



**GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
521 AND 525 ESSA ROAD
BARRIE, ONTARIO**

**for
ENCORE DEVELOPMENT GROUP**

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PML Ref.: 18BF030
Report: 1
July 2018

July 12, 2018

PML Ref.: 18BF030
Report: 1

Mr. Bryan Toteda
Encore Development Group
110 Adesso Drive
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Concord, Ontario
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Dear Mr. Toteda

**Geotechnical Investigation
Proposed Residential Development
521 and 525 Essa Road
Barrie, Ontario**

Peto MacCallum Ltd. (PML) is pleased to present the results of the geotechnical investigation recently completed at the above noted project site. Authorization for the work described in this report was provided by Mr. B. Toteda in the signed Engineering Services Agreement dated April 23, 2018.

Three apartment buildings (about 450 m² each) and twelve townhouse units (about 480 m² total) are proposed for the property at 521 and 525 Essa Road in Barrie. All buildings will be slab-on-grade and four storeys. A parking garage is planned at the ground floor of the apartments, with three residential floors above the parking garage. Site servicing, paved parking and access are planned for the site. The current planned site configuration is shown on Drawing 1, appended. An existing residence currently occupies each site and both will be demolished prior to site development.

The purpose of this investigation was to assess the subsurface conditions at the site, and based on this information, provide comments and geotechnical engineering recommendations for building foundations, site servicing, and pavement design.

Geoenvironmental services (observations, recording, testing or assessment of the environmental conditions of the soil and ground water) were not within the terms of reference for this assignment, and no work has been carried out in this regard. If excess soils requiring transportation off-site are generated, a program of sampling and chemical testing will be needed to determine the chemical properties of the soil to evaluate appropriate Receiving Site options, in accordance with the MOECC document; Management of Excess Soil – A Guide for Best Management Practices, January, 2014.

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

INVESTIGATION PROCEDURES

The field work for this investigation was conducted on June 11 and 12, 2018, and consisted of Boreholes 1 to 8 advanced to 5.0 m depth. Borehole locations are shown on Drawing 1, appended.

Boreholes locations were established in the field by PML based on a site concept plan provided by the Client and site access. Co-ordination of clearances of underground utilities was provided by PML with the aid of a sub-contracted private utility locating company. Boreholes were drilled cognizant of utility locates.

The boreholes were advanced using continuous flight solid stem augers, powered by a track mounted D-25 drill rig, equipped with a manual hammer, supplied and operated by a specialist drilling contractor, working under the full-time supervision of a member of PML's engineering staff.

Topsoil encountered at the surface of the boreholes was measured and samples of the material were collected.

Representative samples of the soils were recovered at frequent depth intervals for identification purposes using a conventional split spoon sampler. Standard penetration tests were carried out simultaneously with the sampling operations to assess the strength characteristics of the substrata. The ground water conditions in the boreholes were assessed during drilling by visual examination of the soil samples, the sampler, and drill rods as the samples were retrieved, and measurement of water in the open boreholes upon completion, if any.



Piezometers comprised of 32 mm diameter PVC pipe (1.5 m of cut slots at the base), filter sand, bentonite seal and flush-mounted protective casing were installed in three boreholes to permit monitoring of the ground water table. Boreholes without piezometers were backfilled in accordance with O.Reg. 903. As per O.Reg. 903, piezometers become the property of the Owner and will have to be decommissioned when no longer required by the Owner. PML would be pleased to assist in this regard.

Ground surface elevations were referenced to the following Temporary Bench Mark (TBM) provided by the Client, as shown on Drawing 1, and described as follows:

TBM: Temporary Bench Mark
Top of Flange of Fire Hydrant No. 3986
Elevation 314.35 (metric, geodetic)

All recovered samples were returned to our laboratory for moisture content determination and detailed examination to confirm field classification. Grain size analyses were carried out on two samples of the major soil types. The results are presented in Figures 1 and 2, attached. Accompanying Atterberg Limits testing was also completed on one of the samples.

SUMMARIZED SUBSURFACE CONDITIONS

Reference is made to the appended Log of Borehole sheets for details of the subsurface conditions, including soil classifications, inferred stratigraphy, Standard Penetration Test N values (N values), ground water observations, piezometer installation details and the results of laboratory moisture content determinations and Atterberg Limits testing.

Due to the soil sampling procedures and the limited size of samples, the depth/elevation demarcations on the borehole logs must be viewed as “transitional” zones, and cannot be construed as exact geologic boundaries between layers. PML should be retained to assist in defining the geological boundaries in the field during construction, if required.

Topsoil was encountered over fill and native layers of clayey silt, silty sand, and sand and silt till. A description of the distribution of the subsurface conditions encountered is provided below.



Topsoil was present at the surface of all boreholes, being 120 to 200 mm thick.

Below the topsoil, a fill unit composed of variable sand and silt content, with trace gravel and local trace organics noted, was observed in all boreholes with the exception of Borehole 1. The fill carried to 0.7 to 2.9 m depth (elevation 312.3 to 313.4). The layer was moist to very moist, with moisture contents of 3 to 25%. N Values were 4 to 26, typically less than 10, indicating variable conditions.

Underlying the fill or topsoil, a native clayey silt layer was encountered in Boreholes 1 to 3 and 5 to 7, carrying to 1.4 to 4.0 m depth (elevation 310.5 to 312.8). A sample of the material from Borehole 6 was submitted for grain size analysis and the results are presented on Figure 1, appended. Atterberg Limits testing showed the material to have a plastic limit of 17% and a liquid limit of 25%. The layer was firm to very stiff based on N Values of 4 to 22, and was about the plastic limit to wetter than plastic limit with moisture contents of 12 to 26%.

Beneath the native clayey silt layer in Borehole 2, a local silty sand layer was encountered to 2.1 m depth (elevation 312.0). The material was compact (N Value of 18) and was very moist with a moisture content of 21%.

A basal silt and sand till deposit was encountered below the upper soil units in all boreholes extending to the 5.0 m depth of exploration in all boreholes. The unit comprised silty sand to sandy silt with trace gravel. Cobbles and boulders were noted. A sample of the material was submitted for grain size analysis and the results are presented on Figure 2, appended. The relative density of the till unit was compact to very dense with N Values of 11 to 65. The till was moist to very moist, with local wet seams, and moisture contents of 7 to 12%.

A summary of the first water strike during drilling, the water/wet cave measurements conducted upon completion of the boreholes, and the water levels recorded in the piezometers on June 20, 2018 is summarized below:



BOREHOLE	FIRST WATER STRIKE DURING DRILLING		WATER LEVEL UPON COMPLETION OF AUGERING		WATER LEVEL IN PIEZOMETERS JUNE 20, 2018	
	Depth (m)	Elevation	Depth (m)	Elevation	Depth (m)	Elevation
1	3.4	310.8	3.7	310.5	1.1	313.1
2	4.6	309.5	No Water	No Water	--	--
3	4.6	310.0	4.0	310.6	--	--
4	4.6	310.2	4.1	310.7	2.3	312.5
5	3.7	310.8	4.0	310.5	--	--
6	4.6	309.9	4.0	310.5	--	--
7	4.0	311.2	4.1	311.1	2.3	312.9
8	4.6	310.2	4.4	310.4	--	--

Based on the above, ground water at the site is residing in wet seams within the till unit. Localized areas of perched water across the site are possible, especially above the till or clayey silt layer.

Ground water levels will fluctuate seasonally, and in response to variations in precipitation.

GEOTECHNICAL ENGINEERING CONSIDERATIONS

General

Three apartment buildings (about 450 m² each) and twelve townhouse units (about 480 m² total) are proposed for the property at 521 and 525 Essa Road in Barrie. All buildings will be slab-on-grade and four storeys. A parking garage is planned at the ground floor of the apartments, with three residential floors above the parking garage. Site servicing, paved parking and access are planned for the site. The current planned site configuration is shown on Drawing 1, appended. An existing residence currently occupies each site and both will be demolished prior to site development.



Site Grading and Engineered Fill

The grading for the site has not been set however, for purposes of this report, it is assumed that the ground floor slab for the proposed buildings will be at about elevation 315.0, slightly above the existing site grades across the site. Based on this, exterior footings would normally be founded at about elevation 313.5, with interior footings at about elevation 314.4.

At these levels, the boreholes show the floor slabs and some footings would be founded on existing fill or firm portions of native clayey silt, which are unsuitable to support footings or floor slabs. As such it is recommended that existing fill be removed and grades raised with engineered fill. Both footings and floor slabs could then be supported on engineered fill, locally footings would be supported on native soils.

In the area of the existing houses, the in-situ fill and foundations will have to be removed, such that the extent of the excavation extends to native soil in all directions. It is noted that fill may be deeper around the existing houses than indicated at the borehole locations.

Reference is made to Appendix A for guidelines for engineered fill construction. The following general highlights are provided:

- Strip existing topsoil, fill, firm clayey silt (Borehole 1), and other deleterious materials down to native inorganic soil. The excavated soil should be segregated and stockpiled for reuse or disposal. Existing house foundations and associated fill will be removed and the excavation will have to extend to native soil in all directions;
- The clayey silt will typically be exposed as the subgrade soil may become sensitive to traffic if wet or allowed to get wet. Proofroll exposed subgrade, if not wet, using a heavy roller to targeted 100% Standard Proctor maximum dry density, under geotechnical review;
- Following geotechnical review and approval of the subgrade, spread approved material in maximum 200 mm thick lifts and uniformly compacted to 100% Standard Proctor maximum dry density in building areas and 95% Standard Proctor maximum dry density in pavement or site servicing areas. If



wet subgrade conditions are present the initial lift or two of engineered fill shall comprise Granular B Type II;

- Subject to geotechnical review during construction, the excavated sand to silty sand fill is only selectively suitable for reuse as engineered fill, subject to remove of organics, topsoil, oversized (over 150 mm) or otherwise deleterious material. A slight grade raise is anticipated at the site and as such imported fill is anticipated. Imported fill should be utilized under buildings or other structures, with on-site soils used in landscaped areas. Imported material should comprise OPSS Select Subgrade Material (SSM) or OPSS Granular B Type I. Other sources of imported material should be reviewed by our office to ensure suitability;
- The engineered fill pad must extend at least 1 m beyond the structure to be supported, then outwards and downwards at no steeper than 45° to the horizontal to meet the underlying approved native subgrade. In this regard, strict survey control and detailed documentation of the lateral and vertical extent of the engineered fill limits should be carried out to ensure that the engineered fill pad fully incorporates the structure to be supported;
- Engineered fill construction must be carried out under full time field review by PML, to approve sub-excavation and subgrade preparation, backfill materials, placement and compaction procedures, and to verify that the specified compaction standards are achieved throughout.

Foundations

As noted above, footings are anticipated at about elevation 314.4 and 313.5. At these levels, footings will be supported on engineered fill and locally the underlying native soil. Footings supported on native soil and/or engineered fill can be designed for a geotechnical bearing resistance at Serviceability Limit State (SLS) of 150 kPa, and a factored bearing resistance at Ultimate Limit State (ULS) of 225 kPa.

It is noted that in the area of the existing houses, fill will likely be present below the depths noted at the borehole locations. As such, as discussed above, existing fill and foundations once fully removed will have to be replaced with engineered fill.



The geotechnical bearing resistance at SLS is based on 25 mm or settlement in the bearing stratum with differential settlement not exceeding 75% of the value.

Footings subject to frost action should be provided with a minimum 1.2 m of earth cover or equivalent.

Prior to placement of structural concrete, all founding surfaces should be reviewed by PML to verify the design bearing capacity is available, or to reassess the design parameters based on the actual conditions revealed in the excavation.

Seismic Design

Based on the soil profile revealed in the boreholes, Site Classification D is applicable for Seismic Site Response as set out in Table 4.1.8.4.A of the Ontario Building Code (2012). Based on the type and relative density of the soil cover at the site there is a low potential for liquefaction of soils to occur.

Floor Slab-on-Grade

Floor slab-on-grade construction is feasible on engineered fill, constructed as discussed earlier.

A minimum 200 mm thick base layer of crushed stone (nominal 20 mm size) is recommended directly beneath the floor slab. Where a vapour sensitive floor finish is to be used then the use of polyethylene sheeting or similar means should be incorporation as a vapour barrier.

Exterior grades should be established to promote surface drainage away from the building.

Site Servicing

Design details were not finalized at the time of this report. For purposes of this report, inverts are assumed to be up to 3.0 m below existing grades.



Trench Excavation and Ground Water Control

Trench excavation and ground water control are described later in the report under Excavation and Ground Water Control.

Pipe Bedding

Engineered fill or native clayey silt, silty sand, or till is expected at invert levels which is considered satisfactory for pipe support.

Where existing fill or other deleterious material is encountered at the design invert level, such material should be sub-excavated and replaced with an increased thickness of bedding material, subject to geotechnical field review and approval.

Standard Granular A bedding, in accordance with OPSS, compacted to 95% Standard Proctor maximum dry density should be satisfactory. For flexible pipes, bedding and cover material should comprise OPSS Granular A. For rigid pipes, the bedding material should comprise OPSS Granular A and cover material may comprise select native soil free of oversized material.

Trench Backfill

Backfill in trenches should comprise select inorganics soil and be placed in maximum 200 mm thick loose lifts compacted to at least 95% Standard Proctor maximum dry density to minimize post construction settlement in the backfill. Topsoil, organic, excessively wet, frozen, oversized (greater than 200 mm), or otherwise deleterious material should not be incorporated as trench backfill. The moisture content of the trench backfill should be within 2% of the optimum moisture content in order to achieve the specified compaction and be close to optimum moisture content in the upper 1 m to prevent subgrade instability issues. Ideally the backfill should comprise excavated site soil, in order to minimize differential frost heave.



The excavated granular soils will comprise fill, native silty sand, and the till deposit. The native inorganic granular soil should generally be acceptable for reuse subject to geotechnical review during construction and moisture content control. The excavated clayey silt should be utilized in landscaped areas only.

Earthworks operations should be inspected by PML to verify subgrade preparation, backfill materials, placement and compaction efforts and ensure the specified degree of compaction is achieved throughout.

Excavation and Ground Water Control

It is anticipated that excavation for the engineered fill/apartment building foundations and site servicing will extend to about 3.0 m below existing grade possibly deeper in the area of the existing houses for removal of existing fill and foundations. Excavation will encounter fill and native clayey silt/silty sand/till. Harder digging and the presence of boulders should be expected within the till deposit.

Subject to the ground water control as discussed below, the site soils encountered at the site should be considered as Type 3 soil requiring excavation sidewalls to be constructed at no steeper than one horizontal to one vertical (1H:1V) from the base of the excavation in accordance with the Occupational Health and Safety Act.

The ground water table was generally encountered below the anticipated excavation depths noted above. Accordingly, it is expected that nuisance ground water seepage should be managed using conventional sump pumping techniques. The presence of perched water above the till or clayey silt should also be expected.

Water taking in Ontario is governed by the Ontario Water Resources Act (OWRA) and the Water Takings and Transfer Regulation O. Reg. 387/04. Section 34 of the OWRA requires anyone taking more than 50,000 L/d to notify the Ministry of the Environment and Climate Change (MOECC). This requirement applies to all withdrawals, whether for consumption, temporary construction dewatering, or permanent drainage improvements. Where it is assessed that more



than 50,000 L/d but less than 400,000 L/d of ground water taking is required, the Owner can register online via the Environmental Activity and Sector Registry (EASR) system. Where it is assessed that more than 400,000 L/d of ground water taking is required then a Category 3 Permit-to-Take-Water (PTTW) is required.

Based on the conditions revealed in the boreholes, a PTTW or registry on the EASR is not anticipated as the excavation will be above the ground water table. Excavation and ground water control requirements should be reviewed when design details are finalized.

Pavement Design and Construction

Based on the boreholes, it is anticipated that the pavement subgrade will comprise moderately frost susceptible sand/silt fills. Based on this, the following pavement structure thicknesses are recommended:

	LIGHT DUTY (CAR PARKING)	HEAVY DUTY (FIRE ROUTE)
Asphalt (mm)	90	110
Granular A Base Course (mm)	150	150
Granular B Subbase Course (mm)	300	450
Total Thickness (mm)	540	710

It is not intended to remove all of the existing fill from under the proposed pavement. However, in order to minimize potential settlement issues it is recommended that following rough grading to the subgrade level, subgrade preparation should include proofrolling and compacting the exposed subgrade with a heavy vibratory compactor to 95% Standard Proctor maximum dry density under geotechnical review. Any unstable zones identified during this process should be sub-excavated and replace with compacted select site material, subject to geotechnical field review.

Imported material for the granular base and subbase should conform to OPSS gradation specifications for Granular A and Granular B, and should be compacted to



100% Standard Proctor maximum dry density. Asphalt should be compacted in accordance with OPSS 310.

For the pavement to function properly, it is essential that provisions be made for water to drain out of and not collect in the base material. The incorporation of subdrains is recommended in conjunction with crowning of the final subgrade to promote drainage towards the pavement edge. Subdrains should be installed at least 300 mm below the subgrade level. Refer to OPSD 216 Series for details regarding pipe, filter fabric or filter sock, bedding and cover material. Maintenance hole/catchbasins should be backfilled with free draining material with frost tapers and stub drains extending out from structures. The above measures will help drain the pavement structure as well as alleviate the problems of differential frost movement between the catchbasins and pavement.

Geotechnical Review and Construction Inspection and Testing

It is recommended that the final design drawings be submitted to PML for geotechnical review for compatibility with site conditions and recommendations of this report.

Earthworks operations should be carried out under the supervision of PML to approve subgrade preparation, backfill materials, placement and compaction procedures and check the specified degree of compaction is achieved throughout.

Prior to placement of structural concrete, all founding surfaces must be inspected by PML to verify the design bearing capacity is available, or to reassess the design parameters based on the actual conditions.

The comments and recommendations provided in the report are based on information revealed in the boreholes. Conditions away from and between boreholes may vary, particularly where foundation and/or service trenches exist. Geotechnical review during construction should be ongoing to confirm the subsurface conditions are substantially similar to those encountered in the boreholes, which may otherwise require modification to the original recommendations.

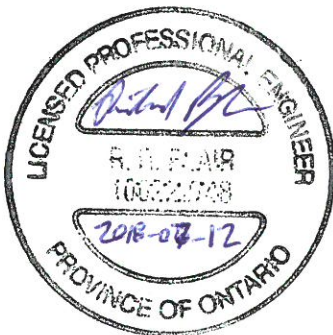


CLOSURE

We trust this report is complete within our terms of reference, and the information presented is sufficient for your present purposes. If you have any questions, or when we may be of further assistance, please do not hesitate to call our office.

Sincerely

Peto MacCallum Ltd.



Richard Blair, P.Eng.
Project Engineer, Geotechnical Services

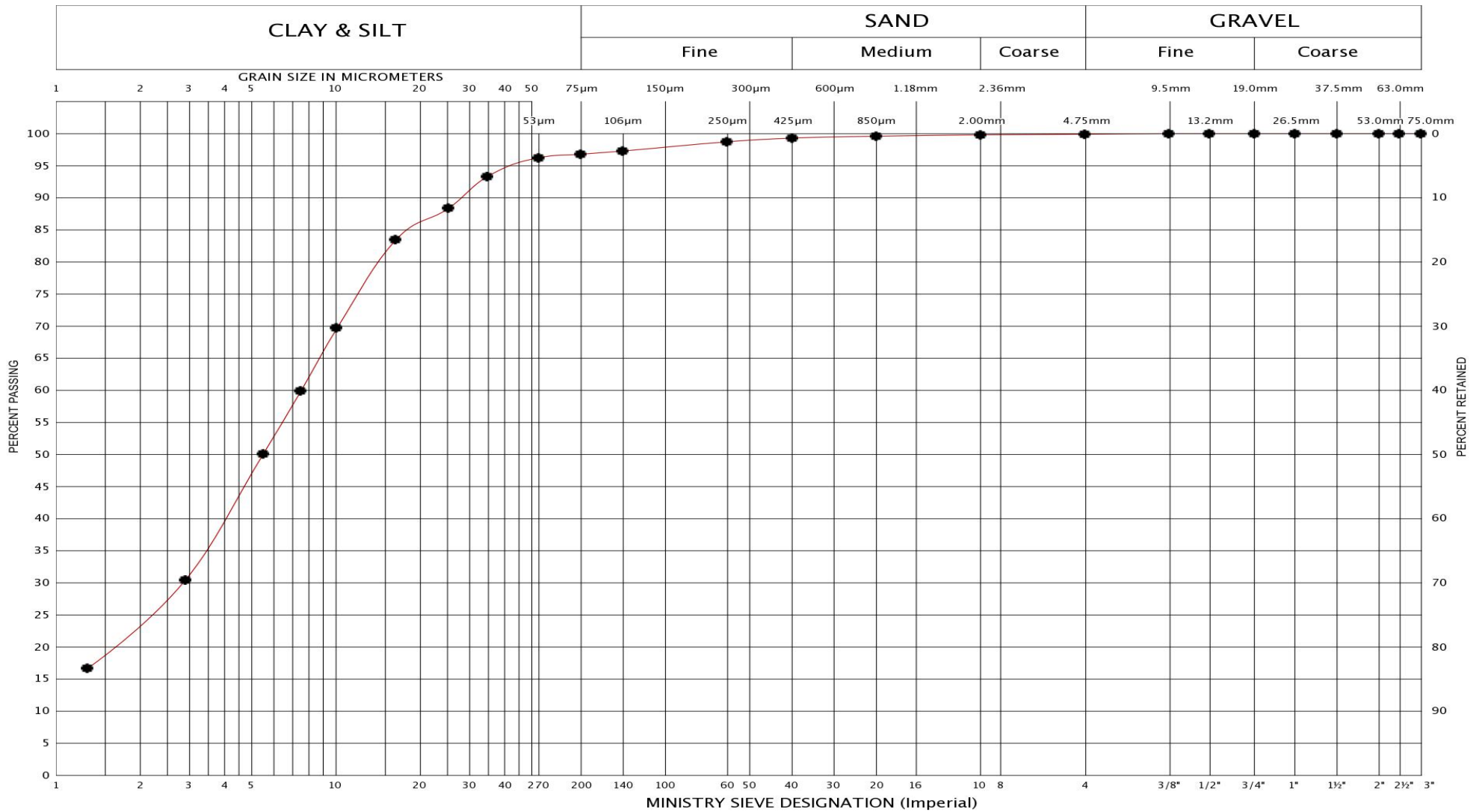


Geoffrey R. White, P.Eng.
Associate
Manager, Geotechnical and Geoenvironmental Services

RB/GRW:jlb

Enclosures:
Figures 1 and 2 - Particle Size Distribution Charts
List of Abbreviations
Log of Borehole Nos. 1 to 8
Drawing 1 - Borehole Location Plan
Appendix A – Engineered Fill

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	6
	SAMPLE	4
	SYMBOL	•

GRAIN SIZE DISTRIBUTION

CLAYEY SILT, Trace Sand; PL: 17%; LL: 25%

FIG No.:	1
Project No.:	18BF030



LIST OF ABBREVIATIONS



PENETRATION RESISTANCE

Standard Penetration Resistance N: - The number of blows required to advance a standard split spoon sampler 0.3 m into the subsoil. Driven by means of a 63.5 kg hammer falling freely a distance of 0.76 m.

Dynamic Penetration Resistance: - The number of blows required to advance a 51 mm, 60 degree cone, fitted to the end of drill rods, 0.3 m into the subsoil. The driving energy being 475 J 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:

<u>CONSISTENCY</u>	<u>N (blows/0.3 m)</u>	<u>c (kPa)</u>	<u>DENSENESS</u>	<u>N (blows/0.3 m)</u>
Very Soft	0 - 2	0 - 12	Very Loose	0 - 4
Soft	2 - 4	12 - 25	Loose	4 - 10
Firm	4 - 8	25 - 50	Compact	10 - 30
Stiff	8 - 15	50 - 100	Dense	30 - 50
Very Stiff	15 - 30	100 - 200	Very Dense	> 50
Hard	> 30	> 200		
WTLL	Wetter Than Liquid Limit			
WTPL	Wetter Than Plastic Limit			
APL	About Plastic Limit			
DTPL	Drier Than Plastic Limit			

TYPE OF SAMPLE

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

LOG OF BOREHOLE NO. 1

17T 602923E 4910588N

PROJECT Proposed Residential Development - 521 and 525 Essa Road

PML REF. 18BF030

LOCATION Barrie, Ontario

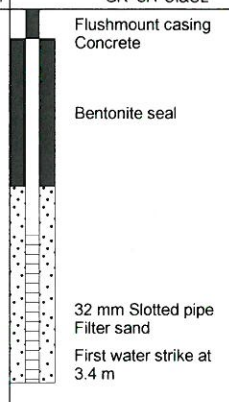
BORING DATE June 12, 2018

ENGINEER GW

BORING METHOD Continuous Flight Hollow Stem Augers

TECHNICIAN AT

SOIL PROFILE			SAMPLES			SHEAR STRENGTH (kPa)		PLASTIC NATURAL LIQUID			UNIT WEIGHT	GROUND WATER OBSERVATIONS AND REMARKS		
DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE				W _p			w	W _L
						50	100	150	200					
0.0	SURFACE ELEVATION 314.15													
0.20	TOPSOIL: Dark brown, sandy silt, trace gravel, very moist		1	SS	4	314								
313.95	CLAYEY SILT: Firm, brown to grey, clayey silt, trace sand, APL		2	SS	6	313								
1.4														
312.8	SILT AND SAND TILL: Compact to dense, brown, sandy silt to silty sand, trace gravel, cobbles and boulders, moist to very moist (wet seams)		3	SS	29	312								
2.0			4	SS	35	312								
3.0			5	SS	36	311								
4.0						310								
5.0	BOREHOLE TERMINATED AT 5.0 m		6	SS	43									
309.2														



Upon completion of augering Water at 3.7 m
Cave at 4.3 m
Water Level Readings:
Date Depth Elev.
2018-06-20 1.1 313.1

NOTES

LOG OF BOREHOLE NO. 2

17T 602919E 4910569N

PROJECT Proposed Residential Development - 521 and 525 Essa Road

PML REF. 18BF030

LOCATION Barrie, Ontario

BORING DATE June 12, 2018

ENGINEER GW

BORING METHOD Continuous Flight Hollow Stem Augers

TECHNICIAN AT

SOIL PROFILE			SAMPLES			SHEAR STRENGTH (kPa)		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT kN/m ³	GROUND WATER OBSERVATIONS AND REMARKS		
DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	+ FIELD VANE Δ TORVANE ○ Qu		W _p	w	W _L				
						▲ POCKET PENETROMETER ○ Q					WATER CONTENT (%)			
						DYNAMIC CONE PENETRATION STANDARD PENETRATION TEST					GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL			
						50	100	150	200					
						20	40	60	80					
SURFACE ELEVATION 314.10														
0.0	0.18	TOPSOIL: Brown, silty sand, trace gravel, moist	1	SS	5	314								
	313.92													
	0.70	FILL: Brown, sand, trace gravel, trace silt, moist												
	313.40													
1.0	1.4	CLAYEY SILT: Stiff, brown to grey, clayey silt, trace sand, APL	2	SS	15	313								
	312.7													
2.0	2.1	SILTY SAND: Compact, brown, silty sand, trace gravel, very moist	3	SS	18	312								
	312.0													
	2.1	SILT AND SAND TILL: Dense to very dense, brown, sandy silt to silty sand, trace gravel, cobbles and boulders, moist to very moist (wet seams)	4	SS	36	311								
	3.0		5	SS	44	310								
	4.0													
	5.0		6	SS	59									
5.0	309.1	BOREHOLE TERMINATED AT 5.0 m												First water strike at 4.6 m
														Upon completion of augering No water Cave at 2.1 m

NOTES

LOG OF BOREHOLE NO. 3

17T 602952E 4910565N

PROJECT Proposed Residential Development - 521 and 525 Essa Road

PML REF. 18BF030

LOCATION Barrie, Ontario

BORING DATE June 12, 2018

ENGINEER GW

BORING METHOD Continuous Flight Hollow Stem Augers

TECHNICIAN AT

SOIL PROFILE			SAMPLES			SHEAR STRENGTH (kPa)		PLASTIC NATURAL LIQUID			UNIT WEIGHT	GROUND WATER OBSERVATIONS AND REMARKS	
DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	+ FIELD VANE	△ TORVANE	○ Qu	LIMIT	MOISTURE CONTENT			LIMIT
						▲ POCKET PENETROMETER	○ Q	○	W _p	w	W _L		
						DYNAMIC CONE PENETRATION STANDARD PENETRATION TEST		×	WATER CONTENT (%)				
						50	100	150	200	10	20	30	40
						20	40	60	80				
0.0	SURFACE ELEVATION 314.55												
0.15	TOPSOIL: Brown, sand, trace gravel, trace silt, wet		1	SS	7								
314.40	FILL: Brown, sandy silt to silty sand, trace gravel, moist to very moist		2	SS	7								
1.0													
1.4													
313.2	CLAYEY SILT: Stiff to very stiff, brown, clayey silt, trace sand, WTPL to APL		3	SS	8								
2.0													
4.0													
310.6	SILT AND SAND TILL: Dense, grey, sandy silt to silty sand, trace gravel, cobbles and boulders, moist (wet seams)		6	SS	43								
5.0	BOREHOLE TERMINATED AT 5.0 m												
309.6													
5.0													First water strike at 4.6 m
6.0													
7.0													
8.0													
9.0													
10.0													
11.0													
12.0													
13.0													
14.0													
15.0													

Upon completion of augering Water at 4.0 m Cave at 4.4 m

NOTES

LOG OF BOREHOLE NO. 4

17T 602993E 4910561N

PROJECT Proposed Residential Development - 521 and 525 Essa Road

PML REF. 18BF030

LOCATION Barrie, Ontario

BORING DATE June 11, 2018

ENGINEER GW

BORING METHOD Continuous Flight Hollow Stem Augers

TECHNICIAN AT

SOIL PROFILE			SAMPLES			SHEAR STRENGTH (kPa)		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT kN/m ³	GROUND WATER OBSERVATIONS AND REMARKS	
DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE				W _p			w
						50	100	150	200				
0.0	SURFACE ELEVATION 314.75												
0.15 314.60	TOPSOIL: Brown, sand, trace gravel, trace silt, moist		1	SS	13								Flushmount casing Concrete
	FILL: Brown, silty sand, trace gravel, moist		2	SS	7								Bentonite seal
1.4 313.4	SILT AND SAND TILL: Compact to dense, brown, sandy silt to silty sand, trace clay, trace gravel, cobbles and boulders, moist (wet seams)		3	SS	20								
			4	SS	11								
			5	SS	17								32 mm Slotted pipe Filter sand
4.6 310.2	Becoming grey		6	SS	38								First water strike at 4.6 m
5.0 309.8	BOREHOLE TERMINATED AT 5.0 m												Upon completion of augering Water at 4.1 m No cave Water Level Readings: Date Depth Elev. 2018-06-20 2.3 312.5

NOTES

LOG OF BOREHOLE NO. 5

17T 602977E 4910538N

PROJECT Proposed Residential Development - 521 and 525 Essa Road

PML REF. 18BF030

LOCATION Barrie, Ontario

BORING DATE June 11, 2018

ENGINEER GW

BORING METHOD Continuous Flight Hollow Stem Augers

TECHNICIAN AT

SOIL PROFILE			SAMPLES			SHEAR STRENGTH (kPa)		PLASTIC NATURAL LIQUID			UNIT WEIGHT kN/m ³	GROUND WATER OBSERVATIONS AND REMARKS		
DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	+ FIELD VANE Δ TORVANE ○ Qu				W _p			W	W _L
						▲ POCKET PENETROMETER ○ Q								
						DYNAMIC CONE PENETRATION STANDARD PENETRATION TEST		WATER CONTENT (%)			GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL			
						50	100	150	200					
						20	40	60	80					
SURFACE ELEVATION 314.50														
0.0	0.15	314.35	1	SS	7									
TOPSOIL: Brown, sand, some silt, trace gravel, moist														
FILL: Brown, sandy silt, trace gravel, trace organics, moist														
1.0	1.4	313.1	2	SS	9									
CLAYEY SILT: Very stiff, brown to grey, clayey silt, trace sand, trace gravel, APL														
2.0	2.1	312.4	3	SS	20									
SILT AND SAND TILL: Compact to dense, brown, sandy silt to silty sand, trace gravel, cobbles and boulders, moist to very moist (wet seams)														
3.0	4.6	309.9	4	SS	16									
Becoming grey														
4.0	5.0	309.5	5	SS	24									
BOREHOLE TERMINATED AT 5.0 m														
First water strike at 3.7 m														
Upon completion of augering Water at 4.0 m Cave at 4.3 m														

NOTES

LOG OF BOREHOLE NO. 6

17T 602922E 4910537N

PROJECT Proposed Residential Development - 521 and 525 Essa Road

PML REF. 18BF030

LOCATION Barrie, Ontario

BORING DATE June 12, 2018

ENGINEER GW

BORING METHOD Continuous Flight Hollow Stem Augers

TECHNICIAN AT

SOIL PROFILE			SAMPLES			SHEAR STRENGTH (kPa)		PLASTIC NATURAL LIQUID			UNIT WEIGHT	GROUND WATER OBSERVATIONS AND REMARKS		
DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	+ FIELD VANE	△ TORVANE	○ Qu	W _p	w			W _L	
						▲ POCKET PENETROMETER	○ Q	○ Q	WATER CONTENT (%)					
						DYNAMIC CONE PENETRATION STANDARD PENETRATION TEST		×						
						50	100	150	200	10	20	30	40	
						20	40	60	80					
0.0	SURFACE ELEVATION 314.50													
0.16	TOPSOIL: Brown, silty sand, trace gravel, moist		1	SS	9									
314.34	FILL: Brown, silty sand, trace gravel, moist		2	SS	14									
1.0														
1.4														
313.1	CLAYEY SILT: Stiff to very stiff, brown to grey, clayey silt, trace sand, trace gravel, APL to WTPL		3	SS	10									
2.0														
3.0														
4.0														
4.0	SILT AND SAND TILL: Very dense, brown, sandy silt to silty sand, trace gravel, cobbles and boulders, very moist (wet seams)		6	SS	65									
310.5														
5.0	BOREHOLE TERMINATED AT 5.0 m													
309.5														
6.0														
7.0														
8.0														
9.0														
10.0														
11.0														
12.0														
13.0														
14.0														
15.0														

First water strike at 4.6 m

Upon completion of augering Water at 4.0 m
Cave at 4.4 m

NOTES

LOG OF BOREHOLE NO. 7

17T 602964E 4910525N

PROJECT Proposed Residential Development - 521 and 525 Essa Road

PML REF. 18BF030

LOCATION Barrie, Ontario

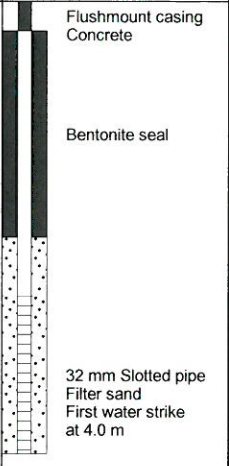
BORING DATE June 11, 2018

ENGINEER GW

BORING METHOD Continuous Flight Hollow Stem Augers

TECHNICIAN AT

SOIL PROFILE			SAMPLES			ELEVATION SCALE	SHEAR STRENGTH (kPa)				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT kN/m ³	GROUND WATER OBSERVATIONS AND REMARKS
DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		+ FIELD VANE	△ TORVANE	○ Qu	▲ POCKET PENETROMETER					
0.0	SURFACE ELEVATION 315.15					315									
0.12	TOPSOIL: Brown, sand, trace gravel, trace silt, moist		1	SS	4	315									
315.03	FILL: Brown, sand trace gravel, trace silt, moist to very moist		2	SS	5	314									
1.0			3	SS	15	313									
2.1	Becoming silty sand		4	SS	26	312									
313.1			5	SS	21	312									
2.9	CLAYEY SILT: Very stiff, brown, clayey silt, trace sand, WTPL		6	SS	15	311									
312.3															
4.0	SILT AND SAND TILL: Compact, grey, sandy silt to silty sand, trace gravel, cobbles and boulders, very moist (wet seams)														
311.2															
5.0	BOREHOLE TERMINATED AT 5.0 m														
310.2															
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. 8

17T 602975E 4910529N

PROJECT Proposed Residential Development - 521 and 525 Essa Road

PML REF. 18BF030

LOCATION Barrie, Ontario

BORING DATE June 11, 2018

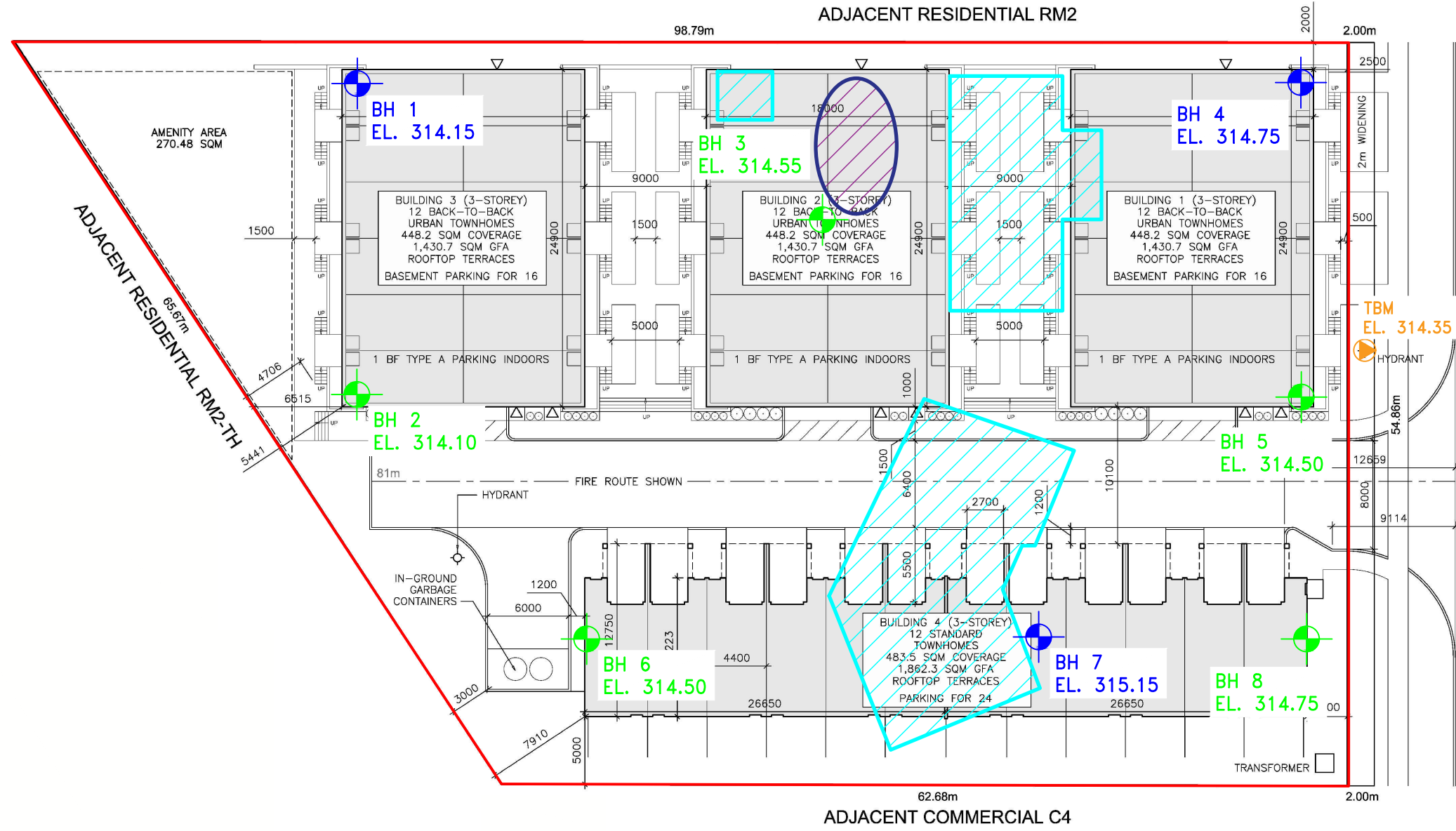
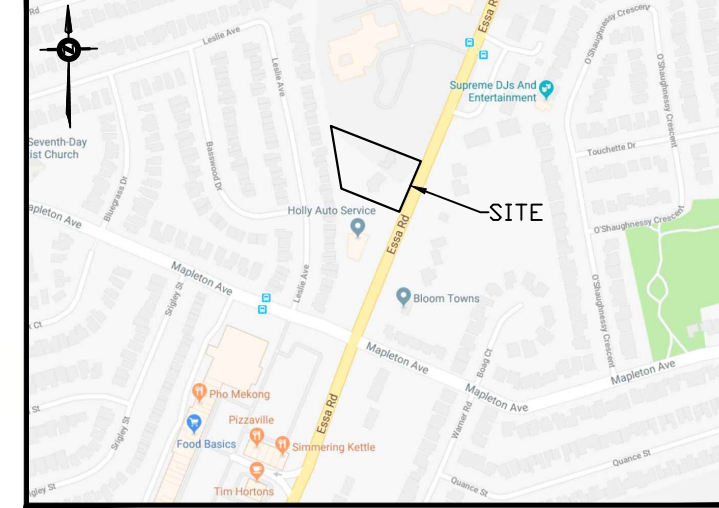
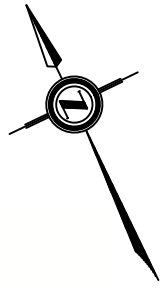
ENGINEER GW

BORING METHOD Continuous Flight Hollow Stem Augers

TECHNICIAN AT

SOIL PROFILE			SAMPLES			SHEAR STRENGTH (kPa)		PLASTIC NATURAL LIQUID			UNIT WEIGHT kn/m ³	GROUND WATER OBSERVATIONS AND REMARKS		
DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	+ FIELD VANE Δ TORVANE ○ Qu				w _p			w	w _L
						▲ POCKET PENETROMETER ○ Q								
						DYNAMIC CONE PENETRATION STANDARD PENETRATION TEST × ●		WATER CONTENT (%)			GRAIN SIZE DISTRIBUTION (%) GR SA S&CL			
0.0	SURFACE ELEVATION 314.75													
0.18 314.57	TOPSOIL: Dark brown, silty sand, trace gravel, moist		1	SS	4									
	FILL: Brown, sandy silt, trace gravel, wood pieces, very moist		2	SS	8									
			3	SS	5									
2.1 312.7	SILT AND SAND TILL: Compact to dense, brown to grey, sandy silt to silty sand, trace gravel, cobbles and boulders, moist (wet seams)		4	SS	26									
			5	SS	22									
			6	SS	47									
5.0 309.8	BOREHOLE TERMINATED AT 5.0 m												First water strike at 4.6 m	
													Upon completion of augering Wet cave at 4.4 m	

NOTES

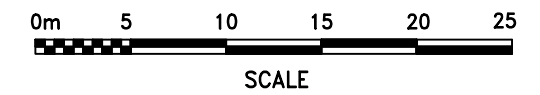


KEY PLAN
BARRIE, ONTARIO

LEGEND:

- SITE LIMITS
- APPROXIMATE LOCATION OF EXISTING BUILDINGS TO BE DEMOLISHED
- APPROXIMATE LOCATION OF EXISTING ABOVE GRADE POOL TO BE REMOVED
- **BH 1** BOREHOLE 1 (WITH PIEZOMETER) SURFACE ELEVATION
EL. 314.15
- **BH 2** BOREHOLE 2 SURFACE ELEVATION
EL. 314.10
- **TBM** TEMPORARY BENCH MARK TOP OF FLANGE OF FIRE HYDRANT #3986 ELEVATION 314.35 (METRIC, GEODETIC)
EL. 314.35

REFERENCE:
BASE PLAN PROVIDED BY CLIENT.



BOREHOLE LOCATION PLAN

PROPOSED RESIDENTIAL DEVELOPMENT
521 AND 525 ESSA ROAD
BARRIE, ONTARIO



DRAWN	RB	DATE	SCALE	PML REF.	DRAWING NO.
CHECKED	CW	JULY 2018	AS SHOWN	18BF030	1
APPROVED	CW				



APPENDIX A

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. Subsurface Preparation

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. Suitable Fill Materials

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. Test Section

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. Inspection and Testing

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.