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Appendix P

Geotechnical Investigation Report

GEOTECHNICAL INVESTIGATION
SCHEDULE "B" CLASS ENVIRONMENTAL ASSESSMENT
SHERIDAN PARK DRIVE EXTENSION
MISSISSAUGA, ONTARIO

for

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Dear Ms. Vandermeer

Geotechnical Investigation
Schedule "B" Class Environmental Assessment
Sheridan Park Drive Extension
City of Mississauga, Ontario

Peto MacCallum Ltd (PML) is pleased to submit our geotechnical investigation report for the above-referenced project. Authorization to proceed with this assignment was provided through email by Ms. Vandermeer on April 05, 2017. Our services were provided in accordance with our Proposal No. FQT8714 dated August 18, 2016.

It is our understanding that plans include construction of the Sheridan Park Drive extension, reconstruction of both the east and west segments of Sheridan Park Drive, construction of new utilities and replacement of underground utility services within the road segments. At the time of this report, road profile drawings showing road grades and utility invert levels were not available.

The purpose of this investigation is to provide geotechnical comments and recommendations for the Sheridan Park Drive extension which will connect the east and west sections of Sheridan Park Drive as well as reconstruction of limited sections of the east and west portion of Sheridan Park Drive. The scope of work for this study included limited chemical testing of selected soil samples to provide options for soil disposal.

The comments and recommendations provided in this report are based on site conditions at the time of this investigation, and are applicable only to the proposed construction project as described in the report. Any changes in the project information will require review by PML to assess the validity of the report and may require modified recommendations, additional investigation and/or analysis.

STREET DESCRIPTION

The existing Sheridan Park Drive is a two-lane undivided road section approximately 10 m wide, and extends from Winston Churchill Boulevard to Speakman Drive. The length of the proposed Sheridan Park Drive extension is approximately 880 m (between the dead ends at west of Speakman Drive/Homelands Drive and east of Winston Churchill Boulevard). The road extension grade slopes downward toward the east with grades varying between elevation 152.8 m and 146.5 m, with topographic relief of approximately 6.0 m. Underground utility services, such as water, storm and sanitary sewers are present along the proposed extension and existing segments of Sheridan Park Drive.

Currently Sheridan Park Drive terminates at Speakman Drive/Homelands Drive on the east and at Speakman Drive just east of Winston Churchill Boulevard on the west. As identified in Mississauga Official Plan, the road is classified as a Major Collector in the City of Mississauga. The traffic data provided by RJ Burnside for the subject road is as below:

TABLE 1

TRAFFIC DATA

STREET	SECTION	DAILY			PERCENT
		EXISTING	**2021**	**2031**	**TRUCKS**
Sheridan Park	Winston Churchill to Speakman	6700	9800	10400	2%
	Speakman to Speakman / Homelands	0	2600	2100	2%
	Speakman / Homelands	7100	9300	9500	1%
Speakman (west)	East of South Sheridan Park	6700	7700	8900	2%
Speakman (east)	South Sheridan Park	5200	5200	5700	1%
Homelands	North Sheridan Park	5500	5300	5600	3%

It is assumed that the road extension will match the elevation of Sheridan Park Drive at the west end (elevation 152.7 m) and closely follow the existing site topography to match the elevation of Sheridan Park Drive at the east end (elevation 146.5 m).

INVESTIGATION PROCEDURES

The field work for this investigation was carried out between September 11 and 13, 2017. Prior to the field work, the site was cleared for the presence of underground services and utilities. A total of eighteen boreholes, labelled BH1 through BH18, were drilled as part of this investigation. The boreholes were advanced to depths ranging from 2.8 to 4.7 m. The approximate locations of the boreholes are shown on the borehole location plan, Drawing 1, appended. The boreholes were located using a Garmin GPSMAP 64 GPS (Global Positioning System) receiver using NAD 83 datum (North American Datum). The geodetic elevation of the boreholes locations was determined by PML’s field personnel using the following geodetic benchmark.

> City of Mississauga Bench Mark Number 601 Located on the North Face at the Main Entrance of Homelands Senior Public School on the South Side of Homelands Dr., 440 ft. West of the W. Branch of Pyramid Cres”. Geodetic elevation 152.685 m.

The boreholes were advanced using a combination of truck mounted drill rig B53 and rubber track drill (similar to CME 55) equipped with 150 mm diameter continuous flight solid stem augers supplied and operated by a specialist drilling contractor.

Representative soil samples were taken at regular depth intervals using a conventional split spoon sampler in conjunction with Standard Penetration Tests. The groundwater conditions in the open boreholes were assessed during drilling by visual examination of the soil, the split spoon sampler and drill rods as the samples were being retrieved and, where encountered, by measuring the groundwater level in the open boreholes.

The recovered samples were returned to our laboratory for detailed visual examination and routine testing to confirm visual field classifications. Moisture content determination tests were conducted on all retrieved samples. Grain size analyses were conducted on ten selected samples. The results of the moisture content determinations are reported on the borehole logs. The results of the grain size analyses are shown on Figures GS-1 to GS-3.

SUMMARIZED SUBSURFACE CONDITIONS

Published Geology

A review of surficial geology maps provided by Department of Energy, Mines and Resources Canada suggest that the surficial geological soil deposits underlying the proposed street are composed of clay to silt textured till, derived from glaciolacustrine deposits or shale. The bedrock formation belongs to the Queenston Formation which typically comprises shale, limestone, siltstone and dolomite.

Summarized Subsurface Conditions

Reference is made to the appended Log of Borehole sheets for details of the field work including soil classification, inferred stratigraphy, standard penetration resistance N values, groundwater observations and laboratory test results.

Due to the soil sampling procedures and limited sample size, the depth/elevation demarcations on the borehole logs must be viewed as "transitional" zones between layers, and cannot be construed as exact geologic boundaries between layers.

It should be noted that a limited number of boreholes were advanced in pavement area, and the contractor must be aware that variations in the thickness of the asphalt and granular base and subbase should be expected. The contract documents should incorporate an allowance for such variations which may impact removal of existing pavement or additional requirement for new pavement materials.

A description of the pavement structure and subgrade conditions is provided in the following paragraphs. Table A1 included in Appendix A shows the pavement structure thickness encountered in boreholes BH1 to BH6 and BH13 to BH18 advanced on the existing pavement structures within the project limits.

The pavement structure and topsoil thicknesses are approximate field measurements. They should not be used for determining exact removal quantities as the thicknesses may vary at locations away from boreholes.

Asphalt

An asphalt layer 100 to 200 mm in thickness was encountered in boreholes BH1 to BH6 and BH13 to BH18 overlying granular base/subbase. The median thickness of asphalt layer was about 150 mm.

Granular Base/Subbase

Below the asphalt, a granular base/subbase consisting of sand and gravel was observed within the boreholes advanced on the existing road. The thickness of the granular base/subbase ranged from 400 to 500 mm with a median thickness of 450 mm. Moisture contents of the granular base/subbase ranged from 4 to 15%.

The total pavement structure thickness including asphalt and granular base/subbase ranged from 500 mm (BH3) to 700 mm (BH6).

Fill

Underlying the pavement structure, fill consisting of sand-silt-clay, trace to some gravel was encountered in all boreholes, advanced on the existing road, except BH14 and 18. About 0.6 m of surficial fill was encountered in borehole BH12. Occasional pockets of organics were found in fill material in boreholes BH2 and 13. The fill extended to depths ranging from 0.5 to 2.7 m depth in BH3 and 6 respectively. N values in the fill ranged from 9 to 22 indicating a very loose to compact relative density.

Topsoil

Surficial topsoil 100 and 150 mm thick was encountered in boreholes BH10 and 11, respectively. The topsoil is generally described as being black mixed with some organics, rootlets and some soil at lower parts.

Silty Clay to Clayey Silt

Silty clay was encountered underneath the fill in BH1 and BH13, and topsoil in BH10 to depths ranging from 0.6 to 1.4 m. Brownish red silty clay to clayey silt was encountered at the ground surface in boreholes BH8 and BH9, and extended to depth ranged from 0.6 to 1.0 m. Underneath the pavement structure in borehole BH14, brownish grey to light grey silty clay to clayey silt was contacted to a depth of 1.4 m.

N values in the silty clay to clayey silt stratum ranged between 11 and 29, indicating a stiff to very stiff consistency. The natural moisture content varied between 8 and 14%, indicating a moist condition.

Silty Clay Till

Underlying the silty clay, a deposit of silty clay till was encountered in BH1 to a depth of 3.8 m.

N value in this stratum was greater than 50, indicating a hard consistency. The natural moisture content of the silty clay till sample ranged from 6 to 8%, indicating a slightly moist to moist condition.

Clayey Silt Till

A very stiff to hard, brownish red surficial clayey silt till deposit was encountered in borehole BH7 and extended to depth 4.7 m. Underneath the fill in boreholes BH2, 3, 4, 5, 6, 12, 15, 16 and 17; topsoil in borehole BH11, silty clay in boreholes BH10 and 13, silty clay to clay silt in boreholes BH8, 9 and 14, and pavement structure in borehole BH18, brownish red to brownish grey clayey silt till deposit was contacted to depths ranging from 2.4 to 4.6 m. N values in this stratum ranged from 8 to greater than 50, indicating the deposit is stiff to hard in consistency. The natural moisture content of the clayey silt till sample ranged from 5 to16%, indicating slightly moist to very moist condition.

Shale Bedrock

Refusal over inferred shale bedrock was encountered at depths ranging from 2.5 m or elevation 145.1 m (BH12) to 4.6 m or elevation 148.1 m (BH4).

Bedrock at east segment of the Sheridan Park Drive extension, especially near the intersection of Homelands Drive/Speakman Drive is anticipated to be shallow, depths ranging from 2.7 to 4.6 m as encountered in boreholes BH15, 16, 17 and 18.

Based on the available geologic information the shale bedrock underlying the site belongs to the Queenston Formation.

Groundwater Conditions

Ground water was not encountered in the boreholes during field drilling. It should be noted that sufficient time did not elapse between the drilling and backfilling of boreholes for the groundwater to stabilize due to which the groundwater conditions at the end of drilling are not representative of stabilized groundwater levels. Groundwater levels could fluctuate with seasonal weather conditions, (i.e. rainfall, droughts, spring thawing).

ASPHALT VISUAL CONDITION SURVEY

A visual condition survey was carried out during field drilling operations between September 11 and 13, 2017 on the west segment (length approximately 150 m) and east segment of Sheridan Park Drive (length approximately 270 m up to the intersection with Homelands Drive/Speakman Drive). The visual survey was conducted using the guidelines provided by the Ministry of Transportation’s Manual for Condition Rating of Flexible Pavements (August 1989), SP-024. It should be noted that the condition survey reflects general surface and cracking distress observed at the time of the investigation and not a comprehensive pavement condition survey. Photographs of typical distress manifestations are referenced in Table 2. The typical pavement distress observed on the existing road segments consisted of the following:

TABLE 2

TYPICAL DISTRESS MANIFESTATIONS

	TYPE OF DEFECT	DISTRESS MANIFESTATION	SEVERITY	DENSITY	PHOTOGRAPH NO.
	Surface	Coarse aggregate loss and crack	Slight to Moderate	Intermittent	P1
	Surface	Coarse aggregate loss and crack	Moderate	Intermittent	P2
	Surface	Distortion, cracks and patching	Moderate	Intermittent	P3
	Surface	Distortion from frost heaving	Severe	Intermittent	P4
	Surface	Distortion from frost heaving	Severe	Intermittent	P5
Cracking	Longitudinal and Transverse crack	Single, Multiple (along curb line)	Slight to moderate	Intermittent	P6
	Longitudinal and Transverse cracks	Single to Multiple	Slight	Intermittent	P7
	Transverse and Longitudinal cracks	Single to Multiple	Slight	Intermittent	P8
	Transverse and Longitudinal	Single, Multiple	Slight	Frequent	P9
	Pavement Edge	Single, Multiple	Moderate	Frequent	P10
	Pavement Edge	Cracks	Slight to moderate	Frequent	P11
	Pavement Edge	Cracks	Slight	Few	P12
	Longitudinal to Transverse	Cracks	Moderate	Intermittent	P13
	Pavement edge crack	Cracks	Slight	Frequent	P14

Distortion is caused by differential frost heave or lack of subgrade support. Longitudinal and transverse cracks can occur due to frost action, natural shrinkage caused by low temperature and may also be age-related.

ENGINEERING DISCUSSION AND RECOMMENDATIONS

Existing Pavement Structure

The subsurface investigation indicates the following pavement structure at the existing road segments at east and west sides of Sheridan Park Drive as shown in Table 3.

TABLE 3

EXISTING PAVEMENT STRUCTURE

Pavement Component	Minimum	Maximum	Median	Average
Asphalt Concrete (mm)	100	200	150	150
Base /Subbase (mm)	400	500	450	465
Total Pavement Structure (mm)	500	700	600	615

The existing Granular Base Equivalency based on median thickness of pavement components is 410. In general, the subsurface investigation indicates uniform asphalt and granular base/subbase conditions at the tested areas. The moisture content determinations on recovered subgrade soil samples indicates relatively higher moisture contents in localized areas such as borehole 5, 13 14, 15 and 17, likely indicating poor drainage conditions in these areas.

Traffic Loading

The equivalent single axle loads (ESAL) for the design lanes were calculated using traffic data provided by the client. Based on the provided traffic data, the maximum cumulative ESALs correspond to an AADT of 5,500 with truck traffic of 3% assuming a growth rate of 3% and a 20 year design life. The input parameters for the design lane ESAL calculation were obtained from the AASHTO Guide for Design of Pavement Structure (1993).

Recommended Pavement Structure Thicknesses

New Road Extension

The pavement structure was designed based on the calculated cumulative ESALs estimated from the provided AADT and subsurface conditions encountered during this investigation. The following references and guidelines were used for pavement design.

- American Association of State Highway and Transportation Officials, “AASHTO Guide for Design of Pavement Structures”, 1993.
- MTO’s “Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions”, March 19, 2008.
- Mississauga Transportation and Works Standard, Pavement and Road Design Base Requirements, 2002.

The AASHTO design parameters used are shown in Table 4.

TABLE 4

SUMMARY OF PARAMETERS USED IN THE PAVEMENT DESIGN

DESIGN PARAMETERS	VALUES
Initial Serviceability Index for New Construction	4.4
Terminal Serviceability Index	2.2
Reliability Level (%)	88
Standard Deviation	0.45
Drainage Coefficient for Granular base and Subbase	1.0
Layer Coefficient of new Hot-mixed Asphaltic Concrete	0.42
Layer Coefficient of Granular Base material (OPSS Granular A)	0.14
Layer Coefficient of Granular Subbase material (OPSS Granular B)	0.09

The modulus of subgrade resilient is estimated to 20 MPa for a subgrade consisting of fine grained soil (silty clay). Based on above references, the thickness of the pavement structure for a major collector with an AADT of 5500 including 3% Truck traffic is shown in Table 5 below:

TABLE 5

RECOMMENDED PAVEMENT STRUCTURE THICKNESS

PAVEMENT COMPONENT	AASHTO 1993	CITY OF MISSISSAUGA 2002[1]
Surface Course Asphalt	40 mm	40 mm
Base Course Asphalt	100 mm	100 mm
Granular A Base course	150 mm	200 mm
Granular B Subbase course	300 mm	400 mm
Total Pavement Structure	**590 mm**	**740 mm**
GBE*	630 mm	748 mm

*GBE factor: Asphalt: 2, Granular Base: 1, Granular Subbase: 0.67

[1] Based on collector road and a frost susceptibility factor of 11 which consists of a soil with maximum of 55% silt.

Based on the above, the City of Mississauga pavement section is recommended for the new road extension as the City of Mississauga method addresses local conditions, such as the frost susceptibility of the road subgrade.

<u>Pavement Structure for Existing Road</u>

Based on the observed pavement distresses along with the pavement structure encountered in the boreholes, three options are provided for rehabilitation/reconstruction of both the west and east segments of Sheridan Park Drive including Homelands Drive/Speakman Drive intersection.

1. Full Depth Reconstruction which consists of removal of asphalt and granular base and replacement.

2. Partial removal of asphalt and granular and resurfacing with new granular and asphalt.

3. Do Nothing, i.e. Leave the pavement structure as it is.

The advantages and disadvantages of each option are discussed in the Table 6 below:

TABLE 6

ADVANTAGE AND DISADVANTAGES OF REHABILITATION OPTIONS

OPTION	ADVANTAGES	DISADVANTAGES
Option 1: Full Depth Reconstruction	• Minimizes frost action effects due to provision of uniform non-frost susceptible materials. • Longer Service Life • Allows for incorporation of other improvements such as drainage, utilities. • Lower maintenance costs over service life of pavement • Allows for remediation of any subgrade issues due to moisture infiltration.	• High initial cost due to removal and disposal of existing pavement structure and incorporation of new pavement structure. • More Traffic Disruption due to more time required for construction. • Removal/or relocation of utilities would disrupt road traffic.
Option 2: Resurfacing	• Relatively lower initial cost due to less requirements for excavation and materials. • Less traffic disruption as it reduces amount of excavation required.	• Shorter service life since existing granular materials do not meet performance standards and are not of uniform depth across the length of the road. • Need for disposal of removed asphalt and granular materials. • Higher maintenance costs as compared to Option 1. • Does not allow for remediation or inspection of the soil subgrade.
Option 3: Do Nothing	• No excavation and removal of pavement structure required thereby reducing disruption of traffic operations. • No initial construction costs.	• Higher maintenance costs as compared to Options 1 and 2. • Shorter service life of less than 3 years.

All the options are discussed in details in the following paragraphs.

Option 1: Reconstruction

The reconstruction option would consist of the City of Mississauga pavement section similar to the pavement section of the road extension. The pavement section would be reconstructed as follows:

Remove the existing asphaltic concrete and granular fill to accommodate a new hot mix asphalt (HMA) over Granular A base and Granular B subbase. The reconstructed pavement structure would consist of the following elements.

Surface Course HMA, Superpave 12.5, OPSS 1151 or equivalent	40 mm
Base Course HMA, Superpave 19.0, OPSS 1151 or equivalent HMA	100 mm
Granular A Base, OPSS 1010	200 mm
Granular B Base, OPSS 1010	400 mm
Total Pavement Thickness	740 mm
Granular Base Equivalency Thickness	748 mm
Minimum Excavation Required	740 mm
Grade Raise	None
Estimated Design Life	20 years

The design life provided assumes routine maintenance is performed over the life of the pavement.

Option 2: Resurfacing with New Asphalt and Granular

Remove existing asphalt concrete and underlying granular fill to depths required to accommodate new HMA and 200 mm of new Granular A base as follows:

Surface Course HMA, Superpave 12.5, OPSS 1151 or equivalent	40 mm
Base Course HMA, Superpave 19.0, OPSS 1151 or equivalent HMA	100 mm
Granular A Base, OPSS 1010	200 mm
Existing Granular based on median values	250 mm
Total Pavement Thickness	590 mm
Granular Base Equivalency Thickness	605 mm
Excavation Required	340 mm
Grade Raise	None
Estimated Design Life	12 years

Option 3: Do Nothing

In this case the existing pavement will be left in place and will have the following section.

Surface and Base Course HMA,	150 mm
Old Existing Granular based on median thickness	450 mm
Total Pavement Thickness	600 mm
Granular Base Equivalency Thickness	410 mm
Excavation Required	None
Estimated Design Life	Less than 3 years

RECOMMENDED PAVEMENT REHABILIATION OPTION

It is recommended that Option 1, Full Depth Reconstruction be considered for the existing road segments since with the exception of one sample, the tested /existing granular base and subbase materials contain fines ranging from 13 to 27%.

Based on OPSS.MUNI 1010 (2013), the percentage of material passing the 75 µm sieve (silt and clay sized particles) should be less than 8% for Granular A and Granular B Type 1 materials.

The excessive content of fines in the existing granular materials renders the pavement structure susceptible to the damaging effects of frost action. Differential frost heave creates a hazard for the driving public and, during the thawing period, the pavement structure is subjected to a reduction in the support strength of the granular materials leading to deterioration of the overall pavement structure. The distress manifestations associated with damage due to frost action and reduced subgrade/granular material support strength were evident in existing pavement in the form of severe cracks and distortion of the pavement surface. Thus, if the existing granular material is left in place, the overall performance of pavement structure will be severely compromised resulting in higher maintenance costs and shortened service life.

Based on our findings, the existing pavement has out lived its useful service life; full-depth reconstruction is recommended.

Material Types

All pavement materials should be in accordance with relevant OPSS specifications. The new Granular A base course should be placed in 200 mm loose lifts and also compacted to a minimum 100% SPMDD within ±2% of its optimum moisture content. All compaction operations should be supervised by geotechnical personnel from PML. Frequent inspection, sampling and testing by PML personnel is recommended to approve the granular compaction and the design properties and placement of the asphalt. Reference is made to OPSS 330 for In-Place Full Depth Reclamation of Bituminous Pavement and Underlying Granular and OPSS 310, for asphalt compaction requirements.

Superpave 9.5 or equivalent is recommended as padding for the pavement. It should be placed in maximum lifts of 50 mm.

Tack coat (SS-1) should be applied to construction joints prior to placing hot mix asphalt to create an adhesive bond. Prior to placing hot mix asphalt, SS1 tack coat must be applied to all existing milled surfaces and between new lifts. Application of tack coat shall be in accordance with OPSS 310 requirements. The tack coat should meet OPSS 1103 requirements.

Reuse of Existing Granular Materials

Grain size analyses were carried out on eight granular base and subbase materials and two subgrade materials consisting of fine grained soil. The grain size distribution results of tested samples of the base, subbase and subgrade materials are shown below.

TABLE 7

GRAIN SIZE DISTRIBUTION RESULTS

SAMPLE IDENTIFICATION	% GRAVEL	% SAND	% SILT & Clay
BH1, SS1	30	52	18
BH1, SS2	2	10	88
BH 4, SS1	23	56	21
BH5, SS1	13	60	27
BH6, SS1	40	47	13
BH13, SS1	27	60	13
BH14, SS1	27	70	3
BH14, SS2	9	15	76
BH15, SS1	25	57	18
BH18, SS1	40	41	19

The test results indicate that the tested granular samples do not meet the OPSS. PROV 1010 Granular A and Granular B specifications, except for one sample retrieved from borehole BH14, which meets requirements for Granular B Type I.

The test results indicate that, in general, granular material removed from the existing base and subbase layers cannot be used as base or subbase in a new pavement structure where free-draining granular base/subbase materials meeting OPSS.PROV 1010 requirements are specified. However, this material can be used as fill, in select applications approved by the design engineer, provided it is free of topsoil, organic and any deleterious materials.

Asphalt Cement Grade

The recommended (minimum) asphalt grade for both surface and base course hot mix asphalt is PGAC 64 - 28 meeting OPSS MUNI 1101 November 2016 requirements.

Drainage

For the pavement to function properly, provision must be made for water to drain out of, and not collect in, the granular courses. It is recommended that full-length perforated sub-drain pipes of 150 mm diameter be installed along both sides of the road extension and the reconstructed pavement below the roadbed level, to ensure effective drainage in accordance with OPSD 216.021. The sub-drain pipes should be surrounded by 20 mm size clear stone drainage zone of minimum 150 mm thickness, which should have suitable non-woven geotextile wraparound to minimize infiltration of fines in pipes which would reduce their effectiveness. A minimum slope of 2% should be maintained throughout the paved sections to ensure proper surface drainage.

Frost Susceptibility

The subgrade soil mainly comprised of sand-silt-clay fill and silty clay to clayey silt till. Silt and clay is considered as highly frost susceptible material and shall not be used for backfilling the utility trenches or raising the grade within the frost depth. A frost depth of 1.2 m is recommended for this site for design purposes.

OTHER CONSIDERATIONS

Excavation

According to information provided by R.J Burnside, a 500/600 mm diameter watermain, 250/375 mm diameter sanitary sewer and a 250/525/600/1500 mm diameter storm sewer pipe are planned along the proposed road extension. It is anticipated that the excavation for the replacement/installation of the proposed sanitary sewer pipes will extend to about 3.0 m depth below the existing ground surface.

The overburden soils encountered across the site consist of the pavement structure, fill, and silty clay to clayey silt till. Conventional open cut excavation methods should be feasible for the construction of the utilities and road extension. Construction excavation must be carried out in accordance with the Occupational Health and Safety Act (OHSA), Ontario Regulations 213/91, amended to Reg. 628/05. According to OHSA, the existing fill and stiff silty clay to clayey silt till encountered at this site can be classified as Type 3, very stiff and hard silty clay to clayey silt till can be classified as Type 2 and Type 1 soil, respectively. The OHSA stipulates an excavation to be cut at a specified inclination based on soil types. Therefore, shallow temporary excavations in overburden soil for this project should be cut at an inclination of 1 horizontal to 1 vertical (1H:1V) for a temporary excavation starting at the base of the excavation. It may be necessary to further flatten the trench side slopes if excessively soft conditions or concentrated seepage zones are encountered locally.

In the event that the aforementioned slopes are not possible to achieve due to space restrictions, the excavation shall be shored according to OHSA O. Reg. 213/91 and its amendments.

Trench side slopes should be continuously examined for evidence of instability, particularly following periods of heavy rain, thawing or when the trench has been left open for extended periods of time. When required, appropriate remedial action must be taken to ensure the continued stability of the trench slope and the safety of workers in the trench.

A trench box may be used in excavations less than 6.0 m deep in Type 1 to Type 3 soils only and provided the groundwater is lowered below the depth of the excavation. The trench box should be placed immediately after the excavation is completed and the excavation backfilled immediately after the trench box is removed. No loads should be placed on the trench boxes. PML should be consulted to evaluate the soil conditions during construction to determine the suitability of the excavation support method.

Foundations of heavily loaded/settlement sensitive structures and/or utilities located within close proximity to the excavation may require underpinning to preserve the integrity of these structures. Further comments and general recommendations in this regard are presented in Figure 1.

Earth Pressure Parameters

In areas where open cut excavations with 1H : 1V side slope are not feasible due to space limitations a shoring system should be used to support the walls of the excavation in accordance with the Occupational Health and Safety Act, 1990 and Regulation 213/1991 for construction projects.

The recommended design earth pressure distribution for single and multi-braced walls for the general soil types encountered in the boreholes are presented on Figures 2 and 3. Recommendations concerning design and construction of the excavation support system are also presented on the Figures. It is recommended that PML be contacted during construction to evaluate subsurface conditions within excavations and provide recommendations based on site observations. Soil parameters to be used in conjunction with Figures 2 and 3 are provided in the Table below:

For the on-site soil, the following geotechnical parameter may be assumed as summarized in Table 8.

TABLE 8

SOIL PARAMETERS FOR SHORING SUPPORT

TYPE OF MATERIAL	BULK DENSITY (kN/m^3)	ANGLE OF INTERNAL FRICTION	PRESSURE COEFFICIENT		
			AT REST (K_0)	ACTIVE (K_A)	PASSIVE (K_P)
OPSS Granular A	23	35	0.43	0.27	3.69
OPSS Granular B, Type II	23	32	0.47	0.31	3.25
Silty clay	17.5	27	0.54	0.37	2.66
Silty clay to Clayey silt Till	18.0	31	0.48	0.32	3.12

Notes:

1. Active pressures can be used when ground movements can be tolerated. Ground movements should be in accordance with applicable codes and standards.
2. At-rest pressures can be used when no ground movements can be tolerated.
3. The full coefficient of passive pressure may require large movements to mobilize, which may not be tolerated by the structure. No passive resistance should be considered for the fill materials.
4. Appropriate surcharge pressure should be considered to account for traffic loading, construction equipment etc.
5. Sloping backfill is not considered in the above Table.
6. Soil Parameters are based on empirical correlations with SPT N values from published literature such as the Canadian Foundation Engineering Manual 2006.

Groundwater Control

The anticipated excavation depths for replacing/installing the underground services are considered to be less than 3.0 m below ground surface and temporary in nature.

Perched water trapped in the fill may be encountered depending on the season and rainfall patterns when the work is conducted. It is anticipated that ground water seepage or surface water that enters excavations can be adequately handled by conventional sump pumping techniques.

Surface water runoff into the excavation should be avoided and diverted away from the excavation.

Pipe Bedding Requirements

It is anticipated that the underground services required as part of this project will be founded over undisturbed native silty clay to clayey silt till.

Pipe bedding thickness, composition and compaction should conform to OPSD 802.03, Class B or local standards. As a general guideline, a minimum 150 mm thick layer of OPSS Granular A material is recommended for pipes 450 mm diameter or less. If the subgrade becomes unduly wet during construction, additional bedding material should be provided. The granular bedding material should be placed in thin lifts not more than 150 mm thick and compacted to at least 98% standard Proctor maximum dry density. The bedding requirement should also satisfy local standards and regulations. In areas where the subgrade is considered suitable for support of the utility, the minimum bedding thickness will apply.

As an alternative, 19 mm clear crushed stone or High Performance Bedding Material (HPBM) may be used as pipe bedding. The 19 mm clear crushed stone or HPBM must be wrapped with an approved synthetic fabric (Terrafix 270R or equivalent) particularly where the subgrade is predominantly silt or fine sand below the groundwater table. Otherwise, the soil fines from the subgrade could infiltrate into the voids of the bedding materials, causing potential loss of subgrade support and subsequent failure of the pipe.

Sand cover material should be carried up as backfill at least 300 mm above the top of the pipe or as per local practice. The material should be placed in thin lifts not more than 300 mm thick and compacted to at least 95% of the standard Proctor maximum dry density.

Trench Backfilling

It is anticipated that the excavated material for utility trenches will mainly comprise minor amounts of mixed fil, silty clay till or clayey silt till. Organic soil, topsoil, deleterious or excessively wet material should not be used as backfill. Should construction extend to the winter season, particular attention must be given to ensure that frozen material is not used as trench backfill.

Reuse of the excavated materials may be possible if they are free of deleterious materials and do not need excessive drying to achieve the required moisture content for effective placement. The suitability of the excavated materials for reuse should be further evaluated by conducting standard Proctor test (ASTM D698), to determine the extent of moisture content adjustment that will be required and its impact on construction operations. The reuse of excavated on-site soil is subject to geotechnical review and confirmatory testing by geotechnical personnel during construction.

The industry standard calls for service trenches to be backfilled with approved material placed in uniform 200 to 300 mm thick lifts within ±2% of the optimum moisture content and compacted to at least 98% of SPMDD. All service trenches shall be backfilled using compactable material, free of organic, debris and large cobbles or boulders. Within the top 1.2 m below proposed paved areas, the material shall consist of material similar to that excavated from the trenches in order to prevent differential frost heave. The trenching and backfilling operations should be carried out in a manner which minimizes the length of trench left open yet accommodates efficient pipe laying and compaction activities. Reference is made to Appendix A for Engineered Fill Placement Guidelines. The trench backfilling procedure should be supervised by PML.

Subgrade Preparation After Utility Installation

On completion of the pipes installation works, and following the backfilling and satisfactory compaction of any underground service trenches up to the subgrade level, the subgrade shall be shaped, crowned and proof-rolled. A "Tandem Axle, dual wheel dump truck shall be used for proof-rolling operations. Any resulting soft areas should be sub-excavated down to competent soil and replaced with approved backfill in accordance with the recommendations provided in this report. Although not anticipated, proper treatments of frost transition between two soils shall be as per OPSD 205.01 to OPSD 205.05 and OPSD 204.01.

The preparation of subgrade shall be scheduled and carried out in a manner so that a protective cover of overlying granular material is placed as quickly as possible in order to avoid deterioration of the subgrade by construction traffic. Frost protection of the surface shall be implemented, if works are carried out during the winter months. Otherwise, all frozen soil must be identified and removed or fully thawed prior to the next stage of construction.

SOIL DISPOSAL OPTIONS

As mentioned earlier, the current sampling and chemical testing program was conducted in conjunction with a geotechnical investigation. For off-site disposal options, soil samples were selected for chemical analyses. During, appropriate precautions were taken to minimize potential cross-contamination between samples.

A total of nine soil samples were selected for chemical analyses

Samples obtained during the field work were immediately placed in glass jars and plastic bags. Observations of visible foreign materials and odors were recorded during the sampling operations. The plastic bag samples were brought to Peto MacCallum Ltd. laboratory for detailed visual examination.

The jar samples were stored at low temperature at the site in a cooler provided by the chemical analytical laboratory. Prior to submission to the chemical analytical laboratory, the jar samples were stored in Peto MacCallum Ltd. laboratory at low temperature.

Applicable Regulatory Standards for Chemical Analyses

In general, the standards of applicable environmental quality depend on the location, land use, and source of potable water at the location of disposal and/or re-use of the excess soils. Regarding off-site disposal, the following provincial Standards are applicable for this project:

- Ontario Regulation 153/04; *Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act* for residential/parkland and/or industrial/commercial land uses in both potable and non-potable ground water condition (Tables 2 and 3) dated March 9, 2004 as amended by Ontario Regulation 511/09 dated July 27, 2009.

Chemical Analyses

Based on the visual examination of soils in the boreholes and the site background information, the retrieved soil samples were submitted to AGAT Laboratories Inc. (AGAT), located in Mississauga, Ontario for chemical testing. AGAT is accredited by the Canadian Association for Laboratory Accreditation (CALA). The soil samples were analyzed for the following parameters.

- Nine soil samples were analyzed for sodium absorption ratio (SAR) parameter listed in the Ontario Regulation 153/04 as amended by Ontario Regulation 511/09.
- Five samples were analyzed for F2 through F4 petroleum hydrocarbons (PHCs) parameters as listed in the Ontario Regulation 153/04 as amended by Ontario Regulation 511/09.

Findings of Chemical Analyses

The results of chemical analyses carried out by AGAT in accordance with the protocol described above are attached in Appendix B and are outlined below.

For on-site reuse and off-site disposal, the results of the soil chemical analyses were compared with the Ontario Regulation 511/09 Standards for residential/parkland and industrial/commercial Property Uses in both potable and non-potable ground water situations (Tables 2 and 3).

Based on the chemical test results the analyzed soil samples complied with the Tables 2 and 3 Site Condition Standards for residential/parkland and industrial/commercial land uses Standards with the following exceptions.

- The soil samples analyzed from BH14 and BH18 exceeded the SAR values for Tables 2 and 3 residential/parkland standards but complied with the industrial/commercial standards, respectively.
- The soil samples analyzed from BH1, BH3 and BH16 exceeded the SAR values for Tables 2 and 3 residential/parkland and industrial/commercial standards, respectively.
- The soil sample analyzed from BH5 exceeded the F3 PHCs value for Tables 2 and 3 residential/parkland standards but complied with the industrial/commercial standards, respectively.

Conclusions and Recommendations

Based on the results of the current sampling and chemical testing program regarding the environmental quality of the soils analysed from the subject site, the following conclusions and recommendations are made.

- Considering the above-noted findings, majority of the soils analyzed exceeded the Ontario Regulation 153/04 (amended) and the analyzed soils are impacted with salt (elevated levels of SAR). The elevated levels of SAR are most likely related to the winter de-icing activities.
- The soils from the BH5 are impacted with F3 PHCs exceeding the Tables 2 and 3 residential/parkland standards but complied with the industrial/commercial standards.
- The impacted soils can be disposed of off-site to industrial/commercial construction sites, such as roadway construction sites where landscaping and plant growth are not considered. The salt impacted soil should not be disposed of to any environmentally sensitive sites, such as within close proximity of water bodies, and the disposed materials should not be in contact with the surface runoff and/or ground water table.
- It should be noted that the acceptance of soils solely depends on the discretion of the receiving sites authorities.
- It is recommended that the site earthwork operations, reuse and/or disposal of the excess soils be monitored under full-time inspection and review of our field staff to ensure that the removed soils are consistent with the sampling and testing program recently carried out and presented in this report.
- If indications of questionable materials or evidence of higher concentrations or other contaminants, and/or other deleterious materials are observed during site removal, the soils should be segregated for further assessment.

CLOSURE

The recommendations in this report have been based on the findings in the borehole locations. Soil conditions may vary between and beyond the boreholes. Variations in conditions, especially the quality and thickness of fill, identified during construction may necessitate modifications in design and construction.

It should be noted that the pavement construction, reconstruction/rehabilitation options submitted in this report were not designed to provide pavements with significantly increased structural/load-bearing capacity, beyond the capability of the existing structural/thickness design observed at the borehole locations. Accordingly, should additional structural capacity be required, additional analysis, that takes into account the new traffic load requirements would be required. PML would be pleased to assist in this regard.

We trust that the information presented in this report is sufficient for your present purposes. Please do not hesitate to contact our office should you have any question regarding the information submitted.

Sincerely

Peto MacCallum Ltd.

LICENSED PROFESSIONAL ENGINEER
M. ZAMSHAD
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Jan 02, 2018
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
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100078972
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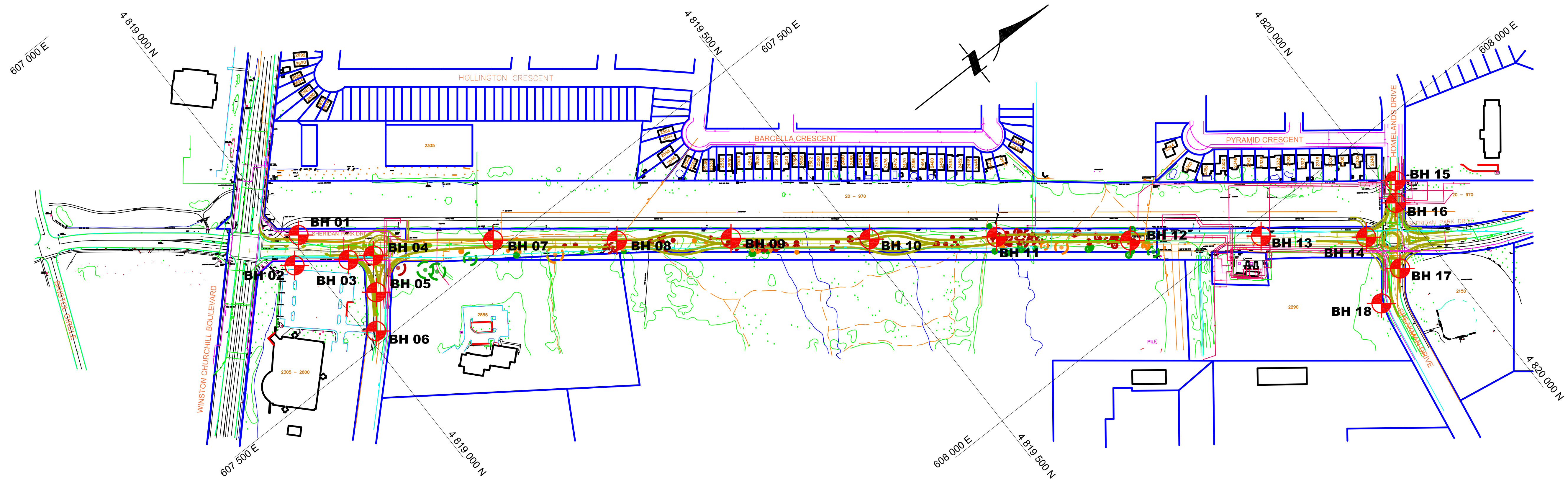
Associate
Manager, Geotechnical Engineering Services

MZ/HG:mm

<u>Attachments</u>:
Drawing 1 – Borehole Location Plan
List of Abbreviations Sheet
Log of Borehole Sheets BH1 to BH18
Figures GS-1 to GS-3 – Particle Size Distribution Charts
Figure 1 – General Guidelines Regarding Underpinning of Utilities Located Close to Excavation
Figures 2 and 3 – Recommendations for Design of Shoring System
Appendix A – Table A1 – Existing Pavement Structure
Appendix B – Findings of Chemical Analyses
Appendix C – Photographs of Pavement Distress
Appendix D – Engineered Fill



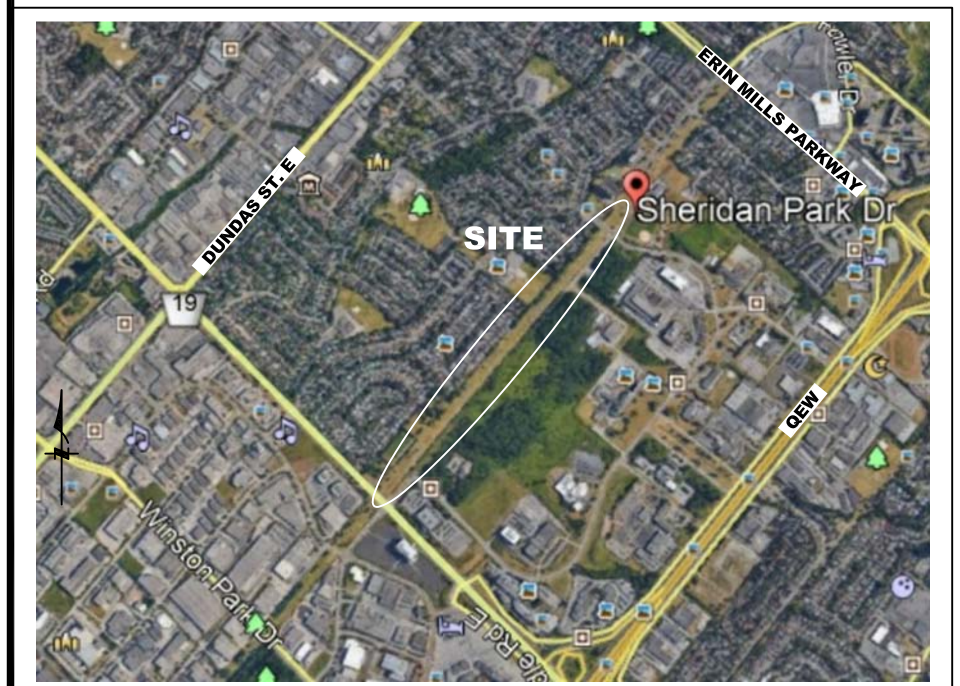
BOREHOLE #	NORTHINGS	EASTINGS	ELEVATION
BH-01	4 819 009.1	607 348.5	152.7
BH-02	4 818 984.6	607 372.4	152.6
BH-03	4 819 036.0	607 404.8	152.8
BH-04	4 819 060.9	607 418.4	152.7
BH-05	4 819 037.9	607 452.8	152.1
BH-06	4 819 010.9	607 486.7	151.7
BH-07	4 819 177.0	607 487.9	152.0
BH-08	4 819 285.7	607 574.0	151.7
BH-09	4 819 387.7	607 651.3	151.2
BH-10	4 819 509.2	607 748.0	150.2
BH-11	4 819 622.7	607 834.1	147.5
BH-12	4 819 737.8	607 929.9	147.6
BH-13	4 819 856.2	608 016.9	146.5
BH-14	4 819 948.0	608 090.8	146.1
BH-15	4 820 012.9	608 061.2	145.7
BH-16	4 819 998.1	608 081.2	145.6
BH-17	4 819 951.4	608 141.8	145.4
BH-18	4 819 915.5	608 159.7	144.9

LEGEND:

BH 18 — BOREHOLE UNDER PRESENT INVESTIGATION

NOTES:

1. THE INFERRED STRATIGRAPHY REFERRED TO IN THIS REPORT IS BASED ON DATA FROM THESE BOREHOLES, SUPPLEMENTED BY GEOLOGICAL EVIDENCE. THE ACTUAL STRATIGRAPHY AT OTHER POINTS BETWEEN THE BORINGS MAY VARY FROM THAT SHOWN.
2. THIS DRAWING WAS REPRODUCED FROM A PLAN DRAWING ***'Sheridan Park Drive Basemap.dwg'*** PROVIDED BY THE CLIENT.



KEY MAP
SCALE 1 : 25,000

No.	REVISIONS	DATE	BY

R. J. BURNSIDE & ASSOCIATES LIMITED

CLASS B ASSESSMENT - SHERIDAN PARK DRIVE
WINSTON CHURCHILL BOULEVARD TO HOMELAND DRIVE
MISSISSAUGA, ONTARIO

BOREHOLE LOCATION PLAN

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN: N.A. / CHECKED: M.Z. / APPROVED: H.G.	DATE	SCALE	JOB NO.	DRAWING NO.
	DEC. 2017	1 : 5,000	17TF012	1

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

Standard Penetration Resistance N: - The number of blows required to advance a standard split spoon sampler 12 in. into the subsoil. Driven by means of a 140 lb. hammer falling freely a distance of 30 in.

Dynamic Penetration Resistance: - The number of blows required to advance a 2 in., 60 degree cone, fitted to the end of drill rods, 12 in. into the subsoil. The driving energy being 350 foot pounds per blow.

DESCRIPTION OF SOIL

The consistency of cohesive soils and the relative density or denseness of cohesionless soils are described in the following terms:

CONSISTENCY	N (blows/ft.)	c (psf)	DENSENESS	N (blows/ft.)
Very Soft	0 - 2	0 - 250	Very Loose	0 - 4
Soft	2 - 4	250 - 500	Loose	4 - 10
Firm	4 - 8	500 - 1000	Compact	10 - 30
Stiff	8 - 15	1000 - 2000	Dense	30 - 50
Very Stiff	15 - 30	2000 - 4000	Very Dense	> 50
Hard	> 30	>4000		

WTPL	Wetter Than Plastic Limit
APL	About Plastic Limit
DTPL	Drier Than Plastic Limit

TYPE OF SAMPLE

SS	Split Spoon	TW	Thinwall Open
WS	Washed Sample	TP	Thinwall Piston
SB	Scraper Bucket Sample	OS	Oesterberg Sample
AS	Auger Sample	FS	Foil Sample
CS	Chunk Sample	RC	Rock Core
ST	Slotted Tube Sample		

- PH Sample Advanced Hydraulically
- PM Sample Advanced Manually

SOIL TESTS

Qu	Unconfined Compression	LV	Laboratory Vane
Q	Undrained Triaxial	FV	Field Vane
Qcu	Consolidated Undrained Triaxial	C	Consolidation
Qd	Drained Triaxial		

Peto MacCallum Ltd. CONSULTING ENGINEERS

LOG OF BOREHOLE NO. BH-1

PROJECT Rehabilitation of Sheridan Park Drive
PML REF. 17TF012
LOCATION Sheridan Park Drive and Winston Churchill Road, Mississauga, Ontario
CO-ORDS: 4 819 009.1 N; 607 348.5 E
ENGINEER M.Z.
BORING METHOD Solid Stem Augers
BORING DATE 12/09/2017
TECHNICIAN M.F.

SURFACE ELEVATION 152.7

DEPTH / ELEV (metres)	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" VALUES	WATER CONTENT	GR	SA	SI	CL	GROUND WATER OBSERVATIONS AND REMARKS
0.0	PAVEMENT STRUCTURE: 150 mm asphalt over 500 mm granular material (sand and gravel)	1	SS	21	○	30	52	(18)		
0.65	FILL: mixture of grey sand, silt and clay, moist									
0.90 / 151.80	SILTY CLAY: stiff greyish red silty clay, moist	2	SS	11	○	2	10	(88)		
1.4 / 151.3	SILTY CLAY TILL: hard greyish red silty clay, trace fine gravel, moist	3	SS	50/13cm	○					
		4	SS	50/8cm	○					
		5	SS	50/5cm	○					
3.8 / 148.8	SHALE BEDROCK: hard grey weathered shale bedrock, moist	6	SS	50/8cm	○					
	BOREHOLE TERMINATED AT 3.9m DEPTH									Upon completion of augering, borehole caved-in to a depth of 2.3m, no free water

Chart headings: SHEAR STRENGTH (kPa): + FIELD VANE, △ TORVANE, ○ Qu, ▲ POCKET PENETROMETER, ○ Q (50, 100, 150, 200); DYNAMIC CONE PENETRATION ×; STANDARD PENETRATION TEST ● (20, 40, 60, 80); PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) (10, 20, 30, 40); UNIT WEIGHT kN/m³; GRAIN SIZE DISTRIBUTION (%) GR SA SI CL; ELEVATION SCALE 152, 151, 150, 149; depth scale 0.0 – 15.0.

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. BH-2

PROJECT Rehabilitation of Sheridan Park Drive
PML REF. 17TF012
LOCATION Sheridan Park Drive and Winston Churchill Road, Mississauga, Ontario
CO-ORDS: 4 818 984.6 N; 607 372.4 E
ENGINEER M.Z.
BORING METHOD Solid Stem Augers
BORING DATE 12/09/2017
TECHNICIAN M.F.

SURFACE ELEVATION 152.60

DEPTH / ELEV (metres)	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" VALUES	WATER CONTENT (%)	GROUND WATER OBSERVATIONS AND REMARKS
0.0	PAVEMENT STRUCTURE: 150 mm asphalt over 500 mm granular material (sand and gravel)	1	SS	16		
0.65 / 0.80 / 151.80	FILL: mixture of brown sand, silt, clay, trace to some gravel, pockets of organics, moist	2	SS	50/13cm		
	CLAYEY SILT TILL: hard brownish red clayey silt, trace gravel, moist	3	SS	50/5cm		
		4	SS	50/15cm		
		5	SS	50/3cm		
4.5 / 148.1	SHALE BEDROCK: hard grey weathered shale bedrock, moist	6	SS	50/3cm		
4.6 / 148.0	BOREHOLE TERMINATED AT 4.6 m DEPTH					Upon completion of augering, borehole caved-in to a depth of 3.7 m, no free water

Chart headings: SHEAR STRENGTH (kPa): +FIELD VANE, △TORVANE, ○ Qu, ▲POCKET PENETROMETER, O Q; 50, 100, 150, 200. DYNAMIC CONE PENETRATION ×; STANDARD PENETRATION TEST ●; 20, 40, 60, 80. PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT W_L; WATER CONTENT (%) 10, 20, 30, 40. UNIT WEIGHT kN/m³. GRAIN SIZE DISTRIBUTION (%) GR SA SI CL. STRAT PLOT. ELEVATION SCALE 152, 151, 150, 149, 148.

Depth scale: 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0, 11.0, 12.0, 13.0, 14.0, 15.0

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. BH-3

PROJECT Rehabilitation of Sheridan Park Drive
PML REF. 17TF012
LOCATION Sheridan Park Drive and Winston Churchill Road, Mississauga, Ontario
CO-ORDS: 4 819 036.0 N; 607 404.8 E
ENGINEER M.Z.
BORING METHOD Solid Stem Augers
BORING DATE 12/09/2017
TECHNICIAN M.F.

SOIL PROFILE — SURFACE ELEVATION 152.80

DEPTH / ELEV (metres)	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" VALUES
0.50	PAVEMENT STRUCTURE: 100 mm asphalt over 400 mm granular material (sand and gravel)	1	SS	21
0.60 / 152.20	FILL: mixture of grey sand, silt, clay, moist	2	SS	47
	CLAYEY SILT TILL: hard brownish red clayey silt, trace gravel, moist	3	SS	50/8cm
		4	SS	50/5cm
3.8 / 148.8		5	SS	50/5cm
3.9 / 148.9	SHALE BEDROCK: hard grey weathered shale bedrock, moist	6	SS	50/3cm
	BOREHOLE TERMINATED AT 3.9 m DEPTH			

SHEAR STRENGTH (kPa): + FIELD VANE, △ TORVANE, ○ Qu, ▲ POCKET PENETROMETER, ○ Q — 50, 100, 150, 200
DYNAMIC CONE PENETRATION ×; STANDARD PENETRATION TEST ● — 20, 40, 60, 80
ELEVATION SCALE: 152, 151, 150, 149
PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%): 10, 20, 30, 40
UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Upon completion of augering, borehole caved-in to a depth of 3.7 m, no free water

Depth scale: 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0, 11.0, 12.0, 13.0, 14.0, 15.0

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. BH-4

PROJECT Rehabilitation of Sheridan Park Drive
LOCATION Sheridan Park Drive and Winston Churchill Road, Mississauga, Ontario
BORING METHOD Solid Stem Augers
CO-ORDS: 4 819 060.9 N; 607 418.4 E
BORING DATE 12/09/2017
PML REF. 17TF012
ENGINEER M.Z.
TECHNICIAN M.F.

SURFACE ELEVATION 152.70

DEPTH / ELEV (metres)	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	GROUND WATER OBSERVATIONS AND REMARKS
0.0	PAVEMENT STRUCTURE: 150 mm asphalt over 500 mm granular material (sand and gravel)	1	SS	18	23 56 (21)	
0.65	FILL: mixture of grey sand, silt, clay, moist					
0.80 / 151.90	CLAYEY SILT TILL: hard brownish red to grey clayey silt, trace gravel, moist	2	SS	50/13cm		
		3	SS	50/13cm		
		4	SS	50/10cm		
		5	SS	50/5cm		
4.5 / 148.2	SHALE BEDROCK: hard grey weathered shale bedrock, moist	6	SS	50/3cm		
4.6 / 148.1	BOREHOLE TERMINATED AT 4.6 m DEPTH					Upon completion of augering, borehole caved-in to a depth of 3.7 m, no free water

Elevation scale: 152, 151, 150, 149

Shear strength (kPa): +FIELD VANE △TORVANE ○ Qu ▲POCKET PENETROMETER ○ Q — 50 100 150 200
DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● — 20 40 60 80
PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30 40
UNIT WEIGHT kN/m³

Depth scale (m): 0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0

NOTES

LOG OF BOREHOLE NO. BH-5

Peto MacCallum Ltd. CONSULTING ENGINEERS

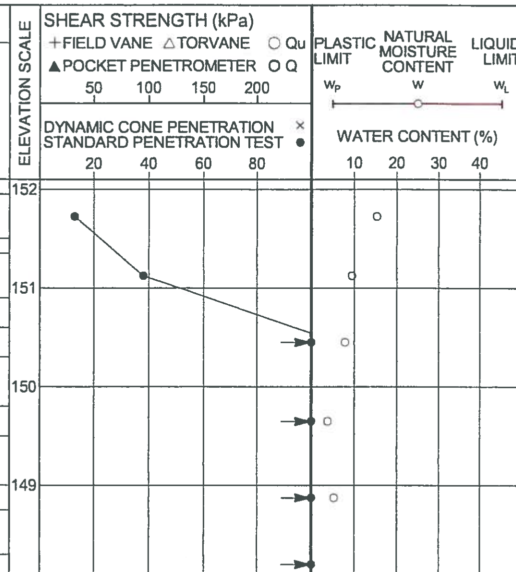
PROJECT Rehabilitation of Sheridan Park Drive
PML REF. 17TF012

LOCATION Sheridan Park Drive and Winston Churchill Road, Mississauga, Ontario
CO-ORDS: 4 819 037.9 N; 607 452.8 E
ENGINEER M.Z.

BORING METHOD Solid Stem Augers
BORING DATE 12/09/2017
TECHNICIAN M.F.

SURFACE ELEVATION 152.10

DEPTH / ELEV (metres)	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" VALUES	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.60	PAVEMENT STRUCTURE: 150 mm asphalt over 450 mm granular material (sand and gravel)	1	SS	13	13 60 (27)
0.80 / 151.30	FILL: brown sand, trace silt, trace clay, trace to some gravel, pockets of organics, moist	2	SS	38	
3.9 / 148.2	CLAYEY SILT TILL: hard brownish red to grey clayey silt, trace sand, trace gravel, moist	3	SS	50/8cm	
		4	SS	50/8cm	
		5	SS	50/8cm	
4.0 / 148.1	SHALE BEDROCK: hard dark grey weathered shale bedrock, moist	6	SS	50/3cm	
	BOREHOLE TERMINATED AT 4.0 m DEPTH				Upon completion of augering, borehole caved-in to a depth of 2.5m, no free water



UNIT WEIGHT kN/m³

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. BH-6

PROJECT Rehabilitation of Sheridan Park Drive
LOCATION Sheridan Park Drive and Winston Churchill Road, Mississauga, Ontario
BORING METHOD Solid Stem Augers
CO-ORDS: 4 819 010.9 N; 607 486.7 E
BORING DATE 12/09/2017
PML REF. 17TF012
ENGINEER M.Z.
TECHNICIAN M.F.

DEPTH / ELEV (metres)	DESCRIPTION	NUMBER	TYPE	"N" VALUES	NATURAL MOISTURE CONTENT (%)	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	GROUND WATER OBSERVATIONS AND REMARKS
0.0	SURFACE ELEVATION 151.70						
0.70 / 151.00	PAVEMENT STRUCTURE: 200 mm asphalt over 500 mm granular material (sand and gravel)	1	SS	22		40 47 (13)	
	FILL: mixture of grey sand, silt, gravel, moist	2	SS	22			
		3	SS	9			
2.4 / 2.7	CLAYEY SILT TILL: hard brownish red clayey silt, trace gravel, moist	4	SS	50/15cm			
2.8 / 148.9	SHALE BEDROCK: hard grey weathered shale bedrock, dry						Upon completion of augering, borehole caved-in to a depth of 1.3m, no free water
	BOREHOLE TERMINATED AT 2.8 m DEPTH						

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q — 50 100 150 200
DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● — 20 40 60 80
PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT W_L — WATER CONTENT (%) 10 20 30 40
UNIT WEIGHT kN/m³
ELEVATION SCALE: 151, 150, 149

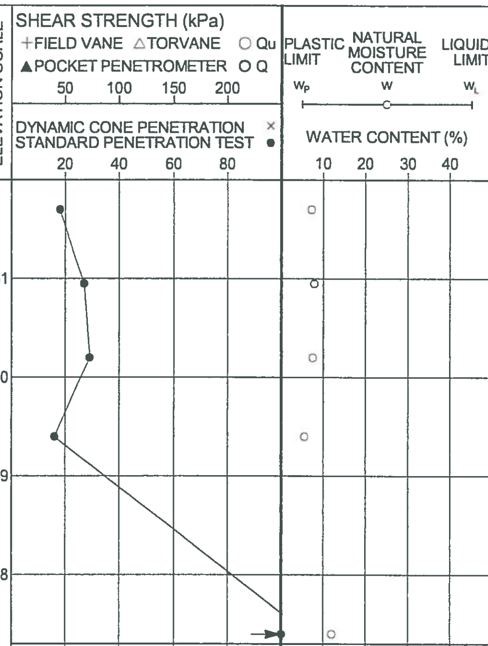
NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. BH-7

PROJECT Rehabilitation of Sheridan Park Drive
PML REF. 17TF012
LOCATION Sheridan Park Drive and Winston Churchill Road, Mississauga, Ontario
CO-ORDS: 4 819 177.0 N; 607 487.9 E
ENGINEER M.Z.
BORING METHOD Solid Stem Augers
BORING DATE 11/09/2017
TECHNICIAN M.F.

DEPTH / ELEV (metres)	SOIL PROFILE DESCRIPTION	SAMPLE NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	WATER CONTENT (%)	GROUND WATER OBSERVATIONS AND REMARKS
0.0	SURFACE ELEVATION 152.00						
	CLAYEY SILT TILL: very stiff brownish red clayey silt, trace fine gravel, moist	1	SS	18			
1.0		2	SS	27	151		
2.0		3	SS	29	150		
		4	SS	16			
3.0					149		
4.0					148		
4.6	becoming hard	5	SS	50/10cm			
147.3	BOREHOLE TERMINATED AT 4.7 m DEPTH						Upon completion of augering, no free water no cave-in



Depth scale (metres): 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0, 11.0, 12.0, 13.0, 14.0, 15.0

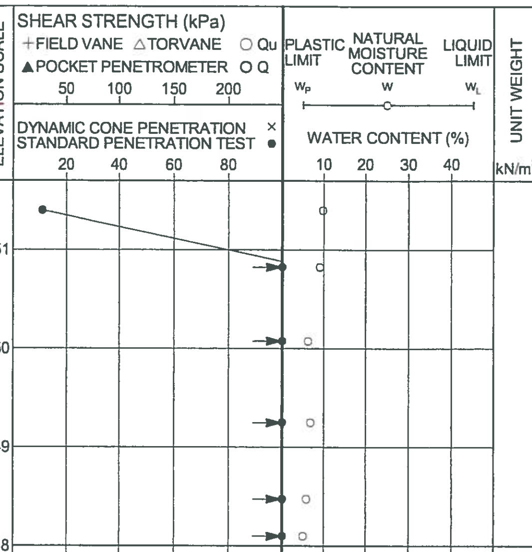
NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. BH-8

PROJECT Rehabilitation of Sheridan Park Drive
PML REF. 17TF012
LOCATION Sheridan Park Drive and Winston Churchill Road, Mississauga, Ontario
CO-ORDS: 4 819 285.7 N; 607 574.0 E
ENGINEER M.Z.
BORING METHOD Solid Stem Augers
BORING DATE 11/09/2017
TECHNICIAN M.F.

DEPTH / ELEV (metres)	DESCRIPTION	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	GROUND WATER OBSERVATIONS AND REMARKS
0.0	SURFACE ELEVATION 151.70					
	SILTY CLAY TO CLAYEY SILT: stiff brownish red silty clay to clayey silt, rootlets, moist	1	SS	11	151	
0.90	occasional sand seams	2	SS	50/5cm		
150.70	CLAYEY SILT TILL: hard brownish red clayey silt, trace gravel, moist	3	SS	50/15cm	150	
		4	SS	50/15cm	149	
3.5		5	SS	50/5cm		
3.7 / 148.0	SHALE BEDROCK: inferred shale bedrock/boulder	6	SS	50/1cm	148	Upon completion of augering, borehole caved-in to a depth of2.2 m, no free water
	BOREHOLE TERMINATED AT 3.7 m DEPTH					



Depth scale: 0.0 – 15.0 m

NOTES

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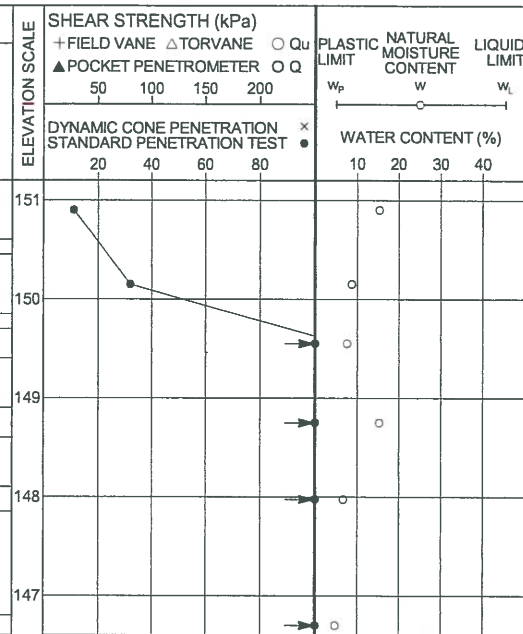
LOG OF BOREHOLE NO. BH-9

PROJECT Rehabilitation of Sheridan Park Drive
PML REF. 17TF012
LOCATION Sheridan Park Drive and Winston Churchill Road, Mississauga, Ontario
CO-ORDS: 4 819 387.7 N; 607 651.3 E
ENGINEER M.Z.
BORING METHOD Solid Stem Augers
BORING DATE 11/09/2017
TECHNICIAN M.F.

DEPTH / ELEV (metres)	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GROUND WATER OBSERVATIONS AND REMARKS
	SURFACE ELEVATION 151.20				
0.60 / 150.60	SILTY CLAY TO CLAYEY SILT: stiff brownish red silty clay to clayey silt, trace to rootlets, moist	1	SS	11	
	CLAYEY SILT TILL: hard brownish red clayey silt, trace gravel, moist	2	SS	32	
		3	SS	50/15cm	
		4	SS	50/13cm	
		5	SS	50/5cm	
4.6 / 146.6		6	SS	50/5cm	
	BOREHOLE TERMINATED AT 4.6 m DEPTH				Upon completion of augering, no free water no cave-in



UNIT WEIGHT kN/m³

GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

NOTES

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LOG OF BOREHOLE NO. BH-10

PROJECT Rehabilitation of Sheridan Park Drive
LOCATION Sheridan Park Drive and Winston Churchill Road, Mississauga, Ontario
BORING METHOD Solid Stem Augers
CO-ORDS: 4 819 509.2 N; 607 748.0 E
BORING DATE 11/09/2017
PML REF. 17TF012
ENGINEER M.Z.
TECHNICIAN M.F.

SHEAR STRENGTH (kPa): + FIELD VANE, △ TORVANE, ○ Qu, ▲ POCKET PENETROMETER, O Q (50, 100, 150, 200)
DYNAMIC CONE PENETRATION ×; STANDARD PENETRATION TEST ● (20, 40, 60, 80)
PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L; WATER CONTENT (%) (10, 20, 30, 40)
UNIT WEIGHT kN/m³
GROUND WATER OBSERVATIONS AND REMARKS; GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

DEPTH / ELEV (metres)	DESCRIPTION	Sample NUMBER	TYPE	"N" VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.0 / 150.20	SURFACE ELEVATION 150.20				
150.10	TOPSOIL: about 100 mm thick				
0.60 / 149.60	SILTY CLAY: very stiff brownish red silty clay, trace sand, moist	1	SS	19	
	CLAYEY SILT TILL: hard brownish red clayey silt, trace gravel, moist	2	SS	65/25cm	
		3	SS	50/13cm	
		4	SS	50/5cm	
		5	SS	50/5cm	
4.4	occasional shale partings				
4.6 / 145.6		6	SS	50/3cm	
	BOREHOLE TERMINATED AT 4.6 m DEPTH				Upon completion of augering, borehole caved-in to a depth of 3.0m, no free water

NOTES

Peto MacCallum Ltd.
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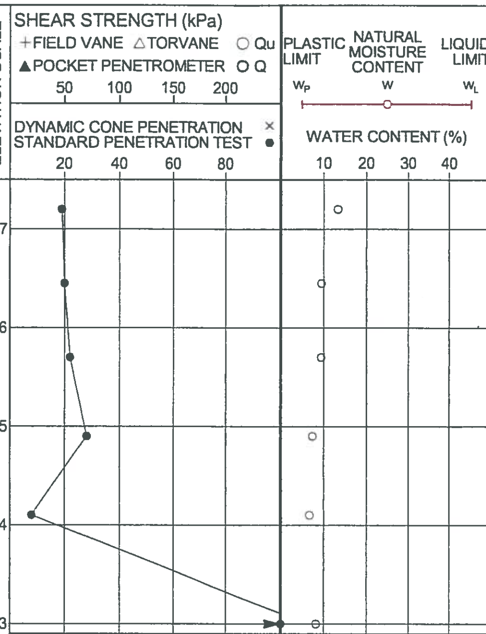
LOG OF BOREHOLE NO. BH-11

PROJECT Rehabilitation of Sheridan Park Drive
PML REF. 17TF012
LOCATION Sheridan Park Drive and Winston Churchill Road, Mississauga, Ontario
CO-ORDS: 4 819 622.7 N; 607 834.1 E
ENGINEER M.Z.
BORING METHOD Solid Stem Augers
BORING DATE 11/09/2017
TECHNICIAN M.F.

SURFACE ELEVATION 147.50

DEPTH / ELEV (metres)	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" VALUES	ELEVATION SCALE
0.15 / 147.35	TOPSOIL: about 150 mm thick, trace to some rootlets	1	SS	19	147
	CLAYEY SILT TILL: very stiff brownish red clayey silt, trace fine gravel, moist	2	SS	20	146
1.8 / 145.7	occasional gravel sized stones	3	SS	22	
		4	SS	28	145
		5	SS	8	144
3.5 / 144.0	some medium grained sand				
4.4	occasional shale partings				
4.6 / 142.9	BOREHOLE TERMINATED AT 4.6 m DEPTH	6	SS	50/5cm	143



UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Upon completion of augering, no free water no cave-in

NOTES

LOG OF BOREHOLE NO. BH-12

PROJECT Rehabilitation of Sheridan Park Drive
PML REF. 17TF012
LOCATION Sheridan Park Drive and Winston Churchill Road, Mississauga, Ontario
CO-ORDS: 4 819 737.8 N; 607 929.9 E
ENGINEER M.Z.
BORING METHOD Solid Stem Augers
BORING DATE 11/09/2017
TECHNICIAN M.F.

DEPTH / ELEV (metres)	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	GROUND WATER OBSERVATIONS AND REMARKS
0.0	SURFACE ELEVATION 147.60					
	FILL: mixture of sand, silt, clay, trace gravel, moist	1	SS	12		
0.60 / 147.00	CLAYEY SILT TILL: hard greyish brown clayey silt, trace fine gravel, moist	2	SS	70/25cm	147	
		3	SS	50/5cm	146	
2.1 / 2.3	brownish red					
2.5	occasional shale partings	4	SS	50/8cm		
145.1	BOREHOLE TERMINATED AT 2.5 m UPON AUGER REFUSAL					Upon completion of augering, no free water no cave-in

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q — 50 100 150 200
DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● — 20 40 60 80
PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L
WATER CONTENT (%) 10 20 30 40
UNIT WEIGHT kN/m³
GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Depth scale: 0.0 – 15.0 m

NOTES

PML Peto MacCallum Ltd.
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LOG OF BOREHOLE NO. BH-13

PROJECT Rehabilitation of Sheridan Park Drive
PML REF. 17TF012
LOCATION Sheridan Park Drive and Winston Churchill Road, Mississauga, Ontario
CO-ORDS: 4 819 856.2 N; 608 016.9 E
ENGINEER M.Z.
BORING METHOD Solid Stem Augers
BORING DATE 13/09/2017
TECHNICIAN M.F.

DEPTH / ELEV (metres)	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	SURFACE ELEVATION 146.50				
0.60	PAVEMENT STRUCTURE: 150 mm asphalt over 450 mm granular material (sand and gravel)	1	SS	13	27 60 (13)
0.80 / 145.70	FILL: mixture of sand, silt, clay, pockets of black organics, moist				
1.4 / 145.1	SILTY CLAY: stiff brownish grey silty clay, trace sand, moist	2	SS	13	
	CLAYEY SILT TILL: hard brownish grey clayey silt, trace sand, trace fine gravel, moist	3	SS	50/13cm	
		4	SS	50/13cm	
3.3 / 143.2	occasional shale partings	5	SS	50/10cm	
4.6		6	SS	50/13cm	
4.7 / 141.8	SHALE BEDROCK: hard grey shale bedrock, moist				
	BOREHOLE TERMINATED AT 4.7m DEPTH				Upon completion of augering, borehole caved-in to a depth of 4.0m, no free water

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200
DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80
PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT W_L
WATER CONTENT (%) 10 20 30 40
UNIT WEIGHT kN/m³
ELEVATION SCALE 146 145 144 143 142

NOTES

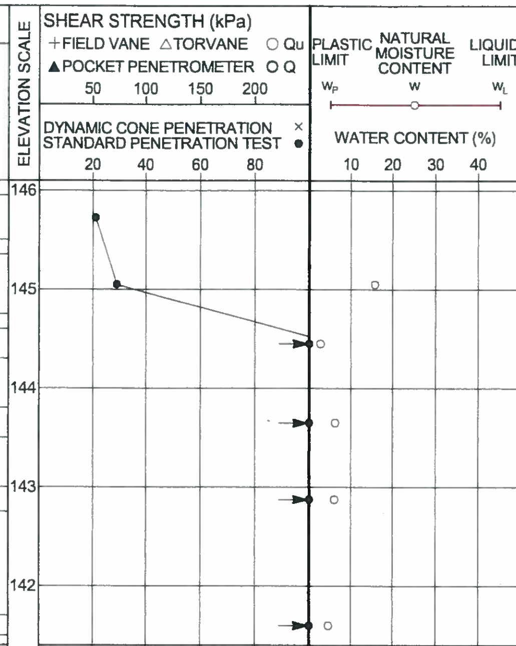
Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. BH-14

PROJECT Rehabilitation of Sheridan Park Drive
LOCATION Sheridan Park Drive and Winston Churchill Road, Mississauga, Ontario
BORING METHOD Solid Stem Augers
CO-ORDS: 4 819 948.0 N; 608 090.8 E
BORING DATE 13/09/2017
PML REF. 17TF012
ENGINEER M.Z.
TECHNICIAN M.F.

SURFACE ELEVATION 146.10

DEPTH / ELEV (metres)	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" VALUES	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	GROUND WATER OBSERVATIONS AND REMARKS
0.0	PAVEMENT STRUCTURE: 150 mm asphalt over 500 mm granular material (sand and gravel)	1	SS	21	27 70 (3)	
0.65 / 145.45	SILTY CLAY TO CLAYEY SILT: hard light grey to brownish grey silty clay to clayey silt, trace sand, moist	2	SS	29	9 15 (76)	
1.4 / 144.7	CLAYEY SILT TILL: hard grey clayey silt, trace gravel, moist	3	SS	50/13cm		
1.8 / 144.3	occasional shale partings					
2.4 / 143.7	brownish grey	4	SS	50/13cm		
		5	SS	50/13cm		
4.6		6	SS	50/10cm		
4.7 / 141.4	SHALE BEDROCK: hard grey to brownish grey shale bedrock, wet					Upon completion of augering, no free water, no cave-in
	BOREHOLE TERMINATED AT 4.7m DEPTH					



UNIT WEIGHT kN/m³

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. BH-15

PROJECT Rehabilitation of Sheridan Park Drive — **PML REF.** 17TF012

LOCATION Sheridan Park Drive and Winston Churchill Road, Mississauga, Ontario — **CO-ORDS:** 4 820 012.9 N; 608 061.2 E — **ENGINEER** M.Z.

BORING METHOD Solid Stem Augers — **BORING DATE** 13/09/2017 — **TECHNICIAN** M.F.

SURFACE ELEVATION 145.70

DEPTH / ELEV (metres)	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" VALUES	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	GROUND WATER OBSERVATIONS AND REMARKS
0.60 / 145.10	PAVEMENT STRUCTURE: 150 mm asphalt over 450 mm granular material (sand and gravel)	1	SS	14	25 57 (18)	
1.4 / 144.3	FILL: mixture of sand, silt, clay, moist	2	SS	9		
2.8	CLAYEY SILT TILL: stiff browmish grey to grey clayey silt, trace gravel, moist	3	SS	12		
		4	SS	50/15cm		
2.9 / 142.8	SHALE BEDROCK: hard grey shale bedrock, moist	5	SS	50/5cm		Upon completion of augering, no free water, no cave-in
	BOREHOLE TERMINATED AT 2.9 m DEPTH					

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q (50 100 150 200)

DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● (20 40 60 80)

PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L; WATER CONTENT (%) (10 20 30 40)

UNIT WEIGHT kN/m³

NOTES

Peto MacCallum Ltd. CONSULTING ENGINEERS

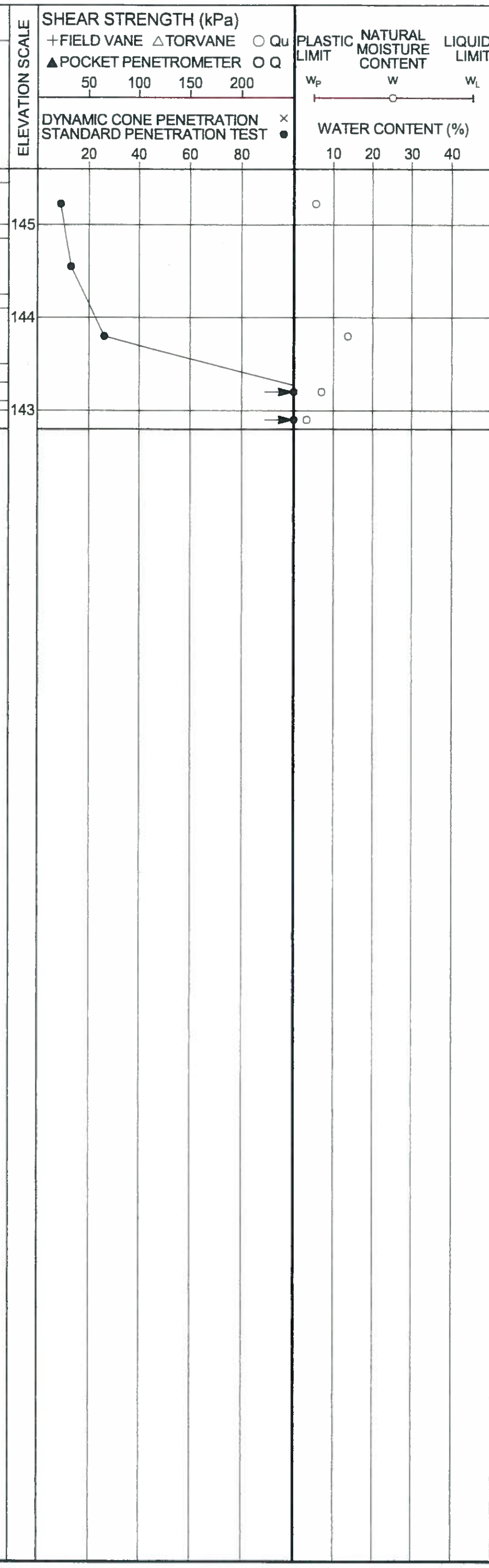
LOG OF BOREHOLE NO. BH-16

PROJECT Rehabilitation of Sheridan Park Drive
PML REF. 17TF012

LOCATION Sheridan Park Drive and Winston Churchill Road, Mississauga, Ontario
CO-ORDS: 4 819 998.1 N; 608 081.2 E
ENGINEER M.Z.

BORING METHOD Solid Stem Augers
BORING DATE 13/09/2017
TECHNICIAN M.F.

DEPTH / ELEV (metres)	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.0	SURFACE ELEVATION 145.60				
0.60 / 145.00	PAVEMENT STRUCTURE: 125 mm asphalt over 450 mm granular material (sand and gravel)	1	SS	9	
1.4 / 144.2	FILL: mixture of sand, silt, clay, trace to some gravel, moist	2	SS	13	
2.6	CLAYEY SILT TILL: very stiff brownish grey clayey silt, trace gravel, moist	3	SS	26	
		4	SS	50/13cm	
2.8 / 142.8	hard	5	SS	50/3cm	
	SHALE BEDROCK: hard grey weathered shale bedrock, moist				Upon completion of augering, borehole caved-in to a depth of 1.8m, no free water
	BOREHOLE TERMINATED AT 2.8 m DEPTH				



NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. BH-17

PROJECT Rehabilitation of Sheridan Park Drive
PML REF. 17TF012
LOCATION Sheridan Park Drive and Winston Churchill Road, Mississauga, Ontario
CO-ORDS: 4 819 951.4 N; 60841.8 E
ENGINEER M.Z.
BORING METHOD Solid Stem Augers
BORING DATE 13/09/2017
TECHNICIAN M.F.

SOIL PROFILE

DEPTH / ELEV (metres)	DESCRIPTION
	SURFACE ELEVATION 145.40
0.60 / 144.70	PAVEMENT STRUCTURE: 150 mm asphalt over 450 mm granular material (sand and gravel)
	FILL: mixture of brown sand, silt, clay, trace gravel, moist
1.8 / 143.6	CLAYEY SILT TILL: very stiff grey clayey silt, trace gravel, moist
2.7 / 142.7	hard, occasional gravel sized stones
3.8	occasional shale partings
3.8 / 141.5	SHALE BEDROCK: hard grey weathered shale bedrock, moist
	BOREHOLE TERMINATED AT 3.9 m DEPTH

SAMPLES

NUMBER	TYPE	"N" VALUES
1	SS	11
2	SS	23
3	SS	78/28cm
4	SS	50/15cm
5	SS	50/10cm
6	SS	50/13cm

ELEVATION SCALE: 145, 144, 143, 142

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q — 50 100 150 200

DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● — 20 40 60 80

PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L

WATER CONTENT (%) 10 20 30 40

UNIT WEIGHT kN/m^3

GROUND WATER OBSERVATIONS AND REMARKS — GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Upon completion of augering, borehole caved-in to a depth of 3.6 m, no free water

Depth scale: 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0, 11.0, 12.0, 13.0, 14.0, 15.0

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. BH-18

PROJECT Rehabilitation of Sheridan Park Drive
PML REF. 17TF012
LOCATION Sheridan Park Drive and Winston Churchill Road, Mississauga, Ontario
CO-ORDS: 4 819 915.5 N; 608 159.7 E
ENGINEER M.Z.
BORING METHOD Solid Stem Augers
BORING DATE 13/09/2017
TECHNICIAN M.F.

SURFACE ELEVATION 144.90

DEPTH / ELEV (metres)	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" VALUES	WATER CONTENT / GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	GROUND WATER OBSERVATIONS AND REMARKS
0.60 / 144.30	PAVEMENT STRUCTURE: 150 mm asphalt over 450 mm granular material (sand and gravel)	1	SS	14	40 41 (19)	
2.3 / 142.6	CLAYEY SILT TILL: hard light grey clayey silt, trace sand, trace gravel, moist	2	SS	31		
		3	SS	70/25cm		
2.7	occasional gravel sized stones	4	SS	50/5cm		
		5	SS	50/5cm		
2.8 / 142.1	SHALE BEDROCK: hard grey weathered shale bedrock, moist					Upon completion of augering, borehole caved-in to a depth of 2.2 m, no free water
	BOREHOLE TERMINATED AT 2.8 m DEPTH					

SHEAR STRENGTH (kPa): +FIELD VANE △TORVANE ○ Qu ▲POCKET PENETROMETER O Q — 50 100 150 200
DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● — 20 40 60 80
PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L — WATER CONTENT (%) 10 20 30 40
UNIT WEIGHT kN/m³
ELEVATION SCALE 144, 143
Depth scale: 0.0 – 15.0

NOTES

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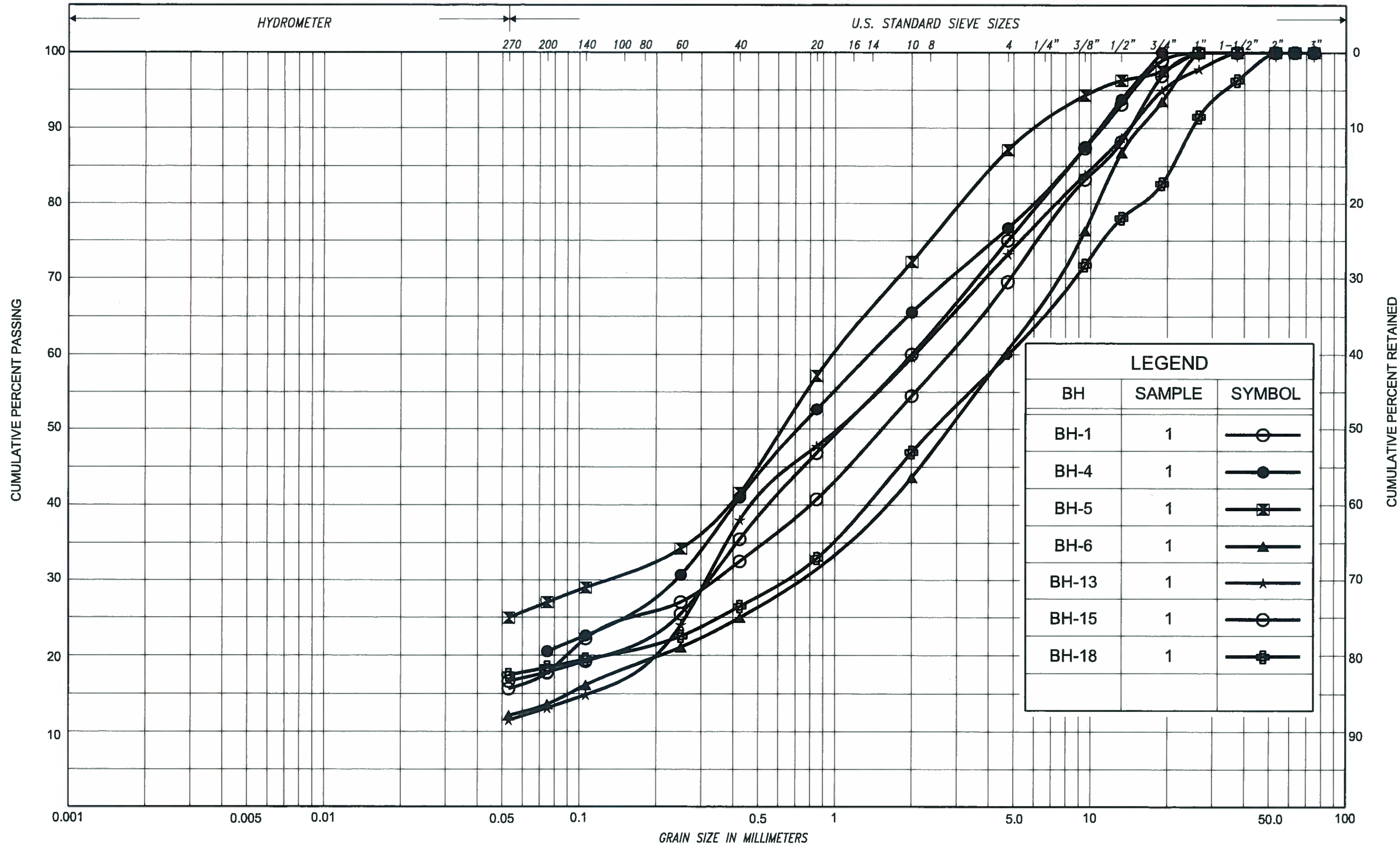
PARTICLE SIZE DISTRIBUTION CHART

PROJECT NO. 17TF012
FIGURE NO. GS-1



SILT & CLAY			SAND: FINE	SAND: MEDIUM	SAND: COARSE	GRAVEL	COBBLES	UNIFIED
CLAY	SILT: FINE	SILT: MEDIUM	SILT: COARSE	SAND: FINE	SAND: MEDIUM	SAND: COARSE	GRAVEL	COBBLES	M.I.T.
CLAY	SILT	SAND: V. FINE	SAND: FINE	SAND: MED.	SAND: COARSE	GRAVEL		U.S. BUREAU

REMARKS: SAND: Sand, some gravel to gravelly, trace to some silt (FILL)

Peto MacCallum Ltd.
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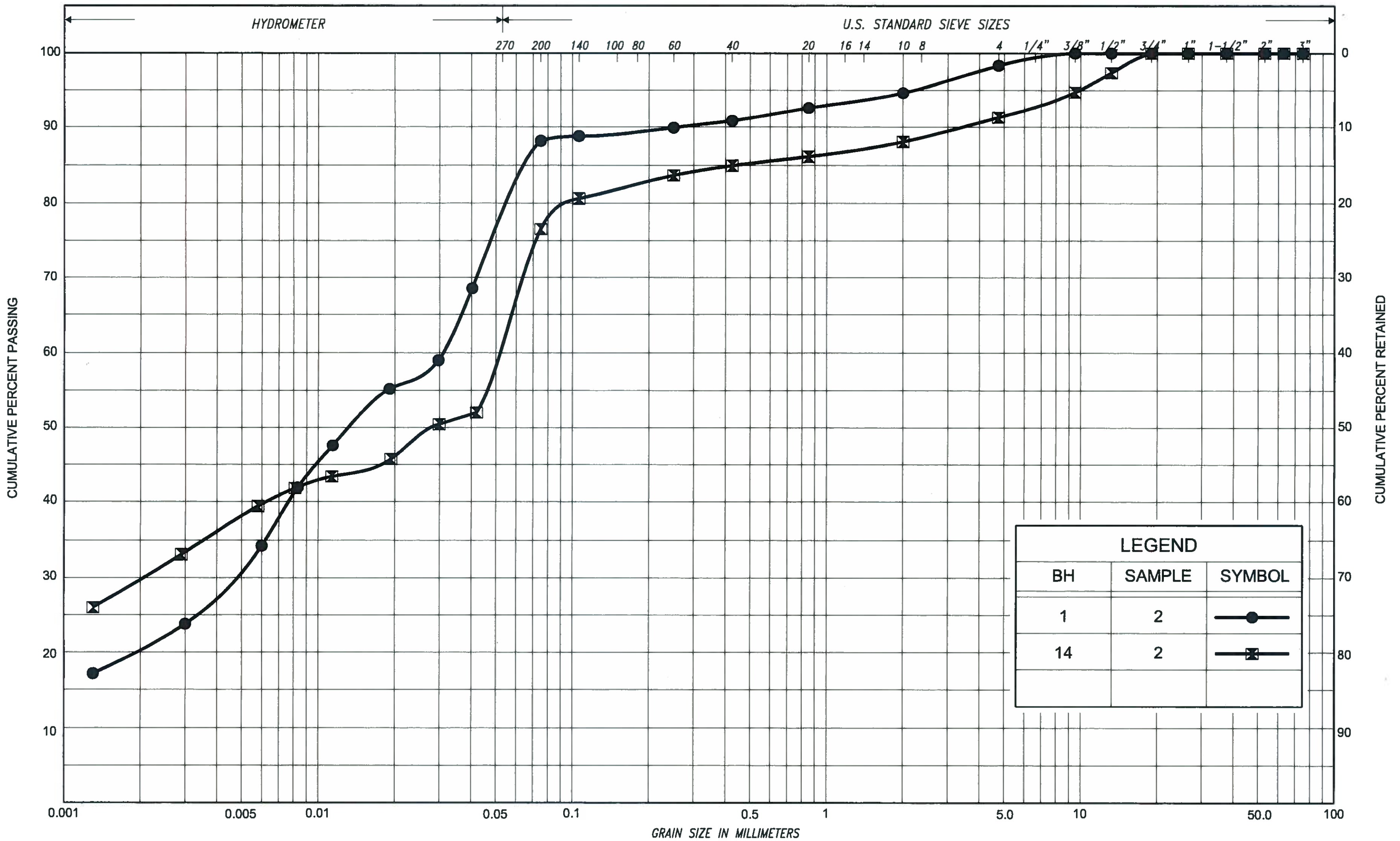
PROJECT NO. 17TF012
FIGURE NO. GS-2

PARTICLE SIZE DISTRIBUTION CHART



SILT & CLAY			SAND: FINE	SAND: MEDIUM	SAND: COARSE	GRAVEL	COBBLES	UNIFIED
CLAY	SILT: FINE	SILT: MEDIUM	SILT: COARSE	SAND: FINE	SAND: MEDIUM	SAND: COARSE	GRAVEL	COBBLES	M.I.T.
CLAY	SILT	SAND: V. FINE	SAND: FINE	SAND: MED.	SAND: COARSE	GRAVEL		U.S. BUREAU

REMARKS: CLAYEY SILT: Clayey silt, some sand, trace gravel (FILL)

Peto MacCallum Ltd.
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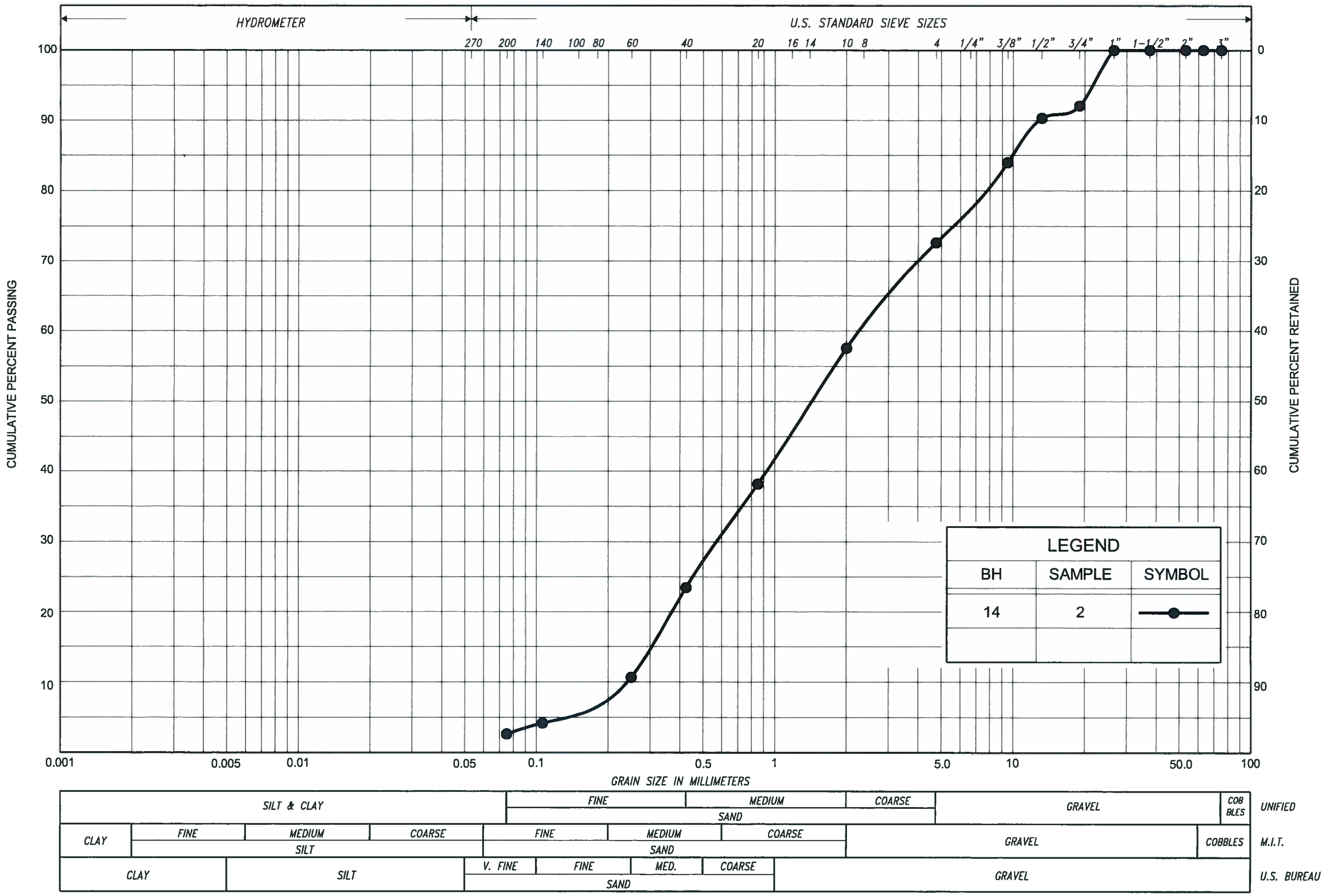
PROJECT NO. 17TF012

FIGURE NO. GS-3

PARTICLE SIZE DISTRIBUTION CHART



REMARKS: SAND: Sand, some gravel (FILL)

NOTES

1. The need to underpin existing footings/utilities is dependent upon soil type, proximity of the existing facility to the face of the excavation, loads imposed on the foundation and permissible movements.

   ZONE A:
   Foundations of relatively heavy and/or settlement sensitive structures/utilities located in Zone A generally require underpinning.

   ZONE B:
   Foundations of structures located within Zone B generally do not require underpinning. Consideration should be given to underpinning of settlement sensitive utilities or heavy foundation units located in this zone.

   ZONE C:
   Utilities and foundations located within Zone C do not normally require underpinning.

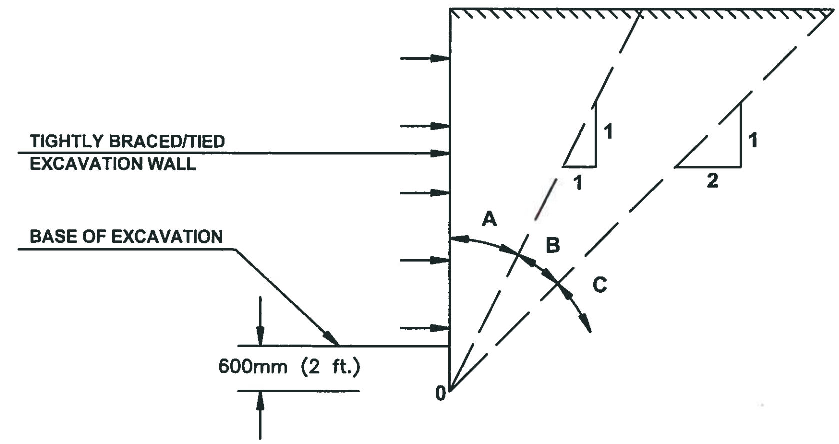
   Underpinning of foundations located in Zones A and B should extend at least into Zone C.

2. As an alternative to underpinning, it may be possible to control movement of existing utilities and foundations by supporting the face of the excavation with bracing/tiebacks or a rigid (caisson) wall. Horizontal and vertical earth pressures imposed on the excavation wall by non—underpinned foundations must be considered in the design of the support system.

3. A condition survey should be conducted prior to construction and appropriate monitoring (surface and insitu) carried out during construction to monitor any movement which may occur.

4. All work should be carried out in accordance with the Occupational Health and Safety Act and local regulations. Good quality workmanship and construction practices are to be employed.

5. This sheet is to be read in conjunction with text of report for this project. Additional comments and recommendations concerning these general guidelines will be provided if required.



If the base of the excavation is in bedrock, point "0" is drawn through the intersection point of the wall and the surface of sound bedrock

STANDARD DRAWING

GENERAL GUIDELINES REGARDING UNDERPINNING OF FOUNDATIONS / UTILITIES LOCATED CLOSE TO EXCAVATION

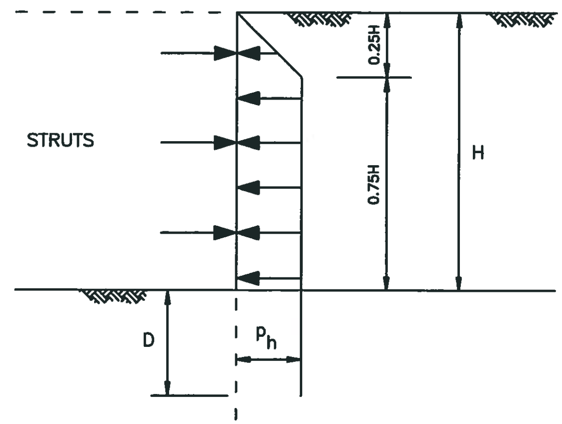
PML Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN:	N.A.	DATE	SCALE	JOB NO.	FIGURE NO.
CHECKED:	M.Z.	OCT. 2017	N.T.S.	17TF012	1
APPROVED:	H.G.				

NOTES

1. The actual magnitude and distribution of the horizontal earth pressures which will act on the bracing system are dependent upon the permissible lateral/vertical movements adjacent to the excavation, the soil type, groundwater conditions, drainage provisions, temporary/permanent surcharge loads, the type of bracing system adopted, weather conditions, quality of workmanship and length of time the excavation will be supported. Hence, the recommended pressure diagram and design parameters should be reviewed when construction details, schedule and type of support system are established.
2. Stability of base of excavation must be confirmed when bracing system design, excavation geometry and surcharge loads are established.
3. Earth pressure diagram is applicable to maximum depth of cut of 12m (40 ft.).
4. Structural components of bracing system should be confirmed adequate for each level of excavation.
5. If sheeting will not permit drainage, bracing system must be designed to resist water pressure.
6. Surcharge loads such as street/construction traffic, supported utilities, adjacent foundations, temporary stockpiles and other loads carried by bracing system are not included in earth pressure diagram.
7. Temporary surcharge loading should not be closer to the face of the excavation than half the depth of excavation unless accounted for in bracing design.
8. If settlement sensitive structures are located near the excavation, special measures should be undertaken to control settlements. A condition survey should be conducted prior to construction and apppropriate monitoring (surface and insitu) carried out during construction.
9. Earth pressure diagram is applicable for relatively short construction periods. If excavation is to be open for long periods, monitoring of deformation is essential, the earth pressure diagram must be reviewed, and remedial works may be required.
10. Earth pressure diagram does not account for extended periods of exposure of the excavation to freezing temperatures.
11. Bracing system should be regularly examined for signs of distress.
12. All work should be carried out in accordance with the Occupational Health and Safety Act and local regulations. Good quality workmanship and construction practices are to be employed.
13. This sheet should be read in conjunction with text of report for this project. Additional comments and recommendations concerning these general guidelines will be provided if required.

EARTH PRESSURE DIAGRAM



p_h = design lateral earth pressure
$= \gamma H - 1.6\, c_s \geqslant 0.4\, \gamma H$

where

c_s = average undrained shear strength of clay along face of excavation
m = dimensionless coefficient
γ = unit weight of soil
H = depth of excavation
D = depth of embedment of soldier piles (if used).

For soil parameters, refer to Table in Report.

LATERAL EARTH PRESSURE DISTRIBUTION

MULTI-BRACED CUTS IN STIFF CLAYS OR CLAYEY SOILS

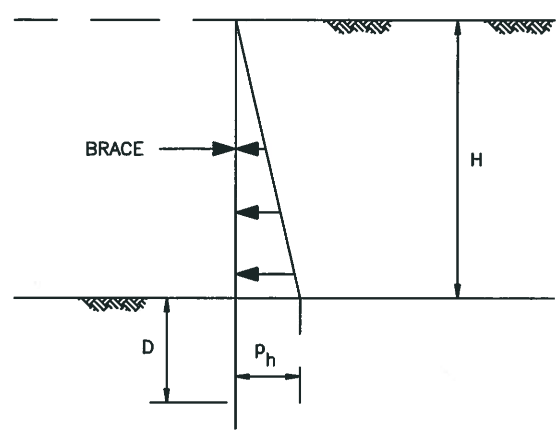
PML Peto MacCallum Ltd. CONSULTING ENGINEERS

DRAWN:	N.A.	DATE	SCALE	JOB NO.	FIGURE NO.
CHECKED:	M.Z.	OCT. 2017	N.T.S.	17TF012	2
APPROVED:	H.G.				

NOTES

1. The actual magnitude and distribution of the horizontal earth pressures which will act on the bracing system are dependent upon the permissible lateral/vertical movements adjacent to the excavation, the soil type, groundwater conditions, drainage provisions, temporary/permanent surcharge loads, the type of bracing system adopted, weather conditions, quality of workmanship and length of time the excavation will be supported. Hence, the recommended pressure diagram and design parameters should be reviewed when construction details, schedule and type of support system are established.
2. Stability of base of excavation must be confirmed when bracing system design, excavation geometry and surcharge loads are established. If groundwater table is well above base of excavation and/or artesian conditions exist, local lowering of the groundwater level will be necessary to prevent bottom heave/piping of the base of the excavation.
3. Earth pressure diagram is applicable to maximum depth of cut of 12m (40 ft.).
4. Structural components of bracing system should be confirmed adequate for each level of excavation.
5. If sheeting will not permit drainage, bracing system must be designed to resist water pressure.
6. Surcharge loads such as street/construction traffic, supported utilities, adjacent foundations, temporary stockpiles and other loads carried by bracing system are not included in earth pressure diagram.
7. Temporary surcharge loading should not be closer to the face of the excavation than half the depth of excavation unless accounted for in bracing design.
8. If settlement sensitive structures are located near the excavation, special measures should be undertaken to control settlements. A condition survey should be conducted prior to construction and apppropriate monitoring (surface and insitu) carried out during construction.
9. Earth pressure diagram is applicable for relatively short construction periods. If excavation is to be open for long periods, monitoring of deformation is essential, the earth pressure diagram must be reviewed, and remedial works may be required.
10. Earth pressure diagram does not account for extended periods of exposure of the excavation to freezing temperatures.
11. Bracing system should be regularly examined for signs of distress.
12. All work should be carried out in accordance with the Occupational Health and Safety Act and local regulations. Good quality workmanship and construction practices are to be employed.
13. This sheet should be read in conjunction with text of report for this project. Additional comments and recommendations concerning these general guidelines will be provided if required.

EARTH PRESSURE DIAGRAM



P_h = design lateral earth pressure
= $K\gamma H$

K = lateral earth pressure coefficient

γ = unit weight of soil

H = depth of excavation

D = depth of embedment of soldier piles (if used).

For soil parameters, refer to Table in Report.

LATERAL EARTH PRESSURE DISTRIBUTION

SINGLY-BRACED CUTS IN COHESIVE OR COHESIONLESS SOILS

Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN: N.A.	DATE	SCALE	JOB NO.	FIGURE NO.
CHECKED: M.Z.	OCT. 2017	N.T.S.	17TF012	3
APPROVED: H.G.				

APPENDIX A

Table A1 – Existing Pavement Structure

Table A1 below present existing pavement structure data obtained from twelve boreholes (six from east end and six from west end of Sheridan Park Drive) drilled along the proposed Sheridan Park Drive with the project limit.

TABLE A1
EXISTING PAVEMENT STRUCTURE

BOREHOLE LOCATION	**ASPHALT THICKNESS (mm)**	**GRANULAR BASE/SUB-BASE (mm)**	**PAVEMENT STRUCTURE (mm)**
BH1	150	500	650
BH2	150	500	650
BH3	100	400	500
BH4	150	500	550
BH5	150	450	600
BH6	200	500	700
BH13	150	450	600
BH14	150	500	550
BH15	150	450	600
BH16	125	450	575
BH117	150	450	600
BH118	150	450	600

APPENDIX B

Findings of Chemical Analyses

5835 COOPERS AVENUE
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CANADA L4Z 1Y2
TEL (905)712-5100
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http://www.agatlabs.com

CLIENT NAME: PETO MACCALLUM LIMITED
165 CARTWRIGHT AVENUE
TORONTO, ON M6A1V5
(416) 785-5110

ATTENTION TO: Mahaboob Alam

PROJECT: 17TF012

AGAT WORK ORDER: 17T261647

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator

TRACE ORGANICS REVIEWED BY: Neli Popnikolova, Senior Chemist

DATE REPORTED: Sep 27, 2017

PAGES (INCLUDING COVER): 8

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 17T261647
PROJECT: 17TF012

CLIENT NAME: PETO MACCALLUM LIMITED

ATTENTION TO: Mahaboob Alam

SAMPLING SITE:

SAMPLED BY:

O. Reg. 153(511) - ORPs (Soil)

DATE RECEIVED: 2017-09-18

DATE REPORTED: 2017-09-27

			SAMPLE DESCRIPTION:	BH1,SS2	BH3,SS3	BH5,SS1	BH8,SS2	BH10,SS2	BH12,SS2	BH14,SS2	BH16,SS1
			SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
			DATE SAMPLED:	2017-09-14	2017-09-14	2017-09-14	2017-09-14	2017-09-14	2017-09-14	2017-09-14	2017-09-14
Parameter	Unit	G / S	RDL	8735985	8735993	8735994	8735996	8736020	8736021	8736022	8736024
Sodium Adsorption Ratio	NA	2.4	NA	19.9	14.1	3.25	0.220	0.141	0.191	7.54	32.4

			SAMPLE DESCRIPTION:	BH18,SS3
			SAMPLE TYPE:	Soil
			DATE SAMPLED:	2017-09-14
Parameter	Unit	G / S	RDL	8736025
Sodium Adsorption Ratio	NA	2.4	NA	8.77

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

8735985-8736025 SAR was determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil).

Certified By: Amanjot Bhela

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AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 17T261647
PROJECT: 17TF012

CLIENT NAME: PETO MACCALLUM LIMITED
ATTENTION TO: Mahaboob Alam
SAMPLING SITE:
SAMPLED BY:

O. Reg. 153(511) - PHCs F2 - F4 (Soil)

DATE RECEIVED: 2017-09-18
DATE REPORTED: 2017-09-27

			SAMPLE DESCRIPTION:	BH1,SS2	BH5,SS1	BH8,SS2	BH12,SS2	BH18,SS3
			SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil
			DATE SAMPLED:	2017-09-14	2017-09-14	2017-09-14	2017-09-14	2017-09-14
Parameter	Unit	G / S	RDL	8735985	8735994	8735996	8736021	8736025
F2 (C10 to C16)	µg/g	10	10	<10	<10	<10	<10	<10
F3 (C16 to C34)	µg/g	240	50	<50	690	<50	<50	<50
F4 (C34 to C50)	µg/g	120	50	<50	1600	<50	<50	<50
Gravimetric Heavy Hydrocarbons	µg/g	120	50	NA	NA	NA	NA	NA
Moisture Content	%		0.1	7.5	2.5	9.9	15.8	4.6
Surrogate	Unit	Acceptable Limits						
Terphenyl	%	60-140		84	82	98	70	86

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

8735985-8736025 Results are based on sample dry weight.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.
Fractions 1-4 are quantified with the contribution of PAHs. Under Ontario Regulation 153, results are considered valid without determining the PAH contribution if not requested by the client.
Quality Control Data is available upon request.

Certified By: NPopukolof

Guideline Violation

AGAT WORK ORDER: 17T261647

PROJECT: 17TF012

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FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: PETO MACCALLUM LIMITED

ATTENTION TO: Mahaboob Alam

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
8735985	BH1,SS2	ON T1 S RPI/ICC	O. Reg. 153(511) - ORPs (Soil)	Sodium Adsorption Ratio	NA	2.4	19.9
8735993	BH3,SS3	ON T1 S RPI/ICC	O. Reg. 153(511) - ORPs (Soil)	Sodium Adsorption Ratio	NA	2.4	14.1
8735994	BH5,SS1	ON T1 S RPI/ICC	O. Reg. 153(511) - ORPs (Soil)	Sodium Adsorption Ratio	NA	2.4	3.25
8735994	BH5,SS1	ON T1 S RPI/ICC	O. Reg. 153(511) - PHCs F2 - F4 (Soil)	F3 (C16 to C34)	µg/g	240	690
8735994	BH5,SS1	ON T1 S RPI/ICC	O. Reg. 153(511) - PHCs F2 - F4 (Soil)	F4 (C34 to C50)	µg/g	120	1600
8736022	BH14,SS2	ON T1 S RPI/ICC	O. Reg. 153(511) - ORPs (Soil)	Sodium Adsorption Ratio	NA	2.4	7.54
8736024	BH16,SS1	ON T1 S RPI/ICC	O. Reg. 153(511) - ORPs (Soil)	Sodium Adsorption Ratio	NA	2.4	32.4
8736025	BH18,SS3	ON T1 S RPI/ICC	O. Reg. 153(511) - ORPs (Soil)	Sodium Adsorption Ratio	NA	2.4	8.77

AGAT Laboratories

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CANADA L4Z 1Y2
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FAX (905)712-5122
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Quality Assurance

CLIENT NAME: PETO MACCALLUM LIMITED

PROJECT: 17TF012

SAMPLING SITE:

AGAT WORK ORDER: 17T261647

ATTENTION TO: Mahaboob Alam

SAMPLED BY:

Soil Analysis

RPT Date: Sep 27, 2017			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - ORPs (Soil)															
Sodium Adsorption Ratio	8735985	8735985	19.9	20.6	3.5%	NA	NA			NA			NA		

Comments: NA signifies Not Applicable.

Certified By: Amanjot Bhela

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Quality Assurance

CLIENT NAME: PETO MACCALLUM LIMITED
PROJECT: 17TF012
SAMPLING SITE:

AGAT WORK ORDER: 17T261647
ATTENTION TO: Mahaboob Alam
SAMPLED BY:

Trace Organics Analysis

RPT Date: Sep 27, 2017			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper
O. Reg. 153(511) - PHCs F2 - F4 (Soil)															
F2 (C10 to C16)	8736347		< 10	< 10	NA	< 10	94%	60%	130%	96%	80%	120%	74%	70%	130%
F3 (C16 to C34)	8736347		< 50	< 50	NA	< 50	113%	60%	130%	93%	80%	120%	80%	70%	130%
F4 (C34 to C50)	8736347		< 50	< 50	NA	< 50	106%	60%	130%	106%	80%	120%	95%	70%	130%

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By: NPopukolof

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Method Summary

CLIENT NAME: PETO MACCALLUM LIMITED
PROJECT: 17TF012
SAMPLING SITE:

AGAT WORK ORDER: 17T261647
ATTENTION TO: Mahaboob Alam
SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Sodium Adsorption Ratio	INOR-93-6007	McKeague 4.12 & 3.26 & EPA SW-846 6010C	ICP/OES
Trace Organics Analysis			
F2 (C10 to C16)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
F3 (C16 to C34)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
F4 (C34 to C50)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
Gravimetric Heavy Hydrocarbons	VOL-91-5009	CCME Tier 1 Method	BALANCE
Moisture Content	VOL-91-5009	CCME Tier 1 Method	BALANCE
Terphenyl	VOL-91-5009		GC/FID

AGAT Laboratories

5835 Coopers Avenue
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Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

15h

Laboratory Use Only

Work Order #: 17T261647

Cooler Quantity:

Arrival Temperatures: 4.6 | 5.4 | 5.6

Custody Seal Intact: ☐Yes ☐No ☐N/A

Notes:

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Report Information:

Company: PETO MACCALLUM LTD
Contact: M. ALAM
Address: 165 CARTWRIGHT AVE TORONTO, ONT
Phone: 416 785 5110 Fax: 416 785 5120
Reports to be sent to:
1. Email: malam@petomaccallum.com
2. Email:

Regulatory Requirements:

(Please check all applicable boxes)

☐ No Regulatory Requirement

☑ Regulation 153/04
Table ___ *Indicate One*
☐ Ind/Com
☑ Res/Park
☐ Agriculture

Soil Texture *(Check One)*
☐ Coarse
☐ Fine

☐ Sewer Use
☐ Sanitary
☐ Storm
Region ___ *Indicate One*
☐ MISA

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
Indicate One

Turnaround Time (TAT) Required:

Regular TAT ☑ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply): 5 DAYS TAT

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

For 'Same Day' analysis, please contact your AGAT CPM

Project Information:

Project: 17TF012
Site Location:
Sampled By:
AGAT Quote #: PML RATE PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

Is this submission for a **Record of Site Condition?** ☐ Yes ☐ No

Report Guideline on *Certificate of Analysis* ☐ Yes ☐ No

Invoice Information:

Bill To Same: Yes ☐ No ☐

Company:
Contact:
Address:
Email:

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI Y/N	Metals and Inorganics	☐ All Metals ☐ 153 Metals (excl. Hydrides)	☐ Hydride Metals ☐ 153 Metals (incl. Hydrides)	ORPs: ☐ B-HWS ☐ Cl⁻ ☐ CN⁻ ☐ Cr6+ ☐ EC ☐ FOC ☐ Hg ☐ pH ☐ SAR	Full Metals Scan	Regulation/Custom Metals	Nutrients: ☐ TP ☐ NH4 ☐ TKN ☐ NO3 ☐ NO2 ☐ NO3+NO2	Volatiles: ☐ VOC ☐ BTEX ☐ THM	CCME Fractions ~~1 to 4~~ F2-F4	ABNs	PAHs	PCBs: ☐ Total ☐ Aroclors	Organochlorine Pesticides	TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Sewer Use	SAR
BH1, SS2	09/14		1	SOIL											✓							✓
BH3, SS3	"		1	"																		✓
BH5, SS1	"		1	"											✓							✓
BH8, SS2	"		1	"											✓							✓
BH10, SS2	"		1	"																		✓
BH12, SS2	"		1	"											✓							✓
BH14, SS2	"		1	"																		✓
BH16, SS1	"		1	"																		✓
BH18, SS3	"		1	"											✓							✓

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
[signature]	Sep 14/17	10:20	[signature]	17/9/18	10:20

Page ____ of ____

Nº: T 050546

APPENDIX C

Photographs of Pavement Distress

Photograph 1: Minor coarse aggregate loss and random crack near Winston Churchill Boulevard.

Photograph 2: Moderate longitudinal crack segregating and coarse aggregate loss.

Photograph 3: Distortion from frost heaving and localized patching.

Photograph 4: Severe distortion from frost heaving near BH2.

Photograph 5: Distortion from frost heaving near BH4.

Photograph 6: Longitudinal and transverse cracks near BH1.

Photograph 7: Random Minor Crack at west end of Sheridan Park Drive.

Photograph 8: Transverse and longitudinal crack near BH3 at west section of Sheridan Park Drive.

Photograph 9: Slight longitudinal and transverse crack near BH5 on Speakman Drive.

Photograph 10: Cracks along curbline near BH15.

Photograph 11: Wheel track crack at north and longitudinal crack along curbline near BH15.

Photograph 12: Crack along curbline near BH17.

Photograph 13: Coarse aggregate loss, moderate longitudinal cracking.

Photograph 14: Minor coarse aggregate loss and longitudinal crack along curbline near BH18.

APPENDIX D

Engineered Fill

ENGINEERED FILL

The information presented in this appendix is intended for general guidance only. Site specific conditions and prevailing weather may require modification of compaction standards, backfill type or procedures. Each site must be discussed, and procedures agreed with Peto MacCallum Ltd. prior to the start of the earthworks and must be subject to ongoing review during construction. This appendix is not intended to apply to embankments. Steeply sloping ravine residential lots require special consideration.

For fill to be classified as engineered fill suitable for supporting structural loads, a number of conditions must be satisfied, including but not necessarily limited to the following:

1. Purpose

The site specific purpose of the engineered fill must be recognized. In advance of construction, all parties should discuss the project and its requirements and agree on an appropriate set of standards and procedures.

2. Minimum Extent

The engineered fill envelope must extend beyond the footprint of the structure to be supported. The minimum extent of the envelope should be defined from a geotechnical perspective by:

- at founding level, extend a minimum 1.0 m beyond the outer edge of the foundations, greater if adequate layout has not yet been completed as noted below; and
- extend downward and outward at a slope no greater than 45° to meet the subgrade

All fill within the envelope established above must meet the requirements of engineered fill in order to support the structure safely. Other considerations such as survey control, or construction methods may require an envelope that is larger, as noted in the following sections.

Once the minimum envelope has been established, structures must not be moved or extended without consultation with Peto MacCallum Ltd. Similarly, Peto MacCallum Ltd. should be consulted prior to any excavation within the minimum envelope.

3. Survey Control

Accurate survey control is essential to the success of an engineered fill project. The boundaries of the engineered fill must be laid out by a surveyor in consultation with engineering staff from Peto MacCallum Ltd. Careful consideration of the maximum building envelope is required.

During construction it is necessary to have a qualified surveyor provide total station control on the three dimensional extent of filling.

4. <u>Subsurface Preparation</u>

Prior to placement of fill, the subgrade must be prepared to the satisfaction of Peto MacCallum Ltd. All deleterious material must be removed and in some cases, excavation of native mineral soils may be required.

Particular attention must be paid to wet subgrades and possible additional measures required to achieve sufficient compaction. Where fill is placed against a slope, benching may be necessary and natural drainage paths must not be blocked.

5. <u>Suitable Fill Materials</u>

All material to be used as fill must be approved by Peto MacCallum Ltd. Such approval will be influenced by many factors and must be site and project specific. External fill sources must be sampled, tested and approved prior to material being hauled to site.

6. <u>Test Section</u>

In advance of the start of construction of the engineered fill pad, the Contractor should conduct a test section. The compaction criterion will be assessed in consultation with Peto MacCallum Ltd. for the various fill material types using different lift thicknesses and number of passes for the compaction equipment proposed by the Contractor.

Additional test sections may be required throughout the course of the project to reflect changes in fill sources, natural moisture content of the material and weather conditions.

The Contractor should be particularly aware of changes in the moisture content of fill material. Site review by Peto MacCallum Ltd. is required to ensure the desired lift thickness is maintained and that each lift is systematically compacted, tested and approved before a subsequent lift is commenced.

7. <u>Inspection and Testing</u>

Uniform, thorough compaction is crucial to the performance of the engineered fill and the supported structure. Hence, all subgrade preparation, filling and compacting must be carried out under the full time inspection by Peto MacCallum Ltd.

All founding surfaces for all buildings and residential dwellings or any part thereof (including but not limited to footings and floor slabs) on structural fill or native soils must be inspected and approved by PML engineering personnel prior to placement of the base/subbase granular material and/or concrete. The purpose of the inspection is to ensure the subgrade soils are capable of supporting the building/house foundation and floor slab loads and to confirm the building/house envelope does not extend beyond the limits of any structural fill pads.

8. Protection of Fill

Fill is generally more susceptible to the effects of weather than natural soil. Fill placed and approved to the level at which structural support is required must be protected from excessive wetting, drying, erosion or freezing. Where adequate protection has not been provided, it may be necessary to provide deeper footings or to strip and recompact some of the fill.

9. Construction Delay Time Considerations

The integrity of the fill pad can deteriorate due to the harsh effects of our Canadian weather. Hence, particular care must be taken if the fill pad is constructed over a long time period.

It is necessary therefore, that all fill sources are tested to ensure the material compactability prior to the soil arriving at site. When there has been a lengthy delay between construction periods of the fill pad, it is necessary to conduct subgrade proof rolling, test pits or boreholes to verify the adequacy of the exposed subgrade to accept new fill material.

When the fill pad will be constructed over a lengthy period of time, a field survey should be completed at the end of each construction season to verify the areal extent and the level at which the compacted fill has been brought up to, tested and approved.

In the following spring, subexcavation may be necessary if the fill pad has been softened attributable to ponded surface water or freeze/thaw cycles.

A new survey is required at the beginning of the next construction season to verify that random dumping and/or spreading of fill has not been carried out at the site.

10. Approved Fill Pad Surveillance

It should be appreciated that once the fill pad has been brought to final grade and documented by field survey, there must be ongoing surveillance to ensure that the integrity of the fill pad is not threatened.

Grading operations adjacent to fill pads can often take place several months or years after completion of the fill pad.

It is imperative that all site management and supervision staff, the staff of Contractors and earthwork operators be fully aware of the boundaries of all approved engineered fill pads.

Excavation into an approved engineered fill pad should never be contemplated without the full knowledge, approval and documentation by the geotechnical consultant.

If the fill pad is knowingly built several years in advance of ultimate construction, the areal limits of the fill pad should be substantially overbuilt laterally to allow for changes in possible structure location and elevation and other earthwork operations and competing interests on the site. The overbuilt distance required is project and/or site specified.

Iron bars should be placed at the corner/intermediate points of the fill pad as a permanent record of the approved limits of the work for record keeping purposes.

11. Unusual Working Conditions

Construction of fill pads may at times take place at night and/or during periods of freezing weather conditions because of the requirements of the project schedule. It should be appreciated therefore, that both situations present more difficult working conditions. The Owner, Contractor, Design Consultant and Geotechnical Engineer must be willing to work together to revise site construction procedures, enhance field testing and surveillance, and incorporate design modifications as necessary to suit site conditions.

When working at night there must be sufficient artificial light to properly illuminate the fill pad and borrow areas.

Placement of material to form an engineered fill pad during winter and freezing temperatures has its own special conditions that must be addressed. It is imperative that each day prior to placement of new fill, the exposed subgrade must be inspected and any overnight snow or frozen material removed. Particular attention should be given to the borrow source inspection to ensure only nonfrozen fill is brought to the site.

The Contractor must continually assess the work program and have the necessary spreading and compacting equipment to ensure that densification of the fill material takes place in a minimum amount of time. Changes may be required to the spreading methods, lift thickness, and compaction techniques to ensure the desired compaction is achieved uniformly throughout each fill lift.

The Contractor should adequately protect the subgrade at the end of each shift to minimize frost penetration overnight. Since water cannot be added to the fill material to facilitate compaction, it is imperative that densification of the fill be achieved by additional compaction effort and an appropriate reduced lift thickness. Once the fill pad has been completed, it must be properly protected from freezing temperatures and ponding of water during the spring thaw period.

If the pad is unusually thick or if the fill thickness varies dramatically across the width or length of the fill pad, Peto MacCallum Ltd. should be consulted for additional recommendations. In this case, alternative special provisions may be recommended, such as providing a surcharge preload for a limited time or increase the degree of compaction of the fill.