

Foundation Investigation Report

*Dry Facility at Southwest Corner of Highway 410-Courtneypark Drive Interchange
Highway 410, Eglington Avenue to Mayfield Road - Contract 2
Mississauga and Brampton, Ontario
Assignment No. 2016-E-0040, G.W.P. 2369-15-00*

Submitted to:

AECOM

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by AECOM on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for the detailed design of the rehabilitation of Highway 410 from Eglinton Avenue to Mayfield Road in the cities of Mississauga and Brampton, Ontario (MTO Agreement No. 2016-E-0040).

This report addresses the foundation investigation carried out in support of the dry facility design located at the southwest corner of the Highway 410 – Courtneypark Drive interchange.

The Terms of Reference and Scope of Work for the foundation engineering services are outlined in MTO's Request for Proposal, dated November 25, 2016, which forms part of the Consultant Agreement (No. 2016-E-0040) for this project. The Scope of Work for the dry facility is outlined in Golder's Change Request dated February 15, 2019. The work has been carried out in accordance with Golder's Supplementary Specialty Plan for this project, dated May 2017.

2.0 SITE DESCRIPTION

The site is in the City of Mississauga, north of the Highway 401/403/410 interchange and south of the Derry Road interchange, as shown on the Key Plan is provided on Drawing 1. The dry facility is located on undeveloped land within the southwest quadrant of the Highway 410 – Courtneypark Drive interchange. Industrial developments surround the site.

The existing ground surface over the proposed dry facility varies from between about Elevation 188.2 m and 189.1 m. To the east of the proposed dry facility, the Highway 410 grade is at approximately Elevation 187.5 m, and to the north, Courtneypark Drive has been constructed on an embankment with its grade up to approximately Elevation 193 m.

3.0 INVESTIGATION PROCEDURES

The field work for this investigation was carried out on November 8, 2018 and March 4 and 5, 2019, during which time three boreholes (designated as Boreholes 17-7, SWM-1 and SWM-2) were advanced within the footprint of the proposed dry facility, as shown on Drawing 1. The borehole records are contained in Appendix A.

The borehole investigation was carried out using a CME-55 track-mounted drill rig, supplied and operated by Geo-Environmental Drilling Inc. of Acton, Ontario. The boreholes were advanced through the overburden using 152 mm and 203 mm outside diameter hollow stem augers. Soil samples were obtained at 0.75 m and 1.5 m intervals of depth using a 50 mm outer diameter (35 mm inner diameter) split-spoon sampler driven by an automatic hammer in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586)¹. Considering the inside diameter of the split-spoon samplers, soil particles larger than 35 mm cannot be retrieved. The results of the in situ field tests (i.e., SPT "N"-values) as presented on the borehole records and in Section 4.0 are uncorrected.

¹ ASTM D1586 – Standard Test Method for Standard Penetration Tests and Split Barrel Sampling of Soils.

The groundwater conditions in the open boreholes were observed during and immediately following the drilling operations. A standpipe piezometer was installed in Borehole SWM-1 to permit monitoring of the water level at the site. The installed piezometer consists of a 50 mm diameter PVC pipe, with a 1.5 m slotted screen sealed within a filter sand pack with the piezometer positioned near the bottom of the borehole. The borehole and annulus surrounding the piezometer pipe above the filter sand pack were backfilled to the ground surface with bentonite pellets. Piezometer installation details and water level readings are described on the borehole records in Appendix A. The remaining boreholes were backfilled to ground surface with bentonite, in accordance with Ontario Regulation 903 (Wells, as amended).

The field work was observed by a member of Golder's engineering staff, who located the boreholes, arranged for the clearance of underground services, observed the drilling, sampling and in situ testing operations, logged the boreholes, and examined the soil samples. The soil samples were identified in the field, placed in labelled containers and transported to Golder's laboratory in Mississauga for further visual examination. Geotechnical laboratory index and classification testing, consisting of natural moisture contents, grain size distributions and Atterberg limits, was conducted on selected samples in accordance with MTO and / or ASTM Standards, as applicable. The results of the geotechnical laboratory testing are given on the borehole records provided in Appendix A, and on the geotechnical laboratory test figures in Appendix B.

The as-drilled borehole locations were surveyed by Golder personnel using a handheld GPS device with a horizontal accuracy of 0.1 m and a vertical accuracy of 0.1 m. The locations provided on the borehole records and shown on Drawing 1 are positioned relative to MTM NAD 83 (Zone 10) coordinates and the ground surface elevations are referenced to geodetic datum. The borehole locations (including in geographic coordinates of latitude and longitude), ground surface elevations, and drilled depths are summarized below.

Borehole I.D.	MTM NAD83 (Zone 10)		Ground Surface Elevation (m)	Borehole Depth (m)
	Northing (m) (Latitude)	Easting (m) (Longitude)		
17-7	4,834,625.3 (43.651441)	290,450.2 (-79.677895)	188.5	10.8
SWM-1*	4,834,572.1 (43.650963)	290,485.6 (-79.677454)	188.0	10.9
SWM-2	4,834,551.6 (43.650779)	290,512.2 (-79.677124)	188.2	12.8

* Auger refusal was encountered at a depth of 2.8 m in Borehole SWM-1 on an obstruction; the drill rig was shifted 2 m south of the original borehole, and drilling and sampling continued from 2.8 m to 10.9 m.

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

This section of Highway 410 is located within the physiographic region known as the South Slope, according to *The Physiography of Southern Ontario* (Chapman and Putnam, 1984)².

The South Slope region is comprised of calcareous clay till with lacustrine clay and silt reworked by glaciers, with numerous scattered drumlins and deep valley cuts caused by streams flowing towards Lake Ontario. The surface topography slopes gradually and uniformly southwards towards Lake Ontario. The overburden within the majority of the South Slope area is underlain by shale bedrock of the Queenston and Georgian Bay Formations, which contain limestone interlayers.

4.2 Subsurface Conditions

The subsurface soil and groundwater conditions as encountered in the boreholes advanced during the investigation, including groundwater level readings, are presented on the borehole records provided in Appendix A. The results of the geotechnical laboratory testing are given on the borehole records provided in Appendix A, and on the geotechnical laboratory test figures in Appendix B.

The results of the in situ field tests (i.e., SPT “N”-values) as presented on the borehole records and in Section 4.2 are uncorrected. The stratigraphic boundaries shown on the borehole records and on the stratigraphic profile and cross-section on Drawing 1 are inferred from non-continuous sampling, observations of drilling progress and the results of Standard Penetration Tests. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. The interpreted stratigraphic profile and cross-section, as shown on Drawing 1, are simplifications of the subsurface conditions. Variation in the stratigraphic boundaries between and beyond boreholes exists and is to be expected.

In general, the subsurface conditions encountered at the site consist of topsoil underlain by firm to stiff clayey silt fill, further underlain by a till deposit that varies from stiff to hard clayey silt till to very dense silt and sand till. A more detailed description of the subsurface conditions is provided in the following sections of this report.

4.2.1 Topsoil

An approximately 100 mm and 150 mm thick layer of topsoil was encountered at ground surface in Boreholes 17-7 and SWM-2, respectively.

4.2.2 Clayey Silt to Sandy Clayey Silt Fill

A 0.5 m to 2.9 m thick layer of fill was encountered at ground surface in Borehole SWM-1 and underlying the topsoil in Boreholes 17-7 and SWM-2; this fill layer extends to between approximately Elevation 185.5 m and 187.5 m as encountered in the boreholes. The fill consists of clayey silt, some sand to sandy clayey silt, and contains trace to some gravel, trace rootlets and trace organics.

The Standard Penetration Test (SPT) “N”-values measured within the cohesive fill range from 7 blows to 10 blows per 0.3 m of penetration, suggesting a firm to stiff consistency.

Grain size distribution testing was carried out on one sample of the cohesive fill and is presented on Figure B-1 in Appendix B. Atterberg limits testing was carried out on one sample of the cohesive fill and measured a liquid limit of

² Chapman, L.J. and Putman, D.F., 1984, *The Physiography of Southern Ontario*, Ontario Geological Society, Special Volume 2, Third Edition. Accompanied by Map p. 2715, Scale 1:600,000.)

about 30 per cent and a plastic limit of about 18 per cent, corresponding to a plasticity index of about 12 per cent. This Atterberg limits testing result is presented on Figure B-2 in Appendix B and indicates the fill consists of clayey silt of low plasticity. The natural water content measured on samples of the cohesive fill ranges from about 15 to 21 per cent, near the plastic limit of the material.

4.2.3 Clayey Silt Till to Silt and Sand Till

A till deposit was encountered underlying the cohesive fill in all boreholes. All boreholes terminated within the till deposit, penetrating it for a thickness of 7.8 m to 12.1 m. The till deposit is generally comprised of clayey silt, some sand to sandy clayey silt, trace to some gravel. However, the till does vary in composition, and grades with depth to a silt and sand till of slight plasticity, as encountered in Borehole SWM-2 below a depth of 8.7 m (Elevation 179.5 m).

Auger grinding was observed during drilling in the till in Boreholes SWM-1 and SWM-2, and auger refusal was encountered at a depth of 2.8 m in Borehole SWM-1, suggesting the presence of cobbles and/or boulders, which are commonly encountered in glacially derived materials and should be expected within this deposit. Shale fragments were encountered at depths below Elevation 179.8 m (8.2 m below ground surface) in the cohesive till deposit in Borehole SWM-1 and rock fragments were encountered at depths below Elevation 178.4 m (9.8 m below ground surface) in the non-cohesive till deposit in Borehole SWM-2.

The SPT “N”-values measured within the cohesive till deposit generally range from 12 blows to 72 blows per 0.3 m of penetration, with values of up to 100 blows for 0.1 m of penetration measured below a depth of about 9 m, suggesting a stiff to hard consistency. The SPT “N”-values measured within the non-cohesive till are 100 blows per 0.3 m of penetration, 102 blows per 0.3 m of penetration and 100 blows for 0.1 m of penetration, indicating a very dense compactness condition.

Grain size distribution testing was carried out on seven samples of the cohesive till deposit and one sample of the non-cohesive till deposit; the results are presented on Figure B-3 in Appendix B. Atterberg limits testing was carried out on six samples of the cohesive till deposit and one sample of the non-cohesive till deposit and measured liquid limits ranging from about 13 to 27 per cent, plastic limits ranging from about 11 to 16 per cent, and plasticity indices ranging from about 2 to 11 per cent. The Atterberg limits testing results are presented on Figure B-2 in Appendix B and indicate the till deposit is comprised predominantly of clayey silt of low plasticity, but that the zone encountered at the base of Borehole SWM-2 grades to silt and sand of slight plasticity. The natural water content measured on samples of the till deposit ranges from about 6 to 15 per cent, generally below or near the plastic limit of the deposit.

4.3 Groundwater Conditions

The groundwater levels in the open boreholes were measured during and upon completion of drilling operations, and are noted on the borehole records in Appendix A. Boreholes SWM-1 and SWM-2 were dry upon completion of drilling, and the water level was measured at a depth of 8.3 m below ground surface (Elevation 180.2 m) in Borehole 17-7 upon completion of drilling. The groundwater level or dry borehole conditions as measured in the open boreholes do not represent the stabilized groundwater conditions.

Borehole SWM-1 was instrumented with a standpipe piezometer screened in the cohesive till deposit. The groundwater level recorded in the standpipe piezometer is shown on the borehole record in Appendix A and summarized in the table below.

Borehole I.D.	Screened Unit	Ground Surface Elevation (m)	April 18, 2019	
			Depth to Groundwater (m)	Groundwater Elevation (m)
SWM-1	Clayey Silt Till	188.0	4.0	184.0

The groundwater level at this site will be subjected to seasonal fluctuations and precipitation events; the water level should be expected to be higher during the spring season or during and following periods of heavy precipitation.

5.0 CLOSURE

This Foundation Investigation Report was prepared by Ms. Darcy Hansen, E.I.T., and was reviewed by Ms. Nikol Kochmanová, P.Eng. a geotechnical engineer with Golder. Ms. Lisa Coyne, P.Eng., an MTO Foundations Designated Contact and Principal of Golder, conducted an independent technical and quality control review of the report.

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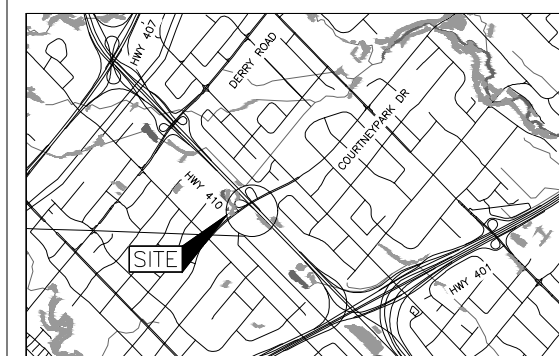
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SHEET



KEY PLAN
SCALE



LEGEND

- | | |
|---|--|
|  | Borehole — Current Investigation |
|  | Seal |
|  | Piezometer |
| N | Standard Penetration Test Value |
| 16 | Blows/0.3m unless otherwise stated
(Std. Pen. Test, 475 j/blow) |
|  | WL in piezometer, measured on April 8, 2019 |
|  | WL upon completion of drilling |

BOREHOLE CO—ORDINATES			
No.	ELEVATION	NORTHING	EASTING
17-7	188.5	4834625.3	290450.2
SWM-1	188.0	4834572.1	290485.6
SWM-2	188.2	4834551.6	290512.2

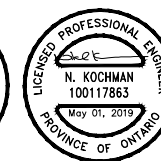
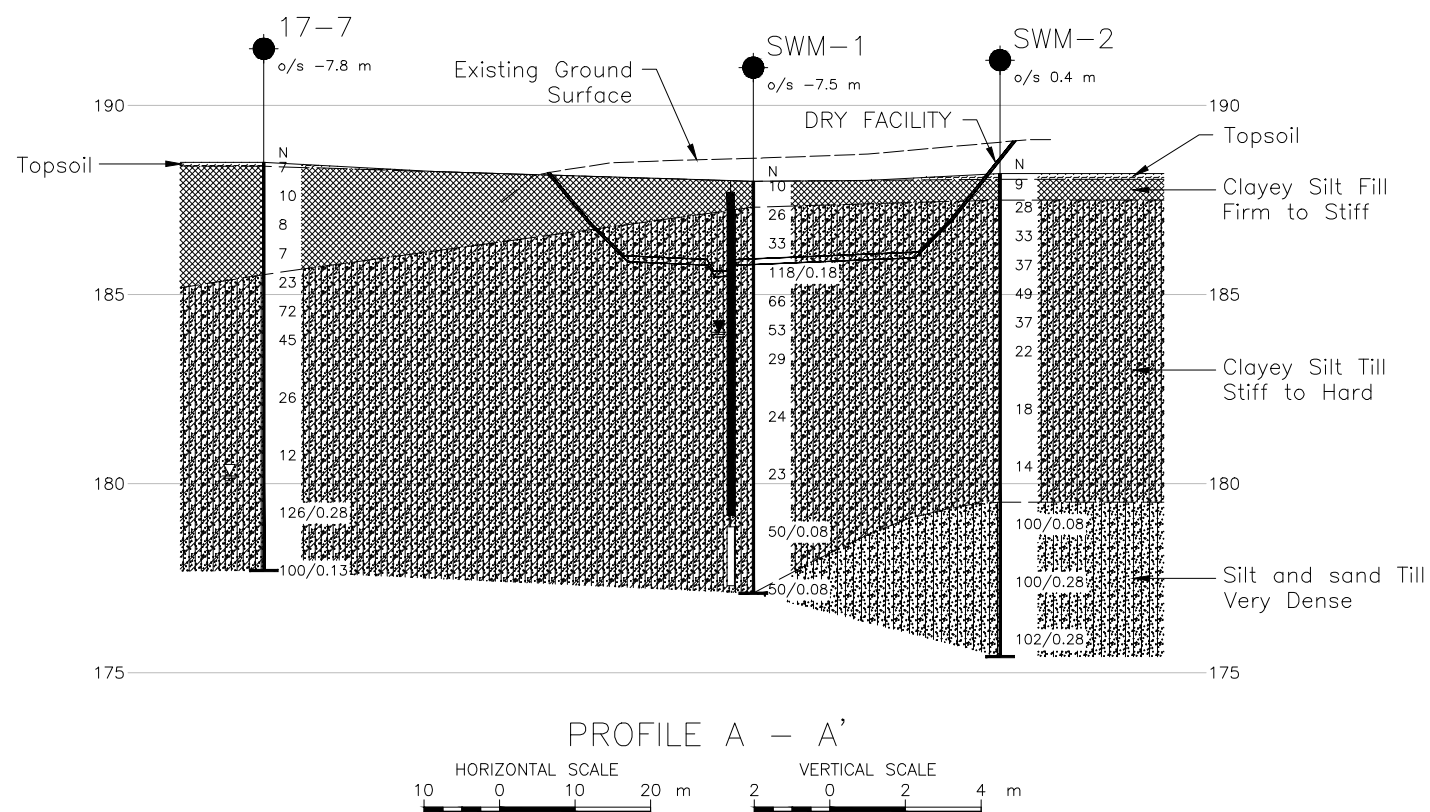
NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

REFERENCE

Base plans provided in digital format by AECOM, drawing file nos.
ACAD_X-60543038-C-ALI-HWY 410.dwg, X-60543038-C-Courtneypark-NO
- Addendum.dwg, received April 04, 2019,
ACAD-X-60543038-C-Base.dwg, received April, 12, 2019 and Dry Facility
Profiles Acad 2013 Scale 500.dwg, received April 16, 2019.



APPENDIX A

Borehole Records

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
$\ln x$,	natural logarithm of x
\log_{10}	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
FoS	factor of safety

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta \sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

(a) Index Properties (continued)

w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity index = $(w_l - w_p)$
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p) / I_p$
I_c	consistency index = $(w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_{α}	secondary compression index
m_v	coefficient of volume change
C_v	coefficient of consolidation (vertical direction)
C_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = $\tan \delta$
c'	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p'	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

* Density symbol is ρ . Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

Notes: 1
2

$\tau = c' + \sigma' \tan \phi'$
shear strength = (compressive strength)/2

LIST OF ABBREVIATIONS

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

I. SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
SS	Split-spoon
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open sampler for a distance of 300 mm (12 in.)

Dynamic Cone Penetration Resistance; N_d :

The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure

PM: Sampler advanced by manual pressure

WH: Sampler advanced by static weight of hammer

WR: Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT)

A electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm² pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

III. SOIL DESCRIPTION

(a) Non-Cohesive (Cohesionless) Soils

Compactness	N
Condition	Blows/300 mm or Blows/ft
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils Consistency

	C_u, S_u	
	kPa	psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	over 200	over 4,000

IV. SOIL TESTS

w	water content
w_p	plastic limit
w_l	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test ¹
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement ¹
D_R	relative density (specific gravity, G_s)
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
γ	unit weight

Note: 1 Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

V. MINOR SOIL CONSTITUENTS

Per cent by Weight	Modifier	Example
0 to 5	Trace	Trace sand
5 to 12	Trace to Some (or Little)	Trace to some sand
12 to 20	Some	Some sand
20 to 30	(ey) or (y)	Sandy
over 30	And (non-cohesive (cohesionless)) or With (cohesive)	Sand and Gravel Silty Clay with sand / Clayey Silt with sand

PROJECT		1669996		RECORD OF BOREHOLE No 17-7				SHEET 1 OF 1		METRIC							
G.W.P.		2369-15-00		LOCATION		N 4834625.3; E 290450.2 MTM NAD 83 ZONE 10 (LAT. 43.651441; LONG. -79.677895)				ORIGINATED BY SK							
DIST		Central HWY 410		BOREHOLE TYPE		152 mm O.D. Hollow Stem Augers; CME55 Track Mounted Drill Rig				COMPILED BY EN							
DATUM		Geodetic		DATE		November 08, 2018				CHECKED BY AMP							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
188.5	GROUND SURFACE							20	40	60	80	100					
0.0	TOPSOIL (100 mm)																
	Sandy clayey silt, some sand, trace gravel, trace rootlets, trace organic (FILL) Firm to stiff Brown, oxidization staining Moist		1	SS	7		188										
			2	SS	10												
			3	SS	8		187										
			4	SS	7		186										
185.5	Sandy CLAYEY SILT to CLAYEY SILT with SAND, trace to some gravel (TILL) Stiff to hard Brown to grey Moist to wet		5	SS	23		185										
3.0			6	SS	72												
			7	SS	45		184										
							183										
	- Grey below 6.1 m depth (Elev. 182.4 m)		8	SS	26		182										
							181										
	- Wet below 7.0 m depth (Elev. 181.5 m)		9	SS	12		180										
							179										
			10	SS	126/0.28												
							178										
177.7	END OF BOREHOLE		11	SS	100/0.13												
10.8	NOTES: 1. Water level measured in on open borehole at a depth of 8.3 m below ground surface (Elev. 180.2 m) upon completion of drilling and removal of augers.																

PROJECT 1669996		RECORD OF BOREHOLE No SWM-1					SHEET 1 OF 1			METRIC					
G.W.P. 2369-15-00		LOCATION N 4834572.1; E 290485.6 MTM NAD ZONE (LAT. 43.650963; LONG. -79.677454)					ORIGINATED BY SE								
DIST Central HWY 410		BOREHOLE TYPE 203 mm O.D. Hollow Stem Augers; CME 55 Track Mounted Drill Rig					COMPILED BY EN								
DATUM Geodetic		DATE March 4, 2019					CHECKED BY NK								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
188.0	GROUND SURFACE							20 40 60 80 100							
0.0	Sandy clayey silt, some gravel, trace organics (FILL)		1	SS	10										
187.3	Stiff Brown Moist														
0.7	CLAYEY SILT, some sand to with sand, trace to some gravel, containing shale fragments below 8.2 m (TILL)		2	SS	26		187								
	Very stiff to hard		3	SS	33		186								4 16 57 23
	Brown to grey below 4.5 m														
	Moist		4	SS	118/0.18										
	- Auger grinding at 0.8 m						185								
	- Auger refusal encountered at 2.8 m, borehole was moved 2 m south and drilling continued.		5	SS	66										
	- Auger grinding at 2.8 m to 3.0 m						184								
			6	SS	53										
							183								8 25 48 19
	- Auger grinding at 5.2 m														
							182								
							181								
							180								
	- Auger grinding at 8.2 m														
	- Shale fragments encountered below 8.2 m						179								
			10	SS	50/0.08										
	- Auger grinding at 9.8 m to 10.7 m						178								
177.1	END OF BOREHOLE		11	SS	50/0.08										7 33 49 11
10.9	NOTES:														
	1. Auger refusal was encountered in the original borehole at a depth of 2.8 m (Elev. 185.2 m). The borehole was moved 2 m south, and drilling continued.														
	2. Open borehole dry upon completion of drilling and installation of piezometer.														
	3. Water level in piezometer measured at a depth of 4.0 m below ground surface (Elev. 184.0 m) on April 18, 2019.														

PROJECT		1669996		RECORD OF BOREHOLE No SWM-2				SHEET 1 OF 1		METRIC							
G.W.P.		2369-15-00		LOCATION				N 4834551.6; E 290512.2 MTM NAD ZONE (LAT. 43.650779; LONG. -79.677124)		ORIGINATED BY							
DIST		Central HWY 410		BOREHOLE TYPE				152 mm O.D. Hollow Stem Augers; CME 55 Track Mounted Drill Rig		COMPILED BY							
DATUM		Geodetic		DATE				March 5, 2019		CHECKED BY							
										NK							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
188.2	GROUND SURFACE						20	40	60	80	100						
0.0	TOPSOIL (150 mm)																
0.2	Clayey silt, some sand, trace gravel, trace rootlets (FILL)		1	SS	9												
187.5	Stiff																
0.7	Brown Moist		2	SS	28												
	Sandy CLAYEY SILT, trace to some gravel (TILL)																
	Stiff to hard		3	SS	33												
	Mottled brown to grey below 4.2 m																
	Moist																
			4	SS	37												
			5	SS	49												
			6A	SS	37												
			6B	SS	37												
			7	SS	22												
			8	SS	18												
			9	SS	14												
	- Auger grinding at a depth of 8.2 m																
179.5	SILT and SAND, trace to some gravel, trace to some clay (TILL)																
8.7	Very dense		10	SS	100/0.03												
	Grey Moist																
	- Trace rock fragments at 9.8 m																
	- Auger grinding from 9.2 m to 10.7 m		11	SS	100/0.28												
			12	SS	102/0.28												
175.4	END OF BOREHOLE																
12.8	NOTES:																
	1. Borehole dry on completion of drilling.																
	2. Borehole caved to 10.4 m on removal of augers.																

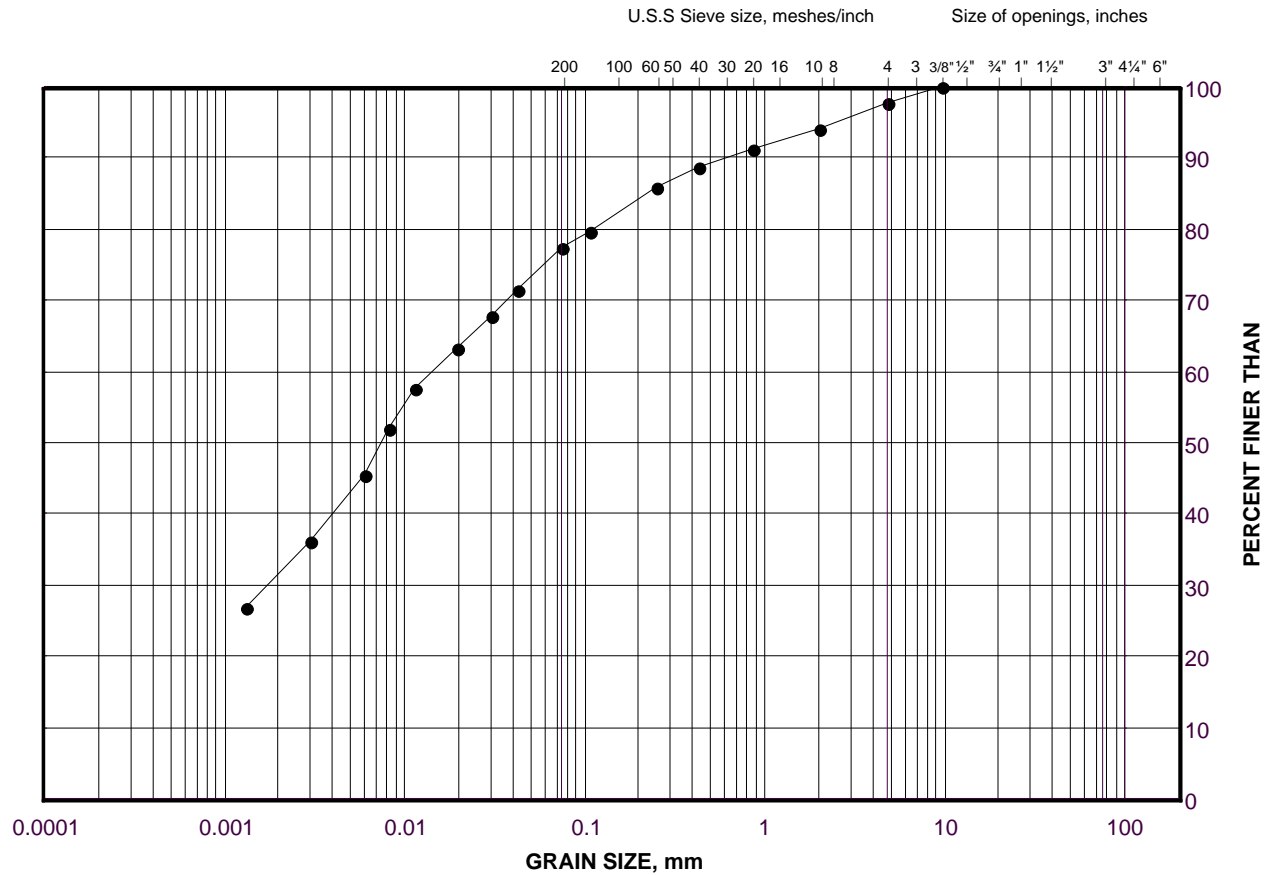
APPENDIX B

Geotechnical Laboratory Test Results

GRAIN SIZE DISTRIBUTION

Sandy Clayey Silt Fill

FIGURE B-1



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

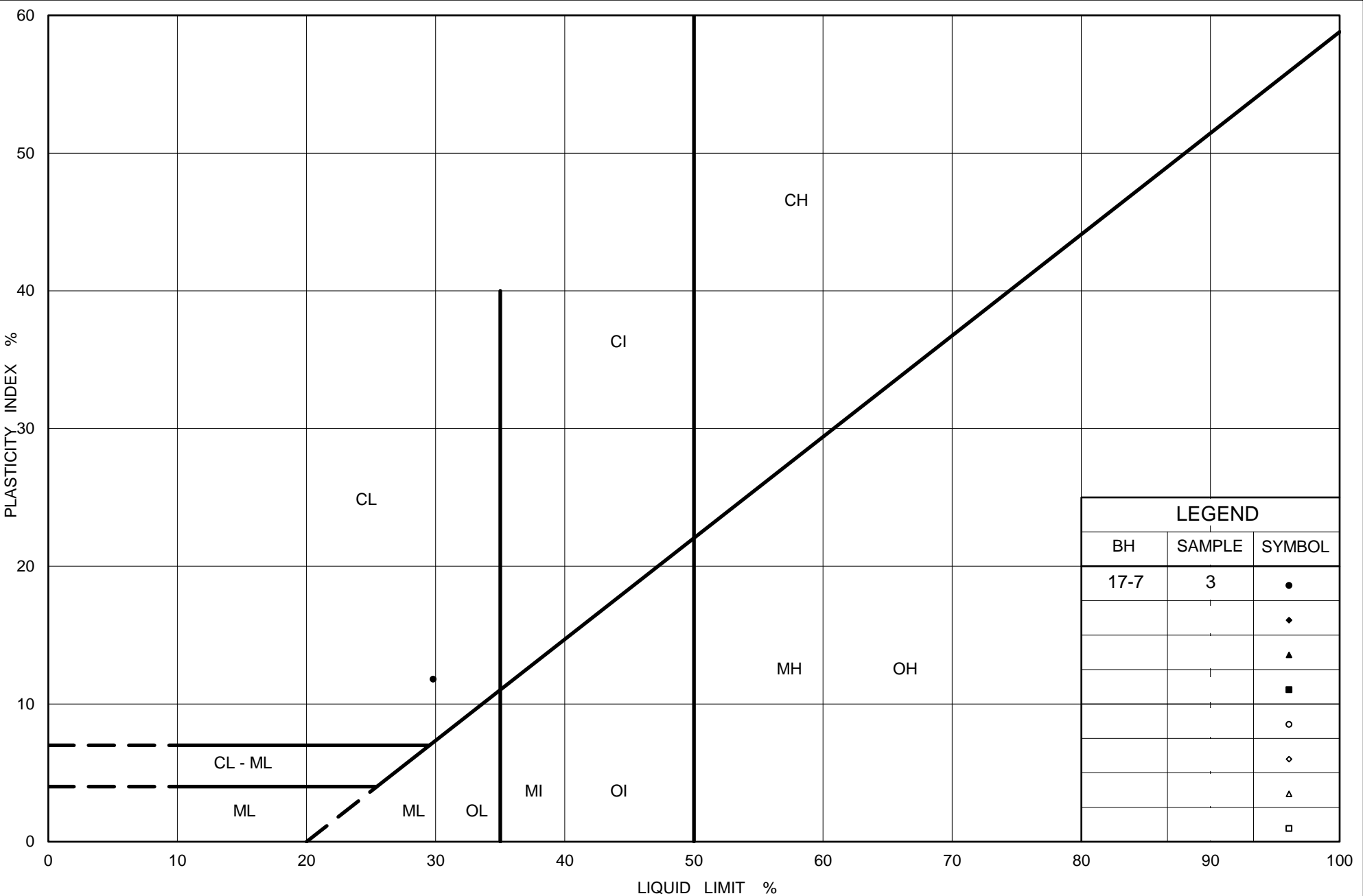
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
•	17-7	3	186.7

Project Number: 1669996

Checked By: NK

Golder Associates

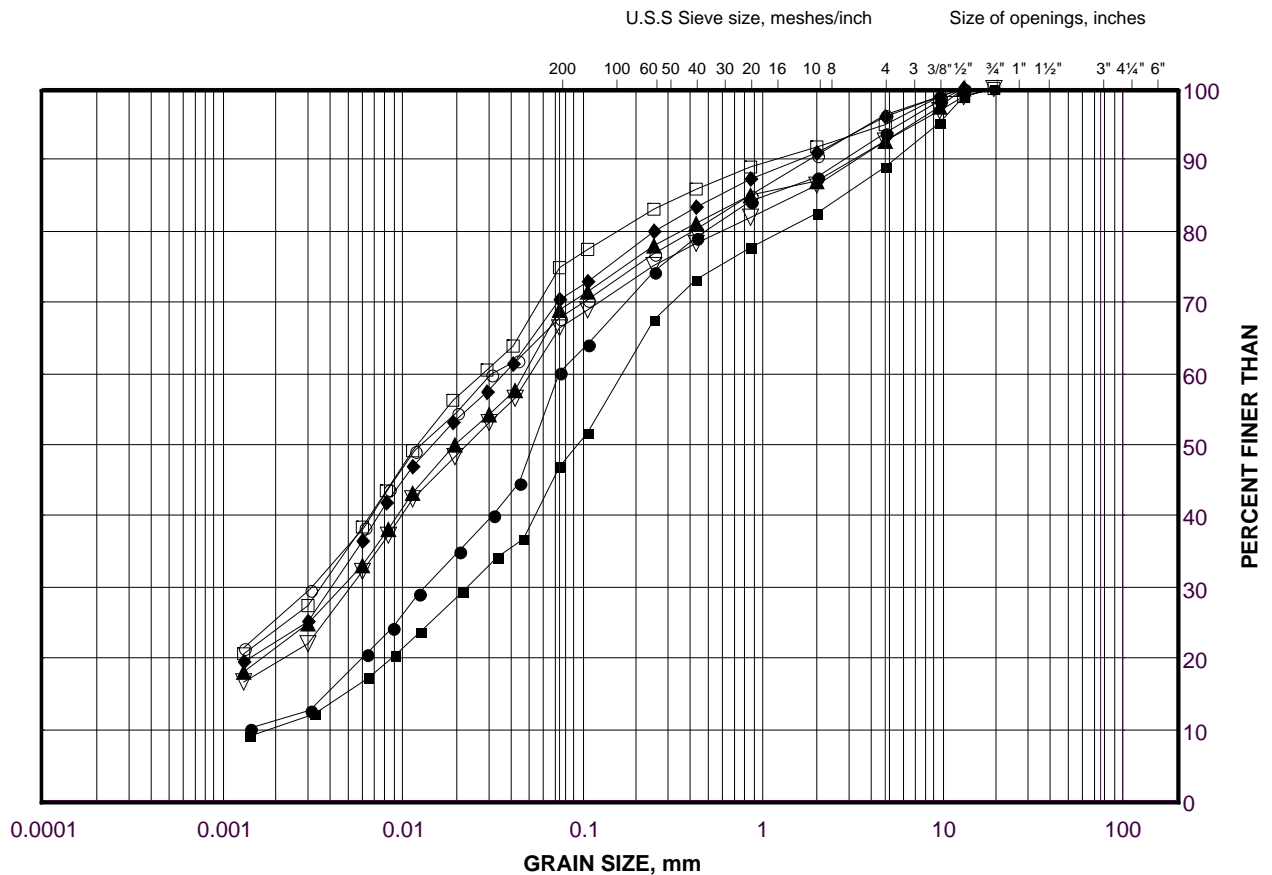
Date: 17-Apr-19



GRAIN SIZE DISTRIBUTION

Clayey Silt Till

FIGURE B-3A



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	SWM-1	10	177.0
■	17-7	10	179.2
◆	SWM-1	3	186.2
▲	SWM-2	4	185.6
▽	SWM-1	7	182.9
○	17-7	7	183.6
□	SWM-2	9	180.3

Project Number: 1669996

Checked By: NK

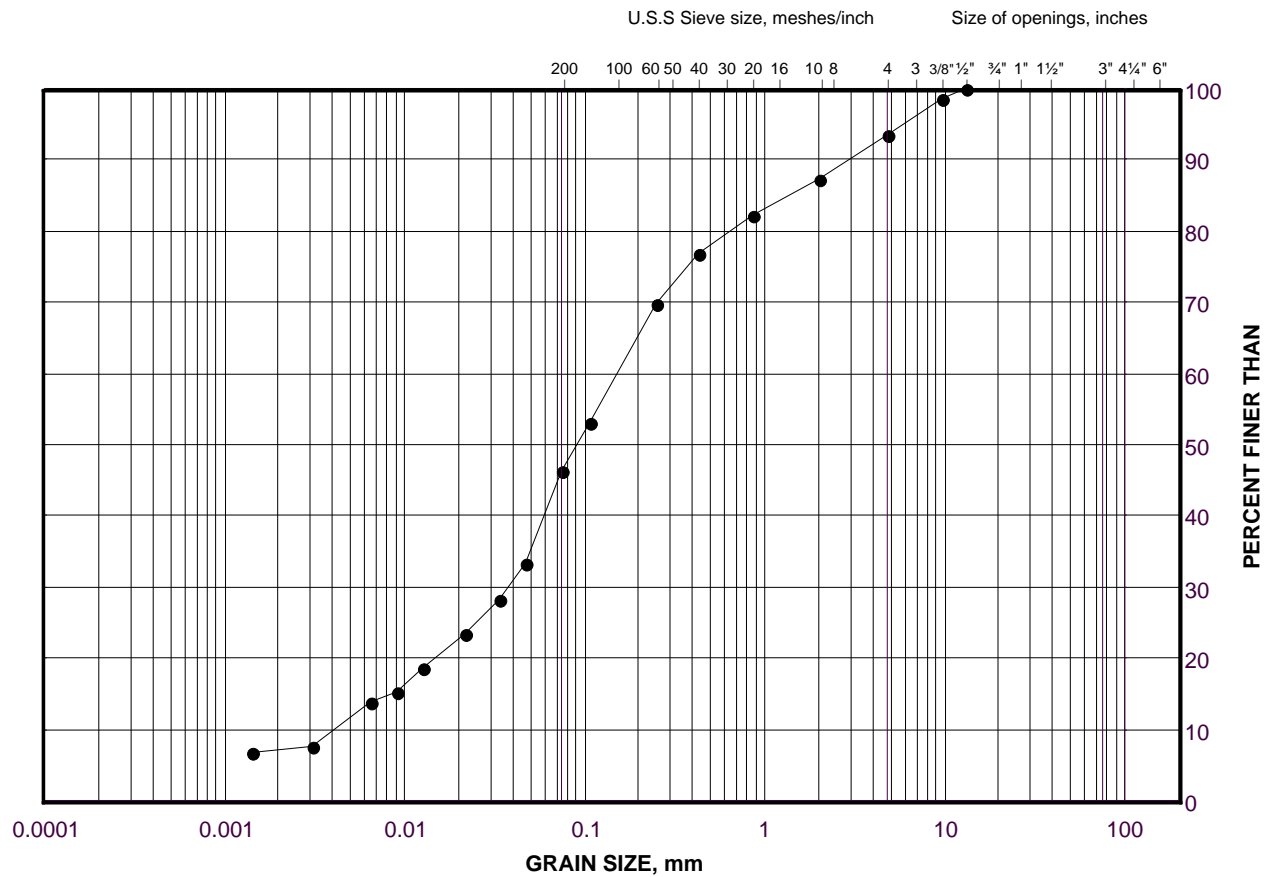
Golder Associates

Date: 17-Apr-19

GRAIN SIZE DISTRIBUTION

Silt and Sand Till

FIGURE B-3B



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

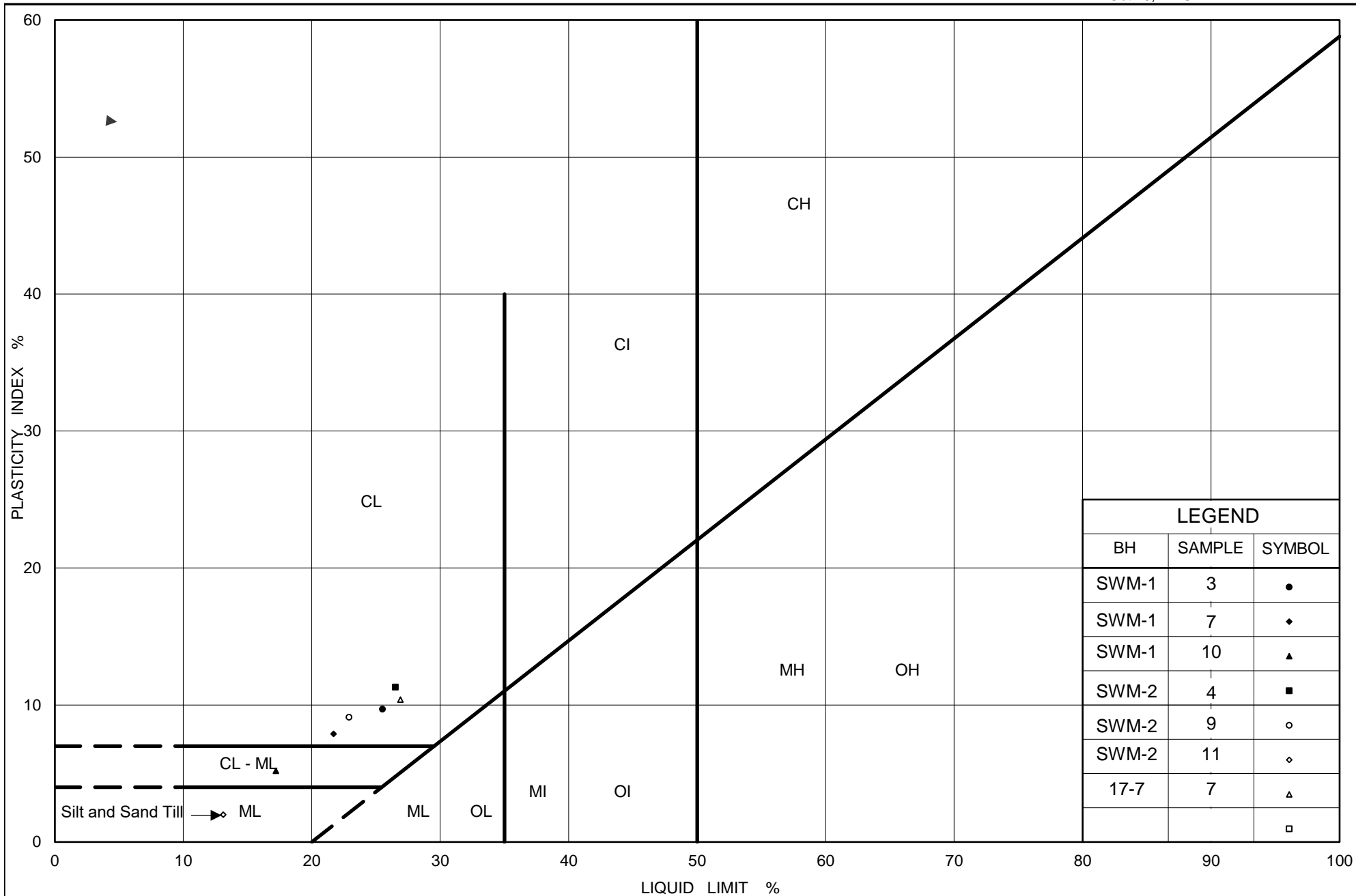
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
•	SWM-2	11	177.2

Project Number: 1669996

Checked By: NK

Golder Associates

Date: 17-Apr-19



Ministry of Transportation

Ontario

PLASTICITY CHART

Clayey Silt Till to Silt and Sand Till

Figure No. B-4

Project No. 1669996 (2200)

Checked By: NK



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