APPENDIX A

GEOTECHNICAL REPORTS

Part I

Peto MacCallum Ltd.
CONSULTING ENGINEERS

GEOTECHNICAL INVESTIGATION
PORT DALHOUSIE PIER
ST. CATHARINES, ONTARIO

for

FISHERIES AND OCEANS CANADA

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PML Ref.: 14HF051
Report: 1
January 2015

Peto MacCallum Ltd.
CONSULTING ENGINEERS

January 16, 2015

PML Ref.: 14HF051
Report: 1

Mr. Mike MacDiarmid
Fisheries and Oceans Canada
PO Box 85120
3027 Harvester Road, Unit 506
Burlington, Ontario
L7R 4K3

Dear Mr. MacDiarmid

Geotechnical Investigation
Port Dalhousie Piers
St. Catharines, Ontario

Peto MacCallum Ltd. (PML) is pleased to present the results of the geotechnical investigation recently completed at the Port Dalhousie Piers in St. Catharines, Ontario. Authorization to proceed with this assignment was provided by Fisheries and Oceans Canada Purchase Order No. F2930-140034 and confirmed with a signed Engineering Service Agreement dated November 10, 2014. The scope of work was revised to include dynamic cone penetration testing and coring of shale bedrock as per Change Order No. 1 dated January 15, 2015.

It is understood that Fisheries and Oceans Canada (DFO) plans to rehabilitate the Port Dalhousie Piers located in in St. Catharines, Ontario. The proposed rehabilitation methods were not known at the time of this report.

The purpose of the geotechnical investigation was to establish the subsurface soil and ground water conditions along the piers and based on the findings, provide geotechnical recommendations for lateral earth pressure parameters and allowable bearing capacities of the subsurface soil.

A limited scope geoenvironmental screening component was included to check the environmental quality of the soil.

The subsurface stratigraphy revealed in the boreholes typically comprised loose to compact variable fill consisting of cobbles, boulders, wood, sand and gravel in Borehole 2 and silt and sand in Borehole 4 overlying very loose to compact sand in Boreholes 2 to 4. The sand was underlain by dense alluvial silt in Borehole 2 and very loose to loose organic silt in Boreholes 3 and 4. A very soft clay layer was encountered below the organic silt in Borehole 4 and was underlain by compact sand.

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BARRIE, HAMILTON, KITCHENER, TORONTO

Shale bedrock was contacted below the alluvial silt and extended to the termination depth in Borehole 2. The shale bedrock was red shale of the Queenston Formation and was judged to be highly weathered to weathered. It is noted that numerous and frequent limestone layers were encountered within the shale.

Detailed comments and recommendations concerning the lateral earth pressure parameters and allowable bearing capacities of the subsurface soil are provided in the attached report.

The measured concentration of the tested parameters complied with the Table 9 (T9) residential/ parkland/institutional/industrial/commercial/community (RPI/ICC) site condition standard (SCS) and Canadian Council of Ministers of the Environment (CCME) Guidelines for Residential/ Parkland land use (coarse textured soil).

We trust the information presented in the attached report will be sufficient for your present purposes. If you have any questions, please do not hesitate to contact our office.

Sincerely

Peto MacCallum Ltd.



Matthew D. St Denis, P.Eng.
Senior Engineer, Geotechnical Services

KF:lad

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AGAT Laboratories Limited, Certificates of Analysis

1. INTRODUCTION

Peto MacCallum Ltd. (PML) is pleased to present the results of the geotechnical investigation recently completed at the Port Dalhousie Piers in St. Catharines, Ontario. Authorization to proceed with this assignment was provided by Fisheries and Oceans Canada Purchase Order No. F2930-140034 and confirmed with a signed Engineering Service Agreement dated November 10, 2014. Services were provided in accordance with the PML proposal, PML Ref.: FQH5004, dated October 29, 2014. The scope of work was revised to include dynamic cone penetration testing and coring of shale bedrock as per Change Order No. 1 dated January 15, 2015.

It is understood that Fisheries and Oceans Canada (DFO) plans to rehabilitate the Port Dalhousie Piers located in in St. Catharines, Ontario. The proposed rehabilitation methods were not known at the time of this report.

The purpose of the geotechnical investigation was to establish the subsurface soil and ground water conditions along the piers and based on the findings, provide geotechnical recommendations for lateral earth pressure parameters and allowable bearing capacities of the subsurface soil.

A limited scope geoenvironmental screening component was included to check the environmental quality of the soil. It should be noted that water sampling and testing was not part of the Terms of Reference for this assignment and the environmental sampling and testing was conducted as a limited screening program. Soil and surface or ground water impairment that has not been identified by the screening program may exist elsewhere at the site. The screening program does not constitute an Environmental Site Assessment as defined under the Environmental Protection Act and O. Reg. 153/04, as amended.

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 project as described in the report. Any changes in the project, including finishing grades and layout will require review by

PML to assess the validity of the report, and may require modified recommendations, additional investigation and/or analysis.

2. INVESTIGATION PROCEDURES

The field work was carried out on November 11, 13 and 14 and December 18, 2014 and consisted of a total of three boreholes (Boreholes 2 to 4) were drilled to termination depths of 13.4 to 24.0 m. The borehole locations are shown on Drawing 1, appended. It is noted that Borehole 1 was not completed as it was determined to be inaccessible using the drilling method outlined in PML's proposal due to structural safety concerns raised after an inspection of the piers by AECOM.

The borehole locations were selected in coordination with DFO and established in the field by PML. Ground surface elevations and UTM co-ordinates at the borehole locations were determined by PML. The following benchmark (BM) was used for vertical reference:

BM: Tablet in west concrete foundation wall of inner lighthouse at entrance to harbour, 1.70 m from northwest corner, 1.35 m from southwest corner, 20 cm below shingle siding (Geodetic Survey of Canada BM No. 561F). Elevation: 75.822 m (metric, geodetic).

The boreholes were advanced using continuous flight hollow stem augers, wash boring and tri-coning inside NW size casing and NX diamond coring, powered by a truck-mounted CME-75 drill rig, supplied and operated by a specialist drilling contractor, working under the full time supervision of a member of the PML engineering staff. It is noted that Boreholes 2 and 3 were completed over water; Borehole 4 was completed on land.

Representative samples of the overburden were recovered at frequent depth intervals using a conventional split-spoon sampler during drilling. Standard penetration, dynamic cone penetration and pocket penetrometer tests were conducted simultaneously with the sampling operation to assess the strength characteristics of the substrata.

The ground water conditions at the borehole locations were assessed during drilling by visual examination of the soil, the sampler and the drill rods as the samples were retrieved and when appropriate by measurement of the water level in the open borehole.

The lake water elevation was obtained from The Canadian Hydrographic Service water level gauging station located in Port Weller, Ontario. The water level elevations are referenced to the International Great Lakes Datum 1985.

The recovered samples were returned to our laboratory for detailed visual examination, classification, routine moisture content determinations and laboratory grain size analysis and Atterberg Limits tests. Selected soil samples were submitted to AGAT Laboratories to assess the environmental properties of the soil. Details concerning the environmental sampling and testing protocol are provided in Section 5.

3. 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, dynamic cone penetration test values, pocket penetrometer shear strength values, rock coring details, ground water observations and the results of laboratory moisture content determinations, grain size analysis and Atterberg Limits tests.

The subsurface stratigraphy revealed in the boreholes typically comprised fill overlying sand underlain by organic/alluvial silt overlying clay and sand mantling weathered shale bedrock.

3.1 Fill

A 2.4 m thick rubble fill layer was contacted at 2.5 m (elevation 73.5) and penetrated at 4.9 m (elevation 71.1) in Borehole 3. The rubble fill layer generally consisted of cobbles, boulders, wood, sand and gravel.

A 100 mm thick topsoil fill layer was encountered surficially in Borehole 4. The topsoil fill comprised silt judged to be moist.

A 4.6 m thick fill layer was contacted below the topsoil fill in Borehole 4 to 4.7 m (elevation 72.1). The fill layer comprised loose silt in the upper 1.6 m, becoming compact sand fill from 1.7 to 4.7 m. Moisture content of the fill ranged from 7 to 13% and was judged to be moist to wet.

3.2 Sand

A 0.5 to 1.7 m thick very loose to compact sand was contacted at 4.7 to 5.1 m (elevation 71.1 to 72.1) and extended to 5.4 and 6.4 m (elevation 70.6 and 70.5) in Boreholes 2 to 4. The moisture content of the sand typically ranged from 13 to 29% and was judged to be saturated.

The results of a grain size test (Figure A1) indicate that the sand stratum comprises 22% gravel, 71% sand and 7% silt and clay.

3.3 Alluvial Silt

A 2.7 m thick dense alluvial silt was contacted below the sand in Borehole 2 at 5.7 m (elevation 70.5) and extended to 8.4 m (elevation 67.8). The moisture content of the silt typically ranged from 16 to 21% and was judged to be damp.

The results of a grain size test (Figure A1) indicate that the alluvial silt stratum comprises 2% gravel, 7% sand and 80% silt and 11% clay. The results of an Atterberg limits test determined the samples to be non-plastic.

3.4 Organic Silt

Organic silt was contacted below the sand at 5.4 and 6.4 m (elevation 70.6 and 70.5), in Boreholes 3 and 4, respectively. The silt layer was contacted to the sampled terminated depth of 15.0 m (elevation 61.0) in Boreholes 3 and was penetrated at 17.5 m (elevation 59.4) in

Borehole 4. The condition of the silt was very loose to loose. The silt was interspersed with layers of sandy or clayey composition and had variable levels of organic content.

The results of a grain size test (Figure A1) indicate that the organic silt stratum comprises 1% gravel, 11% sand and 70% silt and 18% clay. The results of an Atterberg limits test determined the liquid limit, plastic limit and plasticity index values were 38, 25 and 13, respectively (Figure A2).

3.5 Silty Clay

A 3.2 m thick very soft silty clay layer was encountered below the organic silt in Borehole 4. The clay was contacted at 17.5 m (elevation 59.4) and extended to 20.7 m (elevation 56.2). The moisture content of the clay typically ranged from 10 to 20% and was judged to be about to wetter than plastic limit.

The results of a grain size test (Figure A1) indicate that the clay stratum comprises 0% gravel, 13% sand and 71% silt and 16% clay. The results of an Atterberg limits test determined the liquid limit, plastic limit and plasticity index values were 24, 18 and 6, respectively (Figure A2). The Atterberg limits test results indicate silty clay.

3.6 Sand

Compact sand was contacted below the clay in Borehole 4 at 20.7 m (elevation 56.2) and extended to the sampled terminated depth of 22.5 m (elevation 54.4). The moisture content of the sand typically was 18% and was judged to be saturated.

The results of a grain size test (Figure A1) indicate that the sand stratum comprises 4% gravel, 79% sand and 17% silt and clay.

3.7 Shale

Shale bedrock was contacted at 8.4 m (elevation 67.8) and extended to the termination depth of 13.4 m (elevation 62.8) in Borehole 2. The shale bedrock was red shale of the Queenston Formation and was judged to be highly weathered to weathered. It is noted that numerous and frequent limestone layers were encountered within the shale.

Diamond rock coring of the shale was completed from 8.9 to 13.4 m. The Total Core Recovery (TCR) of the rock cores ranged from 90 to 100%. The Rock Quality Designation (RQD) ranged from 40 to 65%. The Fracture Index (FI) of the shale generally ranged from 3 to 7, with localized FI greater than 25 and 10 between 8.9 to 9.2 and 10.4 to 10.7 m, respectively.

Based on the TCR, RQD, FI and visual examination of the rock cores, the shale was medium bedded, poor to fair quality, very thinly to thinly bedded with slightly weathered limestone. The limestone layers were generally measured to be less than 50 mm, with notable exceptions ranging from 87.5 to 225 mm thick, as shown on Borehole 2.

The rock cores are documented in Photograph 1, appended.

3.8 Dynamic Cone Penetration Test

A dynamic cone penetration test was completed from the sampled termination depths of 15.0 and 22.5 m (elevation 61.0 and 54.4) to refusal at 21.4 and 24.0 m (elevation 54.6 and 52.9) in Boreholes 3 and 4, respectively.

3.9 Ground Water Conditions

Upon completion of drilling, free water and cave was observed at 12.2 m (elevation 64.7) in Borehole 4.

At the time of drilling, the water level in Lake Ontario ranged from elevation 74.5 to 74.7. The lake water elevation was obtained from The Canadian Hydrographic Service water level gauging

station located in Port Weller, Ontario. The elevation is referenced to the International Great Lakes Datum 1985.

Ground water levels may fluctuate subject to seasonal variations and precipitation patterns.

4. ENGINEERING DISCUSSION AND RECOMMENDATIONS

It is understood that Fisheries and Oceans Canada (DFO) plans to rehabilitate the Port Dalhousie Piers located in in St. Catharines, Ontario. The proposed rehabilitation methods were not known at the time of this report.

The purpose of the geotechnical investigation was to establish the subsurface soil and ground water conditions along the piers and based on the findings, provide geotechnical recommendations for lateral earth pressure parameters and allowable bearing capacities of the subsurface soil.

The subsurface stratigraphy revealed in the boreholes typically comprised fill overlying sand underlain by organic/alluvial silt overlying clay and sand mantling weathered shale bedrock.

For the weathered shale, a factored net bearing resistance at ULS of 500 kPa can be used for design. Serviceability Limit State (SLS) resistance is not expected to govern the design since the bearing pressure required to mobilize 25 mm of settlement would be greater than the ULS resistance

Due to the variability, organic content and low ‘N’ Values in the fill, sand and organic and alluvial silt and clay layers, significant post-construction settlement would be anticipated. Further analysis of the soil units and details regarding proposed loads, construction procedures and allowable settlement would be required to provide ULS and SLS bearing values and to quantify the order of magnitude of settlement.

The geotechnical lateral earth pressure design parameters for the main soil types encountered in the boreholes are provided in the following table:

Table 2

Design Parameters for Main Soil Types

Soil Type	Saturated / Submerged Unit Weight (kN/m^3)	Undrained Shear Strength (kPa) (Short Term)	Undrained Friction Angle (°) (Long Term)	Rankine Coefficient of Active Earth Pressure (K_a)	Rankine Coefficient of Passive Earth Pressure (K_p)*
Sand	19.0 / 9.2	NA	30	0.33	3.0
Organic Silt	16.0 / 6.2	NA	22	0.45	2.2
Alluvial Silt	18.0 / 8.2	NA	27	0.38	2.7
Silty Clay	20.0 / 10.2	5	15	0.59	1.7

* Coefficient does not include a Factor of Safety.

The lateral earth pressure calculation should include the hydrostatic water level and surcharge, as applicable.

5. GEOENVIRONMENTAL CONSIDERATIONS

A limited scope geoenvironmental screening component was included to check the environmental quality of the soil.

5.1 Chemical Testing Protocol

Representative samples collected during the investigation were returned to our laboratory for detailed visual examination. Soil samples were submitted for chemical analysis to AGAT Laboratories Limited (AGAT), a Canadian Association for Laboratory Accreditation Inc. (CALA) accredited laboratory in Mississauga, Ontario. The chemical analyses conducted by AGAT were in general accordance with the O. Reg. 153/04 (as amended) Protocol for Analytical

Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act dated March 9, 2004, amended as of July 1, 2011.

Selection of samples was conducted in accordance with the DFO Terms of Reference whereby at least four samples from the boreholes are tested for petroleum hydrocarbons (PHC). A total of six soil samples were selected and analyzed for PHC fractions F1 to F4.

A list of all samples submitted for analysis is included as Table B1, appended. It is noted that Sample BH3 SS4 was added to the testing program and is not shown on the chain of custody.

5.2 Pertinent Regulatory Standards

Based on current information, a Table 9 (T9) residential/parkland/institutional/industrial/ commercial/community (RPI/ICC) site condition standard (SCS) would likely apply to the site since the site is located within 30 m of a water body (Lake Ontario), however a full evaluation of applicable SCSs in accordance with Sections 41 and 43.1 of O. Reg. 153/04, as amended, was not within the scope of this assignment and further environmental work would be required to confirm this. It is noted the top 0.15 m in Borehole 2 would be considered 'sediment' as defined in O. Reg. 153/04, as amended.

Since the land is Federal property, the results were also compared to the Canadian Council of Ministers of the Environment (CCME) Guidelines for Residential/Parkland land use (coarse textured soil).

5.3 Analytical Findings

Laboratory Certificates of Analysis compared to Table 9 SCSs and CCME Guidelines are included in Appendix B. The measured values and corresponding Standards (labelled as G/S for Guideline/Standard) are shown on the certificates of analysis with the levels exceeding the applicable Standards in **bold** text.

The measured concentration of the tested parameters complied with the T9 RPI/ICC SCSs and CCME Residential/Parkland Guidelines. As well, Sample BH2 SS1 meets the SCSs for sediment.

We trust the information presented in this report is sufficient for your present purposes. If you have any questions, please do not hesitate to contact our office.

Sincerely
Peto MacCallum Ltd.

For Karel Furbacher, B.Eng.
Project Supervisor



Matthew D. St Denis, P.Eng.
Senior Engineer, Geotechnical Services

KF/MAK:lad



Photograph 1 – Borehole 2 - RC1, RC2 and RC3 – 8.9 to 13.4 m

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:

CONSISTENCY	N (blows/0.3 m)	c (kPa)	DENSENESS	N (blows/0.3 m)
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		

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

TYPE OF SAMPLE

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

PH	Sample Advanced Hydraulically
PM	Sample Advanced Manually

SOIL TESTS

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

Peto MacCallum Ltd.
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LOG OF BOREHOLE NO. 2

METRIC

17T 0640999E
4785525N

1 of 1

PROJECT Port Dalhousie Pier
LOCATION St. Catharines, Ontario
BORING METHOD NW Wash Boring and NQ Diamond Coring
BORING DATE November 14, 2014
PML PROJECT NO. 14HF051
ENGINEER M. D. St. Denis
TECHNICIAN K. Furbacher

ELEV / DEPTH in meters	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	FRACTURE INDEX	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
76.2	Deck Surface						
	DECK - Top of drilling platform						
74.6 / 1.6	WATER						
71.1 / 5.1	SAND: Dense, black gravelly sand, some silt, trace clay, saturated; with occasional shell fragments		1*	SS	62/275mm		
70.5 / 5.7	ALLUVIAL SILT: Dense, grey silt, some clay, trace sand and gravel, damp; with occasional shale fragments		2*	SS	41		Non Plastic 2 7 80 11 G_s = 2.734
69.4 / 6.8	becoming layered with grey and brown silty clay and sand seams		3	SS	41		
68.7 / 7.5	becoming reddish brown, with numerous shale fragments						
67.8 / 8.4	SHALE: Highly weathered, medium bedded, red, poor quality, shale, very thinly to thinly bedded with slightly weathered bluish grey limestone layers (<50 mm except as noted)		4	SS	50/25mm	>25	
66.6 / 9.6	175 mm limestone layer		5	RC		7 4 4 4	RC1 Run = 1.5 m Recovery = 90% RQD = 40%
9.8	150 mm limestone layer						
65.8 / 10.4	becoming weathered, fair quality, with 225 mm limestone layer (fractured)		6	RC		10 7 6 1 5	RC2 Run = 1.5 m Recovery = 100% RQD = 58%
65.0 / 11.1	87.5 mm limestone layer		7	RC		2 4 1 3 6	RC3 Run = 1.5 m Recovery = 100% RQD = 65%
62.9 / 13.4	100 mm limestone layer						* Sample submitted for chemical testing
	BOREHOLE TERMINATED AT 13.4 m						

SHEAR STRENGTH kPa
○ Qu ◘ Q + FIELD VANE
▲/△ POCKET PENETROMETER/TORVANE
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

ELEVATION SCALE: 76 75 74 73 72 71 70 69 68 67 66 65 64 63

DEPTH SCALE: 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0

PML - BH LOG GEO/ENV WITH MWS 14HF051 BOREHOLE LOGS 2 TO 4 2014-12-24.GPJ ON_MOT.GDT 1/16/2015 4:35:58 PM

$+^{7}$ Number refers to sensitivity

20
15 ○ 5 (%) STRAIN AT FAILURE
10

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CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 3

METRIC

17T 0641002E
4785357N

1 of 2

PROJECT Port Dalhousie Pier
LOCATION St. Catharines, Ontario
BORING METHOD NW Wash Boring
BORING DATE November 11 and 13, 2014
PML PROJECT NO. 14HF051
ENGINEER M. D. St. Denis
TECHNICIAN D. Smith

ELEV / DEPTH in meters	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
76.0	Deck Surface					
	DECK - Top of drilling platform					
1.0						
74.7 1.3	WATER					
2.0						
73.5 2.5	RUBBLE FILL: Cobbles, boulders, wood, sand and gravel rubble fill					
3.0						
4.0			1	SS	36	
71.1 4.9	SAND: Very loose, grey, black and brown gravelly coarse sand, trace silt, saturated		2A	SS		22 71 (7)
70.6 5.4			2B*	SS	4	
5.0	ORGANIC SILT: Very loose to loose, grey silt, some clay and sand, trace gravel, saturated; with black organic staining and occasional decayed plant matter					
6.0			3	SS	2	1 11 70 18 G_s = 2.640
7.0			4*	SS	2	
			5	SS	2	
8.0						
9.0			6	SS	2	
66.1 9.9	becoming clayey, with occasional shell fragments					
10.0			7	SS	0	
11.0				FV		Shelby tube attempted at 11.0 m. No recovery.
12.0			8	SS	3	
13.0						
			9	SS	5	
14.0				FV		
61.0 15.0	Cont'd					

SHEAR STRENGTH kPa
○ Qu ◘ Q + FIELD VANE
▲/△ POCKET PENETROMETER/TORVANE
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

ELEVATION SCALE: 75 74 73 72 71 70 69 68 67 66 65 64 63 62

FRACTURE INDEX: 66 81 102

+2 +1

+7 Number refers to sensitivity
20 / 15 / 10 — 5 (%) STRAIN AT FAILURE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 3

METRIC

17T 0641002E
4785357N

PROJECT Port Dalhousie Pier
LOCATION St. Catharines, Ontario
BORING METHOD NW Wash Boring
BORING DATE November 11 and 13, 2014
PML PROJECT NO. 14HF051
ENGINEER M. D. St. Denis
TECHNICIAN D. Smith

ELEV / DEPTH in meters	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH kPa (O Qu, O Q, + FIELD VANE; ▲/△ POCKET PENETROMETER/TORVANE; DYNAMIC CONE PENETRATION ×; STANDARD PENETRATION TEST ●)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	FRACTURE INDEX	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
61.0 15.0	UNSAMPLED: Dynamic cone penetration test					60 59 58 57 56 55	150/75mm			
54.6 21.4	BOREHOLE TERMINATED AT 21.4 m									* Sample submitted for chemical testing

16.0 17.0 18.0 19.0 20.0 21.0 22.0 23.0 24.0 25.0 26.0 27.0 28.0 29.0 30.0

PML - BH LOG GEO/ENV WITH MWS 14HF051 BOREHOLE LOGS 2 TO 4 2014-12-24.GPJ ON_MOT.GDT 1/16/2015 4:36:04 PM

$+^{7}$ Number refers to sensitivity

20
15 — 5 (%) STRAIN AT FAILURE
10

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 4

METRIC

17T 0641095E
4785223N

1 of 2

PROJECT Port Dalhousie Pier
LOCATION St. Catharines, Ontario
BORING METHOD Continuous Flight Hollow Stem Augers
BORING DATE December 18, 2014
PML PROJECT NO. 14HF051
ENGINEER M. D. St. Denis
TECHNICIAN D. Durish

ELEV / DEPTH in meters	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES
76.9	Ground Surface				
0.1	TOPSOIL FILL: Brown silt topsoil fill, some clay, trace sand and gravel, moist		1	SS	9
75.8 / 1.1	FILL: Loose, brown silt fill, some clay, trace sand and gravel, occasional organics				
	some sand		2	SS	46
75.1 / 1.7	compact, brown sand fill, trace gravel and silt, wet				
			3*	SS	11
72.1			4A	SS	
4.7	SAND: Compact, grey, black and brown sand, trace silt and gravel, saturated		4B / 4C*	SS	21
70.5			5	SS	9
6.4	ORGANIC SILT: Very loose to loose, grey silt, some clay to clayey, some sand, trace gravel, saturated; with black organic staining and occasional decayed plant matter, wood fibers, peat and shell fragments		6	SS	5
			7	SS	6
				FV	
			8	SS	5
			9	SS	3
				FV	
			10	SS	7
61.9	Cont'd				

SHEAR STRENGTH kPa
○ Qu ● Q + FIELD VANE
▲/△ POCKET PENETROMETER/TORVANE
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

ELEVATION SCALE: 76 75 74 73 72 71 70 69 68 67 66 65 64 63 62

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

FRACTURE INDEX: 72 72 51

REMARKS & GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

Lake Ontario water level at elevation 74.5

PML - BH LOG GEO/ENV WITH MWS 14HF051 BOREHOLE LOGS 2 TO 4 2014-12-24.GPJ ON_MOT.GDT 1/16/2015 4:36:08 PM

+7 Number refers to sensitivity
20 / 15 / 10 — 5 (%) STRAIN AT FAILURE

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 4

METRIC

17T 0641095E
4785223N

2 of 2

PROJECT Port Dalhousie Pier
PML PROJECT NO. 14HF051
LOCATION St. Catharines, Ontario
BORING DATE December 18, 2014
ENGINEER M. D. St. Denis
BORING METHOD Continuous Flight Hollow Stem Augers
TECHNICIAN D. Durish

ELEV / DEPTH in meters	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
61.9 15.0	ORGANIC SILT: Very loose to loose, grey silt, some clay to clayey, some sand, trace gravel, saturated; with black organic staining and occasional decayed plant matter, wood fibers, peat and shell fragments		11	SS	3	
			12	SS	7	
59.4 17.5	CLAY: Very soft, grey silty clay, trace sand, APL to WTPL		13	SS	0	0 13 71 16 G_s = 2.71
			14	TW		
56.2 20.7	SAND: Compact, reddish brown medium to coarse sand, some gravel, trace silt and clay, saturated		15	SS	12	4 79 (17)
54.4 22.5	UNSAMPLED: Dynamic cone penetration test					
52.9 24.0	BOREHOLE TERMINATED AT 24.0 m					Upon completion of augering, free water and cave to 12.2 m

ELEVATION SCALE: 61, 60, 59, 58, 57, 56, 55, 54, 53

SHEAR STRENGTH kPa
○ Qu ◘ Q + FIELD VANE
▲/△ POCKET PENETROMETER/TORVANE
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

50/0mm

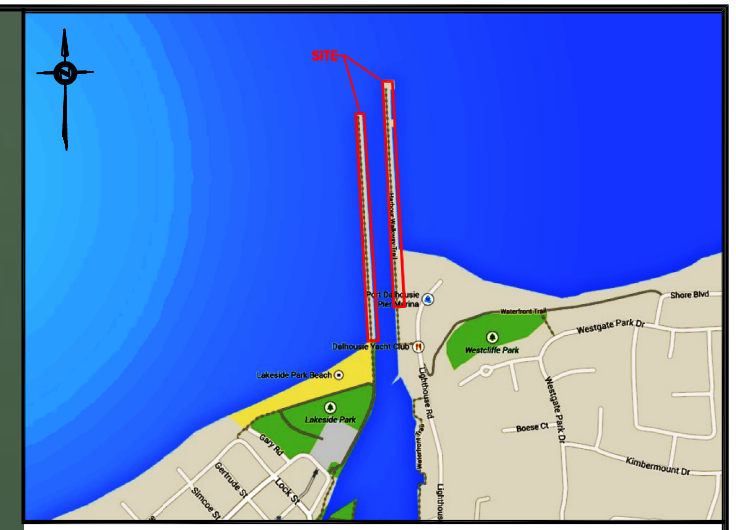
FRACTURE INDEX

16.0 17.0 18.0 19.0 20.0 21.0 22.0 23.0 24.0 25.0 26.0 27.0 28.0 29.0 30.0

+7 Number refers to sensitivity

20
15 — 5 (%) STRAIN AT FAILURE
10





KEY PLAN
ST. CATHARINES, ONTARIO

LEGEND:

BH 4 EL. 76.9 — PML BOREHOLE (BH) LOCATION

BENCHMARK (BM)

BENCHMARK:

TABLET IN WEST CONCRETE FOUNDATION WALL OF INNER LIGHTHOUSE AT ENTRANCE OF HARBOUR, 1.70 m FROM NORTHWEST CORNER, 1.35 m FROM SOUTHWEST CORNER, 20 cm BELOW SHINGLE SIDING (GEODETIC SURVEY OF CANADA BM NO. 561F)
ELEVATION: 75.822 m (METRIC, GEODETIC)

REFERENCE:

PLAN PRODUCED FROM GIS INFORMATION FROM THE NIAGARA REGION ONLINE INTERACTIVE MAPPING SERVICE.

NOTE:

THE INFERRED STRATIGRAPHY REFERRED TO IN THE REPORT IS BASED ON THE DATA FROM THESE BOREHOLES SUPPLEMENTED BY GEOLOGICAL EVIDENCE. THE ACTUAL STRATIGRAPHY BETWEEN THE BOREHOLES MAY VARY.

25 0m 25 50 75 100 150
SCALE

FISHERIES AND OCEANS CANADA

GEOTECHNICAL INVESTIGATION
PORT DALHOUSIE PIER
ST. CATHARINES

BOREHOLE LOCATION PLAN

Peto MacCallum Ltd.
CONSULTING ENGINEERS

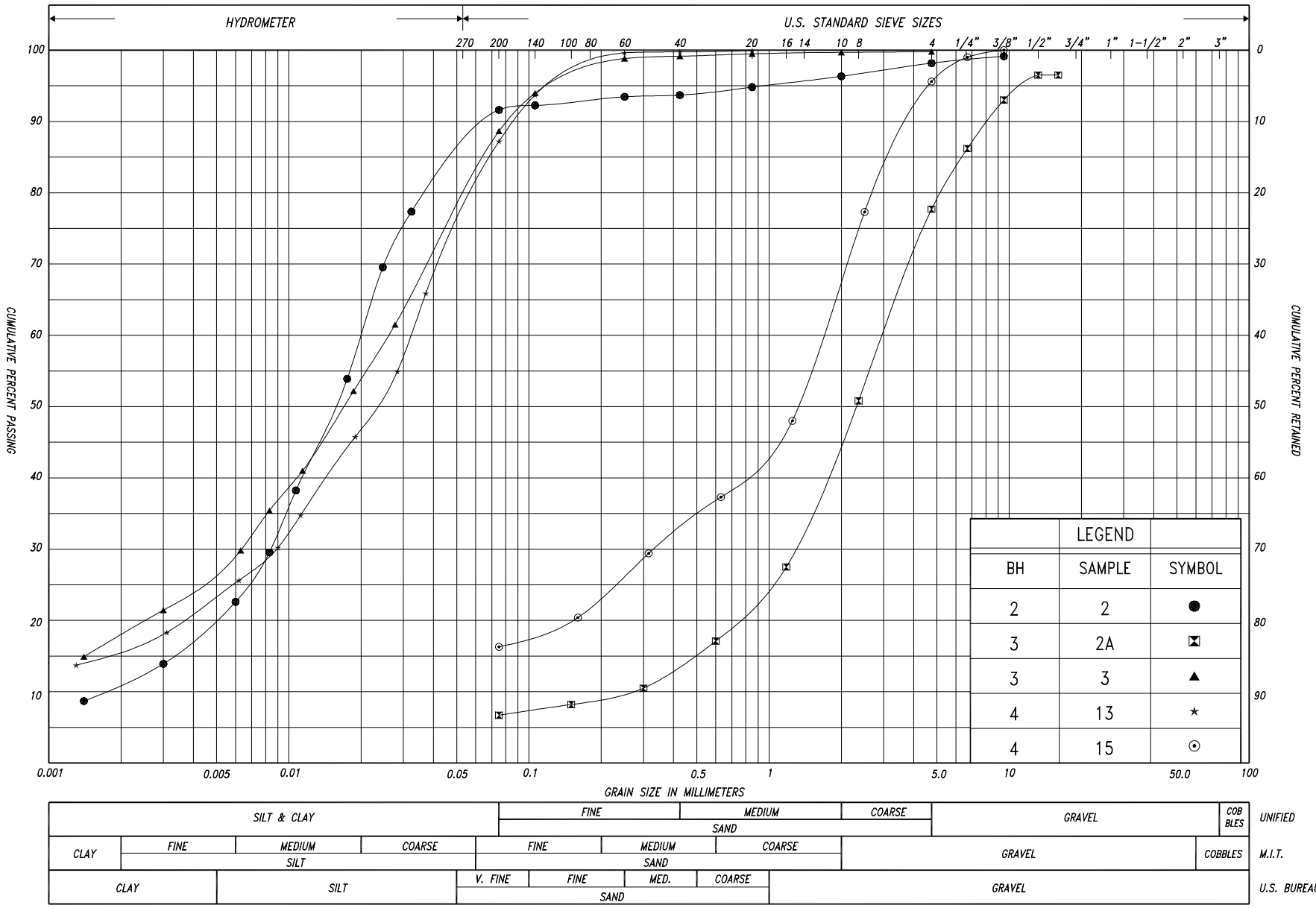
DRAWN	KF	DATE	SCALE	PML REF.	DRAWING NO.
CHECKED	MDS	JAN. 2015	AS SHOWN	14HF051	1
APPROVED	MDS				

Appendix A

Results of Laboratory Testing

Figures A1– Grain Size Analyses

Figures A2 – Atterberg Limits

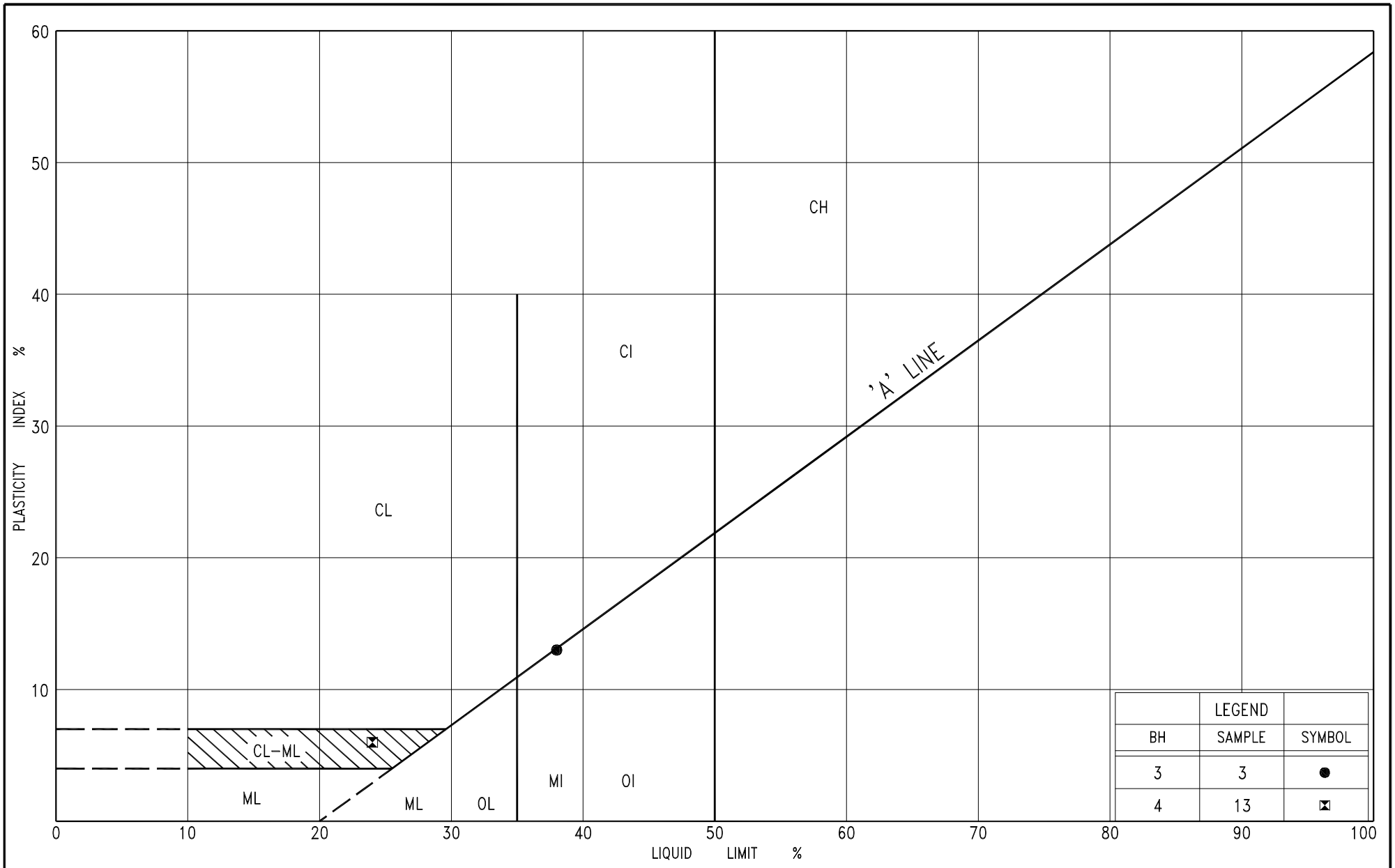


Peto MacCallum Ltd.
CONSULTING ENGINEERS

GRAIN SIZE DISTRIBUTION

FIG No. A1

PROJECT No. 13HF033



Peto MacCallum Ltd.
CONSULTING ENGINEERS

PLASTICITY CHART

FIG No. A2

PROJECT No. 13HF033

Appendix B

Geoenvironmental Screening

Table B1 – Soil Samples Submitted for Chemical Testing

AGAT Laboratories Limited - Certificates of Analysis

TABLE B1

Soil Samples Submitted for Environmental Chemical Testing

Location	Sample ID	Approx. Depth (m)	Description	Type of Chemical Analysis
Borehole 2	BH2 SS1	5.1 – 5.6	Black gravelly sand, some silt, trace clay; with occasional shell fragments	PHC Fractions F1 – F4
Borehole 2	BH2 SS2	5.8 – 6.3	Grey silt, some clay, trace sand and gravel; with occasional shale fragments	PHC Fractions F1 – F4
Borehole 3	BH3 SS2B	5.4 – 5.6	Grey silt, some clay and sand, trace gravel,; with black organic staining and occasional decayed plant matter	PHC Fractions F1 – F4
Borehole 3	BH3 SS4	6.7 – 7.2	Grey silt, some clay and sand, trace gravel,; with black organic staining and occasional decayed plant matter	PHC Fractions F1 – F4
Borehole 4	BH4 SS3	3.0 – 3.5	Brown sand fill, trace gravel and silt	PHC Fractions F1 – F4
Borehole 4	BH4 SS4C	4.8 – 4.9	Grey, black and brown sand, trace silt and gravel	PHC Fractions F1 – F4

Notes:

PHC – Petroleum Hydrocarbons

O. Reg. 153/04, As Amended, Table 9 Standards

(RPI/ICC Property Use)

AGAT Laboratories

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http://www.agatlabs.com

CLIENT NAME: PETO MACCALLUM LIMITED
45 BURFORD ROAD
HAMILTON, ON L8E3C5
(905) 561-2231

ATTENTION TO: Karel Furbacher

PROJECT: 14HF051

AGAT WORK ORDER: 14T920013

TRACE ORGANICS REVIEWED BY: Neli Popnikolova, Senior Chemist

DATE REPORTED: Nov 27, 2014

PAGES (INCLUDING COVER): 5

VERSION*: 1

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

*NOTES

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

Member of: Association of Professional Engineers, Geologists and Geophysicists of Alberta (APEGGA)
Western Enviro-Agricultural Laboratory Association (WEALA)
Environmental Services Association of Alberta (ESAA)

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Results relate only to the items tested and to all the items tested

AGAT Laboratories

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

Certificate of Analysis

AGAT WORK ORDER: 14T920013

PROJECT: 14HF051

CLIENT NAME: PETO MACCALLUM LIMITED

ATTENTION TO: Karel Furbacher

SAMPLING SITE:

SAMPLED BY:Karel F.

O. Reg. 153(511) - PHCs F1 - F4 (Soil)

DATE RECEIVED: 2014-11-24

DATE REPORTED: 2014-11-27

		SAMPLE DESCRIPTION:		BH3 SS2B	BH2 SS1	BH2 SS2	BH3 SS4
		SAMPLE TYPE:		Soil	Soil	Soil	Soil
		DATE SAMPLED:		11/11/2014	11/14/2014	11/14/2014	11/14/2014
Parameter	**Unit**	**G / S**	**RDL**	**6113685**	**6113687**	**6113689**	**6116821**
Benzene	µg/g	0.02	0.02	<0.02	<0.02	<0.02	<0.02
Ethylbenzene	µg/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05
F1 (C6 to C10)	µg/g		5	<5	<5	<5	<5
F1 (C6 to C10) minus BTEX	µg/g	25	5	<5	<5	<5	<5
F2 (C10 to C16)	µg/g	10	10	<10	<10	<10	<10
F3 (C16 to C34)	µg/g	240	50	<50	<50	<50	<50
F4 (C34 to C50)	µg/g	120	50	<50	<50	<50	<50
Gravimetric Heavy Hydrocarbons	µg/g	120	50	NA	NA	NA	NA
Moisture Content	%		0.1	25.3	11.8	14.4	26.5
Toluene	µg/g	0.2	0.08	<0.08	<0.08	<0.08	<0.08
Xylene Mixture	µg/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05
Surrogate	**Unit**	**Acceptable Limits**					
Terphenyl	%	60-140		98	100	110	102

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to T9 (All) - NEW

6113685-6116821 Results are based on sample dry weight.
The C6-C10 fraction is calculated using toluene response factor.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6 - C50 results are corrected for BTEX contributions.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.
Fractions 1-4 are quantified with the contribution of PAHs. Under Ontario Regulation 153, results are considered valid without determining the PAH contribution if not requested by the client.
Quality Control Data is available upon request.

Certified By: N Popowich

Results relate only to the items tested and to all the items tested

AGAT Laboratories

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

Quality Assurance

CLIENT NAME: PETO MACCALLUM LIMITED

AGAT WORK ORDER: 14T920013

PROJECT: 14HF051

ATTENTION TO: Karel Furbacher

SAMPLING SITE:

SAMPLED BY:Karel F.

Trace Organics Analysis

RPT Date: Nov 27, 2014			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - PHCs F1 - F4 (Soil)															
Benzene	6103963		< 0.02	< 0.02	0.0%	< 0.02	122%	50%	140%	97%	60%	130%	92%	50%	140%
Ethylbenzene	6103963		< 0.05	< 0.05	0.0%	< 0.05	108%	50%	140%	113%	60%	130%	96%	50%	140%
F1 (C6 to C10)	6103963		< 5	< 5	0.0%	< 5	101%	60%	140%	93%	80%	120%	82%	60%	140%
F2 (C10 to C16)	6110713		< 10	< 10	0.0%	< 10	106%	60%	140%	100%	80%	120%	77%	60%	140%
F3 (C16 to C34)	6110713		< 50	< 50	0.0%	< 50	105%	60%	140%	107%	80%	120%	98%	60%	140%
F4 (C34 to C50)	6110713		< 50	< 50	0.0%	< 50	82%	60%	140%	116%	80%	120%	86%	60%	140%
Toluene	6103963		< 0.08	< 0.08	0.0%	< 0.08	105%	50%	140%	108%	60%	130%	93%	50%	140%
Xylene Mixture	6103963		< 0.05	< 0.05	0.0%	< 0.05	109%	50%	140%	101%	60%	130%	97%	50%	140%

Certified By: N Popnikolof

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AGAT Laboratories

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http://www.agatlabs.com

Method Summary

CLIENT NAME: PETO MACCALLUM LIMITED

AGAT WORK ORDER: 14T920013

PROJECT: 14HF051

ATTENTION TO: Karel Furbacher

SAMPLING SITE:

SAMPLED BY:Karel F.

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Benzene	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
Ethylbenzene	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
F1 (C6 to C10)	VOL-91-5009	CCME Tier 1 Method	P & T GC/FID
F1 (C6 to C10) minus BTEX	VOL-91-5009	CCME Tier 1 Method	P & T GC/FID
F2 (C10 to C16)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
F3 (C16 to C34)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
F4 (C34 to C50)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
Gravimetric Heavy Hydrocarbons	VOL-91-5009	CCME Tier 1 Method	BALANCE
Moisture Content	VOL-91-5009	CCME Tier 1 Method	BALANCE
Terphenyl	VOL-91-5009		GC/FID
Toluene	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
Xylene Mixture	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS

Results relate only to the items tested and to all the items tested

AGAT Laboratories

5835 Coopers Avenue
Mississauga, ON
L4Z 1Y2
www.agatlabs.com · webearth.agatlabs.com
P: 905.712.5100 · F: 905.712.5122

Chain of Custody Record

Laboratory Use Only
Arrival Temperature: 6.3 - 6.2 - 6.3
AGAT WO #:
Lab Temperature: 6.0 - 6.2 - 6.1
Notes: 14T920013

Client Information

Company: PETO MACCALLUM LTD.
Contact: KAREL FURBACHER
Address: 45 BURFORD RD., HAMILTON
Phone: 905-561-2231 Fax: 905-561-6366
Project: 14HF051 PO:
AGAT Quotation #:

Please note, if quotation number is not provided, client will be billed full price for analysis.

Regulatory Requirements

☒ Regulation 153/04 (reg. 511 Amend.)
Table 1 (Indicate one)
☐ Ind/Com ☐ Res/Park ☐ Agriculture
Soil Texture (check one) ☐ Coarse ☐ Fine

☐ Sewer Use
Region (Indicate one)
☐ Sanitary ☐ Storm

☐ Regulation 558
☐ CCME
☐ Other (specify)
☐ Prov. Water Quality Objectives (PWQO)
☐ None

Turnaround Time Required (TAT) Required*

Regular TAT
☒ 5 to 7 Working Days

Rush TAT (please provide prior notification)
Rush Surcharges Apply
☐ 3 Working Days
☐ 2 Working Days
☐ 1 Working Day

OR
Date Required (Rush surcharges may apply):

*TAT is exclusive of weekends and statutory holidays

Invoice To

Same: Yes ☒ No ☐
Company:
Contact:
Address:

Is this a drinking water sample? (potable water intended for human consumption) ☐ Yes ☒ No
If "Yes", please use the *Drinking Water Chain of Custody Form*

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

Legend Matrix

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

Report Information – reports to be sent to:

1. Name: KAREL FURBACHER
   Email: kfurbacher@petomaccallum.com
2. Name: MATTHEW ST. DENIS
   Email: mst.denis@petomaccallum.com

Sample Identification	Date Sampled	Time Sampled	Sample Matrix	# of Containers	Comments Site/Sample Information	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐ B-HWS ☐ Cl- ☐ CN- ☐ EC ☐ FOC ☐ Cr+6 ☐ SAR ☐ Hg ☐ pH ☐ NO_3/NO_2 ☐ N- Total	Nutrients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3/NO_2	VOC: ☐ VOC ☐ THM ☐ BTEX	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use
BH3 SS2B	NOV 11, 2014	2:00 P.M.	SOIL	2									X						
BH2 SS1	NOV. 14, 2014	8:00 A.M	SOIL	2									X						
BH2 SS2	NOV. 14, 2014	9:30 A.M	SOIL	2									X						

Samples Relinquished By (Print Name and Sign): KAREL FURBACHER — Date/Time: NOV. 21, 2014 8:00 A.M.
Samples Received By (Print Name and Sign): — Date/Time: 10:32
Samples Relinquished By (Print Name and Sign): — Date/Time:
Samples Received By (Print Name and Sign): — Date/Time: 8:55

Pink Copy - Client
Yellow Copy - AGAT
White Copy - AGAT

Page 1 of 1
N°: 41642

AGAT Laboratories

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

CLIENT NAME: PETO MACCALLUM LIMITED
45 BURFORD ROAD
HAMILTON, ON L8E3C5
(905) 561-2231

ATTENTION TO: Danika Durish

PROJECT: 14HF051

AGAT WORK ORDER: 14T931069

TRACE ORGANICS REVIEWED BY: Neli Popnikolova, Senior Chemist

DATE REPORTED: Jan 02, 2015

PAGES (INCLUDING COVER): 5

VERSION*: 1

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

*NOTES

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

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Western Enviro-Agricultural Laboratory Association (WEALA)
Environmental Services Association of Alberta (ESAA)

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AGAT Laboratories

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

Certificate of Analysis

AGAT WORK ORDER: 14T931069

PROJECT: 14HF051

CLIENT NAME: PETO MACCALLUM LIMITED

ATTENTION TO: Danika Durish

SAMPLING SITE:

SAMPLED BY:Danika Durish

O. Reg. 153(511) - PHCs F1 - F4 (Soil)

DATE RECEIVED: 2014-12-22

DATE REPORTED: 2015-01-02

		SAMPLE DESCRIPTION:		BH4 SS3	BH4 SS4C
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		12/18/2014	12/18/2014
Parameter	Unit	G / S	RDL	6212921	6212933
Benzene	µg/g	0.02	0.02	<0.02	<0.02
Ethylbenzene	µg/g	0.05	0.05	<0.05	<0.05
F1 (C6 to C10)	µg/g		5	<5	<5
F1 (C6 to C10) minus BTEX	µg/g	25	5	<5	<5
F2 (C10 to C16)	µg/g	10	10	<10	<10
F3 (C16 to C34)	µg/g	240	50	54	<50
F4 (C34 to C50)	µg/g	120	50	<50	<50
Gravimetric Heavy Hydrocarbons	µg/g	120	50	NA	NA
Moisture Content	%		0.1	14.2	17.5
Toluene	µg/g	0.2	0.08	<0.08	<0.08
Xylene Mixture	µg/g	0.05	0.05	<0.05	<0.05
Surrogate	Unit	Acceptable Limits			
Terphenyl	%	60-140		84	65

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to T9 (All) - NEW

6212921-6212933 Results are based on sample dry weight.
The C6-C10 fraction is calculated using toluene response factor.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6 - C50 results are corrected for BTEX contributions.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.
Fractions 1-4 are quantified with the contribution of PAHs. Under Ontario Regulation 153, results are considered valid without determining the PAH contribution if not requested by the client.
Quality Control Data is available upon request.

Certified By: 

Results relate only to the items tested and to all the items tested

AGAT Laboratories

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CANADA L4Z 1Y2
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FAX (905)712-5122
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: PETO MACCALLUM LIMITED

AGAT WORK ORDER: 14T931069

PROJECT: 14HF051

ATTENTION TO: Danika Durish

SAMPLING SITE:

SAMPLED BY:Danika Durish

Trace Organics Analysis

RPT Date: Jan 02, 2015			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - PHCs F1 - F4 (Soil)															
Benzene	6211930		< 0.02	< 0.02	0.0%	< 0.02	87%	50%	140%	106%	60%	130%	115%	50%	140%
Ethylbenzene	6211930		< 0.05	< 0.05	0.0%	< 0.05	114%	50%	140%	98%	60%	130%	117%	50%	140%
F1 (C6 to C10)	6211930		< 5	< 5	0.0%	< 5	90%	60%	140%	87%	80%	120%	85%	60%	140%
F2 (C10 to C16)	6220937		< 10	< 10	0.0%	< 10	103%	60%	140%	92%	80%	120%	82%	60%	140%
F3 (C16 to C34)	6220937		< 50	< 50	0.0%	< 50	104%	60%	140%	89%	80%	120%	94%	60%	140%
F4 (C34 to C50)	6220937		< 50	< 50	0.0%	< 50	96%	60%	140%	116%	80%	120%	95%	60%	140%
Toluene	6211930		< 0.08	< 0.08	0.0%	< 0.08	114%	50%	140%	97%	60%	130%	111%	50%	140%
Xylene Mixture	6211930		< 0.05	< 0.05	0.0%	< 0.05	97%	50%	140%	91%	60%	130%	113%	50%	140%

Certified By: N Popnikolof

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Results relate only to the items tested and to all the items tested

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: PETO MACCALLUM LIMITED

AGAT WORK ORDER: 14T931069

PROJECT: 14HF051

ATTENTION TO: Danika Durish

SAMPLING SITE:

SAMPLED BY:Danika Durish

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Benzene	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
Ethylbenzene	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
F1 (C6 to C10)	VOL-91-5009	CCME Tier 1 Method	P & T GC/FID
F1 (C6 to C10) minus BTEX	VOL-91-5009	CCME Tier 1 Method	P & T GC/FID
F2 (C10 to C16)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
F3 (C16 to C34)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
F4 (C34 to C50)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
Gravimetric Heavy Hydrocarbons	VOL-91-5009	CCME Tier 1 Method	BALANCE
Moisture Content	VOL-91-5009	CCME Tier 1 Method	BALANCE
Terphenyl	VOL-91-5009		GC/FID
Toluene	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
Xylene Mixture	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS

Results relate only to the items tested and to all the items tested

AGAT Laboratories
5835 Coopers Avenue
Mississauga, ON
L4Z 1Y2
www.agatlabs.com · webearth.agatlabs.com
P: 905.712.5100 · F: 905.712.5122

Chain of Custody Record

Laboratory Use Only
Arrival Temperature: 6.3 6.2 6.6
AGAT WO #:
Lab Temperature: 5.3 5.1 4.9
Notes: 14T931069

Client Information

Company: Peto MacCallum Ltd
Contact: 45 Burford Road
Address: Hamilton, Ontario L8E 3C6
(905-561-2231
Phone: Fax: 905-561-6366
Project: 14HF051 PO:
AGAT Quotation #:

Please note, if quotation number is not provided, client will be billed full price for analysis.

Regulatory Requirements

☑ Regulation 153/04 (reg. 511 Amend.)
Table 1 *Indicate one*
☐ Ind/Com
☐ Res/Park
☐ Agriculture

Soil Texture *(check one)*
☑ Coarse ☐ Fine

☐ Sewer Use
Region *Indicate one*
☐ Sanitary
☐ Storm

☐ Regulation 558
☐ CCME
☐ Other *(specify)*
☐ Prov. Water Quality Objectives (PWQO)
☐ None

Turnaround Time Required (TAT) Required*

Regular TAT
☑ 5 to 7 Working Days

Rush TAT (please provide prior notification)
Rush Surcharges Apply
☐ 3 Working Days
☐ 2 Working Days
☐ 1 Working Day

OR
Date Required (Rush surcharges may apply):

**TAT is exclusive of weekends and statutory holidays*

Invoice To

Same: Yes ☑ No ☐
Company:
Contact:
Address:

Is this a drinking water sample? (potable water intended for human consumption)
☐ Yes ☑ No
If "Yes", please use the *Drinking Water Chain of Custody Form*

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

Legend Matrix

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

Report Information – reports to be sent to:

1. Name: Danika Durish
   Email: ddurish@petomaccallum.com
2. Name: Karel Furbacher
   Email: Kfurbacher@petomaccallum.com

Sample Identification	Date Sampled	Time Sampled	Sample Matrix	# of Containers	Comments Site/Sample Information	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐ B-HWS ☐ Cl- ☐ CN- ☐ EC ☐ FOC ☐ Cr+6 ☐ SAR ☐ Hg ☐ pH ☐ NO_3/NO_2 ☐ N- Total	Nutrients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3/NO_2	VOC: ☐ VOC ☐ THM ☐ BTEX	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use
BH4 SS3	Dec 18'14	8-4	Soil	2	vial							X	X						
BH4 SS4C	"	"	Soil	2	vial							X	X						

Samples Relinquished By (Print Name and Sign):	Date/Time	Samples Received By (Print Name and Sign):	Date/Time
Danika Durish	Dec 19'14 9:30		
Samples Relinquished By (Print Name and Sign):	Date/Time	Samples Received By (Print Name and Sign):	Date/Time

Pink Copy - Client
Yellow Copy - AGAT
White Copy- AGAT

Page 1 of 1
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Canadian Council of Ministers of the Environment (CCME)

Residential/Parkland Guidelines

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: PETO MACCALLUM LIMITED
45 BURFORD ROAD
HAMILTON, ON L8E3C5
(905) 561-2231

ATTENTION TO: Karel Furbacher

PROJECT: 14HF051

AGAT WORK ORDER: 14T920013

TRACE ORGANICS REVIEWED BY: Neli Popnikolova, Senior Chemist

DATE REPORTED: Nov 27, 2014

PAGES (INCLUDING COVER): 5

VERSION*: 1

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

*NOTES

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

Member of: Association of Professional Engineers, Geologists and Geophysicists of Alberta (APEGGA)
Western Enviro-Agricultural Laboratory Association (WEALA)
Environmental Services Association of Alberta (ESAA)

AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation.

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AGAT Laboratories

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http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 14T920013

PROJECT: 14HF051

CLIENT NAME: PETO MACCALLUM LIMITED

ATTENTION TO: Karel Furbacher

SAMPLING SITE:

SAMPLED BY:Karel F.

O. Reg. 153(511) - PHCs F1 - F4 (Soil)

DATE RECEIVED: 2014-11-24

DATE REPORTED: 2014-11-27

		SAMPLE DESCRIPTION:		BH3 SS2B	BH2 SS1	BH2 SS2	BH3 SS4
		SAMPLE TYPE:		Soil	Soil	Soil	Soil
		DATE SAMPLED:		11/11/2014	11/14/2014	11/14/2014	11/14/2014
Parameter	Unit	G / S	RDL	6113685	6113687	6113689	6116821
Benzene	µg/g	0.030	0.02	<0.02	<0.02	<0.02	<0.02
Ethylbenzene	µg/g	0.082	0.05	<0.05	<0.05	<0.05	<0.05
F1 (C6 to C10)	µg/g		5	<5	<5	<5	<5
F1 (C6 to C10) minus BTEX	µg/g	30	5	<5	<5	<5	<5
F2 (C10 to C16)	µg/g	150	10	<10	<10	<10	<10
F3 (C16 to C34)	µg/g	300	50	<50	<50	<50	<50
F4 (C34 to C50)	µg/g	2800	50	<50	<50	<50	<50
Gravimetric Heavy Hydrocarbons	µg/g		50	NA	NA	NA	NA
Moisture Content	%		0.1	25.3	11.8	14.4	26.5
Toluene	µg/g	0.37	0.08	<0.08	<0.08	<0.08	<0.08
Xylene Mixture	µg/g	11	0.05	<0.05	<0.05	<0.05	<0.05
Surrogate	Unit	Acceptable Limits					
Terphenyl	%	60-140		98	100	110	102

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to CCME PHC (Res, C)

6113685-6116821 Results are based on sample dry weight.
The C6-C10 fraction is calculated using toluene response factor.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6 - C50 results are corrected for BTEX contributions.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.
Fractions 1-4 are quantified with the contribution of PAHs. Under Ontario Regulation 153, results are considered valid without determining the PAH contribution if not requested by the client.
Quality Control Data is available upon request.

Certified By: N Popnikolof

Results relate only to the items tested and to all the items tested

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: PETO MACCALLUM LIMITED

AGAT WORK ORDER: 14T920013

PROJECT: 14HF051

ATTENTION TO: Karel Furbacher

SAMPLING SITE:

SAMPLED BY:Karel F.

Trace Organics Analysis

RPT Date: Nov 27, 2014			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - PHCs F1 - F4 (Soil)															
Benzene	6103963		< 0.02	< 0.02	0.0%	< 0.02	122%	50%	140%	97%	60%	130%	92%	50%	140%
Ethylbenzene	6103963		< 0.05	< 0.05	0.0%	< 0.05	108%	50%	140%	113%	60%	130%	96%	50%	140%
F1 (C6 to C10)	6103963		< 5	< 5	0.0%	< 5	101%	60%	140%	93%	80%	120%	82%	60%	140%
F2 (C10 to C16)	6110713		< 10	< 10	0.0%	< 10	106%	60%	140%	100%	80%	120%	77%	60%	140%
F3 (C16 to C34)	6110713		< 50	< 50	0.0%	< 50	105%	60%	140%	107%	80%	120%	98%	60%	140%
F4 (C34 to C50)	6110713		< 50	< 50	0.0%	< 50	82%	60%	140%	116%	80%	120%	86%	60%	140%
Toluene	6103963		< 0.08	< 0.08	0.0%	< 0.08	105%	50%	140%	108%	60%	130%	93%	50%	140%
Xylene Mixture	6103963		< 0.05	< 0.05	0.0%	< 0.05	109%	50%	140%	101%	60%	130%	97%	50%	140%

Certified By: N Popnikolof

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AGAT Laboratories

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MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
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FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: PETO MACCALLUM LIMITED

AGAT WORK ORDER: 14T920013

PROJECT: 14HF051

ATTENTION TO: Karel Furbacher

SAMPLING SITE:

SAMPLED BY:Karel F.

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Benzene	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
Ethylbenzene	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
F1 (C6 to C10)	VOL-91-5009	CCME Tier 1 Method	P & T GC/FID
F1 (C6 to C10) minus BTEX	VOL-91-5009	CCME Tier 1 Method	P & T GC/FID
F2 (C10 to C16)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
F3 (C16 to C34)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
F4 (C34 to C50)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
Gravimetric Heavy Hydrocarbons	VOL-91-5009	CCME Tier 1 Method	BALANCE
Moisture Content	VOL-91-5009	CCME Tier 1 Method	BALANCE
Terphenyl	VOL-91-5009		GC/FID
Toluene	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
Xylene Mixture	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS

Results relate only to the items tested and to all the items tested

AGAT Laboratories

5835 Coopers Avenue
Mississauga, ON
L4Z 1Y2
www.agatlabs.com · webearth.agatlabs.com
P: 905.712.5100 · F: 905.712.5122

Chain of Custody Record

Laboratory Use Only
Arrival Temperature: 6.3 - 6.2 - 6.3
AGAT WO #:
Lab Temperature: 6.0 - 6.2 - 6.1
Notes: 14T920013

Client Information

Company: PETO MACCALLUM LTD.
Contact: KAREL FURBACHER
Address: 45 BURFORD RD., HAMILTON
Phone: 905-561-2231 Fax: 905-561-6366
Project: 14HF051 PO:
AGAT Quotation #:

Please note, if quotation number is not provided, client will be billed full price for analysis.

Regulatory Requirements

☒ Regulation 153/04 (reg. 511 Amend.)
Table 1 (Indicate one)
☐ Ind/Com ☐ Res/Park ☐ Agriculture
Soil Texture (check one) ☐ Coarse ☐ Fine

☐ Sewer Use
Region (Indicate one)
☐ Sanitary ☐ Storm

☐ Regulation 558
☐ CCME
☐ Other (specify)
☐ Prov. Water Quality Objectives (PWQO)
☐ None

Turnaround Time Required (TAT) Required*

Regular TAT
☒ 5 to 7 Working Days

Rush TAT (please provide prior notification)
Rush Surcharges Apply
☐ 3 Working Days
☐ 2 Working Days
☐ 1 Working Day

OR
Date Required (Rush surcharges may apply):

*TAT is exclusive of weekends and statutory holidays

Invoice To

Same: Yes ☒ No ☐
Company:
Contact:
Address:

Is this a drinking water sample? (potable water intended for human consumption) ☐ Yes ☒ No
If "Yes", please use the *Drinking Water Chain of Custody Form*

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

Legend Matrix

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

Report Information – reports to be sent to:

1. Name: KAREL FURBACHER
   Email: kfurbacher@petomaccallum.com
2. Name: MATTHEW ST. DENIS
   Email: mst.denis@petomaccallum.com

Sample Identification	Date Sampled	Time Sampled	Sample Matrix	# of Containers	Comments Site/Sample Information	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐ B-HWS ☐ Cl- ☐ CN- ☐ EC ☐ FOC ☐ Cr+6 ☐ SAR ☐ Hg ☐ pH ☐ NO_3/NO_2 ☐ N- Total	Nutrients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3/NO_2	VOC: ☐ VOC ☐ THM ☐ BTEX	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use
BH3 SS2B	NOV 11, 2014	2:00 P.M.	SOIL	2									X						
BH2 SS1	NOV. 14, 2014	8:00 A.M	SOIL	2									X						
BH2 SS2	NOV. 14, 2014	9:30 A.M	SOIL	2									X						

Samples Relinquished By (Print Name and Sign): KAREL FURBACHER — Date/Time: NOV. 21, 2014 8:00 A.M.
Samples Received By (Print Name and Sign): — Date/Time: 10:32
Samples Relinquished By (Print Name and Sign): — Date/Time:
Samples Received By (Print Name and Sign): — Date/Time: 8:55

Pink Copy - Client
Yellow Copy - AGAT
White Copy - AGAT

Page 1 of 1
N°: 41642

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: PETO MACCALLUM LIMITED
45 BURFORD ROAD
HAMILTON, ON L8E3C5
(905) 561-2231

ATTENTION TO: Danika Durish

PROJECT: 14HF051

AGAT WORK ORDER: 14T931069

TRACE ORGANICS REVIEWED BY: Neli Popnikolova, Senior Chemist

DATE REPORTED: Jan 02, 2015

PAGES (INCLUDING COVER): 5

VERSION*: 1

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

*NOTES

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

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Western Enviro-Agricultural Laboratory Association (WEALA)
Environmental Services Association of Alberta (ESAA)

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MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
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http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 14T931069

PROJECT: 14HF051

CLIENT NAME: PETO MACCALLUM LIMITED

ATTENTION TO: Danika Durish

SAMPLING SITE:

SAMPLED BY:Danika Durish

O. Reg. 153(511) - PHCs F1 - F4 (Soil)

DATE RECEIVED: 2014-12-22

DATE REPORTED: 2015-01-02

		SAMPLE DESCRIPTION:		BH4 SS3	BH4 SS4C
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		12/18/2014	12/18/2014
Parameter	Unit	G / S	RDL	6212921	6212933
Benzene	µg/g	0.030	0.02	<0.02	<0.02
Ethylbenzene	µg/g	0.082	0.05	<0.05	<0.05
F1 (C6 to C10)	µg/g		5	<5	<5
F1 (C6 to C10) minus BTEX	µg/g	30	5	<5	<5
F2 (C10 to C16)	µg/g	150	10	<10	<10
F3 (C16 to C34)	µg/g	300	50	54	<50
F4 (C34 to C50)	µg/g	2800	50	<50	<50
Gravimetric Heavy Hydrocarbons	µg/g		50	NA	NA
Moisture Content	%		0.1	14.2	17.5
Toluene	µg/g	0.37	0.08	<0.08	<0.08
Xylene Mixture	µg/g	11	0.05	<0.05	<0.05
Surrogate	Unit	Acceptable Limits			
Terphenyl	%	60-140		84	65

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to CCME PHC (Res, C)

6212921-6212933 Results are based on sample dry weight.
The C6-C10 fraction is calculated using toluene response factor.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6 - C50 results are corrected for BTEX contributions.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.
Fractions 1-4 are quantified with the contribution of PAHs. Under Ontario Regulation 153, results are considered valid without determining the PAH contribution if not requested by the client.
Quality Control Data is available upon request.

Certified By: N Popowkolof

Results relate only to the items tested and to all the items tested

AGAT Laboratories

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CANADA L4Z 1Y2
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http://www.agatlabs.com

Quality Assurance

CLIENT NAME: PETO MACCALLUM LIMITED

AGAT WORK ORDER: 14T931069

PROJECT: 14HF051

ATTENTION TO: Danika Durish

SAMPLING SITE:

SAMPLED BY:Danika Durish

Trace Organics Analysis

RPT Date: Jan 02, 2015			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - PHCs F1 - F4 (Soil)															
Benzene	6211930		< 0.02	< 0.02	0.0%	< 0.02	87%	50%	140%	106%	60%	130%	115%	50%	140%
Ethylbenzene	6211930		< 0.05	< 0.05	0.0%	< 0.05	114%	50%	140%	98%	60%	130%	117%	50%	140%
F1 (C6 to C10)	6211930		< 5	< 5	0.0%	< 5	90%	60%	140%	87%	80%	120%	85%	60%	140%
F2 (C10 to C16)	6220937		< 10	< 10	0.0%	< 10	103%	60%	140%	92%	80%	120%	82%	60%	140%
F3 (C16 to C34)	6220937		< 50	< 50	0.0%	< 50	104%	60%	140%	89%	80%	120%	94%	60%	140%
F4 (C34 to C50)	6220937		< 50	< 50	0.0%	< 50	96%	60%	140%	116%	80%	120%	95%	60%	140%
Toluene	6211930		< 0.08	< 0.08	0.0%	< 0.08	114%	50%	140%	97%	60%	130%	111%	50%	140%
Xylene Mixture	6211930		< 0.05	< 0.05	0.0%	< 0.05	97%	50%	140%	91%	60%	130%	113%	50%	140%

Certified By: N Popnikolof

AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation.

Results relate only to the items tested and to all the items tested

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: PETO MACCALLUM LIMITED

AGAT WORK ORDER: 14T931069

PROJECT: 14HF051

ATTENTION TO: Danika Durish

SAMPLING SITE:

SAMPLED BY:Danika Durish

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Benzene	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
Ethylbenzene	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
F1 (C6 to C10)	VOL-91-5009	CCME Tier 1 Method	P & T GC/FID
F1 (C6 to C10) minus BTEX	VOL-91-5009	CCME Tier 1 Method	P & T GC/FID
F2 (C10 to C16)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
F3 (C16 to C34)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
F4 (C34 to C50)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
Gravimetric Heavy Hydrocarbons	VOL-91-5009	CCME Tier 1 Method	BALANCE
Moisture Content	VOL-91-5009	CCME Tier 1 Method	BALANCE
Terphenyl	VOL-91-5009		GC/FID
Toluene	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
Xylene Mixture	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS

Results relate only to the items tested and to all the items tested

AGAT Laboratories
5835 Coopers Avenue
Mississauga, ON
L4Z 1Y2
www.agatlabs.com · webearth.agatlabs.com
P: 905.712.5100 · F: 905.712.5122

Chain of Custody Record

Laboratory Use Only
Arrival Temperature: 6.3 6.2 6.6
AGAT WO #:
Lab Temperature: 5.3 5.1 4.9
Notes: 14T931069

Client Information

Company: Peto MacCallum Ltd
Contact: 45 Burford Road
Address: Hamilton, Ontario L8E 3C6
(905-561-2231
Phone: Fax: 905-561-6366
Project: 14HF051 PO:
AGAT Quotation #:

Please note, if quotation number is not provided, client will be billed full price for analysis.

Regulatory Requirements

☑ Regulation 153/04 (reg. 511 Amend.)
Table 1 *Indicate one*
☐ Ind/Com
☐ Res/Park
☐ Agriculture

Soil Texture *(check one)*
☑ Coarse ☐ Fine

☐ Sewer Use
Region *Indicate one*
☐ Sanitary
☐ Storm

☐ Regulation 558
☐ CCME
☐ Other *(specify)*
☐ Prov. Water Quality Objectives (PWQO)
☐ None

Turnaround Time Required (TAT) Required*

Regular TAT
☑ 5 to 7 Working Days

Rush TAT (please provide prior notification)
Rush Surcharges Apply
☐ 3 Working Days
☐ 2 Working Days
☐ 1 Working Day

OR
Date Required (Rush surcharges may apply):

**TAT is exclusive of weekends and statutory holidays*

Invoice To

Same: Yes ☑ No ☐
Company:
Contact:
Address:

Is this a drinking water sample? (potable water intended for human consumption)
☐ Yes ☑ No
If "Yes", please use the *Drinking Water Chain of Custody Form*

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

Legend Matrix

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

Report Information – reports to be sent to:

1. Name: Danika Durish
   Email: ddurish@petomaccallum.com
2. Name: Karel Furbacher
   Email: Kfurbacher@petomaccallum.com

Sample Identification	Date Sampled	Time Sampled	Sample Matrix	# of Containers	Comments Site/Sample Information	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐ B-HWS ☐ Cl- ☐ CN- ☐ EC ☐ FOC ☐ Cr+6 ☐ SAR ☐ Hg ☐ pH ☐ NO_3/NO_2 ☐ N- Total	Nutrients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3/NO_2	VOC: ☐ VOC ☐ THM ☐ BTEX	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use
BH4 SS3	Dec 18'14	8-4	Soil	2	vial							X	X						
BH4 SS4C	"	"	Soil	2	vial							X	X						

Samples Relinquished By (Print Name and Sign):	Date/Time	Samples Received By (Print Name and Sign):	Date/Time
Danika Durish	Dec 19'14 9:30		
Samples Relinquished By (Print Name and Sign):	Date/Time	Samples Received By (Print Name and Sign):	Date/Time

Pink Copy - Client
Yellow Copy - AGAT
White Copy- AGAT

Page 1 of 1
N°: 55201

Peto MacCallum Ltd.
CONSULTING ENGINEERS

GEOTECHNICAL INVESTIGATION
PORT DALHOUSIE HARBOUR WALL
ST. CATHARINES, ONTARIO

for

AECOM

PETO MacCALLUM LTD.
45 BURFORD ROAD
HAMILTON, ONTARIO
L8E 3C6
Phone: (905) 561-2231
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Email: hamilton@petomaccallum.com

Distribution:
3 cc: AECOM
1 cc: PML Hamilton

PML Ref.: 16HF019
Report: 1
June 2016

Peto MacCallum Ltd.
CONSULTING ENGINEERS

June 15, 2016

PML Ref.: 16HF019
Report: 1

Mr. James Wallace, P.Eng.
AECOM
300 Water Street
Whitby, Ontario
L1N 9J2

Dear Mr. Wallace

Geotechnical Investigation
Port Dalhousie Harbour Wall
St. Catharines, Ontario

Peto MacCallum Ltd. (PML) is pleased to present the results of the geotechnical investigation recently completed at the Port Dalhousie harbour wall in St. Catharines, Ontario. Authorization to proceed with this assignment was provided by Mr. James Wallace in an email dated May 12, 2016. Services were provided in accordance with the PML proposal, provided in an email dated May 6, 2016.

It is understood that Fisheries and Oceans Canada (DFO) plans to rehabilitate the Port Dalhousie harbour wall west of the fuelling tanks located in in St. Catharines, Ontario.

PML previously completed a geotechnical investigation (PML Ref.: 14HF051, Report: 1, dated January 16, 2015) to establish the subsurface soil and ground water conditions along the Port Dalhousie piers and provided geotechnical recommendations for lateral earth pressure parameters and allowable bearing capacities of the subsurface soil encountered at the piers.

The purpose of this geotechnical investigation was to establish the subsurface soil and ground water conditions along the wall and based on the findings, provide geotechnical recommendations for lateral earth pressure parameters of the subsurface soil.

The scope of work for this study did not include the observation, recording or assessment of the environmental conditions of the soil, bedrock and groundwater on the property. If excess materials requiring off site disposal are generated during construction, laboratory analysis will be required to determine the chemical properties of the material and evaluate options for off site disposal.

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 project as described in the report. Any changes in the project, including finishing grades and layout 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 was carried out on June 8, 2016 and consisted of one borehole (Borehole 1) drilled to a termination depth of 18.3 m. The borehole location is shown on Drawing 1, appended.

The borehole location was selected in coordination with AECOM and established in the field by PML. The ground surface elevation and UTM co-ordinates at the borehole location was determined by PML. The following benchmark (BM) was used for vertical reference:

BM: Tablet in west concrete foundation wall of inner lighthouse at entrance to harbour, 1.70 m from northwest corner, 1.35 m from southwest corner, 20 cm below shingle siding (Geodetic Survey of Canada BM No. 561F). Elevation: 75.822 m (metric, geodetic).

The boreholes were advanced using continuous flight hollow stem augers powered by a truck-mounted CME-75 drill rig, supplied and operated by a specialist drilling contractor, working under the full time supervision of a member of the PML engineering staff.

Representative samples of the overburden were recovered at frequent depth intervals using a conventional split-spoon sampler during drilling. Standard penetration tests were conducted simultaneously with the sampling operation to assess the strength characteristics of the substrata.

The ground water conditions at the borehole locations were assessed during drilling by visual examination of the soil, the sampler and the drill rods as the samples were retrieved and when appropriate by measurement of the water level in the open borehole.

The lake water elevation was obtained from The Canadian Hydrographic Service water level gauging station located in Port Weller, Ontario. The water level elevations are referenced to the International Great Lakes Datum 1985.

The recovered samples were returned to our laboratory for detailed visual examination, classification and routine moisture content determinations.

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, ground water observations and the results of laboratory moisture content determinations.

The subsurface stratigraphy revealed in the boreholes typically comprised fill over clay underlain by organic silt overlying clay till/shale complex mantling weathered shale bedrock.

Fill

A 50 mm thick granular layer was encountered surficially in the borehole.

A 2.6 m thick fill layer was contacted below the granular. The fill layer comprised loose black gravelly sand fill in the upper 1.4 m, becoming loose/firm silt fill from 1.4 to 2.6 m. Moisture content of the fill ranged from 10 to 22% and was judged to be moist.

Silty Clay

A 1.0 m thick stiff silty clay layer was encountered below the fill. The clay was contacted at 2.6 m (elevation 74.0) and extended to 3.6 m (elevation 73.0). The moisture content of the clay was about 16% and was judged to be about to drier than plastic limit.

Organic Silt

Organic silt was contacted below the clay at 3.6 m (elevation 73.0) and was penetrated at 12.3 m (elevation 64.3). The condition of the silt was very loose to loose. The silt was interspersed with layers of sandy or clayey composition and had variable levels of organic content.

Clay Till/Shale Complex

Clay till/shale complex was contacted below the organic silt deposit at 12.3 m (elevation 64.3). This material generally consisted of clay till with variable amounts of silt, sand, gravel, and shale fragments and represents the transition to the underlying weathered shale bedrock. Moisture content of the silt till/shale complex ranged from 16 to 25%.

Shale

Shale bedrock was contacted at 14.3 m (elevation 62.3) and extended to the termination depth of 18.3 m (elevation 58.3). The shale bedrock was red shale of the Queenston Formation and was judged to be weathered. It is noted that the shale is interbedded with siltstone, limestone and occasionally sandstone layers referred to as “hard layers”.

Ground Water Conditions

Upon completion of drilling, free water and cave was observed at 1.5 m (elevation 75.0).

At the time of drilling, the water level in Lake Ontario was near elevation 75.0. The lake water elevation was obtained from The Canadian Hydrographic Service water level gauging station located in Port Weller, Ontario. The elevation is referenced to the International Great Lakes Datum 1985.

It is noted that the borehole advancement methodology (triconing) requires maintaining a head of water in order to stabilize the base. In this regard, the water levels recorded at the termination of drilling may not accurately represent the long term stabilized ground water level. It is expected that the long term stabilized ground water level at the site will be near the lake water level and is

hydraulically connected to Lake Ontario with a slight downward hydraulic gradient. Ground water levels may fluctuate subject to lake levels, seasonal variations and precipitation patterns.

Engineering Discussion and Recommendations

It is understood that Fisheries and Oceans Canada (DFO) plans to rehabilitate the Port Dalhousie harbour wall west of the fuelling tanks located in in St. Catharines, Ontario.

The purpose of the geotechnical investigation was to establish the subsurface soil and ground water conditions along the harbour wall and based on the findings, provide geotechnical recommendations for lateral earth pressure parameters of the subsurface soil.

The subsurface stratigraphy revealed in the boreholes typically comprised fill over clay underlain by organic silt overlying clay till/shale complex mantling weathered shale bedrock.

The geotechnical lateral earth pressure design parameters for the main soil types encountered in the boreholes are provided in the following table:

Table 1

Design Parameters for Main Soil Types

Soil Type	Saturated / Submerged Unit Weight (kN/m^3)	Undrained Shear Strength (kPa) (Short Term)	Undrained Friction Angle (°) (Long Term)	Rankine Coefficient of Active Earth Pressure (K_a)	Rankine Coefficient of Passive Earth Pressure (K_p)*
Fill	18.0 / 8.2	NA	25	0.41	2.5
Silty Clay	20.0 / 10.2	5	15	0.59	1.7
Organic Silt	16.0 / 6.2	NA	22	0.45	2.2
Clay Till/Shale Complex	22.0 / 12.2	5	27	0.38	2.7

* Coefficient does not include a Factor of Safety.

The lateral earth pressure calculation should include the hydrostatic water level and surcharge, as applicable.

We trust the information presented in this report is sufficient for your present purposes. If you have any questions, please do not hesitate to contact our office.

Sincerely
Peto MacCallum Ltd.



Karel Furbacher, P.Eng.
Project Engineer



Matthew D. St. Denis, P.Eng.
Manager, Geotechnical Services

KF:lad

Enclosures:
List of Abbreviations
Log of Borehole No. 1
Drawing 1 – Borehole Location Plan

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:

CONSISTENCY	N (blows/0.3 m)	c (kPa)	DENSENESS	N (blows/0.3 m)
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		

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

TYPE OF SAMPLE

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

PH	Sample Advanced Hydraulically
PM	Sample Advanced Manually

SOIL TESTS

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

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 1

17T 0641140E
4784974N

PROJECT Port Dalhousie Harbour Wall
LOCATION St. Catharines, Ontario
BORING METHOD Continuous Flight Hollow Stem Augers and Triconing
BORING DATE June 8, 2016
PML REF. 16HF019
ENGINEER M. D. St. Denis
TECHNICIAN M. Rapsey

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES
		SURFACE ELEVATION 76.6				
0.0	76.5	GRANULAR: 50 mm grey crushed limestone granular base				
		FILL: Loose, black gravelly foundry sand fill, damp; with occasional brick and coal fragments		1	SS	8
1.4	75.2	loose/firm, brown, clayey silt fill, trace sand, non to slightly plastic, moist		2	SS	5
2.1	74.5	with black organic lenses				
2.6	74.0	CLAY: Stiff, brown silty clay, trace sand, low plastic, DTPL		3A 3B	SS	13
3.6	73.0	ORGANIC SILT: Very loose to loose, olive brown, organic silt, trace clay to clayey, some sand, trace gravel, saturated; with black organic staining and occasional decayed plant matter, wood fibers, peat and shell fragments		4	SS	7
				5	SS	3
				6	SS	3
				7	SS	2
				8	SS	9
				9	SS	2
10.0	66.6	with occasional silt and sand seams		10	SS	2
12.3	64.3	CLAY TILL/SHALE COMPLEX: Very stiff, reddish brown clay till/shale complex, trace sand and gravel, DTPL		11A 11B	SS	13
				12	SS	18
14.3	62.3	SHALE: Weathered red shale; with occasional bluish grey hard layers				
15.0		CONTINUED				

ELEVATION SCALE: 76, 75, 74, 73, 72, 71, 70, 69, 68, 67, 66, 65, 64, 63, 62

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

▽ El. 75.0 Lake Ontario Water Level

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 1

17T 0641140E
4784974N

PROJECT Port Dalhousie Harbour Wall
LOCATION St. Catharines, Ontario
BORING METHOD Continuous Flight Hollow Stem Augers and Triconing
BORING DATE June 8, 2016
PML REF. 16HF019
ENGINEER M. D. St. Denis
TECHNICIAN M. Rapsey

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L; WATER CONTENT (%)	UNIT WEIGHT kN/m³	GROUND WATER OBSERVATIONS AND REMARKS; GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
15.0	CONTINUED FROM PREVIOUS PAGE						50 100 150 200 / 20 40 60 80	10 20 30 40		
61.6	SHALE: Weathered red shale; with occasional bluish grey hard layers		13	SS	90/175mm	61	>>			
16.0										
17.0						60				
18.0						59				
18.3			14	SS	50/25mm		>>			
58.3	BOREHOLE TERMINATED AT 18.3 m									Upon completion of augering, free water and cave to 1.5 m
19.0										
20.0										
21.0										
22.0										
23.0										
24.0										
25.0										
26.0										
27.0										
28.0										
29.0										
30.0										

NOTES

▽ HYDROSTATIC GROUND WATER LEVEL





KEY PLAN
ST. CATHARINES, ONTARIO

LEGEND:

BH 1
EL. 76.58 — PML BOREHOLE (BH) LOCATION

BENCHMARK:

TABLET IN WEST CONCRETE FOUNDATION WALL OF INNER LIGHTHOUSE AT ENTRANCE OF HARBOUR, 1.70 m FROM NORTHWEST CORNER, 1.35 m FROM SOUTHWEST CORNER, 20 cm BELOW SHINGLE SIDING (GEODETIC SURVEY OF CANADA BM NO. 561F)
ELEVATION: 75.822 m (METRIC, GEODETIC)

REFERENCE:

PLAN PRODUCED FROM GIS INFORMATION FROM THE NIAGARA REGION ONLINE INTERACTIVE MAPPING SERVICE.

NOTE:

THE INFERRED STRATIGRAPHY REFERRED TO IN THE REPORT IS BASED ON THE DATA FROM THESE BOREHOLES SUPPLEMENTED BY GEOLOGICAL EVIDENCE. THE ACTUAL STRATIGRAPHY BETWEEN THE BOREHOLES MAY VARY.

0m 10 20 30 40 50 75
SCALE
(1:1000)

AECOM

GEOTECHNICAL INVESTIGATION
PORT DALHOUSIE HARBOUR WALL
ST. CATHARINES

BOREHOLE LOCATION PLAN

Peto MacCallum Ltd.
CONSULTING ENGINEERS

		DATE	SCALE	PML REF.	DRAWING NO.
DRAWN	KF	JUNE 2016	AS SHOWN	16HF019	1
CHECKED	MDS				
APPROVED	MDS				