316 SOMERSET STREET – GEOTECHNICAL REPORT

Project No.: CP-17-0637

Prepared for:

TC United Group
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March 2018

McINTOSH PERRY

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GEOTECHNICAL INVESTIGATION and
FOUNDATION DESIGN RECOMMENDATION REPORT
316 Somerset Street, Ottawa, Ontario

1.0 INTRODUCTION

This report presents the factual findings obtained from a geotechnical investigation performed at the above-mentioned site, for the proposed construction of a three floor multi-use building in Ottawa, Ontario. The field work was carried out on January 18, 2018 and comprised of two boreholes advanced to a maximum depth of 5.1 m below existing ground surface.

The purpose of the investigation was to explore the subsurface conditions at this site and to provide anticipated geotechnical conditions influencing the design and construction of the proposed building.

McIntosh Perry Consulting Engineers Ltd (McIntosh Perry) carried out the investigation at the request of TC United.

2.0 SITE DESCRIPTION

The property under considerations for proposed development is located 316 Somerset Street, east of the intersection with Chapel Street. The property is located west of the Rideau River in a neighbourhood called Sandy Hill of Ottawa. The property is located in the middle of a residential development. The existing property contains a single family dwelling and a detached single car garage. An asphalt driveway runs along the west of the property to the garage. The property is relatively flat, the backyard is enclosed by a chain link fence and the front yard is surrounded by shrubbery.

It is understood the proposed structure will be a 3-story mixed use building, with a basement.

Location of the property is shown on Figure 1, included in Appendix B.

3.0 FIELD PROCEDURES

Staff of McIntosh Perry Consulting Engineers (McIntosh Perry) visited the site before the drilling investigation to mark out the proposed borehole locations and assess access for drill rig access. Utility clearance was carried out by USL-1 on behalf of McIntosh Perry. Public and private utility authorities were informed and all utility clearance documents were obtained before the commencement of drilling work.

The equipment used for drilling was owned and operated by CCC Geotechnical & Environmental Drilling Ltd. of Ottawa, Ontario. Boreholes were advanced using hollow stem augers aided by a truck-mounted CME-55 drilling rig. Boreholes were advanced to a maximum depth of 5.1 m below the ground level. Soil samples were obtained

at 0.6 m intervals of depth in boreholes using a 50 mm outside diameter split spoon sampler in accordance with the Standard Penetration Test (SPT) procedure. Boreholes were backfilled with auger cuttings. All boreholes were restored to match the original surface. Borehole locations are shown on Figure 2, included in Appendix B. Geotechnical boreholes were only drilled in the driveway and front of the existing building due to restricted access to be backyard caused by detached garage.

4.0 LABORATORY TEST PROCEDURES

Selected samples were tested for moisture content by McIntosh Perry.

The soil samples recovered will be stored in McIntosh Perry storage facility for a period of one month after submission of the final report. Samples will be disposed after this period of time unless otherwise requested in writing by the Client.

5.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

5.1 Site Geology

Based on published physiography maps of the area (Ontario Geological Survey) the site is located within the Ottawa Valley Clay Plains. Surficial geology maps of southern Ontario identify the property as on fine-textured glaciomarine deposits.

The Ottawa Valley between Pembroke and Hawkesbury, Ontario consists of clay plains interrupted by ridges of rock or sand. It is naturally divided into two parts, above and below Ottawa, Ontario. Within the valley, the bedrock is further faulted so that some of the uplifted blocks appear above the clay beds. The sediments themselves in the valley are deep silty clay. Although the clay deposits are grey in color like the limestones that underlies them in part, they are only mildly calcareous and likely derived from the more acidic rock of the Canadian Shield.

5.2 Subsurface Conditions

In general, the site stratigraphy consists of fill material underlain by shale. The soils encountered at this site can be divided into two different zones.

a) Fill
b) Shale

The soils encountered during the course of the investigation, together with the field and laboratory test results are shown on the Record of Borehole sheets included in Appendix C. Description of the strata encountered are given below.

5.2.1 Fill

Asphalt thickness in BH18-1 was observed to be 40 mm and 25 mm in BH18-2. Below the asphalt was a layer of fill which began as brown, moist and compact sand and gravel, with traces of clay and silt. This fill layer then transitioned to a silty gravelly sand described as dark brown, moist and loose. The fill finally transitioned into a dark brown, moist, loose silty sand with some gravel. SPT 'N' values within this layer were 6 to 7 blows/300 mm. Moisture content with this layer was observed to be an average of 24%. The thickness of the fill, was observed to range from 1.5 m to 1.6 m. It is understood two additional boreholes were advanced in the backyard for environmental sampling using portable drilling equipment. The fill encountered in the backyard was observed to be of a similar consistency as the front yard and refusal on shale was encountered at 1.2 m in both boreholes.

5.2.2 Shale

Below the fill in both boreholes was highly weathered to weathered black shale. Due the weathered and fractured nature of the shale, boreholes were advanced into the layer through auguring. The shale was cored in BH18-1 and showed the rock core recovery (CR) ranging from 46% to 100%. Rock quality designation (RQD) for the cored rock samples ranged from 10% to 46%. The recovery and quality increased with depth. Mud seams were observed within the core.

5.3 Groundwater

Groundwater was not observed in the open borehole BH18-1, an accurate water level could not be obtained in borehole BH 18-2 due to the presence of core water. Groundwater level may be expected to fluctuate due to seasonal changes.

6.0 DISCUSSIONS AND RECOMMENDATIONS

6.1 General

This section of the report provides recommendations for the design of a mixed use three storey building, with commercial space located on the ground level, and residential units in the basement and in the second and third floors. The recommendations are based on interpretation of the factual information obtained from the boreholes advanced during the subsurface investigation. The discussions and recommendations presented are intended to provide sufficient information to the designer of the proposed building to select the suitable types of foundation to support the structure.

The comments made on the construction are intended to highlight aspects which could have impact or affect the detailed design of the building, for which special provisions may be required in the Contract Documents. Those who requiring information on construction aspects should make their own interpretation of the factual

data presented in the report. Interpretation of the data presented may affect equipment selection, proposed construction methods, and scheduling of construction activities.

6.2 Project Design

6.2.1 Existing Site Condition

Detailed site condition is provided in Section 2. The property is predominately leveled, and contains a two-storey single family home. The surrounding area consisted of residential homes. The location of the site is shown on Figure 1 included in Appendix B.

6.2.2 Proposed Development

It is understood that the proposed development will be a three-story mixed-use building with a basement, and will likely be a conventional slab on grade with shallow footing foundation.

6.3 Frost Protection

Based on applicable building codes, a minimum earth cover of 1.8 m, or the thermal equivalent of insulation, should be provided for all exterior footings to reduce the effects of frost action.

6.4 Site Classification for Seismic Site Response

Selected spectral responses in the general vicinity of the site for 10% chance of exceedance in 50 years (475 years return period) are as indicated in Table 6-1, shown below and in Appendix D;

Table 6-1: Selected Seismic Spectral Responses (10% in 50 Yrs)

Sa(0.2)	Sa(0.5)	Sa(2.0)	PGA	PGV
0.161	0.088	0.021	0.102	0.068

The site can be classified as a Site Class “C” for soft rock for the purposes of site-specific seismic response to earthquakes based on Table 4.1.8.4.A OBC 2012.

6.5 Slabs-on-Grade

Free-floating Slabs-on-grade should be supported on minimum 200 mm of Granular A compacted to 100% SPMDD. In case the subgrade needs to be raised Granular B type II or Granular A needs to be compacted to minimum 96% SPMDD. If the slab-on-grade is designed to support internal columns, the fill used for the grade raise shall be compacted to minimum 100% SPMDD. The fill should be placed in horizontal lifts of uniform thickness of no more than 300 mm before compaction and it should be placed at appropriate moisture content. The requirements for fill material and compaction may be addressed with a note on the structural drawing for foundation or grading drawing and/or with a Non-Standard Special Provision (NSSP).

All slab-on-grade units shall float independently from all load-bearing structural elements.

6.6 Shallow Foundations

Considering the order of structural loads expected at the foundation level, provision of conventional strip footings will be adequate. Footings are expected to be buried to resist overturning and sliding and also to provide protection against frost action.

The excavation should extend at a minimum to the top of shale, any existing fill and any material from the existing building must be removed from the footprint of the proposed building. Extremely weathered shale and all loose pieces of rock shall be removed from the footprint of the proposed footings. A geotechnical staff shall attend the site upon completion of excavation and approve the subgrade. Shale is expected to degrade relatively quickly upon exposure. Foundation footprint shall be protected by placement of grout or lean concrete upon excavation. The grout reduce the risk of degradation and also improves the integrity of the rock surface. The other option is to rapidly place the forms on the approved subgrade, apply the grout/lean concrete and then proceed with rebar placement. If the shale has to be over-excavated due to surficial poor quality, the grade can be raised by lean concrete within the influence zone of the footing. The influence zone of the footing is defined by a line going outward and downward from the edge of the footing to the subgrade. The lean concrete shall provide compression strength equal or higher than the shale.

If adequate frost cover is not provided, the deficit of earth cover should be compensated by application of synthetic insulation material adequately projecting beyond foundation walls.

6.6.1 Bearing Capacity

Assuming the strip footings are constructed through excavating the fill and exposing the weathered but relatively intact native shale, the following bearing capacity values can be used for structural design;

A factored beading pressure at Ultimate Limit State (ULS) of 350 kPa can be used for the design on approved shale subgrade. If footings are placed on rock, the serviceability settlements are expected to be minimal and there is no relevance to serviceability limit state (SLS).

Due to the expected size of rock fractures, strip footings shall not be less than 0.75 m in width and isolated pad footings shall not be less than 1.5 m in shorter dimension.

6.7 Lateral Earth Pressure

Free draining material should be used as backfill material for foundation walls. If the proper drainage is provided “at rest” condition may be assumed for calculation of earth pressure on foundation walls. The following parameters are recommended for the granular backfill.

Table 6-1: Backfill Material Properties

Borehole	Granular "A"	Granular "B"
Effective Internal Friction Angle, ϕ'	35°	30°
Unit Weight, γ (kN/m^3)	22.8	22.8

7.0 CONSTRUCTION CONSIDERATIONS

Any organic material and existing fill material of any kind, shall be removed from the footprint of the footings and all structurally load bearing elements. If grade raise above the native subgrade is required suitable fill material to conform to specifications of OPSS Granular criteria shall be used. The Structural Fill should be free from any recycled or deleterious material, it should not be placed in lifts thicker than 300 mm and should be compacted as specified.

It is not clear is the founding level will be below groundwater at the time of construction. If water infiltrates into the excavation, a conventional sump and pump method can be applied. The excavated subgrade must be kept dry at all times to minimize the disturbance of the subgrade. Groundwater elevation is expected to fluctuate seasonally.

A geotechnical engineer or technician should attend the site to confirm the type of the material and level of compaction.

Foundation walls should be backfilled with free-draining material such as OPSS Granular types A or B. The native till is not a suitable material for backfilling. Sub-drains with positive drainage to the City sewer should be provided at foundation level.

8.0 SITE SERVICES

At the subject site, the burial depth of water-bearing utility lines is typically 2.4 m below ground surface. If this depth is not achievable due to design restrictions, equivalent thermal insulation should be provided. The contractor should retain a professional engineer to provide detailed drawings for excavation and temporary support of the excavation walls during construction.

Utilities should be supported on minimum of 150 mm bedding of Granular A compacted to minimum 96% of SPMDD. Utility cover can be Granular A or Granular B type II compacted to 96% SPMDD. All covers are to be compacted to 100% SPMDD if intersecting structural elements. The engineer designing utilities shall ensure the proposed utility pipes can tolerate compaction loads.

Cut-off walls should be provided for utility trenches running below the groundwater level to mitigate the settlement risk due to groundwater lowering.

9.0 CEMENT TYPE AND CORROSION POTENTIAL

Among samples retrieved during the investigation, there was not adequate sample recovery encountered for chemical testing. It is expected the building will be founded on shale bedrock, and backfilled with granular material. No sulphate attack is expected from shale bedrock; therefore General Use (Type GU) Portland cement will be adequate. Based on the composition of the proposed backfill (OPSS Granular) it is typically expected to be non-aggressive or mildly-aggressive, for buried steel elements in contact with existing fill. The contractor shall confirm with the material source.

10.0 CLOSURE

We trust this geotechnical investigation and foundation design report meets requirements of your project. The "Limitations of Report" presented in Appendix A are an integral part of this report. Please do not hesitate to contact the undersigned should you have any questions or concerns.

McIntosh Perry Consulting Engineers Ltd.

Mary-Ellen Gleeson, M.Eng., EIT.
Geotechnical Engineering Intern

N'eem Tavakkoli, M.Eng., P.Eng.
Senior Geotechnical Engineer

11.0 REFERENCES

Canadian Geotechnical Society, "Canadian Foundation Engineering Manual", 4th Edition, 2006.

Ontario Ministry of Natural Resources (OMNR), Ontario Geological Survey, Special Volume 2, "The Physiography of Southern Ontario", 3rd Edition, 1984.

Google Earth, Google, 2015.

316 SOMERSET STREET

APPENDIX A
LIMITATIONS OF REPORT

McINTOSH PERRY

LIMITATIONS OF REPORT

McIntosh Perry Consulting Engineers Ltd. (McIntosh Perry) carried out the field work and prepared the report. This document is an integral part of the Foundation Investigation and Design report presented.

The conclusions and recommendations provided in this report are based on the information obtained at the borehole locations where the tests were conducted. Subsurface and groundwater conditions between and beyond the boreholes may differ from those encountered at the specific locations where tests were conducted and conditions may become apparent during construction, which were not detected and could not be anticipated at the time of the site investigation. The benchmark level used and borehole elevations presented in this report are primarily to establish relative differenced in elevations between the borehole locations and should not be used for other purposes such as to establish elevations for grading, depth of excavations or for planning construction.

The recommendations presented in this report for design are applicable only to the intended structure and the project described in the scope of the work, and if constructed in accordance with the details outlined in the report. Unless otherwise noted, the information contained in this report does not reflect on any environmental aspects of either the site or the subsurface conditions.

The comments or recommendation provided in this report on potential construction problems and possible construction methods are intended only to guide the designer. The number of boreholes advanced at this site may not be sufficient or adequate to reveal all the subsurface information or factors that may affect the method and cost of construction. The contractors who are undertaking the construction shall make their own interpretation of the factual data presented in this report and make their conclusions, as to how the subsurface conditions of the site may affect their construction work.

The boundaries between soil strata presented in the report are based on information obtained at the borehole locations. The boundaries of the soil strata between borehole locations are assumed from geological evidences. If differing site conditions are encountered, or if the Client becomes aware of any additional information that differs from or is relevant to the McIntosh Perry findings, the Client agrees to immediately advise McIntosh Perry so that the conclusions presented in this report may be re-evaluated.

Under no circumstances shall the liability of McIntosh Perry for any claim in contract or in tort, related to the services provided and/or the content and recommendations in this report, exceed the extent that such liability is covered by such professional liability insurance from time to time in effect including the deductible therein, and which is available to indemnify McIntosh Perry. Such errors and omissions policies are available for inspection by the Client at all times upon request, and if the Client desires to obtain further insurance to protect it against any risks beyond the coverage provided by such policies, McIntosh Perry will co-operate with the Client to obtain such insurance.

McIntosh Perry prepared this report for the exclusive use of the Client. Any use which a third party makes of this report, or any reliance on or decision to be made based on it, are the responsibility of such third parties. McIntosh Perry accepts no responsibility and will not be liable for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

316 SOMERSET STREET

APPENDIX B
FIGURES

McINTOSH PERRY

450 225 0 450

Scale 1:15,000 Metres

LEGEND

- Site Location
- Local Road
- Major Road
- Wooded Area
- Watercourse
- Waterbody

REFERENCE

GIS data provided by the Ontario Ministry of Natural Resources and Forestry, 2018.

CLIENT: TC UNITED

PROJECT: GEOTECHNICAL INVESTIGATION
316 SOMERSET ST. EAST

TITLE: SITE LOCATION

McINTOSH PERRY
115 Walgreen Road, RR3, Carp, ON K0A1L0
Tel: 613-836-2184 Fax: 613-836-3742
www.mcintoshperry.com

PROJECT NO:	CP-17-0637
Date	Feb., 01, 2018
GIS	JD
Checked By	MG

FIGURE: 1

H:\01 Project - Proposals\2017 Jobs\CP\0CP-17-0637 TCU_Mixed Use Building_316 Somerset Street\Phase One ESA\05 GIS\mxd\0CP-17-0637_Geotechnical01_SiteLocationSomerset.mxd

10 5 0 10

Scale 1:500 Metres

LEGEND

- Borehole Location
- Approximate Property Boundary

REFERENCE

GIS data provided by the Ontario Ministry of Natural Resources and Forestry, 2018.

CLIENT: TC UNITED

PROJECT: GEOTECHNICAL INVESTIGATION
316 SOMERSET ST. EAST

TITLE: BOREHOLE LOCATIONS

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PROJECT NO:	CP-17-0637
Date	Mar., 08, 2018
GIS	JD
Checked By	MG

FIGURE: 2

H:\01 Project - Proposals\2017 Jobs\CP\0CP-17-0637 TCU_Mixed Use Building_316 Somerset Street\Phase One ESA\05 GIS\mxd\0CP-17-0637_Geotechnical\02_BoreholeLocationsSomerset.mxd

316 SOMERSET STREET

APPENDIX C
BOREHOLE LOGS

McINTOSH PERRY

EXPLANATION OF TERMS USED IN REPORT

N-VALUE: THE STANDARD PENETRATION TEST (SPT) N-VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5 kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N-VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N-VALUE IS DENOTED THUS $\bar{N}$.

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60˚ CONE ANGLE) DRIVEN BY 475J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

C_u (kPa)	0 – 12	12 – 25	25 – 50	50 – 100	100 – 200	>200
	VERY SOFT	*SOFT*	*FIRM*	*STIFF*	*VERY STIFF*	*HARD*

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 – 5	5 – 10	10 – 30	30 – 50	>50
	VERY LOOSE	*LOOSE*	*COMPACT*	*DENSE*	*VERY DENSE*

ROCKS ARE DESCRIBED BY THEIR COMPOSION AND STRUCUTRAL FEATURES AND/OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY IS:

RQD (%)	0 – 25	25 – 50	50 – 75	75 – 90	90 – 100
	VERY POOR	*POOR*	*FAIR*	*GOOD*	*EXCELLENT*

JOINT AND BEDDING:

SPACING	50mm	50 – 300mm	0.3m – 1m	1m – 3m	>3m
JOINTING	*VERY CLOSE*	*CLOSE*	*MOD. CLOSE*	*WIDE*	*VERY WIDE*
BEDDING	*VERY THIN*	*THIN*	*MEDIUM*	*THICK*	*VERY THICK*

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

SS	SPLIT SPOON	TP	THINWALL PISTON
WS	WASH SAMPLE	OS	OSTERBERG SAMPLE
ST	SLOTTED TUBE SAMPLE	RC	ROCK CORE
BS	BLOCK SAMPLE	PH	TW ADVANCED HYDRAULICALLY
CS	CHUNK SAMPLE	PM	TW ADVANCED MANUALLY
TW	THINWALL OPEN	FS	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
σ_1, σ_2, σ_3	kPa	PRINCIPAL STRESSES
ε	%	LINEAR STRAIN
ε_1, ε_2, ε_3	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICALL PROPERTIES OF SOIL

m_v	kPa $^{-1}$	COEFFICIENT OF VOLUME CHANGE
c_c	1	COMPRESSION INDEX
c_s	1	SWELLING INDEX
c_a	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
Φ'	-^{o}	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
Φ_u	-^{o}	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = c_u / τ_r

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES	e	1,%	VOID RATIO	e_{min}	1,%	VOID RATIO IN DENSEST STATE
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES	n	1,%	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m^3	DENSITY OF WATER	w	1,%	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kN/m^3	UNIT WEIGHT OF WATER	s_r	%	DEGREE OF SATURATION	D_n	mm	N PERCENT – DIAMETER
ρ	kg/m^3	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kN/m^3	UNIT WEIGHT OF SOIL	w_P	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m^3	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m^3/s	RATE OF DISCHARGE
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL	I_P	%	PLASTICITY INDEX = (W_L – W_L)	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = (W – W_P)/ I_P	i	1	HYDAULIC GRADIENT
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = (W_L – W) / 1_P	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m^3	DENSITY OF SUBMERED SOIL	$e_{,max}$	1,%	VOID RATIO IN LOOSEST STATE	j	kN/m^3	SEEPAGE FORCE
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL						

McINTOSH PERRY

RECORD OF BOREHOLE No BH18-1

DATE:	18/01/2018 -	**LOCATION:**	316 Somerset Street E. ()	**ORIGINATED BY:**	Phil Hulan
ID:	CP-17-0637-SOMERSET	**COORDINATES:**	Lat: 45.424097 , Lon: -75.674788	**COMPILED BY:**	Juli Ushey
CLIENT:	TC United	**DATUM:**	Assumed	**CHECKED BY:**	Mary-Ellen Gleeson
ELEVATION:	100.0 m	**REMARK:**	No water observed in open borehole.	**REPORT DATE:**	08/03/2018

DEPTH - feet	DEPTH - meters	SOIL PROFILE: ELEVATION - m / DEPTH - m	DESCRIPTION	SYMBOL	SAMPLES: TYPE AND NUMBER	STATE	RECOVERY	"N" or RQD	GROUNDWATER CONDITIONS	DYNAMIC CONE PEN. RESISTANCE PLOT / SHEAR STRENGTH (kPa)	WATER CONTENT and LIMITS (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%)
		100.0	Natural ground surface									
		0.0 / 100.0	40mm Asphalt.									
		0.0 / 99.9	Fill : Sand and gravel, traces of silt, brown, moist, compact.									
		0.2	Fill : Silty and gravelly sand, dark brown, moist, loose.									
	1	98.8 / 1.2	Fill : Silty sand, some gravel, black to dark brown, moist, loose. Presence of organic matter.		SS-01		67	6				
5		98.4 / 1.6	Shale with mud seams.		SS-02		67	50				Auger through shale. Harder at 1.98m. 8 minutes to auger 1.52m to 1.98m. 2.5 minutes to auger to 2.29m.
	2				SS-03		90	50				
10	3				RC-04		100	*46*				5 minutes to auger to 3.00m.
					RC-05		46	*10*				
	4											
15					RC-06		93	*12*				
	5	95.0 / 5.1	**END OF BOREHOLE**									
20	6											
	7											
25												
	8											
30	9											

DYNAMIC CONE PEN. RESISTANCE PLOT: 20 40 60 80

SHEAR STRENGTH (kPa): Vane test (◇ Intact, ◆ Remolded); Lab vane (□ Intact, ■ Remolded); 20 40 60 80 100

WATER CONTENT and LIMITS (%): W_P W W_L; 25 50 75

REMARKS & GRAIN SIZE DISTRIBUTION (%): G S M C

\LICENSES7\Sobek\Geotec80\Style\Log_Borehole_v5.sty

McINTOSH PERRY

RECORD OF BOREHOLE No BH18-2

DATE:	18/01/2018 -	**LOCATION:**	316 Somerset Street E. ()	**ORIGINATED BY:**	Phil Hulan
ID:	CP-17-0637-SOMERSET	**COORDINATES:**	Lat: 45.424152 , Lon: -75.674821	**COMPILED BY:**	Juli Ushey
CLIENT:	TC United	**DATUM:**	Assumed	**CHECKED BY:**	Mary-Ellen Gleeson
ELEVATION:	100.0 m	**REMARK:**	No water observed in open borehole.	**REPORT DATE:**	08/03/2018

DEPTH - feet	DEPTH - meters	SOIL PROFILE: ELEVATION - m / DEPTH - m	DESCRIPTION	SYMBOL	SAMPLES: TYPE AND NUMBER	STATE	RECOVERY	"N" or RQD	GROUNDWATER CONDITIONS	DYNAMIC CONE PEN. RESISTANCE PLOT / SHEAR STRENGTH (kPa)	WATER CONTENT and LIMITS (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%)
		100.0	Natural ground surface									
		0.0 / 99.9	25mm Asphalt.									
		0.0 / 99.8	Fill : Sand and gravel, traces of clay and silt, brown, moist, compact.									
		0.2	Fill : Silty and gravelly sand, dark brown, moist, loose.									
5	1	98.7			SS-01		41	7				
		1.2	Fill : Silty sand, some gravel, dark brown, moist, loose.									
		98.4 / 1.5	Shale.		SS-02			50				
	2	97.8 / 2.2	**END OF BOREHOLE**									
10	3											
	4											
15	5											
20	6											
	7											
25	8											
30	9											

DYNAMIC CONE PEN. RESISTANCE PLOT: 20 40 60 80

SHEAR STRENGTH (kPa): Vane test (◇ Intact, ◆ Remolded); Lab vane (□ Intact, ■ Remolded); 20 40 60 80 100

WATER CONTENT and LIMITS (%): W_P W W_L; 25 50 75

REMARKS & GRAIN SIZE DISTRIBUTION (%): G S M C

Augering getting harder at 1.65 m. Soft zone between 1.75 m and 2.11 m. Auger refusal at 2.16 m.

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316 SOMERSET STREET

APPENDIX D
SEISMIC HAZARD CALCULATION

McINTOSH PERRY

2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

February 15, 2018

Site: 45.4241 N, 75.6747 W User File Reference: 316 Somerset St

Requested by: , McIntosh Perry

National Building Code ground motions: 2% probability of exceedance in 50 years (0.000404 per annum)

Sa(0.05)	Sa(0.1)	**Sa(0.2)**	Sa(0.3)	**Sa(0.5)**	**Sa(1.0)**	**Sa(2.0)**	**Sa(5.0)**	**Sa(10.0)**	**PGA (g)**	**PGV (m/s)**
0.447	0.524	**0.440**	0.334	**0.237**	**0.118**	**0.056**	**0.015**	**0.0054**	**0.281**	**0.197**

Notes. Spectral (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s. Values are for "firm ground" (NBCC 2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are specified in **bold** font. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. ***These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.***

Ground motions for other probabilities:

Probability of exceedance per annum	0.010	0.0021	0.001
Probability of exceedance in 50 years	40%	10%	5%
Sa(0.05)	0.044	0.149	0.248
Sa(0.1)	0.061	0.187	0.300
Sa(0.2)	0.055	0.161	0.255
Sa(0.3)	0.044	0.124	0.195
Sa(0.5)	0.031	0.088	0.139
Sa(1.0)	0.015	0.044	0.070
Sa(2.0)	0.0061	0.021	0.033
Sa(5.0)	0.0012	0.0047	0.0081
Sa(10.0)	0.0006	0.0019	0.0032
PGA	0.033	0.102	0.163
PGV	0.021	0.068	0.111

References

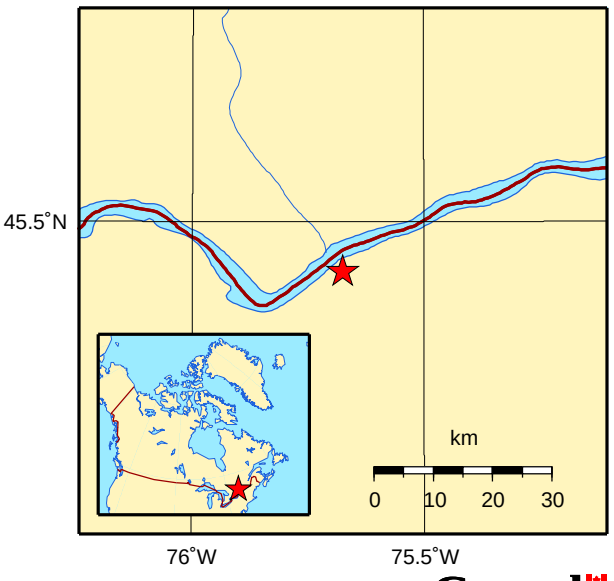
National Building Code of Canada 2015 NRCC no. 56190;
Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

User's Guide - NBC 2015, Structural Commentaries NRCC no. xxxxxx (in preparation)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites *www.EarthquakesCanada.ca* and *www.nationalcodes.ca* for more information

Aussi disponible en français



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