.0 | Loose Wet | | | | | | 258 | | | | |
| 3.0 | Sand<br>some silt, trace clay<br>Compact to loose Reddish brown Moist | | 5 | SS | 15 | | | | | | |
| | | | | | | | 257 | | | | |
| | | | 6 | SS | 15 | | | | | | 0 84 11 5 |
| | | | | | | | 256 | | | | |
| | | | | | | | 255 | | | | |
| 254.3 | | | 7 | SS | 7 | | | | | | |
| 6.7 | End of borehole | | | | | | | | | | |

* 2013 07 11

▽ Water level observed during drilling

▼ Water level measured after drilling

■ Penetrometer test

+7, ×5 : Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. E-19 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** West Service Road, Sta. 9+685, o/s 5.0m Rt. **ORIGINATED BY** K.D.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** May 18, 2012 **CHECKED BY** B.R.G.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) 20 40 60 | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | | | GR SA SI CL |
| 260.9 | Ground Surface | | | | | * | | | | | |
| 260.7 | Topsoil | | | | | | | | | | |
| 0.2 | Silt, some sand silty clay layers varved<br>Compact Grey Moist | | | | | | 260 | | | | |
| 259.4 | | | | | | | | | | | |
| 1.5 | Sand, some silt<br>Compact Brown Moist | | 1 | SS | 17 | | 259 | | | | |
| | | | | | | | 258 | | | | |
| 257.2 | | | 2 | SS | 26 | | | | | | |
| 3.7 | End of borehole | | | | | | | | | | |

* Borehole dry



+7, ×5 : Numbers refer to Sensitivity

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

Ontario

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# RECORD OF BOREHOLE No. CWM-1 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** Coords: 5 101 325.5 N; 316 350.8 E **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** N.S.B.

**DATUM** Geodetic **DATE** October 31, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | SOIL PROFILE DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ NATURAL MOISTURE CONTENT w LIQUID LIMIT $w_L$ WATER CONTENT (%) 20 40 60 | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 256.9 | Top of water | | | | | ▽* ▼* | | | | | |
| 0.0 / 256.6 | Water | | | | | | | | | | |
| 0.3 | Organic clayey silt rootlets<br>Firm Mottled grey/ brown Wet<br>(ALLUVIUM) | | 1 | SS | 4 | | 256 | ○ | ○ | | |
| | | | 2 | SS | 7 | | | ■ | ⊢○⊣ | | 0 1 74 25 |
| 254.6 | Dark grey | | 3 | SS | 4 | | 255 | | ○ | | |
| 2.3 | Sand, trace silt trace clay, trace gravel<br>Compact Grey Wet | | 4 | SS | 14 | | 254 | | ○ | | 7 84 6 3 |
| 253.6 | | | | | | | | | | | |
| 3.3 | Silt, with sand trace clay, trace gravel<br>Compact Grey Wet | | 5 | SS | 16 | | 253 | | ○ | | 2 27 65 6 |
| 252.8 | | | | | | | | | | | |
| 4.1 | Sand, some silt trace clay, trace gravel cobbles<br>Very dense Reddish brown Wet | | 6 | SS | 53 | | 252 | | ○ | | |
| | | | 7 | SS | 30/3cm | | 251 | | | | |
| 249.9 | | | | | | | 250 | | | | |
| 7.0 | End of borehole<br>Refusal on probable boulder | | | | | | | | | | |

* 2012 10 31 (area flooded)

▽ Water level observed during drilling

▼ Water level measured after drilling

■ Penetrometer test

NOTE: Auger grinding from 4.1 to 4.9m and 5.6 to 6.4m



+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. CWM-2 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** Coords: 5 101 328.9 N; 316 345.7 E **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** C.F.H.S.A. and NQ Diamond Coring **COMPILED BY** N.S.B.

**DATUM** Geodetic **DATE** October 29 and 30, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 256.9 | Top of water | | | | | ▽* ▼* | | | | | |
| 256.7 | Water | | | | | | | | | | |
| 0.2 | Topsoil | | | | | | | | | | |
| 256.5 / 0.4 | Organic clayey silt, trace sand<br>Stiff Brown Moist to firm<br>(ALLUVIUM) | | 1 | SS | 1 | | 256 | | | | |
| | | | 2 | SS | 10 | | | 138 | | | 0 3 76 21 |
| 254.7 / 2.2 | Dark Wet grey | | 3 | SS | 4 | | 255 | | | | |
| | Sand, some silt some gravel, trace clay<br>Compact Grey Wet | | 4 | SS | 13 | | 254 | | | | 13 83 (4) |
| 253.8 / 3.1 | Sandy silt<br>Loose to compact Grey Wet | | 5 | SS | 9 | | 253 | | | | |
| 253.1 / 3.8 | Sand, with silt some gravel, trace clay<br>Dense to compact Reddish brown Wet to moist | | 6 | SS | 17 | | | | | | 18 55 23 4 |
| | | | 7 | SS | 40 | | 252 | | | | |
| 250.9 | | | 8 | SS | 26 | | 251 | | | | |
| 6.0 | Sand, with silt some gravel, trace clay boulders to 7.5m depth<br>Dense Reddish brown Moist<br>(TILL)<br>boulders | | | RC | - | | | | | | |
| 249.2 | | | | RC | - | | 250 | | | | |
| 7.7 | | | 9 | SS | 46 | | 249 | | | | |
| | | | 10 | SS | 30/15cm | | 248 | | | | |
| 246.7 | | | | | | | 247 | | | | |
| 10.2 | Granite bedrock<br>Slightly weathered to unweathered<br>High strength<br>Excellent quality | | 11 | RC NQ | REC 100% | | 246 | | | | RQD 96% |
| | | | 12 | RC NQ | REC 100% | | 245 | | | | RQD 99% |
| 243.7 | | | 13 | RC | REC 100% | | 244 | | | | RQD 100% |
| 13.2 | End of borehole<br>* 2012 10 29 & 30 (area flooded)<br>▽ Water level observed during drilling<br>▼ Water level measured after drilling<br>■ Penetrometer test | | | | | | | | | | 'N' casing advanced from 5.0m depth<br>C.F.H.S.A. denotes Continuous flight hollow stem augers |



+7, ×5: Numbers refer to Sensitivity

20 / 15 5 / 10

(%) STRAIN AT FAILURE

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. CWM-3 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** Coords: 5 101 349.1 N; 316 354.0 E **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** N.S.B.

**DATUM** Geodetic **DATE** October 25, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 256.8 | Top of water | | | | | | | | | | |
| 0.0 | Organic silt<br>some clay, trace sand<br>Very loose Brown Wet | | 1 | SS | WH** | | | | ○ | | |
| 256.1 | | | | | | | 256 | | | | |
| 0.7 | (ALLUVIUM)<br>Organic sandy silt<br>some clay | | 2 | SS | 1 | | | | ○ | | |
| | Very loose Grey Wet<br>(ALLUVIUM) | | 3 | SS | 1 | | 255 | | ○ | | |
| 254.6 | | | | | | | | | | | |
| 2.2 | Sand, with silt<br>trace gravel, trace clay<br>silty sand layers | | 4 | SS | 12 | | 254 | | ○ | | |
| | Compact Grey Wet<br>some gravel | | 5 | SS | 14 | | | | ○ | | 12 58 26 4 |
| | | | | | | | 253 | | | | |
| | | | 6 | SS | 7 | | 252 | | ○ | | |
| | | | | | | | 251 | | | | |
| 250.1 | | | 7 | SS | 5 | | | | ○ | | |
| 6.7 | Sand, with silt<br>some gravel, trace clay<br>Very dense Reddish brown Moist | | | | | | 250 | | | | |
| | (TILL) | | 8 | SS | 55 | | 249 | | ○ | | 17 54 24 5 |
| | | | | | | | 248 | | | | |
| | | | 9 | SS | 50/15cm | | | | ○ | | |
| 246.7 | | | | | | | 247 | | | | |
| 10.1 | End of borehole<br>Refusal on probable boulder | | | | | | | | | | |

* 2012 10 25 (area flooded)

▽ Water level observed during drilling

▼ Water level measured after drilling

WH** denotes penetration due to weight of hammer and rods



+7, ×5: Numbers refer to Sensitivity

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

Ontario

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# RECORD OF BOREHOLE No. CWM-4 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** Coords: 5 101 352.5 N; 316 338.7 E **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** N.S.B.

**DATUM** Geodetic **DATE** October 25, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ WATER CONTENT (%) 20 40 60 | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 256.8 | Top of water | | | | | | | | | | |
| 0.0 | Organic silt some clay, trace sand Very loose Brown Wet | | 1 | SS | 2 | | | | ○ | | |
| 256.1 | (ALLUVIUM) | | | | | | | | | | |
| 0.7 | Organic sandy silt some clay Very loose Grey Wet | | 2 | SS | 1 | | 256 | | | | |
| | (ALLUVIUM) | | 3 | SS | 4 | | 255 | | ○ | | |
| 254.6 | | | | | | | | | | | |
| 2.2 | Sand, trace gravel Compact Reddish/ brown Wet | | 4 | SS | 14 | | 254 | | ○ | | |
| | | | 5 | SS | 22 | | | | ○ | | |
| 252.5 | | | | | | | 253 | | | | |
| 4.3 | Silty sand, trace clay Compact Grey Wet | | 6 | SS | 14 | | 252 | | ○ | | 0 53 44 3 |
| 251.0 | | | | | | | 251 | | | | |
| 5.8 | Sand trace silt, trace gravel Compact Grey Wet | | 7 | SS | 12 | | 250 | | | | |
| | with gravel Reddish brown | | 8 | SS | 13 | | 249 | | | | |
| 248.3 | | | | | | | | | | | |
| 8.5 | Sand, with silt with gravel, trace clay cobbles Compact to very dense Grey Moist (TILL) | | 9 | SS | 28 | | 248 | | ○ | | |
| | | | | | | | 247 | | | | |
| | | | 10 | SS | 30/3cm | | 246 | | | | 21 53 22 4 |
| 245.2 | | | | | | | | | | | |
| 11.6 | End of borehole Refusal on probable boulder | | | | | | | | | | |

* 2012 10 25 (area flooded)

▽ Water level observed during drilling

▼ Water level measured after drilling

+7, ×5: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. CWM-5 1 of 2 METRIC

**G.W.P.** 323-00-00 **LOCATION** Coords: 5 101 357.1 N; 316 350.9 E **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** C.F.H.S.A. and NQ Diamond Coring **COMPILED BY** N.S.B.

**DATUM** Geodetic **DATE** October 24 and 25, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|
| 256.8 | Ground surface | | | | | | | | |
| 256.6 / 0.2 | Topsoil | | | | | | | | |
| | Organic sandy silt trace clay | | 1 | SS | 3 | ▽* | | | |
| 256.0 / 0.8 | Loose Mottled Wet grey/brown (ALLUVIUM) | | 2 | SS | 7 | | 256 | | |
| | Organic silt trace sand, trace clay clay layers | | 3 | SS | 2 | | 255 | | |
| 254.6 / 2.2 | Loose Black/ grey Wet (ALLUVIUM) | | 4 | SS | 9 | | 254 | | |
| | peat layers | | | | | | | | |
| 253.9 / 2.9 | Silty sand, trace clay organics sandy silt layers | | 5 | SS | 20 | | 253 | | |
| | Loose Brown Wet Sand, trace silt | | | | | | | | |
| | Compact Reddish Wet brown | | 6 | SS | 24 | | | | |
| 252.3 / 4.5 | Sandy silt, trace clay | | 7 | SS | 3 | | 252 | | |
| | Very loose Brown Wet to loose | | 8 | SS | 5 | | 251 | | 0 40 57 3 |
| | | | 9 | SS | 5 | | 250 | | |
| 249.8 / 7.0 | Sand trace silt, trace gravel | | | | | | | | |
| | Dense to very dense Brown Moist (TILL) | | 10 | SS | 31 | | 249 | | |
| | | | 11 | SS | 45 | | 248 | | |
| | boulders | | | RC | - | | 247 | | |
| | with gravel, some silt trace clay | | 12 | SS | 73 | | 246 | | 26 52 19 3 |
| | | | 13 | SS | 25/3cm | | 245 | | |
| | cobbles and boulders | | | RC NQ | - | | 244 | | |
| | Cont'd | | | | | | 243 | | |
| | | | | | | | 242 | | |

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100

PLASTIC LIMIT $w_P$ NATURAL MOISTURE CONTENT w LIQUID LIMIT $w_L$

WATER CONTENT (%) 20 40 60



+7, ×5: Numbers refer to Sensitivity

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

# RECORD OF BOREHOLE No. CWM-5 2 of 2 METRIC

**G.W.P.** 323-00-00 **LOCATION** Coords: 5 101 357.1 N; 316 350.9 E **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** C.F.H.S.A. and NQ Diamond Coring **COMPILED BY** N.S.B.

**DATUM** Geodetic **DATE** October 24 and 25, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 241.8 | | | | | | | | | | | |
| 241.2 | | | | | | | | | | | |
| 15.6 | Granite bedrock<br>Slightly weathered to unweathered<br>High strength<br>Excellent quality | | 14 | RC NQ | REC 97% | | 241 | | | | RQD 97% |
| | | | 15 | RC NQ | REC 100% | | 240 | | | | RQD 95% |
| | | | 16 | RC NQ | REC 100% | | 239 | | | | RQD 100% |
| 238.0 | | | | | | | 238 | | | | |
| 18.8 | End of borehole<br>Sample 13: Sampler bouncing<br><br>* 2012 10 25<br>▽ Water level observed during drilling<br><br>C.F.H.S.A. denotes Continuous flight hollowstem augers | | | | | | | | | | |



+7, ×5: Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF BOREHOLE No. CWM-6 1 of 1 METRIC

**G.W.P.** 323-00-00 **LOCATION** Coords: 5 101 372.0 N; 316 338.1 E **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** N.S.B.

**DATUM** Geodetic **DATE** October 23, 2012 **CHECKED BY** B.R.G.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 256.8 | Ground surface | | | | | | | | | | |
| 256.6 | Topsoil | | | | | | | | | | |
| 0.2 | Organic sandy silt<br>trace clay<br>clayey silt layers | | 1 | SS | 4 | | | | ○ | | |
| 255.9 | | | | | | | 256 | | | | |
| 0.9 | Loose Brown Moist<br>(ALLUVIUM) | | 2 | SS | 8 | | | | ○ | | |
| | Silty clay, trace sand<br>organics | | | | | | | | | | |
| | Firm Mottled Wet<br>grey/brown<br>(ALLUVIUM) | | 3 | SS | 9 | ▽* | 255 | | ○ | | 0 7 59 34 |
| 254.7 | | | | | | | | | | | |
| 2.1 | Organic clay | | | | | | | | | | |
| 254.5 | | | | | | | | | | | |
| 2.3 | Firm Grey Moist<br>(ALLUVIUM) | | 4 | SS | 13 | | 254 | | ○ | | |
| | Sand<br>trace silt, trace gravel | | | | | | | | | | |
| | Compact Brown Wet | | 5 | SS | 12 | | | | ○ | | |
| | | | | | | | 253 | | | | |
| | | | 6 | SS | 10 | | 252 | | ○ | | |
| | | | | | | | 251 | | | | |
| | Loose to<br>compact | | 7 | SS | 6 | | | | | | |
| | | | | | | | 250 | | | | |
| 249.5 | | | 8 | SS | 20/3cm | | | | | | |
| 7.3 | End of borehole | | | | | | | | | | |
| | Refusal on probable boulder | | | | | | | | | | |
| | Sample 8: Sampler bouncing | | | | | | | | | | |

* 2012 10 23

▽ Water level observed during drilling

▼ Water level measured after drilling

ON MTO_VER3 NEW LOGO 10TF013A-CWM REV.GPJ ON_MOT.GDT 8/7/2014 9:49:27 AM

+7, ×5: Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

# RECORD OF AUGER PROBE No CWM-AP-1 1 of 1

**METRIC**

**G.W.P.** 323-00-00 **LOCATION** West Service Road, Sta. 9+475, o/s 6.0m Rt. **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** July 08, 2013 **CHECKED BY** B.R.G.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | | | GR SA SI CL |
| 257.3 | Ground Surface | | | | | | | | | | |
| 0.0 | Silt, trace sand organics<br>Brown | | 1 | AS | - | | 257 | | | | |
| 255.9 | Grey | | | | | ▼* ▽* | 256 | | | | |
| 1.4 | Sand, trace silt<br>Brown Wet | | | | | | 255 | | | | |
| 254.5 | | | | | | | | | | | |
| 2.8 | Silt<br>trace sand, trace clay<br>Grey Wet | | 2 | AS | - | | 254 | | | | |
| 252.4 | | | | | | | 253 | | | | |
| 4.9 | Sand<br>some gravel, trace silt<br>Brown Wet<br>(TILL)<br>trace gravel<br>Loose | | 3 | AS | - | | 252 | | | | |
| 248.9 | | | | | | | 251 | | | | |
| | | | | | | | 250 | | | | |
| | | | | | | | 249 | | | | |
| 8.4 | End of borehole<br>Refusal on probable boulder | | | | | | | | | | |

* 2013 07 08

▽ Water level observed during drilling

▼ Water level measured after drilling



+7, ×5 : Numbers refer to Sensitivity

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

# RECORD OF AUGER PROBE No CWM-AP-2 1 of 1

**METRIC**

**G.W.P.** 323-00-00 **LOCATION** West Service Road, Sta. 9+480, o/s 25.0m Lt. **ORIGINATED BY** F.P.

**DIST** North Bay **HWY** 11 **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** A.D.

**DATUM** Geodetic **DATE** July 08, 2013 **CHECKED BY** B.R.G.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (20 40 60) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | | | GR SA SI CL |
| 257.5 | Ground Surface | | | | | | | | | | |
| 0.0 / 257.2 | Topsoil | | | | | | | | | | |
| 0.3 | Silt<br>some clay, trace sand<br>organics<br>Brown Moist | | 1 | AS | - | | 257 | | | | |
| 256.1 | | | | | | ▼* ▽* | | | | | |
| 1.4 | Silty sand<br>Brown Wet | | | | | | 256 | | | | |
| 255.4 | | | 2 | AS | - | | | | | | |
| 2.1 | Sand<br>trace silt, trace gravel<br>Brown Wet | | | | | | 255 | | | | |
| 254.7 | | | | | | | | | | | |
| 2.8 | Silt<br>trace to some clay<br>trace sand<br>Brown Wet | | 3 | AS | - | | 254 | | | | |
| 253.2 | | | | | | | | | | | |
| 4.3 | Sand<br>some gravel, trace silt<br>cobbles<br>Brown Wet<br>(TILL)<br>Loose | | 4 | AS | - | | 253<br>252<br>251 | | | | |
| 249.3 | | | | | | | 250 | | | | |
| 8.2 | End of borehole<br>Refusal on probable boulder | | | | | | | | | | |

* 2013 07 08

▽ Water level observed during drilling

▼ Water level measured after drilling



+7 , ×5 : Numbers refer to Sensitivity

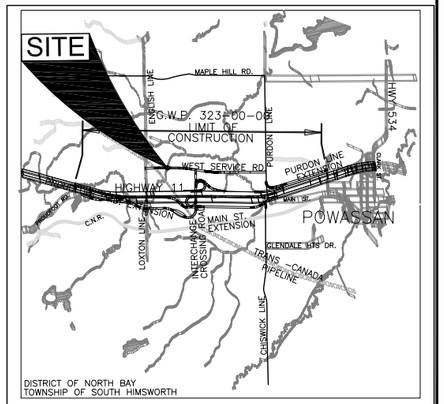
20 / 15 5 / 10 (%) STRAIN AT FAILURE

CONT No
GWP No 323-00-00
WP No

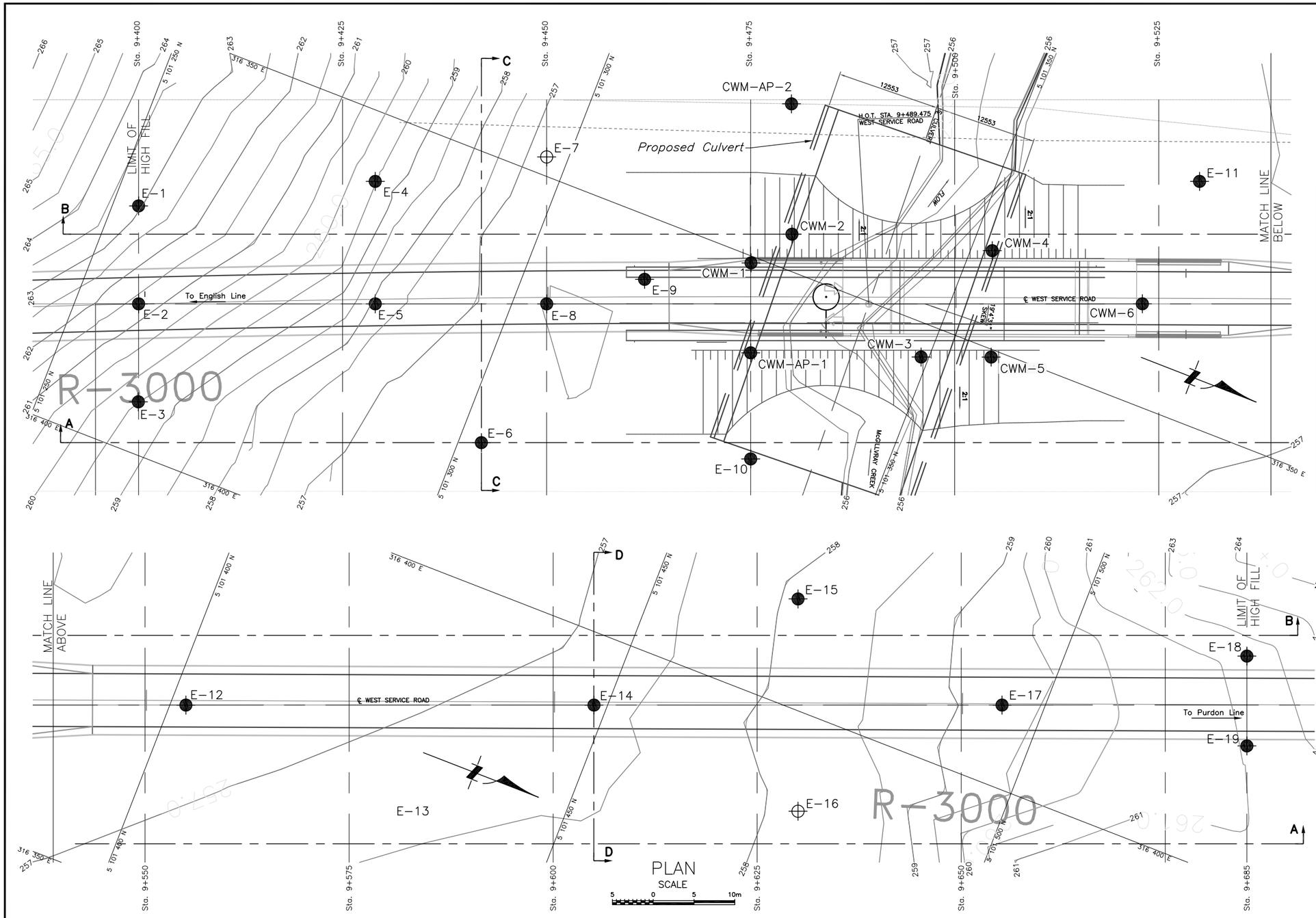
AREA E – WEST SERVICE ROAD
Sta. 9+400 to 9+685
HIGHWAY 11 POWASSAN
BOREHOLE LOCATIONS

SHEET

Peto MacCallum Ltd.
CONSULTING ENGINEERS




KEY PLAN
0.5km 0 0.5km 1.0km 1.5km




PLAN
SCALE
5 0 5 10m

LEGEND

| | |
|---|---|
| ● | Borehole |
| ⊕ | Cone |
| ⊕● | Borehole & Cone |
| N | Blows/0.3m (Std. Pen Test, 475 J/blow) |
| CONE | Blows/0.3m (60 Cone, 475 J/blow) |
| WH | Penetration due to weight of hammer and rods |
| PH | Pushed hydraulically |
| PM | Pushed mechanically |
| ▼ | WL at time of investigation Dec. 2011 |
| ▽ | Head |
| ▽ | ARTESIAN WATER Encountered |
| | PIEZOMETER |

| BH No | ELEVATION | STA. WEST SERVICE RD | o/s CL |
|---|---|---|---|
| E-1 | 262.2 | 9+400 | 12.0m Lt. |
| E-2 | 261.3 | 9+400 | CL |
| E-3 | 259.0 | 9+400 | 12.0m Rt. |
| E-4 | 259.3 | 9+429 | 15.0m Lt. |
| E-5 | 257.6 | 9+429 | CL |
| E-6 | 256.7 | 9+442 | 17.0m Rt. |
| E-7 | 256.3 | 9+450 | 18.0m Lt. |
| E-8 | 256.5 | 9+450 | CL |
| E-9 | 256.5 | 9+462 | 3.0m Lt. |
| E-10 | 257.2 | 9+475 | 19.0m Rt. |
| E-11 | 256.4 | 9+530 | 15.0m Lt. |

(Legend Continues)

NOTES:

1. DRAWINGS E-1, E-2 AND E-3 SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
2. REFER TO DRAWING E-2 FOR PROFILE A-A AND PART OF PROFILE B-B AND E-3 FOR PROFILE B-B (Continued) AND SECTIONS C-C AND D-D.
3. THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
4. DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

(Legend Continues)

| BH No | ELEVATION | COORDINATES NORTHINGS | EASTINGS |
|---|---|---|---|
| CWM-1 | 256.9 | 5 101 325.5 | 316 350.8 |
| CWM-2 | 256.9 | 5 101 328.9 | 316 345.7 |
| CWM-3 | 256.8 | 5 101 349.1 | 316 354.0 |
| CWM-4 | 256.8 | 5 101 352.5 | 316 338.7 |
| CWM-5 | 256.8 | 5 101 357.1 | 316 350.9 |
| CWM-6 | 256.8 | 5 101 372.0 | 316 338.1 |
| CWM-AP-1 | 257.3 | 5 101 329.4 | 316 361.1 |
| CWM-AP-2 | 257.5 | 5 101 323.1 | 316 330.8 |

(Legend Continues)

| BH No | ELEVATION | STA. WEST SERVICE RD | o/s CL |
|---|---|---|---|
| E-12 | 256.7 | 9+555 | CL |
| E-13 | 256.8 | 9+580 | 14.0m Rt. |
| E-14 | 257.2 | 9+605 | CL |
| E-15 | 258.4 | 9+630 | 13.0m Lt. |
| E-16 | 258.7 | 9+630 | 13.0m Rt. |
| E-17 | 259.3 | 9+655 | CL |
| E-18 | 261.0 | 9+685 | 6.0m Lt. |
| E-19 | 260.9 | 9+685 | 5.0m Rt. |

REGISTERED PROFESSIONAL ENGINEER C M P Nascimento Feb. 20, 2015 PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER B. R. GRAY Feb. 20, 2015 PROVINCE OF ONTARIO

REF AECOM Drawings: Hwy11-Design.dwg; X-60157537-C-Hwy11-Base.dwg dated September 2010

– 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 |
| | | |

Geocres No. 31L-184

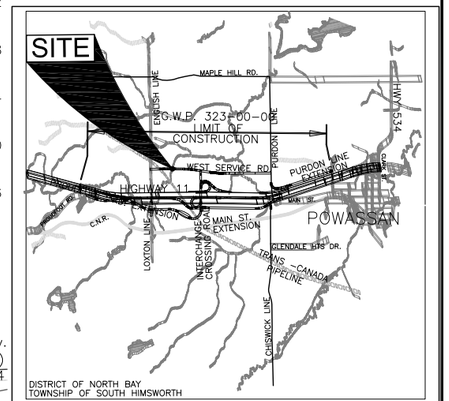
| | | | | | |
|---|---|---|---|---|---|
| HWY No | 11 | | | DIST | North Bay |
| SUBM'D | NA | CHECKED AD | DATE FEB. 20, 2015 | SITE | |
| DRAWN | NA | CHECKED BRG | APPROVED CN | DWG | E-1 |

CONT No
GWP No 323-00-00
WP No

AREA E – WEST SERVICE ROAD
Sta. 9+400 to 9+685
HIGHWAY 11 POWASSAN
SOIL STRATA

SHEET

Peto MacCallum Ltd.
CONSULTING ENGINEERS




LEGEND

- Borehole
- Cone
- Borehole & Cone
- N Blows/0.3m (Std. Pen Test, 475 J/blow)
- CONE Blows/0.3m (60 Cone, 475 J/blow)
- WH Penetration due to weight of hammer and rods
- PH Pushed hydraulically
- PM Pushed mechanically
- WL at time of investigation Dec. 2011
- Head
- ARTESIAN WATER
- Encountered
- PIEZOMETER

| BH No | ELEVATION | STA. WEST SERVICE RD | o/s CL |
|---|---|---|---|

FOR DETAILS, REFER TO DRAWING E–1

NOTES:

1. DRAWINGS E–1, E–2 AND E–3 SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
2. REFER TO DRAWING E–1 FOR BOREHOLE LOCATION PLAN E–3 FOR PROFILE B–B (Continued) AND SECTIONS C–C AND D–D.
3. THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
4. DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

REF AECOM Drawings: Hwy11–Design.dwg; X–60157537–C–Hwy11–Base.dwg dated September 2010

REGISTERED PROFESSIONAL ENGINEER — C M P Nascimento — Feb. 20, 2015 — PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER — B. R. GRAY — Feb. 20, 2015 — PROVINCE OF ONTARIO

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

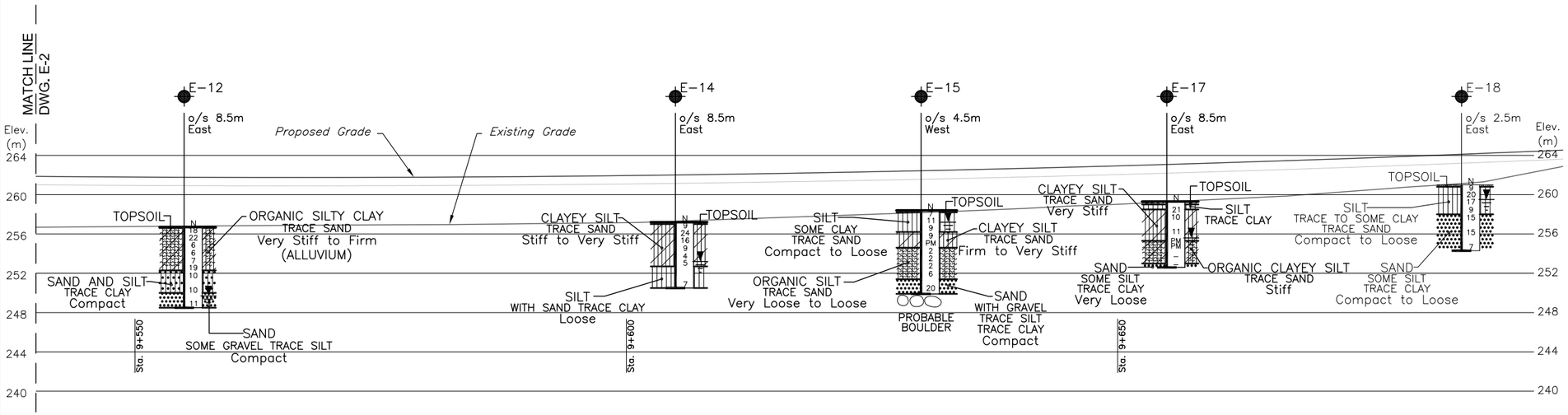
| REVISIONS | | | |
|---|---|---|---|
| | | | |
| | | | |
| DATE | BY | DESCRIPTION | |

Geocres No. 31L–184

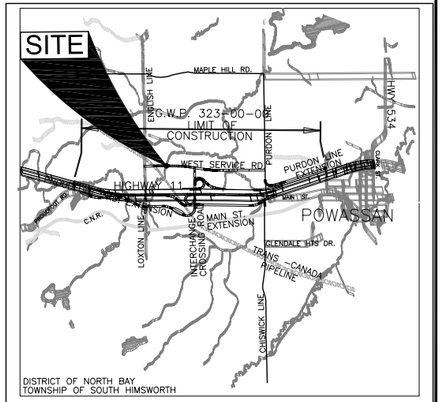
| | | | | | |
|---|---|---|---|---|---|
| HWY No | 11 | | | DIST | North Bay |
| SUBM'D | NA | CHECKED | AD | DATE FEB. 20, 2015 | SITE |
| DRAWN | NA | CHECKED | BRG | APPROVED CN | DWG E–2 |

| | |
|---|---|
| CONT No<br>GWP No 323-00-00<br>WP No | |
| AREA E – WEST SERVICE ROAD<br>Sta. 9+400 to 9+685<br>HIGHWAY 11 POWASSAN<br>SOIL STRATA | SHEET |

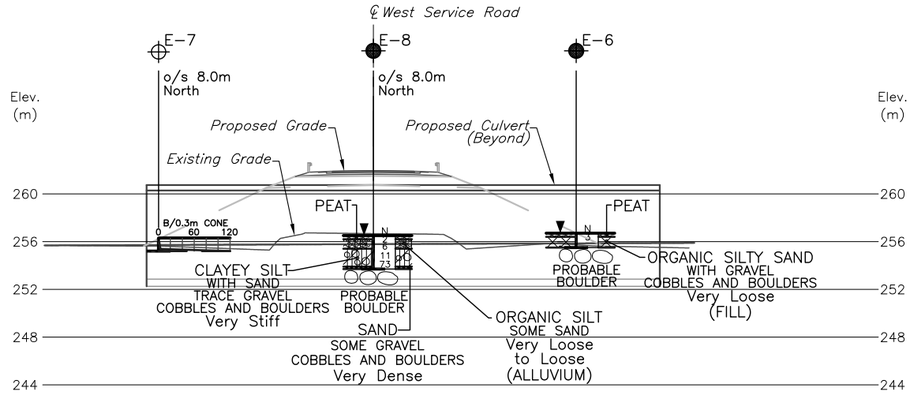
Peto MacCallum Ltd.
CONSULTING ENGINEERS



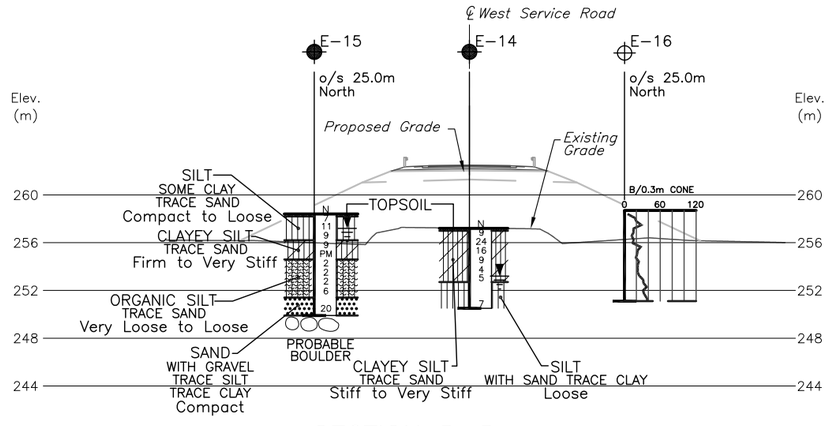

PROFILE B–B (Continued)




KEY PLAN
0.5km 0 0.5km 1.0km 1.5km




SECTION C–C




SECTION D–D

SCALE
5 0 5 10m

LEGEND

| | |
|---|---|
| | Borehole |
| | Cone |
| | Borehole & Cone |
| N | Blows/0.3m (Std. Pen Test, 475 J/blow) |
| CONE | Blows/0.3m (60 Cone, 475 J/blow) |
| WH | Penetration due to weight of hammer and rods |
| PH | Pushed hydraulically |
| PM | Pushed mechanically |
| | WL at time of investigation Dec. 2011 |
| | Head |
| | ARTESIAN WATER Encountered |
| | PIEZOMETER |

| BH No | ELEVATION | STA. WEST SERVICE RD | o/s CL |
|---|---|---|---|
| FOR DETAILS, REFER TO DRAWING E-1 | | | |

NOTES:

1. DRAWINGS E–1, E–2 AND E–3 SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
2. REFER TO DRAWING E–1 FOR BOREHOLE LOCATION PLAN AND E–2 FOR PROFILE A–A AND PART OF PROFILE B–B.
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REGISTERED PROFESSIONAL ENGINEER
C M P Nascimento
Feb. 20, 2015
PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER
B. R. GRAY
Feb. 20, 2015
PROVINCE OF ONTARIO

REF AECOM Drawings: Hwy11–Design.dwg;
X–60157537–C–Hwy11–Base.dwg dated September 2010

– 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 |

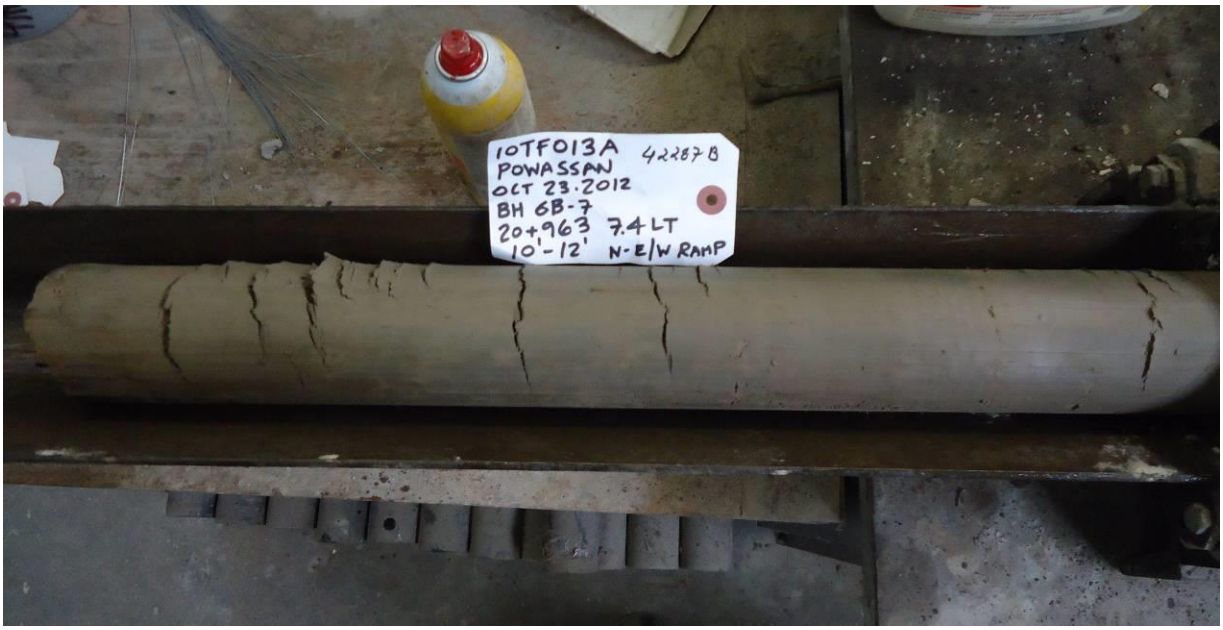
Geocres No. 31L–184

| | | | | | |
|---|---|---|---|---|---|
| HWY No | 11 | | | DIST | North Bay |
| SUBM'D | NA | CHECKED | AD | DATE FEB. 20, 2015 | SITE |
| DRAWN | NA | CHECKED | BRG | APPROVED CN | DWG E–3 |

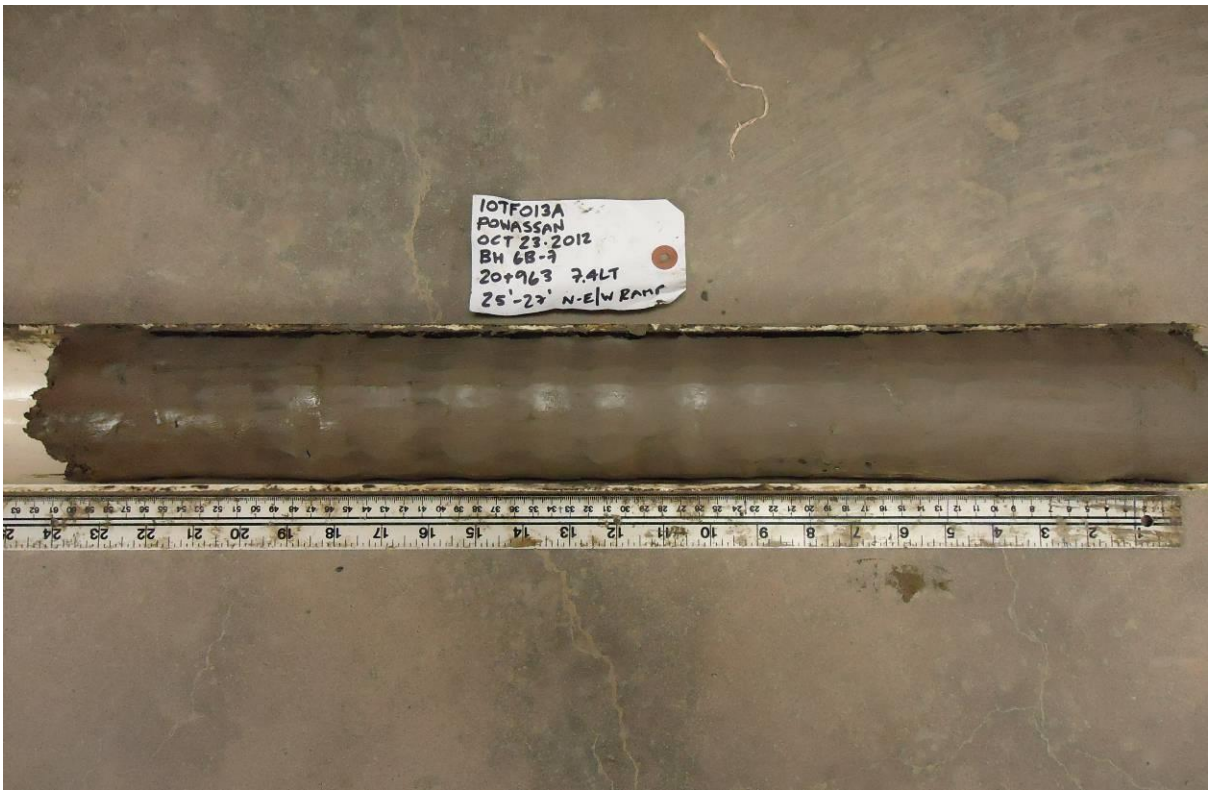
# APPENDIX A

Laboratory Photographs 1 to 3


**Photograph 1:** Extruded thin wall sample TW8 of Silty Clay from borehole 6A-5 at 5.2 to 5.8 m depth. (October 12, 2011)




**Photograph 2:** Extruded thin wall sample TW5 of clayey silt from borehole 6B-7 at 3.1 to 3.7 m depth. (October 12, 2011)




**Photograph 3:** Extruded thin wall sample TW8 from borehole 6B-7 at 7.6 to 8.2 m depth. Varved soil contains about 25 mm thick silt layers over 20 mm thick clayey silt layers. (October 12, 2011)

Peto MacCallum Ltd.
CONSULTING ENGINEERS

# FOUNDATION DESIGN REPORT
# HIGH FILL AREAS

**for**

**HIGHWAY 11 IMPROVEMENTS AND NEW INTERCHANGE AT SOUTH ENTRANCE TO POWASSAN**
**G.W.P. 323-00-00**
**DISTRICT NORTH BAY, ONTARIO**

***HIGHWAY 11 NBL (AREA 1): STA 20+025 TO 20+200***
***E/W-S RAMP (AREA 6A): STA. 21+075 TO 21+125***
***N-E/W RAMP (AREA 6B): STA. 20+890 TO 21+000***
***N-E/W RAMP (AREA C): STA. 21+060 TO 21+100***
***PROUDFOOT ROAD EXTENSION (AREA 11): STA. 8+620 TO 8+710***
***WEST SERVICE ROAD (AREA E): STA. 9+400 TO 9+685***

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Distribution:
5 cc: AECOM for distribution to MTO, Project Manager + one digital copy (PDF)
1 cc: AECOM for distribution to MTO, Pavements and Foundations Section + one digital copy (PDF) and Drawing (AutoCAD)
2 cc: AECOM + one digital copy (PDF)
1 cc: PML Kitchener
1 cc: PML Toronto

PML Ref.: 10TF013A-H1
Index No.: 423FDR
Geocres No.: 31L-184
February 25, 2015

# TABLE OF CONTENTS

Peto MacCallum Ltd.
CONSULTING ENGINEERS

**FOUNDATION DESIGN REPORT**
for
High Fill Areas
Highway 11 Improvements and New Interchange at South Entrance to Powassan
Township of South Himsworth
North Bay Area, Ontario
GWP 323-00-00

## 1. INTRODUCTION

Peto MacCallum Ltd. (PML) was retained by AECOM Canada Ltd. (AECOM) on behalf of the Ministry of Transportation of Ontario (MTO) to provide Foundations Engineering Services for the construction of an interchange on Highway 11 at the south entrance to Powassan. The discussions and recommendations for specific high fill embankments are presented in this Foundation Design Report.

The project limits extend from 5.7 km south of Highway 534, northerly 5.0 km in South Himsworth Township. The purpose of this project is to upgrade the existing four-lane divided highway to a fully controlled access freeway.

Upon completion of the pavement investigations, a total of 4 high fill areas were identified in the initial Scope Change Request (SCR) F-1 dated October 5, 2011 (areas 1, 6A, 6B and 11) and 2 more (areas C and E) were identified in the SCR F-2 dated November 22, 2012 for foundation investigation. For ease of reference, the high fill areas have been assigned identification numbers. The identification number, location and maximum fill height of each high fill area are provided below.

| PML AREA NO. | LOCATION/STATION RANGE | MAXIMUM FILL HEIGHT |
|---|---|---|
| 1 | Highway 11 NBL, Sta. 20+025 to 20+200(*) | 7.8 m (1.8 m fill over existing 6.0 m high embankment) |
| 6A | Proposed E/W-S ramp, Sta. 21+075 to 21+125 | 6.8 m (new embankment) |
| 6B | Proposed N-E/W ramp, Sta. 20+890 to 21+000 | 8.0 m (new embankment) |
| C | Proposed N-E/W ramp, Sta. 21+060 to 21+100 | 6.5 m (new embankment) |
| 11 | Proudfoot Road Extension, Sta. 8+620 to 8+710 | 7.0 m (new embankment) |
| E | Proposed West Service Road, Sta. 9+400 to 9+685(**) | 7.5 m (new embankment) |

Notes: (*) Excluding Sta. 20+106 to 20+178 (proposed NBL Bridge section – refer to PML Report Ref. No.: 10TF013A-S1).
(**) Excluding section from approximately Sta. 9 + 470 to 9+525 (proposed McGillvray Creek Crossing, PML Report Ref. No.: 10TF013A-66) at centreline median.

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*E-mail: toronto@petomaccallum.com*
*BARRIE, HAMILTON, KITCHENER, TORONTO*

In Area 1, the earthworks will include widening of the platform for a new exit ramp as well as raising the existing grade by 1.8 m to a total maximum embankment height of 7.8 m. In Areas 6A, 6B, C, 11 and E new embankments are being proposed with heights from 6.8 to 8.0 m. The high fill areas 6A and 6B make up a single embankment over relatively uniform soil conditions and were considered jointly for the purpose of mitigation recommendations in this report. Area E includes different soil conditions north and south of the McGillvray Creek and recommendations for this Area were provided separately for the sections to the north and south of the Creek.

This report provides recommendations for construction of the embankments within the six high fill areas, where special construction procedures could be required to minimise post-construction settlement of the roadway surface due to consolidation of the subgrade materials, as well as comments on the stability of embankments and construction methods. These comments and recommendations are based on the conditions revealed during the investigation and consider the requirements of the MTO “Embankment Settlement Criteria for Design” dated March 2, 2010.

The Pavement Design Report Ref. No. 10TF013B prepared for this project by PML provides additional recommendations for design and construction of embankments over competent ground that does not require specific stability and settlement analysis.

## 2. DISCUSSIONS AND RECOMMENDATIONS

### 2.1 General

A summary of the subsurface conditions (depth to bottom of clay and depth to probable bedrock) for each of the high fill areas is compiled in the attached Table 1 for reference in this report.

All elevations in this report are expressed in metres. A list of standard specifications referenced in this report is provided in the attached Table 2.

## 2.2 Red Flag Issues

Based on the results of the investigation, it is considered that standard construction methods can be used for the grade raise and widening of the existing embankment in Area 1 and the new embankment construction in Area 6A, 6B, C, 11 and E.

In view of the presence of layers of varved clays and clayey silts below the embankment subgrade in Areas 1, 6A, 6B, C and organic soils in Area 11 and E, it is recommended that mitigation be carried out within the six areas investigated. It is noted that the organic soil layers in Area 11 should be excavated since there will be a requirement to partially excavate the area for the construction of a proposed culvert at approximately Sta. 8+659. It is also noted that organic soils that extended to depths of 7.0 m were encountered below the cohesive deposit in Area E north of McGillvray Creek. Since removal of these soils would require considerable excavation adjacent to the creek valley with potential instability concerns, it is recommended that these soils be left in place and other mitigation measures implemented as outlined in this report.

The results of the pavements investigation has indicated that only a small portion of the earth excavations will be suitable for embankment compaction. Consequently, rock fill should be borrowed to construct the new embankments and the excess excavated earth excavation used for slope flattening when required.

The “red flag” issues outlined in the preceding paragraphs and the recommended methods of overcoming these issues noted in the following sections of the report are intended to alert and aid the designer and the Contractor. These comments and recommendations are based on the conditions revealed during the investigations and no responsibility is assumed by the consultants or the MTO for alerting the Contractor to all critical issues for each foundation alternative. The requirements to deliver acceptable construction quality remain the responsibility of the Contractor.

## 2.3 Analysis of Site Conditions

The selection of embankment construction methods at each high fill area will depend on their stability and post-construction settlements as well as other factors such as environmental considerations, construction schedule and relative costs. As a first step, assessments of the stability and settlement of the proposed embankments were carried out assuming that only site

preparation comprising the excavation of surficial organic and soft materials is carried out. The results of these assessments are provided in the following sections of this report.

Based on the results of these feasibility analyses, the recommendations for the selection of new embankment construction methods as required are provided in Section 3 of this report.

### 2.3.1 Summarized Subsurface Conditions and Geotechnical Parameters

In summary, the subsurface stratigraphy revealed in the high fill area boreholes generally comprised surficial topsoil / peat / fill overlying a cohesionless sandy or silty soil over a cohesive deposit of clayey silt, silty clay, clay and/or cohesionless sandy soils mantling probable bedrock. In Area 1, cohesive soils were only encountered at the east toe of slope. The clayey soils were typically firm to stiff. The relevant data from the soil stratigraphy at each high fill area is summarised in the attached Table 1.

The soil parameters used in the analyses were obtained directly or through correlation from field and laboratory testing and adjusted by engineering judgement in case of layered soil deposits.

The geotechnical data and parameters used for stability and settlement analysis were summarized in the following Sections 2.3.2 and 2.3.3.

### 2.3.2 Embankment Stability

The stability of the new embankment sections was analysed using the limit equilibrium methods and the SLOPE/W software developed by Geo-Slope International Ltd. The software analyses numerous potential failure surfaces and establishes a minimum safety factor aided by the user‘s input. The minimum safety factors of 1.3 and 1.5 are recommended for the design of embankment slopes under short-term total stress and long-term effective stress analysis conditions, respectively.

A summary of the typical engineering properties assumed for the calculations where direct measurements were not obtained is as follows:

| | | ASSUMED STRENGTH PARAMETERS | | | |
|---|---|---|---|---|---|
| | | TOTAL STRESS | | EFFECTIVE STRESS | |
| **SOIL TYPE** | **UNIT WEIGHT ($kN/m^3$)** | **SHEAR STRENGTH (kPa)** | **INTERNAL FRICTION (Degrees)** | **SHEAR STRENGTH (kPa)** | **INTERNAL FRICTION (Degrees)** |
| Rockfill | 18 | 0 | 42 | 0 | 42 |
| New Granular Fill | 23 | 0 | 35 | 0 | 35 |
| Existing Granular Fill | 21 | 0 | 31 | 0 | 31 |
| Peat / Topsoil | 12 | 8 | 0 | 8 | 0 |
| Clayey Soils (firm to stiff) | 18 | 30 to 50 | 0 | 6 to 8 | 25 |
| Sand to silt (loose to compact) | 19 | 0 | 29 to 32 | 0 | 29 to 32 |
| Sand Seams (organic) | 16 | 0 | 20 | 0 | 20 |
| Organic Silt (very loose to loose) | 18 | 0 | 20 | 0 | 20 |

As the first step, the analyses considered the construction of new embankments where only the peat/topsoil/alluvial layers were excavated. Total stress and effective stress analyses respectively for short term (construction) and long term (post-construction) conditions were conducted for all selected areas. The grade raise in Area 1 has been analyzed considering an earth fill embankment with a side slope of 2H:1V and the remaining areas have been analysed considering rockfill embankments with side slopes of 1.25H:1V.

The adjacent Areas 6A and 6B were considered as a single embankment for the stability analysis in view of their uniform subgrade conditions.

Due to varying soil stratigraphy's north and south of McGillvray Creek Area E was analysed as two separate sections, with one south and one north of McGillvray creek.

The results of the total stress slope stability analyses are provided in Figures A-1 to A-6, attached in Appendix A and listed below:

| PML HIGH FILL AREA | APPROXIMATE MAXIMUM EMBANKMENT HEIGHT (m) | MINIMUM FACTOR OF SAFETY | FIGURE NO. |
|---|---|---|---|
| Area 1 | 7.8 (*) | 1.33 | A-1 |
| Areas 6A and 6B | 8.0 | 1.53 | A-2 |
| Area C | 6.5 | 1.50 | A-3 |
| Area 11 | 7.0 | 1.60 | A-4 |
| Area E (south of McGillvray Creek Structure) | 7.5 | 2.25 | A-5 |
| Area E (north of McGillvray Creek Structure) | 5.0 | 1.78 | A-6 |

(*) New fill height of 1.8 m to be placed on an existing 6.0 m high embankment for a total of 7.8 m.

The results of the total stress analyses indicate a minimum safety factor of 1.3 or greater can be obtained for an earthfill embankment with side slope of 2H:1V in Area 1 and rockfill embankments with side slopes of 1.25H:1V for the remaining areas, indicating that the new embankments will be stable during construction.

The results of the effective stress slope stability analyses are summarized in the following table and provided in Figures A-1a to A-6a attached in Appendix A:

| PML HIGH FILL AREA | APPROXIMATE MAXIMUM EMBANKMENT HEIGHT (m) | MINIMUM FACTOR OF SAFETY | FIGURE NO. |
|---|---|---|---|
| Area 1 | 7.8 (*) | 1.50 | A-1a |
| Areas 6A and 6B | 8.0 | 1.62 | A-2a |
| Area C | 6.5 | 1.50 | A-3a |
| Area 11 | 7.0 | 1.55 | A-4a |
| Area E (south of McGillvray Creek Structure) | 7.5 | 2.01 | A-5a |
| Area E (north of McGillvray Creek Structure) | 5.0 | 1.78 | A-6a |

(*) New fill height of 1.8 m to be placed on an existing 6.0 m high embankment for a total of 7.8 m.

The results of the effective stress analyses indicate that the proposed embankment will be stable with a minimum factor of safety values of 1.5 under post-construction conditions.

The slope stability results should be considered in conjunction with the long-term post-construction settlements discussed in the following sections.

### 2.3.3 Embankment Settlement

#### *2.3.3.1 Settlement of Cohesive Soils*

The estimated settlements of cohesive soils were computed based on parameters derived from consolidation testing in Areas 6A and 6B and empirical relationships considering in-situ field vane tests, laboratory water contents and Atterberg limits test results.

Previous consolidation testing data from the existing southbound lane McGillvray Creek Bridge foundation investigation report, W.P. 590-92-01, Contract No. 95-214 was also used to supplement the current information in Areas 1 and 11 (Geocres 31L-60).

Settlements for Area 1 were estimated separately for the Area 1 NBL embankment grade raise of 1.8 m and for the Area 1 widening construct the proposed S-E/W ramp that will include 2.5 m of earth fill over the existing embankment and native soil.

Area E was subdivided into two sections, north and south of McGillvray Creek, due to varying site conditions, similar to the stability analysis assessment.

In summary, the following parameters for clayey soils were employed in the settlement analyses.

| PML HIGH FILL AREA | PRECONSOLIDATION PRESSURE $P'_c$ (kPa) | INITIAL VOID RATIO $e_o$ | COMPRESSION INDEX $C_c$ | RECOMPRESSION INDEX $C_r$ | COEFFICIENT OF CONSOLIDATION $C_v$ ($m^2$ / month) | REFERENCE FIGURE NO. |
|---|---|---|---|---|---|---|
| Area 1 | 90 | 0.8 | 0.2 | 0.02 | 0.4 | Geocres 31L-60 |
| Area 6A, 6B and C (upper cohesive soils) | 1,000 | 0.8 | 0.4 | 0.03 | 1.7 (*) | 6B-C-1 |
| Area 6A, 6B and C (lower cohesive soils) | 610 | 1.4 | 0.8 | 0.04 | 1.7 (*) | 6A-C-1 |
| | 570 | 1.3 | 0.7 | 0.05 | 1.9 (*) | 6B-C-2 |
| Area 11 | 90 | 0.8 | 0.2 | 0.02 | 0.4 | Geocres 31L-60 |
| Area E (north and south of McGillvray creek) | 570 | 1.3 | 0.7 | 0.05 | 0.9 (*) | 6B-C-2 |

(*) Values estimated from the typical Liquid Limits of the respective soil layers.

A summary of the estimated consolidation settlements of the native cohesive soils that would potentially occur under maximum embankment loading if the existing cohesive soils were left in place is given below:

| PML HIGH FILL AREA | MAXIMUM NEW FILL HEIGHT (m) | CLAYEY SOIL THICKNESS (m) | ESTIMATED MAXIMUM SETTLEMENT (mm) | TIME PERIOD FOR 90% COMPLETION OF CONSOLIDATION (months) |
|---|---|---|---|---|
| Area 1 NBL | 1.8 | 0 (*) | 0 (*) | 0 (*) |
| Area 1 Widening | 2.5 | 2.5 | 20 | 1 |
| Area 6A and 6B | 8.0 | 6.0 to 10.6 | 80 | 6 |
| Area C | 6.5 | 2.0 to 5.5 | 45 | 4 |
| Area 11 | 7.0 | 1.4 – 3.4 | 110 | 6 |
| Area E (south of McGillvray Creek Structure) | 7.5 | 0 to 1.5 | 25 | 1 |
| Area E (north of McGillvray Creek Structure) | 5.0 | 0 to 5.5 | 55 | 7 |

(*) In Area 1 cohesive soils are only expected at the east toe of slope of the embankment. Settlement of theses soils is not expected to impact the travelled portion of the NBL embankment.

The estimated maximum settlements of the existing clayey soils in Areas 6A, 6B, C, 11 and E due to loading from the new embankments are 25 to 110 mm. In Area 1, clayey soils were only encountered beneath the east toe of slope (near McGillvray Creek) and are not expected to contribute to settlement of the travelled NBL portion of the roadway in this area, however approximately 20 mm of settlement may occur under the embankment widening for the proposed S-E/W Ramp.

The analysis indicated that about 90% of the estimated settlements would occur within 3 months in Areas 6A and 6B, 4 months within Area C, 6 months in Area 11, 1 month in Area E south of McGillvray Creek and 7 months in Area E north of McGillvray Creek.

#### *2.3.3.2 Settlement of Cohesionless Soils*

Cohesionless soils were encountered above and below cohesive soils in most high fill areas.

The estimated settlements of these cohesionless soils in the high fill areas are in a range from less than 5 mm to 170 mm under the maximum fill height as listed in the table below.

| PML HIGH FILL AREA | MAXIMUM NEW FILL HEIGHT (m) | EXISTING FILL / SAND / SILT THICKNESS (m) | ESTIMATED MAXIMUM SETTLEMENT (mm) |
|---|---|---|---|
| Area 1 NBL | 1.8 | 7.2 to 13.1 | < 5 |
| Area 1 Widening | 2.5 | – | < 5 |
| Areas 6A and 6B | 8.0 | 2.2 to 9.5 | 80 |
| Area C | 6.5 | >2.4 to >5.1 | 80 |
| Area 11 | 7.0 | > 6.8 to 12.1 | 170 |
| Area E (south of McGillvray Creek) | 7.5 | 0 to >6.7 | 130 |
| Area E (north of McGillvray Creek) | 5.0 | >0.9 to >6.9 | 100 |

The largest 170 mm estimated settlements of cohesionless soils are anticipated beneath the new Area 11 embankment due to the up to 12.1 m thick very loose to loose deposits. These settlements will occur during and within 3 months after embankment fill placement. Because the settlements of the cohesionless soils encountered in the listed high fill areas will occur rapidly, these soils will not need to be excavated below the new platform.

An approximate settlement of up to 80 mm in addition to those listed above is expected to occur within the organic sand seams encountered in Area 11 (Proudfoot Road Extension). Up to 60 mm of the estimated settlement is expected to occur in the first year following completion of the fill embankment and settlements of up to 25 mm can be expected to occur over the following decade as organic material continues to decay and consolidate. Part of these organic soils will be excavated for the construction of a new culvert at Sta. 8+659.

Also, settlement of up to 60 mm in addition to those listed above is anticipated in the organic non-cohesive soils encountered north of McGillvray Creek in Area E (West Service Road). Up to

40 mm of the estimated settlement is expected to occur in the first year following completion of the fill embankment and settlements of up to 25 mm can be expected to occur over the following decade as organic material continues to decay and consolidate.

#### *2.3.3.3 Settlement of New Earth Fill / Rockfill*

Earth and/or granular materials are expected to be employed to construct the grade raise and widening in Area 1 and rockfill is expected to be used to construct the new embankments in the remaining areas. Since excavation is expected to be limited to the removal of the topsoil and peat, the new embankments are expected to be constructed above the groundwater table. The earth fill should be placed to a 2H:1V slope or flatter and rockfill embankments should be placed to a slope of 1.25H:1V or flatter.

Settlement of the road surface should be expected as a result of consolidation of the new embankment fill under its own weight. Settlement is expected to be about 0.5% of the total new fill height for earth embankments and 0.5 to 0.75% for rockfill embankments, according to MTO guidelines. The embankments should be constructed in accordance with Section 4.0 – Embankment Design Considerations in this report.

The estimated earth fill settlements for each high fill area resulting from embankment loads constructed as recommended in this report are listed in the following Table and included in the attached Table 3.

| PML HIGH FILL AREA NO. | MAXIMUM EMBANKMENT NEW FILL HEIGHT (m) | MAXIMUM SUBGRADE EXCAVATION DEPTH (m) | TOTAL MAXIMUM FILL DEPTH (m) | MAXIMUM ESTIMATED NEW EARTH / ROCK FILL SETTLEMENT (mm) |
|---|---|---|---|---|
| Area 1 NBL | 1.8 | 0.3 | 2.1 | 10 |
| Area 1 Widening | 2.5 | 0.8 | 3.3 | 15 |
| Areas 6A and 6B | 8.0 | 0.3 | 8.3 | 60 |
| Area C | 6.5 | 0.6 | 7.1 | 55 |
| Area 11 | 7.0 | 0.3 | 7.3 | 55 |
| Area E (south of McGillvray Creek) | 7.5 | 1.8 | 9.3 | 70 |
| Area E (north of McGillvray Creek) | 5.0 | 2.7 | 7.7 | 55 |

Total maximum fill settlement are estimated to be in a range between 10 and 70 mm for the high fill areas and will potentially occur during embankment construction. Approximately 90% of rockfill settlements are expected to be complete within 6 months of construction to full height, according to MTO guidelines.

#### *2.3.3.4 Total Estimated Settlements*

In summary, the total settlements that are estimated to occur in the high fill areas are listed in the following table.

| PML HIGH FILL AREA NO. | SETTLEMENT OF COHESIVE SOILS (mm) | SETTLEMENT OF COHESION-LESS SOILS (mm) | SETTLEMENT OF EARTH/ROCK FILL (mm) | SETTLEMENT OF ORGANIC MATERIAL (mm) | TOTAL ESTIMATED MAXIMUM SETTLEMENTS (mm) | ESTIMATED REMAINING SETTLEMENT AFTER 6 MONTHS(*) (mm) | ESTIMATED REMAINING SETTLEMENT AFTER 12 MONTHS(*) (mm) | ESTIMATED TIME PERIOD FOR 90% COMPLETION OF TOTAL CONSOLIDATION (months) |
|---|---|---|---|---|---|---|---|---|
| Area 1 NBL | 0 | < 5 | 10 | N/A | < 15 | 0 | 0 | 0 |
| Area 1 Widening | 20 | < 5 | 15 | N/A | < 40 | 10 | 0 | 2 |
| Areas 6A and 6B | 80 | 80 | 60 | N/A | 220 | 20 | 5 | 6 |
| Area C | 45 | 80 | 55 | N/A | 180 | 10 | 5 | 4 |
| Area 11 | 110 | 170 | 55 | 80 | 415 | 60 | 30 | 6 |
| Area E (south of McGillvray Creek) | 25 | 130 | 70 | N/A | 225 | 25 | 10 | 4 |
| Area E (north of McGillvray Creek) | 55 | 100 | 55 | 60 | 270 | 70 | 25 | 8 |

Note: (*) The estimate “0” settlement signifies negligible settlement.

It is considered that the estimated post-construction settlements in the table will be within the maximum permissible values indicated in the MTO Embankment Settlement Criteria for Design, dated March 2, 2010 (Areas 1, 6A, 6B and C), for freeways and non-freeways (Areas 11 and E) pavements constructed on compressible soils.

The 15 mm and 40 mm post-construction settlement estimated for the embankment earth fill grade raise and widening in Area 1 were found to be lower than the allowed maximum 50 mm for total settlement and within the maximum allowed differential settlement rate of 200:1 in the MTO guidelines.

In the remaining Areas, acceptable ranges of estimated settlements for rock fill embankments constructed as outlined in this report were obtained without the need for excavation of compressible native soils provided that preloading of the new embankments be implemented.

Consequently, mitigation treatments of high fill areas to mitigate settlements or improve slope stability are not considered to be required for the high fills areas investigated other than preloading as outlined in the following section of this report.

## 3. HIGH FILL AREA TREATMENTS

### 3.1 General

The construction method for each section of the roadway embankments under consideration was reviewed and recommended primarily using the following criteria.

i) Post-construction settlement of the embankment surface due to settlement of the earth fill and consolidation of subgrade material to be acceptable (March 2, 2010 Guidelines)

ii) Stability of the embankment fill

iii) Stability of excavation slopes

iv) Maximum practical depth of excavation for the "long stick" excavator is 12 m, if required

The selection of the preferred treatment option for each of the swamps also depends on other parameters or facets that are being considered by MTO and AECOM**.**

The stable inclination of the embankment fill slope as well as the magnitude of post-construction settlement of the embankment surface and time required for essential completion of primary consolidation for each treatment option are dependent on the embankment height, the composition of the subgrade soil as well as the thickness and pertinent engineering properties of the clayey subgrade soil for those treatment options that do not call for full-depth excavation. The stability and settlement of these soil layers under the proposed embankment were discussed in

the previous sections of this report. The following sections provide a review of each embankment foundation area and recommend the mitigation treatment option, as required.

The existing topsoil, peat and very soft cohesive soils are highly compressible and generally not adequate to support the weight of the embankment to be placed. Excavation of the surficial peat/topsoil and organic deposits is a requirement for all construction methods.

The cohesionless soils underlying the clayey soils such as, silts and sands are considered to be competent and capable of supporting the proposed earth fill embankments. As such, the loose silty/sandy soils may be left in place since settlement of these materials occurs rapidly and during construction.

### 3.2 New Embankment Construction Methods

Several alternative methods of construction are available for the construction of the new embankments and were considered for this project. A summary of the methods, their general advantages and disadvantages is provided in the following table.

| ALTERNATIVE EMBANKMENT CONSTRUCTION METHOD | | ADVANTAGES | DISADVANTAGES |
|---|---|---|---|
| Option 1 | Full excavation (Involves removing all compressible cohesive soils and replacement by rockfill) | - Standardized MTO method of embankment construction<br>- Reduced and predictable long-term settlements | - Requires disposal of excavated soil<br>- May cause instability of existing embankments for twinning sections |
| Option 2 | Preloading and/or surcharging (Leaves compressible cohesive soils in place and allows for preloading and/or surcharging to reduce post-construction settlements) | - Disposal of excavated soil not required<br>- Reduction of long-term settlements | - Requires a long construction period<br>- Post-construction settlement may be excessive<br>- At some areas, it may require toe berms or minimum soil strength for surcharging |

| ALTERNATIVE EMBANKMENT CONSTRUCTION METHOD | | ADVANTAGES | DISADVANTAGES |
|---|---|---|---|
| Option 3 | Partial excavation and preloading / surcharging (The upper zones of compressible cohesive soils are excavated and replaced with rockfill followed by a preloading or surcharge period) | - Reduced disposal of excavated soil<br>- Maintains stability of existing embankment on twinning construction<br>- Reduction of long-term settlements | - Requires a long construction period<br>- Large post-construction settlement possible<br>- At some areas, it may require minimum soil strength for surcharging<br>- Time to complete estimated settlements may be exceeded leading to delay of construction schedule |
| Option 4 | Construction of a bridge to span the area / compressible soil | - No post-construction settlements on bridge section | - Typically too costly and impractical<br>- Differential settlement of approach embankments needs to be engineered |
| Option 5 | Lengthening the construction schedule and/or advance contracts to increase the time period between construction of the embankment and construction of the roadway pavement | - Reduced disposal of excavated soil<br>- Reduced post-construction settlements | - Requires a long construction period<br>- Post-construction settlement possible |
| Option 6 | Use of lightweight fill to minimise the stress imposed on the underlying soil (independently and in conjunction with surcharging and/or wick drains) | - Reduced disposal of excavated soil<br>- Can be constructed over weak soils | - Requires prior treatment of reduce or eliminate excessive embankment settlement to avoid damage to the EPS |
| Option 7 | Installation of wick drains to increase the rate of consolidation and minimise the magnitude of post-construction settlement | - Reduced disposal of excavated soil<br>- Maintain stability of existing embankment<br>- Reduction of long-term settlements | - High mobilization charges for one fill area<br>- Not practical for shallow compressible deposits<br>- Very weak deposits may require a long and/or staged construction period<br>- Potential additional costs due to inaccurate prediction of expected progress of settlement |

The option 1 method of embankment construction (full excavation) normally employed by MTO in areas with low strength compressible soils involves the excavation of these poor quality soils to competent material where practical and backfilling the excavation with rockfill following the procedures stipulated in OPSD 203.010.

The preferred treatment option will also be influenced by the soil profile at the particular area, environmental considerations, the accepted post-construction performance (settlement), design requirements, the construction schedule, construction constraints and economic considerations.

In addition, the impact on the regional hydrogeology by changes made to the natural groundwater level by installation of wick drains could also be a consideration. Further, lightweight fill is not locally available and will require a large number of trucks to travel long distances which will have an adverse impact on both air quality and non-renewable resources.

## 3.3 Recommended Treatments

Excavation of the surficial peat and organic deposits is a requirement for all high fill areas.

Some settlement of the embankment fill surface, both during and following completion of construction, due to settlement of the earth fill or rock fill and consolidation of the subgrade soils should be expected. The magnitude of settlement for the recommended treatment option at each area is summarised in Table 3. The settlement of embankments due to compression of silty / sandy subgrade soil remaining in place is provided in Section 2.3.3.2 of this report.

### 3.3.1 Area 1

#### *3.3.1.1 Site Condition*

This section of the Highway 11 northbound lane extends from Sta. 20+025 to 20+200, excluding the section of the alignment between Sta. 20+106 and 20+178 where a new bridge is proposed. The existing maximum 6 m high embankment will be subject to a grade raise of approximately 1.8 m. In addition, an embankment platform widening to the east will be constructed to accommodate the new S-E/W ramp of the proposed new interchange.

In summary, the subsurface stratigraphy in Area 1 typically comprises existing fill/peat/topsoil overlying cohesionless sandy / silty soil extending to inferred bedrock with localized clayey soils near the McGillvray Creek at the east toe of slope.

#### *3.3.1.2 Discussion and Recommended Treatment*

It is considered feasible to raise the grade and construct the platform widening in Area 1 with standard construction methods, in particular OPSD 203.030 and 208.010. Based on the analysis, the existing embankments in Area 1 will be stable. Because the differential settlement due to soil consolidation beneath the east toe of the embankment is expected to be 40 mm from the proposed grade raise and platform widening, it is recommended that the embankment widening part of the earthworks be preloaded for a period of 2 months prior to construction of the pavement be within the MTO allowable guidelines for transverse differential settlement area to minimize future surface settlements and maintenance requirements near the new bridge approaches.

### 3.3.2 Areas 6A and 6B

#### *3.3.2.1 Site Condition*

This section of the proposed Highway 11 interchange includes the EW-S ramp between Sta. 20+075 and 20+125 (Area 6A) and the adjacent N-EW ramp between Sta. 20+890 and 21+000 (Area 6B). The proposed EW-S and N-EW ramps will be approximately 6.8 and 8.0 m high, respectively. Both ramps will be constructed with a common embankment section.

In summary, the subsurface stratigraphy in Areas 6A and 6B generally comprised surficial topsoil overlying a cohesionless silty/sandy layer, overlying a cohesive and compressible deposit of clayey silt/silty clay (with a varved lower zone) underlain by a lower cohesionless silty/sandy soil typically extending to refusal on probable bedrock/boulder.

Approximately 200 mm of the total estimated settlement of 220 mm is expected to occur in the first 6 months after construction of the embankment.

#### *3.3.2.2 Discussion and Recommended Treatment*

Since the 200 mm (90%) consolidation of the clayey soils beneath the embankment in Areas 6A and 6B is expected to occur over 6 months with a residual of 20 mm, and the maximum allowed

settlement is 100 mm, it is recommended that the area be preloaded a minimum of 4 months period. It is considered that the estimated maximum 120 mm settlements occurred after 4 months will be sufficient to provide a future performance that will meet the minimum requirements of the MTO guidelines for longitudinal and transverse settlement. Consequently, no surcharging needs to be employed in this area in view of the relatively short preloading period. The OPSD 203.010 may be utilized for the new embankment construction.

### 3.3.3 Areas C

#### *3.3.3.1 Site Condition*

This 40 m long section of the proposed Highway 11 interchange extends along the N-E/W ramp between Sta. 21+060 and 21+100. The proposed N-E/W ramp will be approximately 6.5 m high in this section.

In summary, the subsurface stratigraphy in Areas C generally comprised surficial topsoil overlying a cohesionless silty/sandy layer, overlying a cohesive deposit of clayey silt/silty clay underlain by a lower cohesionless silty/sandy soil typically extending to probable bedrock/boulders.

Some 160 mm of the total estimated 180 mm of settlement is expected to occur in Area C during the first 4 months after construction. The residual settlement after 6 months is estimated to be 10 mm.

#### *3.3.3.2 Discussion and Recommended Treatment*

Since the 160 mm (90%) consolidation of the clayey soils beneath the embankment in Area C is expected to occur during construction and within 4 months after embankment fill placement, the estimated 90 mm settlements occurred after the initial 3 month period will be sufficient to provide an adequate future performance of the embankment that will meet the requirement of the MTO roadway settlement guidelines. Consequently, the area should be preloaded for a minimum period of 3 months. It is also considered that no surcharging needs to be employed in this area and OPSD 203.010 may be utilized for the new embankment construction.

### 3.3.4 Area 11

#### *3.3.4.1 Site Condition*

This section of the Proudfoot Road Extension extends from Sta. 8+620 to 8+710 where a new up to 7.0 m high embankment will be constructed.

In summary, the subsurface stratigraphy in Area 11 generally comprised surficial topsoil (locally fill) overlying layered silty clay/clayey silt and/or silty/sandy soils. Numerous approximately 25 mm thick alluvial sand seams containing organic material were encountered in the upper 2.5 to 5.6 m at Sta. 6+670 within the local narrow valley suggesting that the area has been subjected to frequent flooding and alluvial deposition.

Approximately 355 mm settlement of the maximum estimated total of 415 mm is anticipated to occur during the initial 6 months after construction of the embankment. The estimated residual settlement after 6 months is 60 mm.

Long-term settlement of approximately 80 mm magnitude is expected to occur within the organic sand seams as the organic material decays. It is expected that the majority (25 to 60 mm) of the compression of the organic material will occur within the first year after completion of the embankment construction. Organic soils will likely continue to consolidate over time under constant embankment loading. Long term settlement over the decade after construction is estimated to be in the order of 25 to 50 mm.

#### *3.3.4.2 Discussion and Recommended Treatment*

Since the 355 mm (90%) consolidation of the clayey and organic soils beneath the embankment in Area 11 is expected to occur over 6 months and the maximum settlement allowed for non-freeways is 200 mm in the MTO guidelines it is recommended that the area be preloaded for a minimum period of 5 months when the remaining estimated settlement magnitude is expected to occur. No surcharging needs to be employed in this area. It is noted that estimated settlements of some 50 mm are expected to occur within the organic sand seams over the next decade post-construction if these soils are not excavated. It is recommended that excavation of the upper 2.0 m of this organic soil be undertaken to minimize the future settlements in particular to

minimize roadway surface longitudinal settlements because the organic soils will be partially excavated for the construction of a new culvert under the Proudfoot Road extension.

### 3.3.5 Area E

#### *3.3.5.1 Site Condition*

This section of the West Service Road extends from Sta. 9+400 to 9+685 where a new 7.5 m high embankment will be constructed. Since subgrade conditions within the high fill area vary north and south of McGillvray Creek (near station 9+500), it is recommended that two different treatment options be employed within the Area.

In summary, the subsurface stratigraphy in Area E south of McGillvray Creek comprised surficial topsoil / peat generally over alluvial cohesionless soils.

North of McGillvray Creek the subsurface stratigraphy comprised surficial topsoil overlying a cohesionless silty/sandy layer, overlying a cohesive deposit of clayey silt/silty clay underlain by a lower cohesionless silty/sandy soil. Locally, north of the McGillvray Creek, a 1.3 and 2.0 m thick organic silt / clayey silt layer was contacted beneath the cohesive deposit in boreholes E-17 and E-15 at 4.0 and 3.8 m (Sta. 9+655 and Sta. 9+630, respectively).

South of McGillvray Creek, some 200 mm of settlement is estimated to occur during the first 4 months after construction of the embankment, with a residual estimated settlement of 25 mm. A minimum preloading of 2 months period is recommended in this area.

North of McGillvray Creek, some 200 mm of the total 270 mm estimated settlement is expected to occur within the first 6 months after placement of the embankment fill, with a residual settlement estimated at some 70 mm.

As listed in the previous table in Section 2.3.3.4 Total Estimated Settlements, estimated settlements of 60 mm are anticipated in the organic non-cohesive soils encountered north of McGillvray Creek in Area E in addition to those listed for the non-organic soil. Approximately 40 mm of these estimated settlements are expected to occur in the first year following completion of the fill embankment and settlements in the order of 20 mm may occur over the following decade as organic material continues to decay and consolidate.

It is noted that these long-term settlements of some 20 mm are expected to occur within the organic soils north of McGillvray Creek over the next decade post-construction. Since excavation to depths of up to 7.0 m would be required to remove these organic soils it is recommended that these soils be left in place, subject to mitigation measures.

#### *3.3.5.2 Discussion and Recommended Treatment*

Since 90% of the consolidation of the clayey soils beneath the embankment in Area E embankment south McGillvray Creek is expected to occur during and within the 4 months following construction, with a residual settlement of 25 mm, it is recommended that Area E south of McGillvray Creek be preloaded for 2 months and that no surcharging needs to be employed in this area.

Since the 200 mm of estimated total consolidation of the clayey soils beneath the embankment in Area E embankment north McGillvray Creek are expected to occur over 8 months and in view of the variable floodplain nature of this embankment subgrade, it is recommended that Area E north of McGillvray Creek be preloaded for a minimum 8 month time period. No surcharging needs to be employed in this area. The anticipated performance of the pavement within this area should be adequate to meet the MTO guidelines for settlement in non-highway embankments.

# 4. EMBANKMENT DESIGN CONSIDERATIONS

## 4.1 General

Embankments placed on competent material should be constructed in accordance with OPSD 202.010, OPSD 203.010, OPSD 203.020, OPSD 203.030, OPSS 206 and OPSS 209. The side slopes of the embankments should be inclined no steeper than 2H:1V for earth fill and 1.25H:1V for rockfill and as recommended in this report. A 2 m wide mid-height berm should be provided where the design slope height of embankments is more than 8 m for earth fill and 10 m for rock fill. Additional berms at lower fill heights may be required for soil erosion control, as detailed in the Pavement Design Report prepared by PML, Ref. No. 10TF013B.

The embankment platform should be widened to accommodate the settlements during and after construction and also a possible overlay of 200 mm for maintenance purposes.

Embankments in other areas of the alignment such as along the proposed Interchange Crossing Road cuts were found to require embankment side slopes of 2.5H:1V for adequate slope stability purposes. Details are included in the Pavement Design Report.

It is noted that the existing native soils are silty and susceptible to erosion when placed near the local streams, such as the McGillvray Creek. These erosion control recommendations and including those for erosion from rain precipitation are included in the Pavement Design Report.

## 5. CLOSURE

This report was prepared by Mr. A. DeSira, MEng, P.Eng., and reviewed by Mr. B.R. Gray, MEng, P.Eng., MTO Designated Principal Contact. Mr. C.M.P. Nascimento, P.Eng., Project Manager, conducted an independent review of the report.

Yours very truly,

Peto MacCallum Ltd.


Carlos M.P. Nascimento, P.Eng.
Project Manager


Brian R. Gray, MEng, P. Eng.
MTO Designated Principal Contact

AD/CN/BRG:ad-mi-jk

# TABLE 1

## SUMMARY OF SUBSOIL CONDITIONS AND RECOMMENDED TREATMENT

| HIGH FILL AREA | MAXIMUM NEW FILL HEIGHT[1] (m) | DEPTH TO BOTTOM OF ORGANICS (m) | CLAYEY SOIL THICKNESS (m) | DEPTH TO BOTTOM OF CLAYEY SOIL[2] (m) | DEPTH TO PROBABLE BEDROCK / BOULDER (m) | RECOMMENDED MITIGATION TREATMENT |
|---|---|---|---|---|---|---|
| Area 1<br>Sta. 20+025 to 20+200<br>Highway 11 NBL | 1.8 | 0.2 – 0.8 | 0 - 2.5 | 2.8 – 4.5 | 7.2 – 13.1<br>(El. 249.8 – 256.9) | Preloading<br>(2 months) |
| Area 6A & 6B<br>Sta. 21+075 to 21+125<br>E/W-S Ramp & Sta.<br>20+890 to 21+000<br>N-E/W Ramp | 8.0 | 0.2 - 0.3 | 2.8 – 10.6 | 4.3 – 12.0 | 5.2 - 15.8<br>(El. 257.6 – 264.7) | Preloading<br>(4 months) |
| Area C<br>Sta. 21+060 to 21+000<br>N-E/W Ramp | 6.5 | 0.2 – 0.6 | 2.0 – 5.5 | 4.5 – 9.2 | 4.7 – 9.6<br>(El. 264.8 – 270.9) | Preloading<br>(3 months) |
| Area 11<br>Sta. 8+620 to 8+710<br>Proudfoot Road | 7.0 | 0.3 | 1.4 – 3.4 | 2.2 – 4.5 | Not Encountered | Excavate 2.0 m thick organic soils and preloading<br>(5 months) |
| Area E<br>9+400 to 9+500<br>West Service Road | 7.5 | 0.2 – 1.8 | 0 – 1.5 | 2.6 | 0.1 – 15.6<br>(El. 241.2 – 262.1) | Preloading<br>(2 months) |
| Area E<br>9+500 to 9+685<br>West Service Road | 5.0 | 0.3 – 4.4 | 0 – 5.5 | 2.3 - 6.3 | Not Encountered | Preloading<br>(8 months) |

NOTES:
1. Fill height is based on profile received on April 10, 2012
2. Depth to bottom of clayey soil and probable bedrock is based on both borehole and dynamic cone penetration test data.
3. Excavation of peat and other organic soils is a prerequisite for all high fill areas.

# TABLE 2

## LIST OF STANDARD SPECIFICATIONS REFERENCED IN REPORT

| DOCUMENT | TITLE |
|---|---|
| OPSD 202.010 | Slope Flattening Using Surplus Excavated Material on Earth or Rock Embankment |
| OPSD 203.010 | Embankments Over Swamp, New Construction |
| OPSD 203.020 | Embankments Over Swamp, Existing Slope Excavated to 1H:1V |
| OPSD 203.030 | Embankments Over Swamp, Existing Slope Maintained |
| OPSD 208.010 | Benching of Earth Slopes |
| OPSS 206 | Construction Specifications For Grading |
| OPSS 209 | Construction Specifications for Embankments over Swamps and Compressible Soils |

# TABLE 3

## SETTLEMENT OF EMBANKMENT SURFACE

| HIGH FILL AREA | RECOMMENDED TREATMENT (*) (MINIMUM TIME PERIOD) | MAXIMUM FILL HEIGHT (m) | ESTIMATED MAXIMUM SETTLEMENT WITHIN COHESIVE SOIL (mm) | ESTIMATED MAXIMUM SETTLEMENT WITHIN COHESIONLESS SOIL (mm) | ESTIMATED MAXIMUM SETTLEMENT OF NEW EMBANKMENT FILL (mm) | ESTIMATED SETTLEMENT OF ORGANIC MATERIAL (mm) | TOTAL ESTIMATED SETTLEMENT (mm) | TIME FOR 90% SETTLEMENT SOIL (months) | SETTLEMENT REMAINING AFTER 6 MONTHS (mm) |
|---|---|---|---|---|---|---|---|---|---|
| Area 1 NBL | No Treatment Required | 1.8 | 0 | < 5 | 10 | N/A | <15 | 0 | 0 |
| Area 1 Widening | Preloading (2 month) | 2.5 | 20 | < 5 | 15 | N/A | <40 | 1 | 10 |
| Areas 6A and 6B | 4reloading (3 months) | 8.0 | 80 | 80 | 60 | N/A | 220 | 6 | 20 |
| Area C | Preloading (3 months) | 6.5 | 45 | 80 | 55 | N/A | 180 | 4 | 10 |
| Area 11 | Partial excavation (2 m) and Preloading (5 months) | 7.0 | 110 | 170 | 55 | 80 | 415 | 6 | 60 |

# TABLE 3

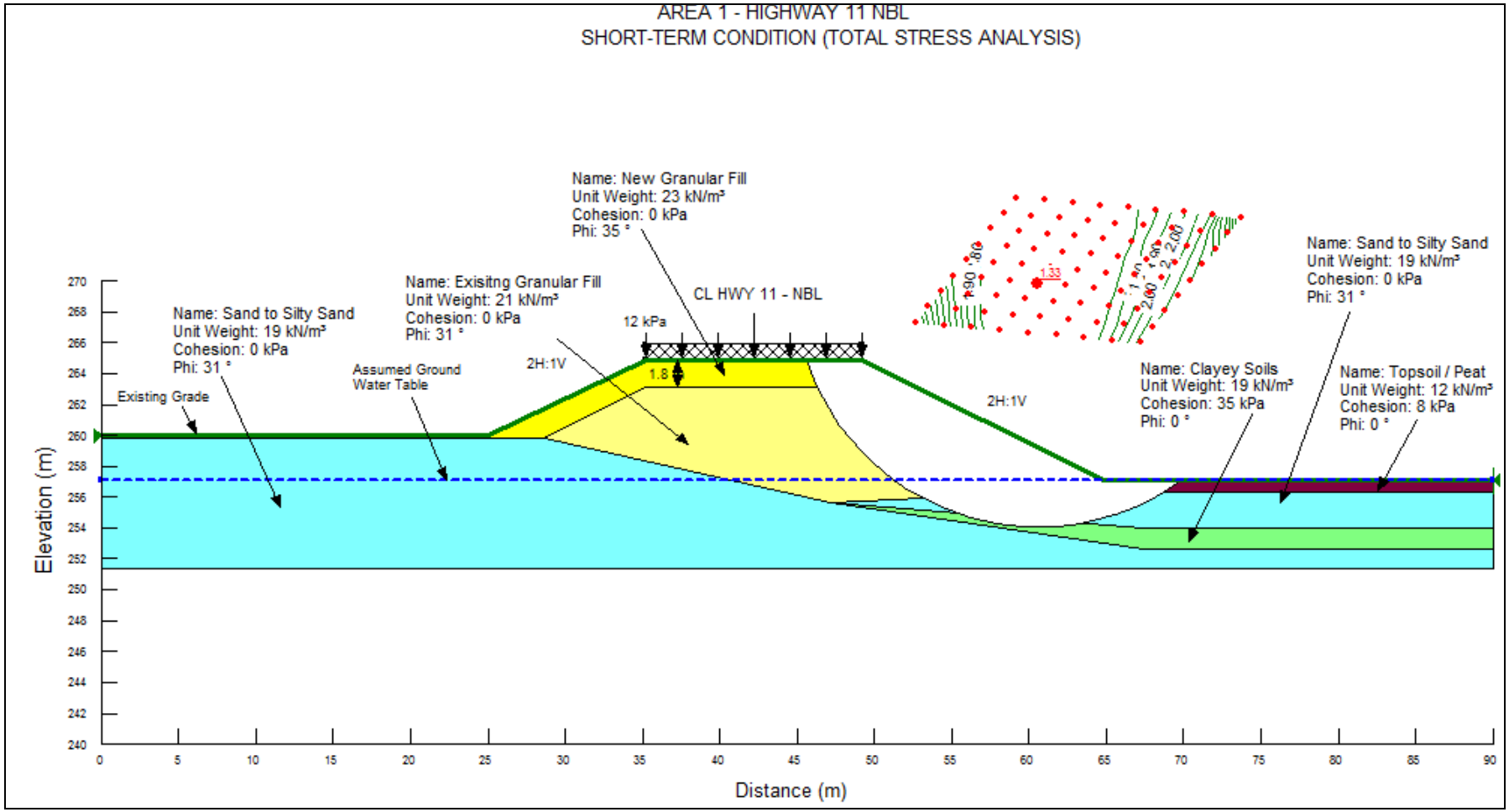
## SETTLEMENT OF EMBANKMENT SURFACE

| HIGH FILL AREA | RECOMMENDED TREATMENT (*) (MINIMUM TIME PERIOD) | MAXIMUM FILL HEIGHT (m) | ESTIMATED MAXIMUM SETTLEMENT WITHIN COHESIVE SOIL (mm) | ESTIMATED MAXIMUM SETTLEMENT WITHIN COHESIONLESS SOIL (mm) | ESTIMATED MAXIMUM SETTLEMENT OF NEW EMBANKMENT FILL (mm) | ESTIMATED SETTLEMENT OF ORGANIC MATERIAL (mm) | TOTAL ESTIMATED SETTLEMENT (mm) | TIME FOR 90% SETTLEMENT SOIL (months) | SETTLEMENT REMAINING AFTER 6 MONTHS (mm) |
|---|---|---|---|---|---|---|---|---|---|
| Area E (South of McGillvray Creek Structure) | Preloading (2 months) | 7.5 | 25 | 130 | 70 | N/A | 225 | 4 | 25 |
| Area E (North of McGillvray Creek Structure) | Preloading (8 months) | 5.0 | 55 | 100 | 55 | 60 | 270 | 8 | 65 |

Note: (*) Recommend preloading treatment does not require excavation of compressible native soils. The organics and otherwise unsuitable soil should be subexcavated from under all of the high fill embankments.

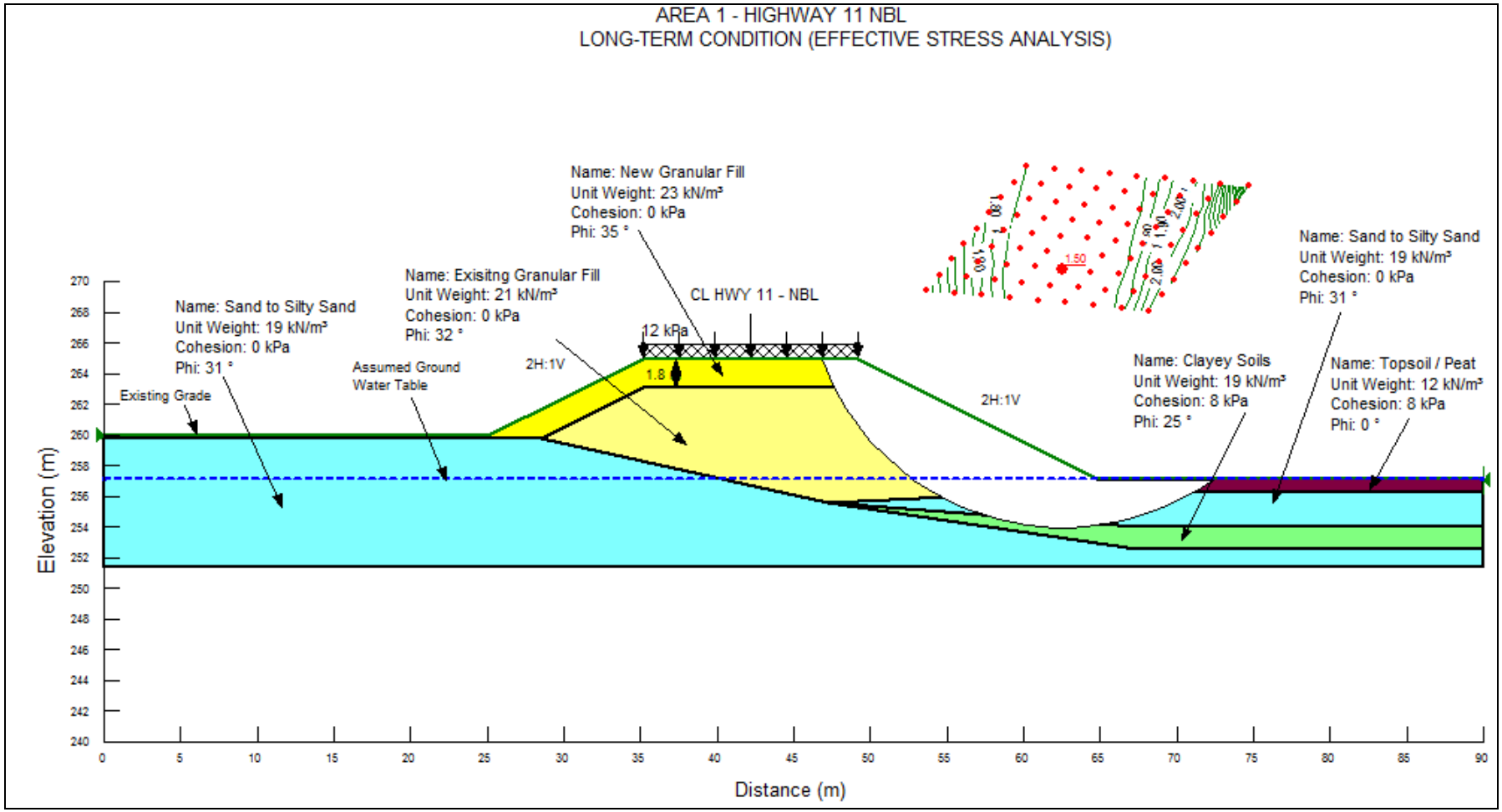
# APPENDIX A

Figures A-1 to A-6 – Slope Stability Analyses Diagrams



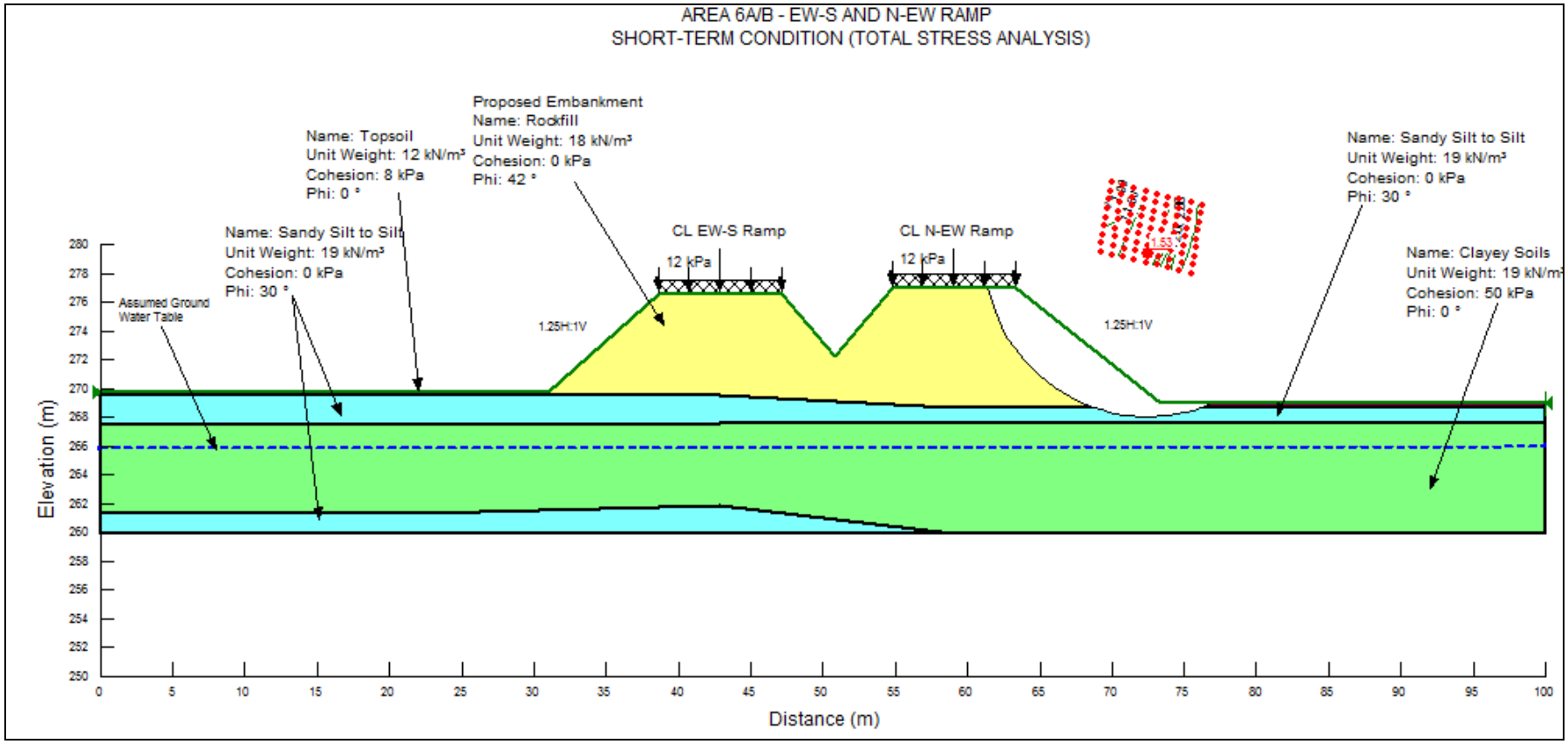

Note: Peat/organic soils subexcavated below embankment. The criterion for the minimum FOS of 1.3 is met.

**FIGURE A-1**



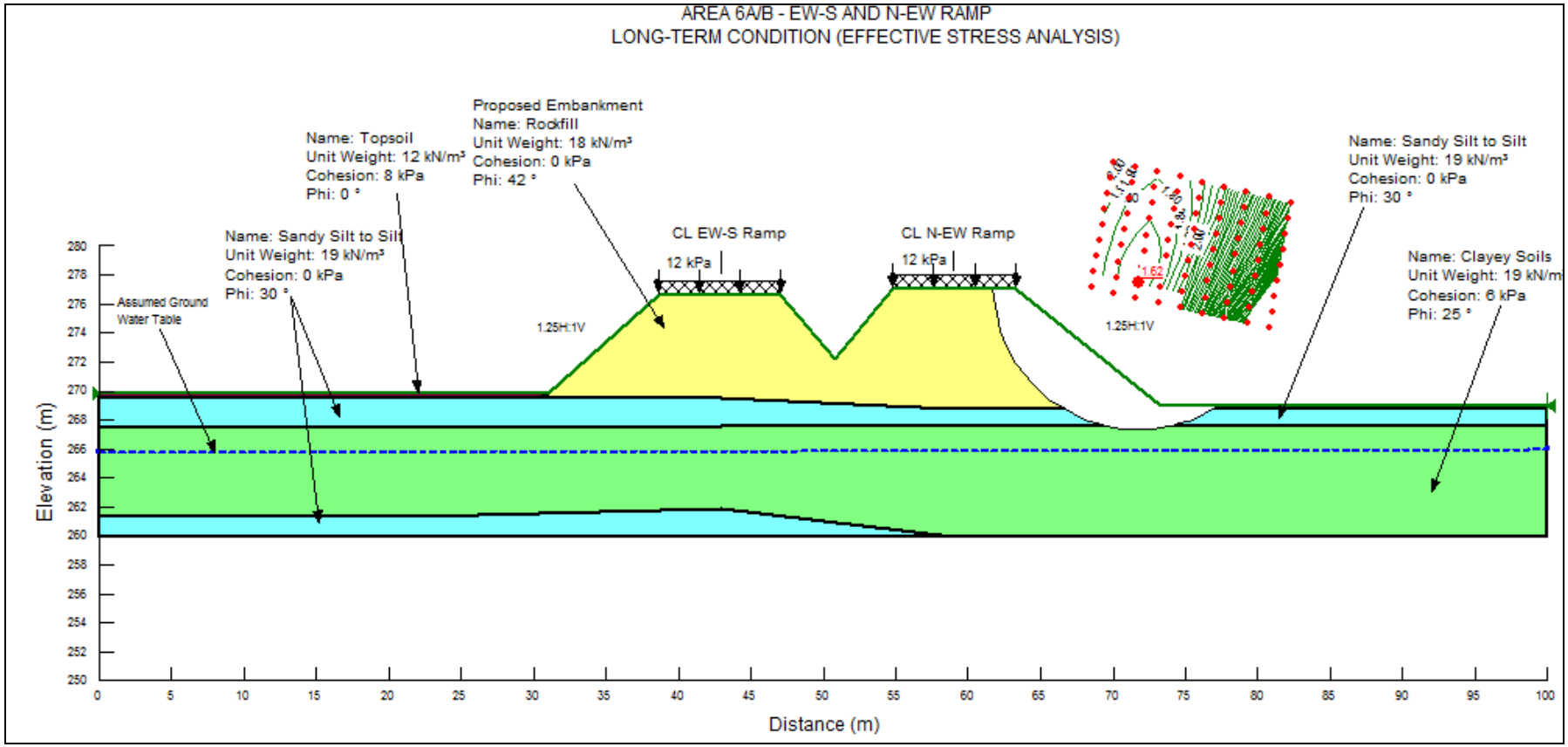

Note: Peat/organic soils subexcavated below embankment. The criterion for the minimum FOS of 1.5 is met.

**FIGURE A-1a**



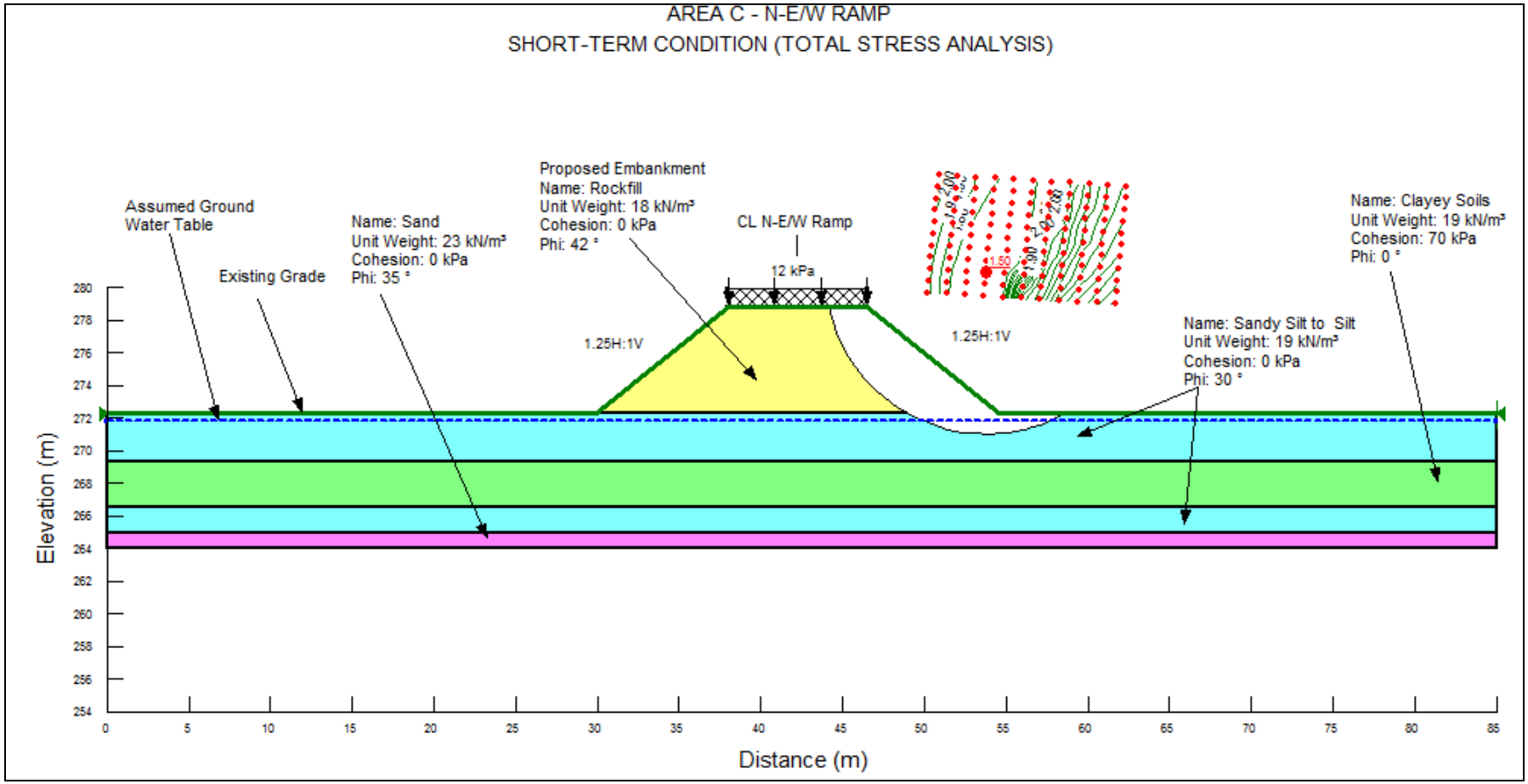

Note: Peat/organic soils subexcavated below embankment. The criterion for the minimum FOS of 1.3 is met.

**FIGURE A-2**



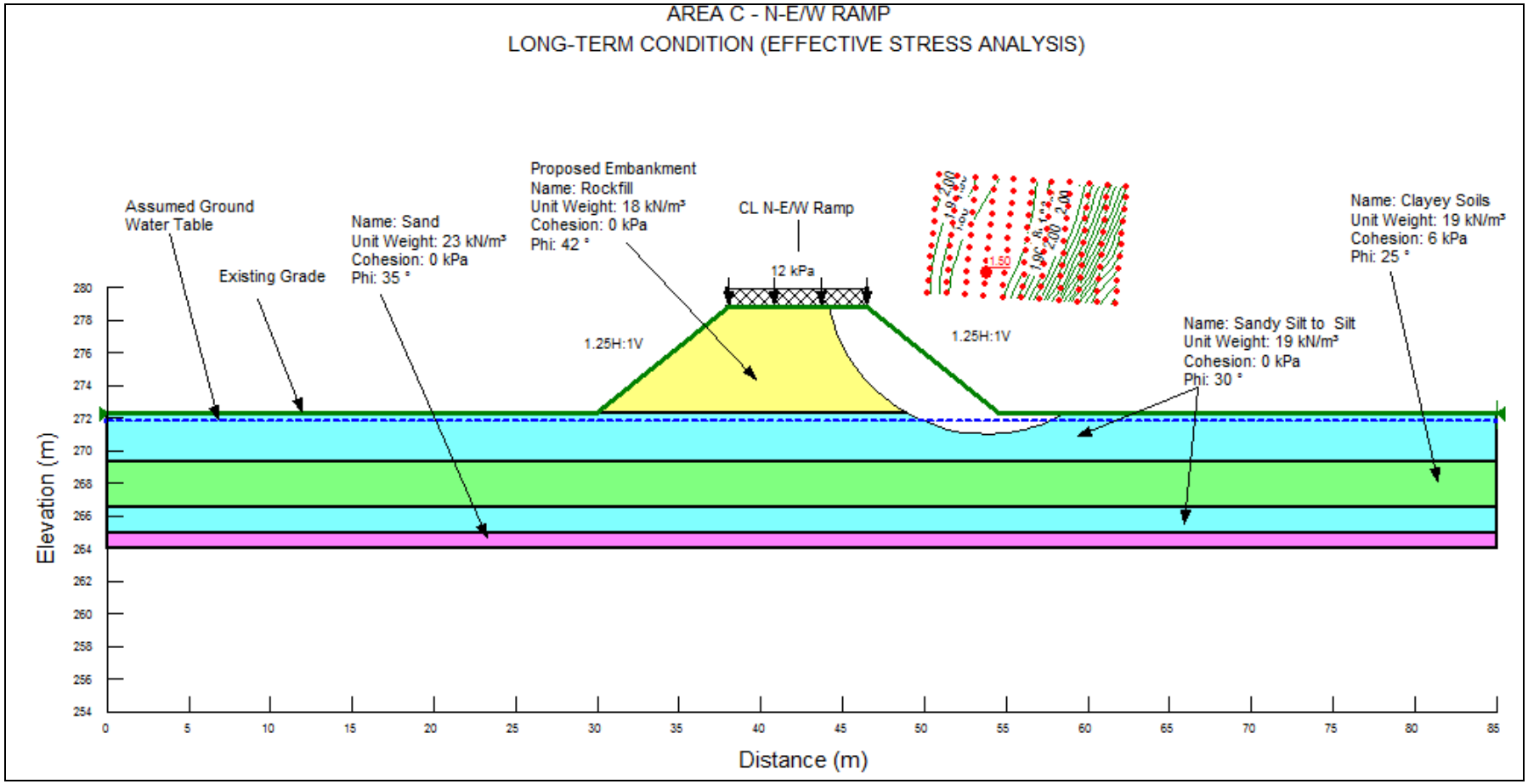

Note: Peat/organic soils subexcavated below embankment. The criterion for the minimum FOS of 1.5 is met.

**FIGURE A-2a**



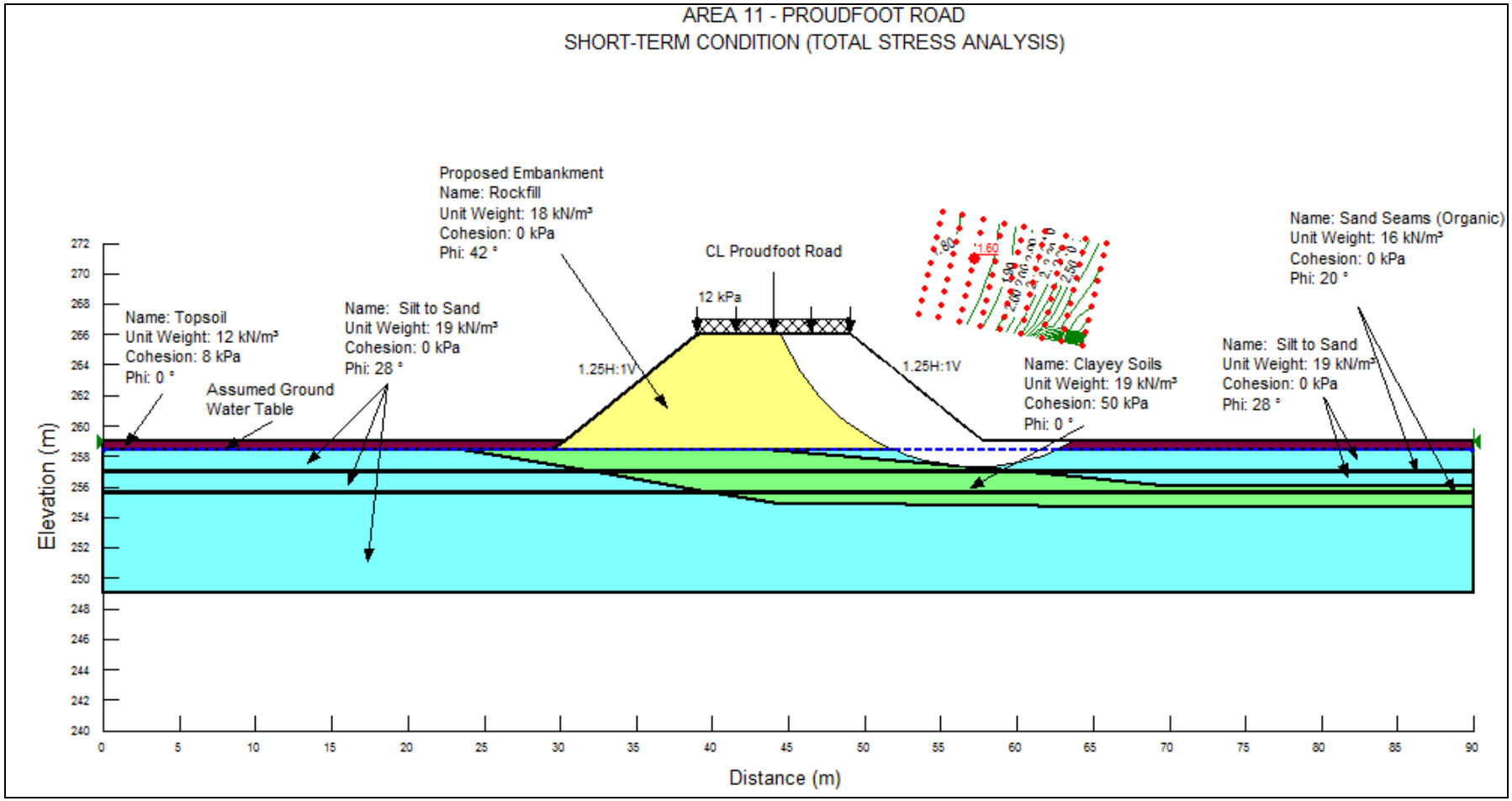

Note: Peat/organic soils subexcavated below embankment. The criterion for the minimum FOS of 1.3 is met.

**FIGURE A-3**



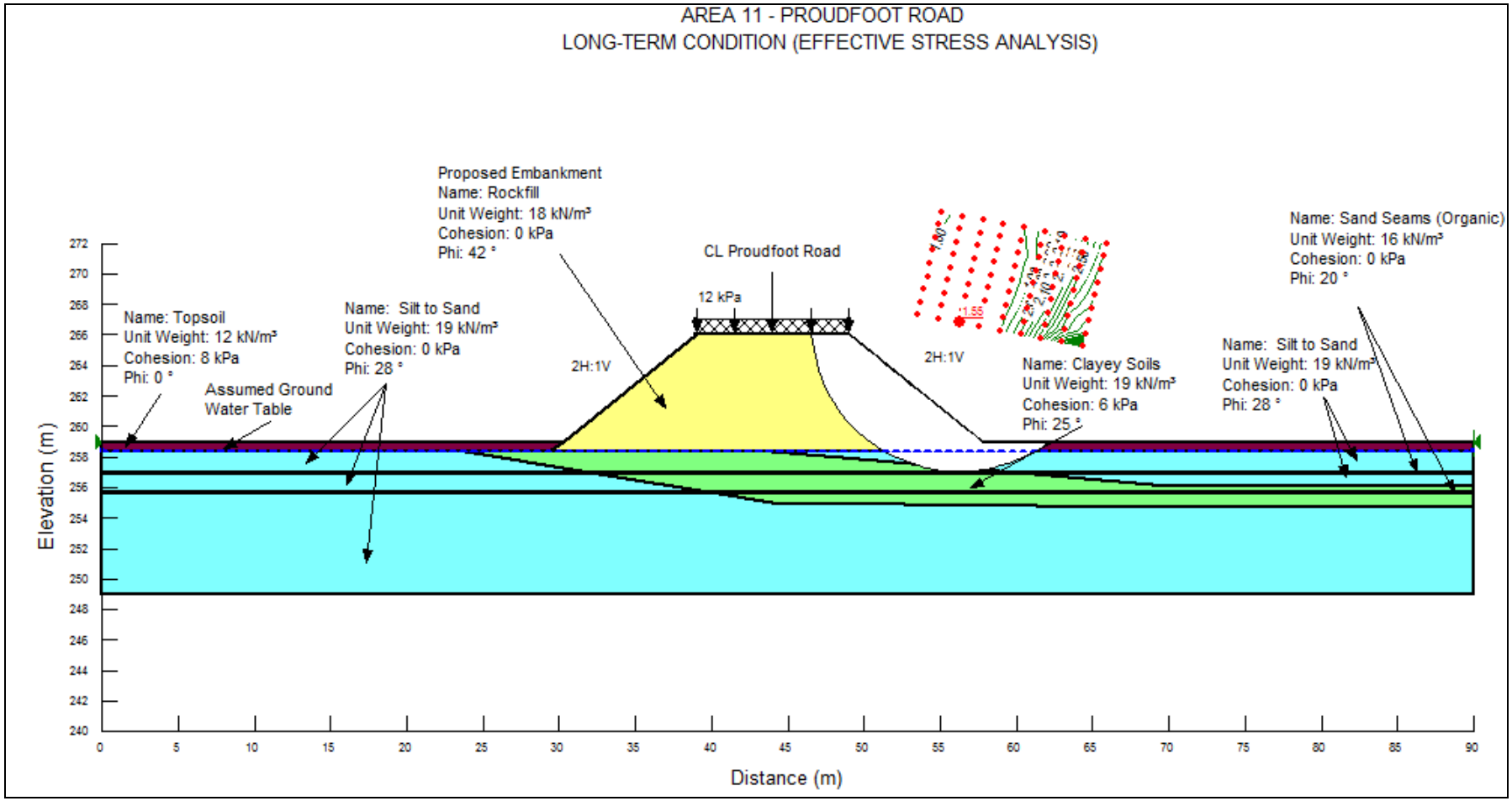

Note: Peat/organic soils subexcavated below embankment. The criterion for the minimum FOS of 1.5 is met.

**FIGURE A-3a**



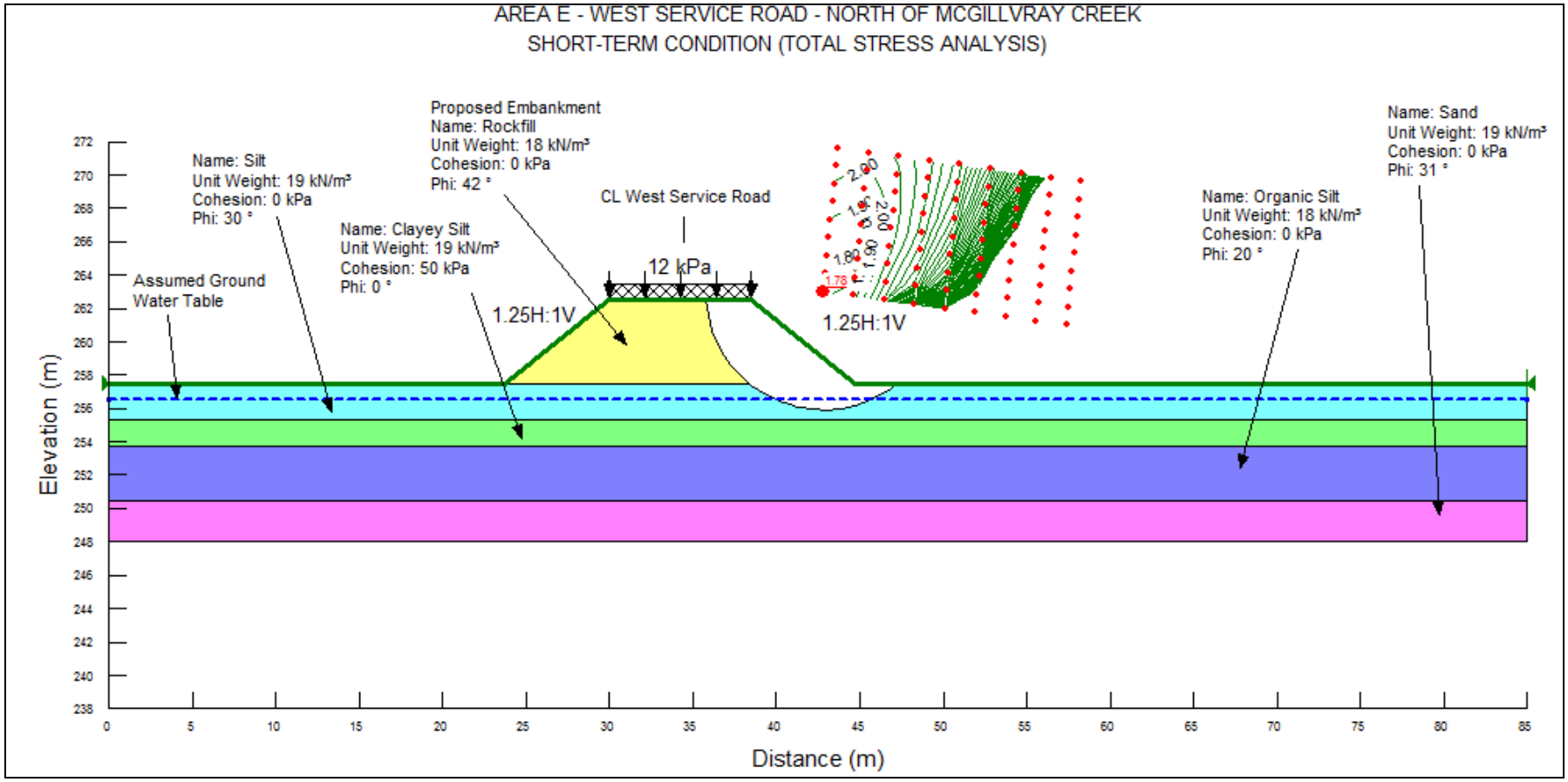

Note: Peat/organic soils subexcavated below embankment. Organic sand seams assumed to be left in place. The criterion for the minimum FOS of 1.3 is met.

**FIGURE A-4**



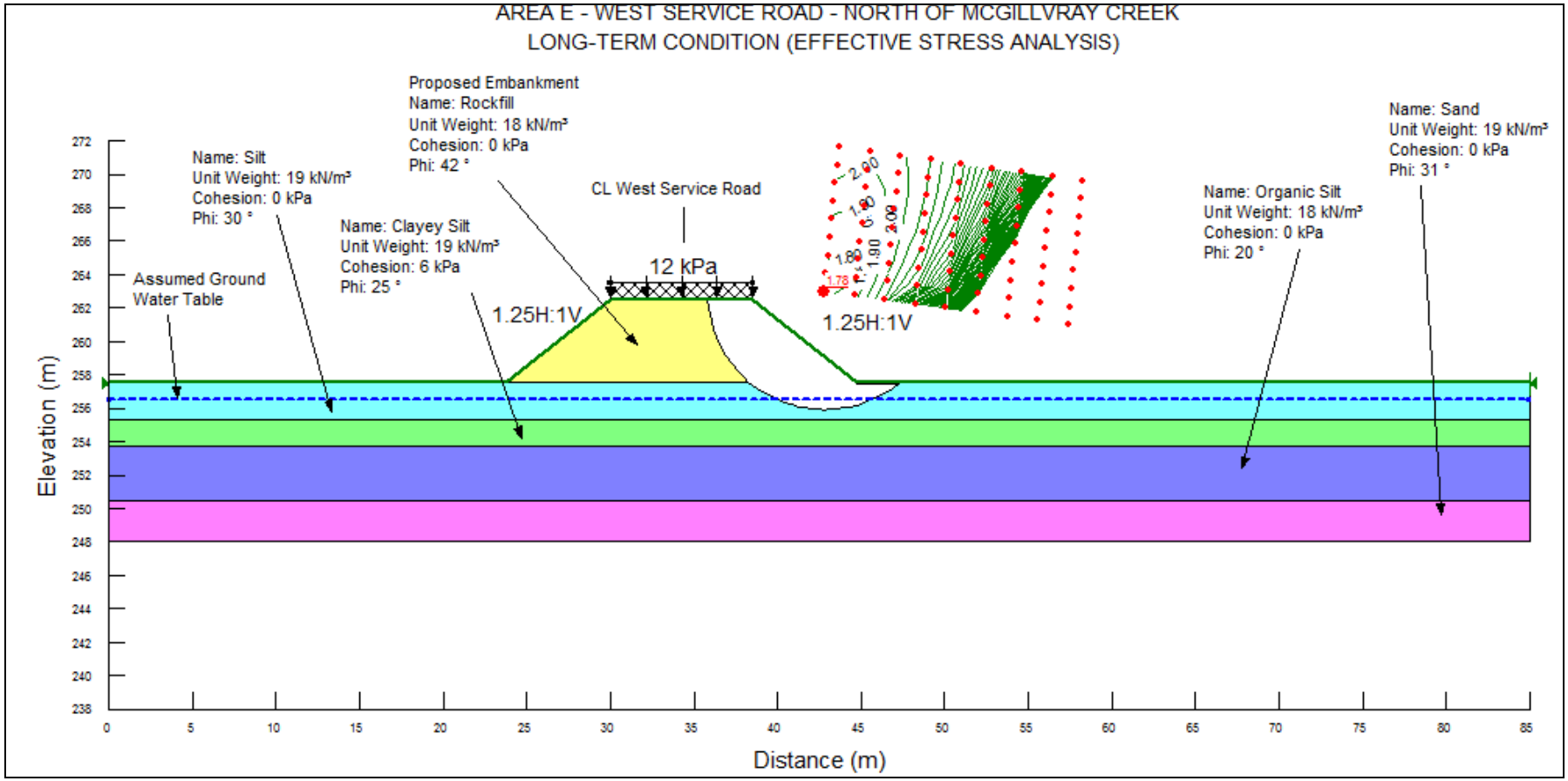

Note: Peat/organic soils subexcavated below embankment. The criterion for the minimum FOS of 1.5 is met.

**FIGURE A-4a**



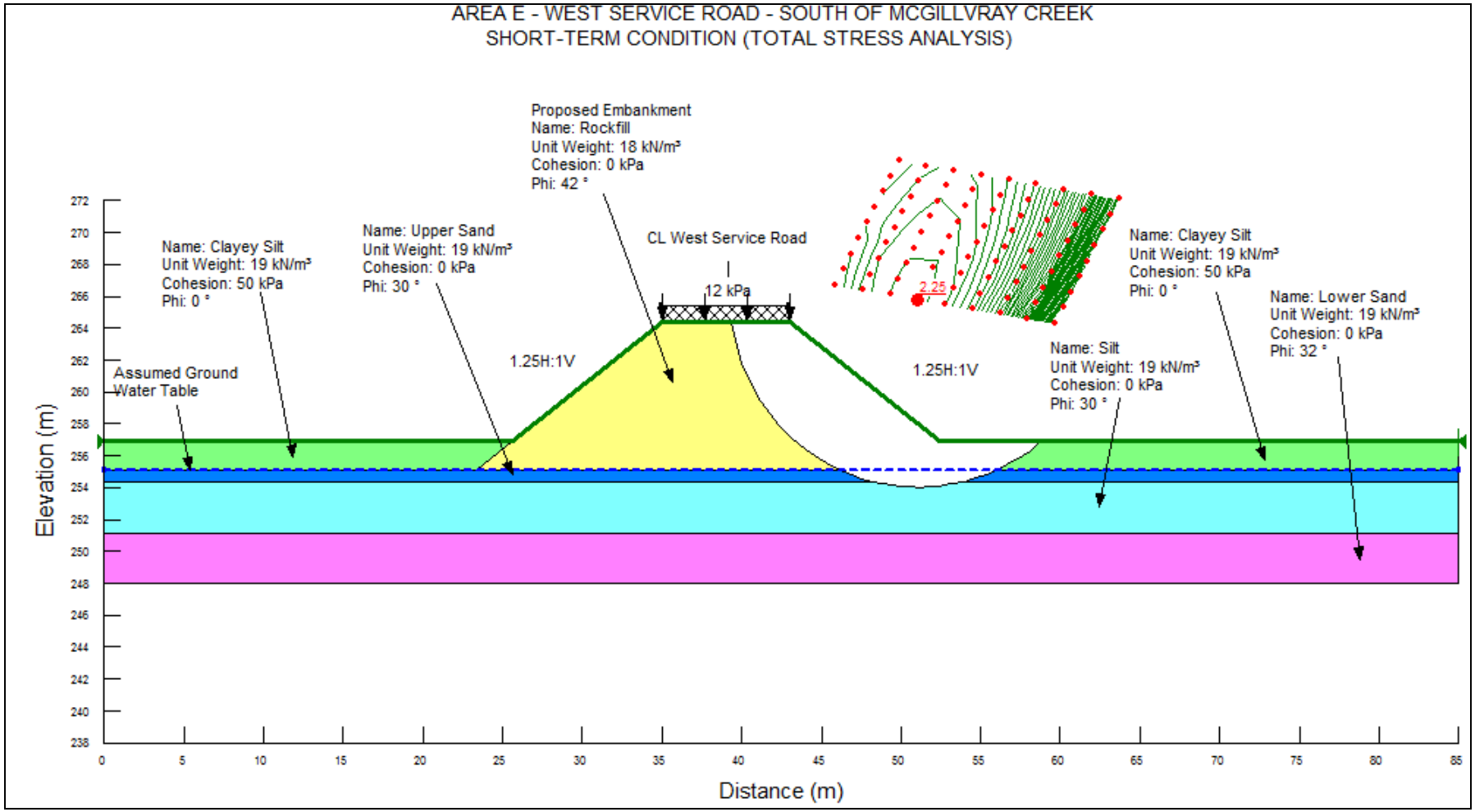

Note: Peat/alluvial soils subexcavated below embankment. Organic silt assumed to be left in place. The criterion for the minimum FOS of 1.3 is met.

**FIGURE A-5**



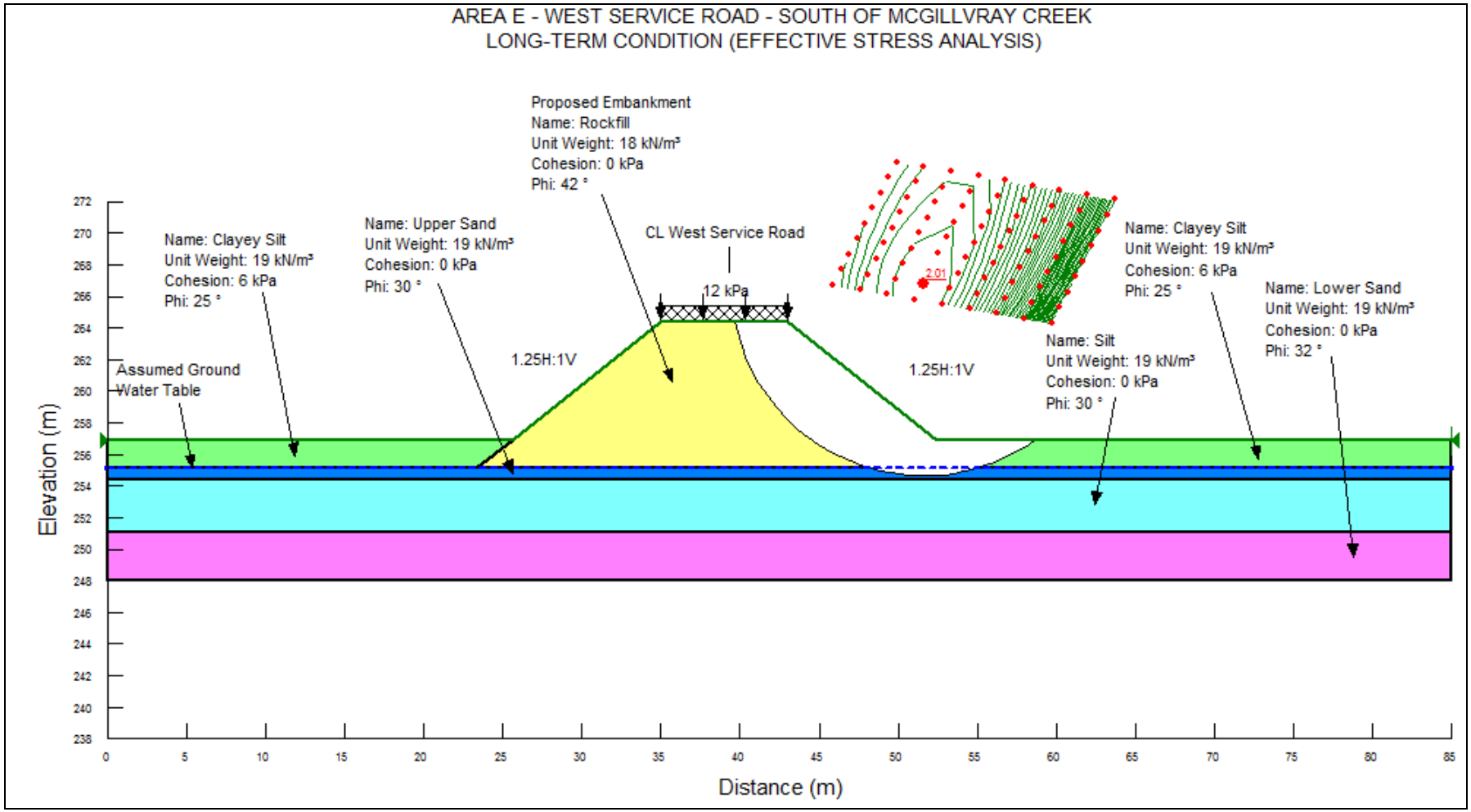

Note: Peat/alluvial soils subexcavated below embankment. Organic silt assumed to be left in place. The criterion for the minimum FOS of 1.5 is met.

**FIGURE A-5a**




Note: Peat/organic/alluvial soils subexcavated below embankment. The criterion for the minimum FOS of 1.3 is met.

**FIGURE A-6**




Note: Peat/organic/alluvial soils subexcavated below embankment. The criterion for the minimum FOS of 1.5 is met.

**FIGURE A-6a**