FOUNDATION INVESTIGATION REPORT

for

RETAINING WALLS
HIGHWAY 7A
TOWNSHIP OF PORT PERRY, ONTARIO
AGREEMENT NO. 2013-E-0039
TASK NO. 2013-E-0039-008

PREPARED FOR MINISTRY OF TRANSPORTATION OF ONTARIO

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Peto MacCallum Ltd.
CONSULTING ENGINEERS

FOUNDATION INVESTIGATION REPORT
for
Retaining Walls
Highway 7A
Township of Port Perry, Ontario
Task No. 2013-E-0039-008

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1. INTRODUCTION

This report summarizes the results of the foundation investigation carried out for the detail design and construction for the replacement of four (4) retaining walls along Highway 7A in Port Perry, Ontario. The study was carried out by Peto MacCallum Ltd. (PML) for the Ministry of Transportation of Ontario (MTO).

A Site and Photograph Location Plan, Drawing RW-1 is attached within this report which indicates the location of each retaining wall and location and direction of each photograph that was taken with respect to each retaining wall. Site photographs indicated on the Site and Photograph Location plan are attached in Appendix FIR-A of this report. Borehole Locations and Soil Strata are shown on attached Drawings, PS-1, SS-1 and OS-1.

An internal MTO technical memorandum concerning the same retaining walls dated November 1, 1994, was reviewed and is attached in Appendix FIR-B of this report.

All elevations in this report are expressed in metres.

2. SITE DESCRIPTION AND RECONNAISSANCE SURVEY

Four retaining walls are to be replaced on Highway 7A between Ottawa Street and Perry Street in Port Perry, Ontario.

The details of each retaining wall identified for replacement can be found in the following table (Table 2).

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Table 2: Details of Existing Retaining Walls

RETAINING WALLS	WALL #	MTO SITE ID	LENGTH (m)	MAX HEIGHT (m)
Perry Street	Wall # 1 and 2	22-579/W, 22-580/W	32 and 11	1.25 and 0.75
Simcoe Street	Wall # 3	N/A	32	0.96
Ottawa Street	Wall # 4	22-578/W	78	1.35

Two of the retaining walls, which are the farthest east along Highway 7A are near each other and are designated as the Perry Street retaining walls. The retaining wall adjacent to Regional Road 2 (Simcoe Street) is designated as the Simcoe Street retaining wall. Lastly, the retaining wall which is the farthest west along Highway 7A is designated as the Ottawa Street retaining wall. The Ottawa Street and Perry Street retaining walls are on the north side of Highway 7A while the Simcoe Street retaining wall is on the south side of Highway 7A. These retaining walls are highlighted in green on the attached Site and Photograph Location Plan.

The site reconnaissance survey was carried out on April 16, 2015. Refer to Appendix FIR-A for the site photographs obtained on April 16 and subsequently on May 12 and 13, 2015 during the borehole drilling of each retaining wall. The site photos provide illustration of the existing slopes and drainage behind the existing walls.

Refer to the attached Borehole Locations and Soil Strata Drawing for illustration of existing above ground utilities, trees and fences in close proximity to the existing walls.

The existing retaining walls are of the modular precast concrete type, such as the Pisa Stone retaining walls. The typical precast concrete element (stone) is approximately 75 mm thick, 300 mm wide and 600 mm long. The walls retain the front and side yards of the respective lots to provide room for a concrete or asphalt sidewalk immediately in front of the retaining walls.

It is noted that the Ottawa Street retaining wall and sections of the Perry Street retaining wall were observed to have a forward lean while the other sections of the Perry Street and the Simcoe Street retaining walls were measured to stand nearly vertical.

According to the technical memorandum attached in Appendix FIR-B, the retaining walls were to be constructed at 1H:8V. Assuming that the walls were constructed as designed, it is concluded that the retaining walls have experienced some movement mostly within the upper portion of the walls.

The photographs attached in Appendix FIR-A illustrate the deterioration of the retaining walls and / or the layers of stones that comprise the walls.

The Ottawa Street retaining wall (photographs 1 to 4) experienced forward movement / sliding or possible overturning in the top four to five lifts of stone near the far west end of the wall, as these layers of stones have been removed (see photograph 1). Forward movement, spacing between stones and outward / forward leaning within the upper portion of the wall was observed throughout the reconnaissance and borehole investigation of the Ottawa Street retaining wall (see photographs 2, 3 and 4). The upper portion of the Ottawa Street retaining wall was measured to be leaning forward / outward at an approximate slope of 1H:10V. Based on photographs 2 and 3, this wall may have been raised by up to 6 rows of stones (450 mm) in the past. No visible weeping holes for drainage of water infiltration that may exist behind the retaining wall were observed, indicating that drainage is being made through the retaining wall stone spaces. The retaining wall also shows signs of missing and / or cracked stones and spacing between blocks near the east end of the walls.

The Simcoe Street retaining wall (photographs 5 to 8) was measured to be near vertical and shows evidence of deteriorated / cracked stones, loose stones that may have been removed and replaced (see photographs 6 to 8). Visible weeping holes were observed and noted at approximate 3 m intervals along the Simcoe Street retaining wall during the site reconnaissance.

The Perry Street retaining walls (photographs 9 to 12) were also measured to be near vertical with a section of the upper portion of the wall leaning forward at an approximate slope of 1H:15V. The stones illustrate deterioration as some stones have been removed while others show vertical cracking and spacing between the stones through which vegetation has grown (see photographs 9 to 11). No visible weeping holes for drainage of water that may exist behind the

retaining walls were observed during the investigation and reconnaissance of the Perry Street retaining walls.

3. SITE PHYSIOGRAPHY

The project site lies within the Port Perry urban area which overlies the Schomberg Clay Plain. The primary physiographic units represented in and around the Port Perry area are; the Oak Ridges Moraine located to the south and the Peterborough Drumlin Field located north of the Moraine, west of Port Perry, and to the east of Lake Scugog toward Peterborough. The soils are well drained Schomberg silty clay loam, imperfectly drained Smithfield silty clay loam, and poorly drained Simcoe silty clay and silt loams (Chapman and Putnam, 1984). These soil types are typical of glacial till plains.

4. INVESTIGATION PROCEDURES

The subsurface investigation for the retaining walls was carried out on May 12 and 13, 2015. A total of six boreholes were advanced behind the four retaining walls along Highway 7A. Refer to the following table (Table 4) for information pertaining to the boreholes advanced for each retaining wall.

Table 4: Details of Borehole Investigation

RETAINING WALL	LENGTH (m)	BOREHOLES	BOREHOLE DEPTH (m)
Perry Street	32 and 11	PS-1 and PS-2	2.9
Simcoe Street	32	SS-1 and SS-2	3.7 to 4.1
Ottawa Street	78	OS-1 and OS-2	3.7

All 6 boreholes were advanced behind the respective retaining walls to obtain information regarding the existing backfill material, groundwater conditions and the founding soil for each retaining wall. Refer to Drawings PS-1, SS-1 and OS-1 for the borehole locations and soil strata.

PML laid out the proposed borehole locations on site in order to organize and carry out the clearances of various underground services and utilities in the vicinity of the proposed borehole locations. Several of the boreholes needed relocation due to interference from underground and overhead services. All the required permission to enter and construct forms were completed and

obtained from the private property owners whose properties fall adjacent to the investigated retaining walls.

The Ottawa Street retaining wall had both boreholes relocated 2 to 3 m behind the retaining wall due to an untraceable asbestos cement watermain that exists approximately 1 m behind the retaining wall, according to The Regional Municipality of Durham Water Locate Department. In addition to the untraceable watermain, overhead utilities including existing hydro poles within 1 m behind the Ottawa Street retaining wall also caused the relocation of boreholes OS-1 and OS-2.

Similarly, borehole PS-2 required relocation due to a 1.2 m wide underground Bell conduit containing multiple ducts located within 1 m behind the retaining walls. Borehole PS-1 was drilled at the proposed location, directly behind the retaining wall, because there was sufficient clearance between the Bell conduit and the back of the retaining wall.

Boreholes SS-1 and SS-2 were relocated from directly behind the wall to 0.8 m behind the retaining wall due to the requirement to maintain the required minimum separation from the overhead utilities including the presence of hydro poles located approximately 1 m in front of the retaining wall.

After completion of the investigation Coe Fisher Cameron Surveyors, a wholly owned subsidiary of J.D. Barnes Limited, determined the coordinates and ground surface elevations of the borehole locations. All elevations in this report are expressed in metres and are referred to the geodetic datum.

Boreholes OS-1, OS-2, PS-1 and PS-2 were advanced using a manual hammer while boreholes SS-1 and SS-2 were advanced using continuous flight solid stem augers, powered by a track mounted 7822DT Geoprobe, supplied and operated by a specialist drilling subcontractor, working under the full-time supervision of a member of the PML engineering staff.

Representative samples of the soils were recovered in the boreholes at depth intervals of 0.75 m. The soil samples were obtained using a split spoon sampler in conjunction with standard

penetration tests. A single in situ vane shear testing was also performed in borehole SS-2 to assess the shear strength of a layer of the cohesive soils.

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 upon completion of drilling. The water level observations are noted on the attached record of boreholes and in subsequent sections of this report.

All boreholes were backfilled in accordance with the MTO guidelines and MOE Reg. 903 for borehole abandonment procedures.

Soils were identified in the field in accordance with the MTO Soil Classification procedures. Recovered soil samples were returned to the PML laboratory in Toronto for detailed visual examination, moisture content determination and soil classification. Laboratory testing including grain size distribution analyses, hydrometer analyses, Atterberg limits testing and specific gravity determination was conducted at the MTO laboratory at the Downsview complex. The laboratory testing program comprised the following tests:

- Natural moisture content determinations (28)
- Grain size distribution analyses (9)
- Hydrometer analyses (8)
- Atterberg limits (8)

The results of the laboratory natural moisture content determinations, grain size distribution analyses and Atterberg limits are shown on the Record of Borehole sheets. The grain size distribution charts for the respective soil types are presented in Figures RW-GS-1 to RW-GS-4 and the Atterberg limits results for the respective soil types are presented in Figures RW-PC-1 to RW-PC-3. The results of Atterberg limits testing, moisture content determinations and frost susceptibility of the soils are listed in Table A.

5. SUMMARIZED SUBSURFACE CONDITIONS

5.1 General

Refer to the Record of Borehole sheets for the details of the subsurface conditions including soil classifications, inferred stratigraphy, soil boundary levels and groundwater observations.

The location of the Perry Street, Simcoe Street and Ottawa Street retaining wall structures are presented on the attached Drawing RW-1.

5.2 Perry Street Retaining Walls

Boreholes PS-1 and PS-2 were advanced behind the 32 and 11 m long retaining walls located within the vicinity of Perry Street. The soil stratigraphy revealed in the boreholes comprised topsoil and / or granular fill overlying cohesive deposits of clayey silt glacial till.

5.2.1 Topsoil

A 0.2 to 0.3 m thick surficial topsoil layer was encountered in boreholes PS-1 and PS-2. The topsoil layer extended to elevations 263.2 and 262.0 in boreholes PS-1 and PS-2 respectively.

5.2.2 Granular Fill

Underlying the topsoil at a depth of 0.3 m in borehole PS-1 was granular fill. The non-cohesive fill layer comprised sandy gravel with 17% silt and organics inclusions. The sandy gravel fill was loose to compact in relative density (SPT-'N' values of 5 to 21) and was penetrated at a depth of 1.8 m (elevation 261.7). The moisture content of the granular fill was determined to range between 2 and 21%. The higher moisture content is attributed to the organic inclusions contained within the fill deposit.

The results of the grain size distribution analysis performed on one sample of the sandy gravel fill in borehole PS-1 is presented in Figure RW-GS-1. The grain size distribution was plotted against the Granular A gradation requirement envelope for comparative purposes for acceptable backfill

material. The granular fill encountered in borehole PS-1 does not meet the requirements for acceptable backfill material due to higher than specified fines content of 17%, while the allowed range is between 5 and 8%.

5.2.3 Clayey Silt Till

Clayey silt glacial till was revealed below the granular fill in borehole PS-1 and below the topsoil in borehole PS-2. The clayey silt till was encountered at depths of 1.8 and 0.2 m (elevation 261.7 and 262.0) in boreholes PS-1 and PS-2 respectively. This stratum was stiff to hard in consistency (SPT-'N' values of 11 to 63) and had a moisture content ranging from 10 to 16%. With a measured thickness of 1.1 and 2.7 m, the clayey silt glacial till was not penetrated upon termination of the boreholes at a depth of 2.9 m (elevation 260.6 and 259.3) in boreholes PS-1 and PS-2 respectively.

The results of Atterberg limits testing and grain size distribution analyses conducted on two samples of clayey silt till from boreholes PS-1 and PS-2 are presented in respective Figures RW-GS-3 and RW-PC-2. The liquid and plastic limits of the clayey silt till in boreholes PS-1 and PS-2 ranged from 25 to 30 and from 15 to 16 respectively, with the plasticity index of 10 to 14.

The clayey silt glacial till in boreholes PS-1 and PS-2 was found to have a medium to high susceptibility to frost heave (MSFH-HSFH) based on the percentage of particles between the 75 and 5 µm sieves. The percentage of particles between the 75 and 5 µm sieves was found to be 43 and 57% based on the 2 samples tested. This medium to high susceptibility to frost heave could impact the performance of the retaining walls if this native soil exists behind the retaining structure at any location above the founding elevation. Refer to Table A for the material properties of the soil.

5.2.4 Groundwater

No groundwater was observed in any of the boreholes during or upon completion of drilling. However, it is noted that the groundwater levels are subjected to seasonal fluctuations and rainfall patterns.

5.3 Simcoe Street Retaining Wall

Boreholes SS-1 and SS-2 were advanced behind the 32 m long retaining wall located within the vicinity of Simcoe Street. The soil stratigraphy revealed in the boreholes comprised topsoil over sandy clayey silt fill overlying cohesive deposits of clayey silt glacial till.

5.3.1 Topsoil

A 0.2 to 0.3 m thick surficial topsoil layer was encountered in boreholes SS-1 and SS-2. The topsoil layer extended to elevations 263.5 and 263.2 in boreholes SS-1 and SS-2 respectively.

5.3.2 Fill

Underlying the topsoil at a depth of 0.2 and 0.3 m in boreholes SS-1 and SS-2 was sandy clayey silt to clayey silt with sand fill. The cohesive fill layer in boreholes SS-1 and SS-2 was soft to stiff in relative density (SPT-'N' values of 2 to 14) and was penetrated at a depth of 1.3 and 1.4 m (elevation 262.4 and 262.1) in boreholes SS-1 and SS-2 respectively. The moisture content of the cohesive fill was determined to range between 12 and 17%.

The results of Atterberg limits testing and grain size distribution analyses conducted on two samples of cohesive fill from boreholes SS-1 and SS-2 are presented in respective Figures RW-GS-2 and RW-PC-1. The liquid limits of the cohesive fill ranged from 18 to 21, while the plastic limit was 13 for both samples. The corresponding plasticity index was found to range from 5 to 8 for the cohesive fill.

The clayey silt fill in boreholes SS-1 and SS-2 was found to have very similar material properties to the native clayey silt till encountered in the boreholes. The remolded cohesive fill has a low to medium susceptibility to frost heave (LSFH-MSFH) based on the percentage of particles between the 75 and 5 µm sieves. The percentage of particles between the 75 and 5 µm sieves was found to be 40 and 38% based on the 2 samples tested. This low to medium susceptibility to frost heave will impact the performance of the retaining wall as this soil was encountered behind the retaining wall. Refer to Table A for the material properties of the soil.

For illustration purposes, the grain size distribution analyses for the cohesive fill in Figure RW-GS-2 was plotted against the Granular A gradation requirements envelope for acceptable backfill material. The cohesive material is not acceptable backfill material for the retaining wall.

5.3.3 Clayey Silt Till

Clayey silt glacial till was revealed below the cohesive fill in boreholes SS-1 and SS-2. The clayey silt till was encountered at depths of 1.3 and 1.4 m (elevation 262.4 and 262.1) in boreholes SS-1 and SS-2 respectively. This stratum was firm to very stiff in consistency (SPT-'N' values of 5 to 28) and had a moisture content ranging from 10 to 18%.

The results of Atterberg limits testing and grain size distribution analyses conducted on two samples of the clayey silt till from boreholes SS-1 and SS-2 are presented in respective Figures RW-GS-3 and RW-PC-2. The liquid and plastic limits of the clayey silt till in boreholes SS-1 and SS-2 ranged from 18 to 24 and from 13 to 14 respectively, with the plasticity index of 5 to 10. With a measured thickness of 2.4 and 2.7 m, the clayey silt glacial till was not penetrated upon termination of the boreholes at depths of 3.7 and 4.1 m (elevation 260.0 and 259.4) in boreholes SS-1 and SS-2 respectively.

The clayey silt glacial till in boreholes SS-1 and SS-2 was found to have a low susceptibility to frost heave (LSFH) based on the percentage of particles between the 75 and 5 µm sieves. The percentage of particles between the 75 and 5 µm sieves was found to be 29 and 37% based on the 2 samples tested. It should be noted that 40 percent of particles between 75 and 5 µm sieves is the limit between low and medium susceptibility to frost heave and this material can result in frost heaving action. The clayey silt glacial till could impact the performance of the retaining wall if this native soil exists behind the retaining structure at any location above the founding elevation. Refer to Table A for the material properties of the soil.

5.3.4 Groundwater

No groundwater was observed in any of the boreholes during or upon completion of drilling. However, it is noted that the groundwater levels are subjected to seasonal fluctuations and rainfall patterns.

5.4 Ottawa Street Retaining Wall

Boreholes OS-1 and OS-2 were advanced behind the 78 m long Ottawa Street retaining wall. The soil stratigraphy revealed in boreholes OS-1 and OS-2 comprised topsoil overlying non-cohesive deposits of sand and silt to sandy silt glacial till.

5.4.1 Topsoil

A 0.3 m thick surficial topsoil layer was encountered in boreholes OS-1 and OS-2. The topsoil layer extended to elevations 271.7 and 269.6 in boreholes OS-1 and OS-2 respectively.

5.4.2 Sand and Silt Till / Sandy Silt Till

Sand and silt to sandy silt glacial till was revealed below the topsoil at a depth of 0.3 m (elevation 271.7 and 269.6) in boreholes OS-1 and OS-2 respectively. This stratum was typically compact to dense in relative density (SPT-'N' values of 13 to 44) and had a moisture content ranging from 8 to 15%. With a measured thickness of 3.4 m, the sand and silt to sandy silt glacial till was not penetrated upon termination of the boreholes at a depth of 3.7 m (elevation 268.3 and 266.2) in boreholes OS-1 and OS-2 respectively.

The results of Atterberg limits testing and grain size distribution analysis performed on one sample of sand and silt till and one sample of sandy silt till from boreholes OS-1 and OS-2 are presented in respective Figures RW-PC-3 and RW-GS-4. The liquid and plastic limits of the sand and silt to sandy silt till was 15 and 12 respectively, with the plasticity index of 3 for both samples.

The sand and silt to sandy silt glacial till was found to have a low to medium susceptibility to frost heave based on the percentage of particles between the 75 and 5 µm sieves. The percentage of

particles between the 75 and 5 µm sieves was found to be 36 and 42% based on the 2 samples tested. This low to medium susceptibility to frost heave could impact the performance of the retaining wall. Refer to Table A for the material properties of the soil.

5.4.3 Groundwater

Perched water was detected in the process of augering at a depth of 2.4 m (elevation 267.5) in borehole OS-2. The perched water dissipated as the borehole advanced to termination. Groundwater was not observed in any of the boreholes during and upon completion of drilling in May 2015. However, it is noted that the groundwater levels are subjected to seasonal fluctuations and rainfall patterns.

6. CLOSURE

The site reconnaissance survey was carried out by Mr. K. R. Daly, B.Eng., EIT and by Mr. R. MacLaughlan, EIT of the MTO Foundations Office. The drilling of the boreholes was carried out under the supervision of Mr. K. R. Daly, B.Eng., EIT, and direction of Mr. C. M. P. Nascimento, P.Eng., Project Manager. The drilling equipment was supplied and operated by Tri-Phase Group. The laboratory testing was carried out by the MTO laboratories in Downsview.

This report was prepared by Mr. K. R. Daly, B.Eng., EIT, Project Supervisor, and reviewed by Mr. G.O. Degil, PhD, P.Eng., Senior Foundation Engineer. Mr. C.M.P. Nascimento, P.Eng., MTO Designated Principal Contact, conducted an independent review of the report.

Yours very truly,

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TABLE A

LIST OF ATTERBERG LIMITS, MOISTURE CONTENT RESULTS AND FROST SUSCEPTIBILITY

SOIL TYPE	BOREHOLE NO.	SAMPLE NO.	SAMPLE DEPTH (m)	LIQUID LIMIT (W_L)	PLASTIC LIMIT (W_P)	PLASTICITY INDEX (PI)	MOISTURE CONTENT (%)	% PARTICLES BETWEEN 5 µm & 75 µm	FROST SUSCEPTIBILITY
Clayey Silt Fill	SS-1	2	0.8 - 1.4	21	13	8	14	40	LSFH-MSFH
	SS-2	2	0.8 - 1.4	18	13	5	12	38	LSFH
Clayey Silt Till	PS-1	4	2.3 – 2.9	30	16	14	15	57	HSFH
	PS-2	3	1.5 – 2.1	25	15	10	13	43	MSFH
	SS-1	4	2.3 – 2.9	24	14	10	17	29	LSFH
	SS-2	3	1.5 – 2.1	18	13	5	12	37	LSFH
Sand and Silt to Sandy Silt Till	OS-1	3	1.5 – 2.1	15	12	3	9	36	LSFH
	OS-2	2	0.8 - 1.4	15	12	3	11	42	MSFH

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

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

RECORD OF BOREHOLE No PS-1

1 of 1

METRIC

G.W.P. 2013-E-0039-008 LOCATION Coords: 4 884 656.2 N; 349 453.8 E ORIGINATED BY K.D.

DIST Central HWY 7A BOREHOLE TYPE Manual Hammer COMPILED BY K.D.

DATUM Geodetic DATE May 13, 2015 CHECKED BY G.D.

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, + 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
263.5	Ground Surface										
0.0 / 263.2	Topsoil										
0.3	Sandy gravel, some silt organic inclusions		1	SS	5		263				
	Loose to Brown Moist compact (FILL)		2	SS	11						46 37 17 0
261.7 / 1.8	Clayey silt, some sand		3	SS	21		262				
	Very stiff Brown Moist to hard (TILL)		4	SS	44		261				0 14 62 24
260.6 / 2.9	End of borehole										

* Borehole dry

ON MTO_VER3 NEW LOGO 15TF002.GPJ ON_MOT.GDT 16/09/2015 10:56:01 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 PS-2 1 of 1 METRIC

G.W.P. 2013-E-0039-008 LOCATION Coords: 4 884 664.8 N; 349 472.5 E ORIGINATED BY K.D.

DIST Central HWY 7A BOREHOLE TYPE Manual Hammer COMPILED BY K.D.

DATUM Geodetic DATE May 13, 2015 CHECKED BY G.D.

SOIL PROFILE			SAMPLES			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 (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	*					GR SA SI CL
262.2	Ground Surface										
262.0 / 0.2	Topsoil										
	Clayey silt, some sand Stiff to hard Brown Moist (TILL)		1	SS	11		262		○		
			2	SS	40		261		○		
			3	SS	63				○		0 19 56 25
			4	SS	48		260		○		
259.3 / 2.9	End of borehole * Borehole dry										

+7, ×5 : Numbers refer to Sensitivity

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

Ontario

Peto MacCallum Ltd. CONSULTING ENGINEERS

Foundation Design

RECORD OF BOREHOLE No SS-1

1 of 1 **METRIC**

G.W.P. 2013-E-0039-008 LOCATION Coords: 4 884 553.6 N; 349 161.7 E ORIGINATED BY K.D.

DIST Central HWY 7A BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY K.D.

DATUM Geodetic DATE May 12, 2015 CHECKED BY G.D.

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, + 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
263.7	Ground Surface										
263.5 / 0.2	Topsoil										
	Clayey silt, with sand Firm to stiff Brown Moist (FILL)		1	SS	4		263				
			2	SS	10						0 23 53 24
262.4 / 1.3	Clayey silt, some sand Firm to stiff Brown Moist (TILL)		3	SS	10		262				
			4	SS	7		261				0 17 49 34
			5	SS	13		260				
260.0 / 3.7	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 SS-2 1 of 1 METRIC

G.W.P. 2013-E-0039-008 LOCATION Coords: 4 884 551.4 N; 349 154.2 E ORIGINATED BY K.D.

DIST Central HWY 7A BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY K.D.

DATUM Geodetic DATE May 12, 2015 CHECKED BY G.D.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLE 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
263.5	Ground Surface										
0.0 / 263.2	Topsoil										
0.3	Sandy clayey silt Soft to stiff Brown Moist (FILL)		1	SS	2		263		○		
			2	SS	14				⊖		0 30 50 20
262.1 / 1.4	Sandy clayey silt Very stiff to stiff Brown Moist (TILL)		3	SS	28		262		⊖		0 30 48 22
			4	SS	18		261		○		
			5	SS	5		260		○		
				FV				+ 2			
259.4 / 4.1	End of borehole * Borehole dry										

ON MTO_VER3 NEW LOGO 15TF002.GPJ ON_MOT.GDT 16/09/2015 10:56:02 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 OS-1

1 of 1

METRIC

G.W.P. 2013-E-0039-008 LOCATION Coords: 4 884 464.6 N; 348 784.3 E ORIGINATED BY K.D.

DIST Central HWY 7A BOREHOLE TYPE Manual Hammer COMPILED BY K.D.

DATUM Geodetic DATE May 13, 2015 CHECKED BY G.D.

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, + 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
272.0	Ground Surface										
0.0 / 271.7	Topsoil										
0.3	Sand and silt, some clay Loose to Brown Moist dense (TILL)		1	SS	6				○		
			2	SS	15		271		○		
			3	SS	24		270		○H		0 42 41 17
			4	SS	33		269		○		
268.3 / 3.7			5	SS	37				○		
	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 OS-2 1 of 1 METRIC

G.W.P. 2013-E-0039-008 LOCATION Coords: 4 884 472.1 N; 348 813.4 E ORIGINATED BY K.D.

DIST Central HWY 7A BOREHOLE TYPE Manual Hammer COMPILED BY K.D.

DATUM Geodetic DATE May 12, 2015 CHECKED BY G.D.

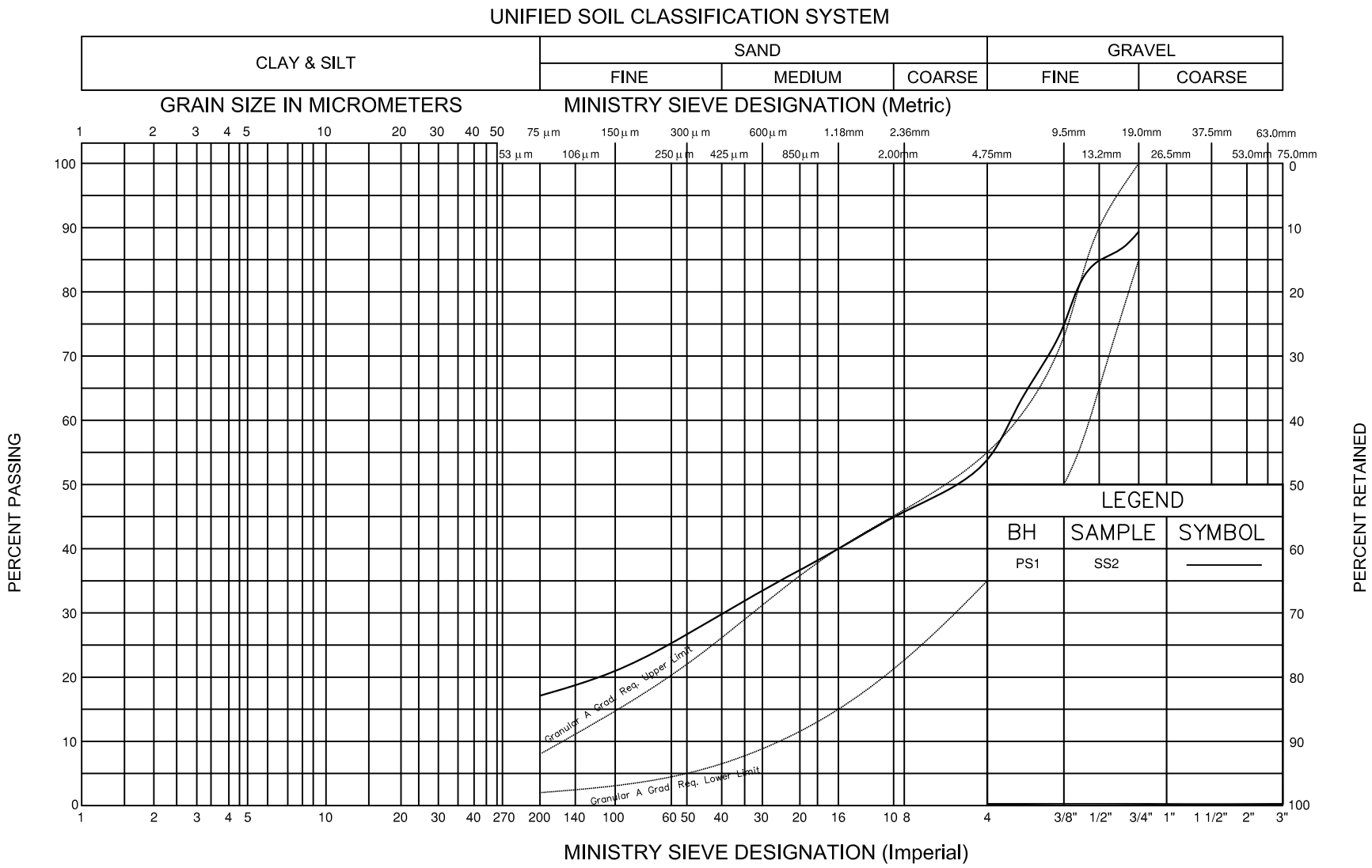
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
269.9	Ground Surface										
0.0 / 269.6	Topsoil		1	SS	3						
0.3	Sandy silt, some clay Loose to dense Brown/grey Moist to wet (TILL)		2	SS	13		269				0 37 49 14
			3	SS	33		268				
			4	SS	44	▽*	267				
266.2			5	SS	36						
3.7	End of borehole										

* 2015 05 12

▽ Water level observed during drilling

+7, ×5 : Numbers refer to Sensitivity

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



Ontario

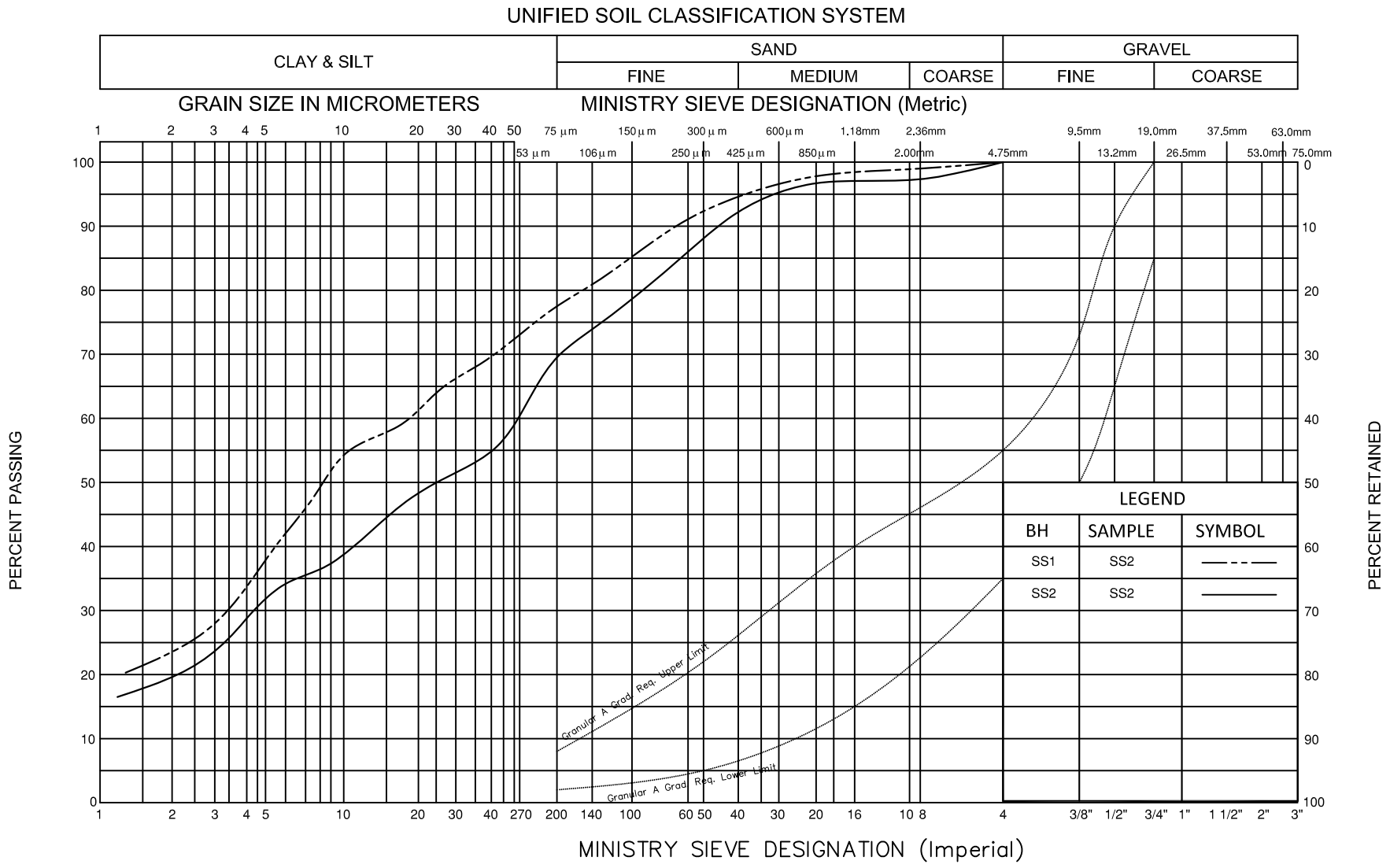
GRAIN SIZE DISTRIBUTION

SANDY GRAVEL, some silt
(FILL)

FIG. No RW-GS-1

HWY 7A Retaining Wall

TASK No. 2013-E-0039-008



Ontario

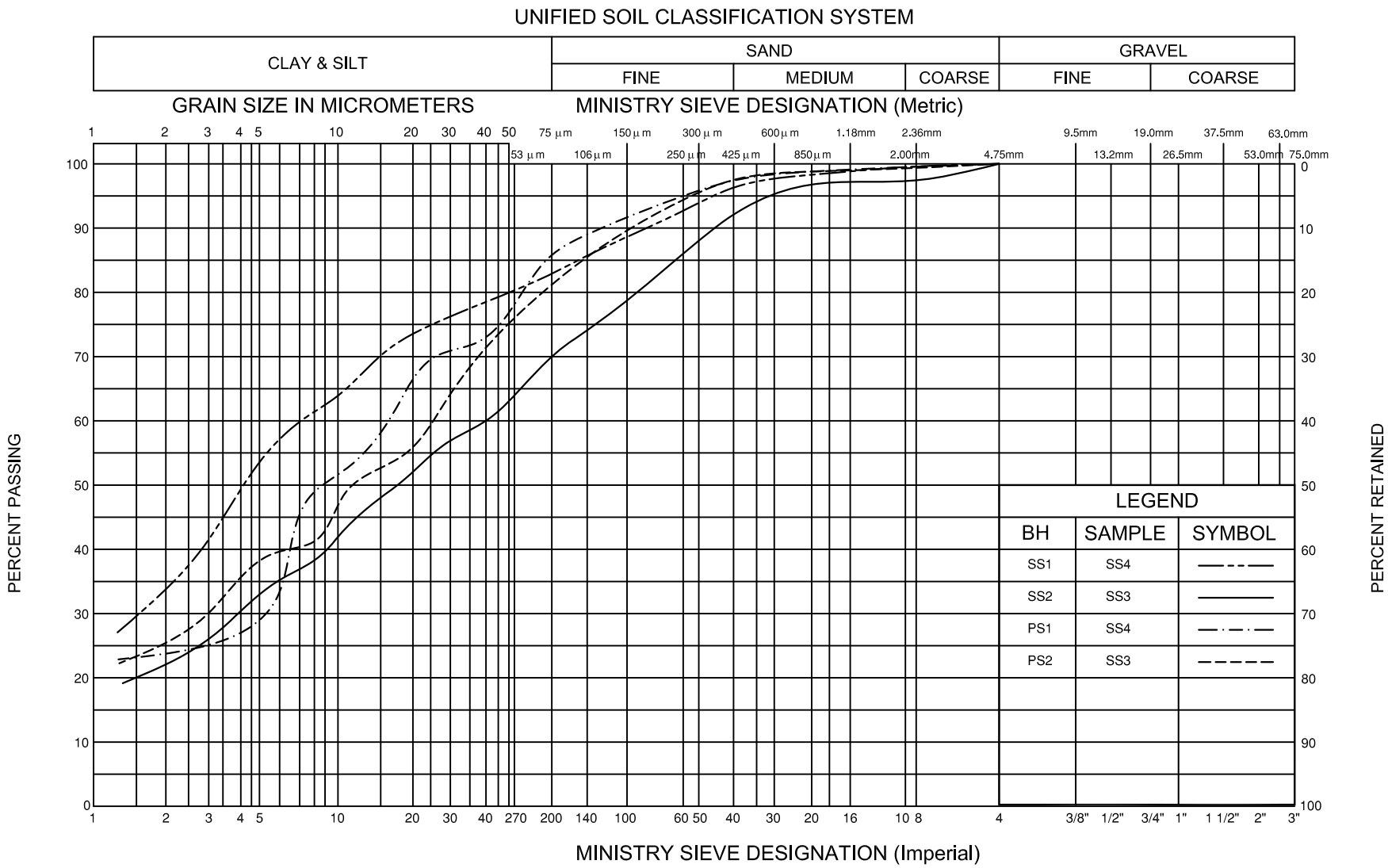
GRAIN SIZE DISTRIBUTION

CLAYEY SILT, with sand to sandy (CL)
(FILL)

FIG. No RW-GS-2

HWY 7A Retaining Wall

TASK No. 2013-E-0039-008



Ontario

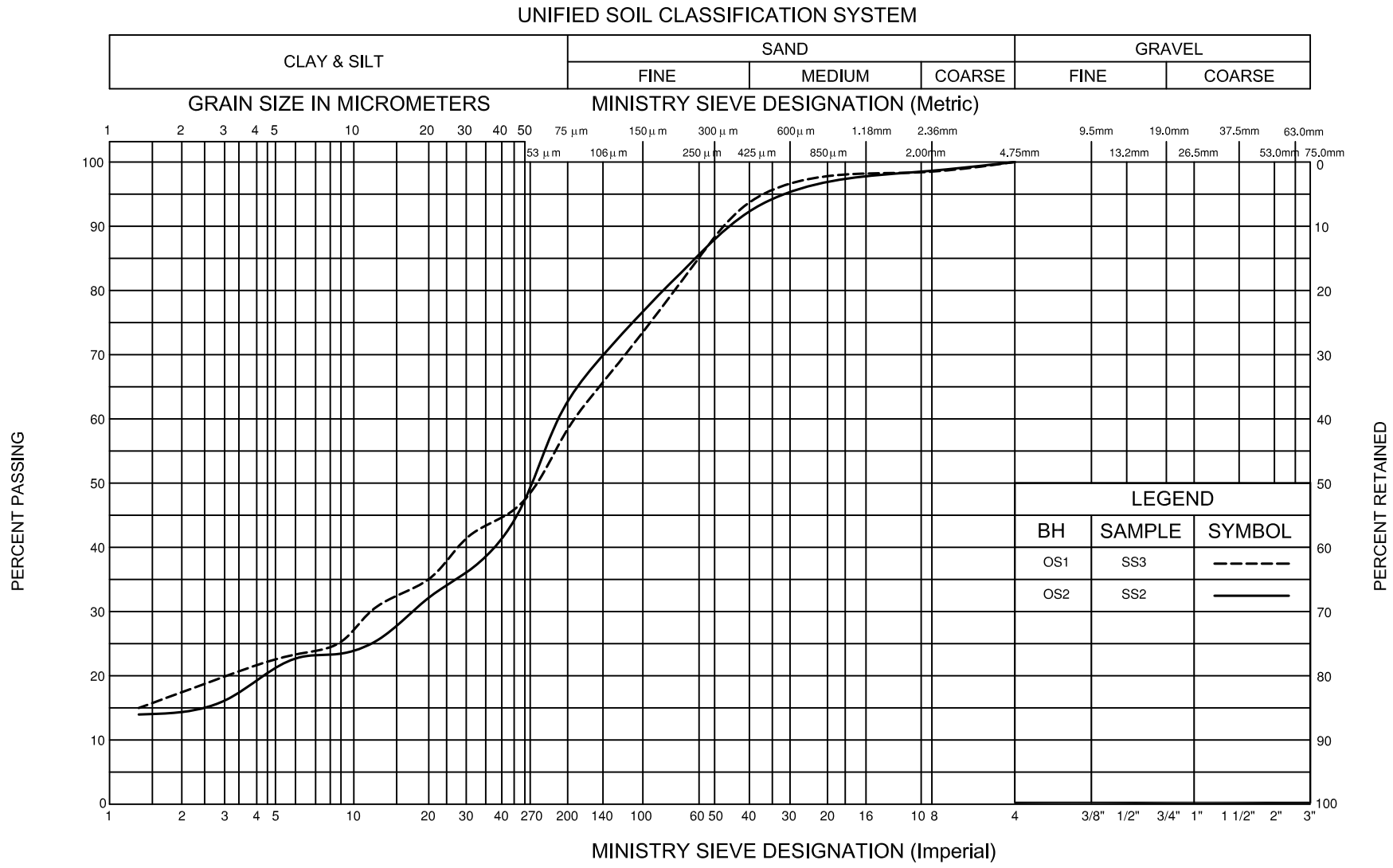
GRAIN SIZE DISTRIBUTION

CLAYEY SILT, some sand to sandy (CL)
(TILL)

FIG. No RW-GS-3

HWY 7A Retaining Wall

TASK No. 2013-E-0039-008



Ontario

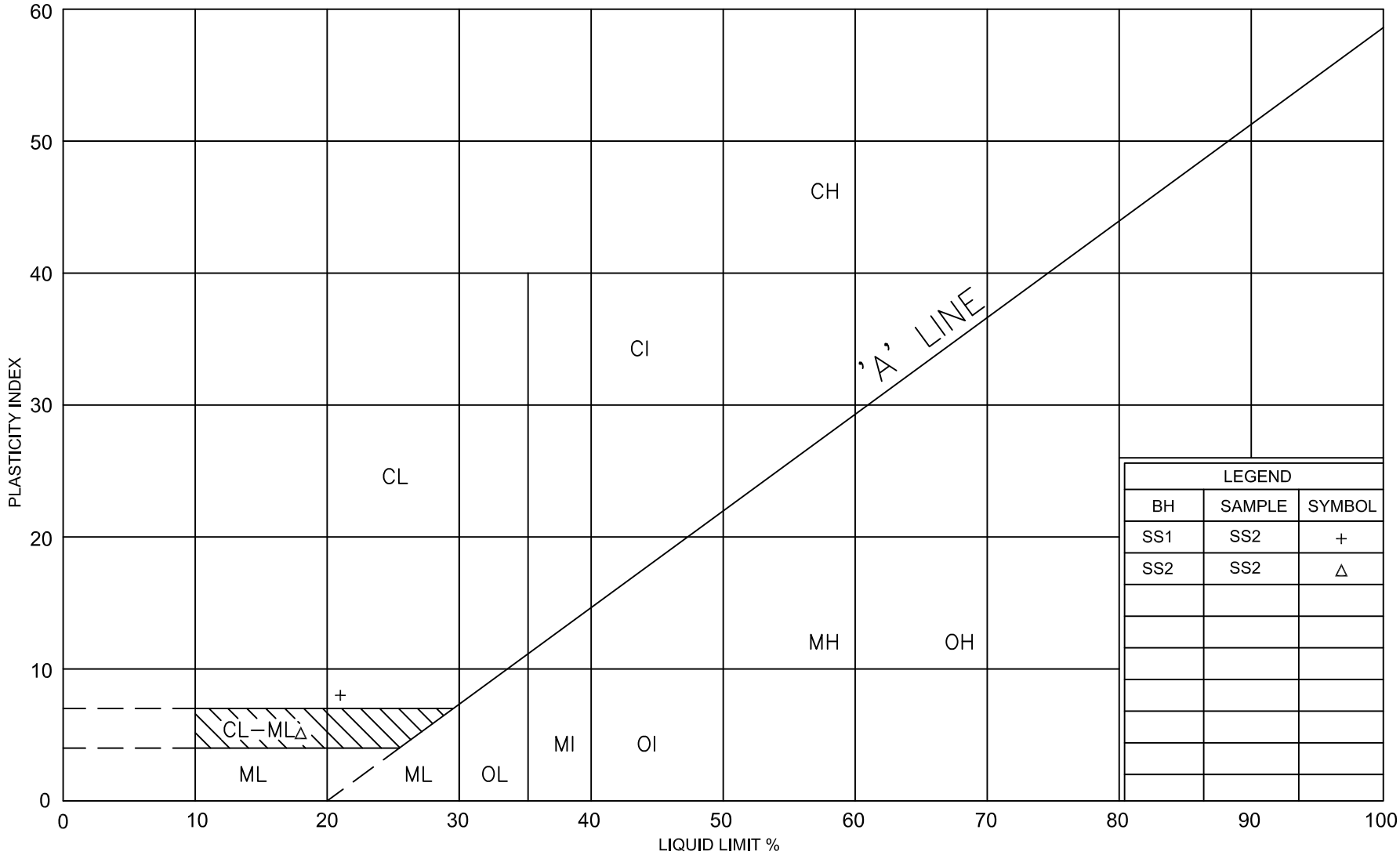
GRAIN SIZE DISTRIBUTION

SAND AND SILT to SANDY SILT, some clay (ML)
(TILL)

FIG. No RW-GS-4

HWY 7A Retaining Wall

TASK No. 2013-E-0039-008



Ontario

PLASTICITY CHART

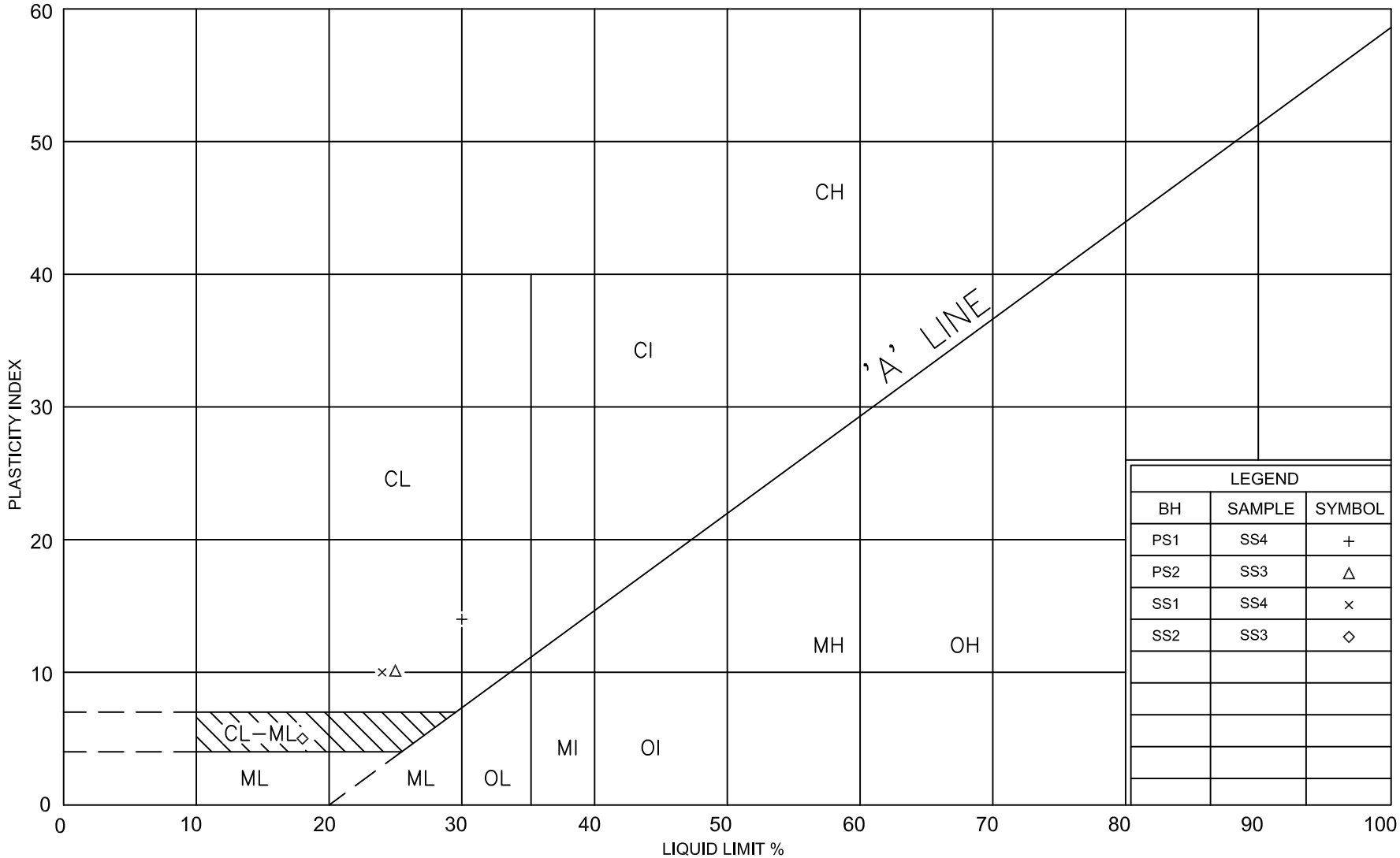
CLAYEY SILT, with sand to sandy (CL-ML / CL)

(FILL)

FIG. No RW-PC-1

HWY 7A Retaining Wall

TASK No. 2013-E-0039-008



Ontario

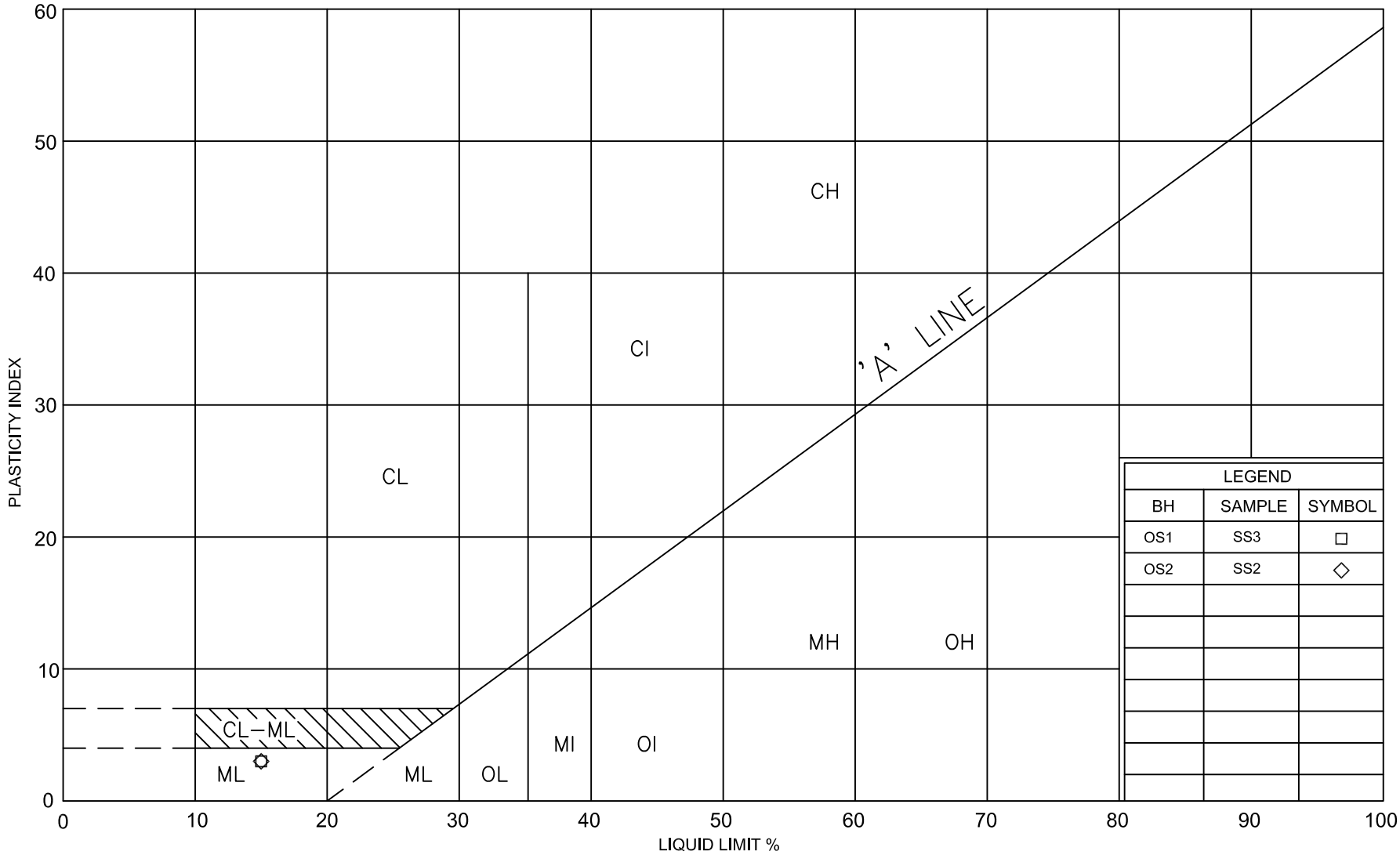
PLASTICITY CHART

CLAYEY SILT, with sand to sandy (CL-ML / CL)
(TILL)

FIG. No RW-PC-2

HWY 7A Retaining Wall

TASK No. 2013-E-0039-008



Ontario

PLASTICITY CHART

SAND AND SILT TO SANDY SILT, some clay (ML)
(TILL)

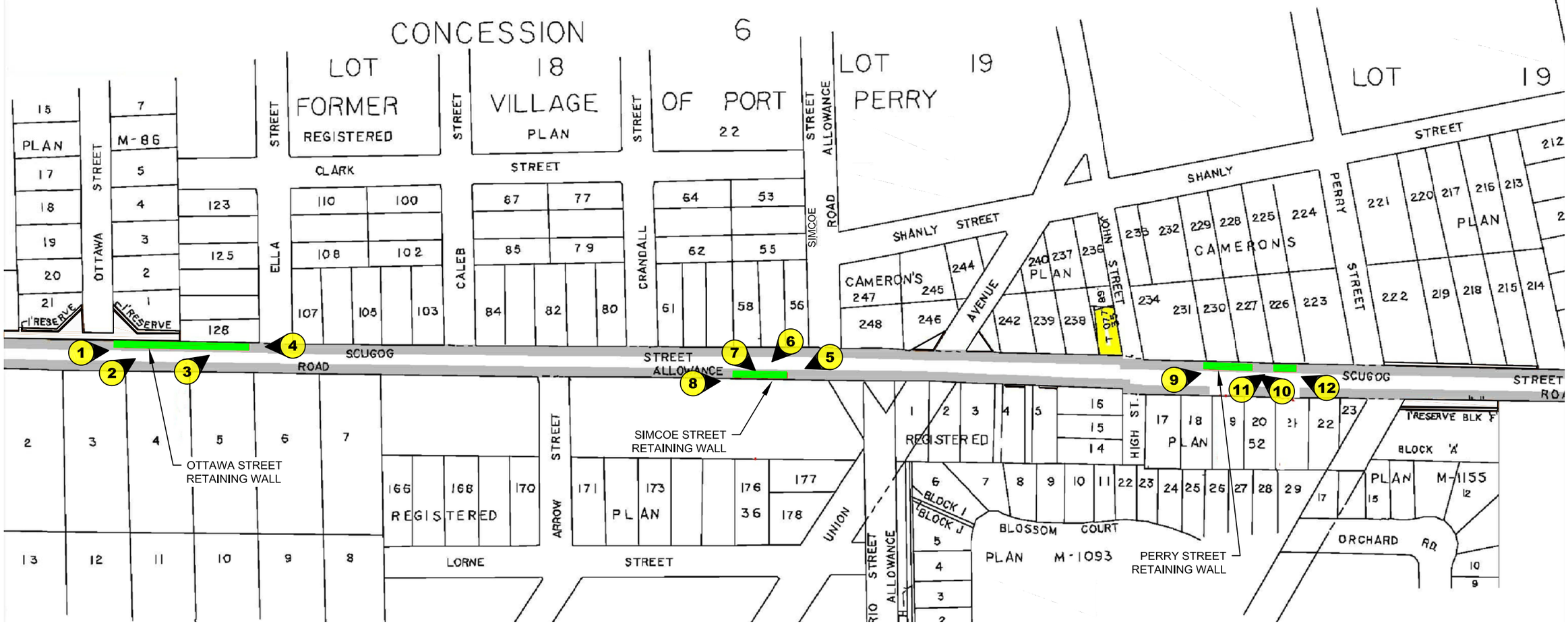
FIG. No RW-PC-3

HWY 7A Retaining Wall

TASK No. 2013-E-0039-008

GEOGRAPHIC TOWNSHIP OF REACH
MUNICIPALITY – TOWNSHIP OF SCUGOG

MTM NAD83



SITE AND PHOTOGRAPH LOCATION PLAN

LICENSED PROFESSIONAL ENGINEER G. DEGIL 100056241 Oct. 15/15 PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER C M P Nascimento Oct. 15, '15 PROVINCE OF ONTARIO

LEGEND:

12 Location and direction of photograph

Approximate location of retaining wall

REFERENCE: THIS DRAWING WAS PREPARED FROM ***'PROPERTY OWNERSHIP PLATES PAGE 1'*** PLATE No. 034-7A/TRS, DRAWING No. 03407AOS DATED MAY 2010 PROVIDED BY THE MINISTRY OF TRANSPORTATION - ONTARIO.

HIGHWAY 7A RETAINING WALLS

PORT PERRY, ONTARIO

METRIC

Ontario

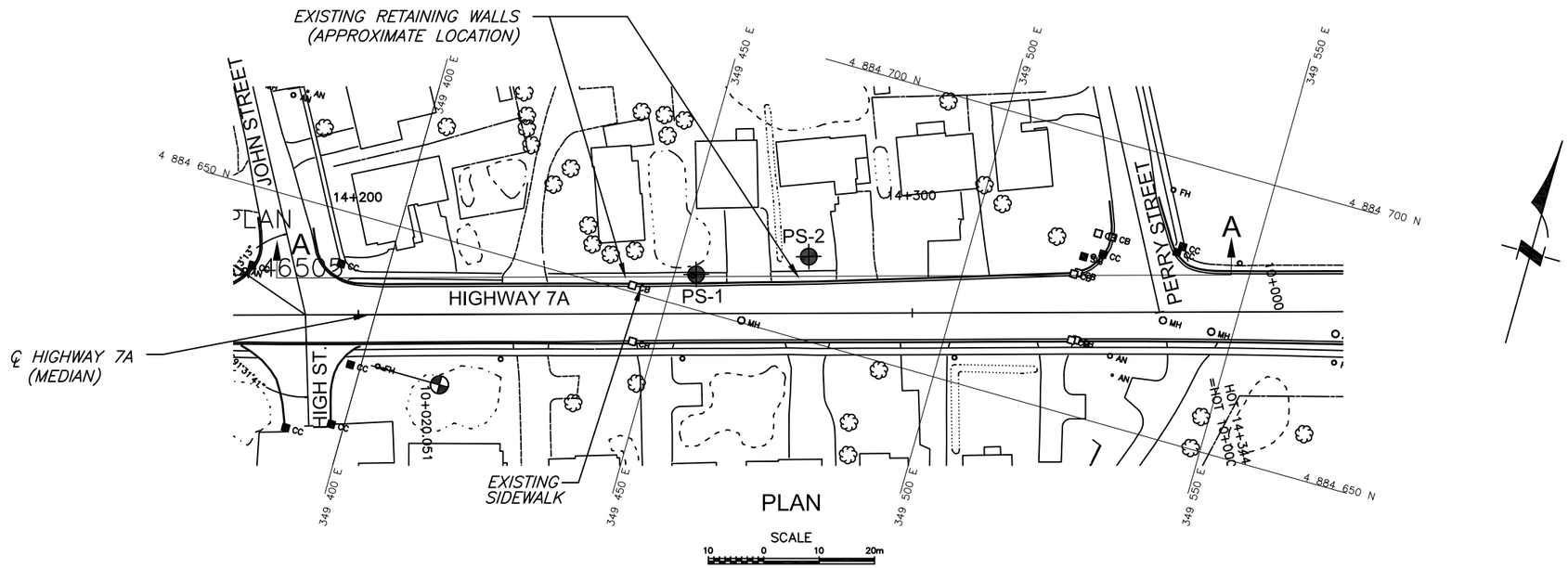
SCALE 50 0 25 50

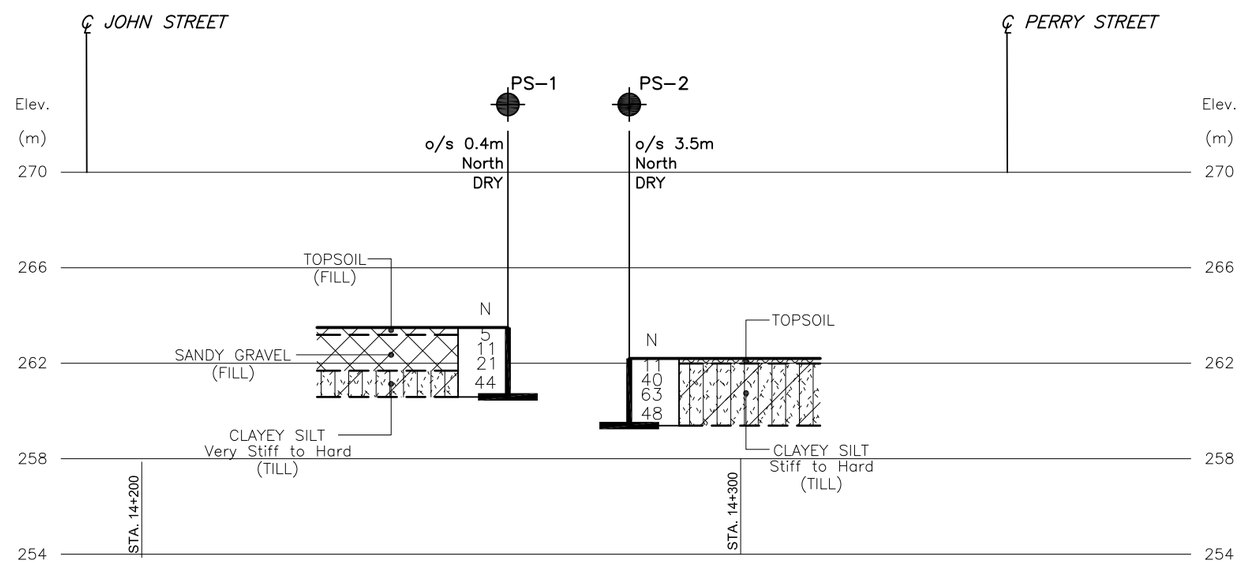
Peto MacCallum Ltd. CONSULTING ENGINEERS

SITE AND PHOTOGRAPH LOCATION PLAN

TASK No. 2013-E-0039-008

DRAWING # RW-1





PROFILE A-A

SCALE
HORIZONTAL
10 0 10 20m

VERTICAL
2.5 0 2.5 5m

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.

LICENSED PROFESSIONAL ENGINEER
G. DEGIL
100056241
Oct. 15/15
PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER
C M P Nascimento
Oct. 15, 15
PROVINCE OF ONTARIO

Reference MTO Drawings:
b-34-7a-46504.dwg, b-34-7a-46505.dwg, and b-34-7a-46506.dwg, undated

CONT No	SHEET
TASK No 2013-E-0039-008	
PERRY STREET RETAINING WALL HIGHWAY 7A BOREHOLE LOCATIONS AND SOIL STRATA	

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS

KEY PLAN
SCALE: 1 : 25,000
250m 0 250m 0.5km

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

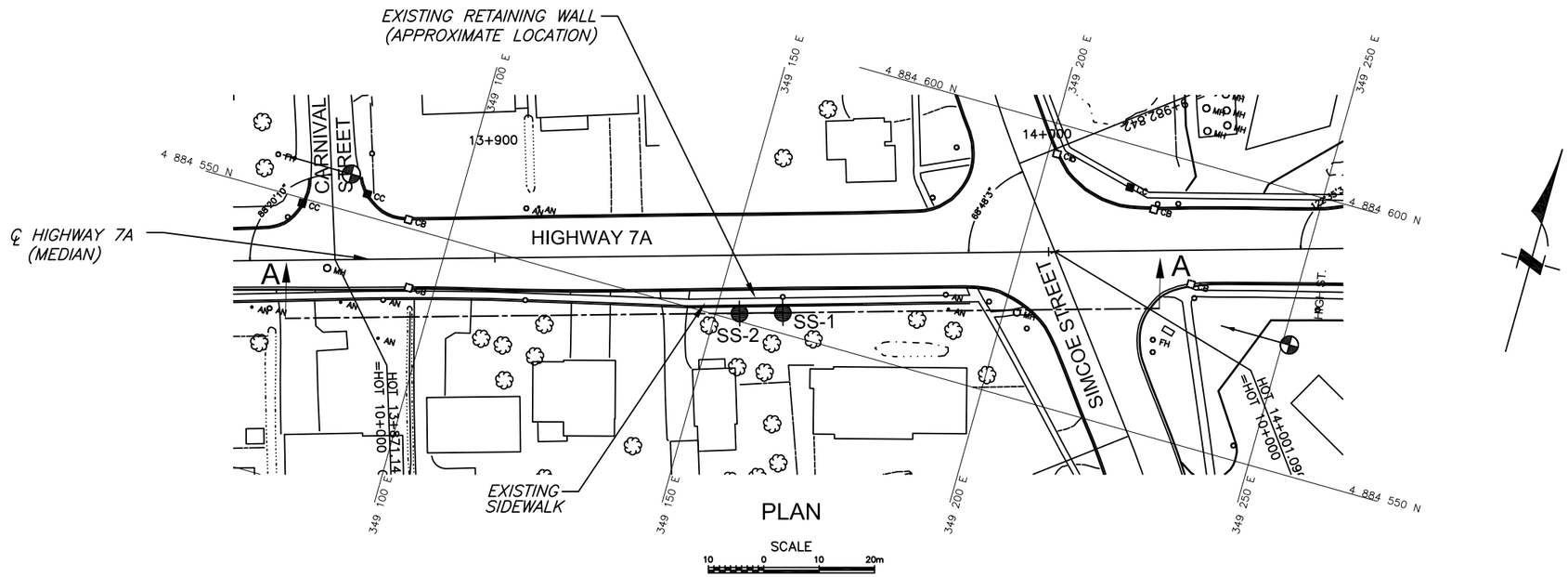
BH No	ELEVATION	NORTHINGS	EASTINGS
PS–1	263.5	4 884 656.2	349 453.8
PS–2	262.2	4 884 664.8	349 472.5

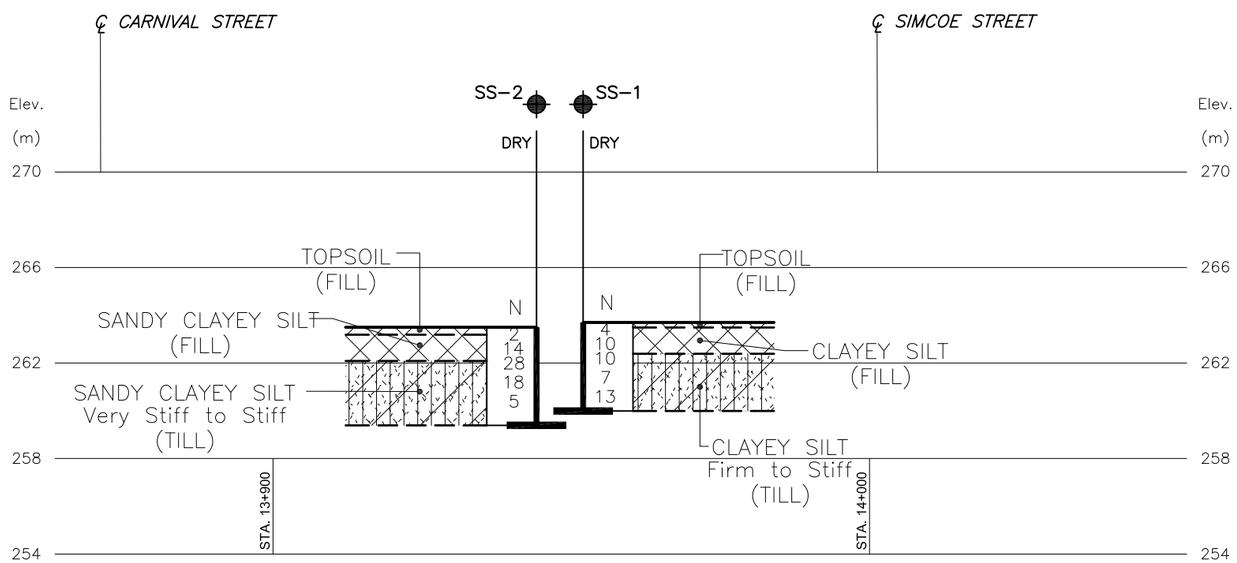
– NOTE –
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS		
DATE	BY	DESCRIPTION

Geocres No. 31D-628

HWY No 7A				DIST Central	
SUBM'D NA	CHECKED KD	DATE OCT. 15, 2015		SITE 22-579/W & 22-580/W	
DRAWN NL	CHECKED GD	APPROVED CN		DWG PS-1	





PROFILE A-A

SCALE
HORIZONTAL
10 0 10 20m
VERTICAL
2.5 0 2.5 5m

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.

LICENSED PROFESSIONAL ENGINEER
G. DEGIL
100056241
Oct. 15/15
PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER
C M P Nascimento
Oct. 15, '15
PROVINCE OF ONTARIO

Reference MTO Drawings:
b-34-7a-46504.dwg, b-34-7a-46505.dwg, and b-34-7a-46506.dwg, undated

CONT No

TASK No 2013-E-0039-008

SIMCOE STREET RETAINING WALL
HIGHWAY 7A
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

Peto MacCallum Ltd.
CONSULTING ENGINEERS

KEY PLAN
SCALE: 1 : 25,000
250m 0 250m 0.5km

LEGEND

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

BH No	ELEVATION	NORTHINGS	EASTINGS
SS-1	263.7	4 884 553.6	349 161.7
SS-2	263.5	4 884 551.4	349 154.2

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

REVISIONS

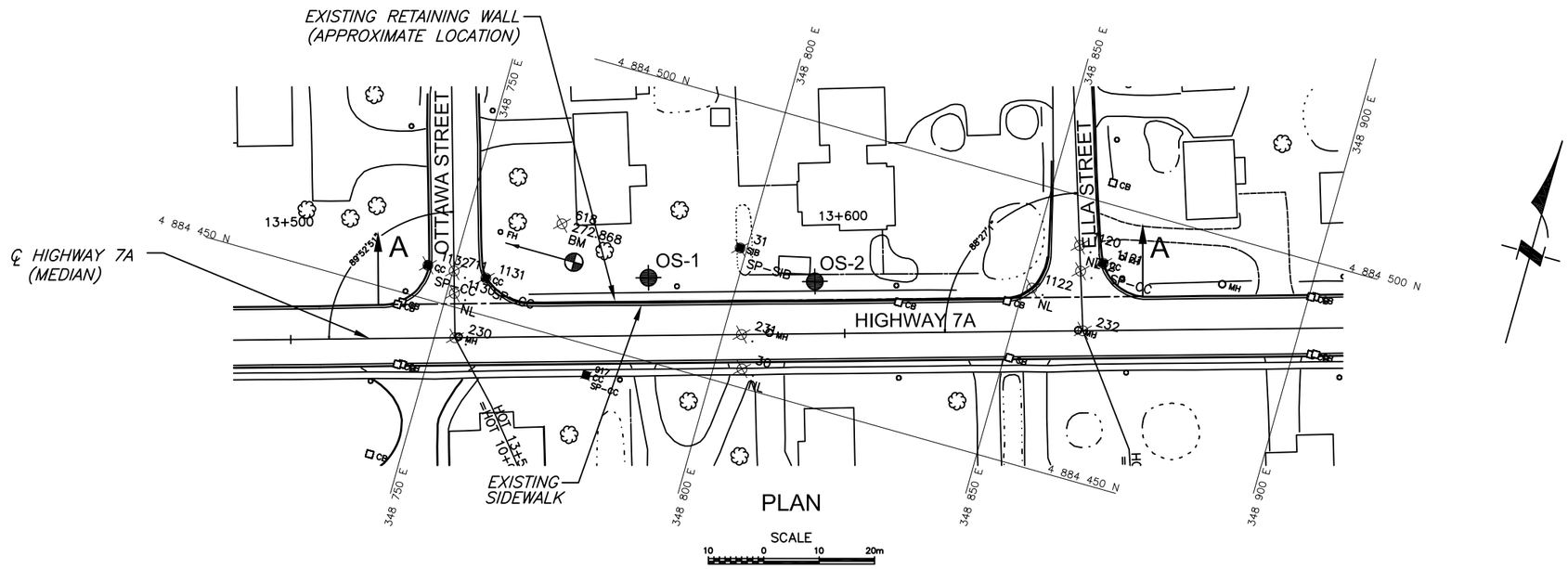
DATE	BY	DESCRIPTION

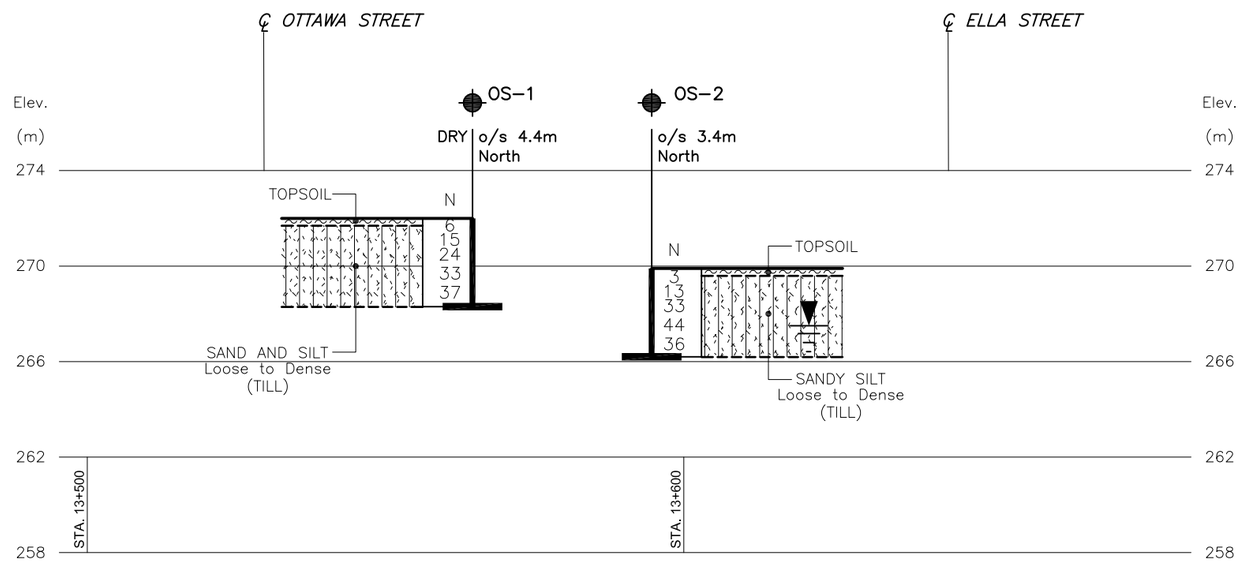
Geocres No. 31D-628

HWY No	7A			DIST	Central
SUBM'D	NA	CHECKED KD	DATE OCT. 15, 2015	SITE	
DRAWN	NL	CHECKED GD	APPROVED CN	DWG	SS-1

CONT No	
TASK No 2013-E-0039-008	
OTTAWA STREET RETAINING WALL HIGHWAY 7A BOREHOLE LOCATIONS AND SOIL STRATA	SHEET

Peto MacCallum Ltd.
CONSULTING ENGINEERS





PROFILE A-A

SCALE
HORIZONTAL
10 0 10 20m
VERTICAL
2.5 0 2.5 5m

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.

LICENSED PROFESSIONAL ENGINEER
G. DEGIL
100056241
Oct. 15/15
PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER
C M P Nascimento
Oct. 15, '15
PROVINCE OF ONTARIO

Reference MTO Drawings:
b-34-7a-46504.dwg, b-34-7a-46505.dwg, and b-34-7a-46506.dwg, undated

LEGEND

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

BH No	ELEVATION	NORTHINGS	EASTINGS
OS-1	272.0	4 884 464.6	348 784.3
OS-2	269.9	4 884 472.1	348 813.4

– 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-628

HWY No	7A			DIST	Central
SUBM'D	NA	CHECKED KD	DATE OCT. 15, 2015	SITE	22-578/W
DRAWN	NL	CHECKED GD	APPROVED CN	DWG	OS-1

APPENDIX FIR-A

Site Photographs

Photograph 1: Taken at the west end of the Ottawa Street retaining wall, facing east. (April 16, 2015)

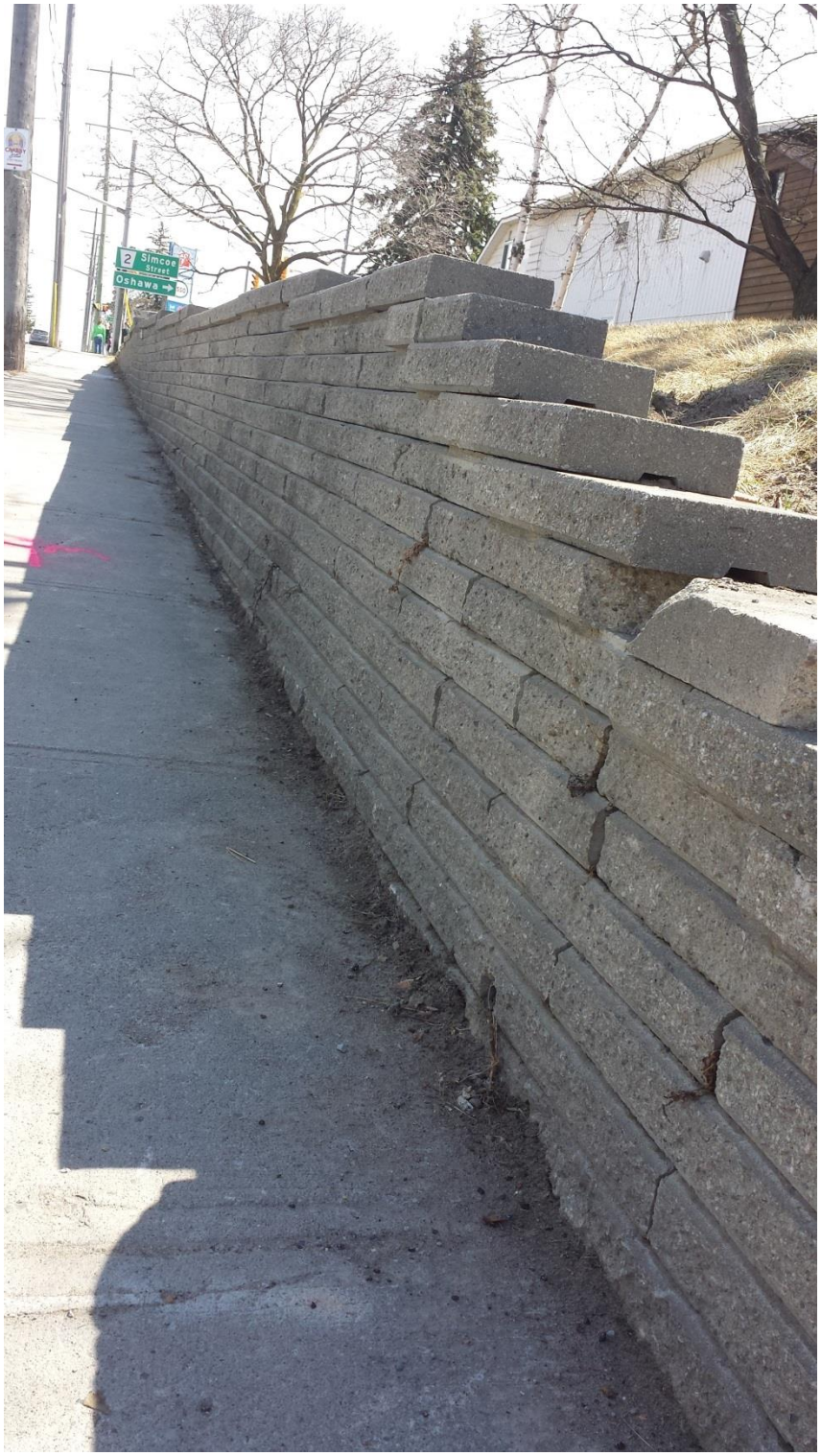
Photograph 2: Taken at the Ottawa Street retaining wall, facing northeast. (May 13, 2015)

Photograph 3: Taken near the east end of the Ottawa Street retaining wall, facing northeast. (May 13, 2015)

Photograph 4: Taken at the east end of the Ottawa Street retaining wall, facing west. (May 13, 2015)

Photograph 5: Taken at the east end of the Simcoe Street retaining wall, facing west. (April 16, 2015)

Photograph 6: Taken at the Simcoe Street retaining wall, facing southwest. (April 16, 2015)



Photograph 7: Taken at the Simcoe Street retaining wall, facing southeast. (April 16, 2015)

Photograph 8: Taken at the west end of the Simcoe Street retaining wall, facing east. (April 16, 2015)

Photograph 9: Taken at the Perry Street retaining wall, facing east. (April 16, 2015)

Photograph 10: Taken at the Perry Street retaining wall, facing west. (April 16, 2015)

Photograph 11: Taken at the Perry Street retaining wall, facing northeast. (April 16, 2015)

Photograph 12: Taken at the Perry Street retaining wall, facing west. (April 16, 2015)

APPENDIX FIR-B

Memorandum dated November 1, 1994

memorandum

Ontario

(416) 235-3731

1994 11 01

To: Karen Smith
Assistant Maintenance Engineer
Central Region
1st Floor, Atrium Tower

From: Pavement and Foundation Design Section
Room 315, Central Building
Downsview, Ontario

Re: Pisa Stone Retaining Wall
Hwy 7A, Near Regional Road 2 in Port Perry
W.O. 94-11013
District 6, Toronto

At your request, we visited the above mentioned site to investigate the cause of distress to a retaining wall. It is understood that the retaining wall was constructed in 1983. Recently some movement took place in the wall which caused a gap between the wall and the retained soil.

The site is located in the southwest corner of Hwy 7A and Regional Road 2 in Port Perry. A 30.5m long and 1m high 'Pisa stone' retaining wall is constructed on the south side of Hwy 7A oriented in the east-west direction. The wall retains the front yard of a house to provide room for a sidewalk on the immediately north side of the wall. The house is situated on the south side of the wall at a distance of about 12m from the wall on a higher ground. The wall is 0.96m high and is constructed with 12 layers of block, each 75mm thick and 600mm long.

The wall appeared to be almost vertical. However, according to the contract drawings (Cont. No 83-84, WP No 138-75-03) the wall was supposed to be constructed at 1H:8V. If the wall was constructed as per drawing, then it means the top of the wall had moved up to 12 cm. According to the drawing, weeping holes were to be provided every 3m (i.e. at least 10 weeping holes in the entire length of the wall), but there were no weeping holes in the retaining wall. We observed two longitudinal cracks in the ground, one adjacent to the wall and the other at a distance of 760mm from the wall. The cracks were 50mm to 75mm wide and of similar depth in a conical shape. The cracks were covered with grass. There were few vertical cracks in the wall as well.

Assuming the Pisa Stone retaining wall was designed to withstand the earth pressures imposed by the geometry, in our opinion, the distress in the wall is due to lack of provision to allow drainage of water behind the retaining wall, e.g. no weeping holes as shown in the drawing and/or inadequate free draining material behind the retaining wall.

Provided that you have no concern for the safety of the residents with respect to the cracks behind the wall, in our opinion, there is no immediate danger to the integrity of the wall. The movement in the wall has been taking place for a long period of time. However, we suggest that if any further movement in the wall is observed, then the wall should be repaired. In order to provide free draining material behind the wall, perhaps the entire wall will have to be replaced. Alternatively, the wall could be replaced with reinforced earth type wall.

If you have any questions please call our office.

K.S.Q. Ahmad, P. Eng.
Foundation Engineer

For

D. Dundas, P. Eng.
Senior Foundation Engineer