



## **Foundation Investigation Report**

Highways 5 and 8 and Hamilton  
Road 52 – Peters Corners

G.W.P. 2829-02-00

*Prepared for:*  
Ministry of Transportation Ontario

*Prepared by:*  
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Geocres No. 40P8-200

Project No. 165000773

June 2012

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**FOUNDATION INVESTIGATION REPORT**

For  
G.W.P 2829-02-00

Overhead Sign  
Stormwater Management Pond  
Gabion Retaining Wall

Highway 5 and 8 and Hamilton Road 52, Peters Corners

## **1.0 Introduction**

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Stantec Consulting Ltd. (Stantec) was retained by the Ministry of Transportation, Ontario (MTO) to undertake the detailed design of the proposed intersection improvements at Peters Corners located at the intersection of Highways 5 and 8, and Hamilton Road 52. The project includes a new Overhead Sign, a Stormwater Management Pond and a Gabion Retaining Wall.

This Foundation Investigation Report has been prepared specifically and solely for the proposed intersection improvements at Peters Corners.

Project Number: GWP 2829-02-00

Project Location: Highways 5 and 8 and Hamilton Road 52, at Peters Corners

The work was carried out under MTO Agreement Number 2829-02-00 with Stantec Consulting Ltd., the Detailed Design Consultant for this project.

## **2.0 Site Description and Geology**

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### Site Location

The site location is shown on the Key Plan inset to Drawing No. 1 provided in Appendix A. The Overhead Sign is anticipated to be on Highway 5 near Station 22+740. The Stormwater Management Pond is to be constructed within the Northeast quadrant of the intersection. The Gabion Retaining Wall will be located on the south side of Highway 5 between approximate Stations 22+950 and 23+000. The intersection of Peters Corners is also being reconfigured to include a traffic circle for the intersection of Highways 5 and 8, and Hamilton Road 52.

### General Site Description

General site photographs showing the intersection are provided in Appendix A.

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Highway 5 is oriented in the east-west direction at the project location with chainage increasing from west to east. Highway 8 is oriented in the northwest-southeast direction with chainage increasing from northwest to southeast. Highways 5 and 8 intersect at Station 22+715 on Highway 5 and 26+509 on Highway 8. Hamilton 52 runs north to south approximately 100 m west of the Highway 5 and 8 intersection.

The existing drainage at the project site consists of drainage ditches and culverts.

### Physiographic Description

The site is located within a physiographic region known as the Norfolk Sand Plain (Chapman and Putnam, 1984). The soils within this region generally consist of silt or clay near surface with sand beds below underlain by dolomite bedrock.

## **3.0 Investigation Procedures**

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### **3.1 FIELD INVESTIGATION**

Prior to carrying out the investigation, Stantec made arrangements to obtain utility clearances for the proposed borehole locations.

A field investigation with 8 boreholes was carried out between March 13 and 16, 2012. The boreholes were designated BH12-1 through BH12-8 and their locations are shown on the Borehole Location Plan, Drawing No.1 in Appendix A.

Boreholes BH12-1 through BH12-3 were advanced within the footprint of the proposed stormwater management pond; borehole BH12-4 was advanced near the anticipated Overhead Sign location; and boreholes BH12-5 through BH12-8 were advanced along the proposed gabion retaining wall structure.

All boreholes were advanced using a track mount CME 75 drill rig with hollow stem augers and soil and bedrock sampling equipment.

The subsurface stratigraphy encountered in each borehole was recorded in the field. Split spoon samples were collected at regularly spaced intervals (typically every 760 mm) during the course of Standard Penetration Testing (ASTM, 1999). All samples recovered were returned to Stantec's Ottawa laboratory for detailed classification and testing. Boreholes were backfilled with auger cuttings and road holes were topped with cold patch asphalt.

Groundwater monitoring wells were installed in borehole BH12-1 and BH12-8. The monitoring well consisted of 50 mm diameter PVC pipe with perforations along the lower 3.0 m and 2.4 m for boreholes BH12-1 and BH12-8, respectively.

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### 3.2 LOCATION AND ELEVATION SURVEY

Elevation and location survey of the borehole locations was performed by Stantec personnel. The ground surface elevation at each borehole location was surveyed with reference to a Geodetic Benchmark provided by MTO.

Table 3.1 summarizes the location and elevation information for the boreholes included in this report.

**Table 3.1: Borehole Information Summary**

	Boreholes							
	BH12-1	BH12-2	BH12-3	BH12-4	BH12-5	BH12-6	BH12-7	BH12-8
MTM Zone 10 Coordinates								
Northing	4793587	4793629	4793613	4793596	4793636	4793645	4793646	4793654
Easting	258767	258757	258796	258866	259108	259152	259198	259247
Ground Surface Elevation (m)	239.8	239.6	239.5	239.7	242.6	243.5	244.5	245.7
Total Depth Drilled (m)	9.9	9.1	7.6	6.7	6.7	6.7	6.7	6.7
End of Borehole Elevation (m)	229.9	230.5	231.9	233.0	235.9	236.8	237.8	239.0
Number of Soil Samples	10	9	9	9	9	9	9	9
Depth Cored (m)	1.5	1.5						

### 3.3 LABORATORY TESTING

All samples were subjected to a detailed visual examination by a Geotechnical Engineer. The following geotechnical laboratory tests were carried out:

<u>Test</u>	<u>No. of Tests</u>
Moisture Content	52
Grain Size Analysis	19
Atterberg Limits	13

Samples remaining after testing will be stored for one year after issuance of the final report. After the storage period, the samples will be discarded.

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### **4.0 Subsurface Conditions**

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#### **4.1 GENERAL**

The subsurface conditions observed in the boreholes are presented in detail on the Borehole Records provided in Appendix B. An explanation of the symbols and terms used to describe the Borehole Records is also provided.

In general, the subsurface stratigraphy consisted of a pavement structure or topsoil over a sand and gravel fill over a silt deposit underlain by dolomite bedrock.

A borehole location plan and a stratigraphic section of the soils encountered within the boreholes are provided on Drawing No. 1 in Appendix A.

#### **4.2 OVERBURDEN**

##### **4.2.1 Pavement Structure**

A pavement structure was encountered in boreholes BH12-2, BH12-3, BH12-4 and BH12-5. The top of road elevation varied from 239.5 m at BH 12-3 on Highway 8 to 242.6 m at BH12-5 on Highway 5.

The pavement structure consisted of the following:

HM Asphalt	140 to 235 mm
Base/ Subbase (Gravelly Sand)	600 to 820 mm

The base/subbase material consisted of a brown gravelly sand.

##### **4.2.2 Topsoil**

Approximately 100 to 150 mm of topsoil was encountered in boreholes BH12-1, BH12-7 and BH12-8.

##### **4.2.3 Fill**

Fill material was encountered in all of the boreholes beneath a layer of asphalt, topsoil or at the ground surface. The fill generally consisted of a gravelly sand base/subbase material over a silty sand to sandy silt embankment fill material. The fill was approximately 0.7 to 4.2 m thick and extended to an elevation ranging from 244.9 to 238.2 m.

The Standard Penetration Test (SPT) blow count N-values observed within the fill ranged from 1 to 42 blows per 0.3 m suggesting a very loose to dense state of compactness.

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Moisture content and grain size distribution tests carried out on representative samples of the fill yielded the following results:

Gravel:	1 and 34%
Sand:	3 and 57%
Fines (silt & clay):	9 and 96%
Moisture content:	4 to 18%

The grain size distribution curve for the fill layer is provided on Figure 1 in Appendix C.

### **4.2.4 Silt**

A silt deposit was encountered in all boreholes immediately beneath the fill or topsoil. The silt generally included a lightly cohesive or clayey layer about 1.5 m thick. The silt was fully penetrated in boreholes BH12-1 to BH 12-3 where its thickness ranged from 6.1 to 6.8 m and its bottom elevation ranged from 231.9 m to 232.2 m.

The SPT N-values for this deposit ranged from 3 to 88 blows per 0.3 m suggesting a very loose to very dense state of compactness.

Within borehole BH12-4 cobbles were encountered at a depth of 4.1 m. Although not encountered within the silt at other locations, the random presence of cobbles (and possibly boulders) should be anticipated.

Moisture content and grain size distribution tests carried out on representative samples of the silt yielded the following results:

Gravel:	0 to 1%
Sand:	0 to 6%
Silt:	58 to 92%
Clay:	5 to 40%
Moisture Content:	12 to 29%

Atterberg limit tests carried out on this material indicated that the silt material ranged from a clay of low plasticity to a non-plastic silt. The grain size distribution curves and the plasticity chart for the silt material are provided on Figures 2 through 4 in Appendix C.

### **4.2.5 Sandy Silt Till**

A thin till deposit was encountered below the silt layer at borehole BH12-1. The till consisted of a sandy silt with a trace of gravel. The till layer was 0.8 m thick and extended to elevation 231.4 m.

A single SPT N-value of 8 blows per 0.3 m was measured in the till, indicating a loose state of compactness.

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Cobbles and boulders were not observed while drilling in the till, however, the presence of these larger particles is typical within glacial till and is expected to be randomly present within the till at this site.

Moisture content and grain size distribution tests carried out on the till sample yielded the following:

Gravel:	7%
Sand:	16%
Silt:	64%
Clay:	13%
Moisture Content:	18%

An Atterberg limit test carried out on this material indicates that the till is non-plastic. The grain size distribution curve and the plasticity chart are shown on Figure 5 and Figure 6, respectively.

### 4.3 GROUNDWATER

The depth to groundwater was inferred in five of the boreholes at the time of drilling between March 13 and March 16, 2012. Groundwater monitoring wells were installed in BH12-1 and BH12-8; the depth to groundwater was measured in a standpipe well on March 29, 2012 and again on May 15, 2012. The measured and inferred (i.e., at the time of drilling) groundwater levels are summarized in Table 4.1.

**Table 4.1: Groundwater Levels**

Borehole No	Ground Surface Elevation (m)	Groundwater	
		Depth (m)	Elevation (m)
Measured on March 29, 2012			
BH12-1	239.8	1.4	238.4
BH12-8	245.7	3.0	242.7
Measured on May 15, 2012			
BH12-1	239.8	1.5	238.3
BH12-8	245.7	3.0	242.7
Inferred (time of drilling)			
BH12-3	239.5	3.9	235.7
BH12-4	239.7	1.8	237.9
BH12-5	242.6	6.1	236.5
BH12-6	243.5	5.3	238.2
BH12-7	244.5	2.1	241.9

Fluctuations in the groundwater due to seasonal variations or in response to a particular precipitation event should be anticipated.



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### **5.0 Miscellaneous**

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The field work was carried out under the supervision of Dan Stunden and Rick Cluthe, Geotechnical Engineering Technologists, under the direction of Mr. Kenton Power, P.Eng.

Down Under Pipe & Cable Locating Ltd. of Rockwood, Ontario, carried out the private and public utility locates for the boreholes.

The CME 75 drilling equipment was supplied and operated by Pontil Drilling of Mount Albert, Ontario.

Elevation and location survey of the borehole locations was carried out by Stantec personnel.

Geotechnical laboratory testing was carried out at Stantec's Ottawa laboratory.

This report was prepared by Katurah Firdaws, and reviewed by Simon Gudina and Raymond Haché.

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### 6.0 Closure

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A subsurface investigation is a limited sampling of a site. The subsurface conditions given herein are based on information gathered at the specific borehole locations. Should any conditions at the site be encountered which differ from those at the borehole locations, we request that we be notified immediately in order to assess the additional information.

Respectfully Submitted;

STANTEC CONSULTING LTD.



Katurah Firdawsi, B.Sc.Eng.



Simon Gudina, Ph.D., P.Eng.  
Geotechnical Engineer



Raymond Haché, M.Sc., P.Eng.  
Designated Principal MTO Foundation Contact



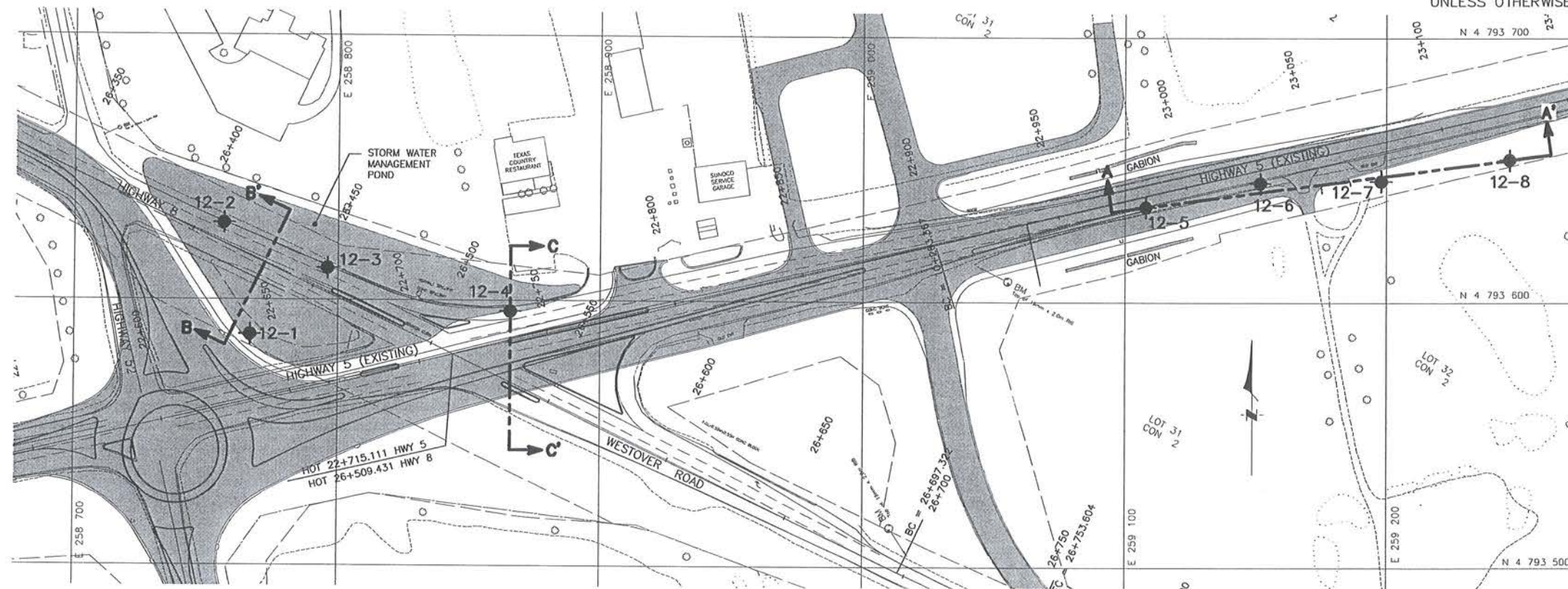
# **APPENDIX A**

Drawings No. 1 & 2 – Borehole Location Plan and Soil Strata Plot

Site Photos

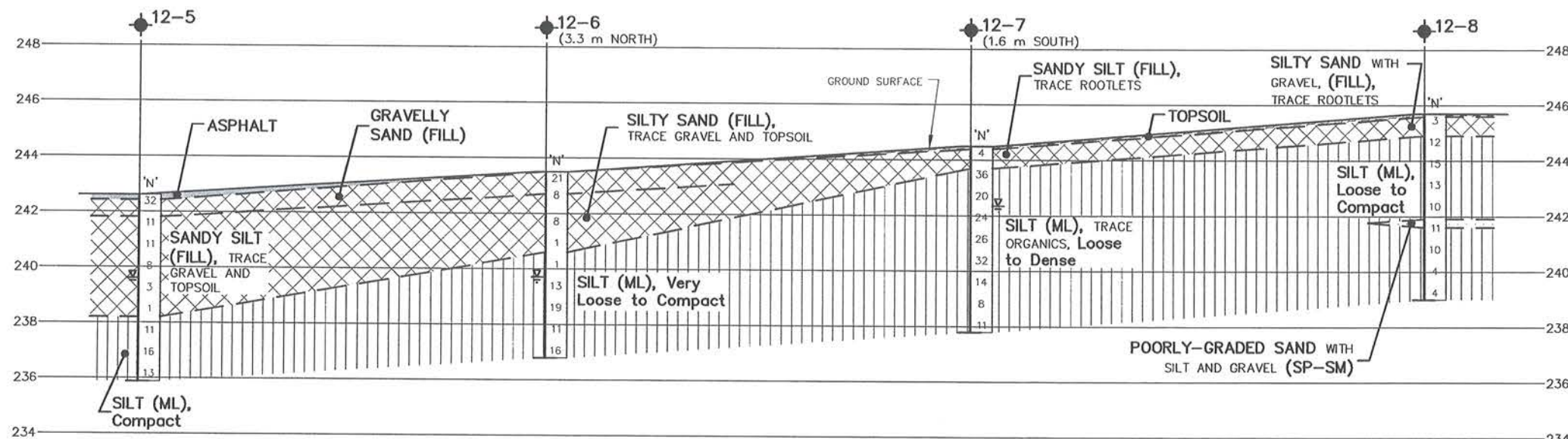


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PLAN

SCALE  
20 m 0 20 40 m



SECTION A-A'

SCALE  
6 m 0 6 12 m HORIZ  
2 m 0 2 4 m VERT

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

PLATE No  
CONT  
WP 2829-02-00  
HIGHWAYS 5 & 8  
PETERS CORNERS, HAMILTON, ONTARIO  
BOREHOLE LOCATIONS & SOIL STRATA



SHEET



KEY PLAN  
NOT TO SCALE

LEGEND

- ◆ Borehole
  - N Blows/0.3m (Std Pen Test, 475 J/blow)
  - WL at time of investigation, March 29, 2012
  - WL Inferred WL at time of investigation, March 2012
- (m NORTH) OFFSET FROM SECTION LINE

No	ELEVATION	MTM ZONE 10 COORDINATES NORTH	EAST
12-1	239.8	4 793 587	258 767
12-2	239.6	4 793 629	258 757
12-3	239.5	4 793 613	258 796
12-4	239.7	4 793 596	258 866
12-5	242.6	4 793 636	259 108
12-6	243.5	4 793 645	259 152
12-7	244.5	4 793 646	259 198
12-8	245.7	4 793 654	259 247

NOTES

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

This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.



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GEORES No	40PB-200	DIST	
HWY No 5 & 8		SITE	
SUBM'D SGD	CHECKED	DATE 2012-06-20	
DRAWN GBB	CHECKED	APPROVED	DWG 1



DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

PLATE No  
CONT  
WP 2829-02-00




HIGHWAYS 5 & 8  
PETERS CORNERS, HAMILTON, ONTARIO  
SOIL STRATA

SHEET



KEY PLAN  
NOT TO SCALE

### LEGEND

- |   |   |
|---|---|
|    | Borehole  |
| N   | Blows/0.3m (Std Pen Test,<br>475 J/blow)            |
|  | WL at time of investigation,<br>March 29, 2012      |
|  | Inferred WL at time of<br>investigation, March 2012 |
| (m EAST)  | OFFSET FROM SECTION LINE                            |

No	ELEVATION	MTM ZONE 10 COORDINATES	
		NORTH	EAST
12-1	239.8	4 793 587	258 767
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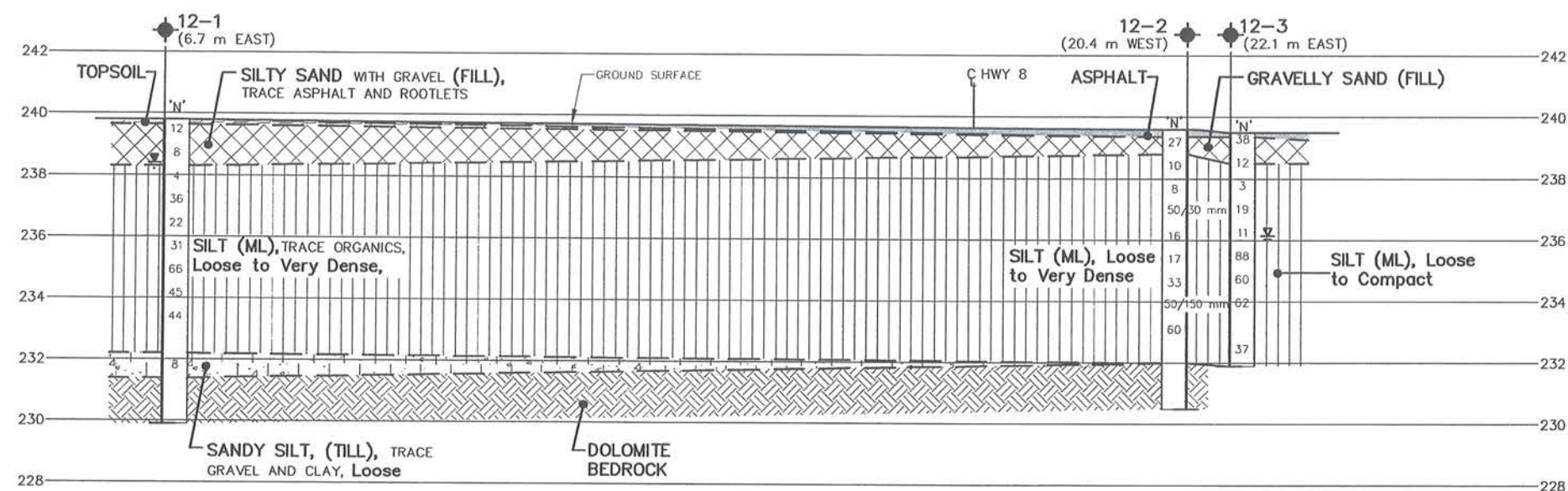
=NOTES=

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

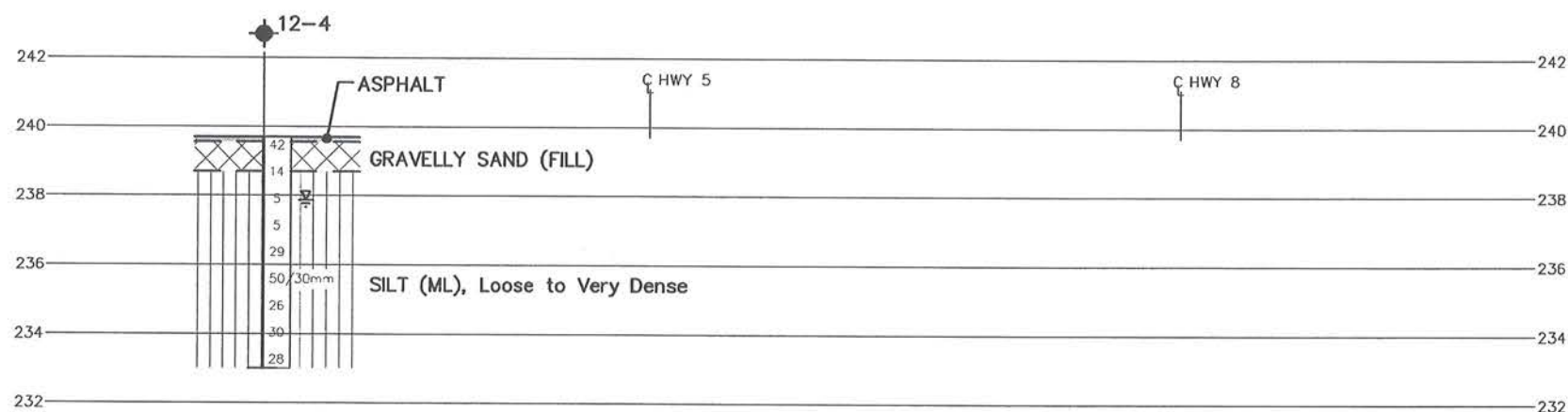
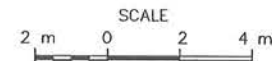
This drawing is for subsurface information only.  
Surface details and features are for conceptual  
illustration.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsway. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

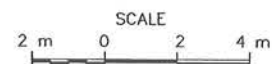
REVISIONS					
	DATE	BY	DESCRIPTION		
GEORES No 40PB-200					
HWY No 5 & B					DIST
SUBM'D SGD		CHECKED	DATE 2012-06-20		SITE
DRAWN GBR		CHECKED	APPROVED <i>SG</i>	DWG 2	



SECTION B-B'



SECTION C-C'







**Photo No. 1: Borehole 12-4 looking west along Hwy 5 – Overhead Sign**



**Photo No. 2: Borehole 12-2 looking south along Hwy 8 – Stormwater Pond**





**Photo No. 3: Borehole 12-3 looking north along Hwy 8 - Stormwater Pond**



**Photo No. 4: Borehole 12-7 looking east along Highway 5 – Gabion Retaining Wall**





**Photo No. 5: Borehole 12-8 looking west along Highway 5 – Gabion Retaining Wall**



**Photo No. 6: Highway 5 Station 23+100 looking east – Gabion Retaining Wall**



# **APPENDIX B**

Symbols and Terms Used on Borehole Records

Borehole Records

## SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

### SOIL DESCRIPTION

#### Terminology describing common soil genesis:

<i>Topsoil</i>	- mixture of soil and humus capable of supporting vegetative growth
<i>Peat</i>	- mixture of visible and invisible fragments of decayed organic matter
<i>Till</i>	- unstratified glacial deposit which may range from clay to boulders
<i>Fill</i>	- material below the surface identified as placed by humans (excluding buried services)

#### Terminology describing soil structure:

<i>Desiccated</i>	- having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.
<i>Fissured</i>	- having cracks, and hence a blocky structure
<i>Varved</i>	- composed of regular alternating layers of silt and clay
<i>Stratified</i>	- composed of alternating successions of different soil types, e.g. silt and sand
<i>Layer</i>	- > 75 mm in thickness
<i>Seam</i>	- 2 mm to 75 mm in thickness
<i>Parting</i>	- < 2 mm in thickness

#### Terminology describing soil types:

The classification of soil types are made on the basis of grain size and plasticity in accordance with the Unified Soil Classification System (USCS) (ASTM D 2487 or D 2488). The classification excludes particles larger than 76 mm (3 inches). The USCS provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification.

#### Terminology describing cobbles, boulders, and non-matrix materials (organic matter or debris):

Terminology describing materials outside the USCS, (e.g. particles larger than 76 mm, visible organic matter, construction debris) is based upon the proportion of these materials present:

<i>Trace, or occasional</i>	Less than 10%
<i>Some</i>	10-20%
<i>Frequent</i>	> 20%

#### Terminology describing compactness of cohesionless soils:

The standard terminology to describe cohesionless soils includes compactness (formerly "relative density"), as determined by the Standard Penetration Test N-Value (also known as N-Index). A relationship between compactness condition and N-Value is shown in the following table.

Compactness Condition	SPT N-Value
<i>Very Loose</i>	<4
<i>Loose</i>	4-10
<i>Compact</i>	10-30
<i>Dense</i>	30-50
<i>Very Dense</i>	>50

#### Terminology describing consistency of cohesive soils:

The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by *in situ* vane tests, penetrometer tests, or unconfined compression tests.

Consistency	Undrained Shear Strength	
	kips/sq.ft.	kPa
<i>Very Soft</i>	<0.25	<12.5
<i>Soft</i>	0.25 - 0.5	12.5 - 25
<i>Firm</i>	0.5 - 1.0	25 - 50
<i>Stiff</i>	1.0 - 2.0	50 - 100
<i>Very Stiff</i>	2.0 - 4.0	100 - 200
<i>Hard</i>	>4.0	>200



## ROCK DESCRIPTION

### Terminology describing rock quality:

RQD	Rock Mass Quality
0-25	<i>Very Poor</i>
25-50	<i>Poor</i>
50-75	<i>Fair</i>
75-90	<i>Good</i>
90-100	<i>Excellent</i>

Rock quality classification is based on a modified core recovery percentage (RQD) in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be due to close shearing, jointing, faulting, or weathering in the rock mass and are not counted. RQD was originally intended to be done on NW core; however, it can be used on different core sizes if the bulk of the fractures caused by drilling stresses are easily distinguishable from *in situ* fractures. The terminology describing rock mass quality based on RQD is subjective and is underlain by the presumption that sound strong rock is of higher engineering value than fractured weak rock.

### Terminology describing rock mass:

Spacing (mm)	Joint Classification	Bedding, Laminations, Bands
> 6000	<i>Extremely Wide</i>	-
2000-6000	<i>Very Wide</i>	<i>Very Thick</i>
600-2000	<i>Wide</i>	<i>Thick</i>
200-600	<i>Moderate</i>	<i>Medium</i>
60-200	<i>Close</i>	<i>Thin</i>
20-60	<i>Very Close</i>	<i>Very Thin</i>
<20	<i>Extremely Close</i>	<i>Laminated</i>
<6	-	<i>Thinly Laminated</i>

### Terminology describing rock strength:

Strength Classification	Unconfined Compressive Strength (MPa)
<i>Extremely Weak</i>	< 1
<i>Very Weak</i>	1 – 5
<i>Weak</i>	5 – 25
<i>Medium Strong</i>	25 – 50
<i>Strong</i>	50 – 100
<i>Very Strong</i>	100 – 250
<i>Extremely Strong</i>	> 250

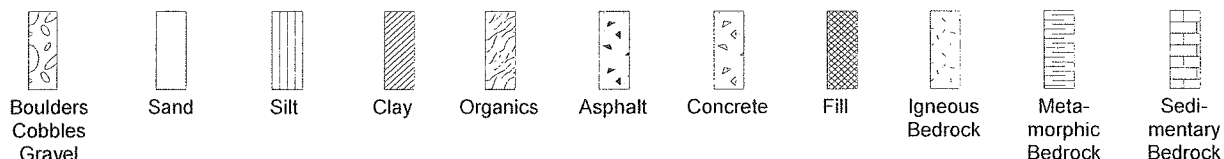
### Terminology describing rock weathering:

Term	Description
<i>Fresh</i>	No visible signs of rock weathering. Slight discolouration along major discontinuities
<i>Slightly Weathered</i>	Discolouration indicates weathering of rock on discontinuity surfaces. All the rock material may be discoloured.
<i>Moderately Weathered</i>	Less than half the rock is decomposed and/or disintegrated into soil.
<i>Highly Weathered</i>	More than half the rock is decomposed and/or disintegrated into soil.
<i>Completely Weathered</i>	All the rock material is decomposed and/or disintegrated into soil. The original mass structure is still largely intact.



## STRATA PLOT

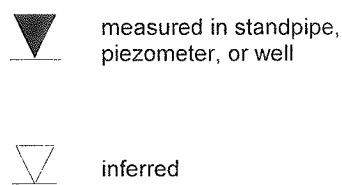
Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



## SAMPLE TYPE

SS	Split spoon sample (obtained by performing the Standard Penetration Test)
ST	Shelby tube or thin wall tube
DP	Direct-Push sample (small diameter tube sampler hydraulically advanced)
PS	Piston sample
BS	Bulk sample
WS	Wash sample
HQ, NQ, BQ, etc.	Rock core samples obtained with the use of standard size diamond coring bits.

## WATER LEVEL MEASUREMENT



## RECOVERY

For soil samples, the recovery is recorded as the length of the soil sample recovered. For rock core, recovery is defined as the total cumulative length of all core recovered in the core barrel divided by the length drilled and is recorded as a percentage on a per run basis.

## N-VALUE

Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 140 pound (64 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (305 mm) into the soil. For split spoon samples where insufficient penetration was achieved and N-values cannot be presented, the number of blows are reported over sampler penetration in millimetres (e.g. 50/75). Some design methods make use of N value corrected for various factors such as overburden pressure, energy ratio, borehole diameter, etc. No corrections have been applied to the N-values presented on the log.

## DYNAMIC CONE PENETRATION TEST (DCPT)

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to A size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone one foot (305 mm) into the soil. The DCPT is used as a probe to assess soil variability.

## OTHER TESTS

S	Sieve analysis
H	Hydrometer analysis
k	Laboratory permeability
$\gamma$	Unit weight
$G_s$	Specific gravity of soil particles
CD	Consolidated drained triaxial
CU	Consolidated undrained triaxial with pore pressure measurements
UU	Unconsolidated undrained triaxial
DS	Direct Shear
C	Consolidation
$Q_u$	Unconfined compression
$I_p$	Point Load Index ( $I_p$ on Borehole Record equals $I_p(50)$ in which the index is corrected to a reference diameter of 50 mm)

	Single packer permeability test; test interval from depth shown to bottom of borehole
	Double packer permeability test; test interval as indicated
	Falling head permeability test using casing
	Falling head permeability test using well point or piezometer



# RECORD OF BOREHOLE No BH 12-1

1 OF 1

METRIC

W.P. 2829-02-00 LOCATION Hwy 8, Peters Corners N: 4 793 587 E: 258 767 ORIGINATED BY DS  
 DIST Eastern HWY 5 & 8 BOREHOLE TYPE Hollow Stem Augers, Splittspoon Sampler COMPILED BY BB  
 DATUM Geodetic DATE 2012 03 13 - 2012 03 13 CHECKED BY KF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED	✕ FIELD VANE						
								● QUICK TRIAXIAL	✕ LAB VANE						
239.8	Topsoil						20 40 60 80 100	10 20 30							
239.8	150 mm TOPSOIL						20 40 60 80 100								
0.2	FILL: Silty sand with gravel, brown -trace asphalt -trace rootlets		1	SS	12									1 3 87 9	
			2	SS	8										
238.3															
1.5	SILT (ML) Loose to very dense Brown, moist -trace organics		3	SS	4									Non-Plastic	
	- dense below 2.3 m - clayey from 2.3 to 3.8 m		4	SS	36										
			5	SS	22									0 3 61 36	
			6	SS	31									Non-Plastic	
			7	SS	66										
			8	SS	45									0 3 92 5	
			9	SS	44									Non-Plastic	
232.2															
7.6	Sandy silt trace gravel trace clay: TILL - Loose - Greyish brown		10	SS	8									7 16 64 13	
231.4															
8.4	Dolomite BEDROCK - light grey to grey - excellent rock mass quality - close to moderate joint spacing - near horizontal discontinuities - unweathered (fresh) discontinuities		11	HQ										REC = 100% RQD = 100%	
229.9															
9.9	End of Borehole														
	Groundwater Level Measured on March 29, 2012														

ONTARIO MTO STANTEC 165000773\_HWY5&8\_PETERSCORNERS.GPJ ONTARIO MOT GDT 12/6/21



**Client:** Ministry of Transportation Ontario (MTO)

Project: Peters Corners Intersection

**Contractor:** Pontil Drilling Ltd. CME-75 Track Mount

Logger: Kenton C. Power

DEPTH FROM	RUN NO.	% CORE RECOVERY	% RQD	DEPTH TO	GENERAL DESCRIPTION (Rock Type/s, %, Colour, Texture, etc.)	STRENGTH	WEATHERING	DISCONTINUITIES						OCCASIONAL FEATURES	DRILLING OBSERVATIONS	
								NO. OF SETS	TYPE/S	ORIENTATION	SPACING	ROUGHNESS	APERTURE			FILLING
8.4	1	100	100	9.9	Grey DOLOMITE bedrock				B	F	CM	RU		T		

EH = Extremely Strong = > 250  
VS = Very Strong = 100-250  
S = Strong = 50-100  
MS = Medium Strong = 25-50  
W = Weak = 5 - 25

VW = Very Weak = 1-5  
EW = Extremely Weak = < 1

STRENGTH (MPa)

WEATHERING  
U = Unweathered = No Signs  
S = Slightly = Oxidized  
M = Moderately = Discoloured  
H = Highly = Friable  
C = Completely = Soil-like

SPACING  
VW = Very Wide = >3m  
W = Wide = 1-3 m  
M = Moderate = 0.3-1 m  
C = Close = 5-30 cm  
VC = Very Close = <5 cm

DISCONTINUITY TYPE  
B = Bedding Joint  
J = Cross Joint  
F = Fault  
S = Shear Plane

ORIENTATION  
F = Flat = 0-20°  
D = Dipping = 20-50°  
V = n-Vertical = >50°

FILLING  
T = Tight, Hard  
O = Oxidized  
SA = Slightly Altered, Clay Free  
S = Sandy, Clay Free  
Si = Sandy, Silty, Minor Clay  
NC = Non-softening Clay  
SC = Swelling, Soft Clay

# RECORD OF BOREHOLE No BH 12-2

1 OF 1

METRIC

W.P. 2829-02-00 LOCATION Hwy 8, Peters Corners N: 4 793 629 E: 258 757 ORIGINATED BY DS  
 DIST Eastern HWY 5 & 8 BOREHOLE TYPE Hollow Stem Augers, Splitspoon Sampler, HQ Rock Core COMPILED BY BB  
 DATUM Geodetic DATE 2012 03 14 - 2012 03 14 CHECKED BY KF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								20	40	60	80	100						20	40	60
239.6	Asphalt																GR SA SI CL			
0.0 239.4	235 mm ASPHALT																			
0.2	FILL: Gravelly sand, brown -crushed		1	SS	27												34 57 (9)			
238.8																	Non-Plastic			
0.8	SILT (ML) Loose to very dense Brown, moist		2	SS	10															
			3	SS	8												Non-Plastic			
			4	SS	50/ 30mm															
	- clayey from 3.0 to 4.5		5	SS	16												0 2 69 29			
			6	SS	17															
	- dense to very dense below 4.6 m		7	SS	33															
			8	SS	50/ 150mm															
			9	SS	60												0 2 90 8			
232.0																				
7.6	Dolomite BEDROCK - light grey to grey - excellent rock mass quality - close to moderate joint spacing - near horizontal discontinuities - unweathered (fresh) discontinuities		10	HQ													REC = 100% RQD = 100%			
230.5																				
9.1	End of Borehole																			

ONTARIO MTO STANTEC 165000773 HWY5&8 PETERSCORNERS GPJ ONTARIO MOT GDT 12/6/21



# Starter

<b>Client:</b>	Ministry of Transportation Ontario (MTO)	<b>Project No.:</b>	165000773
<b>Project:</b>	Peters Corners Intersection	<b>Date:</b>	March 20, 2212
<b>Contractor:</b>	Pontil Drilling Ltd.	<b>Borehole No.:</b>	BH12-2
		<b>Logger:</b>	Kenton C. Power

DEPTH FROM	RUN NO.	% CORE RECOVERY	% RQD	DEPTH TO	GENERAL DESCRIPTION (Rock Type/s, %, Colour, Texture, etc.)	STRENGTH	WEATHERING	DISCONTINUITIES						OCCASIONAL FEATURES	DRILLING OBSERVATIONS	
								NO. OF SETS	TYPE/S	ORIENTATION	SPACING	ROUGHNESS	APERTURE			FILLING
7.6	1	100	100	9.1	Grey DOLOMITE bedrock		S	1	B	F	CM	RU		T		

STRENGTH (MPa)

EH = Extremely Strong = > 250  
VS = Very Strong = 100-250  
S = Strong = 50-100  
MS = Medium Strong = 25-50  
W = Weak = 5 - 25

WEATHERING

U = Unweathered = No Signs  
S = Slightly = Oxidized  
M = Moderately = Discoloured  
H = Highly = Friable  
C = Completely = Soil-like

SPACING

VW = Very Wide = >3m  
W = Wide = 1-3 m  
M = Moderate = 0.3-1 m  
C = Close = 5-30 cm  
VC = Very Close = <5 cm

DISCONTINUITY TYPE

B = Bedding Joint  
J = Cross Joint  
F = Fault  
S = Shear Plane

ORIENTATION

F = Flat = 0-20°  
D = Dipping = 20-50°  
V = n-Vertical = >50°

ROUGHNESS

RU = Rough Undulating  
RP = Rough Planar  
SU = Smooth Undulating  
SP = Smooth Planar  
LU = Slickensided Undulating  
LP = Slickensided Planar

FILLING

T = Tight, Hard  
O = Oxidized  
SA = Slightly Altered, Clay Free  
S = Sandy, Clay Free  
Si = Sandy, Silty, Minor Clay  
NC = Non-softening Clay  
SC = Swelling, Soft Clay



# RECORD OF BOREHOLE No BH 12-3

1 OF 1

METRIC

W.P. 2829-02-00 LOCATION Hwy 8, Peters Corners N: 4 793 613 E: 258 796 ORIGINATED BY DS  
 DIST Eastern HWY 5 & 8 BOREHOLE TYPE Hollow Stem Augers, Splitspoon Sampler, HQ Rock Core COMPILED BY BB  
 DATUM Geodetic DATE 2012 03 13 - 2012 03 14 CHECKED BY KE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
239.5	Asphalt							20	40	60	80	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										</

ONTARIO MTO STANTEC 165000773 HWY5&8 PETERSCORNERS GPJ ONTARIO MOT.GDT 12/6/21

# RECORD OF BOREHOLE No BH 12-4

1 OF 1

METRIC

W.P. 2829-02-00 LOCATION Hwy 8, Peters Corners N: 4 793 596 E: 258 866 ORIGINATED BY DS  
 DIST Eastern HWY 5 & 8 BOREHOLE TYPE Hollow Stem Augers, Splitspoon Sampler COMPILED BY BB  
 DATUM Geodetic DATE 2012 03 13 - 2012 03 13 CHECKED BY KF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		
239.7	Asphalt																		
239.6	140 mm ASPHALT																		
239.4	FILL: Gravelly sand, brown -crushed		1	SS	42														
0.3	FILL: Gravelly sand, brown																		
238.7																			
1.0	SILT (ML) Loose to very dense Brown, moist to wet		2	SS	14											3 18 66 13			
			3	SS	5														
	- clayey from 1.5 to 2.3 m		4	SS	5														
			5	SS	29											0 0 91 9 Non-Plastic			
			6	SS	50/ 30 mm														
			7	SS	26														
			8	SS	30											0 3 92 5			
			9	SS	28														
233.0																			
6.7	End of Borehole																		
	Groundwater observed at 1.83 m depth during drilling																		

ONTARIO MTO STANTEC 165000773 HWY5&8\_PETERSCORNERS.GPJ ONTARIO MOT.GDT 12/6/21

# RECORD OF BOREHOLE No BH 12-5

1 OF 1

METRIC

W.P. 2829-02-00 LOCATION Hwy 5, Peters Corners N: 4 793 636 E: 259 108 ORIGINATED BY RC  
 DIST Eastern HWY 5 & 8 BOREHOLE TYPE Hollow Stem Augers, Splitspoon Sampler COMPILED BY BB  
 DATUM Geodetic DATE 2012 03 16 - 2012 03 16 CHECKED BY KE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
242.6	Asphalt							20	40	60	80	100					
242.4	190 mm ASPHALT							20	40	60	80	100					
0.2	FILL: Gravelly sand, brown		1	SS	32		242										
241.8																	
0.8	FILL: Sandy silt, brown -trace gravel and topsoil		2	SS	11		241										
			3	SS	11		240										
			4	SS	8		240										
			5	SS	3		239										
			6	SS	1		238										
238.2	- some topsoil material																
4.4	SILT (ML) Compact Brown to grey, wet		7	SS	11		237										
			8	SS	16		236										
	- clayey below 6.0 m																
			9	SS	13												
235.9																	
6.7	End of Borehole																
	Groundwater observed at 3.0 m depth during drilling																

ONTARIO MTO STANTEC 165000773 HWY5&8 PETERSCORNERS.GPJ ONTARIO MOT. GOT 12/6/21

# RECORD OF BOREHOLE No BH 12-6

1 OF 1

METRIC

W.P. 2829-02-00 LOCATION Hwy 5, Peters Corners N: 4 793 645 E: 259 152 ORIGINATED BY RC  
 DIST Eastern HWY 5 & 8 BOREHOLE TYPE Hollow Stem Augers, Split Spoon Sampler COMPILED BY BB  
 DATUM Geodetic DATE 2012 03 16 - 2012 03 16 CHECKED BY KF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED		✕ FIELD VANE		● QUICK TRIAXIAL						× LAB VANE		
243.5	Gravel						20	40	60	80	100	10	20	30						
0.0	FILL: Gravelly sand, brown -crushed		1	SS	21															
242.7			2	SS	8															
0.8	FILL: Silty sand Brown, wet -trace gravel and topsoil		3	SS	8															
			4	SS	1															
240.6			5	SS	1															
2.9	SILT (ML) Very loose to compact Brown to grey, moist to wet		6	SS	13															
			7	SS	19															
			8	SS	11															
	- grey below 6.1 m		9	SS	16															
236.8	End of Borehole																			
6.7	Groundwater observed at 3.8 m depth during drilling																			

ONTARIO MTO STANTEC 165000773\_HWY5&8\_PETERSCORNERS.GPJ ONTARIO MOT GDT 12/6/21

# RECORD OF BOREHOLE No BH 12-7

1 OF 1

METRIC

W.P. 2829-02-00 LOCATION Hwy 5, Peters Corners N: 4 793 646 E: 259 198 ORIGINATED BY DS  
 DIST Eastern HWY 5 & 8 BOREHOLE TYPE Hollow Stem Augers, Splitspoon Sampler COMPILED BY BB  
 DATUM Geodetic DATE 2012 03 15 - 2012 03 16 CHECKED BY K/F

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED	✕ FIELD VANE	● QUICK TRIAXIAL	✕ LAB VANE	WATER CONTENT (%)					
							20	40	60	80	100		10	20	30		
244.5	Topsoil					▽											
244.4 0.1	100 mm TOPSOIL FILL: Sandy silt Brown -trace rootlets		1	SS	4										○		
243.7 0.8	SILT (ML) Loose to dense Brown, moist -trace organics		2	SS	36										○		
			3	SS	20												
			4	SS	24												
			5	SS	26										○		
			6	SS	32												
			7	SS	14												
			8	SS	8										○		
			9	SS	11												
237.8 6.7	End of Borehole																

ONTARIO MTO STANTEC 165000773 HWY5&8 PETERSCORNERS GPJ ONTARIO MOT GDT 12/6/21

# RECORD OF BOREHOLE No BH 12-8

1 OF 1

METRIC

W.P. 2829-02-00 LOCATION Hwy 5, Peters Corners N: 4 793 654 E: 259 247 ORIGINATED BY DS  
 DIST Eastern HWY 5 & 8 BOREHOLE TYPE Hollow Stem Augers, Splitspoon Sampler COMPILED BY BB  
 DATUM Geodetic DATE 2012 03 15 - 2012 03 15 CHECKED BY KE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
245.7	Topsoil																
244.9	100 mm TOPSOIL FILL: Silty sand with gravel, brown -trace rootlets		1	SS	3												
244.9	SILT (ML) Loose to compact Brown, moist to wet		2	SS	12												1 3 88 8
			3	SS	15												
			4	SS	13												
			5	SS	10												
			6	SS	11												15 77 (8)
			7	SS	10												
			8	SS	4												0 0 92 8
			9	SS	4												Non-Plastic
239.0	End of Borehole																
6.7	Monitoring Well Measured On March 29, 2012																

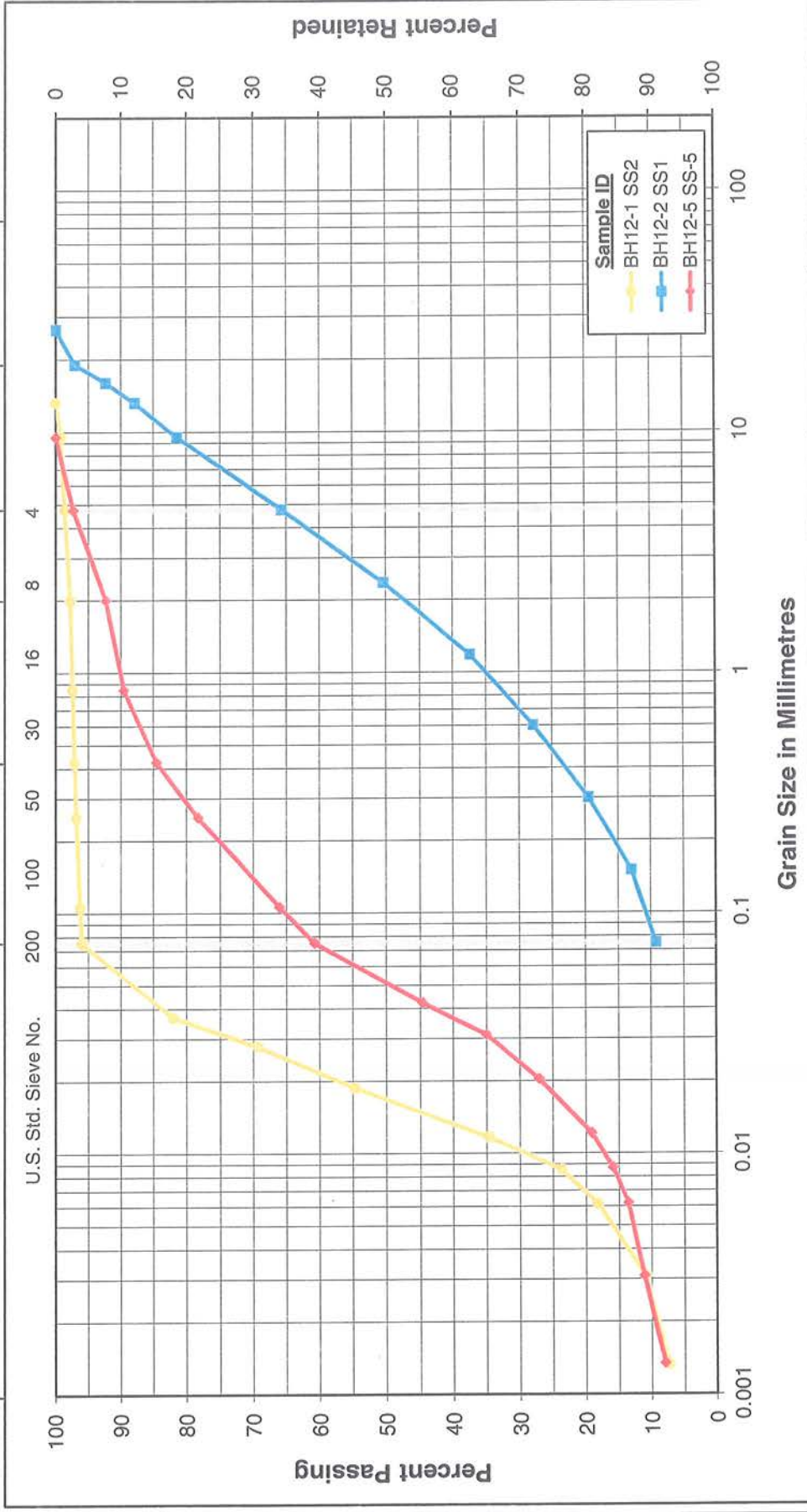
ONTARIO MTO STANTEC 165000773\_HWY5&8\_PETERSCORNERS GPJ ONTARIO MOT GDT 12/6/21

# **APPENDIX C**

Laboratory Test Results

# Unified Soil Classification System

CLAY & SILT		SAND				Gravel	
		Fine	Medium	Coarse	Fine		



## GRAIN SIZE DISTRIBUTION FILL



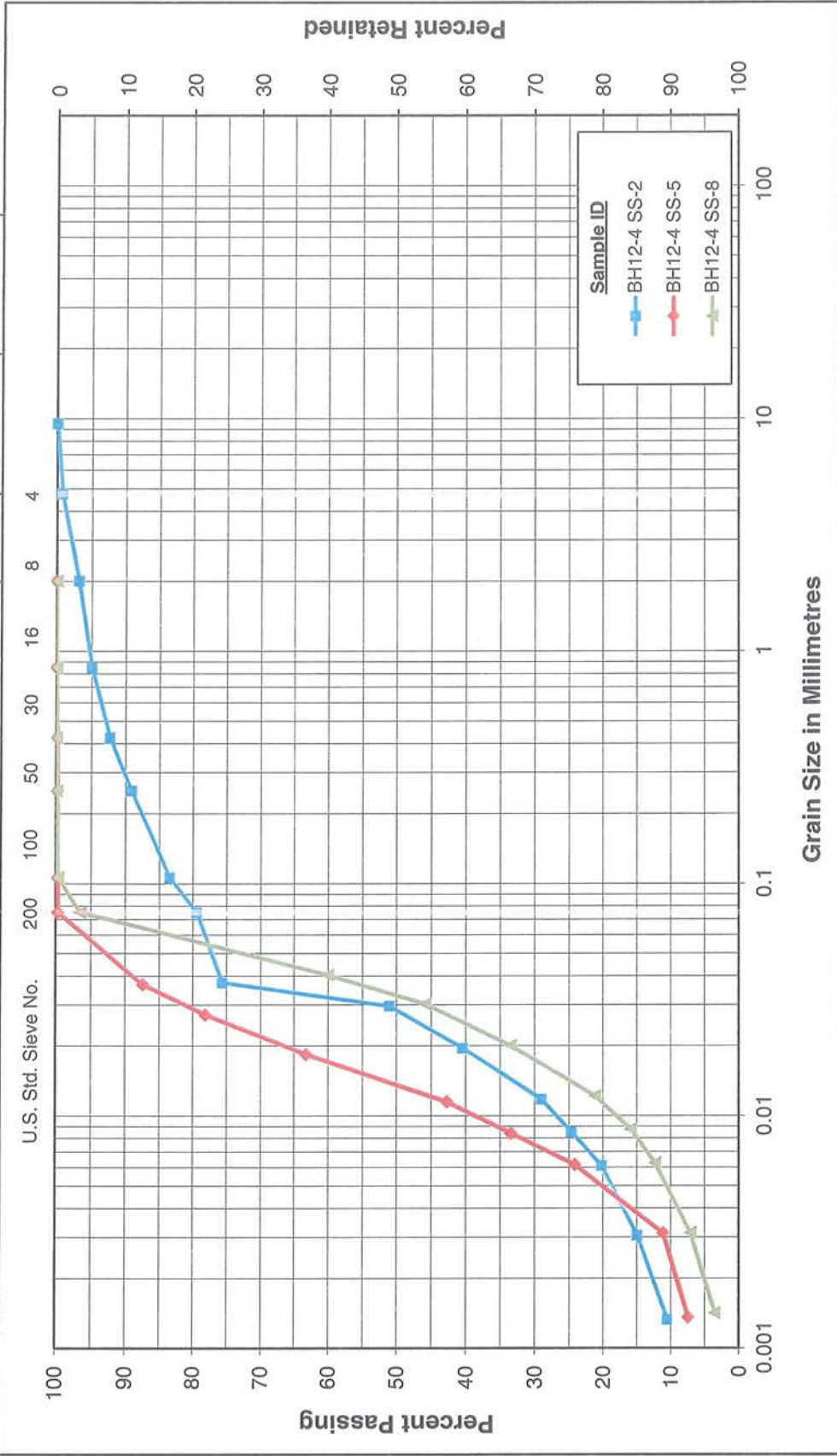
Figure No. 1

Project No. 165000773



# Unified Soil Classification System

		SAND				Gravel	
		CLAY & SILT		Fine	Medium	Coarse	Coarse



## GRAIN SIZE DISTRIBUTION SILT (ML)

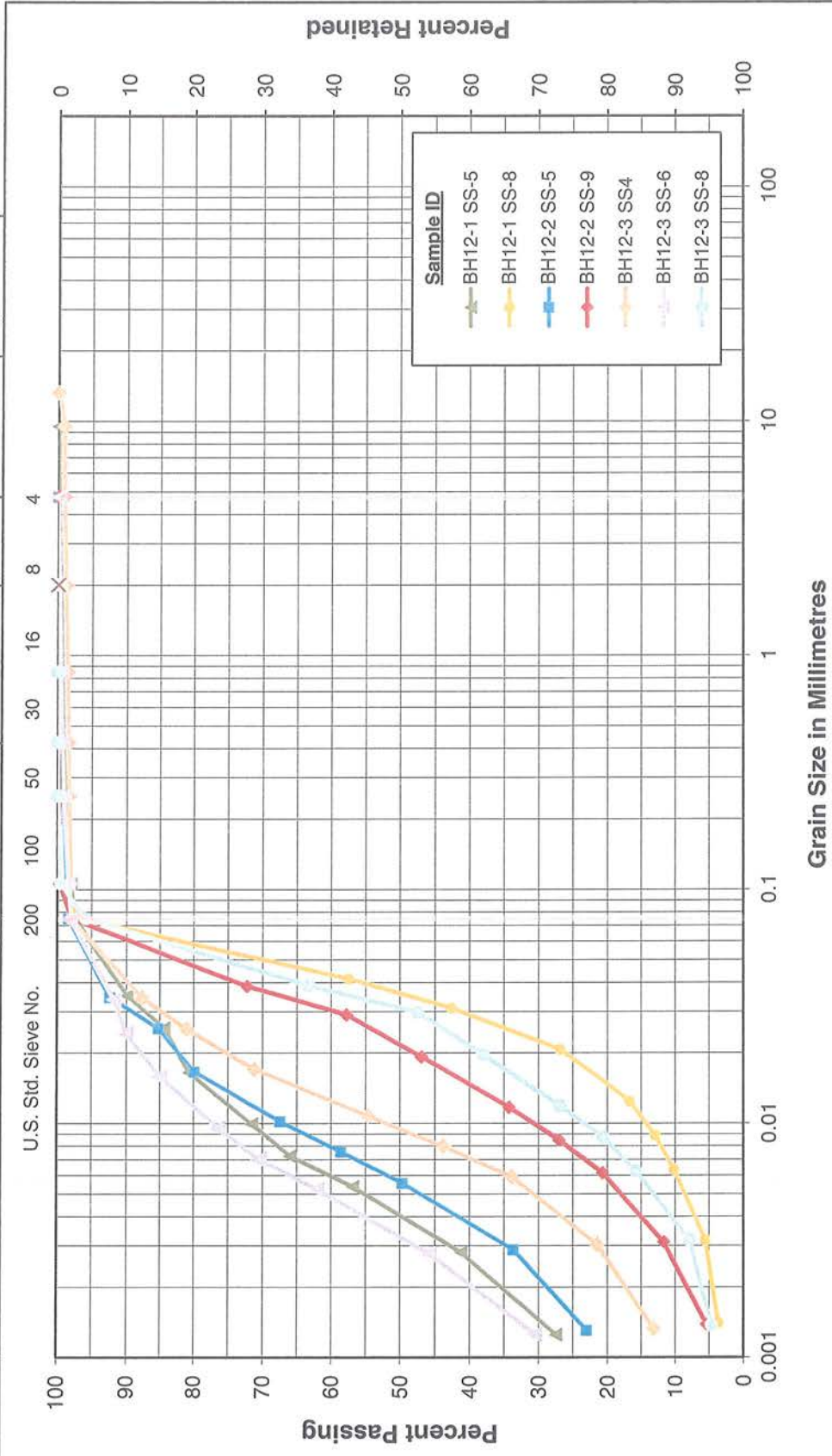
Figure No. 2

Project No. 165000773



# Unified Soil Classification System

CLAY & SILT		SAND				Gravel	
		Fine	Medium	Coarse		Fine	Coarse



## GRAIN SIZE DISTRIBUTION SILT (ML)

Figure No. 3

Project No. 165000773



# Unified Soil Classification System

CLAY & SILT	SAND				Gravel	
	Fine	Medium	Coarse		Fine	Coarse

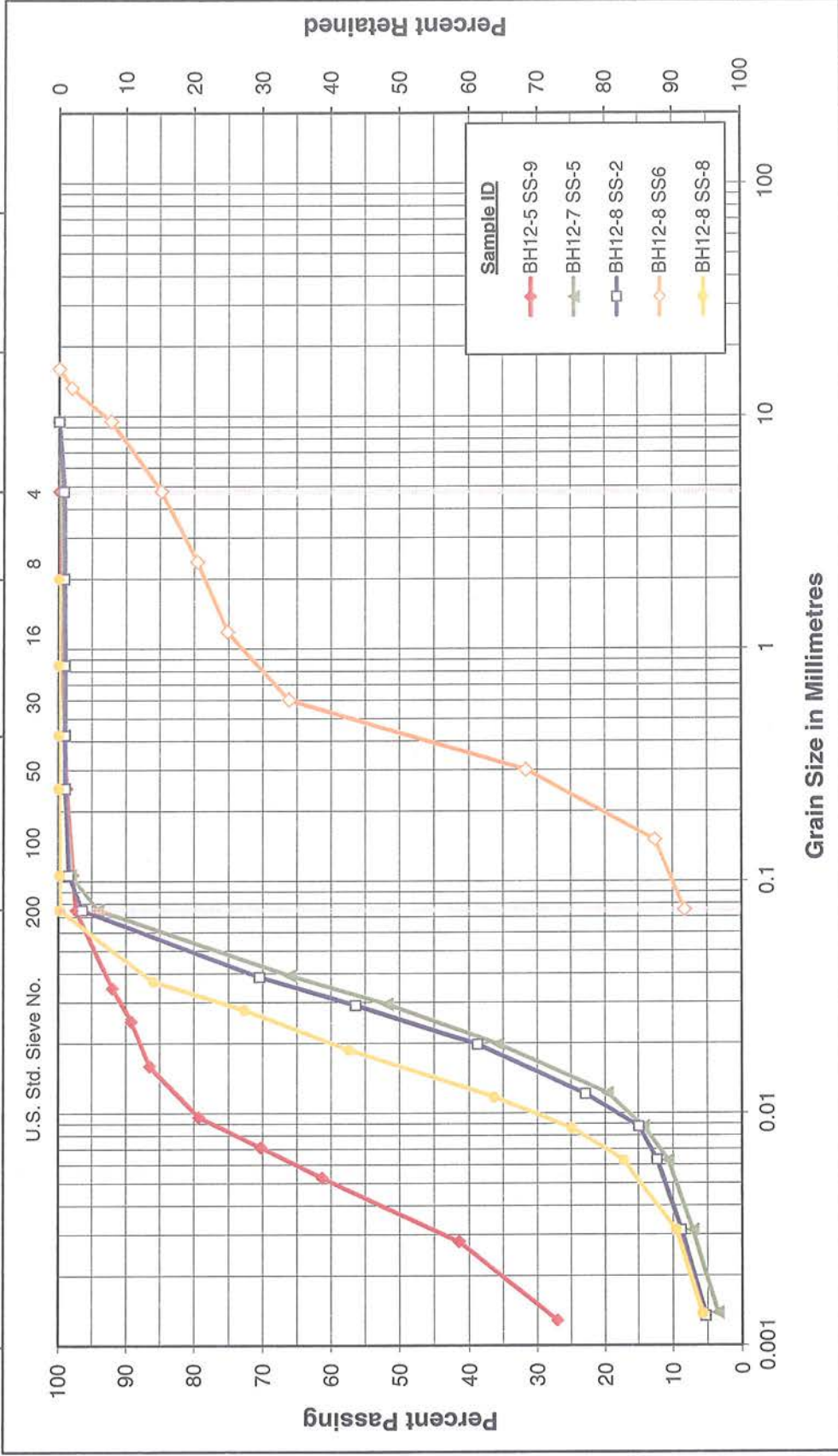


Figure No. 4

**GRAIN SIZE DISTRIBUTION**  
SILT (ML) to Poorly Graded SAND (SP-SM)

Project No. 165000773

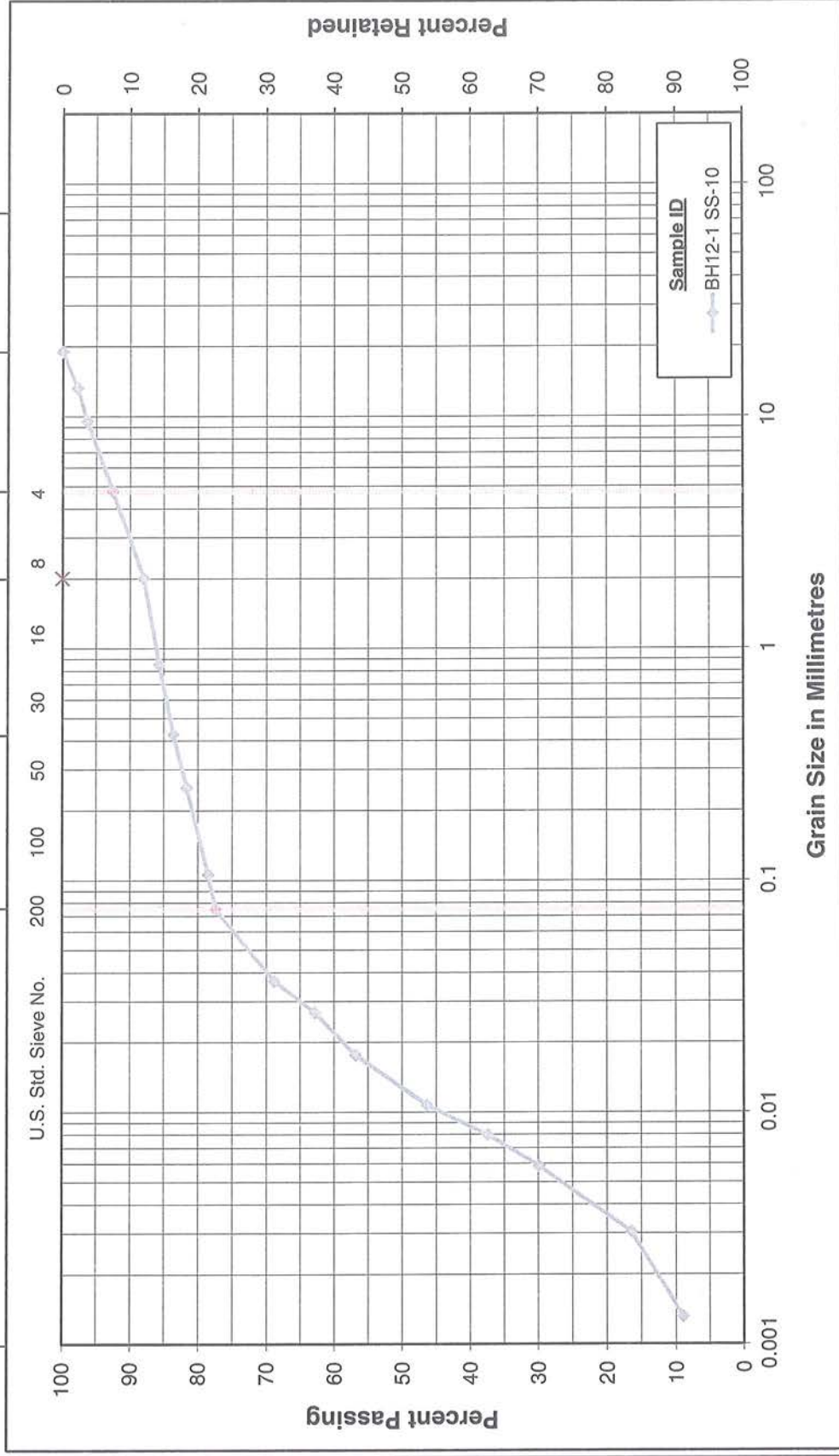


Stantec



# Unified Soil Classification System

CLAY & SILT	SAND			Gravel	
	Fine	Medium	Coarse	Fine	Coarse



## GRAIN SIZE DISTRIBUTION

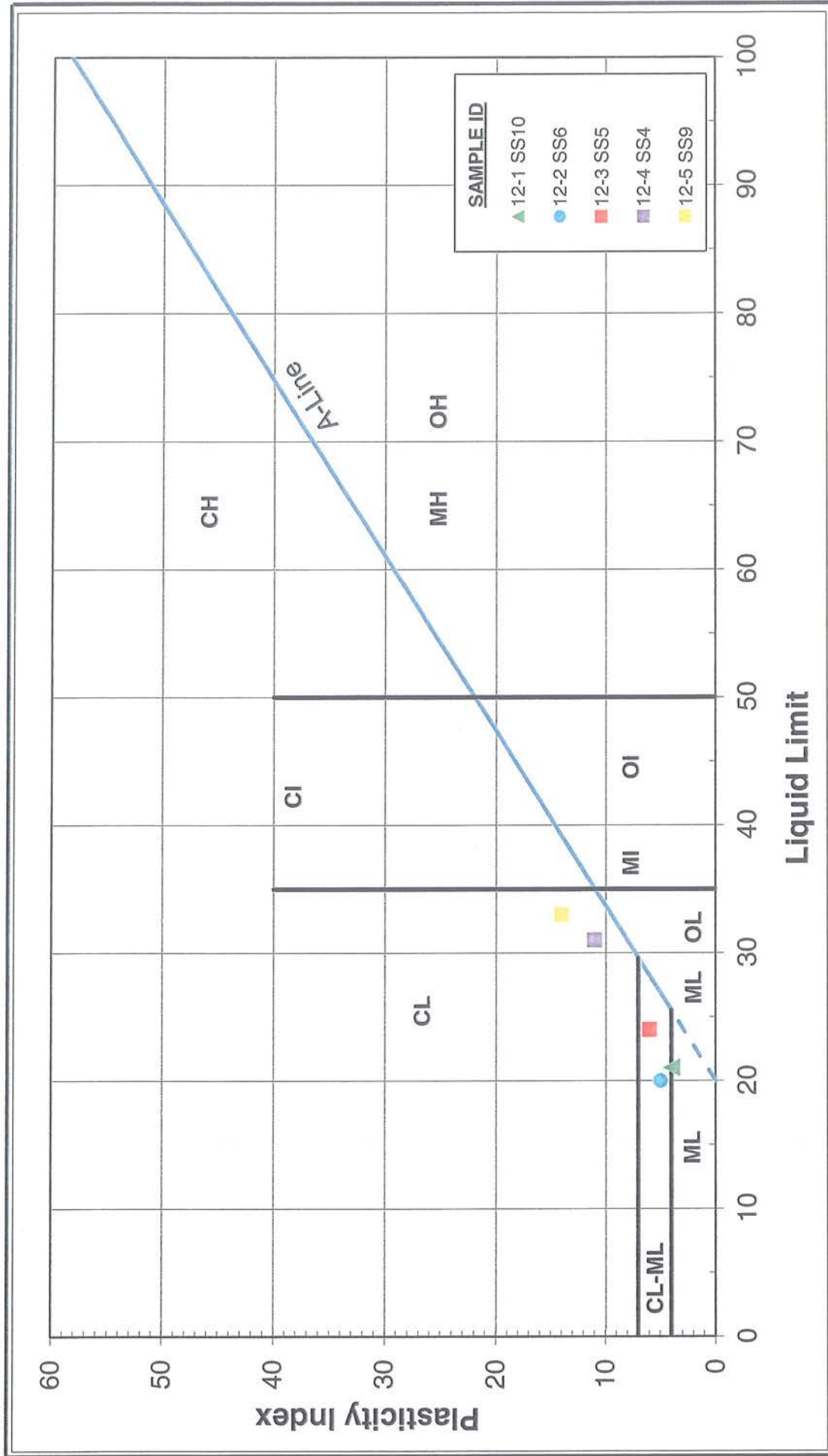
Sandy Silt TILL

Figure No. 5

Project No. 165000773



Stantec



# PLASTICITY CHART

Figure No. 6

Project No. 165000773