Peto MacCallum Ltd.
CONSULTING ENGINEERS

FOUNDATION INVESTIGATION REPORT
for
HIGHWAY 400 BAYFIELD STREET STORM DRAIN INSTALLATION AND CULVERT EXTENSION
RETAINER ASSIGNMENT – TASK NO. 2013-E-0039-002
BARRIE, ONTARIO
G.W.P. 2100-13-00

PREPARED FOR MINISTRY OF TRANSPORTATION OF ONTARIO

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PML Ref.: 14TF010
Index No.: 010FIR
GEOCRES No.: 31D-582
November 17, 2014

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CONSULTING ENGINEERS

FOUNDATION INVESTIGATION REPORT
for
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Retainer Assignment – Task No. 2013-E-0039-002
Barrie, Ontario
GWP 2100-13-00

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1. INTRODUCTION

This report summarizes the results of a foundation investigation carried out on Highway 400 near Bayfield Street for the installation of a new storm sewer, replacement of an existing storm sewer and extension of an existing culvert. The site is located in the City of Barrie, Ontario. The study was carried out by Peto MacCallum Ltd. (PML) for the Ministry of Transportation of Ontario (MTO).

The purpose of this report is to summarize the subsurface stratigraphy encountered at the site of the proposed works during the investigation.

2. SITE DESCRIPTION AND GEOLOGY

The site lies on the west side of Highway 400 between the Highway 400 southbound E/W-S ramp at Bayfield Street and Sunnidale Road in the City of Barrie. Land use in the vicinity of the site includes the Highway 400 transportation corridor, a stormwater control facility with a large berm west of the transportation corridor and dense stands of trees beyond the berm to the west. A channel from the stormwater control facility extends between the existing box culvert under Highway 400 and the stormwater control facility culvert outlet.

The local topography is undulating but generally governed by the Highway 400 transportation corridor. The ground surface is generally slopes downwards from the north to the south and also slopes downwards both east and west of the existing Highway 400 embankment. West of Highway 400 ditch line the ground slopes upwards towards the top of the large berm.

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BARRIE, HAMILTON, KITCHENER, TORONTO

The project site is located within the physiographic region known as the Simcoe Uplands. The Simcoe Uplands comprise a series of broad, rolling glacial till plains (locally sand till), separated by steep-sided flat floored valleys.

3. INVESTIGATION PROCEDURES

The field work for this study was carried out on July 13, 2014 and comprised 4 boreholes drilled to depths of 3.4 to 3.5 m for the proposed storm drain installation (BH's 2 to 5 inclusive), and 2 boreholes drilled to depths of 9.6 and 19.1 m for the proposed culvert extension and storm sewer replacement (BH's 1 and 1A). The locations of the boreholes are shown on appended Drawings B-1 and B-2.

The borehole locations were strategically located to provide soils data for the proposed works while minimizing the impact on the existing Highway 400 traffic. The borehole locations and elevations were surveyed in the field by Rudy Mak Surveying. All elevations in this report are expressed in metres.

The boreholes were advanced using continuous flight solid or hollow stem augers advanced with a track or truck-mounted D-50 drill rig supplied and operated by a specialist drilling contractor, working under the full-time supervision of a PML field technician.

Standard penetration tests and dynamic cone penetration test were conducted to assess the strength characteristics of the substrata. Soil samples were recovered from the boreholes at regular 0.75 and 1.5 m intervals following standard penetration testing. Soils were identified in accordance with MTO soil classification manual procedures.

The groundwater conditions in the boreholes were assessed during drilling by visual examination of the soil, the sampler and drill rods as the samples were retrieved.

The boreholes were backfilled with a bentonite/grout mixture, where required, in accordance with the MTO guidelines and MOE Reg. 903 for borehole abandonment procedures.

The recovered soil samples were returned to our laboratory in Toronto for detailed visual examination, laboratory testing and classification. The laboratory testing program included the following tests:

- Natural moisture content determinations (46)
- Grain size distribution analyses (11)
- Atterberg limit test (3)

The figures prepared to present the results of the laboratory grain size distribution analyses and Atterberg Limit Test are presented in Figures B-GS-1 to B-GS-5 and B-PC-1 to B-PC-2, respectively. The test results are summarized on the Record of Borehole sheets.

4. SUMMARIZED SUBSURFACE CONDITIONS

Reference is made to the appended Record of Borehole sheets 1A and 1 to 5 for details of the subsurface conditions including soil classifications, inferred stratigraphy, standard penetration test data, dynamic cone penetration test data and groundwater observations. The results of laboratory grain size distribution analyses, Atterberg limit test and moisture content determinations are also shown on the Record of Borehole sheets.

The borehole locations and stratigraphic profile prepared from the borehole data are shown on Drawings B-1 and B-2. The boundaries between soil strata have been established at the borehole locations only. Between and beyond the boreholes, these boundaries are assumed and may vary.

In summary, the subsurface stratigraphy revealed in borehole 1A drilled at the culvert extension location, comprised a 1.4 m thick surficial silty sand and topsoil layer over a 3.3 m thick compact sand deposit, above a 4.9 m thick very stiff clayey silt deposit. At the embankment location, directly east of the proposed culvert extension, borehole 1 revealed a 10 m thick compact to dense sand fill layer, above a 2.5 m thick very stiff clayey silt layer, overlying an approximately 7.6 m thick compact to very dense sand deposit. At the location of the culvert extension, the slope is covered by large boulders with diameters in the order of 1 m.

Boreholes 2 to 5, drilled for the proposed storm drain along the Hwy 400 west shoulder generally revealed pavement structure (locally topsoil in borehole 5) over sand or sand till to the 3.4 to 3.5 m exploration depth.

Details of the soil stratigraphy are provided below:

4.1 Pavement Structure

The pavement structure encountered in boreholes 1 to 4 which were drilled through Highway 400 and the Highway 400 E/W-S ramp, included 150 and 250 mm of asphaltic concrete, underlain by 520 to 650 mm of sand and gravel.

4.2 Topsoil

A 100 mm thick layer of topsoil was encountered at the surface at BH#5 and extended to elevation 259.9. A 400 mm thick layer of topsoil was also encountered beneath the silty sand fill at 1.0 m (elevation 244.1) at BH#1A that extended to a for a thickness of 1.4 m (to elevation 243.7).

4.3 Fill

A 0.7 to 9.1 m thick fill unit was encountered beneath the pavement structure at depths of 0.7 and 0.9 m (elevation 254.7 and 251.5) in boreholes 2 and 1, respectively. The fill was also contacted beneath the topsoil at a depth of 0.1 m (elevation 259.9) in borehole 5 and surficially in borehole 1A. The fill unit extended for a thickness of approximately 10.0 m (elevation 242.4) in borehole 1 and for thicknesses ranging from 0.5 m to 1.4 m (elevation 244.1 to 259.5) in boreholes 1A, 2 and 5. The fill was typically loose to compact, with SPT-'N' values ranging from 7 to 28. However the fill was locally very loose and dense in borehole 1 and 1A. The fill was moist to wet with moisture contents of 5 to 23%. Clayey silt layers, topsoil layers, cobbles and boulders and organic inclusions were noted within the fill. The results of an Atterberg Limit Test performed on a sample

of the fill is presented on Figure B-PC-1 and the results of grain size distribution analyses performed on 4 samples of the fill are presented on Figures B-GS-1 and B-GS-2.

4.4 Clayey Silt

A 2.5 and 4.9 m thick clayey silt deposit was contacted beneath the fill at depth of 10.0 m (elevation 242.4) in borehole 1 and beneath the sand at a depth of 4.7 m (elevation 240.4) in borehole 1A. The clayey silt extended to a depth of 12.5 m (elevation 239.9) in borehole 1 and to a depth of greater than 9.6 m (below elevation 235.5), which was the termination depth in borehole 1A. The clayey silt was typically very stiff (locally hard at the bottom of borehole 1A) with SPT-'N' values of ranging from 17 to 27.

The results of grain size distribution analyses and Atterberg Limit Tests performed on two samples of the clayey silt are presented on Figures B-GS-3 and B-PC-2, respectively. Atterberg Limit Testing indicated that the clayey silt had liquid limits ranging from 25 to 28, plastic limits ranging from 14 to 15, and plasticity indices ranging from 11 to 13. The moisture content of the clayey silt was between the plastic limit and liquid limit with moisture contents ranging from 18 to 24%.

4.5 Sand

A 2.1 to 6.6 m thick sand deposit was contacted beneath the clayey silt at a depth of 12.5 m (elevation 239.9) in borehole 1, beneath the topsoil at a depth of 1.4 m (elevation 243.7) in borehole 1A and beneath the fill at a depth of 1.4 m (elevation 254.0) in borehole 2. The sand extended to the clayey silt at 4.7 m (elevation 240.4) in borehole 1A and to the 3.5 and 19.1 m (elevation 251.9 and 233.3) exploration depth in boreholes 2 and 1, respectively. The sand was loose to very dense with SPT-'N' values of 8 blows to 83 blows for 23 cm. The material was wet in boreholes 1 and 1A (moisture contents ranging from 18 to 23%) and moist in borehole 2 (moisture contents ranging from 3 to 6%). The results grain size distribution analyses performed on 3 samples of the sand are presented on Figure B-GS-4.

4.6 Sand Till

A 2.7 to 3.0 m thick sand till layer was contacted beneath the pavement structure at depths of 0.5 and 0.7 m (elevations 256.1 to 259.5) in boreholes 3 to 5 that extended to depths of 3.4 to 3.5 m (elevation 253.4 to 256.5, which was the borehole exploration depth. The till was typically compact to very dense, although locally loose in the upper portion of the layer in borehole 5, with SPT-'N' values typically between 21 and 106. The till was moist, having moisture contents of 3 to 14%. Cobbles and boulders were noted within the layer. The results of grain size distribution analyses performed on 3 samples of the layers are presented on Figure B-GS-5.

4.7 Groundwater

In the process of augering, water strikes were observed at depths of 1.5 and 8.8 m (elevation 243.6) and in boreholes 1A and 1 respectively. Upon completion of augering, groundwater was measured at a depth of 1.5 m (elevation 243.6) in boreholes 1A.

The water level in the stormwater drainage channel at the location of the proposed culvert extension and adjacent to borehole 1A was at elevation 243.7 on July 13, 2014.

The groundwater levels at the site are subject to seasonal fluctuation.

5. CLOSURE

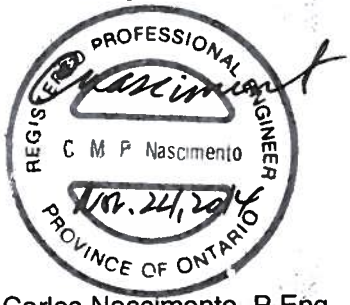
Mr. A. Lo and Mr. P. Portela carried out the field investigation for this study under the supervision of Mr. A. DeSira, MEng, P.Eng. Walker Drilling supplied the drill rig for the subsurface exploration. The laboratory testing of the selected samples was carried out in the PML laboratory in Toronto.

This Foundation Investigation report was prepared by Mr. A. DeSira, MEng, P.Eng., and reviewed by Mr. D. Dundas, P.Eng. Mr. C. M. P. Nascimento, P. Eng., Project Manager and MTO Designated Principal Contact conducted a quality review of the report.

Yours very truly

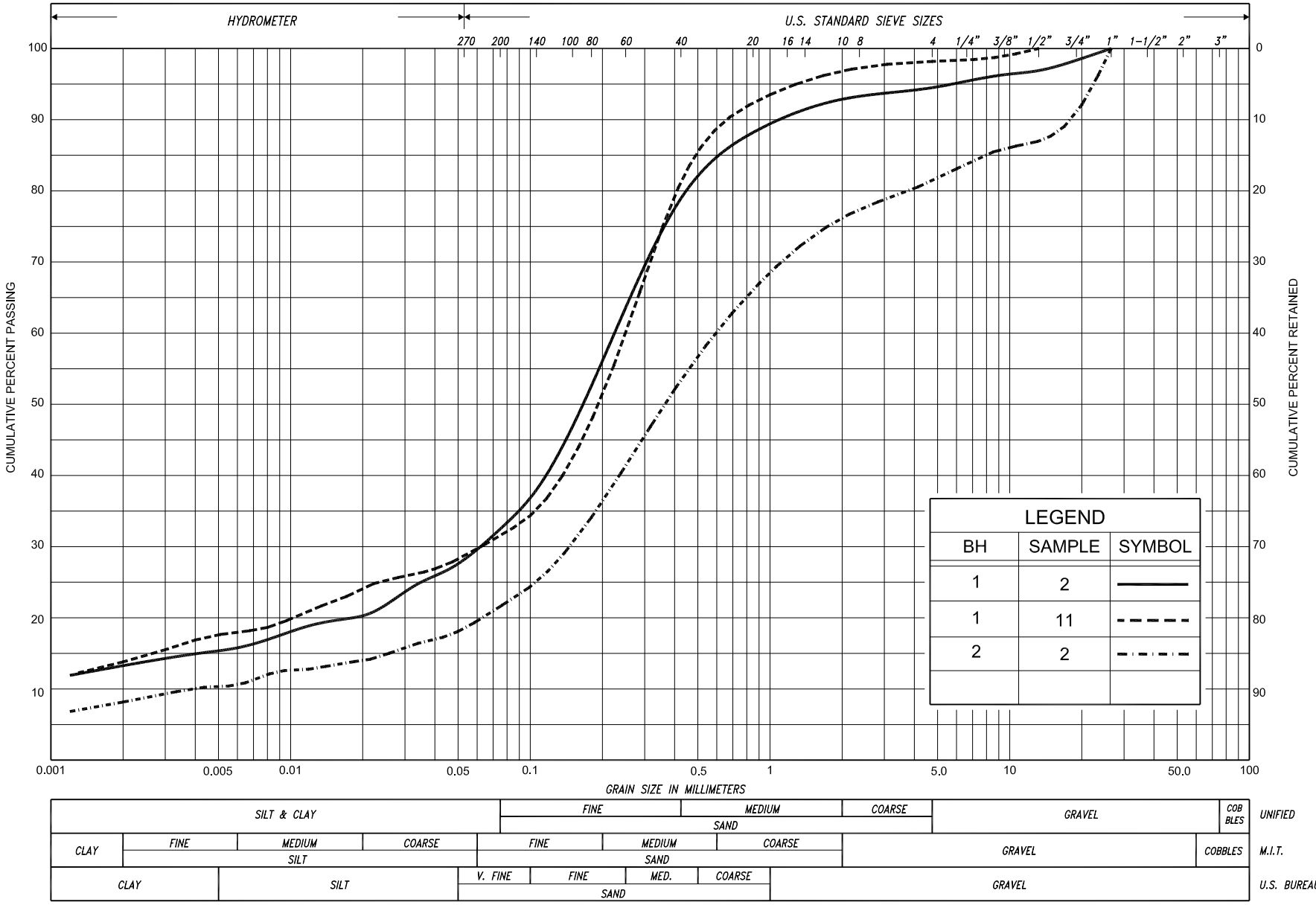
Peto MacCallum Ltd.

David Dundas, P.Eng.
Senior Engineer, Geotechnical Services



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

AD/CN:ad-mi-nk

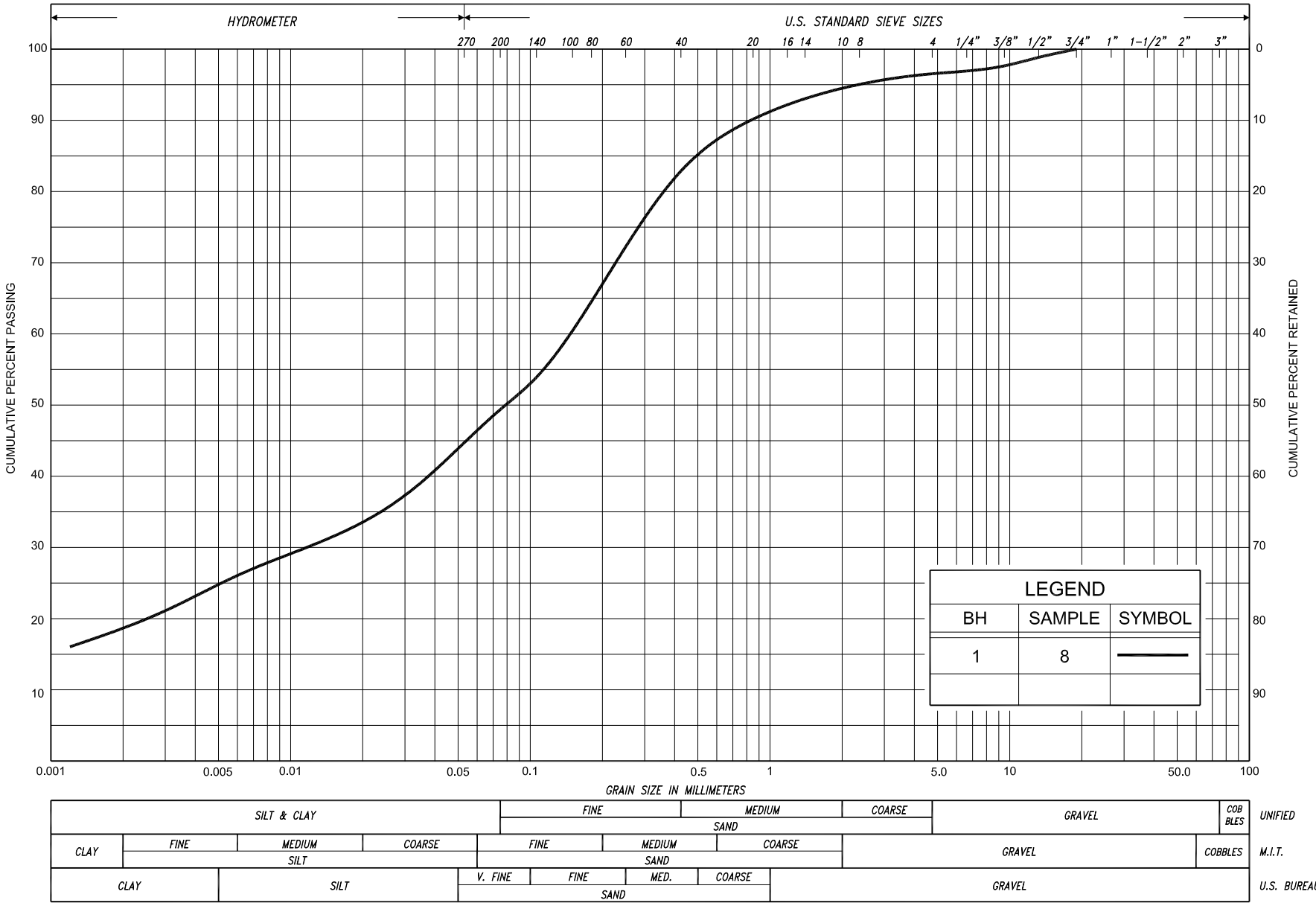


Ontario

GRAIN SIZE DISTRIBUTION

SAND, some silt, trace to some clay, trace to some gravel
(FILL)

FIG No.	B-GS-1
HWY:	400
W.P. No.	2100-13-00

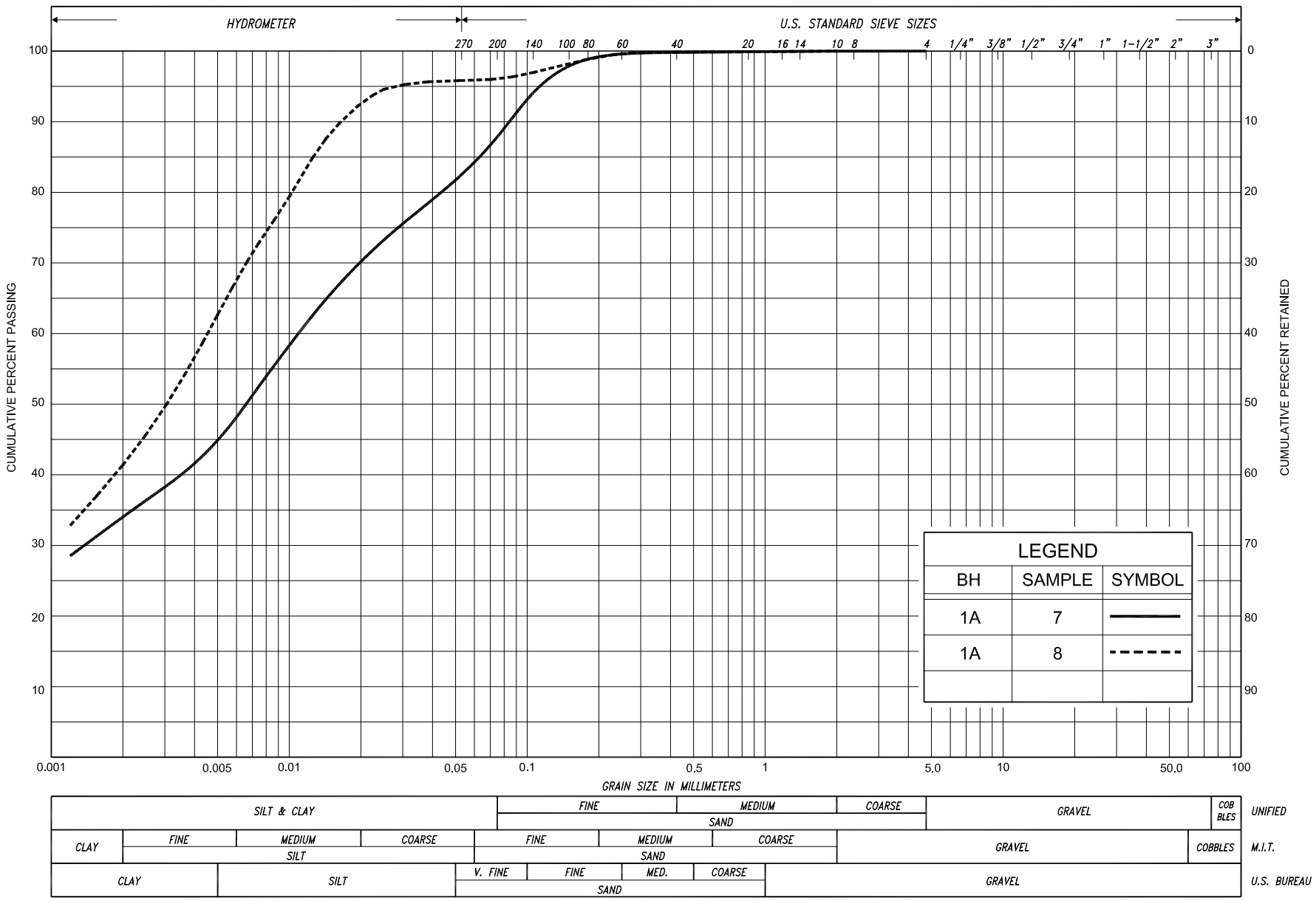


Ontario

GRAIN SIZE DISTRIBUTION

SANDY CLAYEY SILT, trace gravel (CL-ML)
(FILL)

FIG No.	B-GS-2
HWY:	400
W.P. No.	2100-13-00

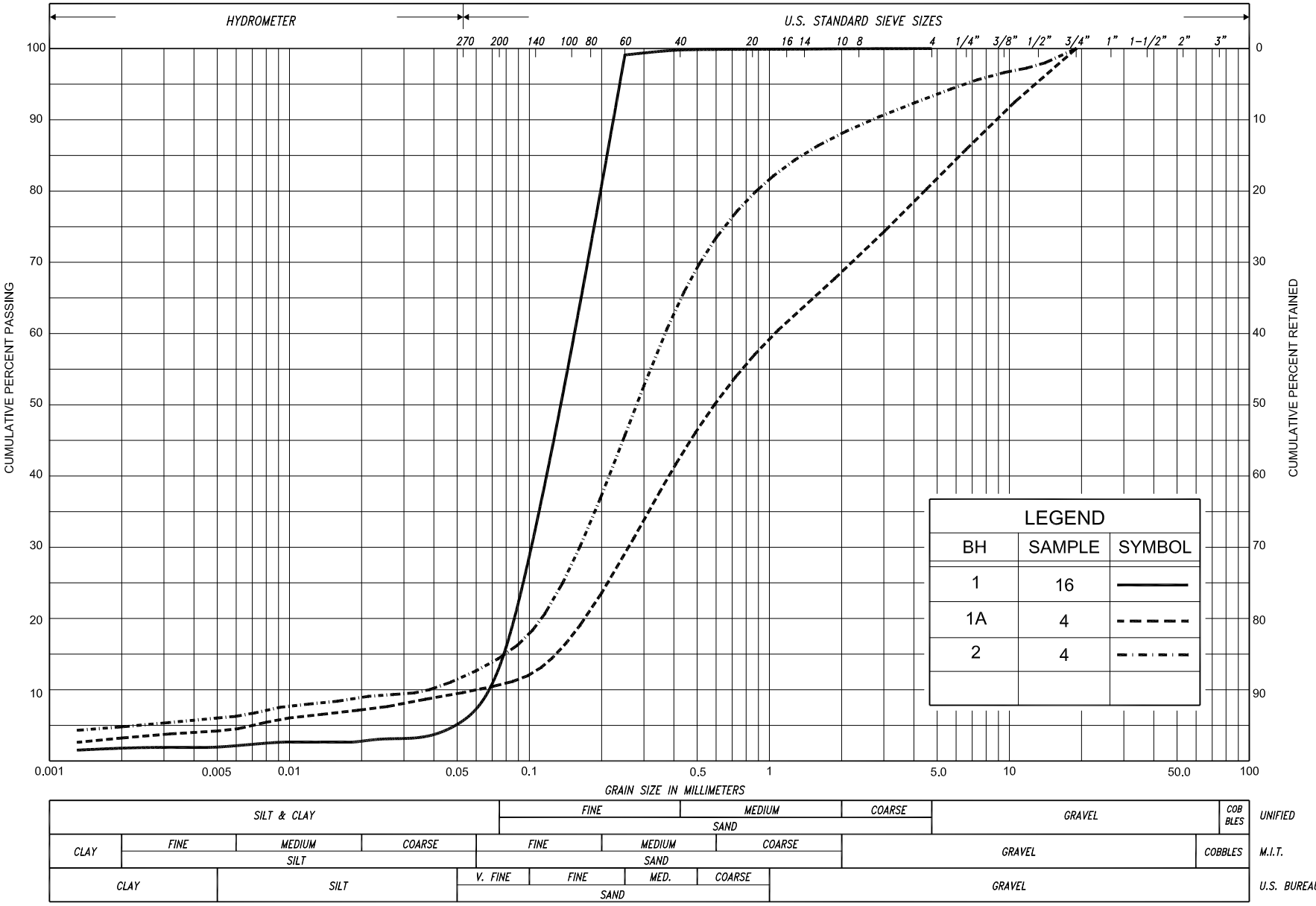


Ontario

GRAIN SIZE DISTRIBUTION

CLAYEY SILT, trace to some sand (CL)

FIG No.	B-GS-3
HWY:	400
W.P. No.	2100-13-00

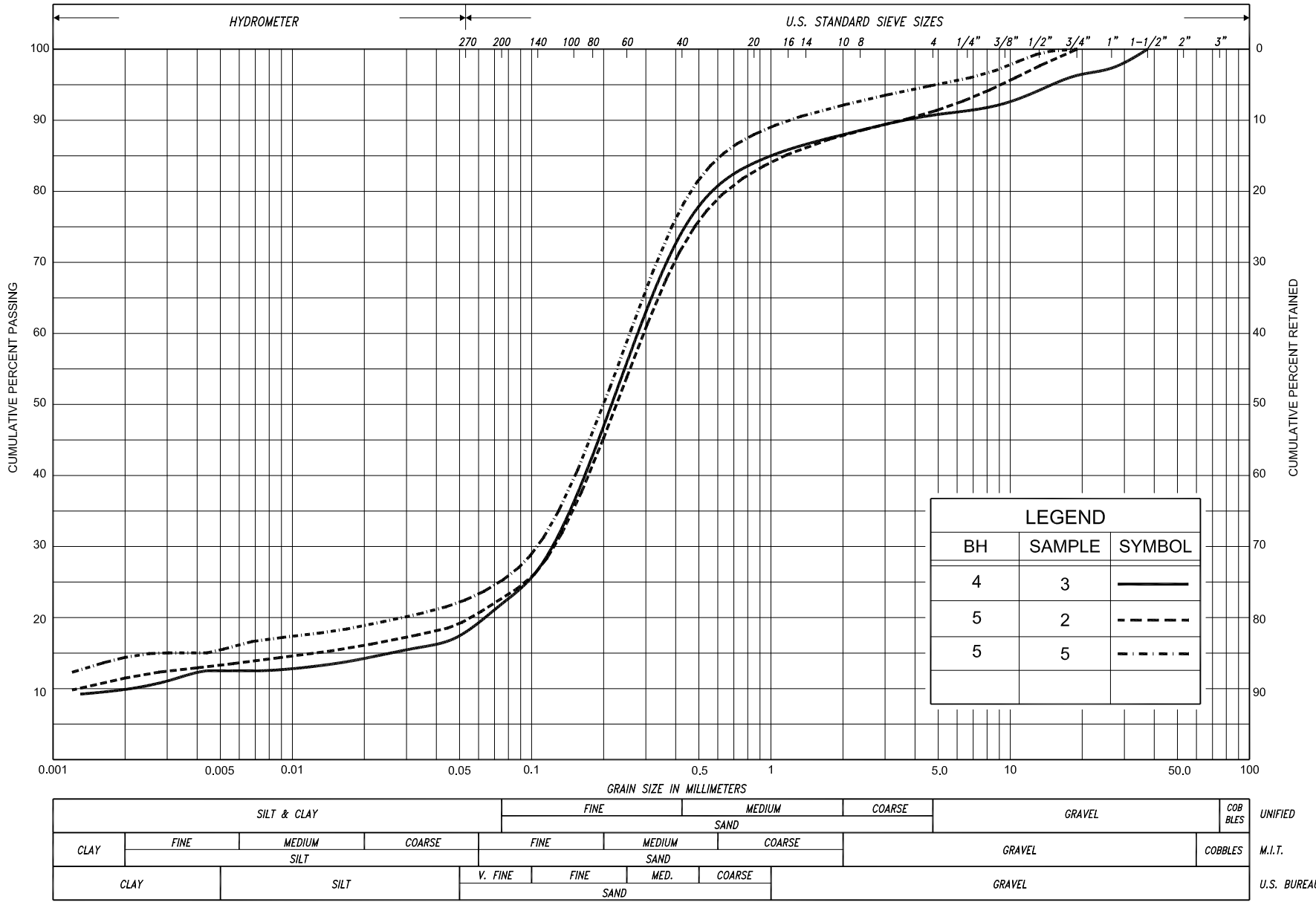


Ontario

GRAIN SIZE DISTRIBUTION

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

FIG No.	B-GS-4
HWY:	400
W.P. No.	2100-13-00

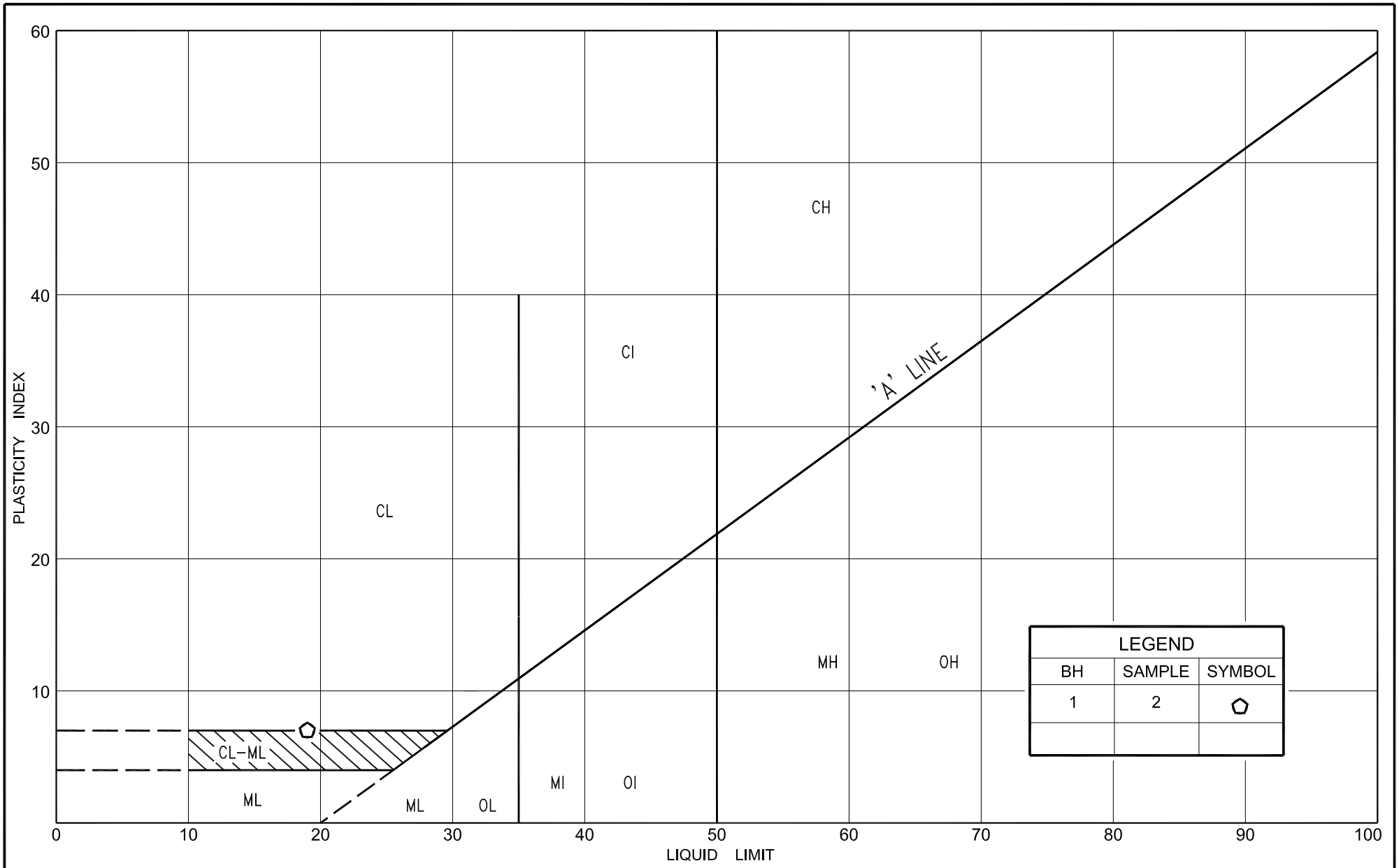


Ontario

GRAIN SIZE DISTRIBUTION

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

FIG No.	B-GS-5
HWY:	400
W.P. No.	2100-13-00

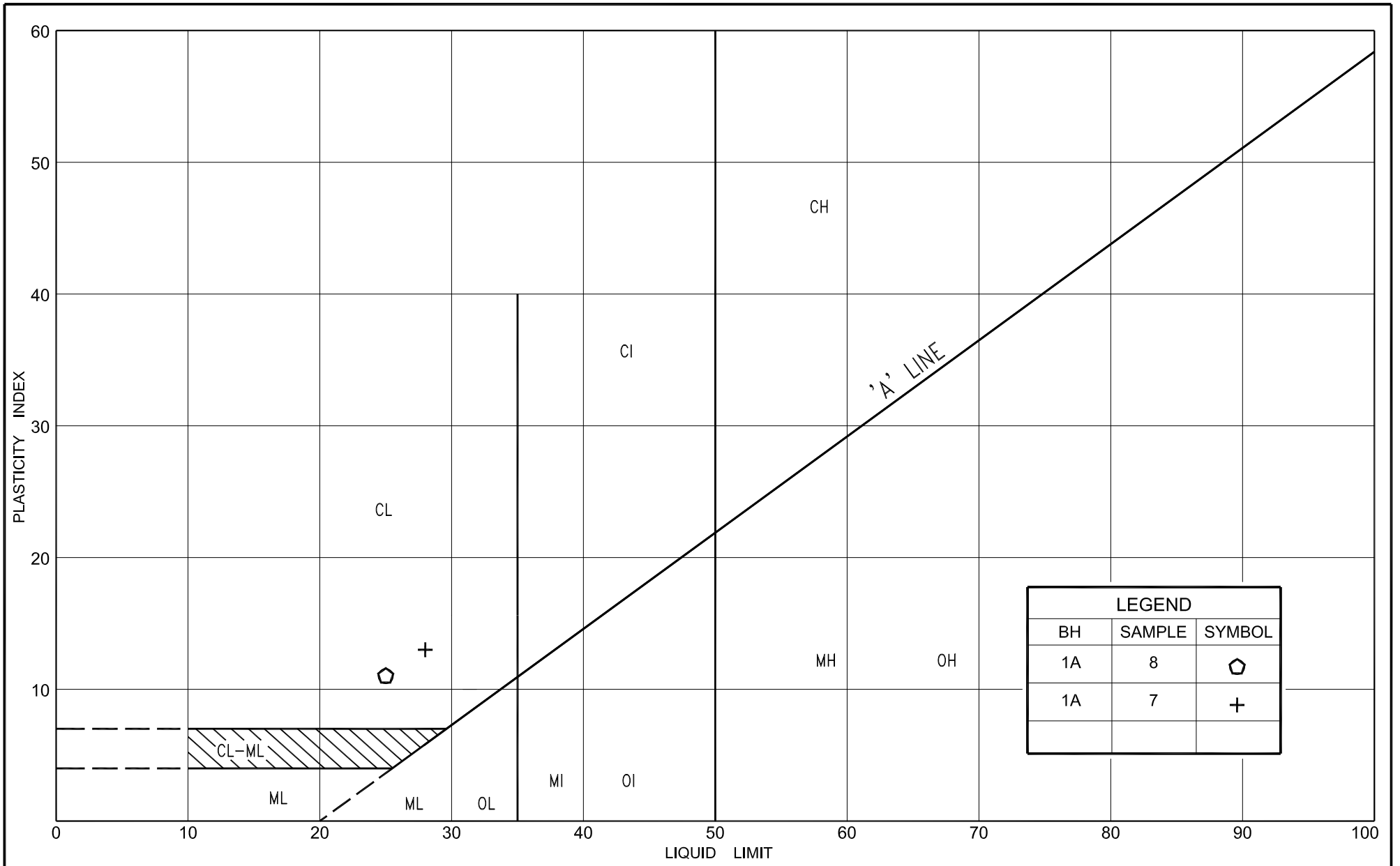


Ontario

PLASTICITY CHART

SANDY CLAYEY SILT, trace gravel (CL-ML)
(FILL)

FIG No.	B-PC-1
HWY:	400
W.P. No.	2100-13-00



Ontario

PLASTICITY CHART

CLAYEY SILT, trace to some sand (CL)

FIG No.	BR-PC-2
HWY:	400
W.P. No.	2100-13-00

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
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	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_α	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
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL
γ'	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

Ontario

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Foundation Design

RECORD OF BOREHOLE No. 1 1 of 2 METRIC

G.W.P. 2100-13-00 **LOCATION** Co-ords. 4 917 125.1 N ; 288 637.8 E **ORIGINATED BY** A.L.

DIST Central **HWY** 400 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

DATUM Geodetic **DATE** July 13, 2014 **CHECKED BY** D.D.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
252.4	Ground Surface							
0.0	250mm aspahlt over 650mm sand and gravel							
	(PAVEMENT FILL)							
251.5								
0.9	Sand, some silt some clay, trace gravel cobbles and boulders		1	SS	18		252	
	Dense to compact Brown/ grey Moist		2	SS	47		251	6 61 19 14
			3	SS	28		250	
	clayey silt layer		4	SS	14		249	
			5	SS	22		248	
	sand layer topsoil inclusions							
	Black		6	SS	16			
	clayey silt seams/layer		7	SS	18		247	
	clayey silt layer		8	SS	17		246	3 48 31 18
	Wet		9	SS	33		245	
			10	SS	15			
			11	SS	3**	▽*	244	2 66 18 14
	Organic sand							
	Black (FILL)		12	SS	31		243	
242.4								
10.0	Clayey silt, trace sand Very stiff Grey Moist		13	SS	17		242	
			14	SS	18		241	
239.9			15	SS	22		240	
12.5	Sand some silt, trace clay Compact Grey Wet						239	
			16	SS	30		238	0 87 11 2
	Cont'd							

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

ON MTO_VER3 NEW LOGO 14TF010.GPJ ON_MOT.GDT 10/14/2014 9:33:51 AM

+7 , ×5 : Numbers refer to Sensitivity

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

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RECORD OF BOREHOLE No. 1 2 of 2 METRIC

G.W.P. 2100-13-00 **LOCATION** Co-ords. 4 917 125.1 N ; 288 637.8 E **ORIGINATED BY** A.L.

DIST Central **HWY** 400 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** A.D.

DATUM Geodetic **DATE** July 13, 2014 **CHECKED BY** D.D.

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
237.4	Sand, some silt Compact Grey Wet (Cont'd.)		17	SS	11		237		○		
	Very dense		18	SS	83/23cm		236		○		
							235				
233.5			19	SS	17**		234		○		
18.9	End of borehole							120/23cm			
233.3 19.1	Switched to dynamic cone penetration test Probable sand Very dense End of dynamic cone penetration test										

* 2014 07 13

▽ Water level observed during drilling

** Low 'N' values due to possible hydraulic disturbance 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. 1A 1 of 1 METRIC

G.W.P. 2100-13-00 **LOCATION** Co-ords. 4 917 133.1 N ; 288 616.7 E **ORIGINATED BY** F.P.

DIST Central **HWY** 400 **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** A.D.

DATUM Geodetic **DATE** July 13, 2014 **CHECKED BY** D.D.

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
245.1	Ground Surface						245				
0.0	Silty sand topsoil and clayey silt inclusions (FILL)		1	SS	1				○		
244.1											
1.0	Topsoil		2	SS	4		244		○		
243.7						▽* ▼*					
1.4	Sand, some gravel trace silt, trace clay Loose to compact Grey Wet		3	SS	18						
			4	SS	29		243		○		19 70 8 3
			5	SS	8		242				
			6	SS	14		241		○		
240.4											
4.7	Clayey silt trace to some sand Very stiff Grey Moist		7	SS	20		240		⊢○⊣		0 12 54 34
			8	SS	23		239		⊢○⊣		0 4 54 42
			9	SS	27		238				
	Hard						237		○		
			10	SS	61		236		○		
235.5											
9.6	End of borehole										

* 2014 07 14

▽ 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 BOREHOLE No. 2 1 of 1 METRIC

G.W.P. 2100-13-00 **LOCATION** Co-ords. 4 917 249.8 N ; 288 705.0 E **ORIGINATED BY** F.P.

DIST Central **HWY** 400 **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** A.D.

DATUM Geodetic **DATE** July 13, 2014 **CHECKED BY** D.D.

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
255.4	Ground Surface										
0.0	180mm asphalt over 520mm sand and gravel										
254.7	(PAVEMENT FILL)		1	SS	14		255		○		
0.7	Sand, some silt some gravel, trace clay		2	SS	9				○		18 60 14 8
254.0	Compact Brown Moist to loose										
1.4	(FILL)										
	Sand, trace silt trace clay, trace gravel		3	SS	17		254		○		
	Compact to Grey Moist very dense										
			4	SS	32		253		○		7 79 9 5
			5	SS	58		252		○		
251.9											
3.5	End of borehole										
	Refusal on probable bedrock										
	* Borehole dry										

+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. 3 1 of 1 METRIC

G.W.P. 2100-13-00 **LOCATION** Co-ords. 4 917 307.2 N ; 288 737.2 E **ORIGINATED BY** F.P.

DIST Central **HWY** 400 **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** A.D.

DATUM Geodetic **DATE** July 13, 2014 **CHECKED BY** D.D.

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
256.8	Ground Surface										
0.0	150mm asphalt over 550mm sand and gravel		1	SS	21				○		
256.1	(PAVEMENT FILL)										
0.7	Sand, some silt some clay, trace gravel sand layers		2	SS	21		256		○		
	Compact to Grey Moist very dense		3	SS	79		255		○		
	(TILL)		4	SS	106		254		○		
	clayey silt layers		5	SS	60/15cm				○		
253.4											
3.4	End of borehole										

* Borehole dry

+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. 4 1 of 1 METRIC

G.W.P. 2100-13-00 **LOCATION** Co-ords. 4 917 371.3 N ; 288 771.9 E **ORIGINATED BY** F.P.

DIST Central **HWY** 400 **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** A.D.

DATUM Geodetic **DATE** July 13, 2014 **CHECKED BY** D.D.

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
258.2	Ground Surface										
0.0	150mm asphalt over 550mm sand and gravel						258				
257.5	(PAVEMENT FILL)		1	SS	14				○		
0.7	Sand, some silt some clay, trace gravel Dense to very dense Grey Moist		2	SS	49		257		○		
			3	SS	62				○		9 69 12 10
	(TILL)		4	SS	65		256		○		
254.7			5	SS	90		255		○		
3.5	End of borehole										

* Borehole dry

+7 , ×5 : Numbers refer to Sensitivity

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

Ontario

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Foundation Design

RECORD OF BOREHOLE No. 5 1 of 1 METRIC

G.W.P. 2100-13-00 **LOCATION** Co-ords. 4 917 443.4 N ; 288 807.5 E **ORIGINATED BY** F.P.

DIST Central **HWY** 400 **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** A.D.

DATUM Geodetic **DATE** July 13, 2014 **CHECKED BY** D.D.

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
260.0	Ground Surface										
259.9 / 0.1	Topsoil										
259.5 / 0.5	Silty sand topsoil inclusions Loose Brown Moist (FILL)		1	SS	7				○		
	Sand, some silt some clay, trace gravel Loose to very dense Grey Moist cobbles and boulders (TILL)		2	SS	7		259		○		9 68 11 12
			3	SS	20/8cm		258				
			4	SS	77				○		
							257				
256.5 / 3.5	End of borehole		5	SS	103				○		5 70 11 14

* Borehole dry

+7, ×5 : Numbers refer to Sensitivity

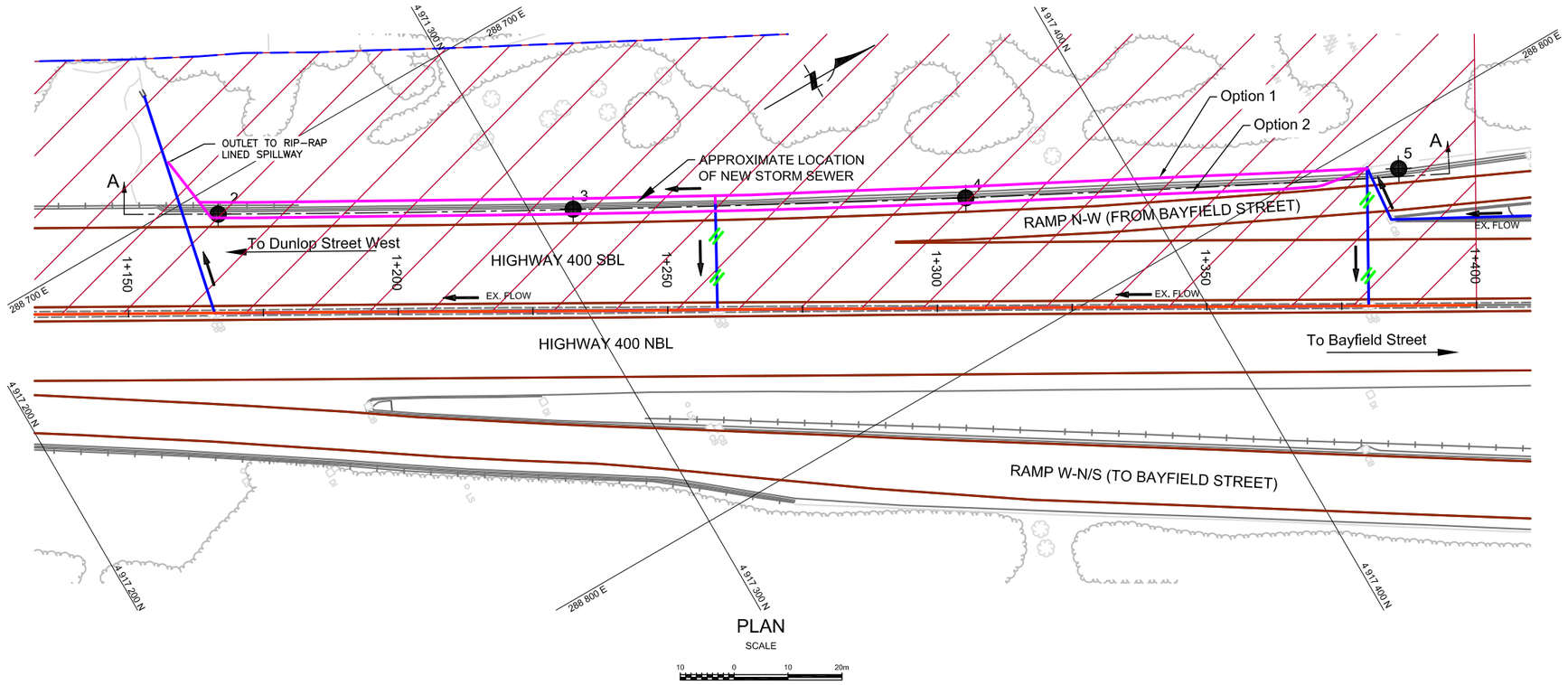
20 / 15 5 / 10 (%) STRAIN AT FAILURE

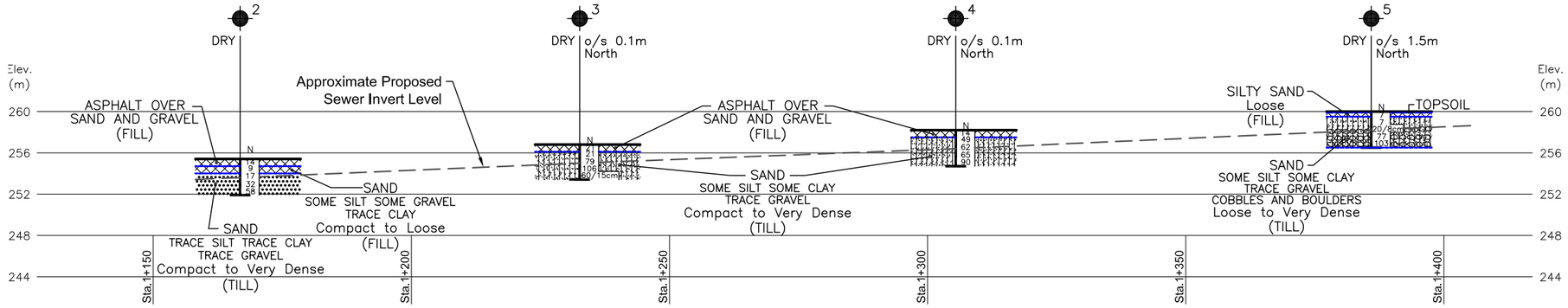
TASK No. 2013-E-0039-0002
WP No 2100-13-00

BAYFIELD STORM SEWER
HIGHWAY 400
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

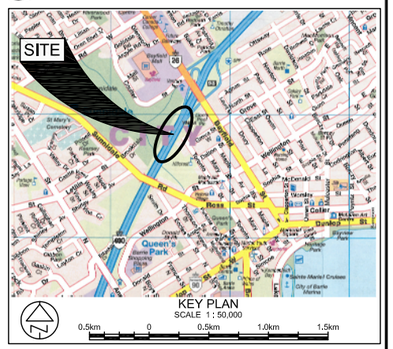
Peto MacCallum Ltd.
CONSULTING ENGINEERS





PROFILE A - A

SCALE
HORIZONTAL
10 0 10 20m
VERTICAL
5 0 5 10m



LEGEND

- Borehole
- Borehole and cone
- Cone penetration test
- N — Blows/0.3m (Std. Pen Test, 475 J/blow)
- CONE — Blows/0.3m (60° Cone, 475 J/blow)
- W L at time of investigation June 2014
- Head ARTESIAN WATER Encountered
- PIEZOMETER

BH No	ELEVATION	COORDINATES NORTHINGS	COORDINATES EASTINGS
2	255.4	4 917 249.8	288 705.0
3	256.8	4 917 307.2	288 737.2
4	258.2	4 917 371.3	288 771.9
5	260.0	4 917 443.4	288 807.5

NOTES:

1. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH RECORD OF BOREHOLES AND REPORT
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.

LICENSED PROFESSIONAL ENGINEER D. H. DUNDAS 2014 11 18 PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER C M P Nascimento Nov. 18, 2014 PROVINCE OF ONTARIO

Reference MTO Drawing:
Bayfield-Plan.dwg; and Base-Gray.dwg both undated

– 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. 31D-582

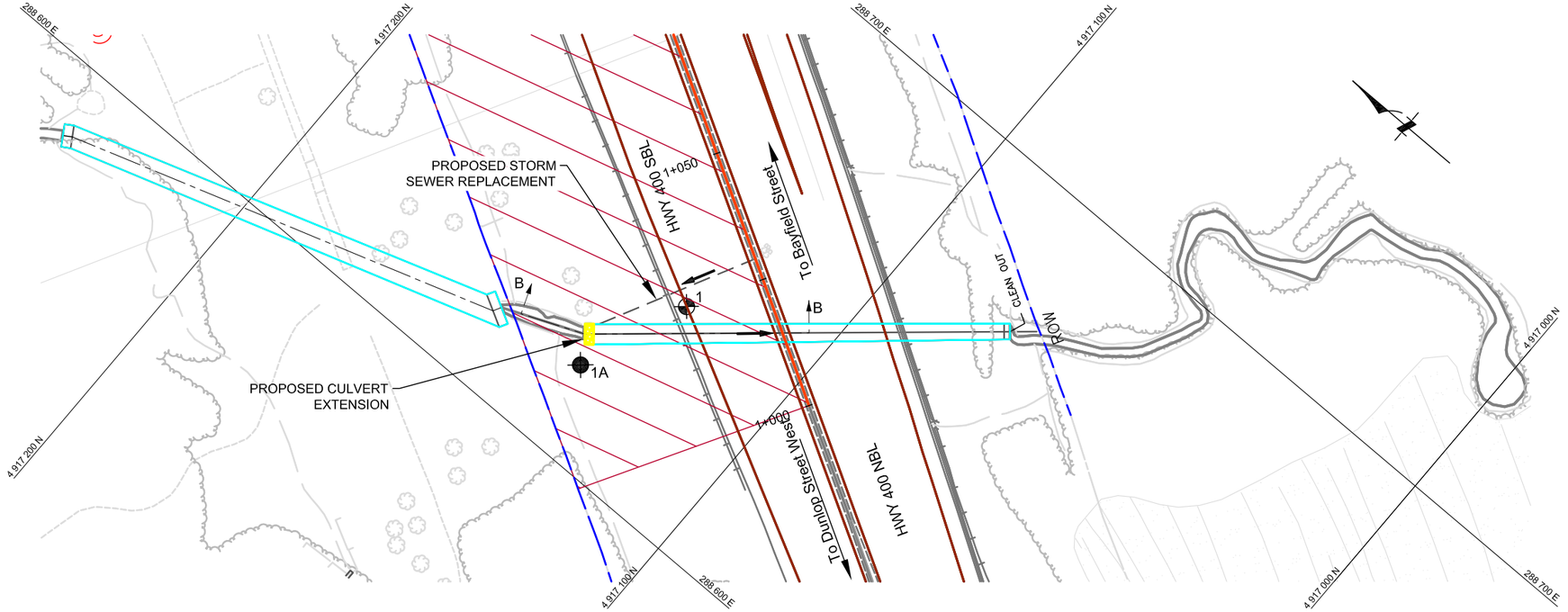
HWY No	400					DIST	CENTRAL
SUBM'D	NA	CHECKED	AD	DATE	NOV. 18, 2014	SITE	
DRAWN	NA	CHECKED	DD	APPROVED	CN	DWG	B-1

TASK No. 2013-E-0039-0002
WP No 2100-13-00

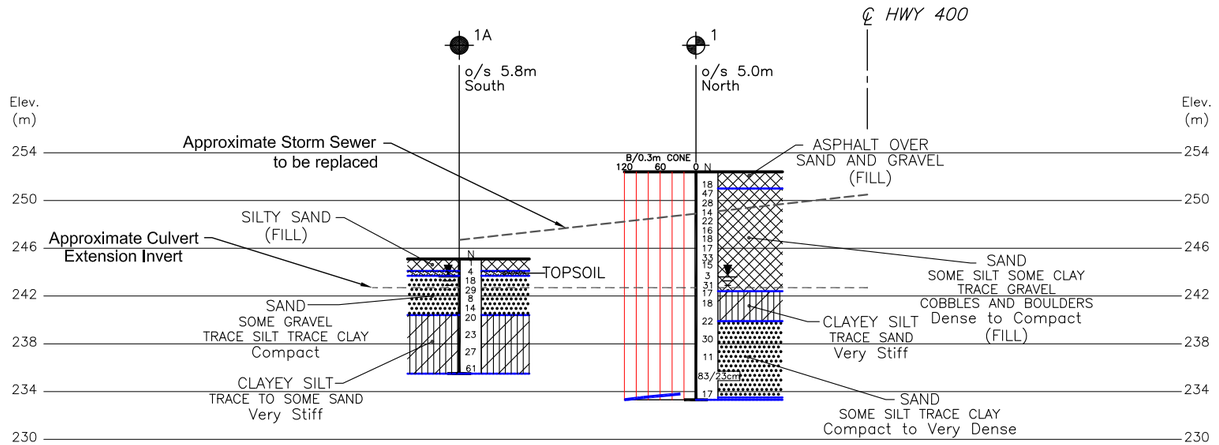
BAYFIELD STORM SEWER
HIGHWAY 400
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

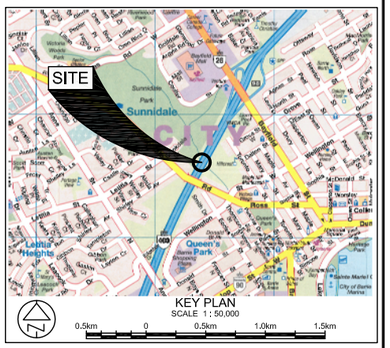
Peto MacCallum Ltd.
CONSULTING ENGINEERS



PLAN
SCALE
10 0 10 20m



PROFILE B - B ALONG ℄ CULVERT
SCALE
5 0 5 10m



LEGEND

- Borehole
- Borehole and cone
- Cone penetration test
- N — Blows/0.3m (Std. Pen Test, 475 J/blow)
- CONE — Blows/0.3m (60° Cone, 475 J/blow)
- W L at time of investigation June 2014
- Head
- ARTESIAN WATER Encountered
- PIEZOMETER

BH No	ELEVATION	COORDINATES NORTHINGS	EASTINGS
1	252.4	4 917 125.1	288 637.8
1A	245.1	4 917 133.1	288 616.7

NOTES:

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LICENSED PROFESSIONAL ENGINEER D. H. DUNDAS 2014 11 18 PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER C M P Nascimento Nov. 18, 2014 PROVINCE OF ONTARIO

Reference MTO Drawing:
Bayfield-Plan.dwg; and Base-Gray.dwg both undated

– NOTE –
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REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 31D-582

HWY No.	400			DIST	NORTH BAY
SUBM'D	NA	CHECKED	AD	SITE	
DRAWN	NA	CHECKED	DD	DWG	B-2
		DATE	NOV. 12, 2014	APPROVED	CN