296 SOMERSET STREET – GEOTECHNICAL REPORT

Project No.: CP-18-0041

Prepared for:

TC United Group
800 Industrial Ave. Unit 9
Ottawa, ON, K1G 4B8

Prepared by:

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Carp, ON K0A 1L0

March 2018

MCINTOSH PERRY

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APPENDICES

GEOTECHNICAL INVESTIGATION and
FOUNDATION DESIGN RECOMMENDATION REPORT
296 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 February 15, 2018 and comprised of two boreholes advanced to a maximum depth of 4.0 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 at 296 Somerset Street, west 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. A shared gravel laneway runs along the east of the property to the garage on the property and two detached garage structures behind the property. The backyard is enclosed by a chain link fence and the front yard contains two large trees, grasses and flowering plants.

It is understood the proposed structure will be a 3-storey 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 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 portable drilling rig. Boreholes were advanced to a maximum depth of 4.0 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.

4.0 LABORATORY TEST PROCEDURES

Selected samples were tested for moisture content by McIntosh Perry. Compressive strength test in accordance with ASTM-D7012 Method C was performed on selected segments of the rock core samples. LRL Associates Ltd. laboratories in Ottawa, Ontario performed the compressive strength test, on behalf of McIntosh Perry. Test results are included in Appendix D.

Paracel Laboratories Ltd., in Ottawa carried out chemical tests on one representative soil sample to determine the soil corrosivity characteristics.

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

A 0.3 m thick layer of topsoil was observed in each borehole. Below the topsoil was a layer of fill comprised of silty sand and some gravel described as brown, moist to wet and loose. This layer extended to a depth of 1.1 m in BH18-1 and 1.2 m in BH18-2. Fragments of glass and brick were present in this layer. SPT 'N' values within this layer were 8 to 2 blows/300 mm. Moisture content with this layer was observed to be an average of 42%.

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 91% to 100%. Rock quality designation (RQD) for this core ranged from 7% to 86%, indicating very poor to good quality. The quality of the rock was observed to increase with depth.

Selected rock core samples were tested in the laboratory to determine the uniaxial compressive strength. The results show an average compressive strength of 61.7 MPa, however the strength was observed to vary over 50 MPa within the same rock core run. The results of rock core samples are included in Table 5.1 below.

Table 5-1: Compressive Strength Test

Borehole	Run No	Depth (m)	L/D Ratio	Strength (MPa)	Description of Failure
BH18-1	4	3.20-3.38	2.07:1	**68.7**	Vertical and diagonal breaking, relatively well-formed cone on one end
BH18-1	4	3.38-3.76	2.10:1	**85.2**	Vertical breaking with well formed cone on one end
BH18-1	4	3.76-3.89	2.08:1	**31.1**	Vertical and diagonal breaking, relatively well-formed cone on both ends

5.3 Groundwater

Groundwater was observed in boreholes BH18-1 at a depth of 1.9 m, however water observed may be as a result of core water in the borehole. Groundwater level may be expected to fluctuate due to seasonal changes.

5.4 Chemical Analysis

The chemical test results conducted by Paracel Laboratories in Ottawa, Ontario, to determine the resistivity, pH, sulphate and chloride content of representative soil and surface water samples are shown in Table 5-2 below:

Table 5-2: Soil Chemical Analysis Results

Borehole	Sample	Depth / El. (m)	pH	Sulphate (%)	Chloride (%)	Resistivity (Ohm-cm)
BH18-2	GS-2	0.6-0.9	7.31	0.0010	0.0030	6,950

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 the event the subgrade needs to be raised, Granular B type II or Granular A can be placed, 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, 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 and isolated pad 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.

The shale at this site is expected to be part of Billings formation. Our tactile examination of retrieved rock core samples indicated presence of pyrite in the shale matrix. Billings shale is known for its expansive behaviour. The granular base supporting the slab-on-grade, due to its porous nature, can let the air entry which will facilitated oxidation of pyrite in the presence of ground moisture. The transferred heat through the basement floor can also accelerate the oxidation process. Shale is expected to degrade relatively quickly upon exposure. Shale upon degradation and heave will substantially lose its strength.

In order to reduce the risk of shale degradation immediately upon excavation and to reduce the risk of subgrade heave under the proposed slab on grade, once the excavation has reached the required depth, shale surface has to be fully covered by grout or lean concrete, whichever available. All lose rock pieces shall be removed upon excavation, then grout/lean concrete shall be applied. The cement paste initially works as a bonding agent on broken rock fragments to improve the integrity at the surface. The permanent coverage reduces the risk of future heave.

A geotechnical staff shall attend the site to approve the subgrade. The rock may need to be excavated beyond the target depth due very poor rock quality.

If the rock has to be over-excavated due to very poor rock quality, the grade can be raised by lean concrete within the influence zone of the footings. 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. Compression strength of lean concrete shall not be less than the provided shale bearing capacity.

Over-excavated subgrade can be also raised by granular material only if the fill conforms to OPSS Granular A and compacted to minimum 100% Standard Proctor Maximum Dry Density. The fill shall be placed once the rock surface is covered with grout/lean concrete. 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, and following the recommendation note Section 6.6, 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. The fill to be placed directly below footings has to be Granular A.

It is not clear if 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.

If the construction season coincides with high groundwater season, water infiltration through weathered shall might be substantial. However grouting the exposed rock surfaces can reduce the risk of infiltration in case of occurrence.

A geotechnical engineer or technician should attend the site to confirm the suitability of subgrade, type of imported material and the 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 CEMENT TYPE AND CORROSION POTENTIAL

A soil sample was submitted to Parcel laboratories for testing of chemical properties relevant to exposure of concrete elements to sulphate attacks as well as potential soil corrosivity effects on buried metallic structural element. Test results are presented in Tables 5-1.

The potential for sulphate attack on concrete structures is moderate. Type GU Portland cement is expected to be adequate to protect buried concrete elements in the subsurface conditions encountered.

The corrosion potential for buried steel elements was determined as 'non-aggressive'.

9.0 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.

LICENSED PROFESSIONAL ENGINEER
N. AZIZI TAVAKKOLI
100150911
Mar. 16/18
PROVINCE OF ONTARIO

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

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

10.0 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.

APPENDIX A
LIMITATIONS OF REPORT

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.

296 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
296 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-18-0041	FIGURE:
Date	Mar., 07, 2018	1
GIS	JD	
Checked By	MG	

H:\01 Project - Proposals\2018 Jobs\CP\0CP-18-0041 TCU_PhOneESA+Geotech_296Somerset\Phase 1 ESA\GIS\mxd\0CP-18-0041_Geotechnical01_SiteLocation296Somerset.mxd

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
296 SOMERSET ST. EAST

TITLE: BOREHOLE LOCATIONS

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PROJECT NO:	CP-18-0041
Date	Mar., 07, 2018
GIS	JD
Checked By	MG

FIGURE: 2

H:\01 Project - Proposals\2018 Jobs\CP\0CP-18-0041 TCU_PhOneESA+Geotech_296Somerset\Phase 1 ESA\GIS\mxd\0CP-18-0041_Geotechnical02_BoreholeLocations296Somerset.mxd

APPENDIX C
BOREHOLE LOGS

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 $\overline{N}$.

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
$\sigma_l, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ε	%	LINEAR STRAIN
$\varepsilon_1, \varepsilon_2, \varepsilon_3$	%	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

P_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 = $\frac{e_{max} - e}{e_{max} - e_{min}}$
P_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
P	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
P_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
P_{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
P'	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

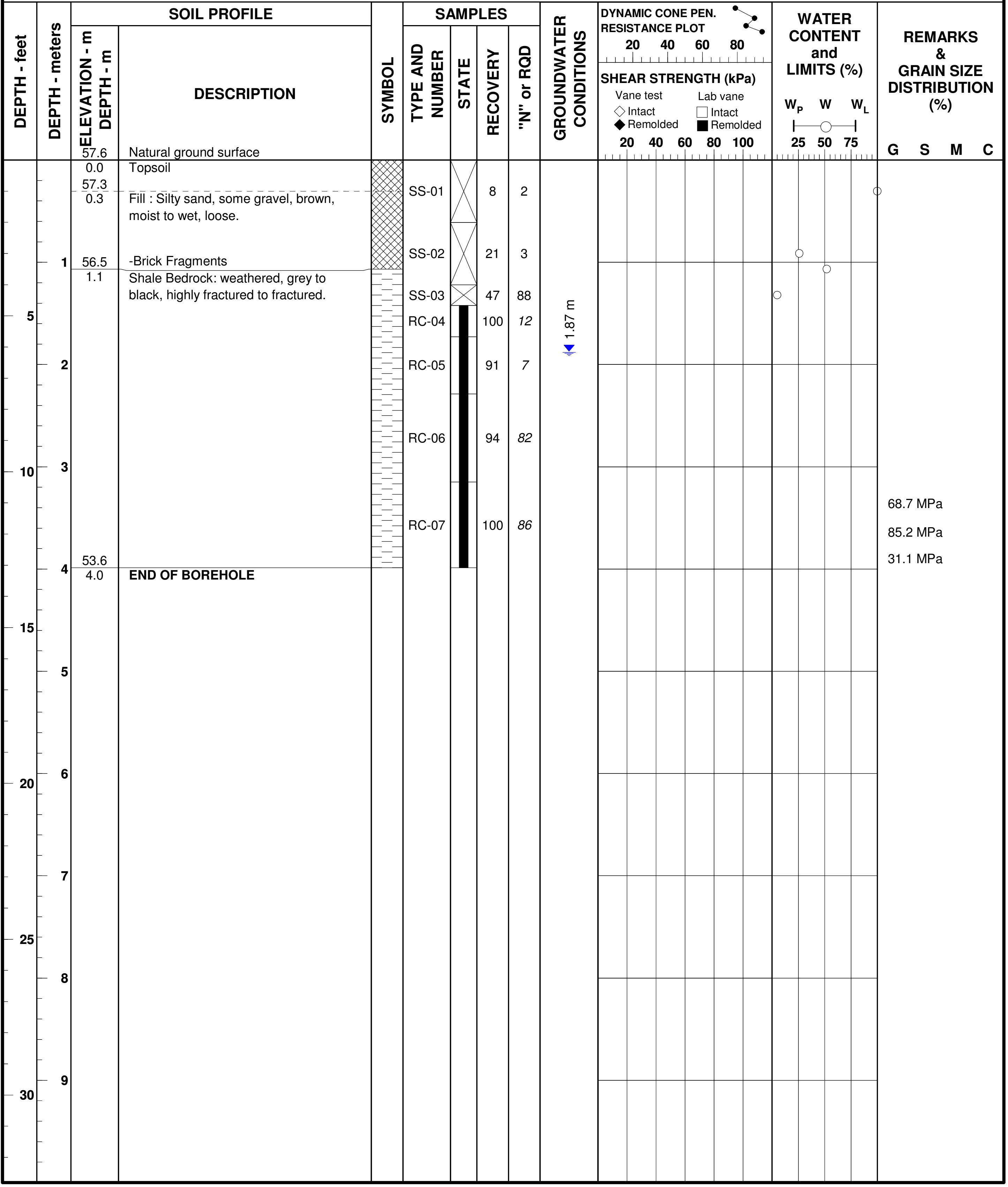
RECORD OF BOREHOLE No 18-1

Page 1 of 1

DATE: 15/02/2018 - 15/02/2018
ID: CP-18-0041-296SOMERS
CLIENT: TC United
ELEVATION: 57.6 m

LOCATION: 296 Somerset St. E. ()
COORDINATES: Lat: 45.423642 , Lon: -75.675733
DATUM: Geodetic
REMARK:

ORIGINATED BY: Phil Hulan
COMPILED BY: Phil Hulan
CHECKED BY: Mary-Ellen Gleeson
REPORT DATE: 06/03/2018



ELEVATION - m DEPTH - m	DESCRIPTION
57.6	Natural ground surface
0.0	Topsoil
57.3 0.3	Fill : Silty sand, some gravel, brown, moist to wet, loose. -Brick Fragments
56.5 1.1	Shale Bedrock: weathered, grey to black, highly fractured to fractured.
53.6 4.0	**END OF BOREHOLE**

TYPE AND NUMBER	RECOVERY	"N" or RQD	REMARKS
SS-01	8	2	
SS-02	21	3	
SS-03	47	88	
RC-04	100	*12*	
RC-05	91	*7*	
RC-06	94	*82*	
RC-07	100	*86*	68.7 MPa 85.2 MPa 31.1 MPa

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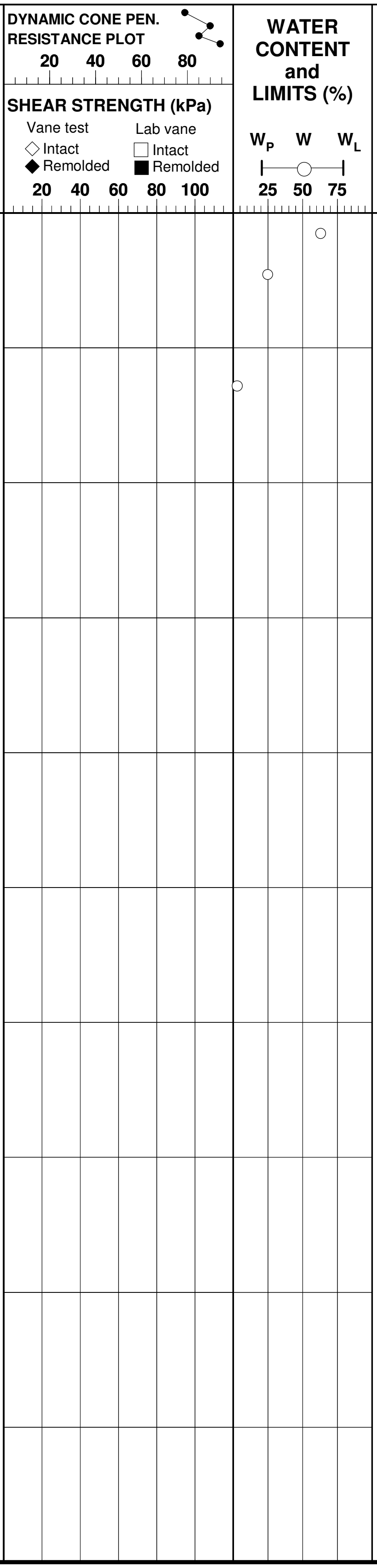
McINTOSH PERRY

RECORD OF BOREHOLE No 18-2

DATE:	15/02/2018 - 15/02/2018	**LOCATION:**	296 Somerset St. E. ()	**ORIGINATED BY:**	Phil Hulan
ID:	CP-18-0041-296SOMERS	**COORDINATES:**	Lat: 45.423653 , Lon: -75.675767	**COMPILED BY:**	Phil Hulan
CLIENT:	TC United	**DATUM:**	Geodetic	**CHECKED BY:**	Mary-Ellen Gleeson
ELEVATION:	57.6 m	**REMARK:**	No water observed in open borehole.	**REPORT DATE:**	06/03/2018

DEPTH - feet	DEPTH - meters	SOIL PROFILE ELEVATION - m DEPTH - m	DESCRIPTION	SYMBOL	SAMPLES TYPE AND NUMBER	STATE	RECOVERY	"N" or RQD	GROUNDWATER CONDITIONS	REMARKS & GRAIN SIZE DISTRIBUTION (%) G S M C
		57.6	Natural ground surface							
		0.0	Topsoil							
		57.3 0.3	Fill : Silty sand, some gravel, brown, moist, loose. Presence of brick and glass fragments.		SS-01 GS-02		8	8		
	1				SS-03		17	20		
		56.4 1.2	Shale		SS-04		60	100		
5		56.3 1.3	**END OF BOREHOLE**							
	2									
10	3									
	4									
15	5									
20	6									
	7									
25	8									
30	9									



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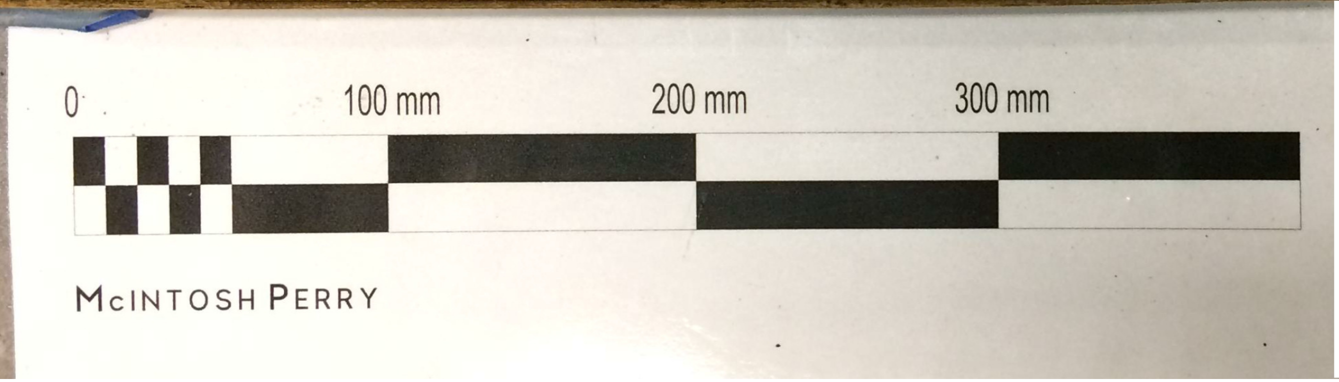
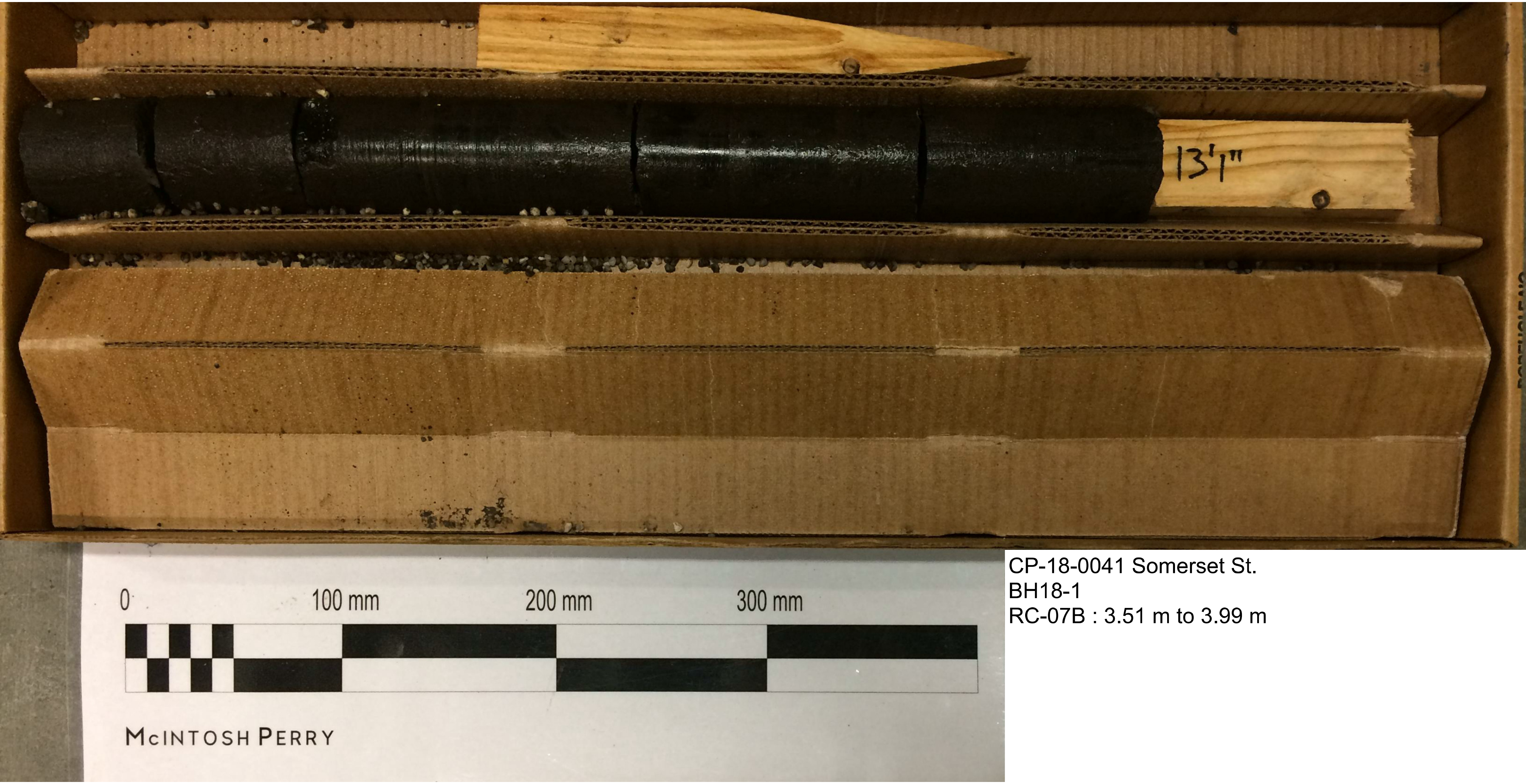


CP-18-0041 Somerset St.
BH18-1
RC-04 :1.42 m to 1.73 m
RC-05 : 1.73 m to 2.29 m
RC-06 : 2.29 m to 3.15 m
RC-07A : 3.15 m to 3.51 m



CP-18-0041 Somerset St.
BH18-1
RC-07B : 3.51 m to 3.99 m

296 SOMERSET STREET

APPENDIX D
LAB RESULTS

LRL Associates Ltd.

Unconfined Compressive Strength of Intact Rock Core

ASTM D 7012: Method C

Client: McIntosh Perry Consulting Engineers
Project: Materials Testing
Location: 296 Somerset Street, Ottawa, ON.

Reference No.: CP-18-0041
File No.: 170496-23
Report No.: 1

Drill Core Information

Date(s) Sampled: February 15, 2018
Sampled By: McIntosh Perry Consulting Engineers
Date Received: February 28, 2018

Laboratory Identification	Core No.	Field Identification	Borehole	Run	Depth	Location / Description
C0679	1		18-1	RC-04	3.20 m - 3.38 m	296 Somerset Street
C0680	2		18-1	RC-04	3.38 m - 3.76 m	296 Somerset Street
C0681	3		18-1	RC-04	3.76 m - 3.89 m	296 Somerset Street

Rock Core Unconfined Compressive Strength Test Data

Laboratory Identification	Core No.	Conditioning	Length, mm	Diameter, mm		MPa	Description of Failure
C0679	1	As received	98.8	47.6		68.7	Vertical and diagonal breaking, relatively well formed cone on one end
C0680	2	As received	102.3	48.8		85.2	Vertical breaking with well formed cone on one end
C0681	3	As received	101.3	48.8		31.1	Vertical and diagonal breaking, relatively well formed cone on both ends

Comments:

Date Issued: March 1, 2018

Reviewed By: WAMcLaughlin

W.A.McLaughlin, Geo.Tech., C.Tech.

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www.paracellabs.com

Certificate of Analysis

McIntosh Perry Consulting Eng. (Carp)

115 Walgreen Road
RR#3 Carp, ON K0A 1L0
Attn: Mary Ellen Gleeson

Client PO: CP-18-0041 Somerset St.
Project: CP-18-0041
Custody: 34144

Report Date: 5-Mar-2018
Order Date: 1-Mar-2018

Order #: 1809407

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1809407-01	CP-18-0041-Somerset-BH18-2 GS-02

Approved By: Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: McIntosh Perry Consulting Eng. (Carp)
Client PO: CP-18-0041 Somerset St.

Report Date: 05-Mar-2018
Order Date: 1-Mar-2018
Project Description: CP-18-0041

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Anions	EPA 300.1 - IC, water extraction	2-Mar-18	5-Mar-18
pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	5-Mar-18	5-Mar-18
Resistivity	EPA 120.1 - probe, water extraction	3-Mar-18	5-Mar-18
Solids, %	Gravimetric, calculation	5-Mar-18	5-Mar-18

Certificate of Analysis

Report Date: 05-Mar-2018

Client: McIntosh Perry Consulting Eng. (Carp)

Order Date: 1-Mar-2018

Client PO: CP-18-0041 Somerset St.

Project Description: CP-18-0041

	Client ID:	CP-18-0041-Somerset -BH18-2 GS-02	-	-	-
	Sample Date:	15-Feb-18	-	-	-
	Sample ID:	1809407-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	78.7	-	-	-
General Inorganics					
pH	0.05 pH Units	7.31	-	-	-
Resistivity	0.10 Ohm.m	69.5	-	-	-
Anions					
Chloride	5 ug/g dry	30	-	-	-
Sulphate	5 ug/g dry	10	-	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	ND	5	ug/g						
Sulphate	ND	5	ug/g						
General Inorganics									
Resistivity	ND	0.10	Ohm.m						

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	16.9	5	ug/g dry	17.6			3.9	20	
Sulphate	17.2	5	ug/g dry	19.6			13.1	20	
General Inorganics									
pH	7.94	0.05	pH Units	7.95			0.1	10	
Resistivity	129	0.10	Ohm.m	125			2.8	20	
Physical Characteristics									
% Solids	82.9	0.1	% by Wt.	86.0			3.7	25	

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	113	5	ug/g	17.6	95.8	78-113			
Sulphate	123	5	ug/g	19.6	103	78-111			

Qualifier Notes:

None

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable
ND: Not Detected
MDL: Method Detection Limit
Source Result: Data used as source for matrix and duplicate samples
%REC: Percent recovery.
RPD: Relative percent difference.

Soil results are reported on a dry weight basis when the units are denoted with 'dry'.
Where %Solids is reported, moisture loss includes the loss of volatile hydrocarbons.

296 SOMERSET STREET

APPENDIX E
SEISMIC HAZARD CALCULATION

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

March 06, 2018

Site: 45.4236 N, 75.6757 W User File Reference: 296 Somerset Street

Requested by: , McIntosh Perry

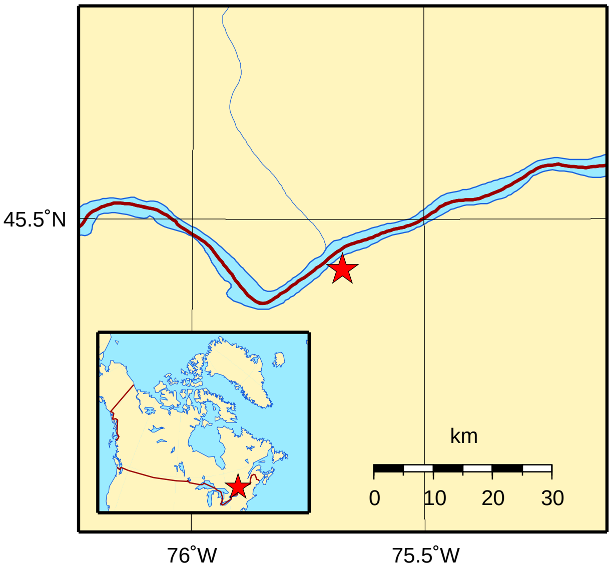
National Building Code ground motions: 2% probability of exceedance in 50 years (0.000404 per annum)

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

Natural Resources Canada Ressources naturelles Canada

Canada